







Twelve Weeks Aerobic Exercise Improves Anxiety and Depression in HIV Positive Clients on Art in Uganda

Mwebaze Nicholas¹ , Constance A.N. Nsibambi² , Edward Ojuka³ , Mshilla Maghanga⁴ 

Abstract

Aim: The study aimed at bridging the gap by assessing the impact of a 12-week aerobic exercise program on anxiety and depression for HIV-positive clients.

Methods: The study, conducted at the General Military Hospital in Uganda, employed a quasi-experimental design. Quantitative data was collected using questionnaires and a sample of 135 people living with HIV on antiretroviral therapy engaged in the study. Quantitative data was analyzed using t-tests, revealing significant reductions in depression and anxiety symptoms among participants.

Results: The findings demonstrated a 58.5% reduction in depression symptoms and a 72% decrease in anxiety symptoms among participants engaged in aerobic exercises. Both groups exhibited improvements, with the experimental group showing greater reductions. The results further revealed that depression and anxiety are two to four times more common in individuals living with HIV than in those without the virus, and depression is also more common in those on HAART than in those without the virus.

Conclusion: The results support the potential of aerobic exercise as a valuable adjunct therapy for people living with HIV on antiretroviral therapy. Well-structured and supervised aerobic exercise was found to be essential for improving the clinical outcomes of PLHIV on ART.

Keywords

Aerobics exercise,
Depression,
Anxiety,
HIV positive clients,
Antiretroviral therapy.

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On İki Haftalık Aerobik Egzersiz, Uganda'da Sanatta HIV Pozitif Müşterilerde Anksiyete ve Depresyonu İyileştiriyor

Özet

Amaç: Çalışma, 12 haftalık bir aerobik egzersiz programının HIV pozitif bireylerde anksiyete ve depresyon üzerindeki etkisini değerlendirerek bu alandaki bilgi boşluğunu doldurmayı amaçlamıştır.

Yöntem: Uganda'daki Genel Askeri Hastanesi'nde gerçekleştirilen çalışmada yarı deneysel bir tasarım kullanılmıştır. Kantitatif veriler, anketler aracılığıyla ve çalışmaya katılan, antiretroviral tedavi gören 135 HIV pozitif bireyden oluşan bir örneklemden toplanmıştır. Veriler, t-testleri kullanılarak analiz edilmiş ve katılımcılar arasında depresyon ve anksiyete semptomlarında önemli azalmalar olduğu belirlenmiştir.

Bulgular: Bulgular, aerobik egzersiz programına katılan bireylerde depresyon belirtilerinde %58,5, anksiyete belirtilerinde ise %72 oranında azalma olduğunu ortaya koymuştur. Her iki grupta da iyileşmeler gözlemlenmiş, ancak deney grubunda daha belirgin azalmalar tespit edilmiştir. Ayrıca, HIV ile yaşayan bireylerde depresyon ve anksiyetenin, HIV taşımayan bireylere kıyasla iki ila dört kat daha yaygın olduğu ve depresyonun, yüksek aktif antiretroviral tedavi (HAART) kullananlarda daha sık görüldüğü belirtilmiştir.

Sonuç: Elde edilen sonuçlar, antiretroviral tedavi gören HIV pozitif bireyler için aerobik egzersizin değerli bir yardımcı tedavi olabileceğini desteklemektedir. İyi yapılandırılmış ve denetimli aerobik egzersizin, HIV ile yaşayan bireylerin klinik sonuçlarını iyileştirmek için önemli olduğu vurgulanmıştır.

Anahtar Kelimeler

Aerobik egzersiz,
Depresyon,
Endişe,
HIV pozitif müşteriler,
Antiretroviral tedavi.

