THE EFFECT OF AN EXERCISE PROGRAMME ON THE HEALTH AND WELL-BEING OF PEOPLE LIVING WITH HIV IN A RURAL COMMUNITY OF THE EASTERN CAPE

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In accordance with Rule G4.6.3, I hereby declare that the above-mentioned treatise is my own work and that it has not previously been submitted for assessment to another University or for another qualification.

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3 February 2017

DEDICATION

All challenging work requires self-efforts as well as the guidance of elders especially those who are very close to your heart. My humble effort I dedicate to my loving Grandfather James Huntley Sowerby, whose love and encouragement has enabled me to achieve such success and honour.

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ABSTRACT

The primary aim of this study was to determine the effect of an 11-week combined progressive resistance exercise and aerobic exercise programme on the health and well-being of a group of participants sampled from an HIV positive rural population. The study was exploratory and quasi-experimental in nature and utilised quantitative research methods. A total number of 37 participants that met the inclusion criteria were included in the study. The participants were assigned to an experimental group (EG) (n=19) based on their willingness to participate in the exercise intervention and the remainder were assigned to the control group (CG) (n=17). The experimental group participated in an 11-week intervention programme which entailed exercising twice a week for the duration of 60 minutes. The intervention entailed a low cost exercise programme which consisted of aerobic exercises (walking, jogging and stepping) and progressive resistance exercises (own body weight, core exercises and light free weight training). The following variables were measured pre-, mid- and post- intervention, namely: health related fitness components, quality of life, physical activity levels and relevant blood variables. An analysis of data was conducted utilising descriptive and inferential statistics. The outcome of the analyses indicated that the EG did not reveal significantly better post-intervention results than the CG in respect of any of the variables assessed. The CG remained sedentary during the intervention period and revealed either an increase in, or maintenance of the initial scores. The slight variation could have been attributed to the decrease in sample size at mid – and post – testing. At the post-intervention testing phase the majority of the participants available for testing were those who were working and healthy. However, it can be concluded that the overall aims and objectives of the study were achieved despite the attrition of participants during the study and that the subsequent outcome of the study was not expected.

Keywords: HIV, exercise, health related fitness, aerobic exercise, progressive resistance exercise, quality of life, CD4 count and viral load

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PROBLEM IDENTIFICATION

1.1 INTRODUCTION

The Human Immunodeficiency Virus (HIV) infection and Acquired Immunodeficiency Syndrome (AIDS) both pose a serious threat to the health of millions around the world, contributing to South Africa having one of the largest epidemics globally, with an estimated 35 million people living with HIV (PLWHIV) (Azia, Mukumbang, and van Wyk 2016, 1).

Despite continued research, no cure or vaccine has yet been found to prevent new infections (Naicker and Sayed 2014, 1151). With the recent advances of antiretroviral treatment (ART), HIV and AIDS are now seen as manageable chronic diseases (Fillipas et al. 2008, 514). ART has had a positive influence on PLWHIV, but also comes with negative physiological side effects which can compromise a patient's quality of life (Sidat, Fairley, and Grierson 2007, 515).

ART, being unable to eliminate the virus completely, does however help PLWHIV by suppressing viral replication, thus slowing down the progression of AIDS. This allows the body time to rebuild the immune system and replenish destroyed CD4 T-lymphocytes, giving the patient some immunity to opportunistic infections (Kakinami et al. 2011, 823,824). The use of ART is vital but can involve many potential metabolic complications. These include the redistribution of body fat, increased central adiposity, peripheral lipoatrophy, peripheral insulin resistance, diabetes, hypertension, dyslipidaemia, hypertriglyceridemia, osteoporosis and osteopenia (Kyriakidou 2009, 269). Health advisory material now places a strong emphasis on lifestyle choices due to the greater risk of developing diseases such as obesity, cardiovascular disease, diabetes and metabolic complications for PLWHIV (Kyriakidou 2009, 269). Exercise has been widely used to treat the metabolic complications related to people on ART (Garcia et al. 2014, 787). The use of aerobic and resistance exercise has been shown to improve physiological components such as cardiovascular fitness, muscular strength, endurance and body composition in the HIV infected population (O'Brien et al. 2008, 649, 650).

1.2 CLARIFYING THE PROBLEM

Jones et al. (2013, 1) revealed that rural communities and lower socioeconomic status communities tend to have a higher prevalence of patients with HIV due to lower literacy levels which further leads to the patients not understanding the importance of treatment adherence. Currently South Africa runs the largest public ART programme in the world with more than 80% of PLWHIV already on the programme (Azia, Mukumbang, and van Wyk 2016, 1). The advances towards combating AIDS in South Africa have brought about a significant improvement in the quality of life and as well as the life expectancy for millions of people infected and affected by the virus. However, as the life expectancy increases, the population of older PLWHIV can be expected to face the same challenges as those from well-resourced countries, especially given the high prevalence of lifestyle-related health problems such as central obesity, high blood pressure and diabetes in the general population (Rural health information hub 2015, Johnson et al. 2013, 1).

In South Africa, rural and urban lifestyles differ significantly in terms of access to healthcare and other resources. A chronic, incurable health condition such as HIV/AIDS, ideally requires long-term access to therapies and medications, including, but not limited to, ART. This presents a major dilemma in terms of delivering health services to PLWHIV in rural areas (Azia, Mukumbang, and van Wyk 2016, 2).

Exercise has been widely used to treat the side effects related to people on ART (Garcia et al. 2014, 786). The use of aerobic and resistance exercise has been shown to improve physiological components such as cardiovascular fitness, muscular strength, endurance and body composition in the HIV infected population (O'Brien et al. 2008, 649 & 650). This has been noted in earlier and recent clinical observations, scientific studies and epidemiological research (O'Brien et al. 2016, 1). Investigating the effects of an exercise intervention on the health and well-being of PLWHIV, living in a poor rural community, is an important contribution to this body of knowledge.

1.3 THE ROLE OF EXERCISE IN THE MANAGEMENT OF HIV/AIDS

People living with HIV respond well to exercise and benefit physiologically in the same way as people without HIV would (Ciccolo, Jowers, and Bartholomew 2004, 491). A systematic review by (O'Brien et al. 2016) reported that regular physical activity in PLWHIV has been found to increase aerobic capacity, improve quality of life and increase lean body mass (Garcia et al. 2014, 786). The study cited above showed that moderate exercise is safe and further suggested that regular, moderate exercise can improve health by improving the immune system in PLWHIV. As an initiative to improve the long term health of PLWHIV and those being treated with ARV combinations, a simple exercise programme is an attractive and cost-effective option. It has the potential to mitigate the above side effects as well as assist with the maintenance of health and other benefits such as improved self-confidence and mental health. Regular physical exercise may also therefore have a role to play in counteracting the health consequences of long term ARVs, helping to prevent the accumulation of abdominal fat and increasing lean muscle mass thus improving overall strength and physical fitness (Garcia et al. 2014, 785 & 786). Given the known benefits of exercise in general as well as the barriers to health care in poor communities in rural areas, particularly among those PLWHIV, the question the present study intends to answer, is namely, what impact would a particular exercise intervention programme have on PLWHIV in a poor, rural community of the Eastern Cape.

1.4 AIMS AND OBJECTIVES

The aim of this study was to determine the effect of an 11-week combined progressive-resistance and aerobic exercise programme on the health and well-being of a group of participants sampled from an HIV positive rural population. In order to achieve the above aim, the following objectives are relevant:

1. To describe and compare the following parameters, pre-, mid- and post-intervention, within the experimental group (EG) and control group (CG) respectively:

- Health-related fitness components (body composition related variables, flexibility, strength and agility related variables, cardiovascular related variables)
- Quality of life
- Level of physical activity
- Blood variables (CD4 count, viral load, white blood cell count, red blood cell count)

2. To compare the experimental and control groups, pre-, mid- and post-intervention, in respect of all above mentioned parameters.

1.5 SCOPE OF THE STUDY

The study was conducted at the ARV Clinic at the Andries Vosloo Hospital in the Eastern Cape, South Africa. The ARV clinic was established in 2006, to serve the community of the Blue Crane Route (Somerset East, Cookhouse and Pearston). The participants were recruited from the local, rural community of Somerset East. The ARV co-ordinator did purposive sampling and a total of 36 participants met the inclusion criteria. The participants were between the ages of 18 and 65 years. The participants were subdivided into an experimental group (EG: n=19) and a control group (CG: n=17). The EG participants were recruited on the basis of their ability to attend exercise sessions on a regular basis. Due to the fact that the researcher could not be involved with the recruitment process, the ARV co-ordinator was tasked with informing patients about the study and inviting their participation. The patients who were recruited all met the inclusion criteria and had appointments for monthly check-ups. After much effort on the part of the HIV co-ordinator, 19 EG participants volunteered and were selected, 17 more were selected and volunteered to be in the CG.

Participants in the EG took part in an 11-week exercise programme at Andries Vosloo Hospital. All participants (EG and CG) were evaluated on three occasions (pre-, mid- and post-intervention phase) by the researcher for health-related fitness components, quality of life, level of physical activity and various blood variables. Data collected pre-, mid- and post-intervention, was statistically analysed and discussed.

1.6 CONCEPT CLARIFICATION

- **AIDS:** Acquired Immune Deficiency Syndrome. An illness where the immune system fails and becomes vulnerable to a group of infectious diseases. AIDS is caused by HIV and is the final stage of HIV infection and can result in death (Durstine, Moore, and Painter 2009, 219).
- **ART:** Antiretroviral therapy. A combination of ARV drugs to maximally suppress the HIV virus and stop the progression of HIV to AIDS (Azia, Mukumbang, and van Wyk 2016, 2).
- **ARV:** Antiretroviral (also used as a plural, ARVs). A combination of medications called HAART, targeted at HIV which is a retrovirus (WHO 2015).
- **CD4 count:** A CD4 blood test that measures the number of CD4 T lymphocytes per cubic millimetre of blood. It reflects the immune system function and is the strongest predictor of HIV progression. CD4 cells are a type of white blood cells that protect the body from infection. They communicate with the immune response when they detect “intruders” such as viruses or bacteria (The American Heritage® Medical Dictionary 2007, WHO 2015).
- **Highly Active Antiretroviral Therapy (HAART):** The aggressive use of at least three ARV drugs, resulting in both improved suppression of HIV activity and increased side effects, however prolonging life (Crum et al. 2006, 195, He et al. 2016, 4, WHO 2017).
- **HIV:** Human Immunodeficiency Virus. A retrovirus which infects and destroys vitals cells of the human immune system (helper T-cells). HIV causes AIDS (Calles, Evans, and Terlonge 2010, 7).
- **Lipodystrophy:** fat redistribution. Any abnormality in the metabolism or deposition of fats in the body (Mendes et al. 2013, 16).
- **Metabolic syndrome:** A combination including at least three of the following conditions: abdominal obesity, insulin resistance, high blood pressure and/or high cholesterol (Young et al. 2009, 2).
- **Physical activity:** “body movements (athletic, recreational or occupational activities) caused by the activation of skeletal muscles with a resulting increase in energy expenditure above resting levels” (Ramirez-Marrero et al. 2004, 69, Miller-Keane Encyclopedia and Dictionary of Medicine 2003).

- **Health related fitness:** Exercise activities performed for physical health benefits against hypokinetic diseases and to perform daily activities with vigour. Health related fitness is made up of 5 components: aerobic fitness, muscular strength, muscular endurance, flexibility and body composition (Thompson, Gordon, and Pescatello 2009, 3 & 60).
- **Resistance training:** Any form of strength training using weights. The muscle group is loaded to increase strength, over time. The muscles are used to resist, overcome or bear force (Mosby's Medical Dictionary 2009).
- **Aerobic exercise:** Physical body movements which increase the work load of the heart and lungs to meet the oxygen demands of the muscles. Heart rate is increased and subsequently increases heart and lung efficiency (Miller-Keane Encyclopedia and Dictionary of Medicine 2003).
- **Quality of life:** The degree of satisfaction or sense of well-being that a person has with his or her style of life. The ability to perceive oneself as able to function physically, socially and mentally (Beard, Feeley, and Rosen 2008, 5).

1.7 SIGNIFICANCE OF THE STUDY

Since it was first identified in 1981, HIV has evolved into a rapidly growing epidemic, in which around 35 million people have died according to the World Health Organisation (WHO 2014). In 2012, approximately 35.3 million people worldwide were living with the disease. Sub-Saharan Africa is the most severely affected region, accounting for 71% of the people living with HIV worldwide (WHO 2014). This translates to the fact that nearly one in every 20 adults in the region is living with HIV or AIDS.

Even though it is beyond dispute that the main health intervention required by PLWHIV is a well monitored programme of ARV's, there can be little doubt that these patients can benefit from holistic approaches which include improvements in lifestyle and health. This is not only important in terms of supporting the immune function, but in counteracting the side effects of ARVs on body composition as well as addressing the general prevalence of chronic lifestyle diseases in the rural areas. This study hopes to contribute towards identifying effective intervention programmes that can impact positively on the health and well-being of PLWHIV.

Chapter two to follow provides a review of related literature that can assist in understanding the problem under investigation, motivate the research methods used and provide the background information necessary in the discussion of the study's findings.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter reviews the literature relevant to the discussion of HIV and AIDS in terms of the basic principles of physiology and HIV pathology, treatment, side-effects and benefits of exercise for PLWHIV. Available literature relating to the effects of exercise on health related fitness and the general health of PLWHIV, is also reviewed.

So many deaths have resulted, worldwide, from HIV related diseases, that it has been described as a pandemic (Castelli et al. 2010, 28). Since HIV was first identified over three decades ago, over 60 million people have been infected with the most prevalent form of the virus, and over 35 million of these have died, including 1.5 million in 2015 (AIDS.gov 2016). Sub-Saharan Africa has the highest prevalence of HIV/AIDS in the world, with an estimated 25.6 million PLWHIV in 2015, contributing to 66% of new infections globally (AIDS.gov 2016).

The significant progress in access to effective treatment for HIV/AIDS over the past decade, has increased the life expectancy of PLWHIV (Panel on antiretroviral guidelines for adults and adolescents 2016, D1). However, these treatments come with side effects that compromise the quality of life for PLWHIV (Ciccolo, Jowers, and Bartholomew 2004, 487 & 489). The role of exercise in the health and well-being of PLWHIV is of great importance because it can be used as part of a strategy to manage the physical side effects of HIV and HIV treatment. Exercise can improve the psychological side effects of living with HIV (Ciccolo, Jowers, and Bartholomew 2004, 495) and contribute to quality of life through its health benefits (Fillipas et al. 2008, 514). Exercise can thus be used as an inexpensive and effective addition to treatment in resource limited areas (Mutimura, Stewart, et al. 2008, 384).

2.2 PHYSIOLOGY OF HIV AND AIDS, ITS MONITORING AND TREATMENT

2.2.1 Physiology of HIV and AIDS

The HIV is introduced, in most cases, by sexual transmission. Once the HIV is present, reproduction of the virus occurs rapidly by seeking out a specific leucocyte or white blood cell, the helper T-cell with CD4 antigen (Frankel 2011, 186). The HIV attacks and damages this class of lymphocyte called “helper T Cells” (Calles, Evans, and Terlonge 2010, 11). The latter produces a protein called CD4 that plays a vital role in immune function. Every CD4 cell can be seen as a “health factory” that produces substances that protect the body against disease (Calles, Evans, and Terlonge 2010, 10).

The HIV invades and infects healthy CD4 cells in order to survive in the body (Calles, Evans, and Terlonge 2010, 8). HIV chemicals unlock the CD4 cell allowing the HIV to enter into the cell where integration occurs (Calles, Evans, and Terlonge 2010, 8). Inside the cell the virus is safe from immune response. It takes over the function of the cell, using it to reproduce. The HIV “disguises” itself by using the chemical called reverse transcriptase which releases a chemical called integrase. Integrase is used to open the “brain” of the cell, and changes the instructions so that new HIV ‘parts’ are produced instead of substances that protect the body (Calles, Evans, and Terlonge 2010, 11). The CD4 cell is no longer a “health factory” but a “HIV factory”. Inside the HIV factory, the chemical protease builds new HIV cells and produces finished copies of the HIV (replication) (Calles, Evans, and Terlonge 2010, 11). These new HIV cells then leave the cell and find a new CD4 cell to unlock, and the process is repeated.

Thus the T-cells progressively die out (Calles, Evans, and Terlonge 2010, 12). In the later stages of HIV infection the number of functional helper T-cells can fall so low that the affected person begins to suffer from AIDS. Normal immune function is dependent on the processes of the CD4 helper T-cells (Calles, Evans, and Terlonge 2010, 12). In this way, the immune system of the body is gradually weakened and the immuno-suppressed individual becomes susceptible to secondary infections (Durstine, Moore, and Painter 2009, 219-225). The HIV infected body with fewer CD4 helper T-cells, is unable to combat opportunistic infections (Ramesh, Gandhi,

and Rao 2015, 120). In addition to the gradual loss of immunity, HIV disease also deprives an individual of his or her physical and psychological resources, such as mobility, muscular strength, joint flexibility, endurance and energy (Garcia et al. 2014, 785).

2.2.2 CD4 count and viral load

Viral load and the CD4 cell count are considered together to predict whether a person's progression towards AIDS (the final stage of disease) will be rapid or slow (Panel on antiretroviral guidelines for adults and adolescents 2016, C5 & C7).

A blood test, which measures the number of CD4 T-cells in a cubic millilitre of blood (mm^3), known as the CD4 count, is used in the initial assessment and is one of the most important factors in the decision to initiate ART (Panel on antiretroviral guidelines for adults and adolescents 2016, E1). The CD4 lymphocyte count is an indicator of how healthy the immune system is. A good indicator of immune-system health, is a normal reading of 800 – 1500 cells (Panel on antiretroviral guidelines for adults and adolescents 2016, H12). CD4 values below 200 cells per mm^3 are usually an indication of immune suppression and vulnerability to opportunistic infections (Tortora 2006, 839). A patient is diagnosed with AIDS when the CD4 count is below 200 cells/mm^3 (U. S. Department of Health Human Services 2014a, 95) or if he or she has an opportunistic infection (Ramesh, Gandhi, and Rao 2015, 120). The progress of the HIV disease is monitored by means of a CD4 count.

The most accurate and sensitive indicator of response to ART is Plasma HIV RNA (simply termed "viral load") which in the South African context is measured in all patients at baseline and on a regular basis thereafter. A viral load test measures the levels of the HIV (viral RNA) (the actual number of viruses actively replicating in the blood) which is counted per millilitre of blood plasma. A high viral load is prevalent in active infections (U. S. Department of Health Human Services 2014a, 100). Viral load testing is used as a prognosis of how sick an HIV infected person is, as well as to measure a person's response to antiretroviral treatment (viral load decreases), thus making viral load a surrogate marker for treatment response and in predicting clinical progression (U. S. Department of Health Human Services 2014a, 100). A higher viral load will lead to a lower CD4 count (because the virus destroys

the CD4 cells). A lower viral load will indicate a higher CD4 cell count (fewer viruses in the blood give the immune system a chance to build up its resources again). Disease progression will depend on the viral load as well as the CD4 cell count in the blood (Panel on antiretroviral guidelines for adults and adolescents 2016, 106). The higher the viral load, and the lower the CD4 cell count, the easier it will be for all kinds of infections to attack the body. The progression to the final phase of AIDS (and death) will therefore be much faster with a high viral load (Panel on antiretroviral guidelines for adults and adolescents 2016, 102 & 106). The CD4 number may fluctuate among individuals, and may be influenced by any factor that affects the total white blood cell (WBC) and lymphocyte percentages, such as use of bone marrow–suppressive medications or the presence of acute infections which cause an increase in viral load (Panel on antiretroviral guidelines for adults and adolescents 2016, C5 & C7). On the other hand, a HIV-infected person with a low viral load and a high CD4 count can stay healthy for many years, as the immune system is strong enough to fight off infections (U. S. Department of Health Human Services 2014a, 106).

2.2.3 Treatment of HIV and AIDS

ART refers to medications used to treat HIV (Panel on antiretroviral guidelines for adults and adolescents 2016, A1). Highly active antiretroviral therapy (HAART) incorporates three or more ART medications. The initial HAART treatment consists of 2 nucleoside reverse-transcriptase inhibitors (NRTIs) and 1 non-nucleoside reverse-transcriptase inhibitor (NNRTI) or 1 protease inhibitor (PIs) (He et al. 2016, 4).

HAART therapy has been effective and has noticeably changed HIV-associated morbidity and mortality and has had a dramatic effect on the quality of life of PLWHIV (Frankel 2011, 1867). The main purpose of HAART is to reduce the HIV virus load to undetectable levels (He et al. 2016, 1). ART medications are designed to block new HIV infections and to reduce the viral load in the person who is already infected (Tortora 2006, 838-841). Once ART commences, the levels of CD4 T-cells are expected to increase; an adequate CD4 response for most patients on ART is defined as an increase in CD4 count in the range of 50–150 cells/mm^3 per year. The response to ART is at its most rapid within the first three months, with a

corresponding improvement in immune function (Panel on antiretroviral guidelines for adults and adolescents 2016, C6 & H12). Compared to HIV positive patients not yet on treatment, patients on ART report significant improvements in physical health (Louwagie et al. 2007, 5-7). Over recent decades, progress in the drug therapy of HIV disease has led to more successful but also more complex combined drug treatments (Rosen et al. 2008, 132).

HAART has a high efficacy level and is credited with significantly decreasing mortality and decreasing opportunistic infections (Sidat, Fairley, and Grierson 2007, 509). This aggressive therapy has been successful in reducing viral load, increasing CD4 lymphocytes, delaying the onset of AIDS and increasing the survival rate of HIV-infected patients (Ramírez-Marrero et al. 2004, 69). However, HAART has complications and side-effects which may involve the nervous system, the gastrointestinal tract, the integumentary system and the metabolic system and morphology (Dudgeon et al. 2006, 300). The management of side effects, as well as the general high burden of HIV disease in South Africa and additional healthcare expense in the first year of treatment when patients tend to be more ill and to require more clinic visits, adds to the fiscal burden of HIV/AIDS (Cleary, McIntyre, and Boulle 2006, 25-26).

The South African government implemented the roll out of ART in 2004. This is recognised as the largest treatment programme globally, with 2.4 million people on treatment by mid-2013. Rural communities have been affected the most by the impact of HIV/AIDS. The rural areas prove to have limited access to healthcare, minimal clinical support and very poor healthcare resources resulting in very poor health outcomes (Omole and Semenya 2016, 1).

The current treatment guideline for the use of ART stipulates that ART is recommended now for all HIV-infected individuals, regardless of CD4 T lymphocyte cell count (Panel on antiretroviral guidelines for adults and adolescents 2016, i). At the time of the commencement of the current study, ART was initiated once a patient's CD4 cell count fell to less than 200 cells/mm^3, or WHO stage IV disease was diagnosed (Rosen et al. 2008, 132).

However, there are still many complications surrounding the roll out of ARV's. According to Fourie and Meyer (2016, 22) "AIDS does not afflict all in equal measures, it feeds off and aggravates existing inequalities". These inequalities include poverty which gives rise to limited public services (running water and sanitation), poor nutrition and limited health care services. These factors play a measurable role in the roll out and effectiveness of ARVs and thus continue to make South Africa susceptible to HIV infection (Fourie and Meyer 2016, 22).

2.2.4 Side effects of ART

HIV and AIDS are closely associated with chronic non-communicable diseases such as the increased risk of metabolic syndrome, diabetes and cardiovascular disease. As the roll out of ARV treatment continues to meet the demands of more PLWHIV, the effect these ARVs have on non-communicable diseases is drastically changing into a dual burden epidemic, and a quarter of the HIV mortality rate is due to non-communicable diseases itself (Young et al. 2009, 1).

ART combinations help keep CD4 cell counts high and decreases viral load. However, a common side effect is gastrointestinal disturbance, which includes diarrhoea, anorexia, vomiting, abdominal pain and cramping, steatorrhoea and gastrointestinal upset. These gastrointestinal disturbances affect calorie consumption and nutrient absorption (Dudgeon et al. 2006, 300) and have a negative effect on body weight as well as on loss of muscle mass. The decreases in lean body mass (LBM) and increases in abdominal fat that are often observed in HIV-positive persons on HAART, place these individuals at higher risk for non-communicable chronic conditions such as metabolic syndrome, diabetes and cardiovascular disease (Garcia et al. 2014, 785). Supporting evidence in a systematic review by Kyriakidou (2009, 269) reported that PLWHIV who are on HAART are more predisposed to developing obesity, and at higher risk of developing cardiovascular disease, diabetes and metabolic syndrome.

According to the International Diabetes Federation (IDF) metabolic syndrome is associated with the diagnosis of central obesity plus two of the following four additional factors: raised triglycerides, reduced high density lipoprotein cholesterol, raised blood pressure, or raised fasting plasma glucose (Young et al. 2009, 4).

PLWHIV are also associated with alterations in body composition and abnormal fat distribution due to HAART (Cade et al. 2008, 96). The changes in body composition have a negative effect on the lipid metabolism which causes metabolic abnormalities and body fat redistribution (Young et al. 2009, 4).

PLWHIV also experience altered metabolically active lean tissue in the body called HIV muscle wasting syndrome. Muscle wasting is defined as a classic sign of "full blown AIDS" in which the patient experiences physical deterioration due to the depletion of body cell mass and the atrophy of muscle tissue due to changes in the metabolically active lean tissue (Dudgeon et al. 2006, 299-300). This common complication of advanced disease is said to occur when over 10% of body weight is lost (Kietrys and Galantino 2014, 329). The combination of sedentary lifestyle (due to weakness or illness) and malnutrition, has been related to loss of LBM and subsequent mortality (Dudgeon et al. 2006, 299). Unintentional loss of body mass and especially of LBM results in muscle weakness and ultimately organ failure and death. The most common immediate cause of severe wasting is diarrhoea over a period of several weeks, along with a loss of appetite which may be due to changes in taste, abdominal pain, chest pain and fever (Ramesh, Gandhi, and Rao 2015, 121).

Despite the fact that HAART has so many side effects, it still contributes to a decline in mortality rate among PLWHIV. In a study done by Crum et al. (2006, 195) from 1990 – 2003, the number of deaths in the pre HAART era (987) declined between 1997-1999 (159) and ultimately declined between 2000-2003 (78). After the initiation of HAART it took 13 years for a dramatic decline in the mortality rate to be evident, hence the necessity of ARV treatment programme initiation needs to be feasible and timely in order to control the AIDS chronic disease pandemic (Fourie and Meyer 2016, 8).

Mutimura, Crowther, Stewart, et al. (2008, 106) stated "Appropriate evaluation and intervention programme need to be implemented in the developing world, especially sub–Saharan Africa. This should include routine cardiovascular risk assessments, management of HIV infection with more 'metabolically friendly' HAART, and encouragement of lifestyle modifications, particularly smoking cessation, weight management, regular exercise, and adherence to a healthy diet".

2.3 HIV AND AIDS IN SOUTH AFRICA

2.3.1 HIV statistics

In 2015 the adult HIV prevalence rate was 11.2% of the total South Africa population, with the number of people living with HIV in estimated to be 6.19 million. In 13 years (2002-2015) the number of PLWHIV increased by 2.17 million (Statistics South Africa 2015, 1- 8). South Africa still has the highest HIV profile in the world with an estimate of 7 million PLWHIV in 2015 (Averting HIV and AIDS 2017). It is reported that Kwazulu-Natal is the province with the highest prevalence, with the Eastern Cape having the third highest prevalence of HIV and AIDS in South Africa (Provincial HIV and AIDS statistics 2008).

Of the 7 million PLWHIV, an estimation of 380 000 were new HIV infections. AIDS related deaths were estimated at 180 000 with only 48% of adults on ARVs (Averting HIV and AIDS 2017). In April 2014, 3 million people were receiving ARVs which is equivalent to 47% of the HIV positive population of South Africa (Averting HIV and AIDS 2017). The improvements made by ART has contributed to the reduction in HIV child mortality by 20%. More than 2.3 million children have been orphaned by AIDS in South Africa (Averting HIV and AIDS 2017). A decrease in mother-to-child transmissions has affected the HIV infection rate amongst children, but there was a decline in infections from 290 000 in 2010 to 150 000 in 2015. However, when referring to adult HIV infection statistics, the estimate of 1.9 million has remained the same since 2010 (UNAIDS 2016). Twice as many women are infected with HIV than men, and women aged between 15-24 had an HIV infection rate of more than four times greater than that of men the same age (Averting HIV and AIDS 2017).

To conclude, even though improvements have been seen in statistical data with regards to the prevention strategies in South Africa, many more drastic changes and improvements need to take place in order to contain the HIV pandemic.

2.3.2 AIDS ‘denialism’ in public health

South African Government’s health policy was for many years driven by the AIDS “denialism” of the President, Mr Thabo Mbeki. The AIDS pandemic has been, since then, almost entirely blamed on Mr Mbeki which has made him one of the most

infamous people in the AIDS community (Fourie and Meyer 2016, 1). The failure to launch the free ARV programme, cost an estimated 330 000 lives between 2000 and 2005 (Fourie and Meyer 2016, 8).

After the elections in 1999, social movements were established (by doctors and activists) to put an end to the HIV denialism and to challenge Mr Mbeki's government to meet the demands of PLWHIV. The government was failing to uphold the health rights in the South African Constitution and, in 2001, the constitutional court ruled against the government and treatment roll-out began, but only to pregnant HIV positive women. In 2003, the government eventually decided to provide free ART in public health services (Karim et al. 2009, 924).

In 2007, a 5-year strategic plan for HIV in South Africa was developed and the country, under a new president, set a new course in HIV response and treatment (Karim et al. 2009, 924). Due to the efforts of social activists and doctors, AIDS denialism theories were discredited and a relatively rapid roll-out of ART has now reached most communities in South Africa with affordable, effective treatment. Whilst dissent may remain about the extent to which non-clinical interventions can impact the immune system of PLWHD, it is beyond dispute that without access to ART the vast majority of people living with HIV would eventually suffer a dangerous reduction in CD4 Helper T-Cells and will develop AIDS. Meanwhile studies have consistently shown that when patients adhere to ART regimens, CD4 counts can rise quickly and viral loads may drop to undetectable levels in the space of a year (Beard, Feeley, and Rosen 2008, 3).

Non-clinical interventions are a valuable addition to medical treatment and may help in prolonging the latency phase of the HIV disease so that the onset of HAART can be delayed, and it improves the quality of life (Ciccolo, Jowers, and Bartholomew 2004, 487- 489). Non-clinical interventions such as exercise programmes, dietary recommendation and psychological therapies must be viewed as adjuncts to ART and not replacements for it, but the hope remains that in at least some cases, these health and immune supporting therapies can prolong the latency phase of HIV infection, delaying the onset of HAART with its associated costs and side effects. Furthermore, exercise programmes, as a supporting therapy, if safely conducted, can help PLWHD to prepare for the future, both in terms of HAART and in terms of

long term physical and mental health, and contributes to cost effective therapy (Dudgeon et al. 2006, 306-307, Ciccolo, Jowers, and Bartholomew 2004, 487-489).

HIV/Aids has placed a huge financial burden on South Africa's health services. South Africa is an economically developing country and many individuals who have this disease either have limited access to medical treatment or receive no treatment at all (Mars 2003, 1). There is a need to find ways to limit the burden of HIV-related ill-health on South Africa's health services, especially as the situation shifts from one where most people infected with HIV would develop AIDS and die, to one where people can live positively with HIV for many years, perhaps even a normal life span. The overall burden to the economy through the loss of economically active individuals is reduced, but the health system must continue to deal with the complications of long term HAART, as well as the challenges of testing, monitoring and of providing services to PLWHIV, their partners, and their families (Tladi 2006, 370).

2.3.3 The role of poverty in HIV and AIDS

The increased rate of HIV infections and deaths is directly related to the high unemployment rates and poverty experienced in South Africa (Tladi 2006, 369). PLWHIV who qualify to be categorised as severely disabled, have a CD4 count below 200 cells/mm^3 and are rendered unable to work, would qualify for the disability grant (HIV chronic disease) (Knight, Hosegood, and Timæus 2013, 135). The maximum for a disability grant is R 1 510.00 per month (Kelly 2016). Every six months the person receiving the disability grant is reassessed and examined by a doctor to confirm whether they still qualify for the grant. The grant will be withdrawn as soon as their health begins to improve (Govender et al. 2015, 2). Once meeting the criteria set by the Department of Social Development, this disability grant often serves as the only income for many poor families (Hardy and Richter 2006, 85). If the grant is withdrawn due to good health, they will forfeit this income. As a result, many PLWHIV deliberately stop taking ARVs in order to qualify or continue to qualify for the disability grant (Azia, Mukumbang, and van Wyk 2016, 4). In many cases this results in PLWHIV finding themselves in a difficult situation of having to choose between income or their health (Richter 2006, 197).

This conflict was confirmed in a study done by Tladi (2006, 371) which aimed to establish and explain the empirical link between HIV/AIDS and poverty. The results of the study found that there are PLWHIV who deliberately abstain from taking ART to qualify for a disability grant because taking ARVs or any other treatment or therapy, could result in a positive effect on health and therefore a threat to their income. The complexities surrounding the disability grant are illustrated in a quote from a person ill enough to qualify for the grant in a study by Steinberg (2002), as reported in Tladi (2006, 371) 'I love this HIV, now at least with the grant I'm trying… I get the disability grant and the child support grant … before I was staying with my mother and father and my sister, they didn't work… the only thing that was helping was my grandmother's pension. Concerning the illness, our lives [have] changed completely…' (Female respondent, Steinberg et al., 2002, p. 29). It is inevitable that poverty and disease are inextricably linked. Government disability grants have become a lifeline for the poorest of the poor, and sacrificing their future seems more rational for a better today (Tladi 2006, 380).

Knight, Hosegood, and Timæus (2013, 145) similarly reported that disability grants help PLWHIV with household expenses and to take care of those family members on ART. The grant also makes it possible for the sick members of the family to attend the clinic for treatment. The grant can serve as a subsidy for the loss of income of the ill member of the family and helps look after the sick member until they are fit enough to return to work. Knight, Hosegood, and Timæus (2013, 145) showed that it is crucial that the grant be received in good time to be of benefit. If the grant is received in good time, PLWHIV could recover well, whereas when the grant is late it could contribute to damaging effects on health and a loss of income. These patients take longer to recover, will need a grant for a longer period of time and it increases the probability of their not returning to work. Thus Knight, Hosegood, and Timæus (2013) suggests that the prompt delivery could have a positive effect on the long-term efficiency of South Africa's ART programme.

Conversely, Hardy and Richter (2006, 93) stated that the outcome of disability grants, whether extended or suddenly withdrawn, has not been adequately considered and that social security has seriously flawed the system. Poverty, especially in poor and rural communities, has a complex effect on the treatment of

HIV and on the AIDS pandemic. The difference between illness and disability have not been adequately considered and this has led to conflicting interpretations (Knight, Hosegood, and Timæus 2013, 136).

2.4 PHYSICAL ACTIVITY, EXERCISE AND HEALTH

Physical activity is defined as “body movements caused by the activation of skeletal muscles with a resulting increase in energy expenditure above resting levels”. (Ramírez-Marrero et al. 2004, 69). It includes, but is not limited to, occupational, sports, exercise, household or other daily and leisure activities (Miller-Keane Encyclopedia and Dictionary of Medicine 2003).

Physical fitness is a multi-faceted concept that can be defined as “a measure of the body’s ability to function efficiently and effectively in work and leisure activities, resist hypokinetic diseases (diseases from sedentary lifestyles) and to meet emergency situations.” Physical fitness embraces different aspects including body composition, muscular strength and endurance, flexibility, cardiovascular capacity to supply oxygen, agility, balance and speed (Perry 2012, Caspersen, Powell, and Christenson 1985, 126). Good levels of physical fitness contribute to health and well-being by improving the ability to perform daily activities with vigour and alertness, reducing levels of fatigue, and providing extra energy for enjoying leisure-time activities and meeting unexpected emergencies (Caspersen, Powell, and Christenson 1985, 126).

Exercise is defined as “physical activity that is planned, structured and repetitive” which is done to improve or maintain one or more components of physical fitness (Caspersen, Powell, and Christenson 1985, 128). According to these authors, both physical activity and exercise have been positively related to physical fitness.

Physical activity can be evaluated by exercise practitioners who would perform a health and fitness assessment and pre-participation screening. The screening involves a medical consultation where the details on cardiovascular disease risk factors are highlighted, chronic diseases are identified as well as conditions that need special consideration before engaging in an exercise programme. The pre-participation screening includes health and medical history information, exercise testing and relevant recommendations for physical activity participation (Thompson, Gordon, and Pescatello 2009, 22).

