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Effects of 8-Week Circuit Exercise Training on the Cardiorespiratory Fitness and Health Status of People Living with HIV at Abakaliki, Ebonyi State, Nigeria

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ABSTRACT

Introduction: Exercise is regarded as an important adjuvant therapy for reducing the negative effects of Antiretroviral Therapy and improving the health status of people living with HIV (PLWH), but there is limited evidence on the effects of circuit exercise training on PLWH.

Objective: This study determined the effects of circuit exercise on the cardiorespiratory fitness and health status of PLWH.

Methods: This pretest-posttest randomized control study recruited 120 PLWH from the HIV clinic at Alex Ekwueme Federal University Teaching Hospital, Abakaliki. Participants were consecutively invited at the clinic to join the study. Fish bowl method was used to randomize the participants to either intervention group or control group. Moderate intensity (50 – 75% MHR) circuit exercise training was administered to the participants 3 times a week, between 30-60 minutes per session, for 8 weeks. Cardiorespiratory fitness and health status were measured at baseline and at 8-week. Descriptive statistics of mean, standard deviation, percentages, and bar chart was used to summarize data. Paired sample t-test and independent sample t-test were used to determine the mean difference within and between the groups respectively. Alpha level was set at $P<0.05$.

Results: There was statistically significant difference in mean score of cardiorespiratory fitness and health status within the intervention group, and between the groups after 8-week circuit exercise training. Bar chart showed improvement in all the domains of health status.

Conclusion: An 8-week circuit exercise training improved cardiorespiratory fitness, and health status of PLWH.

KEYWORDS: Aerobic capacity, Cardiorespiratory fitness, Circuit exercise, HIV/AIDS, Health Status.

INTRODUCTION

People living with human immune virus/acquired immune deficiency syndrome (HIV/AIDS) undergoing highly active antiretroviral therapy (HAART) are having improved life expectancy and changes in symptoms presentation. The HAART has dramatically reduced mortality and morbidity in Human Immuno-Virus (HIV) - infected patients [1]. On the other hand HIV-infected patients are experiencing an increasing frequency of noninfectious side effects and symptoms [2] , associated with HIV infection and its therapy which can significantly impair the benefits of HAART [3]. These side effects/changes in symptoms include impaired cardiorespiratory fitness (functional capacity) and decreased health status. People infected with HIV have abnormally low cardiorespiratory fitness/functional capacities, expressed as lowered capacity to utilize oxygen ($VO_{2\,max}$) and perform physical work [4]. Tests of an individual's ability to use oxygen, functional aerobic capacity (FAC), have shown that those infected with HIV have VO_2 max of 24% - 44% below their age-predicted normal values [5,6].

Although, HAART reduces HIV-related mortality, the extension in a patient's life expectancy comes at the expense of metabolic disorders, adverse health conditions, and a reduction in the quality of life QoL [3,7]. The overall effect is a declining health

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status in PLWH. Health status is an individual's relative level of wellness and illness, taking into account the presence of biological or physiological dysfunction, symptoms, and functional impairment [8]. Health status of patients can be accurately measured by the use of standardized surveys that are inexpensive, easy to administer, and provide information that cannot be determined accurately in any other way. This accesses/measures overall physical and mental health status (Mobility, Self-Care, Usual Activities, Pain/Discomfort, and Anxiety/Depression) without disease-specific questions

Among PLWH, the side effects of HAART can be minimized by leading a healthy lifestyle, as adjuvant therapy to their standard HIV treatments. This includes regular physical activity/exercise, a healthy diet, sufficient sleep, and smoking cessation [7]. Various types of exercises have been considered an important adjuvant therapy for health promotion of patients with HIV [9]. Aerobic exercise also called endurance training is a regimen containing aerobic interventions like walking, cycling, rowing, and stair stepping which has a significant effect on cardiorespiratory fitness [10]. Aerobic exercise is associated with significant increases in maximal oxygen consumption which is an index of functional capacity or cardiorespiratory fitness [11]. Resistance exercise which is defined as exercise that requires muscle contraction against resistance (e.g, body weight or barbells) [10], has been employed as a therapeutic tool in patients with HIV and is considered safe and effective in improving muscle strength and body composition [12]. The effect of combined aerobic and resistance exercise training (CARET) have been examined in PLWH, and literature showed that CARET results in significant improvements in both cardiorespiratory fitness, immune component and QoL[7].

