

# The impact of 12-week supervised aerobic exercise on psychological markers in HIV clients on ART

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## Abstract

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The study aimed to assess the impact of a supervised 12-week aerobic exercise program on paranoid ideation and phobia in HIV-positive clients undergoing antiretroviral therapy (ART). Conducted at the General Military Hospital in Uganda, the study employed a quasi-experimental design. Quantitative data were collected from 135 participants recruited for the study. Data analysis using paired-sample t-tests revealed significant reductions in paranoid ideation and phobia symptoms among participants. Before the intervention, most participants experienced symptoms of paranoid ideation and phobia. After the intervention, the results showed an 81.9% reduction in paranoid ideation symptoms and a 42.3% decrease in phobia symptoms. Aerobic exercise is a valuable adjunct therapy for improving psychological markers in HIV-positive clients on ART.

## Introduction

Human Immunodeficiency Virus (HIV) is a widespread and severe infectious disease responsible for millions of deaths globally. The global spread of this virus, which has taken on the character of a pandemic, has made HIV a central health problem worldwide. Bailes et al. (2011) states that HIV is a retrovirus belonging to the Lentivirus genus, which cause Acquired Immune Deficiency Syndrome (AIDS). The virus slowly affects a human body and deprives it of its immunity by seeking to destroy Clusters of Differentiation 4 (CD4) cells gradually - a type of T-lymphocytes (T-cells) that is critical to the immune system. According to O'Brien et al. (2016), there is a higher chance of opportunistic infections, which can cause psychological impact when the immune system is significantly compromised. There were about 38 million people living with an HIV infection globally (Girardi, 2020). In 2019 alone, 690,000 people died from HIV-related causes, and 33 million have died since the beginning of the epidemic worldwide. HIV prevalence in Uganda is about 1.5 and about 2.5m died due to HIV related illness, with minor regional variations (Yebara et al., 2015). HIV/AIDS is quite common in Sub-Saharan Africa, especially in Uganda, and it continues to claim a significant number of lives, underscoring the urgent need to address the

variables that lead to poor clinical outcomes for people living with HIV (West, 2021). Since Antiretroviral Therapy (ART) effectively changes the illness from fatal to chronic, it has become a general intervention.

Since combination antiretroviral therapy Highly Active Antiretroviral Therapy (HAART) was developed, HIV has become a chronic illness, and many people are living longer and aging with multi-morbidity, medication side effects, and HIV-related health consequences (Maggi et al., 2022; Freedman et al., 2019). Disability-related symptoms such pain, fatigue, activity limitations, difficulties integrating into society, depression, and cognitive impairments are common among people living with HIV (PLWHIV) (Cummins, 2019; Hanass-Hancock et al., 2015). Prior to the widespread use of ART, severe cognitive impairment, also referred to as HIV-associated dementia or HIV encephalopathy, was frequently experienced by PLWHIV who developed acute HIV syndrome after seroconversion (Eggers et al., 2017; Sanmarti et al., 2014). The prevalence of HIV-associated dementia has decreased as a result of the widespread use of ART. In any case, moderate, self-limiting forms of HIV-associated neurocognitive dysfunction (HAND) have become more common, especially in low- and middle-income nations (Paruk & Bhigjee, 2021).

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The Diagnostic and Statistical Manual of Mental Disorders (DSM) system has included paranoid ideation since its inception in 1952, in contrast to the majority of other personality disorders (Cherry et al., 2015). Its name has not changed, and the validity of the construct which has been regarded by most psychiatric classification systems since the early 19<sup>th</sup> century as a strong unitary notion characterized by excessive distrust and suspiciousness has received comparatively little discussion or investigation.

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

The results of the anxiety inventory are then decreased when exercise is coupled with occupational therapy and lifestyle modifications. They came to the conclusion that while exercise seems to be a useful supplementary treatment for anxiety disorders including phobia, it is not as successful as antidepressant therapy. Exercise, both aerobic and non-aerobic, appears to lessen symptoms of anxiety and phobia (Jayakody et al., 2014). It is therefore clear that the combination of the two anti-depressants and exercise will improve the quality of life for patients' anxiety disorders. A phobia becomes diagnosable when a person begins organizing their lives around avoiding the cause of their fear. Social anxiety and agoraphobia are known as complex phobias, as their triggers are less easily recognized. People with complex phobias can also find it harder to avoid triggers, such as leaving the house or being in a large crowd. It is more severe than a normal fear reaction. People with a phobia have an overpowering need to avoid anything that triggers their anxiety.