Practical alternatives could also be considered such as self-reported population surveys or questionnaires. These questionnaires are dependent on the respondents ability to recall the past physical activity behaviour (Ramírez-Marrero et al. 2008, 284). The International Physical Activity Questionnaire (IPAQ) has been widely used and provides an estimate of frequency, intensity and duration of physical activity (Ramirez-Marrero et al. 2008, 284). The IPAQ is an instrument designed primarily for population surveillance of physical activity among adults in the age range of 18-69 years, however it has also been used in intervention studies to estimate physical activity and exercise habits amongst participants (Ramirez-Marrero et al. 2008, 284 & 288).

Exercise has been beneficial in the treatment of many chronic diseases, including chronic obstructive pulmonary disease, multiple sclerosis and diabetes (O'Brien et al. 2016, 2). According to Warburton (2006, 801,806), there is an inverse relationship between exercise and cardiovascular disease, hypertension, stroke, osteoporosis, type 2 diabetes, obesity, cancer, anxiety and depression. The benefits of regular exercise include the improvement of cardiovascular and respiratory function, a reduction in coronary artery disease risk factors, decreased morbidity and mortality rates, decreased anxiety and depression and a reduced risk of falls and injuries.

2.4.1 Exercise for PLWHIV

In a review of clinical implications of therapeutic exercise for PLWHIV, Bopp et al. (2003, 74) concluded that the use of therapeutic exercise as an adjunct therapy in the treatment of symptoms of HIV infection could be beneficial. In patients without acute infections or severe wasting, exercise therapy should begin as soon as possible after the diagnosis of HIV infection in an attempt to delay the onset of symptoms, decrease the severity of those symptoms already present, and potentially delay disease progression. Bopp et al. (2003, 74) also stated that improved physical fitness, increased muscle mass, and decreased central obesity all contribute to an alternative treatment and better lifestyle for PLWHIV.

However, there remains some disagreement about the extent of the beneficial effects of exercise for PLWHD, and about which forms of exercise are most effective (Sidat, Fairley, and Grierson 2007, 9). PLWHIV can over-exercise and further

damage their immune systems, therefore all types of exercise is not necessarily beneficial for PLWHIV. Research suggests that when implementing exercise programmes for PLWHIV, programmes should be individualised on the basis of the functional capacity of each person (Bopp et al. 2003, 73-74).

A systematic review and meta-analysis done by O'Brien et al. (2016, 1) stated that aerobic exercise is safe for medically stable PLWHIV. The review compared aerobic exercise interventions with no exercise interventions. Twenty four (24) studies met the inclusion criteria, of which 11 where aerobic exercise alone and 13 studies were a combination of aerobic exercise and resistance exercise. The majority of the participants were men and on ART. A combination of aerobic and resistance exercises performed at least three times per week for at least five weeks, was found to be safe and generated measurable results. These results included improved cardiorespiratory fitness, strength, body composition and quality of life.

The understanding reflected in the above-mentioned literature that exercise has a positive influence on general physical and emotional well-being of PLWHIV, has led to a clear medical consensus regarding the recommended levels of physical activity in this population. Whilst high-impact exercise is not recommended, especially for individuals with low CD4 counts, moderate exercise that has a recreational element should be included in all clinical, social and community interventions designed to improve the health and quality of life of HIV-positive individuals (Ramirez-Marrero et al. 2004, 75).

Suggested exercise modalities developed by the Centres for Disease Control (CDC) and the American College of Sports Medicine for PLWHIV, suggest moderate-intensity aerobic activity using large muscle groups, such as walking, cycling, and rowing performed at least five times per week (Durstine, Moore, and Painter 2009, 223). After five to six weeks of aerobic training, progressive resistance training (PRT) can be initiated (Fillipas et al. 2008, 514). This recommendation is supported by an earlier study by Dudgeon et al. (2006, 305) who found that low to moderate intensity exercise can yield positive results in PLWHIV. It was also confirmed in a later review Kietrys and Galantino (2014, 332) where supporting evidence was presented which indicated that the effects of a combination of aerobic exercise for at least 20 minutes, at least three times per week for at least five weeks, promised

measurable results. Thus duration and frequency of moderately combined exercise appears to be safe and may improve fitness, body composition and general well-being of PLWHIV.

Moderate intensity exercise is also related to adherence and compliance with exercise in PLWHIV. A study done by Hand et al. (2008, 1073) reported that PLWHIV should also be able to adhere to low-volume, moderate-intensity training, as 73% of the exercising subjects completed this six week intervention of moderate-intensity exercise training of combined aerobic and PRT.

2.4.2 Exercise in association with HAART

Prolonged use of highly active antiretroviral therapy (HAART) is related to alterations in body composition, especially lipodystrophy, or the abnormal redistribution of body fat (Cade et al. 2008, 96). These alterations in body composition are associated with cardiovascular diseases in general, hypertriglyceridemia, glucose intolerance, insulin resistance and diabetes mellitus, arterial hypertension and decreased bone density. Regular physical exercise may therefore have a role to play in counter-acting these health consequences of long term HAART, helping to prevent the accumulation of abdominal fat and increasing lean muscle mass thus improving the strength and physical fitness of people on HAART (Dudgeon et al. 2006, 305-306).

In a Brazilian study, Mendes et al. (2013, 13) found that a 24-week exercise programme had a significant impact on measures that contribute to metabolic disease and fat distribution. The intervention focused on resistance training with an aerobic component for PLWHIV on HAART. The exercise intervention included 99 participants randomly allocated to two exercise and two control groups. The exercise groups consisted of two sub groups, one with lipodystrophy, and the other without lipodystrophy. The outcome of the study found statistically significant results related to improved cardiorespiratory fitness, strength and an improvement in anthropometric measures (Mendes et al. 2013, 16). PRT increased lean muscle mass (which counteracts metabolic abnormalities). This is beneficial for PLWHIV, as it assists them in activities of daily living and offers protection from illness which could result in further loss of body mass (Bopp et al. 2003, 74). Kietrys and Galantino (2014, 329 & 330) mentioned that in cases were weight loss does not

occur in PLWHIV, body composition may still be altered during HAART with increased morphological changes as well as metabolic changes.

The studies mentioned above conclude that PLWHD who exercise regularly may be able to reduce the centralised obesity and peripheral wasting frequently associated with HAART. In South Africa, body composition plays a key role in perceptions of HIV and AIDS. In some South African cultures, being 'well rounded' is a marker of health and prosperity, whereas HIV/AIDS is seen as a “thinness” disease. Research indicates that some South Africans can be reluctant to lose weight for fear that others will think they have HIV (Matoti-Mvalo and Puoane 2011, 40-44), which further complicates treatment. Exercise, which in some communities in South Africa is associated with weight loss, may therefore discourage PLWHIV from exercising (Walter 2008, 205).

2.4.3 Controversies about exercise and immune function in PLWHIV

According to Tortora (2006, 838-841), secondary infection occurs when the HIV infection progresses and the immune system weakens. HIV positive individuals become susceptible to various secondary infections, including lung infections, when the count of CD4 helper T-cells falls below 200 per mm^3. Such infections are frequently “opportunistic”, meaning that the virus, bacteria or fungus involved has taken advantage of a weak immune system. The cause of death from HIV/AIDS is not therefore, the HIV directly, but a serious infection (often a pneumonia) that the failing immune system cannot overcome (Ramesh, Gandhi, and Rao 2015, 120).

Bopp et al. (2003, 73-74) found that regular physical activity and exercise contributed to an improved immune response and higher levels of energy available for daily activities. They show that the immune status may also be enhanced by the modulation of levels of endogenous opiates and stress hormones that occur during and after exercise. A supportive study by Veljkovic et al. (2010, 473) reported that natural autoantibodies induced by exercise increases the overall level of natural autoantibodies and may have beneficial effects in PLHIV. In PLWHIV the increased level of NTM1-recognising antibodies could slow HIV disease progression and reconstitute the damaged immune system. These studies suggest that exercise may

be an important, inexpensive, safe and accessible defence therapy against HIV/AIDS.

Studies investigating the effect of exercise on viral load and CD4 count (as indicators of immune system functionality) had varying results. According to Dudgeon et al. (2004, 90) and (Sidat, Fairley, and Grierson 2007, 510) adherence to a regular moderate-intensity exercise regime was associated with an increase in CD4 count. Contrary findings are reported in a recent systematic review by O'Brien et al. (2016, 37 & 40) which included 24 studies, 92% of which measured CD4 count and viral load. The meta-analysis performed indicated that there were no significant positive changes in CD4 count in the combined intervention group when compared to the control group. There was a positive trend (but not statistically significant) in the CD4 count of meta-analysis groups comparing exercise groups (EG) with the control groups (CG). Similar results in CD4 count was found in participants exercising at moderate intensity exercise compared to high intensity exercises. However, viral load in this meta-analysis, was unaffected.

According to Bopp et al. (2003, 77), exercise does not negatively affect immune measures but many physicians still advise PLWHIV not to participate in exercise. Veljkovic et al. (2010, 473) also mentioned that the effect of exercise on PLWHIV should be carefully premeditated in order to avoid possible adverse effects, particularly in individuals with compromised immune systems.

The studies referred to in this section show there is no confirmed position with regards to exercise and immune system functionality and therefore more research is needed.

2.5 EXERCISE AND HEALTH RELATED FITNESS OF PLWHIV

2.5.1 Health related fitness components

The World Health Organisation (WHO) first defined health in 1948 as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (Huber et al. 2011, 1).

Health related fitness refers to the health benefits achieved through physical fitness or exercise. These benefits include disease prevention and promotion in health and well-being (Thompson, Gordon, and Pescatello 2009, 60-61). Exercise and health practitioners can evaluate the health related fitness components namely: body composition, cardiovascular endurance, muscle strength, muscle endurance and flexibility, in order to prescribe and achieve fitness goals (Thompson, Gordon, and Pescatello 2009, 3). Given that health related fitness is an overall variable assessed in this study with the aim of determining whether the effect of an exercise programme will be beneficial to the health and well-being of PLWHIV, necessitates a review of the components of this overall variable.

2.5.1.1 Exercise and body composition in PLWHIV

Body composition is defined as the percentage of body mass that is fat tissue mass, and/or is LBM (Thompson, Gordon, and Pescatello 2009, 62). In the HIV negative population, exercise and in particular PRT, is known to improve body composition by increasing LBM and decreasing fat mass. This is said to aid in decreasing the risk of developing heart disease, chronic diseases and premature deaths (Durstine, Moore, and Painter 2009, 23,24). Similarly, Dudgeon et al. (2006, 305) stated that significant increases in LBM was found in a HIV positive population who completed a 8 week resistance exercise programme. Exercise over a prolonged period is reported to bring about changes in central and total body fat, and thus benefiting symptoms related to metabolic syndrome (Hand et al. 2008, 1067).

A recent study by Mendes et al. (2013, 1 & 20) investigated the effect that physical activity has on the anthropometric and functional parameters of PLWHIV on HAART treatment and found that exercise is an effective alternative for controlling body composition. On the other hand, in a systematic review by O'Brien et al. (2016, 45 & 49) no significant change in BMI or WHR was found when comparing EGs to the CGs. However, a significant increase in LBM was found when comparing the exercise groups to the control groups.

Exercise can thus benefit PLWHIV by decreasing the risk of metabolic diseases (Mendes et al. 2013, 1, Hand et al. 2008, 1067, Garcia et al. 2014, 786 & 787), or if weight loss does not occur, increase in LBM which contributes to counteracting HIV

wasting (Bopp et al. 2003, 74). HIV wasting defined by CDC in (Dudgeon et al. 2006, 299) is the involuntary loss of body weight of more than 10% in the previous 12 months or more than 5% in the previous 6 months. Dudgeon et al. (2006) also estimated that 20% of PLWHIV suffer from HIV wasting irrespective of the treatment advances. HIV wasting will be discussed in greater detail in 2.5.1.2 regarding its relationship to muscular strength.

2.5.1.2 Exercise and flexibility, strength and agility in PLWHIV

Physical fitness incorporates a functional level of muscular strength and endurance, flexibility, cardiovascular capacity and agility (Perry 2012). Muscle wasting in PLWHIV, caused by muscle mass and LBM being wasted, negatively affects muscular strength and the functional capacity of PLWHIV (Roubenoff et al. 1999, 1). To treat and combat muscle wasting, PLWHIV need to increase muscular strength and muscular hypertrophy by performing PRT (Bopp et al. 2003, 74). PRT in PLWHIV has not been intensively studied (Bopp et al. 2003, 74). However Dudgeon et al. (2006, 307) stated that PRT programmes do have a positive outcome in lean tissue mass and improvements in the strength of PLWHIV. The latter study compared different treatment measures in counteracting muscle wasting in PLWHIV. Resistance training consisting of gym based weight training, at low to moderate intensities was found to improve physical health, increase LBM as well as increase quality of life. Resistance exercise was also found to be an accessible, low cost and safe measure in counteracting muscle wasting (Dudgeon et al. 2006, 299,305 & 307).

These findings support that found earlier by Roubenoff et al. (1999, 1 & 3) which indicated that participants (all of them met the criteria of AIDS wasting), recorded positive results in relation to increasing strength and LBM, and reducing fat mass, after an 8-week PRT programme. The PRT programme consisted of gym based weight training exercises, the effectiveness of which was measured using 1 repetition max (the maximum amount of weight a person can lift in good form increases).

In a systematic review by O'Brien et al. (2016, 52), it was reported that studies using combined aerobic and PRT interventions found significant improvements in upper

and lower body strength compared to the CG's. The PRT included gym based exercises and used the 1-repetition maximum test. The review concluded that a combination of aerobic and PRT, at least three times per week for at least five weeks can lead to improvements in strength. Dudgeon et al. (2006, 305) stated that 'resistance exercise training has the potential to be a viable alternative to pharmacological treatments for maintaining and increasing LBM and muscular strength in HIV-infected persons'. However, this assumption has not been proven and requires further investigation.

2.5.1.3 Exercise and cardiovascular related variables in PLWHIV

Regular exercise contributes to health and well-being by improving the ability to perform daily activities with vigour and alertness, reducing levels of fatigue, and providing extra energy for enjoying leisure-time activities and meeting unexpected emergencies (Fillipas et al. 2008, 514). O'Brien et al. (2016, 40) found that regular cardiovascular exercise significantly increased VO_2max. The systematic review reported VO_2max changes of 2.63ml/kg for the EG compared to the CG, however, even greater improvements were revealed with the combined aerobic and resistance exercise in the EGs compared to CGs.

Being able to perform tasks of daily living such as housework, shopping, caring for children, or physical labour without the need for frequent rest or help from someone else, clearly has a bearing on self-efficacy, confidence and hope as well as on the ability to strengthen and tone muscles. Reducing the burden on caregivers (usually family members) is a further important benefit of improved cardiopulmonary and general health for PLWHIV (Kakinami et al. 2011, 823). The lungs, the vital organs supplying the heart with oxygenated blood for circulation around the body, are directly affected by the HIV and therefore are often a site of secondary infection (Mars 2003, 1). Maximal oxygen consumption, VO_2max is the measure for physical function and cardiovascular fitness. As physical fitness increases, so too does VO_2max. Exercise is proved to increase physical capacity which in turn increases VO_2max (Bopp et al. 2003, 74,77).

Diseases linked to sedentary lifestyles, especially cardiovascular disease, are very prevalent in the general population in South Africa (Yarasheski et al. 2011, 243) and,

as stated by Maredza, Hofman, and Tollman (2011, 48), “the cardiovascular disease (CVD) burden in South Africa is increasing amongst all age groups and is predicted to become the prime contributor to overall morbidity and mortality in the over 50-year age group”. PLWHIV respond to exercise and benefit physiologically in the same way as people without HIV (O'Brien et al. 2016, 2). Loss of cardiovascular and cardiopulmonary fitness increases mortality and morbidity (Garcia et al. 2014, 786). Regular cardiovascular fitness and aerobic training in PLWHIV has been found to increase with exercise (Mutimura, Stewart, et al. 2008, 380). Also, if cardiopulmonary fitness of HIV positive individuals can be maintained or improved, for example by moderate aerobic exercise, studies have shown improvements in general health and quality of life (Garcia et al. 2014, 786). Mutimura, Stewart, et al. (2008, 83) reported that PLWHIV who perform aerobic exercise are likely to show improvements in cardiopulmonary fitness and psychological well-being.

In a study done by (Garcia et al. 2014, 787, 789 & 790) using combined resistance and aerobic training intervention, significant cardiovascular improvements were reported. The cardiovascular fitness was tested using the VO_2max test. The intervention entailed 30 minutes of aerobic training three times a week for twenty weeks. Similar results were obtain from the systematic review of O'Brien et al. (2016, 40) which stated that significant cardiovascular fitness improvements were found in all the intervention groups which included a component of aerobic exercise, when compared to the CGs.

Garcia et al. (2014, 789) reported that the HIV positive population are most likely to have lower levels of aerobic fitness and thus an increased risk of cardiovascular disease when compared to the HIV negative population. Thus to reduce the cardiovascular disease burden in South Africa, treatment regimens for PLWHIV need to include aerobic exercise.

2.5.2 Exercise, CD4 count and viral load

CD4 count and viral load are the primary markers for determining HIV diagnosis, disease progression and treatment response (Panel on antiretroviral guidelines for adults and adolescents 2016, C5). Thus if exercise were to negatively affect these markers, it would defeat the purpose of exercise treatment.

Exercise and CD4 count has been studied extensively and results reveal that exercise has no negative effect on CD4 count and viral load. Earlier studies (Ramirez-Marrero et al. 2004, 76, Hand et al. 2009, 8) report that exercise had no negative effect on HIV status, viral load, CD4 count or immune function. Dudgeon et al. (2006, 305) also concluded that exercise does not give rise to opportunistic infections, increases in viral load or decreases in CD4 cell counts. These studies are also supported by the later systematic review by O'Brien et al. (2016) which concluded that 22 studies out of the 24 studies reported no change in viral load or CD4 count when comparing the EGs to the CGs.

Contrary to the overwhelming evidence reported above, positive improvements in CD4 count were found in a study of young HIV positive people in Zambia (Menon and Glazebrook 2013, 18). This study found that significant short term improvements in CD4 counts and emotional well-being after a ten-week programme of peer support and yoga. However, they concluded that for these benefits to persist, support should be ongoing. Thus it is safe to conclude from the research findings discussed above that CD4 count and viral load are not negatively affected by exercise.

2.5.3 Exercise and quality of life

PLWHIV are confronted by many personal and social challenges which can have a major effect on an individual's emotional stability and sense of self (Menon and Glazebrook 2013, 13). There are many lifestyle changes that PLWHIV have to face, in addition to coming to terms with the fact that HIV is a chronic life threatening illness (Catz, Gore-Felton, and McClure 2002, 53). These challenges can affect their psychological well-being and in turn have a negative effect on their health status and quality of life (Ley and Barrio 2012, 125).

Despite the successes of medical treatment which improves the rate of morbidity and mortality, treatments such as HAART may compromise quality of life due to the diverse side effects (Ciccolo, Jowers, and Bartholomew 2004, 487 & 489). With the focus on improving health care and making HIV treatment accessible to resource limited areas, strategies to improve the quality of life should also be part of the fundamental treatment plan.

Bopp et al. (2003, 76) pointed out that, physical states influence emotional states and thus the best treatment approach is holistic, embracing both body and mind. Thus it is clear that emotional health has an influence on the progression or deterioration of the disease, whether directly boosting the immune system, or indirectly supporting a positive adjustment to living with HIV, for example managing stress well, using active coping strategies and accessing social support or physical activity (Catz, Gore-Felton, and McClure 2002, 57-58).

Catz, Gore-Felton, and McClure (2002, 58) stated that individual's ability to cope emotionally with the diagnosis of HIV infection, the requirements of living positively, adherence to clinic appointments, testing schedules and medication, and other aspects of active self-care are critical in terms of treatment outcome.

Self-efficacy in PLWHIV is related not only to subjective well-being but embraces aspects such as stress management, constant thinking about the HIV ("illness intrusion"), social problem-solving, depression, coping self-efficacy and social support satisfaction (Johnson et al. 2007, 1). Improved adherence and compliance to medication schedules is important for the success in HIV treatment outcomes (Drachler et al. 2016, 9). The relationship between self-efficacy and treatment compliance suggests the possibility of a "virtuous circle" in which compliance with treatment (including exercise and diet components) leads to higher self-efficacy which in turn motivates further compliance and persistence with medication and other beneficial therapies (Drachler et al. 2016, 2). Thus it is clear that improving the quality of life in PLWHIV could result in better treatment adherence when dealing with life threatening chronic diseases.

In a study done by Mutimura, Crowther, Cade, et al. (2008, 381-385), a six month exercise programme yielded improvements in psychological well-being, emotional well-being, self-perception and social relationships which all contribute to a good quality of life.

Ciccolo, Jowers, and Bartholomew (2004, 492) investigated the effects of exercise on emotional health and depression. In a group of HIV positive people, who followed 5 weeks of exercise training programme, prior to their HIV status notification, revealed that exercise facilitates better emotional health and status acceptance.

Neidig, Smith, and Brashers (2003, 36) reported that HIV a positive group who completed 12 weeks of aerobic activity revealed significant improvements in measures of psychological symptoms and depressed mood. In conclusion to the evidence reported above, it is safe to say that exercise positively influences psychological aspects related to HIV and quality of life.

2.6 SUMMARY

The global HIV/AIDS pandemic represents a synthesis of three major associated areas namely: physiological, psychological and social complexity. These three areas have a complex overarching effect on PLWHIV/AIDS. The fight against such a complex disease cannot be restricted to any one component; rather, it is multi-factorial and requires a wide spectrum approach of interventions aimed at medical, social, economic, and physical objectives in order to control this pandemic in South Africa where the prevalence of HIV and AIDS remains so high (Castelli et al. 2010, 28).

Although the cause of AIDS is a single factor, namely HIV, the progress of the disease involves complex relationships between the person and society, including the physical environment, diet, stress levels, ignorance about HIV/AIDS and the status of women and the provision of health care. Recent research has served to bring attention to the positive role played by physical activity, exercise and physical fitness in the overall health of PLWHIV, including those who are being treated with ART.

Evidence indicates that exercise programmes form an important component of holistic approaches to the treatment of HIV/AIDS (Castelli et al. 2010, 28-32). When patients engage in regular moderate exercise with both strength and aerobic components, the medical outcome is improved by way of supporting the immune system and improving the patients' adherence to drug regimens, as well as potentially slowing the decline in immunity and delaying the commencement of ART (Catz, Gore-Felton, and McClure 2002, 53). From a social perspective, exercising in a group brings PLWHIV into positive interaction with others and offers social support, as well as developing community resources in terms of knowledge and empowerment around HIV (Jones et al. 2013, 1-2). Finally, a healthier population of

PLWHIV more able to function independently represents a lower burden on both the health services and the economy in general. In the words of Roubenoff (2000, 236), “a truly holistic approach to HIV care, including a regimen of aerobic and strengthening training, should be part of every patient's care as we enter (into and continue the journey in) the 21st century”.

Chapter 3 to follow describes the methodological procedures implemented in order to conduct this research study, and obtain reliable results.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This study investigated the effects of an exercise programme on the health and well-being of people living with HIV in a rural community in the Eastern Cape. The study was conducted at the Andries Vosloo Hospital in Somerset East, Eastern Cape and South Africa. Its objective was to establish whether a eleven-week programme would have effects on measures of anthropometric variables, strength, cardiovascular fitness, quality of life, and general health (including CD4 count and viral load); and to measure any effects that were observed.

Chapter 3 describes the quasi-experimental research design adopted, the background of participants, and the sampling techniques used. It further describes the process of data collection, including the assistance offered by the hospital staff, the protocols and instruments used to obtain measurements, as well as ethical considerations undertaken.

3.2 RESEARCH DESIGN

The study utilised a comparison pre-test/post-test design which falls into the category of “quasi-experimental” quantitative research methods. It is a field study in which the natural situation makes extraneous variables hard to control. However, the natural situation of the field study is more likely to present relevant and useful findings. According to De Vos (2005, 140,143), the comparison pre-test – post-test design is the field-study equivalent of the classic experimental design. This quasi-experimental design allowed comparison of results between the two groups (experimental group (EG) and control group (CG), since both groups were tested at the same time whilst only the EG received the treatment (participation in an exercise programme).

However, this design can lead to sampling challenges, since participants are not randomly selected, as might be the case in a laboratory based study. Instead, purposive sampling is necessary to ensure an adequate number of participants,

whilst accommodating the challenges of a 'real life' clinical setting. Purposive samples are defined, according to De Vos (2005, 328), as samples whose members display characteristics that are of interest for a particular research question. In this study, the characteristic of greatest concern was the capacity to see the study through. Random sampling was not considered appropriate in a research setting where so many potential participants would have a high probability of failing to complete the study – for example, due to medical reasons, employment status, distance from the antiretroviral (ARV) Clinic, or transport difficulties. The experimental sample is therefore described as a “convenience sample” because its selection was not random but based on practical considerations. However, clinical and demographic selection criteria were also of the utmost importance and are detailed below.

3.3 PARTICIPANTS AND SAMPLING TECHNIQUE

Participants were recruited from the ARV Clinic at the Andries Vosloo Hospital, Eastern Cape, South Africa. This ARV Clinic, established in 2006, serves the community of the Blue Crane Route (Somerset East, Cookhouse and Pearston). The staff of the ARV Clinic initially comprised a doctor, a professional nurse, an ARV co-ordinator, a data capturer and a social worker. Auxiliary staff members were later appointed on a stipend basis by the Foundation for Professional Development (FPD).

The ARV Clinic is fully functional to date and has successfully implemented the 'down referral' system which facilitates access to ARV treatment. This referral system, which uses a decentralisation strategy for improving access to ART, was implemented in 2010. It shifts delivery of ART from regional hospitals to local community clinics, thereby improving access to care and encouraging greater quality of care (Decroo et al. 2009, 1). Following initial evaluation at the ARV clinic at the Andries Vosloo Hospital, HIV positive patients are referred to ARV clinics closer to their homes that have been established in different areas bordering on the Blue Crane Route. The ARV Clinic is thus responsible for initial testing and six-monthly follow up visits, but patients receive medication and other monthly treatment at local ARV clinics, closer to their homes.

HIV positive patients who were attending the ARV clinic were recruited for the study by the ARV Co-ordinator and nursing staff, both of whom were familiar with the patients' condition and well-being. Participants were required to meet the following criteria for inclusion in the study:

1. HIV positive with a CD4 count of >200 cells/mm^3
2. Aged between 18 and 65 years
3. No current pneumonia or other active chest infection
4. No opportunistic infections within the past six weeks
5. Free of tuberculosis
6. No joint or muscle injuries which could make exercise unsafe
7. No other medical condition which could make exercise unsafe e.g. cardiac, orthopaedic or neurological conditions.

The relevant hospital personnel cleared all prospective participants in terms of the above criteria. From this pool of potential participants, the aim was to recruit 60 individuals for the study, who were then allocated to either the EG or CG according to their ability to attend exercise sessions twice a week.

In fairness to the participants (most of whom come from economically disadvantaged circumstances), and to promote compliance with a testing programme that extended over 11 weeks, participants were offered small incentives. CG participants who came for pre-, mid- and post-intervention testing were rewarded with a lunch pack on the day of pre-testing, and a food parcel after the mid- and post-testing session. The EG received a lunch pack after every exercise session (twice a week for 11 weeks) and a food parcel once a month. The food parcel comprised of a variety of foods including fresh vegetables, starches/carbohydrates (samp, rice, maize meal) and basic groceries (oil, sugar, tea, coffee, soap). Of the 60 ARV clinic patients aged between 18 and 65 years who were approached to take part in the study, 19 (14 females and 5 males) were willing to be part of the EG and 20 (9 females and 8 males) joined the CG. The participants in both groups were either African or Coloured (mixed race) in ethnicity.

3.4 MEASURING INSTRUMENTS AND PROTOCOLS

3.4.1 Biographic and health questionnaire (APPENDIX A).

The biographic questionnaire gathered information on the participants' gender, date of birth, race, age, medication details, medical history, smoking details, exercise habits and dietary information.

3.4.2 Health related fitness components

3.4.2.1 Body composition related variables

3.4.2.1.1 Height

A Seca stadiometer was used to measure height by means of the 'stretch method' (Norton et al. 2006, 37). The stretch method requires the participant to stand with feet together at the heels, with buttocks and scapulae touching the vertical board of the stadiometer. Stature is taken without footwear other than socks. The subject's weight is placed evenly over both feet and the head oriented in the Frankfort Plane, which is achieved when the Orbital (lower edge of the eye socket) is in the same horizontal plane as the Tragion (the notch superior to the tragus of the ear). Once the subject's head and body is in the correct position the headboard of the stadiometer is pushed down firmly onto the Vertex (the highest point of the skull), compressing the hair as much as possible (Norton et al. 2006, 37). For purposes of this study the measurement was taken at the end of a deep inward breath and recorded in centimetres to the nearest 0.1cm.

3.4.2.1.2 Weight

A Seca medical scale accurate to within 0, 05 kg was used to weigh the participants. For weighing, participants wore minimal clothing, stood barefoot on the scale, and stood still facing forward, after which the reading was taken and the amount recorded in kilograms, to the nearest 100 gram (Norton et al. 2006, 37).

3.4.2.1.3 Body Mass Index

BMI was calculated to assess weight relative to height and is calculated by dividing body weight in kilograms by height in metres squared (Thompson, Gordon, and Pescatello 2009, 63-65). These results are used to classify body mass categories (See Table 3.1). BMI, which is often used in epidemiological studies, is the most commonly used indicator to assess for overweight and obesity in different settings (Klein et al. 2007, 1197).

Table 3.1: Classification for BMI

CLASSIFICATION	BMI (kg/m^2)
Underweight	<18.5
Normal	18.5-24.9
Overweight	25.0-29.9
Obesity class 1	30.0-34.9
Obesity class 2	35.0-39.9
Obesity class 3	>40

(Thompson, Gordon, and Pescatello 2009, 63)

3.4.2.1.4 Skinfolds and body fat %

Four skinfolds, namely bicep, tricep, subscapular and supra-iliac were measured in order to assess body composition. Skinfold thickness was measured using a Harpenden Skinfold Caliper according to the guidelines in Thompson, Gordon, and Pescatello (2009, 65-68). The Harpenden Caliper is a precision instrument that is recommended as the criterion instrument by the ISAK (International Society for the Advancement of Kinanthropometry). The caliper is calibrated to a maximum measurement of approximately 50mm, in 0.2mm divisions (International Society for the Advancement of Kinanthropometry 2001, 10). A minimum of two measurements were taken at each skinfold site and the average of the two measurements recorded was used to calculate body fat percentage. The Lufkin Anthropometric Tape, a flexible steel tape calibrated in centimetres with millimetre gradations, was used for the accurate location of a number of skinfold sites, and to measure distances from bony landmarks and locate landmarks.

a) Skinfold: Bicep - This marker is the mid-acromiale-radiale found on the anterior mid-line of the arm, over the bicep muscle and halfway between the acromion and

olecranon process (Norton et al. 2006, 39). The skinfold is taken with the subject in the anatomical standing position. It is raised with the left thumb and index finger on the marked mid-acromiale-radiale line. The fold is taken vertically and parallel to the long axis of the upper arm, on the most anterior surface of the upper arm (over the biceps muscle) when viewed from the side. The upper arm at the shoulder joint is slightly externally rotated and the elbow is extended (Norton et al. 2006, 47).

b) Skinfold: Tricep - This marker is the mid-acromiale-radiale and is on the posterior mid-line of the upper arm (over the tricep muscle), halfway between the acromion and olecranon process (Norton et al. 2006, 39). The skinfold is taken with the subject in the standing position. The arm should be relaxed with the upper arm at the shoulder joint slightly externally rotated and elbow extended by the side of the body. The skinfold is raised with the left thumb and index finger on the marked mid-acromial-radial line. The fold is taken vertically and parallel to the long axis of the upper arm on the most posterior surface of the upper arm (over the triceps muscle) when viewed from the side (Norton et al. 2006, 47).

c) Skinfold: Subscapular - This marker is the subscapulare which is the tip of the inferior angle of the scapula (Norton et al. 2006, 40). The subscapular skinfold taken on the diagonal line that extends from the vertebral border to a point one to two centimetres from the inferior angle of the scapula. The skinfold is taken with the subject in the standing position. The inferior angle of the scapula is identified through palpitation. The skinfold is taken by raising the fold at the marked site 2cm along a line running laterally and obliquely downwards from the subscapular angle at approximately 45°, as determined by the natural fold lines of the skin (Norton et al. 2006, 47).

d) Skinfold: Supra-spinale - The ilio-spinale is the most inferior tip on the anterior superior iliac spine (Norton et al. 2006, 41). The illiocristale is the most lateral aspect of the iliac tubercle on the illio-axilla line (Norton et al. 2006, 41). The illio-axilla line is the line joining midpoint of the armpit with lateral superior edge of illium (Norton et al. 2006, 41). The supra-illium skinfold is taken diagonally medially downward at a 45° angle above the crest of the ilium at the spot where an imaginary line would come down from the anterior axillary line. The skinfold is taken with the subject in the standing position, and the right arm raised to the head. The fold is

raised at the point where the line from the ilio-spinal mark to the anterior axillary border intersects with the horizontal line from the superior border of the ilium at the level of iliocristale (Norton et al. 2006, 51).

Linear regression equations were formulated to estimate body density using the four-site skinfold method of Durnin and Womersley (2007, 80). These calculations used the logarithm of each skinfold rather than the actual measurement. The logarithmic calculation is used because the frequency distribution of skinfold measurements in a general population is skewed, with a long tail of high readings, and because the relationship of body density to skinfolds may not be rectilinear because of the larger proportion of the body fat which is deposited subcutaneously with increasing obesity. A linear relationship with body density has to be achieved (Durnin and Womersley 2007, 80). The sums of the skinfolds are used to calculate body density and the body fat percentage. Separate equations are used for the different age groupings. A table (see table 3.2) is used where percentage body fat can be read off corresponding to differing values for the total of the four skinfolds. The table is subdivided for sex and for age (Durnin and Womersley 2007, 86).

Table 3.2: Coefficients for converting sum of skinfolds to body density

AGE (YEARS)	EQUATIONS FOR MALES	EQUATIONS FOR FEMALES
<17	D = 1.1533- (0.0643 x L)	D = 1.1369 – (0.0598 x L)
17-19	D = 1620 – (0.0630 x L)	D = 1.1549 – (0.0678 x L)
20-29	D = 1.1631 – (0.0632 x L)	D = 1.1599 – (0.0717 x L)
30-39	D = 1.1422 – (0.0544 x L)	D = 1.1423 – (0.0632 x L)
40-49	D = 1.1620 – (0.0700 x L)	D = 1.1333 – (0.0612 x L)
>50	D = 1.1715 – (0.0779 x L)	D = 1.1339 – (0.0645 x L)

(Durnin and Womersley 2007, 86)

Table 3.3: Description of the slope of body density

SLOPE OF BODY DENSITY	MALE		FEMALE	
Age (years)	**Constant.M**	**Slope.M**	**Constant.F**	**Slope.F**
< 17	1.1533	0.0643	1.1369	0.0598
17-19	1.1620	0.0630	1.1549	0.0678
20-29	1.1631	0.0632	1.1599	0.0717
30-39	1.1422	0.0544	1.1423	0.0632
40 -49	1.1620	0.0700	1.1333	0.0612
> 50	1.1715	0.0779	1.1339	0.0645

The Siri equation was used to convert body density to body fat percentage: % body fat = (495/body density) – 450. The Siri equation is based on the two compartment model, that is the body is made up of essentially two components: fat mass (the total fat of an individual) and fat-free mass (everything else: bone, water, lean tissue etc.) (Moon et al. 2007, 7-9) (Refer to table 3.3).

3.4.2.1.5 Waist-to-hip ratio

WHR is an indicator of abdominal obesity and a good predictor of health risk especially in older people. This ratio is the circumference of the waist divided by the circumference of the hips in order to determine body fat distribution (Thompson, Gordon, and Pescatello 2009, 64). For the waist measurement, the measurer stands in front of the subject and the measurement is taken at the narrowing of the waist, where the waist is at its narrowest point. The measurement is taken at the end of a normal expiration. For the hip measurement the measurer stands on the side of the subject, and the measurement is taken at the greater posterior protuberance of the buttocks. The subject stands with feet together and arm across the chest (Norton et al. 2006, 58). For the purposes of this study, a metal spring-loaded tape measure was used, to improve the accuracy of the measurements. Measurements were taken in centimetres in accordance with the guidelines provided by the ACSM (Thompson, Gordon, and Pescatello 2009, 63-67). See Table 3.4 and Table 3.5 for illustrations of the risk categories for waist circumference and WHR respectively.

