

## The Influence of a Twelve Weeks Aerobic Exercise Regimen on Neuroticism in HIV Positive Clients in Uganda

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### Abstract

Highly active antiretrovirals have led to a considerable drop in HIV-related morbidity and mortality and a large increase in the life expectancy of HIV positive individuals in Uganda. The likelihood of clinicians coming across people exhibiting neuroticism symptoms associated with the illness has been reported to be on the increase. As much as exercising has been established to have positive effects in alleviating such symptoms, it is noted that, 52% of the population do not follow an exercise regimen and the problem has persisted. This study assessed the influence of aerobic exercise on neuroticism symptoms in HIV positive clients attending an ART clinic in Uganda. A quasi-experimental research design with 67 volunteers in each of the pre- and post-test control groups. The results reveal that at the pre-test stage, all the experimental group participants reported experiencing some form of neuroticism. However, after the aerobic exercises, 80.8% of the experimental study participants reported having been relieved of neuroticism symptoms. In this instance, the experimental group's p-value was smaller than the alpha level (.05) since the test took a 95% threshold for significance. These results imply that aerobic exercises have a significant effect on reducing neuroticism in HIV positive clients on ART.

**Keywords:** Neuroticism, Aerobic exercise, HIV Positive Clients and Barbonian model

## Introduction

Since the diagnosis of Acquired Immune Deficiency Syndrome (AIDS) in humans was made in Uganda in 1981, there have been substantial changes in the quality of human life (Okoroiwu et al., 2022). Human Immunodeficiency Virus (HIV), is a retrovirus that is part of the lentivirus genus, is the source of the illness, according to Bailes et al., (2002) The virus gradually destroys Clusters of Differentiation 4 (CD4) cells a subset of T-lymphocytes (t-cells) that are essential to the immune system in order to impair human immunity. O'Brien et al., (2016) state that when the immune system is severely weakened, there is an increased risk of opportunistic infections, which can lower one's functional work capacity and have additional psychological effects.

Highly Active Antiretroviral Therapy (HAART) has led to a considerable reduction in HIV-related morbidity and death as well as a significant rise in the life expectancy of HIV positive individuals. Therefore, the likelihood that clinicians will come across people exhibiting psychiatric symptoms of the illness is raising (Knights et al., 2017). A person's mental health may be impacted by the stress of managing a severe and protracted disease or condition, such as HIV. HIV+ individuals are more likely to experience anxiety, depression, and cognitive issues. For instance, one of the most prevalent mental health issues that patients with HIV encounter is depression (Arlin Cuncic, 2023). Neuroticism is a trait that helps determine a person's level of emotional stability. Some traits that are frequently linked to it include negative emotions, poor self-regulation (the inability to manage appetites), trouble managing stress, a strong reaction to perceived hazards, and a tendency to complain (Arlin Cuncic 2023). Although neuroticism symptoms were unrelated to CD4 and viral load, these variables were associated with increased reports of adverse ART effects and decreased health perceptions (Johnson and Neilands, 2007).

Furthermore, most studies carried out before this one imply that exercise may be helpful in treating a variety of HIV related symptoms and side effects of the infection and drugs (Ciccolo et al., 2004). Baldwin et al., (2016) indicates that frequent exercise is linked to better physical and mental health. For instance, people who are more physically active reported being considerably more extraverted and less neurotic than people who were less active. Mood significantly improved after the exercise session, with more neurotic people reporting the biggest benefits.

Ganiyu et al., (2013) in their study on physical exercises in Botswana found out that 52% of the population did not follow an exercise regimen. The most common reasons for not exercising were ignorance (65.7%), the conviction that exercising exacerbated their illness (57.6%), and the lack of an exercise partner (24.0%). Laura et al., (2016) also assessed in the context of rehabilitation, home exercise programme adherence is a big obstacle. There were many other contributing causes to this problem, including situational and spychronological elements that are unique to each person. When prescribing customized workouts clinicians need to take these factors into account. Among them forgetting to work out, running out of time, and not being able to fit it into the daily schedule. This study employed Five A's Bardonian Model to prepare the participants to adhere to the exercise programme.

Meta-analytic evaluations indicate that physical exercise and conscientiousness are positively correlated, with some mixed evidence suggesting a slight negative correlation with neuroticism (Rhodes and Boudreau, 2017). According to Rhodes and Boudreau (2017), the effect seems to be more noticeable while engaging in intense physical activity and less noticeable when engaging in lower-intensity lifestyle activities. The results of this study provide credence to the advantages of physical fitness on psychological well-

being. More specifically, individuals with higher levels of corticotrophin releasing factor showed a reduced correlation between neuroticism and depression. For teenagers with greater levels of neuroticism, encouraging physical fitness may be quite helpful (Yeatts et al., 2017). This study evaluated the effect of adherence counselling to retention in an exercise regiment and how that exercise will contribute to reducing the signs of neuroticism in HIV positive patients.