Circuit exercise, is a type of combined-training, which includes both multi-joint resistance exercise and aerobic exercise. Previous research has suggested that a circuit exercise composed of endurance and resistance exercises may be preferred to one focused only on a single mode of exercise [13]. Available literature shows that no study in Nigeria has examined the benefits of circuit training on HIV population. Hence, this work determined the effects of 8-week circuit exercise training on the cardiorespiratory fitness, and health status of PLWH.

MATERIALS AND METHODS

Research Design**:** Pretest-posttest randomized control design.

Ethical consideration**:** An ethical approval was sought and obtained from the Research and Ethics Committee of Alex Ekwueme Federal University Teaching Hospital, Abakaliki before the commencement of the study. All the participants that met the inclusion criteria gave their consent by signing an informed consent to participate in the study.

Subject Selection: A total of 120 participants were recruited from the communicable disease and control research center of Alex Ekwueme Federal University Teaching Hospital, Abakaliki. Participants were consecutively invited to join the study. Fishbowl method was used to randomly assign the participants to either the intervention group or control group. Inclusion criteria included: current use of ARV drugs, age equal or older than 18 years, availability to attend the study activities. Exclusion criteria included: Pregnancy, active opportunistic infections, age younger than 18 years, contraindications to exercise testing and training [9], significant cognitive impairment or inability to follow instructions, involvement in a regular exercise program (defined as two or more structured exercise sessions weekly for more than, or equal to, six months prior to enrolment).

INSTRUMENTS FOR DATA COLLECTION

AHA-ACSM pre-participation screening questionnaire: This was used to screen participants for cardiovascular risk factors and readiness to exercise before the individual starts an exercise program. The questionnaire contains three sections. Section one assesses for history of cardiovascular disease, section two assesses for symptoms, section three assesses for cardiovascular risk factors. The experimental group was screened with this instrument before starting the exercise regimen.

European Quality of Life Questionnaire (EQ-5D-5L): This was used to evaluate the health status of the participant. The EQ-5D-5L descriptive system comprises of five dimensions, each describing a different aspect of health namely: Mobility, Self-care, Usual activities, Pain/discomfort and Anxiety/depression. The health status scores from the EQ-5D-5L was coded and converted into a single summary number (index value) which reflects how good or bad a health state is. It has a consistent internal reliability of 0.85 and validity of 0.73 for the five dimensions among HIV population [14].

Height Meter**:** A locally made height meter was used to measure the subject's height in centimeter. It is a medical device that is used in human height measurement. It is made from a ruler and a horizontal headpiece that is sliding and can be adjusted to rest on the top of the head. Height meters are used routinely in medical assessment, tests and researches.

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METHOD OF DATA COLLECTION

Height: Height was measured in meter (m) using a height meter with subject barefooted. The feet of the participant was placed together on a level floor, and the upper back, buttocks and heels touching the scale, while the head was held erect. With the aid of a ruler, the point of greatest height perpendicular to the height meter reading was taken in meters (m) to two decimal places.
Cardiorespiratory fitness (Maximum oxygen consumption): The maximum oxygen consumption ($V0_{2max}$) was calculated using the resting heart rate equation [15].
VO2max = 15.3 x (MHR/RHR) where MHR = Maximum heart rate (beats/minute) = 208 - (0.7 x Age)
RHR = Resting heart rate (beats/minute) = 20 second heart rate x 3. The VO_{2max} was calculated at baseline and at 8-week.
Health Status: The EQ-5D-L was used to evaluate the health status of the participant. The questionnaire was administered to the participant by the researcher. The health status scores from the EQ-5D-5L was coded and converted into a single summary number (index value) which reflects how good or bad a health state is.