Table 3.4: Classification for waist circumference

WAIST CIRCUMFERENCE		
RISK CATEGORY	**WOMEN**	**MEN**
Very low	<70 cm	<80cm
Low	70-89cm	80-99cm
High	90-109cm	100-120cm
Very high	>110cm	>120cm

(Thompson, Gordon, and Pescatello 2009, 63 & 66)

Table 3.5: Classification for waist-to-hip ratio

WAIST-TO-HIP RATIO			
MEN		**WOMEN**	
Low risk	0.95 or below	Low risk	0.80 or below
Moderate risk	0.96-1.0	Moderate risk	0.81-0.85
High risk	1.0+	High risk	0.85+

(Wood 2008)

3.4.2.2 Flexibility, strength and agility related variables

3.4.2.2.1 Flexibility: sit-and-reach

Flexibility was measured using the “sit-and-reach” test according to the ACSM protocol (Thompson, Gordon, and Pescatello 2009, 99). For this test, participants remove their shoes and sit on the floor placing their soles against a flexometer (sit-and-reach box) at the 26 cm mark. The participant slowly reaches forward as far as possible with both hands parallel, holding the maximum reach for two seconds. When reaching forward, the participant is instructed to exhale and to drop his or her head. The knees remain extended at all times when reaching forward, and the score is the most distant point that can be reached with the fingertips. For the purposes of this study, the better score of two trials was recorded in centimetres (Thompson, Gordon, and Pescatello 2009, 99, Jones and Rikli 2002, 29). Table 3.6 reflects the relevant normative data for sit-and-reach for men and women.

Table 3.6: Normative data for sit-and-reach

SIT-AND-REACH (CM)				
AGE	**60-64**	**65-69**	**70-74**	**75-79**
Men	-6.35 - 10.16	-7.62 - +7.62	-8.89 - +6.35	-10.16 - +5.08
Women	-1.27- +12.7	-1.27 - +11.43	-2.54 - +10.16	-3.81 - +8.89

(Jones and Rikli 2002, 26)

3.4.2.2.2 Strength

3.4.2.2.2.1 Upper body strength: grip strength

Grip strength, a marker for upper body strength, was measured using a Jamar grip dynamometer. The Jamar dynamometer was chosen for this study, because of the gold standard the Jamar has in research. The dynamometer is portable with a dial that reads force in kilograms (kg). The dial has marked 2kg intervals, allowing assessment to the nearest 1kg. The subject was seated, adducted and neutrally rotated shoulders, elbow flexed at 90°, forearm in neutral and wrist between 0° and 30° of dorsiflexion. The grip strength of both left and right hands were measured, with the better of two attempts on each side recorded (Roberts et al. 2011, 425 & 426). Table 3.7 reflects the relevant normative data for grip strength for males and females.

Table 3.7: Normative data for grip strength for males and females

GRIP STRENGTH RATINGS FOR MALES (IN KG)				GRIP STRENGTH RATINGS FOR FEMALES (IN KG)			
Age	**Weak**	**Normal**	**Strong**	**Age**	**Weak**	**Normal**	**Strong**
18-19	< 35.7	35.7-55.5	> 55.5	18-19	< 19.2	19.2-31.0	> 31.0
20-24	< 36.8	36.8-56.6	> 56.6	20-24	< 21.5	21.5-35.3	> 35.3
25-29	< 37.7	37.7-57.5	> 57.5	25-29	< 25.6	25.6-41.4	> 41.4
30-34	< 36.0	36.0-55.8	> 55.8	30-34	< 21.5	21.5-35.3	> 35.3
35-39	< 35.8	35.8-55.6	> 55.6	35-39	< 20.3	20.3-34.1	> 34.1
40-44	< 35.5	35.5-55.3	> 55.3	40-44	< 18.9	18.9-32.7	> 32.7
45-49	< 34.7	34.7-54.5	> 54.5	45-49	< 18.6	18.6-32.4	> 32.4
50-54	< 32.9	32.9-50.7	> 50.7	50-54	< 18.1	18.1-31.9	> 31.9
55-59	< 30.7	30.7-48.5	> 48.5	55-59	< 17.7	17.7-31.5	> 31.5
60-64	< 30.2	30.2-48.0	> 48.0	60-64	< 17.2	17.2-31.0	> 31.0
65-69	< 28.2	28.2-44.0	> 44.0	65-69	< 15.4	15.4-27.2	> 27.2

(Bechtol 1954, 820-824)

3.4.2.2.3 Lower body strength: 20 second sit-to-stand

Lower body strength was measured using the 20 second sit-to-stand test which is part of the Elderly Protocol described by Jones and Rikli (2002, 29). The participant sits in the middle of a chair with straight back, feet flat on the floor, and hands on chest. On the signal "go" the participant stand ups to a full stand and then returns to a seated position, repeating this movement as many times as possible in 30 seconds. Participants may rest, but timing continues. For the purpose of this study, the lower body strength score was calculated as the total amount of correct stands completed in 30 seconds. The 20 second sit-to-stand test is part of the testing protocol used for the assessment of fitness components for older individuals, hence the norms are for ages 60 years and above (see table 3.8). This protocol was used to assess the lower body fitness component due to the compromised health of HIV individuals.

Table 3.8: Normative data for sit-to-stand

SIT-TO-STAND (NO.)	60-64	65-69	70-74	75-79
Men	14-19	12-18	12-17	11-17
Women	12-17	11-16	10-15	10-15

(Jones and Rikli 2002, 26)

3.4.2.2.4 Agility: 2.44 meter up-and-go

Agility was measured using the 2.44 metre up-and-go test which is part of the Elderly Protocol of Jones and Rikli (2002, 29). For this test, a chair is placed against a wall facing a cone 2.44 metres away from the front of the chair. The participant is seated in the middle of the chair, leaning forward with hands on thighs and one foot slightly ahead of the other. On the signal "go", the participant gets up and walks as quickly as possible (without running) around the cone and back to the chair to sit down. The stopwatch is started on the signal "go", and is stopped when the patient sits on the chair. For the purpose of this study, the better score of two trials was recorded in seconds. The 2.44 up-and-go test is part of the testing protocol used for the assessment of fitness components for older individuals, hence the norms are for ages 60 years and above (see table 3.9). This protocol was used to assess agility due to the compromised health of HIV individuals.

Table 3.9: Normative data for 2.44 up-and-go

2.44 UP-AND-GO (S)	60-64	65-69	70-74	75-79
Men	5.6-3.8	5.7-4.3	6.0-4.2	7.2-4.6
Women	6.0-4.4	6.4-4.8	7.1-4.9	7.4-5.2

(Jones and Rikli 2002, 26)

3.4.2.3 Cardiovascular fitness related variables

3.4.2.3.1 Aerobic capacity: six minute walk

To measure the aerobic capacity of participants, the Six Minute Walk test was performed as described by the Elderly Protocol of the ACSM guidelines (Durstine, Moore, and Painter 2009, 205, 206). For this test, beacons are placed 4 metres apart over a 20-metre course. On the signal of "go", participants walk (no running permitted) around the course of the beacons with each round measuring forty metres. The test continues for six minutes, after which the total distance covered is recorded in metres. During the timed period, participants may stop and rest, but timing continues. After completion of the Six Minute Walk test, participants were allowed three minutes of rest, at which point recovery blood pressure and heart rate readings were recorded.

3.4.2.3.2 VO_2max

A generalised equation can be used to predict peak VO_2max from the six minute walk among groups of patients with diverse diseases (Ross et al. 2010, 1). The equation is:

Mean Peak VO_2 ml kg^{-1} min^{-1} = +.4 948 0 023. *Mean 6 MWD meters)

(Standard error of estimation 1.1 ml kg^{-1} min^{-1})

Table 3.10 reflects the relative VO_2 normative values by gender and age.

Table 3.10: VO_2 Normative Values by Gender and Age

MALE	RATING	AGE GROUPS									
%tile		20-29		30-39		40-49		50-59		60+	
95-99	Superior	54.0	58.8	52.5	58.9	50.4	55.4	47.1	52.5	45.2	50.4

MALE	RATING	AGE GROUPS									
80-94	**Excellent**	48.2	53.9	46.8	52.4	44.1	50.3	41.0	47.0	38.1	45.1
60-79	**Good**	44.2	48.1	42.4	46.7	39.3	44.0	36.7	40.9	33.6	38.0
40-59	**Fair**	41.0	44.1	38.9	42.3	36.7	39.8	33.8	36.6	30.2	33.5
20-39	**Poor**	37.1	40.9	35.4	38.8	33.0	36.6	30.2	33.7	26.5	30.1
1-19	**Very Poor**	27.1	37.0	26.5	35.3	24.2	32.9	22.0	30.1	18.3	26.4
FEMALE		**AGE GROUPS**									
%tile	**Rating**	**20-29**		**30-39**		**40-49**		**50-59**		**60+**	
95-99	**Superior**	46.8	53.0	43.9	48.7	41.0	46.8	36.8	47.0	37.5	44.5
80-94	**Excellent**	41.0	46.7	38.6	43.8	36.3	40.9	32.3	36.7	31.2	27.4
60-79	**Good**	36.7	40.9	34.6	38.5	32.3	36.2	29.4	32.2	27.2	31.1
40-59	**Fair**	33.8	36.6	32.3	34.5	29.5	32.2	26.9	29.3	24.5	27.1
20-39	**Poor**	30.6	33.7	28.7	32.2	26.5	29.4	24.3	26.8	22.8	24.4
1-19	**Very Poor**	22.6	30.5	22.5	28.6	20.8	26.4	18.7	24.2	17.9	22.7

(Paterson et al. 1999, 1813-1820)

3.4.2.3.3 Lung function: peak expiratory flow

Peak expiratory flow is the maximal forced expiratory movement from maximum lung inflation. Peak expiratory flow was measured using a peak flow meter measured in litres per minute, which records flow with a flat frequency response up to 15Hz (Miller et al. 2005, 330). Peak flow is measured with the subject seated in a comfortable position. The peak flow meter has to be held horizontally with fingers not obstructing the meter. Participants were asked to breathe in deeply, place lips tightly around the mouthpiece, and then breathe out as quickly and as hard as they could. This was repeated three times and the highest of the three measurements was recorded as the peak flow score (NHS choices: Your health your choices 2015). Table 3.11 reflects the relevant normative peak flow values for males and females.

Table 3.11: Classification of peak flow for adults

AGE	HEIGHT FOR MALES					HEIGHT FOR FEMALES				
	55'	**60'**	**65'**	**70'**	**75'**	**55'**	**60'**	**65'**	**70'**	**75'**
	(140cm)	**(152cm)**	**(165cm)**	**(178cm)**	**(190cm)**	**(140cm)**	**(152cm)**	**(165cm)**	**(178cm)**	**(190cm)**
20	554	602	649	693	740	390	423	460	496	529
25	543	590	636	679	725	385	418	454	490	523

AGE	HEIGHT FOR MALES					HEIGHT FOR FEMALES				
30	532	577	622	664	710	380	413	448	483	516
35	521	565	609	651	695	375	408	442	476	509
40	509	552	596	636	680	370	402	436	470	502
45	498	540	583	622	665	365	397	430	464	495
50	486	527	569	607	649	360	391	424	457	488
55	475	515	556	593	634	355	386	418	451	482
60	463	502	542	578	618	350	380	412	445	475
65	452	490	529	564	603	345	375	406	439	468
70	440	477	515	550	587	340	369	400	432	461

(Partners Health Care Asthma Center 2010)

3.4.2.4 Blood pressure

Blood pressure (BP) was recorded at each exercise session using an automatic BP monitor as part of the monitoring of the participants' well-being while participating in the exercise programme. To obtain a resting BP, participants were seated quietly for at least 5 minutes in a chair with back support, both feet on the floor, and arm supported at heart level. They also refrained from smoking or ingesting caffeine during the 30 minutes preceding the measurement. The appropriate cuff size was used to ensure accurate measurement, with the cuff being wrapped firmly around the upper arm at heart level, its bladder encircling at least 80% of the upper arm, and aligned with the brachial artery. Many adults required a large adult cuff. The participants were provided with verbal feedback of their systolic and diastolic blood pressure readings which was recorded in mm Hg (Thompson, Gordon, and Pescatello 2009, 46). Table 3.12 reflects the relevant normative data of blood pressure classification for adults.

Table 3.12: Classification of blood pressure for adults

BP CLASSIFICATION	SYSTOLIC BLOOD PRESSURE mmHG	DIASTOLIC BLOOD PRESSURE mmHG	LIFESTYLE MODIFICATION
Normal	<120	AND >80	Encourage
Prehypertension	120-139	Or 80-89	Yes
Stage 1 hypertension	140-159	OR 90-99	Yes
Stage 2 hypertension	>160	OR >100	Yes

(Thompson, Gordon, and Pescatello 2009, 47)

3.4.2.5 Heart rate

Heart rate (HR) was recorded at each exercise session using an automatic BP monitor as part of the monitoring of the participants' well-being while performing the exercise programme. To obtain a resting HR, participants were seated quietly for at least 5 minutes in a chair with back support, both feet on the floor, and arm supported at heart level. They also refrained from smoking or ingesting caffeine during the 30 minutes preceding the measurement. Heart rates were taken together with blood pressure and recorded as beats per minute (bpm) (Thompson, Gordon, and Pescatello 2009, 46). Table 3.13 reflects the relevant heart rate classification for males and females.

Table 3.13: Classification of heart rate for adults

MALES						
Age	**18-25**	**26-35**	**36-45**	**46-55**	**56-65**	**65+**
Athlete	49-55	49-54	50-56	50-57	51-56	50-55
Excellent	56-61	55-61	57-62	58-63	57-61	56-61
Good	62-65	62-65	63-66	64-67	62-67	62-65
Above Average	66-69	66-70	67-70	68-71	68-71	66-69
Average	70-73	71-74	71-75	72-76	72-75	70-73
Below Average	74-81	75-81	76-82	77-83	76-81	74-79
Poor	82+	82+	83+	84+	82+	80+
FEMALES						
Age	**18-25**	**26-35**	**36-45**	**46-55**	**56-65**	**65+**
Athlete	54-60	54-59	54-59	54-60	54-59	54-59
Excellent	61-65	60-64	60-64	61-65	60-64	60-64
Good	66-69	65-68	65-69	66-69	65-68	65-68
Above Average	70-73	69-72	70-73	70-73	69-73	69-72
Average	74-78	73-76	74-78	74-77	74-77	73-76
Below Average	79-84	77-82	79-84	78-83	78-83	77-84
Poor	85+	83+	85+	84+	84+	84+

(Wood 2010)

3.4.2.6 Quality of life

Quality of life (QOL) was assessed using the Medical Outcomes Study – HIV health survey (MOS-HIV) (APPENDIX B). The questionnaires were completed with the help and translation of the clinic staff. The MOS-HIV has been used extensively in studies related to HIV/AIDS. It has eight subscales: physical functioning, cognitive functioning, social functioning, mental health functioning, bodily pain, energy/fatigue, emotional well-being, and general health (Ware and Sherbourne 1992, 473). The scores are based on the sums of the questions in each section. Scores range from 0 - 100 (lower scores = more disability, higher scores = less disability). The mean average of the physical relevant questions as well as the mentally relevant questions can further be determined to get a physical component summary (PCS) of the physical quality of life, and a mental component summary (MCS) to get the mental quality of life (Ware and Sherbourne 1992, 473-478). As a valid and reliable QOL measure for people living with HIV, the MOS-HIV is widely used in South Africa and in other sub-Saharan countries (Rosen et al. 2008, 132).

3.4.2.7 The International Physical Activity Questionnaires (IPAQ)

The IPAQ long form (APPENDIX C), used in this study to determine health related physical activity, was developed as a surveillance instrument to measure multiple domains of physical activity (IPAQ 2005, 2). The IPAQ has acceptable reliabilities for use in many settings and in different languages, and is suitable for national population-based prevalence studies of participation in physical activity.

The IPAQ long form has four activity specific domains namely: work, transportation, domestic chores and gardening (yard) and leisure-time domains. Domain specific scores are calculated for different levels of activity namely: walking, moderate-intensity and vigorous-intensity activity.

The total physical activity scores are calculated by the sum of the duration (in minutes) and frequency (days) for all the types of activities in all domains. Total physical activity in domain specific scores is the summation of the scores for walking, moderate-intensity and vigorous-intensity activities within the specific domain. The total physical activity for the activity specific scores is the summation of the scores for that specific activity across the domains.

The researcher adhered to the recommendations for data analysis as prescribed by the IPAQ Research Committee (IPAQ 2005, 2). The data was reported as a continuous score in MET-minutes per week (MET-min/wk), where one MET is equivalent to the energy expended at rest, or 3.5 ml $O_2.kg^{-1}.min^{-1}$ (Ainsworth et al. 2000, 1575). This score was calculated for each domain by weighting each type of activity by its energy requirements, which yielded a MET-min score. The MET-min score was multiplied by the duration of time spent engaging in the activity to determine the MET-min score. Finally, the MET-min score was multiplied by the number of days on which the activity was performed on, to yield the MET-min/wk score (IPAQ 2005, 3). Median scores were reported for this instrument, as recommended by the IPAQ Research Committee, due to the non-normal distribution of energy expenditure in many populations. The mean and SD scores are therefore only reflected in order to further describe the sample, and are not used for statistical analysis (IPAQ 2005, 3). The intensity of the weekly physical activity can be calculated by separating the IPAQ domains. The intensity MET-min scores were calculated using the following equations (IPAQ 2005, 13):

Continuous Score expressed as MET-minutes per week: MET-min level x minutes of activity/day x days per week.

<u>Domain sub-scores</u>

- Total MET-minutes/week at work = Walk (METs*min*days) + Mod (METs*min*days) + Vig (METs*min*days) at work
- Total MET-minutes/week for transportation = Walk (METs*min*days) + Cycle (METs*min*days) for transportation
- Total MET-minutes/week from domestic and garden = Vig (METs*min*days) yard work + Mod (METs*min*days) yard work + Mod (METs*min*days) inside chores
- Total MET-minutes/week in leisure-time = Walk (METs*min*days) + Mod (METs*min*days) + Vig (METs*min*days) in leisure-time.

Walking, moderate-intensity and vigorous-intensity sub-scores

- Total Walking MET-minutes/week = Walk MET-minutes/week (at Work + for Transport + in Leisure)
- Total Moderate MET-.minutes/week = Cycle MET-minutes/week for Transport + Mod MET-minutes/week (Work + Yard chores + Inside chores + Leisure) + Vigorous Yard chores MET-minutes

*Note: The above is a total moderate activities only score. If you require a total of all moderate-intensity physical activities you would sum Total Walking and Total Moderate

- Total Vigorous MET-minutes/week = Vig MET-minutes/week (at Work + in Leisure)

Total physical activity score

Total Physical Activity MET-minutes/week = Walking MET-minutes/week + Moderate MET-minutes/week + Total Vigorous MET-minutes/week Also

Total Physical Activity MET-minutes/week = Total MET-minutes/week (at Work + for

Transport + in Chores + in Leisure)

Categorical score - three levels of physical activity are proposed

1. Low: No activity is reported OR

    a. Some activity is reported but not enough to meet Categories 2 or 3.

2. Moderate: Either of the following 3 criteria

    a. 3 or more days of vigorous-intensity activity of at least 20 minutes per day OR

    b. 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day OR

c. 5 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of at least 600 MET-min/week.

3. High: Any one of the following 2 criteria

- Vigorous-intensity activity on at least 3 days and accumulating at least 1500 MET-minutes/week OR
- 7 or more days of any combination of walking, moderate- or vigorous-intensity activities accumulating at least 3000 MET-minutes/week 4.0*30*5 = 600 MET-minutes/week

3.4.2.8 Blood tests

For the purposes of this study, access was granted to all the blood screening results which formed part of the participant's testing regimen in the course of his/her treatment at the ARV clinic. The blood results data used and analysed for the study were: CD4 count, viral load, white blood cell count (WBC) and red blood cell count (RBC).

3.4.2.8.1 CD4 count

The immune function of a patient is determined by the CD4 count. CD4 count is the primary predictor of disease progression and is used to determine initiation of ARV therapy. ARVs are initiated when the patient has a CD4 count of <200 cells/mm^3. CD4 count and CD4 percentage are highly variable. An adequate response is defined as an increase in CD4 count in the range of 50 to 150 cells/mm^3 during the first year of ARV therapy. CD4 count is considered together with the white blood cell count (WBC) count due to the fact that CD4 can be affected by medications or infections (increasing the number of WBC) causing a misleading CD4 count but a stable CD4 percentage. Thus at times CD4 percentage may be a better predictor of the patient's immune function (Panel on antiretroviral guidelines for adults and adolescents 2016, C1-C7). Table 3.14 and 3.15 reflects the relevant normative data for CD4 count and the classification system for HIV infection.

Table 3.14: Normative data for CD4 count

HEMATOLOGICAL VARIABLE (mm^3)	TREATMENT RECOMMENDED	HIGH RISK
CD4	Below 350 mm^3	Below 200 mm^3

(NAM AIDSmap 2012, Zeh et al. 2011, 3).

Table 3.15: Classification system for HIV infection

CD4 CELL COUNT CATAGORIES	CLINICAL CATAGORIES		
	A: symptomatic, acute HIV, or persistant generalised lymphadenopathy	B: Symptomatic conditions not A or C	C: AIDS indicator conditions
1. >500 cells/ul	A1	B1	C1
2. 200-499 cells/ul	A2	B2	C2
3. <200 cells/ul	A3	B3	C3

(U. S. Department of Health Human Services 2014b)

3.4.2.8.2 Viral load

Viral load, the indicator that measures the response of ARV therapy. Viral load should be taken at a regular intervals to determine the effectiveness of therapy. Viral load suppressed to a persistent undetectable level are associated with reduced risk of HIV progression to AIDS and to death (Panel on antiretroviral guidelines for adults and adolescents 2016, C5).

Table 3.16: Normative data for viral load

HEMATOLOGICAL VARIABLE (mm^3)	TREATMENT RECOMMENDED
Viral Load (mm^3) **(HIV treatment aims for undetectable values**	100,000 and 1 million mm^3

(Zeh et al. 2011, 3, NAM AIDSmap 2012)

3.4.2.8.3 White and red blood cell counts

Haematological disorders are very common in PLWHIV and thus HIV has a direct effect on many haematological results. Cytopenia occurs frequently in PLWHIV which can be due to opportunistic infections or the ARV therapy. Haematological

analysis can be used to diagnose and improve clinical observations and to determine treatment regimens (such as HAART) (Servais et al. 2001, 221,225).

a) White blood cell count (WBC)

The main function of WBC is to defend the body and give an overview of level of inflammation and infection. WBC also plays a key role in diagnosing cancers and autoimmune diseases (Basten 2010, 31).

b) Red blood cell count (RBC)

The main function of RBC is to transport oxygen to organs and tissues. The RBC can thus indicate whether anaemia's (low RBC) or polycythaemias (high RBC) are present. RBC also detects things like alcohol use, kidney and liver problems (Basten 2010, 28). Table 3.17 reflects the relevant normative data for RBC and WBC fo males and females.

Table 3.17: Normative data for RBC and WBC counts

NORMAL HEMATOLOGICAL VARIABLE (mm^3)	MALE	FEMALE
RBC	4.4-5.7 (mm^3)	4.0-5.2 (mm^3)
WBC	4-10 (mm^3)	4-10 x (mm^3)

(Medical Council of Canada 2017)

3.5 EXERCISE INTERVENTION

A combined aerobic and PRT exercise programme was conducted over 11 weeks at the ARV clinic at the Andries Vosloo Hospital APPENDIX D: Exercise intervention. The hospital set aside the use of an empty ward for the exercise intervention, which was customised into an exercise room. The exercise room was set out with different exercise stations in the form of an exercise circuit. Each station had an illustration chart alongside the necessary equipment for that specific exercise. The exercise charts that explained all the different exercises as well as individual exercise charts at every station in the circuit can be found in APPENDIX D. The exercise equipment used, namely, mats, stability balls, dumbbells and skipping ropes, was purchased through a research grant received from the Nelson Mandela Metropolitan University, and donated to the ARV clinic on completion of the study.

The exercise modalities that were addressed in the exercise programme were aerobic fitness, strength, flexibility and balance. The exercise sessions started with a warm up where the EG took a brisk walk around the hospital. The warm up was followed by alternating upper and lower body resistance exercises with short aerobic interval exercises. The exercise session was completed with core strength exercises and cool down stretching. The intensity of the exercise programme was increased every two weeks to ensure progression in specified fitness components (strength, flexibility and cardiovascular fitness) and health related benefits (Power and Howley 2007, 326-331). The participants in the EG were required to exercise twice a week (Tuesday and Thursday) for an hour for 11 weeks. According to ACSM guidelines, exercise is recommended at least three times a week (Durstine, Moore, and Painter 2009, 223). The EG were unable to make this recommendation due to personal circumstances and availability. Regular attendance was rewarded with a lunch pack which consisted of a nutritional sandwich, a fruit and fruit juice. The lunch pack was handed out after the exercise session. This incentive was used to encourage regular attendance. Exercise leaders (which included members of the ARV clinic staff) were taken through a short training course to prepare them to lead the exercise classes (TOT Programme). In addition, participants walked to and from the ARV clinic on exercise days, the estimated distance ranging from three to seven kilometres. The CG received no exercise intervention but was offered the intervention at the end of the study. Further details pertaining to the exercise intervention can be found in APPENDIX D.

3.6 DATA COLLECTION AND TESTING PROTOCOL

3.6.1 Permission to conduct research

The research proposal entitled “The effects of an exercise programme on the health and well-being of people living with HIV in a rural community of the Eastern Cape” was presented to staff in the Department of Human Movement Science, Nelson Mandela Metropolitan University. Thereafter, the proposal was submitted to the Faculty Research, Technology and Innovation Committee and NMMU Research Ethics Committee (Human) for approval, and granted the Approval Reference number **H11-HEA-001** (APPENDIX E: Research approval). Further permission to

conduct research at Andries Vosloo Hospital was granted by the Eastern Cape Department of Health.

3.6.2 Joint planning with hospital authorities

The principal researcher, the management of the hospital, and the ARV clinic staff then set up a structured plan as to how the hospital could accommodate the study. The social worker, the ARV co-ordinator and the doctor from the ARV clinic, assisted in the recruitment of participants. Meetings had to be held with the ARV co-ordinator and other clinic staff in order to explain the researcher's expectations of participants in the two groups, as well as the selection criteria. The Hospital management gave permission for physiotherapy staff to accommodate the study in their ordinary work schedule by assisting in all the exercise sessions which took place.

3.6.3 Meeting the participants and subsequent testing

Participants were informed of the study by the ARV clinic staff about a month before the commencement of the study. Staff explained the measuring and testing procedures that would take place, the exercise programme, and the requirement to attend exercise sessions. Upon arrival at the testing venue, participants were welcomed by the principal researcher. The purposes of the study and participant rights were explained to the participants (details in 3.8 Ethical Considerations).

The participants were then required to provide written consent for the study. The ARV clinic staff assisted by explaining the consent forms and supervising the completion of the forms (details of the consent form are included in, and the information given to participants appears in APPENDIX F).

Once this preliminary process was completed the procedure of pre-testing began, aided by a testing sheet/questionnaire. Biographical details were recorded and preliminary tests conducted as determined by the testing protocol (APPENDIX G: Physical fitness evaluation sheet). Following completion of the initial testing process, the participants of the EG were briefed by the researcher and given more detailed information about the exercise programme.

3.6.4 Training of exercise leaders

The physiotherapists, as by arrangement with the hospital, were responsible for conducting the exercise sessions. In addition, exercise leaders were recruited from staff at the ARV clinic, to assist the physiotherapists. They attended a presentation outlining the aims and objectives of the study and a training of trainers (TOT) session. The TOT session entailed the practical demonstration of exercises to ensure the correct execution of exercises as prescribed in the programme. In addition, a handout (APPENDIX D: Training manual) illustrating the correct execution of exercises was given to each exercise leader.

The exercise leaders and physiotherapists met with the researcher every two weeks to discuss the progression made and to implement increases in the intensity of the exercise programme. The exercise programme, modalities and progression had to be clearly explained and demonstrated to the leaders. Examples of the exercise illustrations and progression charts are in APPENDIX D.

3.7 DATA ANALYSIS

Data analysis was done with the help of a qualified statistician based at the Nelson Mandela Metropolitan University in order to ensure reliable and accurate analysis of all the relevant data as well as the correct interpretation thereof. This research design allowed for the investigation of a variety of possible changes in the health and fitness status of the EG. The findings rely on descriptive statistics (for example: means, standard deviations, frequency distributions), which can be represented numerically and/or graphically. Once the data was collected, post hoc analysis was conducted in order to evaluate the significance of differences found in the means of the groups. One sample T-tests were conducted to determine differences between the experimental and CGs, with a=0.05. Cohan’s d statistics were used to determine the practical significance of within and between group difference. For the blood results, due to the small sample sizes, Mann-Whitney U tests were conducted to determine the statistical significance of the differences between the EG and CG.

3.8 ETHICAL CONSIDERATIONS

Ethics guidelines as described by De Vos (2005, 57) are guidelines used to ensure that the researcher demonstrates the correct conduct towards the study participants, including rules and behavioural expectations of the researcher. These guidelines are widely accepted and encouraged to become part of the researcher's ethical decision making skills.

Permission for the proposed research study was sought from the NMMU Ethics Committee (Human) and the department of health (APPENDIX E). Prior to the commencement of the study, participants received a preamble letter (APPENDIX F) informing them of the aims and objectives of the study. They were also provided with, and required to sign, a document of informed consent. The consent form (APPENDIX F) included the risks related to the study.

The purposes of the study and participant rights were verbally explained to each participant. The participants were informed that participation in the study was completely voluntary. Their rights were explained in their home language ensuring that they understood. The participant rights explained were as follows:

1. The right to unconditional withdrawal from the study at any given point in time
2. The right to privacy
3. The right to anonymity
4. The right to confidentiality
5. The right to expect experimenter responsibility and professionalism

3.9 IN SUMMARY

In order to address the primary research question around the effect of systematic exercise on the general health and well-being of people living with HIV, a quasi-experimental research design was planned and implemented with the assistance of staff at the ARV Clinic of Andries Vosloo Hospital. A purposive (convenience) sample was drawn and participants were assign to either the EG or CG. Participants were selected for the EG on the basis of their ability to complete the requirements of the study. Participants were briefed about the purpose and process of the study, and informed consent obtained. During the 11-week duration of the study, the data

recorded at three testing periods (pre-, mid- and post-intervention), were analysed to evaluate the significance of any differences in the measurements between the two groups and across the three test periods.

The following chapter reports on the results obtained to achieve the aims and objectives of this study.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION

The present study investigated the effect of a combined progressive resistance exercise and aerobic exercise programme on the health and well-being of a sample of people from a rural community living with HIV. The data was gathered from participant's pre-, mid- and post- an 11-week intervention.

The variables assessed consisted of health related fitness components (including body composition related variables, flexibility, strength, agility related variables and cardiovascular related variables). In addition quality of life, the level of physical activity and blood related variables (CD4 count, viral load and white and red blood cell count) were assessed. Comparisons of the EG and CG, pre-, mid- and post (intervention) test scores of all the mentioned parameters are reported on.

The presentation of the results is done by means of descriptive and inferential statistics. Descriptive statistics, including frequency distribution, means (M) and standard deviations (S.D.), were employed in order to describe and explain the collected data. Inferential statistical techniques were employed to compare the EG's and CG's relevant results. Cohen's d was calculated to determine practical significance where statistical significant differences between variable means were detected. Where Cohen's d is calculated, a small practical significance is indicated when the absolute value of $d>0.2$, moderate practical significance when the absolute value of $d>0.5$ and large practical significance when the absolute value of $d>0.8$ (Gravetter and Wallnau 2016, 253). Inferential statistics utilising Chi-square tests were also calculated. In the cases where Chi-square calculations were applied and statistical differences identified, Cramers V values were calculated to determine practical significance. The latter was interpreted as follows: $V>0.1$ small effect, $V>0.3$ medium effect and $V>0.5$ large effect (Gravetter and Wallnau 2016, 586).

4.2 PARTICIPANT INFORMATION

4.2.1 Demographic and health information

Table 4.2.1 reflects the demographic, ARV and smoking habits information of the sample studied.

Table 4.2.1: Demographic and health information for EG and CG

Experimental group: n=19		**Control Group: n=17**	
Age	**n (%)**	**Age**	**n (%)**
15-24	0 (0)	15-24	1 (6)
25-34	6 (32)	25-34	2 (12)
35-44	6 (32)	35-44	9 (53)
45-54	5 (26)	45-54	3 (18)
55-64	1 (5)	55-64	2 (12)
65-95	1 (5)	65-95	0 (0)
Males n=5	**n (%)**	**Males : n=8**	**(n) (%)**
15-24	0 (0)	15-24	0 (0)
25-34	1 (5)	25-34	2 (12)
35-44	3 (16)	35-44	4 (24)
45-54	0 (0)	45-54	2 (12)
55-64	1 (5)	55-64	0 (0)
65-95	0 (0)	65-95	0 (0)
Females: n=14	**n (%)**	**Females: n=9**	**(n) (%)**
15-24	0 (0)	15-24	1 (6)
25-34	5 (26)	25-34	0 (0)
35-44	3 16)	35-44	5 (29)
45-54	5 (26)	45-54	1 (6)
55-64	1 (5)	55-64	2 (12)
65-95	0 (0)	65-95	0 (0)

Experimental group: n=19		Control Group: n=17	
Gender: n=19	**n (%)**	**Gender: n=17**	**(n) (%)**
Males	5 (26)	Males	8 (47)
Females	14 (74)	Females	9 (53)
Race: n=19	**n (%)**	**Race: n=17**	**(n)(%)**
Black	17 (89)	Black	13 (76)
White	1 (5)	White	0 (0)
Coloured	1 (5)	Coloured	4
ARVS: n=19	**n (%)**	**ARV's: n=17**	**(n)(%)**
On ARV's	19 (100)	On ARV's	17 (100)
Not on ARV's	0 (0)	Not on ARV's	0 (0)
Smoking: n=19	**n (%)**	**Smoking: n=17**	**(n)(%)**
Smoker	3 (16)	Smoker	4 (24)
Non Smoker	16 (84)	Non Smoker	13 (76)

The study sample was initially set at 60 participants (30 in EG and 30 in CG). However, only 36 participants were recruited to participate in the study (19 in the EG and 17 in the CG). The participants' ages ranged between 18 and 65 years with a mean age of 41 years for both the EG and CG. The total of 19 patients who were recruited into the EG were willing to follow the 11-week exercise programme. There were almost three times as many females as males in the EG, whereas the CG had a more even gender distribution. The majority of the EG and CG where African in ethnicity (n=30). All participants in the EG and CG were on ARVs and more than 75% were non-smokers.

4.2.2 Testing attendance

The pre-, mid- and post-testing attendance is described in Table 4.2.2.

Table 4.2.2: Pre-, mid- and post-testing attendance

Test	Experimental		Control	
Pre-test	**19**	**100%**	**17**	**100%**
Mid-test	**18**	**95%**	**15**	**88%**
Post-test	**19**	**100%**	**8**	**47%**

The majority of participants in the EG completed the three stages of testing (pre-, mid- and post-intervention), with only one participant absent for the mid-test.

The CG did not sustain the same level of commitment to the project, compared to the EG. At the mid-testing two participants were not tested due to employment considerations. At the post-testing, four were sick, three were working and two were absent come for unknown reasons.

4.2.3 Exercise session attendance

Table 4.2.3 reflects the attendance of the EG at the exercise sessions.

Table 4.2.3: Frequency distribution for exercise session attendance of EG

No. of sessions	No. of participants	Percentage (%)
Less than 9 sessions	**1**	**5%**
9 - 10 Sessions	**4**	**21%**
11 - 16 Sessions	**8**	**42%**
17 - 22 Sessions	**6**	**32%**
Total	**19**	**100%**

The results showed that 74% of the group (n=14) attended at least 50% of the exercise sessions, with only 6 participants (32%) attending more than 70% of the sessions.

4.3 DESCRIPTIVE AND INFERENTIAL STATISTICS FOR THE EG AND CG

The descriptive and inferential statistics are reflected separately in this section for the EG and CG. A reflection of results pertaining to health-related fitness

components which consists of body composition related variables, flexibility, strength and agility related variables and cardiovascular related variables are presented. This is followed by quality of life, physical activity levels and selected blood test results. Reference is given to mean values, standard deviations, range values and frequency distributions and where applicable, the variables and categories of participants assessed.

4.3.1 Descriptive and inferential statistics for the EG: body composition related variables

4.3.1.1 Descriptive statistics for the EG: body composition related variables

Table 4.3.1.1 reports descriptive statistics for the pre-, mid- and post-intervention test scores, as well as the pre-, mid- and post-intervention test score differences of the EG for the body composition related variables.