Smith-Nielsen et al. proposed different subgroups of PPD, which were partially caused by the patterns of comorbidity among the personality disorders (PD), even though he did not specifically disagree with the unitary idea. While most PDs may display paranoid-like traits, narcissistic, antisocial, obsessive, and passive-aggressive personality profiles appear to have the

highest prevalence of these traits (Smith-Nielsen et al., 2016). While most people with PPD are suspicious and project negative sentiments and intentions onto others, Smith-Nielsen et al. (2016) believes that people with antisocial and compulsive characteristics are more likely to exhibit overt hostility that leads to harsh conflict, retaliation, and desertion. This study therefore found it necessary to investigate the impact of a supervised 12 weeks aerobic exercise to paranoid ideation and phobia in HIV positive clients on ART. Secondary HIV+ mania, sometimes known as "HIV mania," is characterised by agitation, disruption, insomnia, high activity, and excessive talkativeness.

Psychotic symptoms including paranoid ideation and visual or auditory hallucinations are common in them (Singer and Thames 2016). Stigma and phobia pose significant obstacles for women living with HIV since they are constantly scrutinised by others and face rejection and labelling in the societies they live in (Shamsaei et al., 2020). The symptoms of anxiety and despair, which are frequently the causes of phobic and paranoid beliefs, can be lessened by aerobic exercise. Research shows that aerobic exercise improves mental health outcomes and lessens anxiety sensitivity in people with HIV and other chronic illnesses (Zschucke et al., 2013; Vancampfort et al., 2017). In addition to increasing the activity of neurotransmitters like dopamine and serotonin, aerobic exercise releases endorphins, which elevate mood and lessen anxiety. These neurochemical actions play a crucial role in controlling negative thought patterns and lowering the risk of paranoia (Dishman et al., 2006). Despite all these evidences aerobic exercise has been underscored in HIV management as an additional therapy to improve the quality of life of HIV positive clients. This study was conducted to access the impact of aerobic exercise on improving paranoid ideation and phobia in HIV positive clients in Uganda.

## Methods

### Study Design

A quasi-experimental research design was adopted, where participants were purposively selected based on specific inclusion criteria.

### Study Location

The study was conducted at the General Military Hospital (GMH) Bombo, located in Luwero District, Uganda.

## Target Population

The target population comprised HIV-positive patients at GMH-Bombo who were receiving antiretroviral therapy (ART). Eligible participants were adults aged 20 years or older who had been on ART for at least one year. Patients meeting these criteria were invited to volunteer for the study. A total of 135 clients volunteered, and they were randomly assigned into two groups: the experimental group (n=67) and the control group (n=68). The study aimed to assess changes in specific outcomes over time, particularly to evaluate the impact of an aerobic exercise intervention (Estrada & Pardo, 2019).

During the 12-week aerobic exercise intervention, 18 participants dropped out. For consistency in statistical analysis, 18 participants were randomly excluded from the control group to equalize the sample sizes.

## Inclusion Criteria

HIV positive clients taking their ART treatment from Bombo Military Hospital, who were on treatment for 12 months or more, without any limitation for exercise, asymptomatic, 20 years of age and above, able to attend the aerobic exercise sessions for at least three times or more a week and adhering to their ART. Besides the 12 months of ART treatment and 20 years of age and above. This age group are usually categorized as adults with most of their cut-off points during assessment of clinical outcomes. The clients were also included based on their willingness to participate in the study.

## Exclusion Criteria

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

## Intervention Protocol

Following a six-month period of health education sessions about the study, 3,300 out of 4,150 clients met the inclusion criteria. Of these, 135 clients voluntarily agreed to participate. Purposive sampling was used to select participants based on treatment duration, absence of symptoms, age, and willingness to participate. Volunteerism was deemed appropriate due to the stigma associated with HIV, as well as participants' time and financial constraints related to attending aerobic exercise sessions.

The intervention included a structured aerobic exercise program supervised by fitness trainers and guided by the researcher. Exercises followed a five-phase aerobic protocol based on ACSM guidelines (Colberg et al., 2016). The program included brisk walking, jogging, and aerobic dancing for 30 minutes, five days a week, at moderate intensity with uplifting music. The exercise sessions progressed as follows:

Week 1–2: Tempo of 120 BPM (beats per minute).

Week 3–4: Tempo of 130 BPM.

Week 5–6: Tempo of 140 BPM.

Week 7–12: Tempo of 150 BPM.

Each session consisted of:

A 5-minute warm-up followed by stretching.