Literature in HIV management has greatly informed this study what is known about the physical and psychological health of people living with HIV. HIV has an immense impact on immune function and leaves one defenseless to opportunistic infections, according to initial research (Okoroiwu et al., 2022; O'Brien et al., 2016). HIV treatment has revolutionized since the early 1980s when HIV was identified as the cause of AIDS. Advances like HAART have played an important role in curbing morbidity and mortality (Knights et al., 2017). PLHIV are still not doing well, however, with regards to their physical and mental health despite recent advancements.

An important component of HIV treatment is mental health. Practitioners have seen an increase in psychiatric symptoms in PLHIV treatment has increased lifetime expectancy (Knights et al., 2017). Depression is the most common mental health condition among this group, and stress caused by having a chronic illness, such as HIV, can increase symptoms (Arlin Cuncic, 2023). Additionally, research has found that personality features like neuroticism, wherein a person lacks the ability to regulate their own emotions, correlate with the mental well-being of HIV patients (Arlin Cuncic, 2023; Johnson & Neilands, 2007). Such findings lead one to infer that the curing of the psychological and emotional effects of HIV is just as useful as curing its physical symptoms. Physical activity has also been found to be essential in boosting mental health and controlling HIV symptoms.

Evidence indicates that exercise improves psychological functioning, in addition to physical functioning. For example, chronic exercise has been linked with higher emotional stability, better mood, and lower neuroticism (Baldwin et al., 2016). Additionally, research shows that people with higher physical activity have improved mental health, including decreased anxiety and depression (Ciccolo et al., 2004). Compliance with physical exercise programs remains a problem, nonetheless, as participation is hampered by administrative inefficiencies, demotivation, and perception of aggravating an illness (Ganiyu et al., 2013; Laura et al., 2016). Apart from its physical benefits, research has shown that exercise may also reduce the psychological impact of neuroticism among individuals with HIV. Conscientiousness, which is positively correlated with physical activity, can reduce the negative outcomes of neuroticism, based on meta-analytic estimates (Rhodes & Boudreau, 2017).

As a result, adding exercise to the HIV treatment regime might prove to be a valid intervention in helping to better the physical and psychological wellbeing of HIV patients. The overall well-being of people with HIV is greatly determined by the incorporation of psychological care, for instance, adherence counseling, and physical exercise. The literature shows that in a bid to promote good health outcomes and well-being among people with HIV, clinicians must take into consideration providing care that is holistic in scope and addresses both physical and psychological needs of the individuals (Laura et al., 2016).

## **Material and Method**

### **Ethics Committee Permission**

The study was conducted in compliance with the World Medical Association's Code of Ethics, also known as the Declaration of Helsinki, and was approved by the Lacor Hospital Institutional Research and Ethical Committee (RHIREC) No 0183/07/2020. And thereafter approved by Uganda National Council for Science and Technology Ref: HS 1276ES

## Research Design

This study used a quasi-experimental research design with a pre-test and post-test control group.

## Location of the Study

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

## Target Population

The target group included patients at General Military Hospital-Bombo who were HIV-positive and undergoing treatment; in particular, it included patients who were 20 years of age or older and on ART for at least a year. This group which made-up the bulk of the 4150 patients receiving ART treatment at GMH use the same access points and are assessed the same way.

## Inclusion and Exclusion Criteria

Inclusion criteria encompassed clients meeting specific conditions such as being asymptomatic, on ART for 12 months and more, and volunteering for aerobic exercise sessions. Exclusion criteria considered limitations to exercise, opportunistic infections, signs and symptoms of HIV disease, and the age category of children, adolescents, and clients on ART for less than 12 months.

## Sampling Procedure and Sample Size

3300 clients meeting the eligibility criteria
135 volunteered to take part in the study volunteers were chosen due to the nature of the participants, being HIV positive clients which is highly stigmatizing and participants needed to commit more time to attend atleast 3 sessions a week
01 eliminated by the physical activity readiness
134 allocated to the two groups 67 to experimental and 67 to control
18 dropped out from experimental group and 18 were selected at random and dropped from the control group to make it easy to compare the two groups
49 in experimental completed the sessions
Quantitative data were analyzed using two-sample t-tests, with a significance level set at $p \leq 0.05$ . The Statistical Package for Social Sciences (SPSS) version 20.0 was used for all analyses.

## Data Collection Procedure

Five A's psychological counselling framework Bardonian model was used to prepare participants for the exercise and also ensure adherence to the aerobic exercise programme. The five A's involves the following:

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

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

**Agree:** based on the participants' desire and self-assurance in their capacity to modify their behavior, we jointly established targets. We also decided on the times so that each person

could choose their most convenient time, but everyone was to receive training in the afternoon.