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INTRODUCTION

Since the Human Immunodeficiency Virus (HIV) first caused Acquired Immune Deficiency Syndrome (AIDS) in 1981, significant advancements have been made in the treatment of the illness (Younai, 2013). The quality of life and longevity of people living with HIV have been greatly improved by antiretroviral therapy (ART), especially the Highly Active Antiretroviral Therapy (HAART). Still, there are ongoing difficulties, particularly with mental health, particularly with anxiety and depression in ART users (Prabhu and Van Wacker, 2023). Like many other African countries, Uganda is faced with a significant

¹ **Corresponsible Author:** Department of Sport science, Kyambogo University, Kampala, Uganda, mwebazen17@gmail.com

² Department of Sport science, Kyambogo University, Kampala, Uganda, cnsibambi@gmail.com

³ Department of Physiology, Lira University, Lira, Uganda, edwardojuka277@gmail.com

⁴ Faculty of Business and Development Studies, Gulu University, Gulu City, Uganda, mshilla2000@gmail.com

HIV epidemic. Over 1.5 million Ugandans are HIV positive, and the country has had over 2.5 million AIDS-related fatalities, according to UNAIDS (Ssebiryo, 2011). People living with HIV frequently experience mental illnesses, which are frequently misdiagnosed and left untreated. The COVID-19 pandemic has further exacerbated this condition (West, 2021). Although ART has significantly improved PLHIV health outcomes, it is not without problems. ART is linked to negative side effects including as fatigue, nausea, discomfort, anxiety, and depression. Moreover, the financial burden and the requirement for frequent medical visits provide difficulties, especially for those residing in isolated regions (Pollock et al., 2020).

The National Library of Medicine (US) (2006) defines anxiety as a feeling of worry, dread, and nervousness. It can cause you to perspire, feel stiff and fidgety, and cause your heartbeat to quicken. It might be a typical response to stress, and this could lead to persistent anxiety disorders. Even though depression is a common mental illness that is characterized by a low mood or a prolonged loss of desire or focus, it is significant because it can make it difficult for a person to enjoy life and even perform the most basic tasks (Fekadu et al., 2017). Anxiety is frequently accompanied by mental health conditions that are developed by those who suffer depression. In addition to their pain, they can impede the overall success of an HIV-positive individual as they are the primary cause of nonadherence (Tran et al., 2017).

As a further therapy option, aerobic exercise has shown promise in reducing the symptoms, problems, and unfavorable side effects associated with long-term HIV infection (Nkweke, 2021). According to Hand's (2009) research, aerobic exercise can improve an HIV/AIDS patient's overall quality of life, as well as their health, happiness, and life satisfaction. It can also lessen depression. But even with these suggestions, informal observations suggest that aerobic exercise has not received much attention in Uganda when it comes to HIV management. Even with advancements in HIV treatment, there is still no cure, and some HIV-positive people continue to have less than ideal clinical outcomes (Lacob et al., 2017). The HIV response is hampered by adverse effects of antiretroviral therapy (ART), obesity, dietary imbalances, and sedentary lifestyles, among other problems (Kabthymmer et al., 2021). The study also shows how important it is for future investigations to focus on the particular kinds, frequency, and methods of aerobic exercise that work best for those living with HIV. Consequently, it is crucial to incorporate this knowledge into clinical practice so that medical professionals can prescribe exercise as a powerful way to improve the mental health and clinical outcomes of HIV-positive patients receiving antiretroviral therapy (ART). There is potential for improving the general well-being of PLHIV in Uganda through the investigation of aerobic exercise as a supplemental treatment. A comprehensive approach to HIV management can be achieved by addressing the psychological, immunological, and physical elements; this might potentially transform HIV care in the nation.

HIV/AIDS continues to be a major worldwide health burden, and antiretroviral therapy (ART) is essential to treating the illness (Kumah et al., 2023). While there are established advantages to antiretroviral therapy (ART), such as decreased mortality and enhanced quality of life, there are also disadvantages, such as possible adverse effects (Eggleton & Nagalli, 2020). Despite its obvious advantages, antiretroviral therapy (ART) has a number of adverse effects, which might include nausea, exhaustion, and neuropsychiatric problems such as insomnia and peripheral neuropathy (Zimek et al., 2023). These difficulties may exacerbate psychological anguish and have an effect on PLHIV's general well-being and mental health. Aware of these problems, scientists have focused on the possible advantages of exercise as an adjunctive treatment for those on antiretroviral therapy (ART) (Nosrat et al., 2017).