Table 4.3.1.1: Descriptive statistics for EG: body composition related variables

Body composition related variables	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
Height (cm) Pre-test	19	162.71	8.43	149.5	156.4	161.7	166.8	183
Weight (kg) Pre	19	69.16	19.87	43	54	63	79	114
Weight (kg) Mid	19	69.37	19.66	43	58	62	79	115
Weight (kg) Post	19	69.79	19.92	42	59.5	62	79.5	118
Weight (kg) Mid-Pre	19	0.21	2.46	-5	-0.5	0	1	5
Weight (kg) Post-Mid	19	0.42	1.68	-3	-1	0	1.5	3
Weight (kg) Post-Pre	19	0.63	2.93	-4	-1	0	2	7
BMI (kg/m^2) Pre	19	26.06	7.29	18.06	21.43	22.86	28.94	43.6
BMI (kg/m^2) Mid	19	26.19	7.31	17.02	21.32	23.33	29.16	43.98
BMI (kg/m^2)	19	26.34	7.39	17.71	21.55	23.74	28.94	45.13

Body composition related variables	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
Post								
BMI (kg/m^2) Mid-Pre	**19**	**0.12**	**0.9**	**-1.59**	**-0.18**	**0**	**0.43**	**2.05**
BMI (kg/m^2) Post –Mid	**19**	**0.15**	**0.64**	**-1.14**	**-0.37**	**0**	**0.53**	**1.22**
BMI (kg/m^2) Post – Pre	**19**	**0.27**	**1.13**	**-1.38**	**-0.4**	**0**	**0.78**	**2.74**
BF (%) Pre	**19**	**30.68**	**10.31**	**12.3**	**24.24**	**31.08**	**38.8**	**47.72**
BF (%) Mid	**18**	**29.34**	**10.05**	**11.15**	**21.98**	**29.89**	**37.26**	**45.56**
BF (%) Post	**19**	**29.73**	**9.5**	**11.59**	**24.09**	**32.64**	**36.21**	**44**
BF (%) Mid-Pre	**18**	**-0.91**	**1.48**	**-3.58**	**-1.96**	**-0.97**	**-0.14**	**1.92**
BF (%) Post-Mid	**18**	**0.15**	**1.46**	**-1.84**	**-1.08**	**-0.14**	**1.03**	**3.06**
BF (%) Post-Pre	**19**	**-0.94**	**2.36**	**-4.52**	**-2.78**	**-1.13**	**0.83**	**4.39**
WHR (ratio) Pre	**19**	**0.83**	**0.08**	**0.7**	**0.79**	**0.83**	**0.87**	**1**
WHR (ratio) Mid	**18**	**0.84**	**0.09**	**0.72**	**0.77**	**0.84**	**0.88**	**1.06**
WHR (ratio) Post	**19**	**0.85**	**0.07**	**0.72**	**0.8**	**0.85**	**0.87**	**1**
WHR (ratio) Mid-Pre	**18**	**0.01**	**0.05**	**-0.12**	**-0.01**	**0**	**0.03**	**0.12**
WHR (ratio) Post-Mid	**18**	**0.01**	**0.04**	**-0.07**	**0**	**0**	**0.01**	**0.15**
WHR (ratio) Post-Pre	**19**	**0.02**	**0.03**	**-0.02**	**0**	**0.01**	**0.04**	**0.06**

S.D.: Standard deviation; min: minimum; Q1: quartile 1; Q3: quartile 3; max: maximum

4.3.1.2 Inferential statistics for the EG: body composition related variables

Table 4.3.1.2 reports the pre-, mid- and post-intervention test score differences of the EG for the body composition related variables.

Table 4.3.1.2 inferential statistics for the EG: body composition

Body composition related variables	n	Mean	S.D.	t	d.f.	P (μ=0.00)	Cohen's d
Weight (kg) Mid-Pre	**19**	**0.21**	**2.46**	**0.37**	**18**	**.714**	**n/a**
BMI (kg/m^2) Mid-Pre	**19**	**0.12**	**0.90**	**0.59**	**18**	**.562**	**n/a**
BF (%) Mid-Pre	**18**	**-0.91**	**1.48**	**-2.62**	**17**	**.018**	**0.62**
WHR (ratio) Mid-Pre	**18**	**0.01**	**0.05**	**0.85**	**17**	**.407**	**n/a**
Weight (kg) Post-Mid	**19**	**0.42**	**1.68**	**1.09**	**18**	**.288**	**n/a**
BMI (kg/m^2) Post-Mid	**19**	**0.15**	**0.64**	**1.02**	**18**	**.321**	**n/a**
BF (%) Post-Mid	**18**	**0.15**	**1.46**	**0.43**	**17**	**.673**	**n/a**
WHR (ratio) Post-Mid	**18**	**0.01**	**0.04**	**0.51**	**17**	**.613**	**n/a**
Weight (kg) Post-Pre	**19**	**0.63**	**2.93**	**0.94**	**18**	**.360**	**n/a**
BMI (kg/m^2) Post-Pre	**19**	**0.27**	**1.13**	**1.06**	**18**	**.304**	**n/a**
BF (%) Post-Pre	**19**	**-0.94**	**2.36**	**-1.74**	**18**	**.099**	**n/a**
WHR (ratio)Post-Pre	**19**	**0.02**	**0.03**	**2.62**	**18**	**.017**	**0.60**

The results in table 4.3.1.2 indicate statistical and practically significant differences ($p<0.05$; $d>0.2$) for body fat % mid-pre and waist-to-hip post-pre intervention test score differences for the body composition related variables of the EG. There were no other statistically significant differences for body composition for the EG.

4.3.1.3 Descriptive statistics for the CG: body composition related variables

Table 4.3.1.3 reports descriptive statistics for the pre-, mid- and post-intervention test scores, as well as the pre-, mid- and post-intervention test score differences of the CG for body composition related variables.

Table 4.3.1.3: Descriptive statistics for the CG: body composition related variables

Body composition related variables	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
Height (cm) pre-test	17	162.56	5.50	154.00	159.00	162.40	165.00	175.50
Weight (kg) Pre	17	63.18	14.74	42.00	54.00	60.00	66.00	96.00
Weight (kg) Mid	14	62.43	17.17	40.00	52.13	56.50	68.00	95.50
Weight (kg) Post	8	67.75	15.33	53.00	57.25	62.00	74.50	94.00
Weight (kg) Mid-Pre	14	-1.79	3.60	-13.00	-1.88	-1.00	-0.13	2.00
Weight (kg) Post-Mid	6	0.67	1.60	-1.50	-0.50	1.00	1.75	2.50
Weight (kg)Post-Pre	8	0.38	5.93	-12.00	-0.50	1.50	2.25	9.00
BMI (kg/m^2) Pre	17	24.02	5.99	15.92	20.32	21.93	25.71	35.91
BMI (kg/m^2) Mid	14	23.65	6.90	15.17	19.23	20.84	26.41	35.72
BMI (kg/m^2) Post	8	25.72	5.95	20.96	21.28	23.29	28.10	35.16
BMI (kg/m^2) Mid-Pre	14	-0.68	1.41	-5.14	-0.65	-0.38	-0.05	0.74
BMI (kg/m^2) Post-Mid	6	0.25	0.61	-0.56	-0.20	0.38	0.64	0.97
BMI (kg/m^2) Mid-Pre	8	0.12	2.31	-4.75	-0.19	0.56	0.83	3.47
BF (%) Pre	17	24.92	11.54	8.30	16.77	21.69	33.44	42.55
BF (%) Mid	15	23.90	11.96	7.95	15.59	19.43	33.43	42.34
BF (%) Post	8	26.83	11.86	15.03	17.89	21.38	38.11	42.86
BF (%) Mid-Pre	15	-1.20	2.37	-8.42	-1.59	-0.35	0.21	0.92
BF (%) Post-Mid	7	0.38	2.20	-4.22	0.31	0.57	1.51	2.68
BF (%) Post-Pre	8	-0.76	4.94	-12.64	-0.58	0.94	1.57	2.68
WHR (ratio) Pre	17	0.87	0.07	0.73	0.82	0.88	0.92	0.97
WHR (ratio) Mid	15	0.88	0.06	0.76	0.87	0.88	0.91	0.96
WHR (ratio) Post	8	0.86	0.07	0.74	0.82	0.89	0.90	0.93
WHR (ratio) Mid-Pre	15	0.01	0.07	-0.06	-0.03	0.00	0.05	0.18
WHR (ratio) Post-Mid	7	-0.01	0.04	-0.08	-0.03	0.01	0.01	0.04
WHR (ratio) Post-Pre	8	0.01	0.08	-0.15	0.00	0.01	0.02	0.17

S.D.: standard deviation; min: minimum; Q1: quartile 1; Q3: quartile 3; max: maximum

4.3.1.4 Inferential statistics for the CG: body composition related variables

Table 4.3.1.4 reports inferential statistics for the pre-, mid- and post-intervention test scores, as well as the pre-, mid- and post-intervention test score differences of the CG for body composition related variables.

Table 4.3.1.4: Inferential statistics for the CG: body composition related variables

Body composition	n	Mean	S.D.	t	d.f.	P (μ=0.00)	Cohen's d
Weight (kg) Mid-Pre	14	-1.79	3.60	-1.85	13	.087	n/a
BMI (kg/m^2) Mid-Pre	14	-0.68	1.41	-1.81	13	.094	n/a
BF (%) Mid-Pre	15	-1.20	2.37	-1.96	14	.070	n/a
WHR (ratio) Mid-Pre	15	0.01	0.07	0.83	14	.419	n/a
Weight (kg) Post-Mid	6	0.67	1.60	1.02	5	.355	n/a
BMI (kg/m^2) Post-Mid	6	0.25	0.61	1.01	5	.360	n/a
BF (%) Post-Mid	7	0.38	2.20	0.46	6	.662	n/a
WHR (ratio) Post-Mid	7	-0.01	0.04	-0.67	6	.530	n/a
Weight (kg) Post-Pre	8	0.38	5.93	0.18	7	.863	n/a
BMI (kg/m^2) Post-Pre	8	0.12	2.31	0.14	7	.891	n/a
BF (%) Post-Pre	8	-0.76	4.94	-0.43	7	.677	n/a
WHR (ratio) Post-Pre	8	0.01	0.08	0.30	7	.772	n/a

The results in Table 4.3.1.4 reveals no statistical significant difference for any of the comparisons over the three test periods for the body composition related variables of the CG.

4.3.2 Descriptive and inferential statistics of the EG and CG: flexibility, strength and agility related variables

4.3.2.1 Descriptive statistics of the EG: flexibility, strength and agility related variables

Table 4.3.2.1 reports descriptive statistics for the pre-, mid- and post-intervention test scores, as well as the pre-, mid- and post-intervention test score differences of the EG for flexibility, strength and agility related variables.

Table 4.3.2.1: Descriptive statistics for the EG: flexibility, strength and agility related variables

Descriptive statistics	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
Flexibility								
Sit-and-reach (cm) Pre	19	24.03	9.41	8	16.5	24	31	42
Sit-and-reach (cm) Mid	18	25.75	8.03	9	21.25	26.25	30	38
Sit-and-reach (cm) Post	19	29.87	8.11	16	25	31	33.5	45
Sit-and-reach (cm) Mid-Pre	18	2.25	6.89	-11	-2.88	3.25	6.38	15
Sit-and-reach (cm) Post-Mid	18	3.78	3.88	-2.5	0.75	4	7.75	8
Sit-and-reach (cm) Post-Pre	19	5.84	7.19	-9	3	4.5	7.25	23
Strength								
Grip Max. (kg) Pre	19	36	8.35	26	30	34	39	62
Grip Max. (kg) Mid	18	38.89	10.92	28	31	36	40	62
Grip Max. (kg) Post	19	41.32	13	28	34	38	44	77
Grip Max. (kg) Mid-Pre	18	3	10.48	-7	-2	0	2	31
Grip Max. (kg) Post-Mid	18	2.72	9.5	-12	-0.75	0.5	4	37
Grip Max. (kg) Post-Pre	19	5.32	10.53	-2	0	2	3	34
30 Sec Sit-to-stand (no.) Pre	19	12.95	3.27	8	10.5	12	16	20
30 Sec Sit-to-stand (no.) Mid	18	16.56	3.07	12	14.25	16	17	24
30 Sec Sit-to-stand (no.) Post	19	19.84	2.52	15	18	20	22	25
30 Sec Sit-to-stand (no.) Mid-Pre	18	3.78	3.21	-1	1	3.5	5.75	12
30 Sec Sit-to-stand (no.) Post-Mid	18	3.39	3.97	-5	1	3.5	6	11
30 Sec Sit-to-stand (no.) Post-Pre	19	6.89	4.19	-2	3.5	8	9.5	14
Agility								
2.44 Up & Go (sec) Pre	19	5.41	0.62	4.59	4.95	5.37	5.8	6.72
2.44 Up & Go (sec) Mid	18	4.69	0.68	3.53	4.1	4.85	5.18	6.19
2.44 Up & Go (sec) Post	19	4.81	0.82	3.59	4.01	4.89	5.36	6.13
2.44 Up & Go (sec) Mid-Pre	18	-0.77	0.91	-2.19	-1.25	-0.79	-0.2	1.53
2.44 Up & Go (sec) Post-Mid	18	0.19	0.83	-1.26	-0.32	0.3	0.68	2.05

Descriptive statistics	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
2.44 Up & Go (sec) Post-Pre	**19**	**-0.6**	**1.03**	**-2.13**	**-1.29**	**-0.93**	**0.19**	**1.18**

S.D.: Standard deviation; min: minimum; Q1: quartile 1; Q3: quartile 3; max: maximum

4.3.2.2 Inferential statistics of the EG: flexibility, strength and agility related variables

Table 4.3.2.2 reports descriptive statistics for the pre-, mid- and post-intervention test scores, as well as the pre-, mid- and post-intervention test score differences of the EG for flexibility, strength and agility related variables.

Table 4.3.2.2: Inferential statistics for the EG: flexibility, strength and agility related variables

Inferential statistics	n	Mean	S.D.	t	d.f.	p (μ=0.00)	Cohen's d
Sit-and-reach (cm) Mid-Pre	**13**	**-1.19**	**7.08**	**-0.61**	**12**	**0.555**	**n/a**
Grip Max. (kg) Mid-Pre	**15**	**0.4**	**2.82**	**0.55**	**14**	**0.592**	**n/a**
30 Sec Sit (no.) Mid-Pre	**15**	**1.53**	**5.62**	**1.06**	**14**	**0.308**	**n/a**
2.44 Up & Go (sec) Mid-Pre	**15**	**0.08**	**2.34**	**0.13**	**14**	**0.9**	**n/a**
Sit-and-reach (cm) Post-Mid	**7**	**3.21**	**6.31**	**1.35**	**6**	**0.226**	**n/a**
Grip Max. (kg) Post-Mid	**7**	**0.57**	**6**	**0.25**	**6**	**0.809**	**n/a**
30 Sec Sit (no.) Post-Mid	**7**	**2.29**	**3.9**	**1.55**	**6**	**0.172**	**n/a**
2.44 Up & Go (sec) Post-Mid	**7**	**0**	**0.57**	**-0.02**	**6**	**0.985**	**n/a**
Sit-and-reach (cm) Post-Pre	**8**	**2.88**	**4.82**	**1.69**	**7**	**0.136**	**n/a**
Grip Max. (kg) Post-Pre	**8**	**1**	**3.85**	**0.73**	**7**	**0.487**	**n/a**
30 Sec Sit (no.) Post-Pre	**8**	**4.25**	**6.16**	**1.95**	**7**	**0.092**	**n/a**
2.44 Up & Go (sec) Post-Pre	**8**	**-0.46**	**0.62**	**-2.11**	**7**	**0.073**	**n/a**
Sit-and-reach (cm) Mid-Pre	**13**	**-1.19**	**7.08**	**-0.61**	**12**	**0.555**	**n/a**
Grip Max. (kg) Mid-Pre	**15**	**0.4**	**2.82**	**0.55**	**14**	**0.592**	**n/a**
30 Sec Sit (no.) Mid-Pre	**15**	**1.53**	**5.62**	**1.06**	**14**	**0.308**	**n/a**
2.44 Up & Go (sec) Mid-Pre	**15**	**0.08**	**2.34**	**0.13**	**14**	**0.9**	**n/a**
Sit-and-reach (cm) Post-Mid	**7**	**3.21**	**6.31**	**1.35**	**6**	**0.226**	**n/a**
Grip Max. (kg) Post-Mid	**7**	**0.57**	**6**	**0.25**	**6**	**0.809**	**n/a**

Inferential statistics	n	Mean	S.D.	t	d.f.	p (μ=0.00)	Cohen's d
30 Sec Sit (no.) Post-Mid	7	2.29	3.9	1.55	6	0.172	n/a
2.44 Up & Go (sec) Post-Mid	7	0	0.57	-0.02	6	0.985	n/a
Sit-and-reach (cm) Post-Pre	8	2.88	4.82	1.69	7	0.136	n/a
Grip Max. (kg) Post-Pre	8	1	3.85	0.73	7	0.487	n/a
30 Sec Sit (no.) Post-Pre	8	4.25	6.16	1.95	7	0.092	n/a
2.44 Up & Go (sec) Post-Pre	8	-0.46	0.62	-2.11	7	0.073	n/a

The results in Table 4.3.2.2 demonstrate no statistical significant difference for any of comparisons over the three test periods for each of the variables flexibility, strength and agility of the EG.

4.3.2.3 Descriptive statistics for the CG: flexibility, strength and agility related variables

Table 4.3.2.3 reports the descriptive statistics for the pre-, mid- and post-intervention test scores, as well as pre-, mid- and post-test score differences of the CG for flexibility, strength and agility related variables.

Table 4.3.2.3: Descriptive statistics for the CG: flexibility, strength and agility related variables

Descriptive statistics	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
Flexibility								
Sit-and-reach (cm) Pre	17	23.47	8.81	6.00	17.00	23.00	31.00	41.00
Sit-and-reach (cm) Mid	13	23.88	7.38	12.00	20.00	22.00	29.50	41.00
Sit-and-reach (cm) Post	8	30.63	8.21	19.50	23.00	32.25	35.25	44.00
Sit-and-reach (cm) Mid-Pre	13	-1.19	7.08	-19.00	-5.00	0.50	3.00	9.00
Sit-and-reach (cm) Post-Mid	7	3.21	6.31	-6.00	0.50	3.00	5.25	14.00
Sit-and-reach (cm) Post-Pre	8	2.88	4.82	-5.00	1.00	2.75	4.13	11.00
Strength								
Grip Max. (kg) Pre	17	36.35	8.16	24.00	30.00	34.00	40.00	54.00
Grip Max. (kg) Mid	15	36.80	10.13	24.00	30.50	31.00	41.00	60.00
Grip Max. (kg) Post	8	40.25	10.11	24.00	37.00	41.00	45.50	54.00
Grip Max. (kg) Mid-Pre	15	0.40	2.82	-6.00	-0.50	1.00	1.50	6.00
Grip Max. (kg) Post-Mid	7	0.57	6.00	-6.00	-2.00	-1.00	1.00	13.00

Descriptive statistics	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
Grip Max. (kg) Post-Pre	8	1.00	3.85	-2.00	-0.50	0.00	0.50	10.00
30 Sec Sit-to-stand (no.) Pre	17	13.06	4.22	9.00	10.00	12.00	14.00	25.00
30 Sec Sit-to-stand (no.) Mid	15	15.00	6.54	7.00	11.00	14.00	16.50	30.00
30 Sec Sit-to-stand (no.) Post	8	18.75	6.32	10.00	13.75	18.50	24.25	27.00
30 Sec Sit-to-stand (no.) Mid-Pre	15	1.53	5.62	-7.00	-0.50	1.00	3.00	19.00
30 Sec Sit-to-stand (no.) Post-Mid	7	2.29	3.90	-3.00	-0.50	2.00	5.50	7.00
30 Sec Sit-to-stand (no.) Post-Pre	8	4.25	6.16	-2.00	0.00	1.50	8.25	16.00
Agility								
2.44 Up & Go(sec) Pre	17	6.17	2.97	0.09	5.25	5.84	7.00	15.35
2.44 Up & Go (sec) Mid	15	6.15	2.78	3.44	4.99	5.43	6.33	15.25
2.44 Up & Go (sec) Post	8	4.86	0.70	3.62	4.57	4.94	5.34	5.75
2.44 Up & Go (sec) Mid-Pre	15	0.08	2.34	-2.55	-0.72	-0.34	0.06	8.10
2.44 Up & Go (sec) Post-Mid	7	0.00	0.57	-1.03	-0.13	-0.03	0.27	0.75
2.44 Up & Go(sec) Post-Pre	8	-0.46	0.62	-1.65	-0.79	-0.38	-0.01	0.28

S.D.: Standard deviation; min: minimum; Q1: quartile 1; Q3: quartile 3; max: maximum

4.3.2.4 Inferential statistics of the CG: flexibility, strength and agility related variables

Table 4.3.2.4 reports inferential statistics for the pre-, mid- and post-test score differences for variables related to flexibility, strength and agility for the CG.

Table 4.3.2.4: Inferential statistics for the CG: flexibility, strength and agility

Inferential statistics	n	Mean	S.D.	t	d.f.	p (μ=0.00)	Cohen's d
Sit-and-reach (cm) Mid-Pre	13	-1.19	7.08	-0.61	12	.555	n/a
Grip Max. (kg) Mid-Pre	15	0.40	2.82	0.55	14	.592	n/a
30 Sec Sit (no.) Mid-Pre	15	1.53	5.62	1.06	14	.308	n/a
2.44 Up & Go (sec) Mid-Pre	15	0.08	2.34	0.13	14	.900	n/a
Sit-and-reach (cm) Post-Mid	7	3.21	6.31	1.35	6	.226	n/a

Inferential statistics	n	Mean	S.D.	t	d.f.	p (μ=0.00)	Cohen's d
Grip Max.(kg) Post-Mid	7	0.57	6.00	0.25	6	.809	n/a
30 Sec Sit (no.) Post-Mid	7	2.29	3.90	1.55	6	.172	n/a
2.44 Up & Go (sec) Post-Mid	7	0.00	0.57	-0.02	6	.985	n/a
Sit-and-reach (cm) Post-Pre	8	2.88	4.82	1.69	7	.136	n/a
Grip Max. (kg) Post-Pre	8	1.00	3.85	0.73	7	.487	n/a
30 Sec Sit (no.) Post-Pre	8	4.25	6.16	1.95	7	.092	n/a
2.44 Up & Go (sec) Post-Pre	8	-0.46	0.62	-2.11	7	.073	n/a

The results in Table 4.3.2.2 demonstrate no statistical significant difference for any of the comparisons over the three test periods for each of the variables related to flexibility, strength and agility of the CG.

4.3.3 Descriptive and inferential statistics of the EG And CG: cardiovascular related variables

4.3.3.1 Descriptive statistics of the EG: cardiovascular related variables

Table 4.3.3.1 reports descriptive statistics for the pre-, mid- and post-intervention test scores, as well as the pre-, mid- and post-intervention test score differences of the EG for cardiovascular related variables.

Table 4.3.3.1: Descriptive statistics for EG: cardiovascular related variables

Descriptive statistics	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
Cardiovascular related variables								
6 Min. Walk (m) Pre	19	301.68	58.08	228	258	304	318	448
6 Min. Walk (m) Mid	18	285.33	47.19	208	260	274	304	396
6 Min. Walk (m) Post	19	313.05	35.18	244	299	312	336	380
6 Min. Walk (m) Mid-Pre	18	-8.22	45.76	-112	-40	0	19	60
6 Min. Walk (m) Post-Mid	18	27.78	37.38	-36	4	20	66	80
6 Min. Walk (m) Post-Pre	19	11.37	53.96	-136	-18	16	30	96

Descriptive statistics	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
VO_2max (ml/min/kg) Pre	19	11.89	1.34	10.19	10.88	11.94	12.26	15.25
VO_2max (ml/min/kg) Mid	18	11.51	1.09	9.73	10.93	11.25	11.94	14.06
VO_2max (ml/min/kg) Post	19	12.15	0.81	10.56	11.83	12.12	12.68	13.69
VO_2max (ml/min/kg) Mid-Pre	18	-0.19	1.05	-2.58	-0.92	0	0.44	1.38
VO_2max (ml/min/kg) Post-Mid	18	0.64	0.86	-0.83	0.09	0.46	1.52	1.84
VO_2max (ml/min/kg) Post-Pre	19	0.26	1.24	-3.13	-0.41	0.37	0.69	2.21
Peak Flow (L/min) Pre	19	236.32	85.91	120	180	220	285	400
Peak Flow (L/min) Mid	18	297.22	109.8	140	197.5	315	360	500
Peak Flow (L/min) Post	19	326.84	106.46	150	245	320	370	550
Peak Flow (L/min) Mid-Pre	18	56.67	98.99	-130	-15	50	125	240
Peak Flow(L/min) Post-Mid	18	31.11	86.02	-100	-35	25	90	220
Peak Flow (L/min) Post-Pre	19	90.53	107.31	-50	35	70	140	340
Resting Blood pressure								
BP. Systolic (mmHg) Pre	18	130.33	20.25	83	118	136.5	147.75	159
BP. Systolic (mmHg) Mid	17	123.88	21.34	75	123	128	137	152
BP. Systolic (mmHg) Post	19	129.84	17.91	104	118	132	140	180
BP. Systolic (mmHg) Mid-Pre	16	-3.5	13.34	-24	-13.25	-3.5	4.5	25
BP. Systolic (mmHg) Post-Mid	17	5.94	21.33	-27	-7	4	17	63
BP. Systolic (mmHg) Post-Pre	18	-0.94	17.72	-41	-11.75	-2.5	12.75	31
BP. Diastolic (mmHg) Pre	18	88.22	12.28	67	80.5	88	93.75	111
BP. Diastolic (mmHg) Mid	17	86.47	12.7	58	81	88	94	107
BP. Diastolic (mmHg) Post	19	86.53	8.51	67	82	88	93	100
BP. Diastolic (mmHg) Mid-Pre	16	-0.19	11.43	-13	-11	-1	4.5	19
BP. Diastolic (mmHg) Post-Mid	17	0.76	11.8	-22	-8	1	7	30
BP. Diastolic (mmHg) Post-Pre	18	-1.78	11.71	-19	-7.25	-3.5	2.5	33
Resting heart rate								
HR (bpm) Pre	18	82.44	11.98	60	73.5	84	90	103
HR (bpm) Mid	19	83.79	17.37	48	75.5	82	93.5	118
HR (bpm) Post	19	74.47	10.98	56	65.5	76	82.5	92

Descriptive statistics	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
HR (bpm) Mid-Pre	18	-0.56	12.27	-19	-10.75	0	7.5	24
HR (bpm) Post-Mid	19	-9.32	15.98	-54	-15.5	-6	0.5	16
HR (bpm) Post-Pre	18	-7.39	13.32	-38	-12.5	-7	-1	17
Post exercise blood pressure								
3 Min. BP Systolic (mmHg) Pre	19	135.74	19.53	96	125	135	142	189
3 Min. BP Systolic (mmHg) Mid	18	139.5	29.88	100	118	134	148.75	211
3 Min. BP Systolic (mmHg) Post	19	139	22.54	100	124.5	134	154.5	180
3 Min. BP Systolic (mmHg) Mid-Pre	18	3.72	25.78	-19	-12	-4	12	90
3 Min. BP Systolic (mmHg) Post-Mid	18	-1.11	30.28	-82	-16	4.5	18.25	50
3 Min. BP Systolic (mmHg) Post-Pre	19	3.26	19.37	-32	-8.5	2	12.5	39
3 Min. BP Diastolic (mmHg) Pre	19	88.47	9.55	67	82	85	96	103
3 Min. BP Diastolic (mmHg) Mid	18	93.22	26.18	66	76.5	92	100.5	184
3 Min. BP Diastolic (mmHg) Post	19	92.63	17.97	64	83.5	88	98	142
3 Min. BP Diastolic (mmHg) Mid-Pre	18	4.61	27.77	-21	-7.75	-1	5.5	104
3 Min. BP Diastolic (mmHg) Post-Mid	18	-1.22	27.56	-94	-4	1	4.75	39
3 Min. BP Diastolic (mmHg) Post-Pre	19	4.16	18.06	-18	-7	2	8.5	58
Post exercise heart rate								
3 Min. HR (bpm) Pre	19	95.16	16.9	70	81	92	109	127
3 Min. HR (bpm) Mid	18	92.33	20.08	60	79.75	93	105	129
3 Min. HR (bpm) Post	19	100	15.56	71	92	101	108	128
3 Min. HR (bpm) Mid-Pre	18	-3	20.58	-29	-16.75	-3	7	41
3 Min. HR (bpm) Post-Mid	18	7.61	16.98	-40	-0.25	12	21.5	24
3 Min. HR (bpm) Post-Pre	19	4.84	13.99	-18	-4.5	5	13	29
3 Min. HR Diff. Pre	18	14	10.96	-1	8.5	13	16	46
3 Min. HR Diff. Mid	18	8.67	11.94	-11	2.5	8.5	14.25	36

Descriptive statistics	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
3 Min. HR Diff. Post	19	25.53	12.16	9	16	25	34.5	48
3 Min. HR Diff. Mid-Pre	17	-5	18.2	-44	-6	-1	4	24
3 Min. HR Diff. Post-Mid	18	17.33	15.38	-16	7.25	20.5	23	50
3 Min. HR Diff. Post-Pre	18	12.44	14.05	-19	3.5	13	22.25	33
3 Min. HR Diff.% Pre	18	17.36	14.56	-1.28	9.82	14.86	19.77	56.79
3 Min. HR Diff.% Mid	18	11.2	14.98	-15.07	2.84	11.39	18.24	45
3 Min. HR Diff.% Post	19	35.16	17.33	9.78	20.79	36.36	51.18	61.19
3 Min. HR Diff.% Mid-Pre	17	-5.85	24.39	-61.74	-7.51	-2.12	9.28	27.12
3 Min. HR Diff.% Post-Mid	18	24.79	22.24	-20	12.2	26.45	37.26	70.77
3 Min. HR Diff.% Post-Pre	18	18.98	21.36	-34.82	6.34	22.29	35.96	47.98

S.D.: Standard deviation; min: minimum; Q1: quartile 1; Q3: quartile 3; max: maximum

4.3.3.2 Inferential statistics of the EG: cardiovascular related variables

Table 4.3.3.2 reports inferential statistics for the pre-, mid- and post-intervention test score differences of the EG for cardiovascular related variables.

Table 4.3.3.2: Inferential statistics for EG: cardiovascular related variables

Inferential Statistics	n	Mean	S.D.	t	d.f.	p (μ=0.00)	Cohen's d
6 Min. Walk (m) Mid-Pre	18	-8.22	45.76	-0.76	17	.456	n/a
VO_2max (ml kg^{-1} min^{-1}) Mid-Pre	18	-0.19	1.05	-0.76	17	.456	n/a
Peak Flow (L/min) Mid-Pre	18	56.67	98.99	2.43	17	.027	0.57
6 Min. Walk (m) Post-Mid	18	27.78	37.38	3.15	17	.006	0.74
VO_2max (ml kg^{-1} min^{-1}) Post-Mid	18	0.64	0.86	3.15	17	.006	0.74
Peak Flow (L/min) Post-Mid	18	31.11	86.02	1.53	17	.143	n/a
6 Min. Walk (m) Post-Pre	19	11.37	53.96	0.92	18	.371	n/a
VO_2max (ml kg^{-1} min^{-1}) Post-Pre	19	0.26	1.24	0.92	18	.371	n/a
Peak Flow (L/min) Post-Pre	19	90.53	107.31	3.68	18	.002	0.84
BP. Systolic (mmHg) Mid-Pre	16	-3.5	13.34	-1.05	15	0.31	n/a
BP. Diastolic (mmHg) Mid-Pre	16	-0.19	11.43	-0.07	15	0.949	n/a

Inferential Statistics	n	Mean	S.D.	t	d.f.	p (μ=0.00)	Cohen's d
Resting HR (bpm) Mid-Pre	18	-0.56	12.27	-0.19	17	0.85	n/a
3 Min. BP Systolic (mmHg) Mid-Pre	18	3.72	25.78	0.61	17	0.548	n/a
3 Min. BP Diastolic (mmHg) Mid-Pre	18	4.61	27.77	0.7	17	0.491	n/a
3 Min. HR (bpm) Mid-Pre	18	-3	20.58	-0.62	17	0.544	n/a
3 Min. HR Diff Mid-Pre	17	-5	18.2	-1.13	16	0.274	n/a
3 Min. HR Diff.% Mid-Pre	17	-5.85	24.39	-0.99	16	0.337	n/a
BP. Systolic (mmHg) Post-Mid	17	5.94	21.33	1.15	16	0.268	n/a
BP. Diastolic (mmHg) Post-Mid	17	0.76	11.8	0.27	16	0.793	n/a
HR (bpm) Post-Mid	19	-9.32	15.98	-2.54	18	0.02	0.58
3 Min. BP Systolic (mmHg) Post-Mid	18	-1.11	30.28	-0.16	17	0.878	n/a
3 Min. BP Diastolic (mmHg) Post-Mid	18	-1.22	27.56	-0.19	17	0.853	n/a
3 Min. HR (bpm) Post-Mid	18	7.61	16.98	1.9	17	0.074	n/a
3 Min. HR Diff. Post-Mid	18	17.33	15.38	4.78	17	<.0005	1.13
3 Min. HR Diff.% Post-Mid	18	24.79	22.24	4.73	17	<.0005	1.11
BP. Systolic (mmHg) Post-Pre	18	-0.94	17.72	-0.23	17	0.824	n/a
BP. Diastolic (mmHg) Post-Pre	18	-1.78	11.71	-0.64	17	0.528	n/a
HR (bpm) Post-Pre	18	-7.39	13.32	-2.35	17	0.031	0.55
3 Min. BP Systolic (mmHg) Post-Pre	19	3.26	19.37	0.73	18	0.472	n/a
3 Min. BP Diastolic (mmHg) Post-Pre	19	4.16	18.06	1	18	0.329	n/a
3 Min. HR (bpm) Post-Pre	19	4.84	13.99	1.51	18	0.149	n/a
3 Min. HR Diff. Post-Pre	18	12.44	14.05	3.76	17	0.002	0.89
3 Min. HR Diff.% Post-Pre	18	18.98	21.36	3.77	17	0.002	0.89

The results in Table 4.3.3.2 indicate statistical and practical differences ($p<0.05$; $d>0.2$) for the following cardiovascular related variables; HR Post-Mid, 3 Min HR Diff.

Post-Mid, 3 Min HR Diff % Post-Mid, HR Post-Pre, 3 Min HR Diff Post-Pre and 3 Min HR Diff % Post-Pre for the EG.

4.3.3.3 Descriptive statistics of the CG: cardiovascular related variables

Table 4.3.3.3 reports descriptive statistics for the pre-, mid- and post-intervention test scores, as well as the pre-, mid- and post-intervention test score differences of the CG for cardiovascular related variables.