At least 25 minutes of aerobic activity.

A 5-minute cool-down with relaxation activities.

## Data Collection Procedure

Pre- and post-intervention psychological assessments were conducted by trained counsellors using standardized assessment tools. The aerobic exercise sessions were carefully supervised, with detailed monitoring of participant adherence and performance.

## Statistical Analysis

Quantitative data were analysed using a two-sample t-test to compare the means of the experimental and control groups. A p-value  $\leq 0.05$  was considered statistically significant. All analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 20.0.

## Results

Following a 12-week supervised aerobic exercise program, the data of 98 participants (49 in the experimental group and 49 in the control group) were analysed. A total of 18 participants dropped out from the experiment group because they didn't have enough time to engage in the aerobic exercise and thus created an elimination measure and 18 results from the control group were selected randomly and dropped for easy statistical comparison.

Table 1 shows that the majority (67.3%) of participants in the experimental group were males while the females constituted 32.7%. Similarly, for the control group the males constituted 71.4% and the females 28.6%. This is a fair reflection of the member of the study population (clients attending the ART Clinic at Bombo Military Hospital) where the males are slightly

above 2,490 (>60%) and female are slightly below 1,660 (<40%).

The results also show that majority of the participants were between the age of 38-47 years although those in experimental group had a slightly higher number (67.3%) compared to 51% in the control group. The least number of participants (2%) who participated in the survey from the two categories were in different age, the experimental group were in the age bracket of 48-57 years and control group were in the age bracket of 20-27 years.

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

Regarding education, the majority (51%) of the participants had a secondary education, followed by 30% who had primary education. In this study, the participants' educational background was also deemed to be significant details in Table 1.

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

According to the results, there was a general improvement as the participants reported less of the paranoid ideation problems they experienced prior to the aerobic exercises for the experimental groups. From 0.4% of the participants who indicated that they there were more experimental group participants who indicated that they did not at all have any of the paranoid ideation feeling two weeks prior to the study, to 81.9% giving a positive percentage improvement of 81.5%. The rating of the control group on the other hand improved from 5.3% to 31.4% (a variance of 26.1%). The fact that there was more significant improvement among the experimental subject implies that the aerobic exercises have a positive contribution to the psychological status of HIV positive clients on ART.

**Table 1**  
Demographic information of participants.

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

**Table 2**  
Effects of aerobic exercises on paranoid ideation.

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

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

Statement: How often in the previous 2 weeks you felt the following?

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

Table 3 presents pre-test and post-test results, differences between tests and paired group comparisons. The results of the experimental group show a significant difference between the mean of the post-test to the pre-test of -1.76 (0.71 – 2.47) compared to that of the control group of only -0.55 (1.91 – 2.46).

The experimental group's mean was -1.759, with a 95% confidence interval of -1.986 to -2.533. This shows that the calculated mean indeed falls within the confidence interval. The calculated mean for the control group was equally within the 95% confidence interval considering that it was -0.550 and the interval ranged from -0.824 to -0.276. The t-test of the experimental group was established to be statistically significant as

the p-value of <0.001 is less than 0.05. The results are:  $t(48) = -15.619$ ;  $p < 0.001$ . The t-test of the control group was also statistically significant as the results were:  $t(39) = -4.061$ ;  $p = <.001$ .

Considering that the p-value of the experimental group in this case was <.001, the null hypothesis that, "Aerobic exercises have no significant effects on psychological markers (paranoid ideation) of HIV positive clients on ART", is rejected. These results imply that aerobic exercises have an effect of reducing the paranoid ideation in HIV positive clients on ART.

The participants were asked to indicate how often in the previous two weeks before the study the participants were bothered by psychosocial problems such as phobia participants gave their responses. The results above show that there was a general improvement as more experimental participants reported not experiencing any phobia after participating in the aerobic exercises. The experimental group reported a variance of 42.3% (87.2 – 44.8%) compared to the control group whose variance was 17.7% (35.9 – 18.2%). The fact that there was more significant improvement among the experimental subject implies that the aerobic exercises have a positive contribution.

**Table 3**

Results of pre-test and post-test paranoid tests and paired group comparisons.

Variables	Tests	n	Mean	SD	t	df	p
Experimental Group	Post-paranoid	49	.71	.770	-15.619	48	<0.001
	Pre-paranoid	49	2.47	.145			
Control Group	Post-paranoid	40	1.91	.848	-4.061	39	<0.001
	Pre-paranoid	40	2.46	.188			

**Table 4**

Results of pre-test and post-test phobia tests and paired group comparisons.