Psychological symptoms like anxiety, depression, neuroticism, and paranoid ideation are most seen in HIV + patients on antiretroviral therapy (ART). Seid et al. (2020) examined the health effects of chronic depression in people living with HIV after HAART became available. Clients with chronic depressive symptoms had an approximately two-fold increased risk of unsatisfactory treatment outcomes and, ultimately, death from AIDS when compared to those who had never experienced depression; the effects of depression were particularly evident in women with low CD4 cell counts at the beginning of the research. Moreover, the decline in CD4 count was greater in depressed individuals.

People living with HIV often exhibit a wide range of signs and symptoms of fear and hopelessness. It is well known that HIV infection can cause insomnia, which is defined as not getting enough or high-quality sleep (Nokes & Kendrew, 2001). Many authors have connected the development of HIV illness and stress. Studies like those done by Antoni et al. (2002) demonstrated that stress

reduction can stop HIV-positive individuals from getting sicker and prevents them from getting infected again. On many psychological markers, the influence has not been assessed with precision.

According to Bopp et al. (2003), participants in aerobic exercise had a protective effect against immune function impairments caused by stress, as compared to the sedentary customers in the control group. It has been suggested by researchers such as Antoni et al. (2002) that “exercises may produce beneficial physiological changes in the HIV-infected population such as improved body composition and increases in both strength and endurance.” Like this, it has been demonstrated that exercise improves the quality of life by having a good impact on psychological illnesses including anxiety and depression (Demers, 2013).

In a different study, Smith and Merwin (2021) employed a mental and health exam. It was shown that there was a significant increase in mental or emotional health following twelve (12) weeks of combination massages and exercise treatment. By addressing the underlying symptoms that contribute to depression, exercise therapy may be beneficial for clients living with HIV in terms of their psychological well-being (Bopp et al., 2003). While exercise was not as effective as antidepressant medications, it did appear to reduce anxiety symptoms in persons with anxiety disorders. When depression medicine and exercise were combined, the clinical impression results improved. When exercise is combined with occupational therapy and lifestyle changes, the results of the anxiety inventory also decline. They concluded that although exercise appears to be a helpful adjunctive treatment for anxiety disorders, antidepressant therapy outperforms it. Aerobic and non-aerobic exercise seems to reduce anxiety symptoms (Jayakody et al., 2014). It follows that people with anxiety disorders would have a better quality of life when they take the two antidepressants along with exercise.

Aerobic exercise training has antidepressant and anxiolytic effects in addition to providing protection against the harmful effects of stress. There is still potential for therapeutic application of antidepressants and anxiolytics, as their advantages have been most amply demonstrated in subclinical diseases. However, the way the data points to the idea that receiving fitness instruction triggers a process that confers enduring stress resilience (Salmon, 2001). It has been shown that cardiovascular exercise reduces sensitivity to fear in general. It may also reduce anxiety sensitivity by exposing the person to unpleasant physical feelings. Broman et al. (2004) studied the impact of aerobic exercise on anxiety susceptibility. It was shown that before to, during, and one week following therapy, self-ratings of anxiety sensitivity, fear of physiological symptoms linked to anxiety, and generalized anxiety were collected. The results demonstrated that both high- and low-intensity exercise reduced anxiety sensitivity. Conversely, high-intensity exercise led to a greater number of treatment responders and a faster overall reduction in anxiety sensitivity when compared to low-intensity exercise. The only method to reduce fear of anxiety-related bodily symptoms was to engage in high-intensity exercise.