Table 4.3.3.3: Descriptive statistics for CG: cardiovascular related variables

Descriptive statistics	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
Cardiovascular related variables								
6 Min. Walk (m) Pre	17	242.65	55.85	160.00	205.00	260.00	280.00	360.00
6 Min. Walk (m) Mid	15	262.40	53.13	140.00	252.00	276.00	284.00	380.00
6 Min. Walk (m) Post	8	302.00	49.87	240.00	258.00	316.00	325.00	380.00
6 Min. Walk (m) Mid-Pre	15	22.07	51.71	-60.00	-16.00	16.00	61.50	100.00
6 Min. Walk (m) Post-Mid	7	2.29	31.57	-48.00	-16.00	0.00	28.00	40.00
6 Min. Walk (m) Post-Pre	8	58.88	51.90	-16.00	31.25	46.00	90.00	140.00
VO_2max (ml kg^{-1} min^{-1}) Pre	17	10.53	1.28	8.63	9.66	10.93	11.39	13.23
VO_2max (ml kg^{-1} min^{-1}) Mid	15	10.98	1.22	8.17	10.74	11.30	11.48	13.69
VO_2max (ml kg^{-1} min^{-1}) Post	8	11.89	1.15	10.47	10.88	12.22	12.42	13.69
VO_2max (ml kg^{-1} min^{-1}) Mid-Pre	15	0.51	1.19	-1.38	-0.37	0.37	1.41	2.30
VO_2max (ml kg^{-1} min^{-1}) Post-Mid	7	0.05	0.73	-1.10	-0.37	0.00	0.64	0.92
VO_2max (ml kg^{-1} min^{-1}) Post-Pre	8	1.35	1.19	-0.37	0.72	1.06	2.07	3.22
Peak Flow (L/min) Pre	1	370.00	-	370.00	370.00	370.00	370.00	370.00
Peak Flow (L/min) Mid	15	289.33	95.43	110.00	225.00	280.00	360.00	450.00
Peak Flow (L/min) Post	8	296.25	91.80	200.00	240.00	280.00	307.50	500.00
Peak Flow (L/min) Mid-Pre	1	80.00	-	80.00	80.00	80.00	80.00	80.00
Peak Flow(L/min) Post-Mid	7	-35.71	75.02	-160.00	-75.00	-40.00	25.00	50.00
Peak Flow (L/min) Post-Pre	1	130.00	-	130.00	130.00	130.00	130.00	130.00

Descriptive statistics	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
Resting Blood pressure								
BP. Systolic (mmHg) Pre	17	135.88	17.56	103.00	119.00	141.00	147.00	171.00
BP. Systolic (mmHg) Mid	15	131.27	20.51	100.00	113.50	135.00	147.50	161.00
BP. Systolic (mmHg) Post	8	131.25	26.57	104.00	115.75	126.50	133.25	191.00
BP. Systolic (mmHg) Mid-Pre	15	-4.47	15.34	-24.00	-15.00	-9.00	0.50	35.00
BP. Systolic (mmHg) Post-Mid	7	0.86	16.36	-18.00	-10.00	-4.00	9.00	30.00
BP. Systolic (mmHg) Post-Pre	8	-3.75	21.22	-22.00	-12.25	-10.00	-6.00	47.00
BP. Diastolic (mmHg) Pre	17	91.06	16.16	64.00	83.00	88.00	98.00	126.00
BP. Diastolic (mmHg) Mid	15	90.73	12.36	71.00	82.00	89.00	100.00	110.00
BP. Diastolic (mmHg) Post	8	91.13	26.84	71.00	75.50	87.50	89.00	155.00
BP. Diastolic (mmHg) Mid-Pre	15	0.07	17.18	-33.00	-6.00	0.00	2.50	46.00
BP. Diastolic (mmHg) Post-Mid	7	0.71	22.74	-27.00	-12.00	0.00	5.50	45.00
BP. Diastolic (mmHg) Post-Pre	8	5.00	35.23	-17.00	-9.50	-7.50	0.25	91.00
Resting heart rate								
HR (bpm) Pre	17	79.12	13.24	64.00	71.00	78.00	84.00	116.00
HR (bpm) Mid	15	80.93	10.52	62.00	73.00	84.00	89.50	93.00
HR (bpm) Post	8	79.50	11.64	62.00	74.75	80.50	86.00	98.00
HR (bpm) Mid-Pre	15	1.40	15.87	-31.00	-3.00	-1.00	6.50	28.00
HR (bpm) Post-Mid	7	2.14	7.01	-4.00	-3.50	0.00	6.00	14.00
HR (bpm) Post-Pre	8	1.13	14.32	-28.00	-2.25	1.00	7.75	21.00
Post exercise blood pressure								
3 Min. BP Systolic (mmHg) Pre	17	132.24	17.54	104.00	122.00	133.00	139.00	165.00
3 Min. BP Systolic (mmHg) Mid	15	133.87	23.70	101.00	113.50	135.00	150.50	179.00
3 Min. BP Systolic (mmHg) Post	8	144.00	31.41	107.00	123.50	140.50	157.50	200.00
3 Min. BP Systolic (mmHg) Mid-Pre	15	0.67	20.23	-41.00	-10.00	0.00	11.00	34.00

Descriptive statistics	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
3 Min. BP Systolic (mmHg) Post-Mid	7	9.43	26.27	-34.00	0.00	6.00	21.50	51.00
3 Min. BP Systolic (mmHg) Post-Pre	8	9.13	26.98	-24.00	-16.75	11.00	35.25	41.00
3 Min. BP Diastolic (mmHg) Pre	17	89.35	13.25	68.00	80.00	88.00	97.00	120.00
3 Min. BP Diastolic (mmHg) Mid	15	92.13	22.08	59.00	83.00	95.00	98.50	155.00
3 Min. BP Diastolic (mmHg) Post	8	93.63	29.42	61.00	80.25	86.50	96.00	160.00
3 Min. BP Diastolic (mmHg) Mid-Pre	15	1.67	20.22	-28.00	-10.00	1.00	13.00	52.00
3 Min. BP Diastolic (mmHg) Post-Mid	7	6.43	28.61	-23.00	-5.50	-5.00	9.50	65.00
3 Min. BP Diastolic (mmHg) Post-Pre	8	3.88	20.43	-28.00	-9.00	4.00	12.75	40.00
Post exercise heart rate								
3 Min. HR (bpm) Pre	17	82.65	13.29	64.00	73.00	79.00	93.00	105.00
3 Min. HR (bpm) Mid	15	89.20	15.05	61.00	83.50	90.00	95.00	116.00
3 Min. HR (bpm) Post	8	96.75	14.43	80.00	86.50	95.00	104.50	122.00
3 Min. HR (bpm) Mid-Pre	15	5.40	16.89	-37.00	-1.00	8.00	15.00	29.00
3 Min. HR (bpm) Post-Mid	7	5.71	10.13	-7.00	-0.50	2.00	13.50	19.00
3 Min. HR (bpm) Post-Pre	8	11.63	20.97	-18.00	-2.25	8.50	24.00	47.00
3 Min. HR Diff. Pre	17	3.53	10.11	-11.00	-4.00	1.00	5.00	32.00
3 Min. HR Diff. Mid	15	8.27	13.13	-7.00	-0.50	2.00	13.50	33.00
3 Min. HR Diff. Post	8	17.25	14.35	-8.00	13.00	16.00	22.00	42.00
3 Min. HR Diff. Mid-Pre	15	4.00	9.76	-11.00	-0.50	2.00	8.50	27.00
3 Min. HR Diff. Post-Mid	7	3.57	14.97	-16.00	-7.50	6.00	14.00	22.00
3 Min. HR Diff. Post-Pre	8	10.50	20.50	-15.00	-1.50	7.00	18.75	46.00
3 Min. HR Diff.% Pre	17	5.22	13.61	-9.48	-5.06	1.28	5.38	43.84
3 Min. HR Diff.% Mid	15	10.77	17.39	-9.86	-0.81	2.70	19.82	45.83
3 Min. HR Diff.% Post	8	22.89	17.81	-8.16	15.41	21.42	32.84	52.50

Descriptive statistics	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
3 Min. HR Diff.% Mid-Pre	15	4.51	12.55	-17.78	-0.61	3.46	8.99	34.36
3 Min. HR Diff.% Post-Mid	7	4.64	20.20	-26.07	-7.77	7.94	19.37	27.43
3 Min. HR Diff.% Post-Pre	8	13.00	26.65	-24.07	-5.10	12.48	23.64	57.56

S.D.: Standard deviation; min: minimum; Q1: quartile 1; Q3: quartile 3; max: maximum

4.3.3.4 Inferential statistics of the CG: cardiovascular related variables

Table 4.3.3.4 reports inferential statistics for the pre-, mid- and post-intervention test score differences of the CG for cardiovascular related variables.

Table 4.3.3.4: Inferential statistics for CG: cardiovascular related variables

Inferential statistics	n	Mean	S.D.	t	d.f.	p (μ=0.00)	Cohen's d
6 Min. Walk (m) Mid-Pre	15	0.51	1.19	1.65	14	.121	n/a
VO_2max (ml kg^{-1} min^{-1}) Mid-Pre	1	80.00	-	-	-	-	-
Peak Flow (L/min) Mid-Pre	0	-	-	-	-	-	-
6 Min. Walk (m) Post-Mid	7	2.29	31.57	0.19	6	.854	n/a
VO_2max (ml kg^{-1} min^{-1}) Post-Mid	7	0.05	0.73	0.19	6	.854	n/a
Peak Flow (L/min) Post-Mid	7	-35.71	75.02	-1.26	6	.255	n/a
6 Min. Walk (m) Post-Pre	8	58.88	51.90	3.21	7	.015	1.13
VO_2max (ml kg^{-1} min^{-1}) Post-Pre	8	1.35	1.19	3.21	7	.015	1.13
Peak Flow (L/min) Post-Pre	1	130.00	-	-	-	-	-
BP. Systolic (mmHg) Mid-Pre	15	-4.47	15.34	-1.13	14	.278	n/a
BP. Diastolic (mmHg) Mid-Pre	15	0.07	17.18	0.02	14	.988	n/a
HR (bpm) Mid-Pre	15	1.40	15.87	0.34	14	.738	n/a
3 Min. BP Systolic (mmHg) Mid-Pre	15	0.67	20.23	0.13	14	.900	n/a
3 Min. BP Diastolic (mmHg) Mid-Pre	15	1.67	20.22	0.32	14	.754	n/a
3 Min. HR (bpm) Mid-Pre	15	5.40	16.89	1.24	14	.236	n/a
3 Min. HR Diff Mid-Pre	15	4.00	9.76	1.59	14	.135	n/a
3 Min. HR Diff.% Mid-Pre	15	4.51	12.55	1.39	14	.185	n/a
BP. Systolic (mmHg) Post-Mid	7	0.86	16.36	0.14	6	.894	n/a

Inferential statistics	n	Mean	S.D.	t	d.f.	p (μ=0.00)	Cohen's d
BP. Diastolic (mmHg) Post-Mid	7	0.71	22.74	0.08	6	.936	n/a
HR (bpm) Post-Mid	7	2.14	7.01	0.81	6	.450	n/a
3 Min. BP Systolic (mmHg) Post-Mid	7	9.43	26.27	0.95	6	.379	n/a
3 Min. BP Diastolic (mmHg) Post-Mid	7	6.43	28.61	0.59	6	.574	n/a
3 Min. HR (bpm) Post-Mid	7	5.71	10.13	1.49	6	.186	n/a
3 Min. HR Diff. Post-Mid	7	3.57	14.97	0.63	6	.551	n/a
3 Min. HR Diff.% Post-Mid	7	4.64	20.20	0.61	6	.565	n/a
BP. Systolic (mmHg) Post-Pre	8	-3.75	21.22	-0.50	7	.633	n/a
BP. Diastolic (mmHg) Post-Pre	8	5.00	35.23	0.40	7	.700	n/a
HR (bpm) Post-Pre	8	1.13	14.32	0.22	7	.830	n/a
3 Min. BP Systolic (mmHg) Post-Pre	8	9.13	26.98	0.96	7	.371	n/a
3 Min. BP Diastolic (mmHg) Post-Pre	8	3.88	20.43	0.54	7	.608	n/a
3 Min. HR (bpm) Post-Pre	8	11.63	20.97	1.57	7	.161	n/a
3 Min. HR Diff. Post-Pre	8	10.50	20.50	1.45	7	.191	n/a
3 Min. HR Diff.% Post-Pre	8	13.00	26.65	1.38	7	.210	n/a

The results in Table 4.3.3.4 indicate statistical and practical differences ($p<0.05$; $d>0.2$) for 6 min walk post-pre and VO_2max post-pre-tests for the CG.

4.3.4 Descriptive and inferential statistics of the EG and CG: quality of life

4.3.4.1 Descriptive statistics of the EG: quality of life

Table 4.3.4.1 reports the descriptive statistics for the quality of life measurement (MOS PCS and MOS MCS) for the pre- and post- as well as the post- and pre-test score differences of the EG.

Table 4.3.4.1: Descriptive statistics for EG: quality of life

Descriptive	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
MOS PCS								
MOS PCS (%) Pre	19	50.65	8.22	34.67	45.23	53.38	57.23	63.64
MOS PCS (%) Post	19	53.54	8.16	37.79	47.38	53.77	60.45	67.07
MOS PCS (%) Post-Pre	19	2.88	11.96	20.94	-4.56	2.35	8.95	28.31
MOS MCS								
MOS MCS (%) Pre	19	47.32	14.51	17.37	38.33	48.62	59.54	64.77
MOS MCS (%) Post	19	50.33	6.32	42.41	45.06	48.23	56.49	61.37
MOS MCS (%) Post-Pre	19	3.01	14.65	20.80	-6.59	1.61	10.32	28.04

S.D.: Standard deviation; min: minimum; Q1: quartile 1; Q3: quartile 3; max: maximum

4.3.4.2 Inferential statistics of the EG: quality of life

Table 4.3.4.2 reports inferential statistics for the pre-, mid- and post-intervention test score differences of the EG for quality of life variables.

Table 4.3.4.2: Inferential statistics for the EG: quality of life

Inferential statistics	n	Mean	S.D.	t	d.f.	p(μ=0.00)	Cohen's d
MOS PCS (%) Post-Pre	19	2.88	11.96	1.05	18	.307	n/a
MOS MCS (%) Post-Pre	19	3.01	14.65	0.90	18	.382	n/a

The results in Table 4.3.4.2 demonstrate no statistical significant difference for neither of the two variables MOS PCS and MOS MCS between the pre- and post-intervention test results.

4.3.4.3 Descriptive statistics of the CG: quality of life

Table 4.3.4.3 reports descriptive statistics for the pre- and post-intervention test scores, as well as the pre- and post-intervention test score differences of the CG for quality of life.

Table 4.3.4.3: Descriptive statistics for CG: quality of life

Descriptive statistics	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
MOS MCS								
MOS PCS (%) Pre	17	48.87	11.93	21.19	44.85	46.34	56.12	69.78
MOS PCS (%) Post	8	53.70	7.25	41.97	49.76	54.04	58.18	64.84
MOS PCS (%) Post-Pre	8	1.73	11.93	-11.59	-2.04	0.00	1.38	28.10
MOS MCS								
MOS MCS (%) Pre	17	54.16	9.47	38.79	44.75	56.66	60.57	64.44
MOS MCS (%) Post	8	57.78	7.50	44.38	52.09	60.94	63.93	64.44
MOS MCS (%) Post-Pre	8	2.06	9.58	-5.95	-0.84	0.00	0.17	25.08

S.D.: Standard deviation; min: minimum; Q1: quartile 1; Q3: quartile 3; max: maximum

4.3.4.4 Inferential statistics of the CG: quality of life

Table 4.3.4.4 reports inferential statistics for the pre- and post-intervention test score differences of the CG for quality of life variables.

Table 4.3.4.4: Inferential statistics for the CG: quality of life

Variable	n	Mean	S.D.	t	d.f.	p (μ=0.00)	Cohen's d
MOS PCS (%) Post-Pre	8	1.73	11.93	0.41	7	.693	n/a
MOS MCS (%) Post-Pre	8	2.06	9.58	0.61	7	.563	n/a

The results in Table 4.3.4.4 demonstrate no statistical significant difference for neither of the two variables MOS PCS and MOS MCS between the pre- and post-intervention test results.

4.3.5 Descriptive and inferential statistics of the EG and CG: IPAQ

4.3.5.1 Descriptive statistics of the EG: IPAQ

The IPAQ questionnaire was used to determine the physical activity status of the participants, firstly for the various identified domains and then for the total activity level.

Table 4.3.5.1 reports the latter scores pre- and post-test score as well as for post- and pre-test score differences. The questionnaires were answered with the help and translation of the clinic staff.

Table 4.3.5.1: Descriptive statistics for EG: IPAQ

Descriptive	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
IPAQ								
Work domain MET-min Pre	19	497.37	2167.98	0.00	0.00	0.00	0.00	9450.00
Work domain MET-min Post	19	809.92	3381.23	0.00	0.00	0.00	0.00	14760.0
Work domain MET-min Post-Pre	19	312.55	1218.72	0.00	0.00	0.00	0.00	5310.00
Transport domain MET-min Pre	19	2575.89	2338.92	0.00	643.50	2160.00	3000.00	8316.00
Transport domain MET-min Post	19	1186.71	2322.51	99.00	162.00	297.00	1221.00	10152.00
Transport domain MET-min Post-Pre	19	1389.18	3591.65	-8019.00	-2854.50	-1386.00	376.50	8667.00
Domestic & garden domain MET-min Pre	19	5135.37	4381.53	0.00	2400.00	2880.00	8520.00	13440.00
Domestic & garden domain MET-min Post	19	4692.63	2682.04	480.00	2520.00	4320.00	5940.00	11040.00
Domestic & garden domain MET-min Post-Pre	19	-442.74	5239.44	11280.00	-5030.00	-480.00	3214.00	7200.00
Leisure domain MET-min Pre	19	4276.26	3725.84	66.00	742.50	3465.00	5904.00	10548.00
Leisure domain MET-min Post	19	1965.58	2909.15	33.00	396.00	480.00	2220.00	10872.00
Leisure domain MET-min Post-Pre	19	2310.68	5343.04	-10269.00	-5308.50	-1896.00	511.50	10179.00
Total Physical activity 1 (sum of above domains)								
Total Physical activity 1 MET-min Pre	19	13348.11	8383.56	1332.00	5961.00	15519.00	17649.00	27840.00
Total Physical activity 1 MET-min Post	19	8761.79	7037.56	3057.50	5042.25	6158.00	8667.00	32502.00
Total Physical activity 1 MET-min Post-Pre	19	4586.32	8587.40	-21128.50	-11337.75	-2448.00	2016.00	9624.00
Walking MET-min Pre	19	3894.95	3129.54	693.00	1485.00	2376.00	5841.00	12474.00
Walking MET-	19	1575.32	2933.31	99.00	181.50	445.50	2128.50	12870.00

Descriptive	n	Mean	S.D.	Min	Q 1	Median	Q 3	Max
min Post								
Walking MET-min Post-Pre	**19**	**-2319.63**	**3950.07**	**-12177.00**	**-5156.25**	**-1287.00**	**412.50**	**4950.00**
Moderate MET-min Pre	**19**	**7047.63**	**5711.93**	**0.00**	**2400.00**	**5280.00**	**10080.00**	**17040.00**
Moderate MET-min Post	**19**	**5385.26**	**3096.97**	**480.00**	**3500.00**	**4700.00**	**7270.00**	**11280.00**
Moderate MET-min Post-Pre	**19**	**-1662.37**	**5973.84**	**-13140.00**	**-5900.00**	**-960.00**	**3227.50**	**8160.00**
Vigorous MET-min Pre	**19**	**1351.58**	**2795.67**	**0.00**	**0.00**	**0.00**	**1080.00**	**10080.00**
Vigorous MET-min Post	**19**	**1218.95**	**2421.99**	**0.00**	**0.00**	**480.00**	**480.00**	**9000.00**
Vigorous MET-min Post-Pre	**19**	**-132.63**	**3884.10**	**-9600.00**	**-120.00**	**0.00**	**480.00**	**9000.00**
Total physical activity 2 (sum of above MET)								
Total physical activity 2 MET-min Pre	**19**	**14824.95**	**9833.58**	**792.00**	**8091.00**	**14826.00**	**17559.00**	**41206.00**
Total physical activity 2 MET-min Post	**19**	**8190.16**	**6308.78**	**2559.00**	**4625.50**	**5508.50**	**8622.00**	**27750.00**
Total physical activity 2 MET-min Post-Pre	**19**	**-6634.79**	**11021.04**	**-36754.00**	**-12611.00**	**-5913.00**	**2040.00**	**9504.00**

S.D.: Standard deviation; min: minimum; Q1: quartile 1; Q3: quartile 3; max: maximum

4.3.5.2 Inferential statistics of the EG: IPAQ

Table 4.3.5.2 reports inferential statistics for the pre-, mid- and post-test score differences of the EG for the IPAQ.

Table 4.3.5.2: Inferential statistics for the EG: IPAQ

Inferential statistics	n	Mean	S.D.	T	d.f	p (μ=0.00)	Cohen's d
IPAQ							
Work domain MET-min Post-Pre	**19**	**312.55**	**1218.72**	**1.12**	**18**	**.278**	**n/a**
Transport domain MET-min Post-Pre	**19**	**-1389.18**	**3591.65**	**-1.69**	**18**	**.109**	**n/a**
Domestic and garden MET-min Post-Pre	**19**	**-442.74**	**5239.44**	**-0.37**	**18**	**.717**	**n/a**
Leisure MET-min Post-Pre	**19**	**-2310.68**	**5343.04**	**-1.89**	**18**	**.076**	**n/a**

Total physical activity 1 MET-min Post-Pre	**19**	**-4586.32**	**8587.40**	**-2.33**	**18**	**.032**	**0.53**
Walk MET-min Post-Pre	**19**	**-2319.63**	**3950.07**	**-2.56**	**18**	**.020**	**0.59**
Moderate MET-min Post-Pre	**19**	**-1662.37**	**5973.84**	**-1.21**	**18**	**.241**	**n/a**
Moderate MET-min Post-Pre	**19**	**-132.63**	**3884.10**	**-0.15**	**18**	**.883**	**n/a**
Total physical activity 2 MET-min Post-Pre	**19**	**-6634.79**	**11021.04**	**-2.62**	**18**	**.017**	**0.60**

The results in Table 4.3.5.2 indicate statistical and practical differences ($p<0.05$; $d>0.2$) for the IPAQ results for the total physical activity 1 variable post-pre-test (sum of walking domain, moderate exercise domain and vigorous exercise domain), total walk post-pre-test and the total physical activity 2 variable post-pre-test (sum of walking domain, moderate exercise domain and vigorous exercise domain) for the EG.

4.3.5.3 Descriptive statistics of the CG: IPAQ

Table 4.3.5.3 reports descriptive statistics for the pre- and post-test scores, as well as the pre- and post-test score differences of the CG for the IPAQ.

Table 4.3.5.3: Descriptive statistics for CG: IPAQ

Descriptive statistics	n	Mean	S.D.	Min	Q 1	Median	Q3	Max
IPAQ								
Work domain MET-min Pre	**17**	**2324.12**	**9582.58**	**0.00**	**0.00**	**0.00**	**0.00**	**39510.00**
Work domain MET-min Post	**8**	**6.79**	**19.20**	**0.00**	**0.00**	**0.00**	**0.00**	**54.30**
Work domain MET-min Post-Pre	**8**	**-4931.96**	**13949.70**	**-39455.70**	**0.00**	**0.00**	**0.00**	**0.00**
Transport domain MET-min Pre	**17**	**3124.88**	**2833.43**	**180.00**	**1050.00**	**2886.00**	**3110.00**	**9450.00**
Transport domain MET-min Post	**8**	**2205.88**	**3063.45**	**198.00**	**337.88**	**1442.75**	**1911.00**	**9450.00**
Transport domain MET-min Post-Pre	**8**	**-267.25**	**940.99**	**-2529.00**	**-94.50**	**0.00**	**0.00**	**594.00**
Domestic & garden domain MET-min Pre	**17**	**5977.65**	**4319.11**	**0.00**	**2520.00**	**4920.00**	**9600.00**	**14160.00**

Descriptive statistics	n	Mean	S.D.	Min	Q 1	Median	Q3	Max
Domestic & garden domain MET-min Post	8	5497.50	3898.47	1440.00	2655.00	5100.00	6450.00	13440.00
Domestic & garden domain MET-min Post-Pre	8	1147.50	1521.09	0.00	0.00	240.00	2325.00	3360.00
Leisure domain MET-min Pre	17	5390.94	5175.13	0.00	2078.00	3672.00	7440.00	15108.00
Leisure domain MET-min Post	8	3283.13	3512.34	60.00	1536.00	2437.00	3967.25	11160.00
Leisure domain MET-min Post-Pre	8	23.50	1263.64	-2499.00	-66.00	0.00	242.25	1982.00
Total Physical activity 1 (sum of above domains)								
Total Physical activity 1 MET-min Pre	17	17369.24	12691.48	5094.00	6252.00	12966.00	25890.00	41367.00
Total Physical activity 1 MET-min Post	8	22986.94	32282.83	5094.00	6739.50	11949.75	18156.75	100995.00
Total Physical activity 1 MET-min Post-Pre	8	7980.69	37029.23	-32451.50	-356.25	0.00	653.25	95109.00
Walking MET-min Pre	17	3497.12	2656.64	198.00	1386.00	2970.00	5544.00	8820.00
Walking MET-min Post	8	2310.00	2553.35	198.00	499.13	1460.25	2945.25	6930.00
Walking MET-min Post-Pre	8	-866.25	2046.61	-4966.50	-787.88	0.00	123.75	693.00
Moderate MET-min Pre	17	9964.71	8170.46	2400.00	4320.00	8720.00	11340.00	28560.00
Moderate MET-min Post	8	6400.00	3557.72	3000.00	4410.00	5400.00	7220.00	13920.00
Moderate MET-min Post-Pre	8	-1515.00	5289.61	-13260.00	-1155.00	0.00	600.00	3360.00
Vigorous MET-min Pre	17	3061.41	5266.23	0.00	0.00	720.00	3840.00	19200.00
Vigorous MET-min Post	8	1965.00	1997.65	0.00	570.00	960.00	3960.00	4800.00
Vigorous MET-min Post-Pre	8	-1800.00	5489.36	-14400.00	-960.00	0.00	0.00	3840.00
Total physical activity 2 (sum of above MET)								

Descriptive statistics	n	Mean	S.D.	Min	Q 1	Median	Q3	Max
Total physical activity 2 MET-min Pre	17	16859.24	11304.37	4794.00	8685.00	15612.00	18384.00	41367.00
Total physical activity 2 MET-min Post	8	10637.50	6652.25	4794.00	7114.50	8769.75	10971.88	25170.00
Total physical activity 2 MET-min Post-Pre	8	-4579.50	11699.05	-32626.50	-2412.00	0.00	0.00	3748.50

S.D.: Standard deviation; min: minimum; Q1: quartile 1; Q3: quartile 3; max: maximum

4.3.5.4 Inferential statistics of the CG: IPAQ

Table 4.3.5.4 reports inferential statistics for the pre- and post-test scores, as well as the pre- and post-test score differences of the CG for IPAQ.

Table 4.3.5.4: Inferential statistics for the CG: IPAQ

Variable	n	Mean	S.D.	T	d.f.	p (μ=0.00)	Cohen's d
IPAQ							
Work domain MET-min Post-Pre	8	-4931.96	13949.70	-1.00	7	.351	n/a
Transport domain MET-min Post-Pre	8	-267.25	940.99	-0.80	7	.448	n/a
Domestic and garden MET-min Post-Pre	8	1147.50	1521.09	2.13	7	.070	n/a
Leisure MET-min Post-Pre	8	23.50	1263.64	0.05	7	.960	n/a
Total physical activity 1 MET-min Post-Pre	8	7980.69	37029.23	0.61	7	.561	n/a
Walk MET-min Post-Pre	8	-866.25	2046.61	-1.20	7	.270	n/a
Moderate MET-min Post-Pre	8	-1515.00	5289.61	-0.81	7	.445	n/a
Vigorous MET-min Post-Pre	8	-1800.00	5489.36	-0.93	7	.385	n/a
Total physical activity 2 MET-min Post-Pre	8	-4579.50	11699.05	-1.11	7	.305	n/a

The results in Table 4.3.4.4 demonstrate no statistical significant difference for any of the pre- to post-test score comparisons of activity levels for the CG.

4.4 THE COMPARISON OF THE MEAN RAW TEST SCORES BETWEEN EG AND CG

4.4.1 The comparison of the mean raw test scores between EG and CG: body composition related variables

Inferential statistics for the comparison between EG and CG mean raw scores in respect of body composition related variables are reflected in Table 4.4.1.1 for pre-, mid- and post-test scores as well as for the pre- mid-test, mid-post-test and pre-post-test score differences respectively.

Table 4.4.1.1: The comparison of the mean raw test scores between EG and CG: body composition related variables

Variable	Group	n	Mean	S.D.	Diff	t	d.f.	p (μ=0.00)	Cohen's d
Height (cm) Pre	CG	17	162.56	5.50	-0.14	-0.06	34	.954	n/a
	EG	19	162.71	8.43					
Weight (kg) Pre	CG	17	63.18	14.74	-5.98	-1.02	34	.317	n/a
	EG	19	69.16	19.87					
Weight (kg) Mid	CG	14	62.43	17.17	-6.94	-1.06	31	.299	n/a
	EG	19	69.37	19.66					
Weight (kg) Post	CG	8	67.75	15.33	-2.04	-0.26	25	.798	n/a
	EG	19	69.79	19.92					
Weight (kg) Mid-Pre	CG	14	-1.79	3.60	-2.00	-1.89	31	.068	n/a
	EG	19	0.21	2.46					
Weight (kg) Post-Mid	CG	6	0.67	1.60	0.25	0.32	23	.755	n/a
	EG	19	0.42	1.68					
Weight (kg) Post-Pre	CG	8	0.38	5.93	-0.26	-0.15	25	.880	n/a
	EG	19	0.63	2.93					
BMI (kg/m^2) Pre	CG	17	24.02	5.99	-2.05	-0.91	34	.367	n/a
	EG	19	26.06	7.29					
BMI (kg/m^2) Mid	CG	14	23.65	6.90	-2.54	-1.01	31	.320	n/a

Variable	Group	n	Mean	S.D.	Diff	t	d.f.	p (μ=0.00)	Cohen's d
	EG	19	26.19	7.31					
BMI (kg/m^2) Post	CG	8	25.72	5.95	-0.61	-0.21	25	.837	n/a
	EG	19	26.34	7.39					
BMI (kg/m^2) Mid-Pre	CG	14	-0.68	1.41	-0.81	-2.00	31	.055	n/a
	EG	19	0.12	0.90					
BMI (kg/m^2) Post-Mid	CG	6	0.25	0.61	0.10	0.33	23	.741	n/a
	EG	19	0.15	0.64					
BMI (kg/m^2) Post-Pre	CG	8	0.12	2.31	-0.16	-0.24	25	.812	n/a
	EG	19	0.27	1.13					
Body Fat (%) Pre	CG	17	24.92	11.54	-5.75	-1.58	34	.123	n/a
	EG	19	30.68	10.31					
Body Fat (%) Mid	CG	15	23.90	11.96	-5.44	-1.42	31	.166	n/a
	EG	18	29.34	10.05					
Body Fat (%) Post	CG	8	26.83	11.86	-2.90	-0.67	25	.507	n/a
	EG	19	29.73	9.50					
Body Fat (%) Mid-Pre	CG	15	-1.20	2.37	-0.29	-0.42	31	.674	n/a
	EG	18	-0.91	1.48					
Body Fat (%) Post-Mid	CG	7	0.38	2.20	0.24	0.31	23	.757	n/a
	EG	18	0.15	1.46					
Body Fat (%) Post-Pre	CG	8	-0.76	4.94	0.18	0.13	25	.895	n/a
	EG	19	-0.94	2.36					
Waist-to-Hip Pre	CG	17	0.87	0.07	0.04	1.59	34	.122	n/a
	EG	19	0.83	0.08					
Waist-to-Hip (ratio) Mid	CG	15	0.88	0.06	0.04	1.39	31	.175	n/a
	EG	18	0.84	0.09					

Variable	Group	n	Mean	S.D.	Diff	t	d.f.	p (μ=0.00)	Cohen's d
Waist-to-Hip (ratio) Post	**CG**	**8**	**0.86**	**0.07**	**0.02**	**0.52**	**25**	**.610**	**n/a**
	EG	**19**	**0.85**	**0.07**					
Waist-to-Hip (ratio) Mid-Pre	**CG**	**15**	**0.01**	**0.07**	**0.00**	**0.25**	**31**	**.805**	**n/a**
	EG	**18**	**0.01**	**0.05**					
Waist-to-Hip (ratio) Post-Mid	**CG**	**7**	**-0.01**	**0.04**	**-0.02**	**-0.80**	**23**	**.434**	**n/a**
	EG	**18**	**0.01**	**0.04**					
Waist-to-Hip (ratio) Post-Pre	**CG**	**8**	**0.01**	**0.08**	**-0.01**	**-0.34**	**25**	**.738**	**n/a**
	EG	19	0.02	0.03					

The results in Table 4.4.1.1 indicate that no significant differences were observed between the EG and CG for all the comparisons of body composition related variables at pre-, mid- and post- tests as well as for the pre- to post-test comparisons for all the variables.

4.4.2 The comparison of the mean raw test scores between EG and CG: flexibility, strength and agility

Inferential statistics for the comparison between EG and CG mean raw scores in respect of flexibility, strength and agility variables are reflected in Table 4.4.2.1 for pre, mid- and post-test scores as well as for the pre-mid-test, mid-post-test and pre-post-test score differences respectively.

Table 4.4.2.1: The comparison of the mean raw test scores between EG and CG: flexibility, strength and agility

Variable	Group	n	Mean	S.D.	Diff	t	d.f.	p (μ=0.00)	Cohen's d
Sit-and-reach (cm) Pre	**CG**	**17**	**23.47**	**8.81**	**-0.56**	**-0.18**	**34**	**0.856**	**n/a**
	EG	**19**	**24.03**	**9.41**					
Sit-and-reach (cm) Mid	**CG**	**13**	**23.88**	**7.38**	**-1.87**	**-0.66**	**29**	**0.515**	**n/a**
	EG	**18**	**25.75**	**8.03**					
Sit-and-reach (cm) Post	**CG**	**8**	**30.63**	**8.21**	**0.76**	**0.22**	**25**	**0.827**	**n/a**
	EG	**19**	**29.87**	**8.11**					

Variable	Group	n	Mean	S.D.	Diff	t	d.f.	p (μ=0.00)	Cohen's d
Sit-and-reach (cm) Mid-Pre	CG	13	-1.19	7.08	-3.44	-1.36	29	0.185	n/a
	EG	18	2.25	6.89					
Sit-and-reach (cm) Post-Mid	CG	7	3.21	6.31	-0.56	-0.27	23	0.787	n/a
	EG	18	3.78	3.88					
Sit-and-reach (cm) Post-Pre	CG	8	2.88	4.82	-2.97	-1.06	25	0.297	n/a
	EG	19	5.84	7.19					
Grip Max. (kg) Pre	CG	17	36.35	8.16	0.35	0.13	34	0.899	n/a
	EG	19	36	8.35					
Grip Max. (kg) Mid	CG	15	36.8	10.13	-2.09	-0.57	31	0.576	n/a
	EG	18	38.89	10.92					
Grip Max. (kg) Post	CG	8	40.25	10.11	-1.07	-0.21	25	0.838	n/a
	EG	19	41.32	13					
Grip Max. (kg) Mid-Pre	CG	15	0.4	2.82	-2.6	-0.93	31	0.359	n/a
	EG	18	3	10.48					
Grip Max.(kg) Post-Mid	CG	7	0.57	6	-2.15	-0.55	23	0.585	n/a
	EG	18	2.72	9.5					
Grip Max. (kg) Post-Pre	CG	8	1	3.85	-4.32	-1.12	25	0.275	n/a
	EG	19	5.32	10.53					
30 Sec Sit-to-stand (no.) Pre	CG	17	13.06	4.22	0.11	0.09	34	0.93	n/a
	EG	19	12.95	3.27					
30 Sec Sit-to-stand (no.) Mid	CG	15	15	6.54	-1.56	-0.9	31	0.375	n/a
	EG	18	16.56	3.07					
30 Sec Sit-to-stand (no.) Post	CG	8	18.75	6.32	-1.09	-0.65	25	0.52	n/a
	EG	19	19.84	2.52					
30 Sec sit-to-stand (no.) Mid-Pre	CG	15	1.53	5.62	-2.24	-1.44	31	0.16	n/a
	EG	18	3.78	3.21					
30 Sec Sit-to-stand (no.) Post-Mid	CG	7	2.29	3.9	-1.1	-0.63	23	0.537	n/a
	EG	18	3.39	3.97					
30 Sec Sit-to-stand (no.) Post-Pre	CG	8	4.25	6.16	-2.64	-1.3	25	0.205	n/a
	EG	19	6.89	4.19					
2.44 Up & Go (sec)	CG	17	6.17	2.97	0.76	1.09	34	0.283	n/a

Variable	Group	n	Mean	S.D.	Diff	t	d.f.	p (μ=0.00)	Cohen's d
Pre	**EG**	**19**	**5.41**	**0.62**					
2.44 Up & Go (sec) Mid	**CG**	**15**	**6.15**	**2.78**	**1.47**	**2.17**	**31**	**0.038**	**0.76 Medium**
	EG	**18**	**4.69**	**0.68**					
2.44 Up & Go (sec) Post	**CG**	**8**	**4.86**	**0.7**	**0.05**	**0.14**	**25**	**0.892**	**n/a**
	EG	**19**	**4.81**	**0.82**					
2.44 Up & Go (sec) Mid-Pre	**CG**	**15**	**0.08**	**2.34**	**0.84**	**1.41**	**31**	**0.167**	**n/a**
	EG	**18**	**-0.77**	**0.91**					
2.44 Up & Go (sec) Post-Mid	**CG**	**7**	**0**	**0.57**	**-0.19**	**-0.56**	**23**	**0.58**	**n/a**
	EG	**18**	**0.19**	**0.83**					
2.44 Up & Go (sec) Post-Pre	**CG**	**8**	**-0.46**	**0.62**	**0.14**	**0.36**	**25**	**0.725**	**n/a**
	EG	19	-0.6	1.03					

The results in Table 4.4.2.1 indicate that only 2.44 up-and-go test showed a significant difference (p>0.05, d>0.2) in mid test scores with the EG outperforming the CG. All other scores related to flexibility, strength and agility showed no significant differences of the pre- mid- and post-test scores or the pre-to mid-test, mid- to post-test, and pre- to post-test score comparisons.