Groups	Tests	n	Mean	SD	t	df	p
Experimental Group	Post-phobia	41	.60	.616	-9.563	40	< 0.001
	Pre-phobia	41	1.54	.217			
Control Group	Post-phobia	36	1.72	.831	-2.826	35	<0.05
	Pre-phobia	36	2.17	.375			

The results of the experimental group show a significant difference between the mean of the post-test to the pre-test of -0.94 (0.60 – 1.54) compared to that of the control group of only -0.45 (1.72 – 2.17). Looking at the standard deviations of the two results, there were also differences with that of the post-test being higher.

The calculated mean of the experimental group was -0.932 while the 95% confidence interval of the difference ranged from -1.129 to -0.735. This shows that the calculated mean indeed falls within the confidence interval. The calculated mean for the control group was equally within the 95% confidence interval considering that it was -0.450 and the interval ranged from -0.773 to -0.127. The t-test of the experimental group was established to be statistically significant as at  $p < 0.05$ . The results are:  $t(40) = -9.563$ ;  $p < 0.001$ . The t-test of the control group was also statistically significant as the results were:  $t(35) = -2.826$ ;  $p = .008$ .

Considering that the p-value of the experimental group in this case was  $<.001$  which was less than the alpha level (.005) since a 95% level of significance was considered in this test, the null hypothesis that, "Aerobic exercises have no significant effects on psychological markers (phobia) of HIV positive clients on ART", is rejected. These results imply that aerobic exercises have an effect of reducing phobia in HIV positive clients on ART.

## Discussion

The findings on the effects of aerobic exercises on the paranoid ideation in the study participants show that

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

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

In summary, this study established that there was a general improvement as far as phobia is concerned as more experimental participants reported not

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

These findings corroborate the claims made by Broman et al. (2004) that aerobic exercise has been shown to reduce generalized anxiety and may also reduce anxiety sensitivity through exposure to feared physiological sensations. Seid et al. (2020) posit that psychological markers such as paranoid ideation, depression, neuroticism, interpersonal sensitivity, and anxiety are the most common in HIV positive clients on ART.

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

Banyan mental health (2021) opines that as much as agoraphobia and social anxiety disorder can both cause avoidance of certain situations, this may be to a different extent; and that, anxiety disorders can coincide with panic disorder and can cause the patient to go into substance abuse as a way to coping with the symptoms. Andriote (2012) adds that, “the other major types of anxiety disorder are panic disorder and agoraphobia, social phobia and other phobias, obsessive compulsive disorder (OCD), post-traumatic stress disorder (PTSD), generalized anxiety disorder (GAD), acute stress disorder and anxiety disorder due to a general medical condition”. It follows that most of these may be reduced by aerobic exercises.

## Conclusion

The findings of this study demonstrate that a well-structured, supervised 12-week moderate-intensity aerobic exercise program, conducted at a tempo of 120–150 beats per minute, significantly improved CD4 cell counts in HIV-positive clients on ART. These results underscore the importance of structured and supervised

aerobic exercise in enhancing clinical outcomes for people living with HIV (PLHIV) receiving ART.

HIV-positive individuals who participated in the exercise intervention experienced marked improvements, enabling them to be more productive and perform daily activities with less fatigue, similar to their HIV-negative counterparts. Furthermore, the intervention led to a reduction in depressive symptoms, a key psychological marker. This aligns with findings by Seid et al. (2020), who highlighted that chronic depression in PLHIV is associated with poorer treatment outcomes and an increased likelihood of AIDS-related mortality.

By alleviating depressive symptoms and enhancing physical well-being, aerobic exercise not only improves quality of life but also has the potential to reduce mortality rates in HIV-positive clients on ART. These findings advocate for integrating aerobic exercise programs into routine care for PLHIV to optimize both psychological and clinical outcomes.

## Authors' Contribution

Study Design: MN, CANN, EO, MM; Data Collection: MN; Statistical Analysis: MM; Manuscript Preparation: MN, CANN, EO, MM.

## Ethical Approval

The Study was approved by Lacor Hospital Institutional Research and Ethical Committee (RHIREC) No 0183/07/2020 and it was carried out in accordance with the Code of Ethics of the World Medical Association also known as a declaration of Helsinki. And thereafter approved by Uganda National Council for Science and Technology Ref: HS 1276ES

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## Conflict of Interest

The authors hereby declare that there was no conflict of interest in conducting this study.

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