When exercise was done at a higher intensity than low-intensity exercise, there were more treatment responders and a faster decline in a global sensitivity to anxiety measure (Askari et al., 2020). Zarshenas et al. (2013) examined the effects of brief aerobic exercise on depressive symptoms and body image in Iranian women. For a period of four weeks, the experimental group participated in an aerobic exercise program, while the control group was told to wait. The depressive symptoms of the experimental group were demonstrated to be significantly less than those of the control group. When evaluating appearance for the body image dependent variables in the aerobic exercise group, significant improvements were also observed in appearance orientation, health orientation, and disease orientation (Zarshenas et al., 2013). Aerobic exercise has been shown to further improve all three categories of physical, emotional, and cognitive symptoms of depression as a multimodal adjunctive treatment added to routine care. This is especially true since it improves life quality in terms of social connections and mental health (Askari et al., 2020).

According to O'Brien et al. (2016), aerobic exercise has a beneficial effect on the physical and emotional health of individuals living with HIV, especially when it is done for an extended period and at a moderate intensity. It has been demonstrated that aerobic exercise mimics the symptoms and outcomes of long-term HIV infection without having the negative effects of ART. Additionally, overall health, mood, and life satisfaction have improved, and anxiety and depression have decreased, according to research looking at the efficacy of aerobic exercise in adults on ART (Poon, 2022). It is strongly advised to incorporate aerobic exercise into the management of HIV symptoms. According to O'Brien et al. (2016), implementing aerobic exercise treatment as soon as possible after diagnosis may help to

delay the onset and severity of symptoms, decrease the development of the disease, and lower the total cost of treating HIV-positive patients. Based on each client's specific symptomology and functional skills, customized aerobic exercise routines, beginning with moderate-intensity activities like walking, cycling, and aerobic dancing, can be helpful (Pedersen and Saltin, 2015).

It is common for HIV-positive people taking ART to experience psychological problems such as anxiety and despair. Combining exercise with standard therapy has shown promise in improving mental health outcomes for those living with HIV. Exercise, especially aerobic exercises, has been proven to have good impacts on psychological well-being, including reductions in anxiety and depressive symptoms (Heissel et al., 2019). The idea that a 12-week aerobic fitness program can help HIV-positive individuals on ART with their anxiety and depression is supported by the data in a few studies. This article highlights the possibility of exercise as a supplemental therapy while admitting the difficulties and adverse effects connected with ART. Personalized exercise routines are crucial for clinicians to consider, nevertheless, as each HIV-positive person has different demands and capacities (Ibeneme et al., 2019). Because of HAART, HIV infection once thought to be a fatal illness is now a chronic condition. Although HAART has greatly extended the life expectancy of those living with HIV, it is also linked to a few comorbidities, problems with disabilities, and a reduction in the ability to exercise (Berhan et al., 2022). According to Nosrat et al. (2017), exercise has become a vital management tactic for enhancing the recovery and general health of HIV/AIDS patients. Exercise is essential for reducing HIV-related adverse effects as well as the cardiometabolic and morphological problems brought on by HAART, such as mitochondrial dysfunction, oxidative stress, and inflammation. Exercise can help HIV-positive people live longer, have better quality of life, have more aerobic capacity, be more functional, and have a lower risk of cardiovascular illness (Grace et al., 2015).

Maintaining an HIV-positive person's general health and well-being is crucial as they are living longer. This study shows how a 12-week aerobic fitness program helps HIV-positive clients using ART feel less depressed and anxious (Daniels and Van Niekerk, 2018). In the era of cutting-edge medical therapies for HIV/AIDS, people living with HIV can improve their physical and mental health by implementing safe and supervised exercise programs, which will improve their quality of life (Guerra et al., 2015).

METHOD

Model of the research

A quasi-experimental research design was used to conduct the study, where participants were selected purposively, those who met the criteria were asked to volunteer and those who volunteered were allocated to the two groups randomly: the experimental group and the control group. The aim of the study was to determine how aerobic exercise affected the experimental group's anxiety and depression results.