CIRCUIT EXERCISE TRAINING

Participants were grouped into 5-10 subjects for ease of supervision by the researchers. They filled out the demographic data sheet (age, gender, and educational status). Participants were screened for cardiovascular risk factors using AHA-ACSM Preparticipation Screening Questionnaire. After being certified fit for exercise, the exercise session commenced. Before the training period, the patients underwent an exercise familiarization session to ensure proper execution of technique. The participants trained 3 times a week (with at least 1 day of rest between sessions) at moderate intensity (50 – 75% MHR), and between 30- 60 minutes per session for 8 weeks under the supervision of the researchers. Each session included a warm-up and cool-down period involving 10 min of low-intensity and light stretching activities. The training program consisted of 10 types of resistance and aerobic exercise. Specifically, the resistance exercise program comprised of push-up, squat, crunches, side lunge and superman exercise and an aerobic exercise program comprised of a light jumping, running on the spot, foot stamping, steps, jumping jack. Each exercise in the training program was performed for 60 **sec**, and resting time was 20 seconds between stations and 3 min between sets.

DATA ANALYSIS

Data was analyzed using SPSS (Statistical Package for Social Sciences) Version 16.0 (SPSS Inc, Chicago, IL). The data collected was computed and summarized using the descriptive statistics of mean, standard deviation, percentages, and bar charts. . Paired sample t-test and independent sample t-test were used to determine the mean difference within and between the groups respectively. The differences between mean values were expressed at a confidence interval of 95%.

RESULTS

A total of 120 participants were recruited for this study. They were randomized to either the control group (60 participants) or exercise group (60 participants). The total mean value and standard deviation of age, and height are 41.31±8.38 and 1.61±0.81 respectively. The participants comprised of a total of 43(35.83%) males, and77 (64.17%) females. A total of 7(5.84%) participants had no formal education, 33(27.5%) had primary education, 37(30.83%) had secondary education, and 43(35.83) had tertiary education. Table I shows the socio-demographic characteristics of the participants.

Table I: Socio-Demographic Characteristics of the Participants

Variable	Control group (N=60) Mean±SD	Exercise group (N=60) Mean±SD	Total
Age(Years)	42.31± 8.71	41.00±8.04	41.31±8.38
Height (m)	1.61 ±0.78	1.61± 0.75	1.61±0.81
Gender			
Male	22 (36.7%)	21 (35%)	43 (35.83%)
Female	38 (63.3)	39 (65%)	77 (64.17%)

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Educational Level			
No education	2 (3.33%)	5 (8.33%)	7 (5.84%)
Primary	18 (30%)	15 (25%)	33 (27.5%)
Secondary	18 (30%)	19 (31.7)	37 (30.83%)
Tertiary	22 (36.7)	21(35%)	43 (35.83)

N= Number of participants; SD= Standard deviation; %=Percentage

Table II shows mean significant difference in cardiorespiratory fitness/maximum oxygen consumption ($V0_{2max}$), and health status within the intervention group after 8-week circuit exercise intervention.

Table II: Within Group Comparison of Cardiorespiratory Fitness ($Vo_{2max)}$) and Health Status

Variable	Mean	SD	Mean	SD	MD	*t*-value	*P*-value
	Pre		Post				
Control group (N=60)							
VO2max	35.24	5.32	35.29	4.67	-0.05	-0.91	0.928
Health status	0.81	0.11	0.81	0.10	0.00	0.04	0.966
Intervention group (N=60							
VO2max	35.31	5.43	37.57	4.63	-2.27	-4.22	0.000*
Health Status	0.81	0.13	0.89	0.06	-0.08	-8.87	0.000*

N= Number of participants; SD= Standard deviation; MD=Mean difference; *=Significant difference

Table III shows mean significant difference in $V0_{2max}$, and health status between the control and exercise groups after 8-week circuit exercise training.

Table III: Between Group Comparison of Cardiorespiratory Fitness ($Vo_{2max\_}$ and Health Status

	Control group (N=60) Mean	SD	Intervention group (N=60) Mean	SD	MD	*t*-value	*P*-value
Pre							
VO2max	35.24	5.32	35.31	5.43	-0.07	-0.07	0.947
Health status	0.81	0.11	0.81	0.10	0.00	0.15	0.965
Post							
VO2max	35.30	4.67	37.57	4.63	-2.27	-2.67	0.009*
Health Status	0.81	0.10	0.89	0.06	-0.08	-1.93	0.000*

N= Number of participants; SD= Standard deviation; MD=Mean difference; *=Significant difference

Figure 1 to 5 shows the proportion of response by level of severity for all the dimensions of health status using EQ-5D-5L at baseline and at 8-week in the intervention group .