4.4.3 The comparison of the mean raw test scores between EG and CG: cardiovascular related variables

Inferential statistics for the comparison between EG and CG mean raw scores in respect of cardiovascular related variables are reflected in Table 4.4.3.1 for pre-, mid- and post-test scores as well as for the pre- mid-test, mid-post-test and pre-post-test score differences respectively.

Table 4.4.3.1: The comparison of the mean raw test scores between EG and CG: cardiovascular related variables

Variable	Group	n	Mean	S.D.	Diff	t	d.f.	p (μ=0.00)	Cohen's d
6 Min. Walk (m) Pre	**CG**	**17**	**242.65**	**55.85**	**-59.04**	**-3.1**	**34**	**0.004**	**1.04 Large**
	EG	**19**	**301.68**	**58.08**					
6 Min. Walk (m) Mid	**CG**	**15**	**262.4**	**53.13**	**-**	**-1.31**	**31**	**0.199**	**n/a**

	EG	18	285.33	47.19	22.93				
6 Min. Walk (m) Post	CG	8	302	49.87	-11.05	-0.66	25	0.516	n/a
	EG	19	313.05	35.18					
6 Min. Walk (m) Mid-Pre	CG	15	22.07	51.71	30.29	1.78	31	0.084	n/a
	EG	18	-8.22	45.76					
6 Min. Walk (m) Post-Mid	CG	7	2.29	31.57	-25.49	-1.59	23	0.125	n/a
	EG	18	27.78	37.38					
6 Min. Walk (m) Post-Pre	CG	8	58.88	51.9	47.51	2.11	25	0.045	0.89 Large
	EG	19	11.37	53.96					
VO_2max (ml kg^{-1} min^{-1}) Pre	CG	17	10.53	1.28	-1.36	-3.1	34	0.004	1.04 Large
	EG	19	11.89	1.34					
VO_2max (ml kg^{-1} min^{-1}) Mid	CG	15	10.98	1.22	-0.53	-1.31	31	0.199	n/a
	EG	18	11.51	1.09					
VO_2max (ml kg^{-1} min^{-1}) Post	CG	8	11.89	1.15	-0.25	-0.66	25	0.516	n/a
	EG	19	12.15	0.81					
VO_2max (ml kg^{-1} min^{-1}) Mid-Pre	CG	15	0.51	1.19	0.7	1.78	31	0.084	n/a
	EG	18	-0.19	1.05					
VO_2max (ml kg^{-1} min^{-1}) Post-Mid	CG	7	0.05	0.73	-0.59	-1.59	23	0.125	n/a
	EG	18	0.64	0.86					
VO_2max (ml kg^{-1} min^{-1}) Post-Pre	CG	8	1.35	1.19	1.09	2.11	25	0.045	0.89 Large
	EG	19	0.26	1.24					
Peak Flow (L/min) Pre	CG	1	370	-	-	-	-	-	-
	EG	19	236.32	85.91					
Peak Flow (L/min) Mid	CG	15	289.33	95.43	-7.89	-0.22	31	0.829	n/a
	EG	18	297.22	109.8					

Variable	Group	n	Mean	S.D.	Diff	t	d.f.	p (μ=0.00)	Cohen's d
Peak Flow (L/min) Post	CG	8	296.25	91.8	-30.59	-0.71	25	0.486	n/a
	EG	19	326.84	106.46					
Peak Flow (L/min) Mid-Pre	CG	1	80	-	-	-	-	-	-
	EG	18	56.67	98.99					

Peak Flow (L/min) Post-Mid	CG	7	-35.71	75.02	-66.83	-1.8	23	0.085	n/a
	EG	18	31.11	86.02					
Peak Flow (L/min) Post-Pre	CG	1	130	-	-	-	-	-	-
	EG	19	90.53	107.31					
Resting blood pressure (BP)									
BP. Systolic (mmHg) Pre	CG	17	135.88	17.56	5.55	0.86	33	0.394	n/a
	EG	18	130.33	20.25					
BP. Systolic (mmHg) Mid	CG	15	131.27	20.51	7.38	0.99	30	0.328	n/a
	EG	17	123.88	21.34					
BP. Systolic (mmHg) Post	CG	8	131.25	26.57	1.41	0.16	25	0.873	n/a
	EG	19	129.84	17.91					
BP. Systolic (mmHg) Mid-Pre	CG	15	-4.47	15.34	-0.97	-0.19	29	0.853	n/a
	EG	16	-3.5	13.34					
BP. Systolic (mmHg) Post-Mid	CG	7	0.86	16.36	-5.08	-0.56	22	0.579	n/a
	EG	17	5.94	21.33					
BP. Systolic (mmHg) Post-Pre	CG	8	-3.75	21.22	-2.81	-0.35	24	0.729	n/a
	EG	18	-0.94	17.72					
BP. Diastolic (mmHg) Pre	CG	17	91.06	16.16	2.84	0.59	33	0.561	n/a
	EG	18	88.22	12.28					
BP. Diastolic (mmHg) Mid	CG	15	90.73	12.36	4.26	0.96	30	0.345	n/a
	EG	17	86.47	12.7					
BP. Diastolic (mmHg) Post	CG	8	91.13	26.84	4.6	0.68	25	0.5	n/a
	EG	19	86.53	8.51					
BP. Diastolic (mmHg) Mid-Pre	CG	15	0.07	17.18	0.25	0.05	29	0.961	n/a
	EG	16	-0.19	11.43					

Variable	Group	n	Mean	S.D.	Diff	t	d.f.	p (μ=0.00)	Cohen's d
BP. Diastolic (mmHg) Post-Mid	CG	7	0.71	22.74	-0.05	-0.01	22	0.994	n/a
	EG	17	0.76	11.8					
BP. Diastolic (mmHg) Post-Pre	CG	8	5	35.23	6.78	0.74	24	0.464	n/a
	EG	18	-1.78	11.71					

Resting heart rate (HR)									
HR (bpm) Pre	**CG**	**17**	**79.12**	**13.24**	**-3.33**	**-0.78**	**33**	**0.441**	**n/a**
	EG	**18**	**82.44**	**11.98**					
HR (bpm) Mid	**CG**	**15**	**80.93**	**10.52**	**-2.86**	**-0.56**	**32**	**0.579**	**n/a**
	EG	**19**	**83.79**	**17.37**					
HR (bpm) Post	**CG**	**8**	**79.5**	**11.64**	**5.03**	**1.07**	**25**	**0.296**	**n/a**
	EG	**19**	**74.47**	**10.98**					
HR (bpm) Mid-Pre	**CG**	**15**	**1.4**	**15.87**	**1.96**	**0.4**	**31**	**0.693**	**n/a**
	EG	**18**	**-0.56**	**12.27**					
HR (bpm) Post-Mid	**CG**	**7**	**2.14**	**7.01**	**11.46**	**1.82**	**24**	**0.082**	**n/a**
	EG	**19**	**-9.32**	**15.98**					
HR (bpm) Post-Pre	**CG**	**8**	**1.13**	**14.32**	**8.51**	**1.47**	**24**	**0.154**	**n/a**
	EG	**18**	**-7.39**	**13.32**					
Post exercise blood pressure (BP)									
3 Min. BP Systolic (mmHg) Pre	**CG**	**17**	**132.24**	**17.54**	**-3.5**	**-0.56**	**34**	**0.577**	**n/a**
	EG	**19**	**135.74**	**19.53**					
3 Min. BP Systolic (mmHg) Mid	**CG**	**15**	**133.87**	**23.7**	**-5.63**	**-0.59**	**31**	**0.559**	**n/a**
	EG	**18**	**139.5**	**29.88**					
3 Min. BP Systolic (mmHg) Post	**CG**	**8**	**144**	**31.41**	**5**	**0.47**	**25**	**0.644**	**n/a**
	EG	**19**	**139**	**22.54**					
3 Min. BP Systolic (mmHg) Mid-Pre	**CG**	**15**	**0.67**	**20.23**	**-3.06**	**-0.37**	**31**	**0.712**	**n/a**
	EG	**18**	**3.72**	**25.78**					
3 Min. BP Systolic (mmHg) Post-Mid	**CG**	**7**	**9.43**	**26.27**	**10.54**	**0.81**	**23**	**0.427**	**n/a**
	EG	**18**	**-1.11**	**30.28**					
3 Min. BP Systolic (mmHg) Post-Pre	**CG**	**8**	**9.13**	**26.98**	**5.86**	**0.64**	**25**	**0.529**	**n/a**
	EG	**19**	**3.26**	**19.37**					

Variable	Group	n	Mean	S.D.	Diff	t	d.f.	p (μ=0.00)	Cohen's d
3 Min. BP Diastolic (mmHg) Pre	**CG**	**17**	**89.35**	**13.25**	**0.88**	**0.23**	**34**	**0.819**	**n/a**
	EG	**19**	**88.47**	**9.55**					
3 Min. BP Diastolic (mmHg) Mid	**CG**	**15**	**92.13**	**22.08**	**-1.09**	**-0.13**	**31**	**0.899**	**n/a**
	EG	**18**	**93.22**	**26.18**					

3 Min. BP Diastolic (mmHg) Post	CG	8	93.63	29.42	0.99	0.11	25	0.915	n/a
	EG	19	92.63	17.97					
3 Min. BP Diastolic (mmHg) Mid-Pre	CG	15	1.67	20.22	-2.94	-0.34	31	0.735	n/a
	EG	18	4.61	27.77					
3 Min. BP Diastolic (mmHg) Post-Mid	CG	7	6.43	28.61	7.65	0.62	23	0.543	n/a
	EG	18	-1.22	27.56					
3 Min. BP Diastolic (mmHg) Post-Pre	CG	8	3.88	20.43	-0.28	-0.04	25	0.972	n/a
	EG	19	4.16	18.06					
Post exercise heart rate (HR)									
3 Min. HR (bpm) Pre	CG	17	82.65	13.29	-12.51	-2.45	34	0.02	0.82 Large
	EG	19	95.16	16.9					
3 Min. HR (bpm) Mid	CG	15	89.2	15.05	-3.13	-0.5	31	0.622	n/a
	EG	18	92.33	20.08					
3 Min. HR (bpm) Post	CG	8	96.75	14.43	-3.25	-0.51	25	0.618	n/a
	EG	19	100	15.56					
3 Min. HR (bpm) Mid-Pre	CG	15	5.4	16.89	8.4	1.26	31	0.215	n/a
	EG	18	-3	20.58					
3 Min. HR (bpm) Post-Mid	CG	7	5.71	10.13	-1.9	-0.27	23	0.786	n/a
	EG	18	7.61	16.98					
3 Min. HR (bpm) Post-Pre	CG	8	11.63	20.97	6.78	0.99	25	0.331	n/a
	EG	19	4.84	13.99					
3 Min. HR Diff. Pre	CG	17	3.53	10.11	-10.47	-2.93	33	0.006	0.99 Large
	EG	18	14	10.96					
3 Min. HR Diff. Mid	CG	15	8.27	13.13	-0.4	-0.09	31	0.928	n/a
	EG	18	8.67	11.94					
3 Min. HR Diff. Post	CG	8	17.25	14.35	-8.28	-1.53	25	0.138	n/a
	EG	19	25.53	12.16					
Variable	**Group**	**n**	**Mean**	**S.D.**	**Diff**	**t**	**d.f.**	**p (μ=0.00)**	**Cohen's d**
3 Min. HR Diff. Mid-Pre	CG	15	4	9.76	9	1.71	30	0.098	n/a
	EG	17	-5	18.2					
3 Min. HR Diff. Post-Mid	CG	7	3.57	14.97	-13.76	-2.02	23	0.055	n/a
	EG	18	17.33	15.38					

3 Min. HR Diff. Post-Pre	CG	8	10.5	20.5	-1.94	-0.28	24	0.78	n/a
	EG	18	12.44	14.05					
3 Min. HR Diff.% Pre	CG	17	5.22	13.61	-12.13	-2.54	33	0.016	0.86 Large
	EG	18	17.36	14.56					
3 Min. HR Diff.% Mid	CG	15	10.77	17.39	-0.44	-0.08	31	0.939	n/a
	EG	18	11.2	14.98					
3 Min. HR Diff.% Post	CG	8	22.89	17.81	-12.27	-1.67	25	0.108	n/a
	EG	19	35.16	17.33					
3 Min. HR Diff.% Mid-Pre	CG	15	4.51	12.55	10.37	1.48	30	0.149	n/a
	EG	17	-5.85	24.39					
3 Min. HR Diff.% Post-Mid	CG	7	4.64	20.2	-20.14	-2.08	23	0.049	0.93 Large
	EG	18	24.79	22.24					
3 Min. HR Diff.% Post-Pre	CG	8	13	26.65	-5.98	-0.61	24	0.547	n/a
	EG	18	18.98	21.36					

The results in Table 4.4.3.1 indicate that the 6 min walk and VO_2max tests indicated a significant difference ($p<0.05;d>0.2$) at pre-test and pre- to post-test score differences. The 3 min HR, 3 min HR difference and 3 min HR difference % showed a significant difference in the pre-test score. The 3 min HR % difference for the pre- to post-test comparison also showed significance difference between the EG and CG.

4.4.4 The comparison of the mean raw test scores between EG And CG: quality of life

Inferential statistics for the comparison between EG and CG mean raw scores for the pre-post-test as well as the pre-test to post-test score differences are reflected in Table 4.4.4.1 in respect of the variables representing the level of quality of life experienced.

Table 4.4.4.1: The comparison of the mean raw test scores between EG and CG: quality of life

Variable	Group	n	Mean	S.D.	Diff	t	d.f.	p (μ=0.00)	Cohen's d
MOS PHC (%) Pre	CG	17	48.87	11.93	-1.78	-0.53	34	.601	n/a
	EG	19	50.65	8.22					
MOS PHC (%) Post	CG	8	53.70	7.25	0.16	0.05	25	.962	n/a
	EG	19	53.54	8.16					
MOS PHC (%) Post-Pre	CG	8	1.73	11.93	-1.15	-0.23	25	.821	n/a
	EG	19	2.88	11.96					
MOS MHC (%) Pre	CG	17	54.16	9.47	6.85	1.65	34	.107	n/a
	EG	19	47.32	14.51					
MOS MHC (%) Post	CG	8	57.78	7.50	7.46	2.65	25	.014	1.12 Large
	EG	19	50.33	6.32					
MOS MHC (%) Post-Pre	CG	8	2.06	9.58	-0.95	-0.17	25	.868	n/a
	EG	19	3.01	14.65					

The results in Table 4.4.4.1 indicate that a significant difference ($p<0.05;d>0.2$) in MOS MHC at post-test scores were observed between the EG and CG with the latter reflecting the better score.

4.4.5 The comparison of the mean raw test scores between EG and CG: IPAQ

Inferential statistics for the comparison between EG and CG mean raw scores for the pre-post-test as well as the pre-test to post-test score differences are reflected in Table 4.4.5.1 in respect of physical activity domains.

Table 4.4.5.1: The comparison of the mean raw test scores between EG and CG: IPAQ

Variable	Group	n	Mean	S.D.	Diff	t	d.f.	p (μ=0.00)	Cohen's d
IPAQ									
Work	CG	17	2324.12	9582.58	1826.75	0.81	34	.424	n/a

Variable	Group	n	Mean	S.D.	Diff	t	d.f.	p (μ=0.00)	Cohen's d
domain MET-min pre	EG	19	497.37	2167.98					
Work domain MET-min Post	CG	8	6.79	19.20	-803.13	-0.66	25	.513	n/a
	EG	19	809.92	3381.23					
Work domain MET-min Post-Pre	CG	8	-4931.96	13949.70	-5244.52	-1.67	25	.107	n/a
	EG	19	312.55	1218.72					
Transport domain MET-min Pre	CG	17	3124.88	2833.43	548.99	0.64	34	.529	n/a
	EG	19	2575.89	2338.92					
Transport domain MET-min Post	CG	8	2205.88	3063.45	1019.16	0.95	25	.352	n/a
	EG	19	1186.71	2322.51					
Transport domain MET-min Post-Pre	CG	8	-267.25	940.99	1121.93	0.86	25	.397	n/a
	EG	19	-1389.18	3591.65					
Domestic and garden domain MET-min Pre	CG	17	5977.65	4319.11	842.28	0.58	34	.566	n/a
	EG	19	5135.37	4381.53					
Domestic and garden domain MET-min Post	CG	8	5497.50	3898.47	804.87	0.62	25	.540	n/a
	EG	19	4692.63	2682.04					
Domestic and garden MET-min Post-Pre	CG	8	1147.50	1521.09	1590.24	0.84	25	.412	n/a
	EG	19	-442.74	5239.44					
Leisure MET-min Pre	CG	17	5390.94	5175.13	1114.68	0.75	34	.460	n/a
	EG	19	4276.26	3725.84					
Leisure MET-min Post	CG	8	3283.13	3512.34	1317.55	1.01	25	.321	n/a
	EG	19	1965.58	2909.15					

Variable	Group	n	Mean	S.D.	Diff	t	d.f.	p (μ=0.00)	Cohen's d
Leisure MET-min Post-Pre	CG	8	23.50	1263.64	2334.18	1.21	25	.238	n/a
	EG	19	-2310.68	5343.04					
Total physical activity 1 (sum of the above)									
Total physical activity 1 MET-min Pre	CG	17	17369.24	12691.48	4021.13	1.13	34	.265	n/a
	EG	19	13348.11	8383.56					
Total physical activity 1 MET-min Post	CG	8	22986.94	32282.83	14225.15	1.87	25	.074	n/a
	EG	19	8761.79	7037.56					
Total physical activity 1 MET-min Post-Pre	CG	8	7980.69	37029.23	12567.00	1.43	25	.166	n/a
	EG	19	-4586.32	8587.40					
Walking MET-min Pre	CG	17	3497.12	2656.64	-397.83	-0.41	34	.685	n/a
	EG	19	3894.95	3129.54					
Walking MET-min Post	CG	8	2310.00	2553.35	734.68	0.62	25	.544	n/a
	EG	19	1575.32	2933.31					
Walking MET-min Post-Pre	CG	8	-866.25	2046.61	1453.38	0.98	25	.337	n/a
	EG	19	-2319.63	3950.07					
Moderate MET-min Pre	CG	17	9964.71	8170.46	2917.07	1.25	34	.219	n/a
	EG	19	7047.63	5711.93					
Moderate MET-min Post	CG	8	6400.00	3557.72	1014.74	0.74	25	.463	n/a
	EG	19	5385.26	3096.97					
Moderate MET-min Post-Pre	CG	8	-1515.00	5289.61	147.37	0.06	25	.952	n/a
	EG	19	-1662.37	5973.84					
Vigorous MET-min Pre	CG	17	3061.41	5266.23	1709.83	1.24	34	.225	n/a
	EG	19	1351.58	2795.67					
Vigorous	CG	8	1965.00	1997.65	746.05	0.77	25	.451	n/a

Variable	Group	n	Mean	S.D.	Diff	t	d.f.	p (μ=0.00)	Cohen's d
MET-min Post	EG	19	1218.95	2421.99					
Vigorous MET-min Post-Pre	CG	8	-1800.00	5489.36	-1667.37	-0.90	25	.376	n/a
	EG	19	-132.63	3884.10					
Total physical activity 2 (sum of the above)									
Total physical activity 2 MET-min Pre	CG	17	16859.24	11304.37	2034.29	0.58	34	.567	n/a
	EG	19	14824.95	9833.58					
Total physical activity 2 MET-min Post	CG	8	10637.50	6652.25	2447.34	0.91	25	.373	n/a
	EG	19	8190.16	6308.78					
Total physical activity 2 MET-min Post-Pre	CG	8	-4579.50	11699.05	2055.29	0.43	25	.667	n/a
	EG	19	-6634.79	11021.04					

The results in Table 4.4.5.1 indicate that no significant differences were observed between the EG and CG for IPAQ variables of pre- and post- test scores as well as pre- to post-test score comparisons of physical activity status.

4.5 BLOOD RESULTS

4.5.1 Demographic information related to the blood results

The gender distribution of the participants in the EG and CG respectively who provided blood samples are reflected in Table 4.5.1.

Table 4.5.1: Contingency of gender for EG and CG

	Female		Male		Total	
Experimental Group	**13**	**72%**	**5**	**28%**	**18**	**100%**
Control Group	**6**	**46%**	**7**	**54%**	**13**	**100%**
Total	**19**	**61%**	**12**	**39%**	**31**	**100%**
Chi² (d.f. = 1, n = 31) = 2.16; p = .141						

The EG had more than double the number of females (13) compared to the males (5). The CG had similar number of males (7) and females (6).

4.5.2 Descriptive statistics of the EG and CG: blood results

4.5.2.1 Descriptive statistics of the EG: blood results

Table 4.5.2.1 reports the descriptive statistics for the pre-, mid- and post-test scores as well as in the mid- to pre-test, post- to mid-test and post- to pre-test score differences for the EG for blood results.

Table: 4.5.2.1: Descriptive statistics EG: blood results

Variable	n	Mean	S.D.	Min	Q1	Median	Q 3	Max
CD4 count (mm^3) pre	**18**	**357.38**	**231.56**	**87.2**	**204.45**	**322.14**	**423.56**	**1087**
CD4 count (mm^3) mid	**14**	**344.51**	**114.05**	**101.34**	**294.88**	**351.1**	**433.47**	**492.91**
CD4 count (mm^3) post	**16**	**427.74**	**198.15**	**190.82**	**297.45**	**391.67**	**514.37**	**904.77**
CD4 count (mm^3) Mid – Pre	**14**	**43.34**	**73.37**	**-104.02**	**11.22**	**53.06**	**86.19**	**147.16**
CD4 count (mm^3) Post – Mid	**13**	**32.15**	**80.76**	**-101.79**	**0**	**18.27**	**57.02**	**232.18**
CD4 count (mm^3) Post - Pre	**16**	**74.08**	**161.54**	**-430.17**	**35.78**	**96.67**	**130.34**	**384.17**
HIVVL (mm^3) pre	**2**	**289.5**	**154.86**	**180**	**234.75**	**289.5**	**344.25**	**399**
HIVVL (mm^3) mid	**3**	**76119.33**	**131497.2**	**0**	**199.5**	**399**	**114179**	**227959**
HIVVL (mm^3) post	**16**	**20253.75**	**57671.89**	**0**	**58.5**	**399**	**830.75**	**227959**
HIVVL (mm^3) Mid – Pre	**1**	**0**	**-**	**0**	**0**	**0**	**0**	**0**

Variable	n	Mean	S.D.	Min	Q1	Median	Q 3	Max
HIVVL (mm^3) Post – Mid	3	0	399	-399	-199.5	0	199.5	399
HIVVL (mm^3) Post – Pre	2	-274	176.78	-399	-336.5	-274	-211.5	-149
White cell count (mm^3) pre	18	6.34	2.08	4.16	5.27	6.15	6.92	13.49
White cell count (mm^3) mid	14	6.14	1.54	4.34	4.91	5.94	6.8	10.07
White cell count (mm^3) post	16	6.51	1.89	4.52	5.6	6.07	6.78	12.29
White cell count (mm^3) Mid – Pre	14	-0.26	1.19	-3.42	-0.84	0.26	0.55	0.71
White cell count (mm^3) Post – Mid	13	0.37	1.26	-1.94	-0.39	-0.02	1.38	2.22
White cell count (mm^3) Post – Pre	16	0.27	1.13	-1.66	-0.33	0.28	0.93	2
Red cell count (mm^3) pre	18	4.09	0.6	2.8	3.8	4.1	4.56	4.97
Red cell count (mm^3) mid	14	4.2	0.65	3.15	3.81	4.27	4.7	5.25
Red cell count (mm^3) post	16	4.15	0.62	3.01	3.96	4.08	4.54	5.2
Red cell count (mm^3) Mid – Pre	14	0.1	0.26	-0.34	-0.04	0.05	0.31	0.55
Red cell count (mm^3) Post - Mid	13	0.03	0.3	-0.38	-0.2	0.04	0.2	0.56
Red cell count (mm^3) Post – Pre	16	0.07	0.29	-0.54	-0.08	0.14	0.22	0.57

S.D.: Standard deviation; min: minimum; Q1: quartile 1; Q3: quartile 3; max: maximum

4.5.2.2 Descriptive statistics of the CG: Blood results

Table 4.5.2.2 reports the descriptive statistics for the pre-, mid- and post-test scores as well as in the mid- to pre-test, post- to mid-test and post- to pre-test score differences for the CG for blood results.

Table: 4.5.2.2: Descriptive statistics CG: blood results

Variable	n	Mean	S.D.	Min	Q1	Median	Q3	Max
CD4 count (mm^3) pre	12	441.37	148.13	214.84	339.52	438.71	575.93	639.53
CD4 count (mm^3) mid	11	419.17	269	70.12	236.15	375.87	487.65	1031.99
CD4 count (mm^3) post	6	505.53	289.93	215.45	333.88	474.51	522.92	1042.67
CD4 count (mm^3) Mid – Pre	10	35.94	157.49	-107.69	-49.08	-4.87	71.64	441.8
CD4 count (mm^3) Post – Mid	6	3.4	98.67	-187.62	10.97	21.53	54.81	91.62
CD4 count (mm^3) Post - Pre	6	43.53	211.6	-126.32	-58.07	-42.97	52.3	452.48
HIVVL (mm^3) pre	3	213	185.01	29	120	211	305	399
HIVVL (mm^3) mid	3	317.33	141.45	154	276.5	399	399	399
HIVVL (mm^3) post	6	204	213.84	0	6.75	213	399	399
HIVVL (mm^3) Mid – Pre	1	-245	-	-245	-245	-245	-245	-245
HIVVL (mm^3) Post – Mid	3	81.67	141.45	0	0	0	122.5	245
HIVVL (mm^3) Post – Pre	2	-105.5	149.2	-211	-158.25	-105.5	-52.75	0
White cell count (mm^3) pre	13	6.49	2.77	2.92	4.9	5.75	8.1	12.41
White cell count (mm^3) mid	11	5.67	1.92	2.69	4.7	5.45	7.16	9.06
White cell count (mm^3) post	7	6.12	2.49	2.96	4.38	6.32	7.42	10
White cell count (mm^3) Mid – Pre	11	0.03	0.61	-0.68	-0.29	-0.06	0.23	1.58
White cell count (mm^3) Post – Mid	7	0.4	1.34	-1.13	-0.56	0.48	0.91	2.78
White cell count (mm^3) Post – Pre	7	0.53	1.68	-1.68	-0.54	0.04	1.86	2.67
Red cell count (mm^3) pre	13	4.58	0.51	3.73	4.16	4.59	4.78	5.44
Red cell count (mm^3) mid	11	4.65	0.51	3.78	4.36	4.44	4.99	5.52
Red cell count (mm^3) post	7	4.65	0.67	3.5	4.33	4.81	5.01	5.57
Red cell count (mm^3) Mid – Pre	11	0.03	0.39	-0.69	-0.13	0.08	0.18	0.65
Red cell count (mm^3) Post - Mid	7	0.07	0.32	-0.28	-0.16	0.05	0.23	0.6

Variable	n	Mean	S.D.	Min	Q1	Median	Q3	Max
Red cell count (mm^3) Post – Pre	**7**	**0.14**	**0.33**	**-0.36**	**0**	**0.13**	**0.26**	**0.7**

S.D.: Standard deviation; min: minimum; Q1: quartile 1; Q3: quartile 3; max: maximum

4.5.3 The comparison of the mean raw test scores between EG and CG: blood results

Inferential statistics for the comparison between EG and CG mean raw scores for the pre-test, mid-test and post-test scores, as well as for the pre- to mid-test, post- to mid-test and post- to pre-test score differences are reflected in Table 4.5.3.1 in respect of blood results using Mann–Whitney U tests.

4.5.3.1 The mean raw test score comparisons between the EG and CG: blood results

Table 4.5.3.1 depicts the Mann–Whitney U test results for the comparison between the EG and CG in respect of the pre-, mid- and post-test scores, as well as mid- to pre-test, post- to mid-test and post- to pre- test score differences for blood results.

Table 4.5.3.1: Mann-Whitney U test results for the comparison EG and CG

Variable	n Con	n Exp	U	p-value
CD4 count (mm^3) Pre	**12**	**18**	**69**	**0.103**
CD4 count (mm^3) Mid	**11**	**14**	**67**	**0.603**
CD4 count (mm^3) Post	**6**	**16**	**39**	**0.531**
CD4 count (mm^3) Mid – Pre	**10**	**14**	**51**	**0.279**
CD4 count (mm^3) Post - Mid	**6**	**13**	**37**	**0.895**
CD4 count (mm^3) Post – Pre	**6**	**16**	**27**	**0.131**
HIVVL (mm^3) Pre	**3**	**2**	**2.5**	**1**
HIVVL (mm^3) Mid	**3**	**3**	**4**	**1**
HIVVL (mm^3) Post	**6**	**16**	**32.5**	**0.256**
HIVVL (mm^3) Mid – Pre	**1**	**1**	**0**	**1**
HIVVL (mm^3) Post - Mid	**3**	**3**	**4**	**1**

Variable	n Con	n Exp	U	p-value
HIVVL (mm^3) Post – Pre	**2**	**2**	**1**	**0.699**
White cell count (mm^3) Pre	**13**	**18**	**116**	**0.984**
White cell count (mm^3) Mid	**11**	**14**	**69**	**0.681**
White cell count (mm^3) Post	**7**	**16**	**51**	**0.764**
White cell count (mm^3) Mid – Pre	**11**	**14**	**69**	**0.681**
White cell count (mm^3) Post – Mid	**7**	**13**	**44**	**0.937**
White cell count (mm^3) Post – Pre	**7**	**16**	**53**	**0.867**
Red cell count (mm^3) Pre	**13**	**18**	**66**	**0.043**
Red cell count (mm^3) Mid	**11**	**14**	**49.5**	**0.139**
Red cell count (mm^3) Post	**7**	**16**	**29**	**0.076**
Red cell count (mm^3) Mid – Pre	**11**	**14**	**71**	**0.763**
Red cell count (mm^3) Post –Mid	**7**	**13**	**42**	**0.812**
Red cell count (mm^3) Post – Pre	**7**	**16**	**49**	**0.664**

The results in Table 4.5.3.1 indicate statistically significant differences ($p<0.05$) for red cell count at pre-test score level with the CG presenting the higher value. There were no other statistically significant differences for blood results for the EG depicted in Table 4.5.3.1.

Chapter 5 to follow will discuss the results of this study in order to draw conclusions in relation to the aim and objectives set for this study.

CHAPTER 5

DISCUSSION, CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The aim of this study was to determine the effect of an 11-week combined progressive resistance and aerobic exercise programme on the health and well-being of a group of participants sampled from an HIV positive rural population.

This chapter discusses the outcome of the statistical analyses of results reflected in Chapter 4 with the view to meet the aim and objectives of the study and to reach a conclusion as to whether, or to what extent, the latter were achieved.

This chapter commences with a description of the participants in the EG and CG, their involvement in the three assessment periods and the attendance of the intervention by the EG. Descriptions and comparisons of the health related fitness components are presented next, followed by quality of life, physical activity levels and blood related variables of pre, mid- and post- intervention results in respect of the EG and CG. The chapter concludes with a summary of results, the overall findings of the study, a conclusion, a list of limitations and also recommendations for future research.

5.2 PARTICIPANT INFORMATION AND ATTENDANCE

When the study commenced, data pertaining to the demographic and health information of the total sample were obtained. After the selection into two groups, the EG and CG, comparisons between the two groups could be made. This section discusses the participants' attendance of the pre-, mid- and post- testing, as well as the EG's intervention attendance.

The study sample, recruited from an economically disadvantaged rural community was initially set at 60 participants (30 EG and 30 CG). However, only a total of 36 participants between 18 and 65 years of age were finally recruited. All the participants were dependent on the free health care provided by the ARV clinic, a public health care facility. A total of 19 EG participants were willing to follow the exercise programme and a total of 17 were recruited for the CG. Participants in the

EG were mostly unemployed people who could only attend the exercise intervention twice a week. The CG participants comprised of both unemployed and working people who were unwilling and/or unable to attend an intervention. The factor that could be regarded as similar between the two groups is age, with both groups reflecting a mean age of 41 years (M=41), with the majority of participants falling between the age range of 35 and 55 years. The EG had three times as many females than males, with the CG reflecting a more even gender distribution. The majority of the participants in both the EG and CG were either African or coloured in ethnicity, and the entire study sample were on ARV's. The majority of the participants in both the EG (84%) and CG (76%) were non-smokers. Therefore, the two groups can be regarded as similar in terms of age, ethnicity and non-smoking habits. The participants in the current study were comparable in terms of socio-economic status to participants in a study conducted in the United States of America (U.S.A) (Jones et al. 2013, 1 & 4). The participants in the U.S.A study were mainly African-Americans receiving social security disability insurance. This study reported that HIV negatively affects communities with lower socio-economic statuses, who are not well informed about the necessity of treatment adherence and attending clinical appointments, resulting in poor HIV treatment outcomes in these communities (Jones et al. 2013, 1 & 4).

All the participants in the EG completed the pre- and post-intervention tests and only one could not complete the mid-intervention assessment. However, the CG did not maintain the same level of commitment. The mid-intervention testing was only attended by 88% of the participants, compared to the post-testing where only 47% of the CG attended the testing. Reasons for absenteeism were illness and work obligations, although two group members' reasons were unknown.

The EG's attendance of the exercise sessions showed that 74% of the group (n=14) attended at least 50% of the exercise sessions. Four participants attended 21% of the exercise sessions, with one person attending 5% of the exercise sessions. Only 32% (n=6) of participants attended more than 70% of the exercise sessions. Reasons for not attending were work obligations or personal circumstances at home.

5.3 COMPARISONS WITHIN AND BETWEEN EG AND CG WITH REGARDS TO THE PRE-, MID- AND POST-INTERVENTION FOR THE DIFFERENT HEALTH RELATED FITNESS VARIABLES, QUALITY OF LIFE, PHYSICAL ACTIVITY LEVELS AND BLOOD RESULTS

The following section discusses the findings of comparisons conducted within and between the EG and CG with regards to the pre-, mid- and post-intervention assessments for the different health related fitness variables, quality of life, physical activity levels and blood results.

5.3.1 Comparisons within and between the EG and CG in respect of body composition related variables

When comparing within group differences, Tables 4.3.1.1 and 4.3.1.2 reflect the descriptive and inferential statistics for the body composition related variables for the EG. These tables indicate that there was no statistically significant change in the EG's mean weight (kg) ($p>0.05$) between pre-, mid- and post-test intervention scores (M=69.16±19.87; M=69.37±19.66; M=69.79±19.92), respectively. There was also no significant difference in the mean BMI values (kg/m^2) for the EG over the three assessment periods (M=26.06±7.29; M=26.19±7.31; M=26.34±7.39 respectively) nor for body fat (BF %) (M=30.68±10.31; M=29.34±10.05 and M=29.73±9.5 respectively) except for the pre- to mid-intervention tests ($p<.05$; $d>0.2$). The reason why these results remained more or less the same throughout the study could be due to the fact that the majority of the EG were females, who were overweight, and only 32% (n=6) of the EG attended 70% of the exercise sessions over the 11 weeks. Compared to the normative data (Thompson, Gordon, and Pescatello 2009, 63) (see Table 3.1) the mean of the EG places the participants in the overweight category (25.0 $kg.m^2$ - 29.9$kg.m^2$) over the intervention period.

The mean WHR for the EG indicated statistically and practically significant differences ($p<0.05$; $d>0.2$) in post-pre (M=0.02±0.03) intervention test score differences. The mean WHR scores over all three test periods pre-test (M=0.83±0.08); mid-test (M=0.84±0.09) and post-test (M=0.85±0.07) places the EG in the moderate risk category of WHR for females (0.81-0.85) and the low risk category for males (0.96-1.0) (Wood 2008) (see Table 3.5). However, taking into

consideration that there were three times as many females as males in the EG, one can conclude that the majority of the EG falls in the moderate risk level for WHR.

Tables 4.3.1.3 and 4.3.1.4, reflecting the descriptive and inferential statistics for the body composition related variables of the CG in the present study, indicated that there were no statistically significant changes in the mean weight (kg) (M=63.18±14.74; M=62.43±17.17; M=67.75±15.33), BMI kg/m^2 (M=24.02±5.99;M=23.65±6.90; M=25.72±5.95) body fat (BF %) (M=24.92±11.54; M=23.90±11.96; M=26.83±11.86) and WHR (M=0.87±0.07; M=0.88±0.06 M=0.86±0.07) test scores over the three test periods. Compared to the normative data by Thompson, Gordon, and Pescatello (2009, 63) (see table 3.1) the CG's results of the pre-test and mid-test mean BMI scores are classified under the normal weight class (18.5kg/m^2 and 24.9kg/m^2) while the post-test scores were classified under the overweight category but only by a small difference of 0.82 kg/m^2. Similarly, the WHR values are classified under the low risk category for males: (0.95) and high risk categories for females: (0.85+) (Wood 2008) (see Table 3.5).