Study group of the research

After receiving health education for about 6 months, 3,300 clients of 4,150 met the inclusion criteria. Participants were selected purposively based on their age, willingness to volunteer, duration on treatment and absence of symptoms. Given to stigma caused by HIV, time and the cost participants were to incur in coming daily to attend aerobic exercise sessions, volunteering was seen to be more appropriate.

The target population was comprised of HIV positive patients at GMH-Bombo who were receiving their antiretroviral therapy (ART). Eligible participants were adults aged 20 years or older who had been on ART for at least one year. Clients meeting these criteria were invited to volunteer to take part in the study. A total of 135 clients volunteered, and they were randomly assigned into the two groups: the experimental group (n=67) and the control group (n=68). The study aimed to assess changes in anxiety and depression over time. During the 12-weeks exercise intervention, 18 participants dropped out. For consistency in statistical analysis, 19 participants were randomly excluded from the control group to equalize the sample sizes at 49 for each group.

Data collection tools of the research

Trained counsellors to conduct psychological evaluation both before (pre-test) and after the sessions (post-test). The aerobic exercise workouts were closely watched over, and participants' compliance was closely tracked.

Exercise protocol

A planned aerobic exercise program overseen by fitness instructors and guided by the researcher was the main intervention. A five phase aerobic exercise program based on ACM standards was used for the exercise (Colberg et al., 2016). The program included brisk walking, jogging, for not less than 30 minutes, five days a week, at moderate intensity guided by music at a set tempo. The exercise session progressed as follows: week 1-2: tempo of 120BPM (beats per minute). Week 3-4: tempo of 130 BPM. Week 5-6: tempo of 140BPM. Week 7-12: tempo of 150BPM. This was followed to ensure progressive progression. Every session included: warming up for five minutes, then stretching, followed by cardiovascular exercise for at least twenty-five minutes. A five minutes cool down that included relaxing exercises.

The study further employed a Psychosocial assessment tool a modified client health questionnaire.

Data analysis of the research

Quantitative data was analysed using two sample t-test to compare the means for two different samples namely experimental and control group. A p-value ≤ 0.05 was considered statistically significant. All analysis was performed using the Statistical Package for Social Sciences (SPSS) version 20.0.

FINDINGS

The study investigated the impact of aerobic exercises on depression and anxiety symptoms in HIV-positive individuals receiving antiretroviral therapy (ART). The results revealed a significant improvement in depression symptoms, with a 58.5% reduction and 86.0% of participants reporting no depression post-exercise. The experimental group demonstrated a greater decrease in mean depression scores compared to the control group. The calculated means fell within the confidence intervals, and t-tests confirmed statistical significance for both groups.

Similarly, the study found a significant reduction in anxiety symptoms among participants engaging in aerobic exercises. The calculated means for the experimental and control groups fell within their respective confidence intervals, and t-tests confirmed statistical significance. These results led to the rejection of the null hypothesis, indicating that aerobic exercises have a positive effect on reducing anxiety in HIV-positive individuals on ART.

The findings align with previous research suggesting that aerobic exercise contributes to psychological well-being and can alleviate symptoms of depression and anxiety in individuals with HIV. The study emphasizes the importance of exercise interventions in improving mental health outcomes for HIV-positive individuals, considering the elevated prevalence of depression and anxiety in this population compared to those without HIV/AIDS.

Effects of Aerobic Exercise on Depression and Anxiety

Aerobic exercises included the frequency of exercising, intensity of the exercise, duration and the type which was a 5 phases of aerobics exercise classes. Then depression and anxiety were the psychological markers under study. To assess depression and anxiety, a Psychosocial Assessment Tool was adopted from Client Health Questionnaire with modification by Spitzer, Kroenke et al. (2001). Participants were required to indicate how often in the previous two weeks before the study they were bothered by depression and anxiety.