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

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

This helped the study to come up with personal action plans for the participants this may have contributed to ensuring adherence to exercise. The study listed specific goals in behavioural terms listed barriers and came up with strategies to address barriers. Follow-up specific plans were made including formation of WhatsApp groups for each exercise day. Shared plans with the practice teams and all the research assistants. (HIV prevention and treatment guideline, 2020).

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

They were informed about what was involved in the exercise. The exercises included brisk walking, jogging and aerobic dance at moderate intensity. The days that the participants chose to attend, knowing that they would have time, determined how they were grouped. At least three times a week, each subject attended under the careful supervision of the research assistants, fitness coaches and the researcher. Water was available for use during the sessions, and for those who needed it afterward, there was a handy restroom. Every session began with five minutes of warm-up, stretching, and aerobic dance exercise. It also included five minutes of cool-down exercises and relaxation. The ACSM guidelines were followed for all forms of exercise training (Colberg et al., 2016).

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

Sub-groups were formed according to the days selected and the time of exercise set with the participants. The intervention included a structured aerobic exercise program done under the supervision of the researcher and under the instruction of fitness trainers. The exercises were performed according to a five-phase aerobic protocol constructed as per the ACSM standards (Nicholas et al., 2024). Throughout the course of the program, jogging, aerobic dance, and thirty minutes of brisk walking were conducted by the volunteers, five days a week, facilitated by music in the background with a controlled tempo. The progression of workout sessions from the beginning to end was as follows: Week 1-2 tempo of 120 beats per minute, Week 3 -5, 130 beats per minute, Week 6-7 140 beats per minute, and Week 8 to 12 150 beats per minute. All exercises began with a warm-up of five minutes and then stretching exercises. A minimum of 25 minutes of aerobic exercise. Five minutes of relaxing exercise and a cool-down.

### **Data Analysis and Presentation**

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



regarded as statistically significant. Version 20.0 of the Statistical Package for Social Sciences (SPSS) was used for all analysis.

## Findings

### Response rate of study participants

Out of a total of 135 participants who had voluntarily accepted and qualified to take part in the study were randomly allocated in the experimental and control groups each taking 67 participants. A total of 18 participants dropped out from the experiment group and 18 were selected randomly from the control group and dropped for easy statistical comparison. This gave an attrition rate of 27% which was good enough for the experimental study considering that Meyer et al., (2022) indicates that a response rate of 70% and above is acceptable. This was attributed to adherence counselling using 5 As Bardonian model provided to the participants prior to the study.

**Table 1:** Effects of aerobic exercises on neuroticism

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

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

### Source: Primary Data

The results in table 1 reveal that at the pre-test stage, all the experimental group participants reported experiencing some form of neuroticism. However, after the aerobic exercises, 80.8% of the experimental study participants reported having been relieved of the symptoms. This was against a variance of 19.9% in the case of the control group. These results suggest that the aerobic exercises were of a benefit to the participants by relieving the feelings that had reported about earlier.

The inferential results start with a paired-samples t-test was conducted and the outputs were as presented in the three Tables 2, 3 and 4

**Table 2:** Paired samples statistical results

Group to which subject belongs			Mean	N	Std. Deviation	Std. Error Mean
Experimental Group	Pair 1	Post-neuroticism	.78	45	.842	.126
		Pre-neuroticism	2.51	45	.037	.006

Control Group	Pair 1	Post-neuroticism	1.84	39	.929	.149
		Pre-neuroticism	2.29	39	.486	.078

**Source:** Primary Data, 2023

It was noted from the results displayed in Table 2 that the pre-test and post-test mean values differed from one another. The experimental group's mean post-test to pre-test difference was -1.73 (0.78 – 2.51), which is significantly higher than the control group's mean of -0.45 (1.84 – 2.29). It was also noted that the experimental group's standard deviation was larger than the control group's when comparing the two sets of data. This shows a significant improvement in the clients of the experimental group.

**Table 3:** Paired samples correlation

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

**Source:** Primary Data (2023)

Table 3 shows that there was no correlation between the neuroticism scores obtained in the experimental and control groups before and after the test. The pre-test and post-test results do not show a linear connection, according to this.

Table 4 presents the results of the calculation of sample means and indicates whether or not they are statistically significant. The sample means are shown to fall within the confidence ranges.

**Table 4:** Paired samples results

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

**Source:** Primary Data, 2023

According to Table 4, the experimental group's computed mean was -1.722, and the difference's 95% confidence interval stretched from -1.976 to -1.468. This demonstrates that the computed mean does, in fact, fall inside the confidence interval. Given that the control group's computed mean was -0.455 and the interval included the range of -0.808 to -0.102, it fell inside the 95% confidence interval.