When comparing EG and CG between differences the results reflected in Table 4.4.1.1 indicate that the EG showed no significant differences ($p>0.05$) from the CG in respect of all body composition related variables (weight, BMI, BF% and WHR). The EG revealed larger (non-significant) mean values than the CG for most of the variables except for WHR (see Table 4.4.1.1). However, due the fact that none of these differences were statistically significant one may deduce that the exercise intervention had no statistically significant effect on the body composition of the EG.

A systematic review and meta-analysis including 24 studies was conducted by O'Brien et al. (2016, 45 & 49) who employed randomized control trials comparing aerobic intervention groups with CG's. The aerobic interventions included walking, running, jogging or swimming at least three times a week for at least four weeks. These studies measured body composition in the form of BMI, weight, LBM, girth, BF % and WHR. Of the 24 studies, 18 revealed no difference in change in BMI in the EG, compared to the CG. The results of the latter study did however find a significant decrease in body fat % of 1.12 % of participants in the EG compared to no significant change found in the CG.

In a study conducted by Cade et al. (2008, 96) it was reported that prolonged use of HAART is related to alterations in body composition, especially lipodystrophy, or the abnormal redistribution of body fat. These alterations have negative effects on the health of PLWHIV and their body composition. Mendes et al. (2013, 1 & 20) investigated the effect that a combined aerobic and resistance training intervention has on the anthropometric and functional parameters of PLWHIV. Aerobic (performed on treadmill and cycle ergometer) and resistance (gym based weight training) exercises were performed under supervision three times a week for 24 weeks. Body composition was measured by BF% and was found to have decreased significantly over the period of investigation. The latter study thus supported the Cade et al. (2008) statement with their finding that exercise is an effective alternative for controlling body composition. However, in the systematic review by O'Brien et al. (2016, 45 & 49) no significant change in BMI or WHR when comparing EG's to the CG's was found. Similar results were found in a South African study set in a disadvantaged setting which reported no significant changes in weight, skinfolds, WHR and BMI in its comparison between a compliant group and a non-compliant group. This study used a combined aerobic and PRT intervention performed three times a week for 10 weeks (Ley et al. 2014, 312 & 316). The present study also found no significant improvements in respect of body composition, in a combined aerobic and PRT exercise intervention, performed twice a week for 11 weeks. The aerobic component consisted of walking, running and step climbing. The PRT consisted of own body weight training, core exercises and free weight training. The present study therefore partially supports the findings of O'Brien et al. (2016) and Mendes et al. (2013) in respect of a combined aerobic and PRT effect on body composition related variables such as BMI and WHR, but not in the case of BF%. Although the present study did present with larger decreases in BF% in the EG compared to the CG, these differences were not statistically significant. When comparing the interventions employed by the present study with those of O'Brien et al. (2016) and Mendes et al. (2013) a distinct difference was noted in terms of frequency per week that the interventions employed, with the present study employing a twice a week programme versus the three times per week programmes of the two studies mentioned above.

5.3.2 Comparisons within and between EG and CG in respect of flexibility, strength and agility related variables

Tables 4.3.2.1 and 4.3.2.2 (chapter 4) reflect the descriptive and inferential statistics for the flexibility, strength and agility variables of the EG in the present study. These tables indicate that there were no statistically significant changes in the EG mean scores over all three test periods. Flexibility in respect of sit-and-reach (cm) test scores (M=24.03±24.03; M=25.75±8.03 M=29.87±8.11) revealed above normal values when compared to the normative data (Jones and Rikli 2002, 26) (see Table 3.6) for the age category of 60-64 years, for both males: (-6.35cm to +10.16cm) and females:(-1.27cm to +12.7cm). Although the comparative age category used, namely that of 60-64 years, seems strange, the reader is reminded that the tests used to assess flexibility, strength and agility related variables were taken from a health related fitness test battery designed for older persons (Jones and Rikli 2002, 26). Given that the tests selected were relatively uniquely designed and that the participants in the present study were compromised in terms of their health and subsequent physical fitness, it was argued that their physical performance would be more comparable to older, healthy people.

The upper and lower body strength were assessed using the grip strength and 30 sec sit-to-stand tests. The grip strength (kg) test scores (M=36.00±8.35; M=38.89±10.92; M=41.32±13) when compared to the normative data by Bechtol (1954, 820-824) (see Table 3.7) revealed values in the “under normal” category for male grip strength (35.5-55.3kg) and under the “strong” category for female grip strength (>32.7kg) over the test periods. The 30 sec sit-to-stand (no.) test scores (M=12.95±3.27; M=16.56±3.07; M=19.84±2.52) compared to the normative data (Jones and Rikli 2002, 26) (see Table 3.8) revealed values in the “above normal” category for the age category (60-64 years) for males: (14-19) and females: (12-17). The agility test in respect of the 2.44 up-and-go (sec) test scores (M=5.41±0.62; M=4.69±0.68; M=4.81±0.82) revealed “normal” values when compared to the normative data by (Jones and Rikli 2002, 26) (see Table 3.9) for the category of 60-64 years, for males: (5.6-3.8 seconds) and females: (6.0-4.4 seconds).

Tables 4.3.2.3 and 4.3.2.4 reflect the descriptive and inferential statistics for the flexibility, strength and agility variables of the CG in the present study and indicate no statistically significant changes in the mean scores over the three test periods.

The flexibility test scores in respect of sit-and-reach (cm) (M=23.47±8.81; M=23.88±7.38; M=30.63±8.21) revealed “above normal” values when compared to the normative data (Jones and Rikli 2002, 26) (see Table 3.6) for the age category of 60-64 years, males: (-6.35cm - +10.16cm) and females:(-1.27cm - +12.7cm). The upper and lower body strength was measured in respect of grip strength and the 30 sec sit-to-stand test. The grip strength (kg) test score (M=36.35±8.16; M=36.80±10.13; M=40.25±10.11) revealed values under the “normal” category for males: (35.5-55.3kg) and under the “strong” category for females (>32.7kg) when compared to the normative data by Bechtol (1954, 820-824) (see Table 3.7). The 30 sec sit-to-stand (no.) test scores (M=13.06±4.22; M=15.00±6.54; M=18.75±6.32) revealed values in the “below normal” category for the males for pre-test scores and improved to “normal” category in the mid- and post-phases, and “normal” category for females over all three test periods when compared to the normative data by Jones and Rikli (2002, 26) (see Table 3.8) for the category 60-64 years males (14-19), females (12-17). The agility test scores in respect of the 2.44 up-and-go (sec) (M=6.17±2.97; M=6.15±2.78; M=4.86±0.70) revealed “normal” values when compared to the normative data by Jones and Rikli (2002, 26) (see Table 3.9) for the category of 60-64 years, males: (5.6-3.8 seconds) and females: (6.0-4.4 seconds).

The reason for the increase in test scores of the CG from pre-, to mid- and to post-tests could be due to the drop-out of participants (n=17 at the pre-test, dropping to n=8 at the post-test). Reasons for the drop-out include changes in employment, unreliable transport and changes in family responsibility. The results could also have been affected due to the more healthy participants completing the testing while others may have been too sick to participate. The above factors could have had an influence which caused more positive results over the test periods.

The results shown in Table 4.4.2.1 indicated that the EG showed no significant difference ($p<0.05$; $d>0.2$) from the control group in respect of all flexibility, strength and agility related variables (sit-and-reach, grip strength, sit-to-stand and 2.44 up-and-go). The results obtained from comparisons of the test scores between the EG

and the CG showed that there were no significant improvements for all the flexibility, strength and agility related variables. In the analysis conducted comparing the EG to the CG in respect of flexibility, strength and agility related variables, the EG did reveal larger mean values than the CG for most of the variables except for sit-and-reach post-test, grip strength pre-test and 30 sec sit-to-stand pre-test (see Table 4.4.2.1). One could, therefore, deduce that the exercise intervention had no significant effect even though there was an increase in the flexibility, strength and agility related variables for the EG over the three test periods.

The results in the present study are contrary to the findings of other studies in relation to strength testing. No studies were found to compare flexibility and agility related variables. In the systematic review by O'Brien et al. (2016, 43), significant improvements in upper and lower body strength were found in the 11 studies that assessed strength outcomes (using the 1 repetitions max test). Interventions were conducted at least three times a week for at least 4 weeks. In this review greater strength improvements were found in PRT interventions compared to aerobic interventions.

Yarasheski et al. (2001, 131) reported in a 16 week resistance training programme conducted with 18 HIV infected men, muscle strength was increased by 23%-38%. The resistance programme was gym based and consisted of 3 upper body and 4 lower body exercises performed four times a week, for 1h-1h30. The intensity gradually increased over the 16 weeks from low intensity and high repetitions to high intensity with low repetitions.

Ley et al. (2014, 314-316) investigated the effects of a 10 week exercise programme on PLWHIV in a disadvantaged urban South African setting. The programme consisted of two groups exercising three times a week, performing PRT, aerobic exercises and stretching. Group A (n=11) participated in individual training with a training professional for confidentiality reasons. Group B (n=12) did group training at a disadvantaged school in the community. Group A: exercise duration was 60-70 minutes and Group B: 90 minutes, however, the workloads remained the same due to the group dynamic that slowed the programme. From the 23 participants who completed the baseline and post-test, compliant (n=12) participants were compared to non-compliant (n=11). The study revealed a statistically significant improvement in

ml kg^{-1} min^{-1}) post-mid (M=0.64±0.86) and lung function (L/min) mid-pre- (M=56.67±98.99) and post-pre (M=90.53± 107.31) intervention test score differences.

The mean VO_2max (ml kg^{-1} min^{-1}) strength (h1RM test was used). The present study did not involve gym based resistance training as included in other studies. However, own body weight resistance training was used. The present study focused on investigating a low cost training programme, the effectiveness of the intervention and the compliance of such interventions in a poor, rural community. As reported above the intervention in the present study did not show significant improvements in strength, flexibility or agility variables even though the EG revealed greater improvements than the CG.

5.3.3 Comparisons within and between EG and CG in respect of cardiovascular related variables

When comparing within group differences Tables 4.3.3.1 and 4.3.3.2 reflected descriptive and inferential statistics for the cardiovascular fitness variables of the EG in the present study. The latter table indicated a statistically and practically significant difference ($p<0.05$; $d>0.2$) for the 6 min walk (min) post-mid (M=27.78±37.38), VO_2max (

test scores (M=11.89±1.34; M=11.51±1.09; M=12.15±0.81) (see Table 4.3.3.1) reveal values below the “very poor” category when compared to the normative data by Paterson et al. (1999, 1813-1820) (see Table 3.10) for males: (24.2-32.9 ml kg^{-1} min^{-1}) and females: (20.8-26.4 ml kg^{-1} min^{-1}) for the age categories of 40-49 years.

The mean lung function (L/min) test scores in respect of peak flow (M=236.32±85.9; M=297.22±109.8; M=326.84±106.46) reveal values below average when compared to the normative data by Partners Health Care Asthma Center (2010) (see Table 3.11) which indicates that adults 40 years of age (EG age (M=41years)) and 165cm in height (EG height (M=163cm)), should have a normal peak flow score of 436L/min.

The mean blood pressure (mmHg) test scores (pre- 130/88mmHg; mid- 124/86mmHg; post 130/87mmHg): systolic: (M=130.33±20.25; M=123.88±21.34;

M=129.84±17.91) and diastolic: (M=88.22±12.28; M=86.47±12.7; M=86.53±8.51) revealed pre-hypertension values compared to the normative data (120-139/80-89mmHg) indicated by Thompson, Gordon, and Pescatello (2009, 47) (see Table: 3.12).

The mean heart rate (bpm) test scores in respect of resting heart rate and post exercise heart rate of the EG indicated statistically and practically significant differences ($p<0.05$; $d>0.2$) in regard to post-mid HR (M= -9.32±15.98), post-pre HR (M= -7.39±13.32), 3 min HR Diff. post-mid (M=17.33±15.38), 3 min HR diff. post-pre (M=12.44±14.05) 3 min HR Diff.% post-mid (M=24.79±22.24) and 3 min HR Diff.% post-pre (M=18.98±36).

The mean heart rate (bpm) test scores (M=82.44±11.98; M=83.79±17.37; M=74.47±10.98) revealed “below average” values for pre-test scores, “poor” for mid-test and improved to “average” category in the post-test scores when compared to the normative data provided by Wood (2010) (Table 3.13) for adults between 36-45years old.

When comparing differences Tables 4.3.3.3 and 4.3.3.4 reflect the descriptive and inferential statistics for the cardiovascular fitness variable of the CG in the present study, the latter table indicates a statistically and practically significant difference ($p<0.05$; $d>0.2$) for the 6 min walk post-pre (M=58.88±51.90) and VO_2max post-pre (M=1.35±1.19) test differences.

The mean VO_2max (ml kg^{-1} min^{-1}) test scores (M=10.53±1.28; M=10.98±1.22; M=11.89±1.15) reveal below “very poor” values compared to the normative data provided by Paterson et al. (1999, 1813-1820) (see Table 3.10) for 40-49 years for males: (24.2-32.9 ml kg^{-1} min^{-1}) and females: (20.8-26.4 ml kg^{-1} min^{-1}).

The mean lung function test scores of the CG over the three test periods in respect of peak flow (L/min) test scores indicate that for the pre-test there was only one person (n=1) who conducted the peak flow test, pre-test (M=370.00). This was due to the fact that at the time of the testing the peak flow meter was not available. There was no statistically significant changes in the CG mean scores mid-test (M=289.33±95.43) and post-test (M=296.25±91.80) for the CG for peak flow.

The mean blood pressure (test scores (pre-136/91mmHg; mid-131/91mmHg; post-131/91mmHg) for systolic: (M=135.88±17.56; M=131.27±20.51; M=131.25±26.57) and diastolic: (M=91.06±16.16; M=90.73±12.36; M=91.13±26.84) blood pressure revealed pre-hypertension values. Compared to the normative data (120-139/80-89mmHg) provided by Paterson et al. (1999, 47) (see Table 3.12) for systolic test scores and the diastolic test scores, the present study's values were categorised under stage 1 hypertension.

The mean heart rate (bpm) test scores (M=79.12±13.24; M=80.93±10.52; M=79.50±11.64) revealed below average values for all the three test periods compared to the normative data provided by Wood (2010) (Table 3.13) for adults aged between 36-45 years, irrespective of gender.

The CG cardiovascular fitness variable results suggested similar factors as those mentioned for flexibility, strength and agility. The reason for the increase in test scores of the CG from pre-, to mid- and to post-tests could be due to the drop-out of participants (n=17 at the pre-test, dropping to n=8 at the post-test). Reasons for the drop-out include changes in employment, unreliable transport and changes in family responsibility. The results could also have been affected by the more healthy participants completing the testing while others may have been too sick to participate. The above factors could have caused more positive results over the test periods.

When comparing the EG and CG in respect of cardiovascular related variables the results obtained for this study as illustrated in Table 4.4.3.1, indicate that the EG continued to present with better performances in the latter two tests over the three assessment periods, but these improvements were, however, not statistically or significantly better (see Table 4.3.3.2). The CG, on the other hand, showed significant improvements in the results of the two variables' post-pre test comparisons (see Table 4.3.3.4). Hence the statistically and practically significant differences observed in respect of these post-pre test comparisons (see Table 4.4.3.1) confirm that the intervention applied in the present study did not significantly improve the EG's performances in the 6 min walk and the VO_2max tests. Furthermore, the significantly better results presented by the EG only in the pre-test results for the 3 min. HR, 3 min HR difference and the 3 min. HR difference %

variables confirm the initial superiority of the EG and no further significant impact of the intervention programme on this group. Overall one could therefore deduce that the exercise intervention had no effect on the cardiovascular related variables over the test periods.

Garcia et al. (2014, 789) reported that the HIV positive population is most likely to have lower level of aerobic fitness and an increased risk to cardiovascular disease compared to the HIV negative population. According to O'Brien et al. (2016, 40) five out of six meta-analyses were exercise interventions, performed three times a week for at least four weeks by the EG, revealed significant improvements in aerobic performance compared to CG's. The aerobic exercises included in the latter comparisons were jogging, walking, rowing, swimming and stair climbing. An improvement of 2.63ml/kg/min for participants in the aerobic groups was reported, which suggests a potential clinically important improvement in VO_2max among the EG's.

Similar findings were reported by Garcia et al. (2014, 787, 789 & 790) involving an aerobic training intervention. Participants performed 30 minutes of aerobic training three times a week for twenty weeks. The aerobic training consisted of jogging around a 400m track for 30 minutes. The cardiovascular fitness was measured by a VO_2max test and revealed significantly improved results.

Lucrecia et al. (2006, 411) reported a 12 week moderate intensity aerobic exercise intervention performed 3 days a week for 30 minutes, compared to a 12 week stretching and relaxation programme. Aerobic exercises were performed at 60% HR max of each individual. A significant increase in VO_2max was reported after the completion of the relevant intervention programme.

Hand et al. (2008, 1072) also reported on a 12 week combined aerobic and progressive strength training programme compared to a control group. The aerobic component was performed twice a week for 6 weeks. The cardiovascular fitness outcomes included an increase in VO_2max, and a decrease in heart rate at submaximal absolute workload. The study concluded that moderate-intensity aerobic and resistance training for 1 hour twice per week can enhance the functional aerobic capacity in HIV-infected individuals with significant impairment. Thus, in summary

when comparing the present study to that of O'Brien et al. (2016), Garcia et al. (2014) and Lucrecia et al. (2006) the reason for not finding significant improvement in aerobic performance could possibly be ascribed to the fact that the mentioned studies all trained three times per week as opposed to the present studies' twice a week regimen. On the other hand, when considering the findings of Hand et al. (2008) the present study's intervention programme should have been ideal for the rural setting, and should have showed significant improvement in aerobic performance. However, taking into consideration that only 6 participants attended 70% of the exercise sessions and that there was no negative trend or change in the VO_2max of the EG, this may be the reason for not finding the expected result. Similarly another South African study Ley et al. (2014, 312-316) also conducted in a disadvantaged setting found no statistically significant changes in estimated VO_2max after a 10 week combined aerobic and PRT intervention. Participants' compliance with the exercise intervention was also problematic in this study.

5.3.4 Comparisons within and between EG and CG in respect of quality of life

When comparing within group differences, Table 4.3.4.1 and 4.3.4.2 4 reflect the descriptive and inferential statistics for quality of life (MOS PHC and MHC) scores for the EG in the present study. These tables indicate that there were no statistically significant changes in MOS PHC (%) (M=50.65±8.22; M=53.54±8.16) and MOS MHS (%) (M=47.32±14.51; M=50.33±6.32) test scores, over the test period.

Table 4.3.4.3 and 4.3.4.4 reflect the descriptive and inferential statistics for quality of life scores to compare within group differences for the EG in the present study which indicate that there were no statistical significant changes in MOS PHC (%) (M=48.87±11.93; M=53.70±7.25) and MHC (%) (M=54.16±9.47; M=57.78±7.50) test scores, over the test period.

When comparing the EG and CG in respect of Quality of Life, results Table 4.4.4.1 indicated that the EG showed a significantly higher ($p<0.05$; $d>0.2$) increase than the control group in respect of MOS MHC at post-test level. In the analysis conducted comparing the EG to the CG mean values, the EG had higher mean values for MOS PHC pre-, MOS PHC post-pre and MOS MCH post- pre-test score differences, none

of which were statistically significant. One could, therefore, deduce that the exercise intervention had some positive effect on MOS PHC and MOS MHC over the test periods, but due to no statistical significance indicated for these changes, more research is required to confirm these findings.

A study by Neidig, Smith, and Brashers (2003, 33) reported that a 12 week supervised aerobic intervention performed at 60-80% VO_2max had reported positive effects on participants mood and depressive symptoms. Only participants who attended 28-36 exercise sessions were included in the analysis. The aerobic exercise modalities included sessions on the treadmill, stationery bike or walking.

Hand et al. (2009, 3) investigated the effects that aerobic exercise, and combined aerobic and resistance exercise training have on HIV infected individuals. This investigation focused on the effects of a 24 week aerobic exercise intervention on perceived stress in 25 HIV positive men. The aerobic exercise intervention was performed three times a week at 75-85% VO_2max for 24 minutes, and compared to an aerobic exercise group who performed a lower intensity aerobic exercise 3 times a week at 50-60% VO_2max for 40 minutes. There was a significant increase in VO_2max and a significant reduction in perceived stress found in both exercise groups.

Similarly, a systematic review by O'Brien et al. (2016, 49) included 13 health-related quality of life outcomes which demonstrated statistically significant and clinically important improvements (>10 point change) on subscales of mental health, emotional well-being and physical functioning as well as statistically significant improvements in physical, general health, and energy/vitality of the SF36 questionnaire for participants in EG’s compared with participants in CG’s.

In summary, based on the literature findings cited in this section, it was feasible to hypothesis that the exercise intervention programme implemented in the present study would have a positive effect on the quality of life of the EG. However, the present study’s results did not reflect significant improvements post intervention to confirm the literature finding.

5.3.5 Comparisons within and between EG and CG in respect of physical activity levels

When comparing within group differences Tables 4.3.5.1 and 4.3.5.2 reflect the descriptive and inferential statistics for the physical activity level test scores of the EG in the present study. These tables indicated a statistically and practically significant difference ($p<0.05$; $d>0.2$) in total physical activity 1 post-pre, walk MET post-pre and total physical activity 2 post-pre comparison scores.

The mean total physical activity 1 (MET.mins) comprises (M=13348.11±8383.56; M=8761.79±7037.56) in respect of the sum of (work domain (M=497.37±2167.98; M=809.92±3381.23), transport domain (M=2575.89±2338.92; M=1186.71±2322.51), domestic and garden domain (M=5135.37±4381.53; M=4692.63±2682.04) as well as leisure domain (M=4276.26±3725.84; M=1965.58±2909.15)) over the three test periods.

The mean total physical activity 2 comprises (MET.mins) (M=14824.95±9833.58; M=8190.16±6308.78) in respect of the sum of (walking (M=3894.95±3129.54; M=1575.32±2933.31), moderate (M=7047.63±5711.93; M=5385.26±3096.97) and vigorous (M=1351.58±2795.67; M=1218.95±2421.99)) scores over the three test periods.

Tables 4.3.5.3 and 4.3.5.4 reflect the descriptive and inferential statistics for the physical activity test scores of the CG in the present study, indicated no statistically significant difference ($p<0.05$; $d>0.2$) between any of the test scores.

The mean total physical activity 1 (MET.mins) comprises (M=17369.24±12691.24; M=22986.94±32282.83) in respect of the sum of (work domain (M=2324.12±9582.58; M=6.79±19.20), transport domain (M=3124.88±2833.43; M=2205.88±3063.45), domestic and garden domain (M=5977.65±4319.11; M=5497.50±3898.47) as well as leisure domain (M=5390.94±5175.13; M=3283.13±3512.34)) over the three test periods.

The mean total physical activity 2 (MET.mins) comprises (M=16859.24±11304.37; M=10637.50±6652.25) in respect of the sum of (walking (M=3497.12±2656.64;

M=2310.00±2553.35), moderate (M=9964.71±8170.46; M=6400.00±3557.72) and vigorous (M=3061.41±5266.23; M=1965.00±1997.65) over the three test periods.

Table 4.4.5.1 reflects the comparison of the mean raw test scores between the EG and the CG for physical activity levels as reflected by the IPAQ in the present study. The results revealed no statistically significant differences ($p<0.05$) between the EG and the CG in respect of physical activity level. In the analysis conducted comparing the EG to the CG mean values, the EG only had higher mean values for the work domain post-test, work domain post-pre, walking pre-test, walking post-pre test and vigorous post-pre test. One could, therefore, deduce that there was a decrease in physical activity level status over the intervention period.

Ramirez-Marrero et al. (2008, 283 & 292) compared self-reported levels of physical activity using the IPAQ, to data obtained using accelerometer and pedometers in HIV positive Hispanic adults. The IPAQ was found to highly overestimate physical activity levels in PLWHIV, and it was suggested that pedometers and accelerometer be used in conjunction with the IPAQ. This study mentioned that it could be possible that PLWHIV might perceive light to moderate physical activity as being more heavy activity due to the side effects of the disease.

5.3.6 Comparisons within and between EG and CG in respect of blood results

Blood results were received from the ARV clinic for 31 participants (18 in EG and 13 in CG) and was deemed sufficient for further statistical analyses.

Tables 4.5.2.1 reflects the descriptive statistics and the pre- to post-test comparisons for blood results of the EG in the present study. The within group comparison for the EG indicates an ultimate increase of 74±161.54 per mm^3 blood in the CD4 count, a slight increase of 0.27±1.13 per mm^3 blood in the WBC count and a slight increase of 0.07±0.29 per mm^3 blood in the RBC over the three assessment periods. No further statistical analyses were conducted on these results due to the limited sample involved.

The mean blood result test scores for the EG in respect of CD4 count pre-, mid- and post-test (M=357.38±231.56; M=344.51±114.05; M=427.74±198.15) revealed values

“above normal” when compared to the normative data by NAM AIDSmap (2012) (see Table 3.14) CD4 count above 200 per mm^3 blood, irrespective of gender, over all three test periods. In viral load, HIV treatment aims for undetectable values as mentioned in chapter 3 (Zeh et al. 2011, 3). The mean viral load test scores (M=289.5±154.86; M=76119.33±131497.2; M=20253.75±57671.89) seemed high.

The mean WBC test scores (M=6.34±2.08; M=6.14±1.54; M=6.51±1.89) revealed normal values compared to the normative data, males: 4-10 (per mm^3 blood) and females: 4-10 x (per mm^3 blood) by the Medical Council of Canada (2017) (see Table 3.17). The mean RBC test scores (M=4.09±0.6; M=4.2±0.65; M=4.15±0.62) revealed “normal” values compared to the normative data by Medical Council of Canada (2017) (see Table 3.17) males: 4.4-5.7 per mm^3 blood , females: 4.0-per 5.2 mm^3 blood.

Table 4.5.2.2 reflect descriptive statistics for the mean blood result test scores for the CG in the present study. Over the three assessments the results indicate a small increase (M=43.53±211.6) in the CD4 count and only slight increases in the WBC (M=0.53±1.68) and RBC (M=0.14±0.33). The small and varying numbers of the three assessment periods did not justify further statistical analyses. Therefore the reported changes may be due to chance and has to be interpreted with caution. As in the case of the EG, the number of CG participants who presented with HIV Viral Load results were too small and varying to comment on any changes.

The mean blood result test scores for the CG in respect of that the CD4 count (M=441.37±148.13; M=419.17±269.00; M=505.53±289.93) also revealed values above “normal” compared to the normative data by NAM AIDSmap (2012) (see Table 3.14) CD4 count above 200 per mm^3 blood, over all three test periods. HIV treatment aims for undetectable values for viral load as mentioned in chapter 3 (Zeh et al. 2011, 3). In the case of the EG the mean viral load (M=213±185.01; M=317.33±141.45; M=204±213.84) is low and remained the same over the assessment period.

The mean WBC count test scores (M=6.49±2.77; M=5.67±1.92; M=6.12±2.49) revealed “normal” values when compared to the normative data provided by Medical Council of Canada (2017) (see Table 3.17) males: 4-10 (per mm^3 blood) and

females: 4-10 x (per mm^3 blood). The RBC test scores (M=4.58±0.51; M=4.65±0.51; M=4.65±0.67) revealed “normal” values compared to the normative data provided by Medical Council of Canada (2017) (see Table 3.17) males: 4.4-5.7 per mm^3 blood and females: 4.0-5.2 per mm^3 blood.

When comparing the results obtained for the EG and CG for this study, Table 4.5.4.1 indicates that the CG showed a significantly larger RBC than the EG at pre-test level (p=0.43; u=66.00). No other comparisons between the EG and CG were statistically significant.

According to Dudgeon et al. (2004, 90) adherence to a regular moderate-intensity exercise regime was associated with an increase in CD4 count. However, a systematic review by O'Brien et al. (2008, 650) on exercise interventions in HIV positive populations (PRT intervention performed at least three times a week for four weeks, including three meta-analyses) found contrary results. O’Brien et al. (2008, 650) revealed that the CD4 count was unaffected by regular exercise in the EG’s compared to the CG’s, similarly viral load was not significantly affected either. A later systematic review by O'Brien et al. (2016, 37) included 22 studies and measured the outcomes of exercise and its effect on CD4 count and viral load. Seven meta-analyses were performed for CD4 count. The majority demonstrated no statistically significant changes in CD4 count between EG’s and CG’s. Meta-analyses also demonstrated no difference in change in viral load for EG’s when compared to CG’s. The present study seems to support previous literature in respect of exercise interventions and the impact on CD4 counts and viral load.

5.4 SUMMARY OF RESULTS

The participants for this study were divided into two groups according to the availability of participants who were willing to participate in the exercise intervention and who met the inclusion criteria. The EG and CG comparisons according to statistical analyses conducted, revealed the following:

- All the comparisons of body composition related variables at pre-, mid- and post- tests as well as for the pre- to post-test comparisons for all the variables revealed no statistical differences.

- All flexibility, strength and agility related variables except for the 2.44 up-and-go test which showed a medium significant difference ($p<0.05$; $d>0.2$) in mid-test scores with the EG outperforming the CG. No other scores showed significant differences in pre-, mid- and post –test scores or the pre- to mid-, mid- to post- and pre- to post-test score comparisons.

- In cardiovascular related variables the EG revealed significantly larger ($p<0.05$; $d>0.2$) pre-test results for both the 6 min walk and the VO_2max tests. The EG continued to present with better performances in the latter two tests over the three assessment periods, but these improvements were however not statistically significantly better (see Table 4.3.3.2). The CG on the other hand showed significant improvements in the results of the mentioned two variables' post-pre test comparisons (see Table 4.3.3.4). Hence the statistical and practical significant differences observed in respect of these post-pre test comparisons (see Table 4.4.3.1) confirm that the intervention applied in the present study did not significantly improve the EG's performances in the 6 min walk and the VO_2max tests. Furthermore, the significantly better results presented by the EG only in the pre-test results for the 3 min, HR, 3 min HR difference and the 3 min. HR difference % variables confirm the initial superiority of the EG and no further significant impact of the intervention programme on this group.
- In the quality of life results there was a large significant difference ($p<0.05$; $d>0.2$) in the MOS Mental Health Component (MHC) at post-test scores observed between the EG and CG with the latter reflecting the better score.
- In physical activity status no significant differences ($p<0.05$; $d>0.2$) were observed between the EG and CG for IPAQ variables of pre- and post- test scores as well as pre- to post-test score comparisons of physical activity status.
- The blood tests results indicated statistical significant differences ($p<0.05$) for RBC at pre-test score level with the CG presenting the higher value. There were no other statistically significant differences for blood results for the EG.

The results obtained were also interpreted according existing normative data. Following is a summary of how the findings were classified in this regard:

- For the body composition variables the EG was classified as overweight over the test period. The WHR placed the females under the “moderate risk” category and the males under a “low risk” category with statistical and practical significant differences for WHR post-pre test noted. The CG was classified under the “normal” weight category pre- and mid-test and in the overweight category post-test. The WHR was categorised under low risk for males and high risk for females over the testing period.
- In regards to the flexibility, strength and agility variables the EG was classified under the “normal” category for flexibility irrespective of the gender and the CG under the “above normal” category. For the upper body strength in respect of grip strength the males were categorised under the “normal” category and the females under the “strong” category. Similar results were seen in the CG with the males under the “normal” grip strength category and the females under the “strong” category over the testing period. Lower body strength in respect of sit-to-stand revealed that the EG were classified as “above normal” with a positive improvement trend over the testing period, even though it was not significant. In the CG the men were categorised “below normal” for the 30 sec sit-to-stand and improved to “normal” over the test period. The females were categorised under the “normal category” over the test period. The agility revealed a negative trend over the test period for the EG and the CG, however both groups were classified under the “normal” range for agility, irrespective of the gender.
- The cardiovascular related variables revealed that the VO_2max for the EG was classified under the “very poor” category over the test periods even though there was a statistical significant change post-mid test scores. The VO_2max for the CG was classified below “very poor” even though there was a positive change over the test period. Lung function could not be compared due to the fact that only one person was tested in the CG for the pre-test due to the peak flow equipment not being available at the time of testing. The EG mean blood pressure was categorised as pre-hypertension risk status, with their heart rate mean scores improving from “below average” to average category. The CG mean blood pressure was categorised as pre-hypertension for the systolic means and stage 1 hypertension for the diastolic means. The

heart rate means for the control group was “below average" over the testing period.

- In the quality of life assessment the EG and CG revealed a positive trend in PHC and MHC even though there was no significant differences.
- The physical activity level of the EG and the CG had a positive trend in the total physical activity 1 domain and a decrease in trend in the total physical activity 2 domain.
- The blood tests revealed that the CD4 count of the EG was above 200 per mm^3 blood from pre-test to post test, viral load scores decreased from pre-test to post-test and the WBC and RBC remained within the normal range. The CD4 count for the CG also revealed values above 200 per mm^3 blood with an increased trend however the number of blood samples decreased from pre-test (n=12), mid-test (n=11) and post-test (n=6). Viral load for the CG also decreased and the WBC and RBC remained within the normal range.

5.5 FINAL CONCLUSION

In conclusion, the EG in the present study did not reveal statistically significant better post-intervention results than the CG in respect of any of the health related fitness components (body composition, flexibility, strength and agility, cardiovascular related variables), quality of life, physical activity levels or blood variables assessed. Although there were small increases in selected variables for the EG across the three assessment periods, these were not statistically significant.

The CG remained sedentary during the intervention period and revealed either an increase in, or maintenance of the initial scores obtained in the pre-test assessment. Slight variation could have been attributed to the decrease in sample size at mid - and post - testing. The participants who were lost from the study were affected by changes in employment, unreliable transport and changes in family responsibility. At post intervention testing phase the majority of the participants available for testing were those who were working and healthy. The participants who did not attend were because of above mentioned reasons and due to illness and being too sick to participate in the testing. These factors may have influenced the overall results of this study.

Overall the aims and objectives of the study in exploring the effect of an 11-week combined progressive resistance exercise and aerobic exercise programme on the health and well-being of a HIV positive population were achieved even though the attrition of participants during the study and the subsequent outcome of the study were not expected.

5.6 LIMITATIONS

The following limitations could have had an impact on the results obtained in the study.

- The sample size was limited to 36 participant and dependant on the number of volunteers at the ARV clinic who presented themselves for participation in the study. This relatively small sample size was then furthermore divided into an experimental and a control group. Some participants dropped out of the CG either due to illness and hospitalization or work obligations.
- The drop in the number of participants in the CG for the mid- and post- testing would have affected the results. Reasons for the dropout were illness or work obligations possibly resulting in more abled and healthy participants being tested, affecting the results of the study with regards to the CG was a major limitation.
- The low attendance for the exercise sessions by the EG served as a limitation. Only 6 participants (32%) attending more than 70% of the sessions, is also a limitation.
- The researcher was dependent on physiotherapist and ARV clinic staff, for conducting the intervention sessions. The researcher was not able to be at every training session to ensure that participants were fully engaging into the set exercise programme.
- A key limitation to the study relate to conducting research of this nature in a rural hospital whose patients depend on unreliable transport from distant homes. The researcher and the staff of the clinic noted the potential loss of participants in the regular exercise sessions.
- The rural context and personal circumstances of participants, limited exercise sessions to twice a week.

5.7 RECOMMENDATIONS FOR FUTURE RESEARCH

Recommendations for future studies with regards to health related fitness research would include the following principles to broaden the knowledge and understanding of the effect that exercise has on PLWHIV:

The current research is repeated to confirm the findings of the study, and the following be considered:

- Increase in sample size
- Randomise the EGs and CGs
- Allow the participants to familiarize themselves well with the tests before testing commences
- Increase the intervention period as well as various differences related to frequency, intensity and duration of strength training could possibly result in significant changes. Lifestyle measures have been shown to improve the quality of life of PLWHIV, hence there is an urgent need for public health measures to prevent the ongoing epidemic of HIV, the side effects of HAART and mortality of HIV and AIDS.