The inferential analysis was conducted by testing the study hypotheses using the paired-samples T-test.

H₀: Aerobic exercises have significant effect on depression and anxiety of HIV positive clients on ART.

Effects of aerobic exercise on anxiety

The findings on the effects of aerobic exercises on anxiety as experienced by the participants prior to the study were as presented in Table 1

Table 1. Effects of aerobic exercises on anxiety

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

Scale: (0) = Not at all; (1) = Half a day; (2) = More than half a day; and (3) = Nearly every day; Source: Primary Data (2023)

A paired-sample t-test was used to do the inferential analysis using the Statistical Package for Social Sciences (SPSS) version 20 and the outputs of this test comprised of two tables 2 and 3.

The mean values of the pre- and post-test were determined to find out if the findings differed. The experimental group's results indicate a substantial difference between the post-test mean and the pre-test mean of $-1.57 (0.85 - 2.42) \pm 0.147$ in contrast to the control group's measurably lower $-0.45 (1.89 - 2.34) \pm 0.227$. Looking at the standard deviations of the two results, there were also differences with that of the post-test being higher. The wider variation of the standard variation indicates differences in characteristics of the participants which was wider in the control group.

Table 2: Paired samples correlation table

Group to which subject belongs		n	r	p	
Experimental Group	Pair 1	Post-anxiety & pre-anxiety	46	-.091	.549
Control Group	Pair 1	Post-anxiety & pre-anxiety	36	-.182	.289

Source: Primary Data (2023); $p < 0.05$

Table 2 shows that there was no correlation between the anxiety scores obtained from the pre- and post-tests in the experimental and control groups. This suggests that the pre-test and post-test results do not have a linear relationship. The experimental group's computed mean was -1.574 , with a 95% confidence interval around the difference that spanned from -1.803 to -1.345 . This demonstrates that, in fact, the computed mean falls inside the confidence interval. Given that the interval included the range from -0.730 to -0.170 and the computed mean for the control group was -0.450 , it fell within the 95% confidence interval.

Given that the p-value of < 0.001 is less than 0.05 , the experimental group's t-test was determined to be statistically significant. $t(45) = -13.841$, $p < 0.001$ are the findings. The results of the control group's t-test, $t(35) = -3.3264$, $p = 0.002$, which is less than 0.05 , were likewise found to be statistically significant.

The null hypothesis, which states that aerobic exercises have no significant effects on psychological markers (anxiety) of HIV positive clients on ART, is rejected considering the experimental group's p-value < 0.001 in this case being less than the alpha level (0.05) since a 95% level of significance was taken into consideration in this test. These results imply that aerobic exercises have an effect of reducing anxiety in HIV positive clients on ART. For the control group the small reduction could have been caused by continuous follow-up calls by the study team to ensure the group members do not feel left out of the study.

Effects of aerobic exercise on depression

Table 3 shows the descriptive results on the effects of aerobic exercises on depression in the study participants at the pre-test and post-test stages for both the experimental and control groups.

Table 3. Effects of aerobic exercises on depression

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

Scale: (0) = Not at all; (1) = Half a day; (2) = More than half a day; and (3) = Nearly every day; Source: Primary Data (2023)

The results show that there was a general improvement in the relief of the symptoms of depression by 58.5% this can be evidenced by a shift towards zero which depicts the reduction of signs of depression. At the post-test level, 86.0% of the participants reported not experiencing depression compared to 27.5% at the pre-test stage. This was against a variance of 13.4% as for the control group. These results imply that there was a significant improvement among the experimental subject upon engaging in the aerobic exercises. The paired-samples T-test was used to perform the inferential analysis, the findings show, there was a noteworthy distinction between the experimental group's mean post-test to pre-test of -0.96 (0.61 – 1.57) and the control group's mean of -0.35 (1.75 – 2.10). Looking at the standard deviations of the two results, there were also differences with that of the post-test being higher.