The null hypothesis, “Aerobic exercises have no significant effects on neuroticism of HIV positive clients on ART,” is rejected in light of the experimental group's p-value in this instance being less than the alpha level (.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 neuroticism in HIV positive clients on ART.

## Discussion and Conclusion

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

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

According to the results of this study aerobics reduce neuroticism, it follows that they also reduce anxiety because Kotov et al., (2010) opine that neuroticism is strongly associated with anxiety. As a result, there will also likely be less psychopathology, guilt, psychological inflexibility, and emotion dysregulation, all of which could account for the correlation that Paulus et al. (2016) found between neuroticism and anxiety.

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

Exercise improves cognitive functioning, mental health, and memory; it also hinders the development of certain neurological conditions. While exercising, oxygen saturation and angiogenesis (blood vessel growth) occur in areas of the brain associated with rational thinking and as well as social, physical and intellectual performance. Exercise drops stress hormones and increases the number of neurotransmitters like serotonin and norepinephrine, which are known to accelerate information processing. Exercise upregulates neurotrophins (brain-derived neurotrophic factor, insulin-like growth factor, and basic fibroblast growth factor). These support the survival and differentiation of neurons in the developing brain, dendritic branching, and synaptic machinery in the adult brain.

The result of this research, as well as the descriptive and paired-samples T-test, emphasizes the significant role aerobic exercise can play in reducing neuroticism among HIV patients. Through aerobic exercise on a regular basis, the subjects demonstrated significant reduction in being neurotic, which is accompanied by increased emotional stability and reduced anxiety and stress. This finding concurs with Baldwin et al. (2016), who obtained positive association between elevated physical activity and lower neuroticism, particularly among individuals with higher levels of physical activity. Such findings are emphasized as indicative of the therapeutic efficacy of exercise as an addition to existing HIV treatments as a method for improving mental and overall health status in individuals infected with HIV. Because neuroticism is a primary predictor of adverse mental health consequences, the addition of regular aerobic exercise to HIV treatment regimens has the potential to significantly enhance quality of life and decrease psychological distress.



Lastly the current study are consistent with the collective evidence linking neuroticism to a variety of psychological challenges, including anxiety and depression. As highlighted by Kotov et al. (2010), neuroticism has robust associations with heightened anxiety, and therefore it must be a priority area of interventions aimed at improving mental health. The results in the current study show that aerobic exercise not only reduces neuroticism but possibly can also alleviate anxiety as well as concomitant psychopathology such as guilt and emotional dysregulation, as suggested by Paulus et al. (2016). The physiological mechanisms by which these effects take place are supported by evidence of the neurobiological benefits of exercise, including increased oxygen saturation, increased levels of brain-derived neurotrophic factor (BDNF), and improved neurotransmitter function (Hausenblas & Giacobbi, 2004). These biological adjustments are required for cognitive and affective processing, suggesting that exercise can be critical in physical and mental management of HIV. Thus, the incorporation of exercise in HIV therapy may have a multi-faceted impact on patient outcomes, both physical and mental, in relation to surviving with the virus.

## Conclusion

The findings indicate that the participants of the experimental investigation reported feeling less neurotic signs and symptoms overall. These findings imply that the participants benefited from the aerobic exercise by experiencing relief from the emotions they had previously expressed during pre-test. The results show that there is a significant difference in the mean difference between the pre-test and post-test between the experimental group and the control groups. This demonstrates a notable improvement in the experimental group's customers, suggesting that aerobic exercise has a major impact on the neuroticism of HIV positive clients receiving antiretroviral therapy.

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

Therefore, this study recognized the significant contribution of aerobic exercise in reducing neuroticism and enhancing mental health of HIV patients. The results of both descriptive and paired-samples T-tests recognize aerobic exercises as being effective in the treatment of neuroticism feelings, with less anxiety, emotional instability, and stress. These findings are in line with current literature, such as Baldwin et al. (2016), which demonstrated a positive relationship between physical activity and reduced neuroticism. Furthermore, the neurobiological mechanisms underlying these gains, such as improved oxygenation, enhanced neurotrophins, and neurotransmitter functioning, speak to the fact that exercise is fundamental to cognitive and emotional process. This supports the conclusion that the inclusion of regular aerobic exercise in HIV treatment regimens can yield significant improvements in mental and physical health, reduce psychological distress, and enhance overall quality of life in individuals infected with HIV.

**Patients Consent Statement**

All participants completed an informed consent after a careful explanation of the study purpose, procedures and the potential risks. However, signing consent did not waive the participant's legal right they had freedom to withdraw their consent at any time they wished without any penalty.

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**Conflict of interest**

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

**Data availability**

The data sets generated and analyzed during the study are available from the corresponding author on reasonable request.

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