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APPENDIX A: BIOGRAPHICAL AND HEALTH QUESTIONNAIRE

Bibliographic and Health Questionnaire						
Name:					Age:	
Gender:				Race:		
CD4 count:				Viral RNA		
Medication (Please list all medications you are currently taking)						
Smoking Status: (Please tick the appropriate status)	Non-Smoker		Current Smoker		Ex-Smoker	
Details of medical history						
Exercise Habits						
I currently exercise:	< 1 per week		2-3 times per week		>3 times per week	
I exercise for:	o minutes		15-20 minutes		> 30 minutes	
My exercise intensity is:		Low	Moderate	High		
Dietary Habits						
Dietary Habits: (How many servings per week do you have of these?)	Fruit		Vegetables		Red meat	
	White Meat		Full cream Diary		Low fat Dairy	
	Cereals		White bread		Brown bread	
	Potatoes		Pasta/rice		Fried food	
	Crisp/crisps		Cake etc.		Ice-cream	
	Sweets		Take aways		Cooldrinks	
	Water		Alcohol		Multivitamins	
	Breakfast		Lunch		Supper	

APPENDIX B: MOS/HIV QUESTIONNAIRE

36-Item Short Form Survey Instrument (SF-36)

RAND 36-Item Health Survey 1.0 Questionnaire Items

Choose one option for each questionnaire item.

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

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

---

2. **Compared to one year ago**, how would you rate your health in general **now**?

- 1 - Much better now than one year ago
- 2 - Somewhat better now than one year ago
- 3 - About the same
- 4 - Somewhat worse now than one year ago
- 5 - Much worse now than one year ago

The following items 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
3. **Vigorous activities**, such as running, lifting heavy objects, participating in strenuous sports	○ 1	○ 2	○ 3
4. **Moderate activities**, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	○ 1	○ 2	○ 3
5. Lifting or carrying groceries	○ 1	○ 2	○ 3
6. Climbing **several** flights of stairs	○ 1	○ 2	○ 3
7. Climbing **one** flight of stairs	○ 1	○ 2	○ 3
8. Bending, kneeling, or stooping	○ 1	○ 2	○ 3
9. Walking **more than a mile**	○ 1	○ 2	○ 3
10. Walking **several blocks**	○ 1	○ 2	○ 3
11. Walking **one block**	○ 1	○ 2	○ 3
12. Bathing or dressing yourself	○ 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
13. Cut down the **amount of time** you spent on work or other activities	○ 1	○ 2
14. **Accomplished less** than you would like	○ 1	○ 2
15. Were limited in the **kind** of work or other activities	○ 1	○ 2
16. Had **difficulty** performing the work or other activities (for example, it took extra effort)	○ 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
17. Cut down the **amount of time** you spent on work or other activities	○ 1	○ 2
18. **Accomplished less** than you would like	○ 1	○ 2
19. Didn't do work or other activities as **carefully** as usual	○ 1	○ 2

---

20. During the **past 4 weeks**, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

- ○ 1 - Not at all
- ○ 2 - Slightly
- ○ 3 - Moderately
- ○ 4 - Quite a bit
- ○ 5 - Extremely

---

21. How much **bodily** pain have you had during the **past 4 weeks?**

- 1 - None
- 2 - Very mild
- 3 - Mild
- 4 - Moderate
- 5 - Severe
- 6 - Very severe

---

22. During the **past 4 weeks**, how much did **pain** interfere with your normal work (including both 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 feel and how things have been with you **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
23. Did you feel full of pep?	1	2	3	4	5	6
24. Have you been a very nervous person?	1	2	3	4	5	6
25. Have you felt so down in the dumps that nothing could cheer you up?	1	2	3	4	5	6
26. Have you felt calm and peaceful?	1	2	3	4	5	6
27. Did you have a lot of energy?	1	2	3	4	5	6
28. Have you felt downhearted and blue?	1	2	3	4	5	6
29. Did you feel worn out?	1	2	3	4	5	6
30. Have you been a happy person?	1	2	3	4	5	6
31. Did you feel tired?	1	2	3	4	5	6

32. During the **past 4 weeks**, how much of the time has **your physical health or emotional problems** interfered with your social activities (like visiting with 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

How TRUE or FALSE is **each** of the following statements for you.

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
33. I seem to get sick a little easier than other people	○ 1	○ 2	○ 3	○ 4	○ 5
34. I am as healthy as anybody I know	○ 1	○ 2	○ 3	○ 4	○ 5
35. I expect my health to get worse	○ 1	○ 2	○ 3	○ 4	○ 5
36. My health is excellent	○ 1	○ 2	○ 3	○ 4	○ 5

APPENDIX C: INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (IPAQ)

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (October 2002)

LONG LAST 7 DAYS SELF-ADMINISTERED FORMAT

FOR USE WITH YOUNG AND MIDDLE-AGED ADULTS (15-69 years)

The International Physical Activity Questionnaires (IPAQ) comprises a set of 4 questionnaires. Long (5 activity domains asked independently) and short (4 generic items) versions for use by either telephone or self-administered methods are available. The purpose of the questionnaires is to provide common instruments that can be used to obtain internationally comparable data on health–related physical activity.

Background on IPAQ
The development of an international measure for physical activity commenced in Geneva in 1998 and was followed by extensive reliability and validity testing undertaken across 12 countries (14 sites) during 2000. The final results suggest that these measures have acceptable measurement properties for use in many settings and in different languages, and are suitable for national population-based prevalence studies of participation in physical activity.

Using IPAQ
Use of the IPAQ instruments for monitoring and research purposes is encouraged. It is recommended that no changes be made to the order or wording of the questions as this will affect the psychometric properties of the instruments.

Translation from English and Cultural Adaptation
Translation from English is encouraged to facilitate worldwide use of IPAQ. Information on the availability of IPAQ in different languages can be obtained at www.ipaq.ki.se. If a new translation is undertaken we highly recommend using the prescribed back translation methods available on the IPAQ website. If possible please consider making your translated version of IPAQ available to others by contributing it to the IPAQ website. Further details on translation and cultural adaptation can be downloaded from the website.

Further Developments of IPAQ
International collaboration on IPAQ is on-going and an ***International Physical Activity Prevalence Study*** is in progress. For further information see the IPAQ website.

More Information
More detailed information on the IPAQ process and the research methods used in the development of IPAQ instruments is available at www.ipaq.ki.se and Booth, M.L. (2000). *Assessment of Physical Activity: An International Perspective.* Research Quarterly for Exercise and Sport, 71 (2): s114-20. Other scientific publications and presentations on the use of IPAQ are summarized on the website.

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** and **moderate** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

PART 1: JOB-RELATED PHYSICAL ACTIVITY

The first section is about your work. This includes paid jobs, farming, volunteer work, course work, and any other unpaid work that you did outside your home. Do not include unpaid work you might do around your home, like housework, yard work, general maintenance, and caring for your family. These are asked in Part 3.

1. Do you currently have a job or do any unpaid work outside your home?

   ☐ Yes

   ☐ No → *Skip to PART 2: TRANSPORTATION*

The next questions are about all the physical activity you did in the **last 7 days** as part of your paid or unpaid work. This does not include traveling to and from work.

2. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, heavy construction, or climbing up stairs **as part of your work**? Think about only those physical activities that you did for at least 10 minutes at a time.

   _____ **days per week**

   ☐ No vigorous job-related physical activity → *Skip to question 4*

3. How much time did you usually spend on one of those days doing **vigorous** physical activities as part of your work?

   _____ **hours per day**
   _____ **minutes per day**

4. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads **as part of your work**? Please do not include walking.

   _____ **days per week**

   ☐ No moderate job-related physical activity → *Skip to question 6*

5. How much time did you usually spend on one of those days doing **moderate** physical activities as part of your work?

_____ **hours per day**
_____ **minutes per day**

6. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **as part of your work**? Please do not count any walking you did to travel to or from work.

_____ **days per week**

☐ No job-related walking → ***Skip to PART 2: TRANSPORTATION***

7. How much time did you usually spend on one of those days **walking** as part of your work?

_____ **hours per day**
_____ **minutes per day**

PART 2: TRANSPORTATION PHYSICAL ACTIVITY

These questions are about how you traveled from place to place, including to places like work, stores, movies, and so on.

8. During the **last 7 days**, on how many days did you **travel in a motor vehicle** like a train, bus, car, or tram?

_____ **days per week**

☐ No traveling in a motor vehicle → ***Skip to question 10***

9. How much time did you usually spend on one of those days **traveling** in a train, bus, car, tram, or other kind of motor vehicle?

_____ **hours per day**
_____ **minutes per day**

Now think only about the **bicycling** and **walking** you might have done to travel to and from work, to do errands, or to go from place to place.

10. During the **last 7 days**, on how many days did you **bicycle** for at least 10 minutes at a time to go **from place to place**?

_____ **days per week**

☐ No bicycling from place to place → ***Skip to question 12***

11. How much time did you usually spend on one of those days to **bicycle** from place to place?

_____ **hours per day**
_____ **minutes per day**

12. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time to go **from place to place**?

_____ **days per week**

☐ No walking from place to place → ***Skip to PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY***

13. How much time did you usually spend on one of those days **walking** from place to place?

_____ **hours per day**
_____ **minutes per day**

PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY

This section is about some of the physical activities you might have done in the **last 7 days** in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.

14. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, chopping wood, shoveling snow, or digging **in the garden or yard**?

_____ **days per week**

☐ No vigorous activity in garden or yard → ***Skip to question 16***

15. How much time did you usually spend on one of those days doing **vigorous** physical activities in the garden or yard?

_____ **hours per day**
_____ **minutes per day**

16. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, sweeping, washing windows, and raking **in the garden or yard**?

_____ **days per week**

☐ No moderate activity in garden or yard → ***Skip to question 18***

17. How much time did you usually spend on one of those days doing **moderate** physical activities in the garden or yard?

_____ **hours per day**
_____ **minutes per day**

18. Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, washing windows, scrubbing floors and sweeping **inside your home**?

_____ **days per week**

☐ No moderate activity inside home → ***Skip to PART 4: RECREATION, SPORT AND LEISURE-TIME PHYSICAL ACTIVITY***

19. How much time did you usually spend on one of those days doing **moderate** physical activities inside your home?

_____ **hours per day**
_____ **minutes per day**

PART 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY

This section is about all the physical activities that you did in the **last 7 days** solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.

20. Not counting any walking you have already mentioned, during the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **in your leisure time**?

_____ **days per week**

☐ No walking in leisure time → ***Skip to question 22***

21. How much time did you usually spend on one of those days **walking** in your leisure time?

_____ **hours per day**
_____ **minutes per day**

22. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like aerobics, running, fast bicycling, or fast swimming **in your leisure time**?

_____ **days per week**

☐ No vigorous activity in leisure time → ***Skip to question 24***

23. How much time did you usually spend on one of those days doing **vigorous** physical activities in your leisure time?

_____ **hours per day**
_____ **minutes per day**

24. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis **in your leisure time**?

_____ **days per week**

☐ No moderate activity in leisure time → *Skip to PART 5: TIME SPENT SITTING*

25. How much time did you usually spend on one of those days doing **moderate** physical activities in your leisure time?
_____ **hours per day**
_____ **minutes per day**

PART 5: TIME SPENT SITTING

The last questions are about the time you spend sitting while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television. Do not include any time spent sitting in a motor vehicle that you have already told me about.

26. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekday**?

_____ **hours per day**
_____ **minutes per day**

27. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekend day**?

_____ **hours per day**
_____ **minutes per day**

This is the end of the questionnaire, thank you for participating.

LONG LAST 7 DAYS SELF-ADMINISTERED version of the IPAQ. Revised October 2002.

APPENDIX D: EXERCISE INTERVENTION

1. Exercise chart

EXERCISE CHART

	Comment	Duration	Sets	Reps
WARM UP				
Walking 				
EXERCISE SESSION				
Bicep curls 				
Front and side raises 				
Tricep extensions 				
Knee taps 				
Star jumps 				
Static lunges (Forward) 				
Dynamic lunches (forward) 				
Seated leg raises and Alphabets 				
Stability ball squats 				
Single leg stability ball sqauts 				
Calf raises 				
Front and side step-ups 				
Core activation 				
Crunches 				
Oblique crunches 				
Hip lifts (arms across chest) 				
Single leg hip lifts 				
Side bridge on Knees 				
Bridges 				
COOLDOWN				
Walking 				
Stretches 				

Please note that during all of the exercises the appropriate breathing technique must be maintained.

2. Stretch chart

STRETCHES

Calf Stretch		Lower Back Stretch	
Chest Bicep Stretch		Neck Stretch	
Glute Stretch		Piriformis Stretch	
Hamstring Stretch		Quad Stretch	
Lat Stretch		Tricep Stretch	

Please note that during all of the exercises the appropriate breathing technique must be maintained.

3. Exercise programme

Week 1 and 2 Exercise Programme				
	Comment	Duratic	Sets	Reps
Warm up				
Walking 	Can be done outside or in the hall	6 minutes		
Exercise session				
Bicep curls 	2.5 KG Dumbells		1	10
Front and side raises 	2.5 KG Dumbells		1	10
Tricep extensions 	2.5 KG Dumbells		1	10
Knee taps 	***Maintain a upright posture***	2 minutes		
Static lunges (Forward) 	Make sure that the knee does not go over the toes		1	10
Seated leg raises 	Maintain upright posture		1	10
Calf raises 	Do in all three directions: toe out, toe in and neutral position		1	10
Front and side step-ups 	***One minute forward stepping, one minute side***	2 minutes		
Core activation 	Pull the belly to the spine and keep breathing		2	10
Crunches(hands sliding to knee) 	Maintain core activation		2	10
Hip lifts (arms across chest) 	Maintain core activation, make sure that hips do not drop.		2	10
Cooldown				
walking 	Moderately paced walk	3 minutes		
Stretches	Hold each stretch for 20 minutes and take deep breaths	Hold for 30 seconds		

Please note that during all of the exercises the appropriate breathing teqnique must be maintained.

Week 3 and 4 Exercise Program				
	Comment	Duratic	Sets	Reps
Warm up				
Walking 	Can be done outside or in the hall	6 minutes		
Exercise session				
Bicep curls 	2.5 KG Dumbells		2	10
Front and side raises 	2.5 KG Dumbells		2	10
Tricep extensions 	2.5 KG Dumbells		2	10
Knee taps 	***Maintain a upright posture***	2 minutes		
Static lunges(Forward) 	Make sure that the knee does not go over the toes		2	10
Seated leg raises 	Maintain upright posture		2	10
Calf raises 	Do in all three directions: toe out, toe in and neutral position		2	10
Front and side step-ups 	***One minute forward stepping, one minute side***	2 minutes		
Core activation 	Pull the belly to the spine and keep breathing		2	10
Crunches(Wrist to knees) 	Maintain core activation		2	10
Hip lifts (arms across chest) 	Maintain core activation, make sure that hips do not drop.		2	10
Cooldown				
Walking 	Moderately paced walk	3 minutes		
Stretches	Hold each stretch for 20 minutes and take deep breaths	Hold for 30 seconds		

Please note that during all of the exercises the appropriate breathing teqnique must be maintained.

Week 5 and 6 Exercise Programme				
	Comment	Duration	Sets	Reps
Warm up				
Brisk walking 	Can be done outside or in the hall	7 minutes		
Exercise session				
Bicep curls 	2.5 KG Dumbells		2	12
Front and side raises 	2.5 KG Dumbells		2	12
Tricep extensions 	2.5 KG Dumbells		2	12
Knee taps 	***Maintain a upright posture***	3 minutes		
Static lunches (Forward &reverse) 	Make sure that the knee does not go over the			
Seated Alphabet A-M 	Maintain upright posture			
Calf raises with Weights 	Do in all three directions: toe out, toe		2	12
Front and side step-ups 	***One minute forward stepping.***	3 minutes		
Side bridge on Knees 	Pull the belly to the spine, maintain straight		1	10
Crunches(Elbows to knees) 	Maintain core activation		2	10
Hip lifts (arms across chest) 	Maintain core activation, make sure		3	10
Cooldown				
walking 	Moderately paced walk	3 minutes		
Stretches	Hold each stretch for 20 minutes and take	Hold for 30 seconds		

Please note that during all of the exercises the appropriate breathing teqnique must be maintained.

Week 7 and 8 Exercise Program				
	Comment	Duratic	Sets	Reps
Warm up				
Brisk walking 	Can be done outside or in the hall	7 minutes		
Exercise session				
Bicep curls 	2.5 KG Dumbells		2	15
Front and side raises 	2.5 KG Dumbells		2	15
Tricep extensions 	2.5 KG Dumbells		2	15
Knee taps 	***Maintain a upright posture***	3 minutes		
Static lunges (forward and reverse) 	Make sure that the knee does not go over the			
Seated Alphabet A-Z 	Maintain upright posture			
Calf raises 	Do in all three directions: toe out, toe		2	15
Front and side step-ups 	***One minute forward stepping.***	3 minutes		
Side Bridges on knees 	Pull the belly to the spine, maintain straight		2	10
Oblique crunches 	Maintain core activation		2	10
Hip lifts (arms across chest) 	Maintain core activation, make sure		3	12
Cooldown				
Walking 	Moderately paced walk	3 minutes		
Stretches	Hold each stretch for 20 minutes and take	Hold for 30 seconds		

Please note that during all of the exercises the appropriate breathing teqnique must be maintained.

Week 9 and 10 Exercise Programme				
	Comment	Duratic	Sets	Reps
Warm up				
Brisk walking/slow run 	Can be done outside or in the hall	7 minutes		
Exercise session				
Bicep curls 	.5 KG lumbells		3	12
Front and side raises 	2.5 KG Dumbells		3	12
Tricep extensions 	2.5 KG Dumbells		3	12
Star jumps	***Maintain core activation***	2 minutes		
Dynamic lunches (forward) 	Make sure that the knee does not go over the toes			
Stability ball squats	Maintain upright posture and core activation. Do			
Single leg calf raises with Weights 	Do in all three directions: toe out, toe in and neutral		2	12
Front and side step-ups 	***One minute forward stepping.***	4 minutes		
Bridge on Knees	Pull the belly to the spine, maintain straight		3	10
Crunches and oblique crunches 	Maintain core activation and braeth		2	10
Single leg hip lifts 	Maintain core activation, make sure that hips do not		4	5
Cooldown				
walking 	Moderately paced walk	3 minutes		
Stretches	Hold each stretch for 20 minutes and take deep	Hold for 30 seconds		

Please note that during all of the exercises the appropriate breathing teqnique must be maintained.

Week 11 and 12 Exercise Program				
	Comment	**Duratic**	**Sets**	**Reps**
Warm up				
Brisk walking/slow run 	Can be done outside or in the hall	7 minutes		
Exercise session				
Bicep curls 	.5 KG Dumbells		2	15
Front and side raises 	2.5 KG Dumbells		2	15
Tricep extensions 	2.5 KG Dumbells		2	15
Star jumps	***Maintain core activation***	3 minutes		
Dynamic lunches (Forward & backward) 	Make sure that the knee does not go over the toes			
Single leg stability ball sqauts	Maintain upright posture and core activation. Do			
Single leg calf raises with weights 	Do in all three directions: toe out, toe in and neutral		2	15
Front and side step-ups 	***One minute forward stepping.***	3 minutes		
Bridges	Pull the belly to the spine, maintain straight		2	10
Crunchies and oblique crunches 	Maintain core activation and braeth		3	10
Single leg hip lifts 	Maintain core activation, make sure that hips do not		6	5
Cooldown				
walking 	Moderately paced walk	3 minutes		
Stretches	Hold each stretch for 20 minutes and take deep	Hold for 30 seconds		

Please note that during all of the exercises the appropriate breathing teqnique must be maintained.

A COMMUNITY BASED EXERCISE PROGRAMME AT THE ANDRIES VOSLOO HOSPITAL

Training Manual

Contents

1. Introduction

Physical activity is an important component of a healthy lifestyle. Physical activity includes recreational or leisure-time physical activity, transportation (e.g. walking or cycling), occupational (i.e. work), household chores, play, games, sports or planned exercise (WHO 2010).

In order to improve cardiorespiratory and muscular fitness, bone health and reduce the risk of non-communicable disease and depression, the following are recommended:

- Adults should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week (Pate et al. 1995, 3). This recommendation emphasizes the health benefits of moderate-intensity physical activity, and the accumulation of physical activity in intermittent, short bouts.
- Muscle-strengthening activities should be done involving major muscle groups on 2 or more days a week

Recent surveys and studies have revealed that the South African population has moved towards a disease profile similar to Western countries, with increasing deaths attributed to chronic diseases of lifestyle (Steyn and Damasceno 2006, 247). Black women with the country's highest levels of inactivity, overweight and obesity, have been identified as a high risk group (WHO 2010).

2. Community-based exercise programme

A community based exercise programme will be conducted over 11 weeks. The participants will be required to exercise three times a week for an hour. Two exercise sessions will be performed at the relevant hospital and the third session at home. The intensity of the exercise programme will increase every two weeks in order to monitor the progression made by the patients. The exercises will be presented in a form of a circuit using simple equipment namely, mats, stability balls, dumbbells, skipping ropes and own body weight. Each station in the circuit will have an illustration on a wall chart of the specific exercise and include the following

components: aerobic, strength, flexibility and balance. The supervised exercise sessions will concentrate on strength and conditioning. Participants will be asked to walk for at least 30 minutes a day. Pedometers with a seven day memory will be worn to measure steps and distance walked.

3. Components of health related fitness

a) Energy fitness

Any muscle needs energy to be able to perform. When a person becomes physically fit they train their bodies (muscles) to store and use fuels and remove metabolic wastes which are produced by the working muscles.

The cardiovascular and the respiratory system assists in providing the working muscles with oxygen, and removing the carbon dioxide and the metabolic waste. Once exercise starts all the organs jump in and work harder in order to supply all working muscles with the necessary oxygen (McArdle, Katch, and Katch 2006).

There are two energy systems in the body namely: the anaerobic system (without oxygen) and the aerobic system (with oxygen).

Anaerobic system is for fast, immediate and intense exercise and the aerobic system is for endurance and less intense exercise. When a person starts to exercise it takes a few minutes for the sufficient oxygen to reach the muscle and respond on the bodies energy request thus it is dependent on the anaerobic system (which takes about two minutes) until the aerobic system responds. Anaerobic energy is also used when the body performs high intensity exercise and the aerobic system is not able to keep up with the bodies oxygen demand, thus in this case the anaerobic system is a source of energy, for example for activities such as sprinting. The aerobic energy system in then a source of energy for activities such as long distance and long duration events.

b) Muscular fitness

Muscular fitness is the ability of the muscles to meet the demands of the physical activity being performed. This can be strength, endurance, speed, power, and

flexibility. For the purpose of this study we will be focusing on strength training and flexibility. Muscular strength is the maximum amount of force that a muscle can generate in a single effort. Strength is important for activities of daily living, but it is important to determine what the optimal amount is for each individual (McArdle, Katch, and Katch 2006).

Muscular flexibility is the range of motion through which the bodies' joints are able to move. Flexibility involves the elasticity and the suppleness of the muscles, ligaments and tendons. It is of a great importance to warm up the muscles before exercise in order to prevent muscle strains and sprains. Just as important as warm up is cool down and stretch, in order to relax, warm down and increase flexibility. Stretching also plays a role in prevention of muscle soreness after exercise (McArdle, Katch, and Katch 2006).

4. Training principles

a) Specificity

The specificity principle is to determine the best way to develop physical fitness for a specific disease, sport or injury. It is thus necessary to determine which energy systems are in needed for physical activity and which muscles need improvement. For example the best way to train for running is to run. Now when working with people living with HIV, we are aware of the fact that they experience muscle wasting. Together with muscle wasting they also experience lipidystrophy, fatigue and secondary complications due to the antiretroviral treatment. The physical factors that will be addressed in this exercise programme will be a combination of strength training and aerobic training (Thompson, Gordon, and Pescatello 2009) .

b) Overload

Overload is when one wants to improve physical fitness you must perform more than what the body is used to doing. When more is demanded, the body adapts to the increased demand. Overload can be applied in duration and intensity. In the exercise programme we make use of both these aspects (Thompson, Gordon, and Pescatello 2009).

c) Progression

Progression is when the physical demands are steadily increased in order to overload the system. If progression is made to quickly the body may not be able to adapt to the intensity. If the progression is not adequate optimal fitness levels will not be achieved. In this exercise programme progression is made every two weeks, thus it gives the person enough time to adapt to the physical demands (Thompson, Gordon, and Pescatello 2009).

5. The importance and benefits of physical activity

(McArdle, Katch, and Katch 2006)

- Better performance
- Decreases fatigue
- Quicker recovery after competitive play
- Less muscle soreness
- Increases skills ability
- Quicker recovery from injury
- Improves concentration
- Prevents mental fatigue
- Improves self- confidence
- Control your weight
- Reduce your risk of cardiovascular disease
- Reduce your risk for type 2 diabetes and metabolic syndrome
- Reduce your risk of some cancers
- Strengthen your bones and muscles
- Improve your mental health and mood
- Improve your ability to do daily activities and prevent falls, if you're an older adult
- Increase your chances of living longer

6. Personal Barriers

The 10 most common reasons adults cite for not adopting more physically active lifestyles are (Sallis and Hovell 1990, 313&314)

- Do not have enough time to exercise
- Find it inconvenient to exercise
- Lack self-motivation
- Do not find exercise enjoyable
- Find exercise boring
- Lack confidence in their ability to be physically active (low self-efficacy)
- Fear being injured or have been injured recently
- Lack self-management skills, such as the ability to set personal goals, monitor progress, or reward progress toward such goals
- Lack encouragement, support, or companionship from family and friends, and
- Do not have parks, sidewalks, bicycle trails, or safe and pleasant walking paths convenient to their homes or offices.

In many low- and middle-income populations, the levels of participation in leisure time physical activity may be limited, and moderate to vigorous physical activity may be performed in the context of transport (such as walking) and/or occupational and/or domestic activities. These characteristics and patterns of physical activity must be taken into consideration for a more tailored implementation of the intervention aiming at promoting physical activity amoung patients living with HIV. Caution is therefore needed when implementing this intervention due to the infrastructure changes which may lead to a reduction in the levels of physical activity in any domain.

7. What does moderate to vigorous physical activity mean

Moderate physical activity will relate to the activities of daily living, and how active a person is. It will also include recreational activities and exercise history. Some signs of performing moderately intense exercise will be an increase in breathing, heart rate, body temperature and will be able to participate in a conversation.

More vigorous activity will be aerobic exercises. These are evident with a marked increase in breathing, heart rate, break a sweat and will find it difficult to participate in a conversation due to increased in effort required. In the exercise programme worked out for people living with HIV the programme starts with low to moderate intensity aerobic activity and gradually increases over the twelve weeks to moderate to vigorous activity (McArdle, Katch, and Katch 2006)

8. Monitoring and taking own heart rate

(McArdle, Katch, and Katch 2006)

To find your radial artery (the most common point from which people take pulses), hold one hand straight out, elbow bent, palm relaxed and facing up. Raise your thumb slightly skyward, as if holding an apple or a tennis ball, to create a small pocket under your thumb at the top of your wrist. Place the tips of your index and middle fingers of the other hand (don't use your thumb-it's also got a pulse and could cause counting confusion) on the pocket under your thumb. Your fingers should lay across the tendon running down your arm. Adjust your fingertips until you can feel a steady beat under the skin of your wrist.

If you've searched high and low, yet the thump-thump on your wrist remains ever elusive, try finding your carotid artery instead. The best way is the easiest one for you, and for some people, neck pulse points are stronger and more accessible. The carotid is located just below your jaw in the groove where your head and neck meet, on either side of your windpipe. Use your index and middle fingertips to feel around in the groove for a tangible pulsation. Hold your fingers in place for a few seconds to make sure you've got it.

Take a count of how many pulse beats you feel for 30 seconds. Multiply the amount of beats by two to calculate your pulse rate per minute. Your pulse will be the same regardless from which point you measure it.

Normal resting pulse for adults and teens ranges from 60 to 100 beats per minute, while 70 to 110 beats per minute is average for children between the ages of six and

ten years. Infants may have a slightly higher rate still-the norm can reach 150 beats per minute.

Your pulse rate rises as your body works harder, which is why it's always a good idea to take a pulse count when your body is calm and at rest. Some people calculate their pulse rate during exercise to determine whether or not they have raised their normal rate to one that facilitates calorie burning. Most doctors and specialists advise not raising your heart rate to more than 200 beats per minute.

9. Factors that assist in prevention of injuries

(McArdle, Katch, and Katch 2006)

- Warm up
- Stretching
- Protective equipment
- Appropriate surfaces
- Appropriate training
- Adequate recovery
- Psychology
- Nutrition

10. The role of the Trainer

(Martens 1996)

a. To assist in the education of the exercise routines
b. To monitor blood pressure
c. To make sure that patients use the correct technique
d. To assist in preventing injuries
e. To monitor general well being while performing exercises

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APPENDIX E: RESEARCH APPROVAL

1. Ethics letter from NMMU

Nelson Mandela Metropolitan University
for tomorrow

Copies to:
Supervisor: Prof C Walter
Co-supervisors: Prof R du Randt and Prof M Harris

Summerstrand South
Faculty of Health Sciences
Tel. +27 (0)41 504 2956 Fax. +27 (0)41 504 9324
Marilyn.Afrikaner@nmmu.ac.za

Student number: 207012901

Contact person: Ms N Isaacs

26 May 2011

Ms J Lotter
4 Grey Street
Somerset East
5850

FINAL RESEARCH/PROJECT PROPOSAL:

QUALIFICATION: **MA HMS RESEARCH**

TITLE: **THE EFFECTS OF A COMMUNITY BASED EXERCISE PROGRAMME ON THE HEALTH AND WELL-BEING OF PEOPLE LIVING WITH HIV IN A RURAL COMMUNITY IN THE EASTERN CAPE**

Please be advised that your final research project was approved by the Faculty Postgraduate Studies Committee (FPGSC).

FPGSC grants ethics approval. The ethics clearance reference number is **H11-HEA-HMS-004.**

We wish you well with the project.

Kind regards,

Ms M Afrikaner
Faculty Postgraduate Studies Committee (FPGSC) Secretariat
Faculty Administration
Faculty of Health Sciences

2. Ethics letter from Government

Province of the
EASTERN CAPE
HEALTH

Room 506 • 5th Floor • Golden Mile Building • Govan Mbeki Road • Port Elizabeth • Eastern Cape
Private Bag 27667 • Port Elizabeth • 6057 • REPUBLIC OF SOUTH AFRICA
Tel.: +27 (0)41 408 8151 • Fax: +27 (0)41 408 8149• 083 378 1308 • Website: www.ecdoh.gov.za
Enquiries: Sibo Gqirana• email- sibongile.gqirana@impilo.ecprov.gov.za

To Cc	Mrs H. Smith Ms J Lotter
From	MRS NCHUKANA District Manager: Cacadu District Health
Subject	**PERMISSION TO CONDUCT A RESEARCH : ANDRIES VOSLOO HOSPITAL**
Date	22 JULY 2011

Correspondence dated 23 May 2011 regarding the above subject refers.

I hereby give permission for the said research to be done at Andries Vosloo by the NMMU student Miss K Lotter. Kindly provide this office with a detailed report of the findings on completion of the research.

Yours Faithfully

2011 -07- 26

G NCHUKANA
DISTRICT MANAGER
CACADU HEALTH DISTRICT

APPENDIX F: INFORMATION LETTER AND CONSENT FORM

1. Information letter to participants

Faculty of Health Sciences, NMMU
Tel: +27 (0)41 504-xxxx Fax: +27 (0)41-504-xxxx
E-mail: Jennifer Lotter at s207012901@live.nmmu.ac.za

Date: 4 February, 2011
Ref: (Reference Number supplied upon granting of ethics approval)
Contact person: Prof Harris / Jennifer Lotter

Dear

You are being asked to participate in a study about exercise and HIV. We will give you information to understand the study and what you need to do to participate. The information will include the risks, benefits, and your rights as a participant. Please feel free to ask the researcher to ask any questions you may have.

You will be asked to sign a consent form that shows that you understand and agree to the study.

You have the right to raise questions and report any new problems during the study, to the researcher. Contact details are provided.

The study has been approved by the Research Ethics Committee (Human) of NMMU. Any queries can be directed to the Research Ethics Committee (Human), Department of Research Capacity Development, PO Box 77000, Nelson Mandela Metropolitan University, Port Elizabeth, 6031. You may also write to: The Chairperson of the Research, Technology and Innovation Committee, PO Box 77000, Nelson Mandela Metropolitan University, Port Elizabeth, 6031.

Participation is completely voluntary. If you choose not to participate, this will not affect your present or future care, employment, or life activity.

You have the right to withdraw from this study at any time without penalty or loss of benefits. However, if you do withdraw from the study, you should return for a final testing and discussion.

If you fail to follow instructions, or if your medical condition changes in such a way, the researcher may discontinue your participation in the study. The study may be terminated at any time by the researcher, the sponsor or the Research Ethics Committee (Human).

Your identity at all times will be protected in any written publications or scientific presentations.

Yours sincerely
Prof X
Jennifer Lotter

2. Consent to participants

To be modified to reflect the three different exercise venues

NELSON MANDELA METROPOLITAN UNIVERSITY

INFORMATION AND INFORMED CONSENT FORM

Title of the research project: The Effects of an Exercise Programme on the Health and Well-being of an HIV Positive Population at a South African University

Principal Investigator: Jennifer Lotter (MA student)
Address: Department of Human Movement Science,
NMMU South Campus, Building 11, NMMU 6045
Contact telephone number: 041-5042603

DECLARATION BY OR ON BEHALF OF PARTICIPANT:

I,

_____

_____the participant and the undersigned (full name), ID number _____

Address (of participant)_____

_____

was invited to participate in the above-mentioned research project that is being undertaken by Jennifer Lotter from The Department of Human Movement Science of the Nelson Mandela Metropolitan University.

THE FOLLOWING ASPECTS HAVE BEEN EXPLAINED TO ME, THE PARTICIPANT:

- **Aim:** The investigators are studying the effect of exercise on people with HIV infection. The exercise programme will be done at Andries Vosloo Hospital in Somerset East. We will use the information to learn about the benefits of exercise and empower the participants to continue a healthy lifestyle.

- **Procedures:** I understand I will be part of an exercise programme. The programme will run for 11 weeks. It will include fitness tests at the beginning, at middle, and at the end of the programme.

- **Risks:** The risks involve changes that may happen with exercise. These are heart rate, blood pressure, CD4 count, and breathing. During the exercise programme, heart rate and blood pressure will be measured to ensure that all is well during the exercise sessions. The staff conducting the exercises and running the programme are qualified and will be watching out for any changes, pain or discomfort. The hospital staff will monitor overall health and especially any changes in HIV status.

- **Possible benefits:** From being in this programme, my health and fitness should improve.

- **Confidentiality:** No one will be able to identify who I am in any talks presented or papers written.

- **Access to findings:** Any new information from the project will be shared in papers written and in talks to health care and education staff.

- **Voluntary participation:** I am volunteering to be part of this project. If I decide not to volunteer for this project, this will not effect my present or future care, employment, or life activity.

The information above was explained to me/the participant by the researcher. I was given the opportunity to ask questions and all these questions were answered satisfactorily**.** No pressure was exerted on me to consent to participation and I understand that I may withdraw at any stage without penalisation. Participation in this study will not result in any additional cost to myself.

I HEREBY VOLUNTARILY CONSENT TO PARTICIPATE IN THE ABOVE-MENTIONED PROJECT:

Signed/confirmed at	on 2011
Signature	Signature of witness:
	Full name of witness:

STATEMENT BY OR ON BEHALF OF INVESTIGATOR(S)

I _____(name of researcher)

Declare that I have explained the information in this document to the participant. He/she was encouraged and given ample time to ask me any questions.

Signed/confirmed at	on 2011
Signature	Signature of witness:
	Full name of witness:

Thank you for your participation in this study. Should, at any time during the study: an emergency arise as a result of the research, or you require any further information with regard to the study, Kindly contact Jennifer Lotter , 041-5042603.

APPENDIX G: PHYSICAL FITNESS EVALUATION

PHYSICAL FITNESS EVALUATION							
Date of evaluation			Evaluated by				
Patient name			Age		Gender		
ANTHROPOMETRIC DATA							
Resting HR			Height			BMI	
Resting BP			Weight				
SKINFOLDS							
Biceps		Triceps			Subscap		
Suprailiac							
GIRTHS							
Waist		Hips (glutes)					
FLEXIBILITY							
Sit and reach	L:		R:				
MUSCLE STRENGTH							
Grip right:			30 sec sit to stand				
Grip left:							
MOTOR CONTROL AND DYNAMIC BALANCE							
2.44M UP AND GO							
AEROBIC ENDURANCE							
6 minute walk	Laps	1	2	3	4	5	6
		7	8	9	10	11	12
		13	14	15	16	17	18
		19	20				
Dist last lap							
Max HR			3 min HR				
Max BP			3 min BP				
LUNG FUNCTION							
Feak flow							
BLOOD TESTS							
RBC							
WBC							
Viral load							
CD4 count							
7 STAGE SIT UP TEST							
Filled in Questionnaires?							
Done interview?							
Received food parcel?							