Table 4. Paired Samples Correlation

Group to which subject belongs			n	r	p
Experimental Group	Pair 1	Post-depression & pre-depression	47	-.311	.034
Control Group	Pair 1	Post-depression & pre-depression	38	.351	.031

Source: Primary Data (2023)

Table 4 shows that there was no correlation between the depression scores obtained before and after the test in either the experimental or control group. This suggests that the pre-test and post-test results do not have a linear relationship. Determining whether the calculated sample means fall within the confidence intervals and whether the findings are statistically significant were also crucial. Paired Samples Results indicate that the experimental group's calculated mean was -0.957, with a 95% confidence interval around the difference that spanned from -1.141 to -0.774. This demonstrates that the computed mean does, in fact, fall within the confidence interval. Given that the control group's computed mean was -.347 and the interval included the range of -0.617 to -0.078, it fell within the 95% confidence interval. Since the experimental group's t-test has a p-value of less than 0.05 (<0.001), it was determined to be statistically significant. According to the findings, $t(46) = -10.495$, $p < 0.001$. The control group's t-test yielded statistically significant results, with $t(37) = -2.608$ and $p = 0.013$, both of which are greater than 0.05 but not significant at the 99.0% level. Given that a 95% level of significance was applied in this test and the experimental group's p-value was $p < .001$, which is less than the alpha level (.05), the null hypothesis, which states that "Aerobic exercises have no significant effects on psychological markers (depression) of HIV positive clients on ART," is rejected. These results imply that aerobic exercises have an effect of reducing depression in HIV positive clients on ART.

Table 5. Summary results of hypotheses testing

Hypothesis	Dimension	p-Value	Verdict
H₀₃ significant effects on depression and anxiety of HIV positive clients on ART	Depression	<0.001	Rejected
	Anxiety	<0.001	Rejected

Source: Primary Data (2023)

The results above show that all the three study hypotheses were rejected implying that aerobic exercises according to this study were very useful in HIV positive clients on ARVs.

DISCUSSION

According to the results in Table 1, there was a variance of 72.5% (74.5% - 2.0%) as for the experimental group while that for the control group was 16.7% (29.5 – 12.8%) suggesting that there was general improvement in the relieve of anxiety upon participating in the aerobic exercises. These results imply that, HIV positive clients on ARVs can relieve any feelings of anxiety by undertaking organised and supervised aerobic exercises. The fact that there was more significant improvement among the experimental subject implies that the aerobic exercises have a positive contribution.

According to the results, there was general improvement in the relief of anxiety upon participating in the aerobic exercises. These results imply that, HIV positive clients on ARVs can be relieved of any feelings of anxiety by undertaking aerobic exercises. This was supported by the paired-samples T-test which showed that the post-test results indicated that the participants had lower levels of anxiety compared to the time before the exercises (pre-test). Similarly, the hypothesis test also indicated that aerobic exercises reduce anxiety in HIV positive clients on ART.

These results are in line with a study conducted in 2014 by Jayakody et al. that suggested aerobic and non-aerobic exercise may help lessen anxiety symptoms. Exercise may appear to reduce anxiety symptoms, but antidepressant medications function more effectively. The results were also consistent with a study by Heidarya et al. (2011), which discovered that stress levels decrease with increased physical fitness and that aerobic exercise dramatically reduced anxiety in the experimental group. Currently, studies conducted by Antoni et al. (2002) also imply that stress reduction can halt the development of HIV-positive people's illness and avoid secondary infections. Askari et al. (2020) contend that higher levels of exercise result in more people responding to therapy and decrease anxiety sensitivity faster than lower levels of exercise. Aerobic exercise has been shown to reduce anxiety in general and may also reduce anxiety sensitivity by exposing participants to physiological sensations that they find distressing (Broman et al., 2004).

The results of this study support those of Heissel et al. (2019), who found that patients with HIV who engaged in aerobic exercise experienced reduced levels of anxiety in their meta-analysis examining the impact of exercise on anxiety and depression in PLHIV. Heissel et al. (2019) also showed that exercise frequency, type, and expert supervision all played significant roles in lowering feelings of anxiety and sadness in those living with HIV. Exercise therapies have been shown to be beneficial in reducing anxiety and depression symptoms in people living with HIV/AIDS (PLHIV), and engaging in extremely frequent exercise three or more times a week appears to be moderately to considerably useful in reducing these symptoms in PLHIV.

The findings of this study, along with others, are critical because, as per Heissel et al. (2019), depression and anxiety are two to four times more common in individuals living with HIV/AIDS than in those without the virus, and depression is also more common in those on HAART than in those without the virus.

The findings of the inferential and descriptive analyses indicated that engaging in aerobic exercise improved the symptoms of depression. Aerobic exercise also statistically significantly reduces depression in HIV positive individuals, according to the results of the hypothesis test.

The findings of Bopp et al. (2003), who hypothesized that exercise therapy may improve the psychological health of HIV-positive patients by treating the underlying symptoms that lead to depression, are supported by these data. Moreover, aerobic exercise training has anxiolytic and antidepressant qualities and protects against the harmful effects of stress. As a multimodal supplementary treatment to regular care, aerobic exercise has been shown by Askari et al. (2020) to further enhance all three categories of physical, emotional, and cognitive symptoms of depression. This is particularly true as aerobic exercise enhances social interactions and psychological well-being, two areas of quality of life. This is also in line with research by Jaggars et al. (2014), which showed that aerobic exercise on a regular basis can improve mental health by lowering depressive symptoms. In particular, they employed a twice-weekly, six-week, moderate-intensity exercise regimen.

Sujianto's (2021) study, which looked at how aerobic exercise affected depression in people with HIV, is likewise in line with these results. According to Sujianto's research, there was a statistically significant change in the mean depression score before and after the aerobic exercise intervention. This

finding raises the possibility that aerobic exercise can help HIV patients feel less depressed. They concur with the findings of Nosrat et al. (2017), which shown notable variations in depression levels in such clients, as well as those of Heissel et al. (2019), which demonstrated that a four-week aerobic exercise program can, in fact, alleviate symptoms of anxiety and depression in PLHIV. Additionally, they bolster those of Nosrat et al. (2017) However, in addition to showing that aerobic exercise lowers depression, it also raises HIV patients' CD4 counts. The results of the current study, however, were in line with those of O'Brien et al. (2016), who found that among PLHIV, there are notable improvements in quality of life and depressive symptoms in addition to improved oxygen consumption, exercise duration, knee flexion, and body composition as determined by lean body mass and percent body fat.

To summarize, the results show that: aerobic exercise significantly lowers psychological markers in HIV positive clients on ART, such as: depression and anxiety. All of these effects were statistically significant and had a p-value of less than 0.001.

RESULTS

The study clearly shows the results regarding how aerobic exercise affects many facets of HIV-positive clients using ART are outlined in the section; depression and anxiety symptoms of HIV-positive clients on ART significantly reduced after 12 weeks of supervised moderate-intensity aerobic exercise using a musical tempo of 120–150 beats per minute. Well-structured and supervised aerobic exercise was found to be essential for improving the psychological markers of PLHIV on ART. It is hypothesized that aerobic exercise may lower death rates in this population due to its beneficial effects on depression and anxiety.

SUGGESTIONS

MoH should authorise the use of aerobic exercise as an additional therapy in the care and treatment of HIV positive clients on ART in Uganda to improve their quality of life.

There is need for HIV positive clients to regularly participate in aerobic exercise. This can further be of help in weight management, help to reduce pre-disposing factors of noncommunicable disease in HIV positive clients and improve their quality of life.

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Ethical Approval Permission Information

Ethics Committee: Lacor Hospital Institutional Research and Ethical Committee

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