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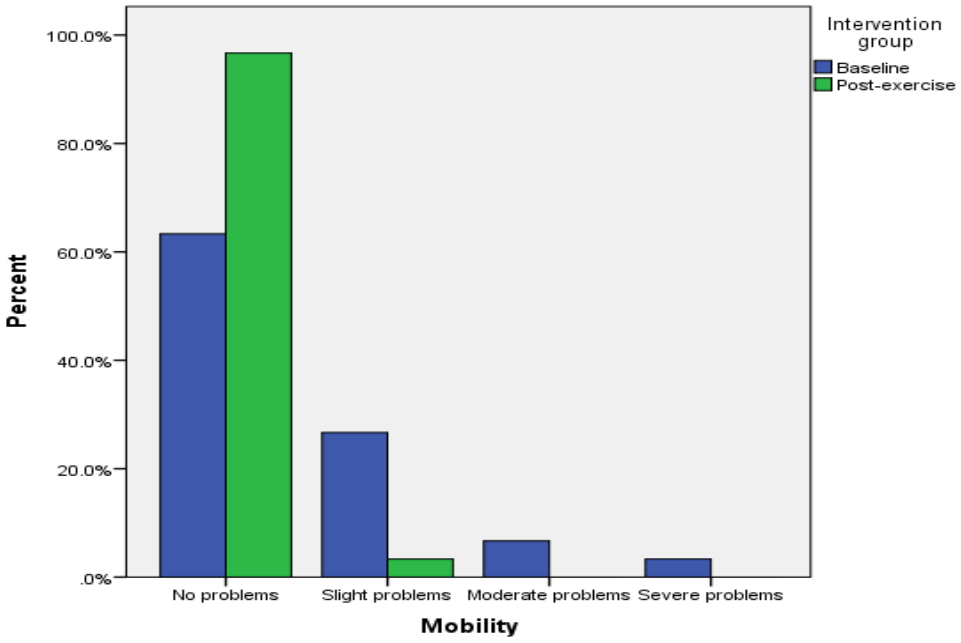

Fig 1: Changes in proportion of response in mobility at baseline and at 8-week within the intervention group.

Figure 1 shows that participants in the intervention group recorded only "no problem", and "slight problems" in mobility after t8-week circuit exercise intervention.

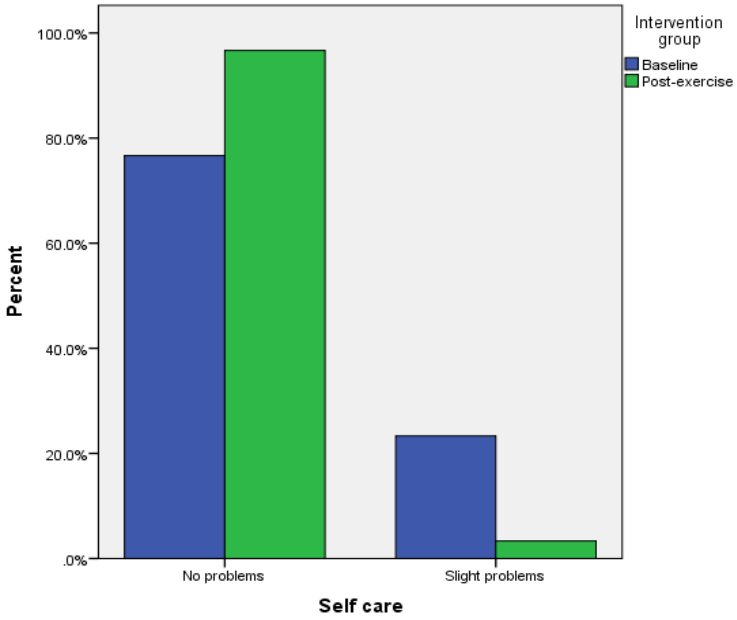

Fig 2: Changes in proportion of response in self-care at baseline and at 8-week within the intervention group.

Figure 2 shows that participants in the intervention group recorded "no problems", and "slight problems". After 8-week exercise training, majority of the participants recorded no problems and lesser number of the participants recorded slight problems.

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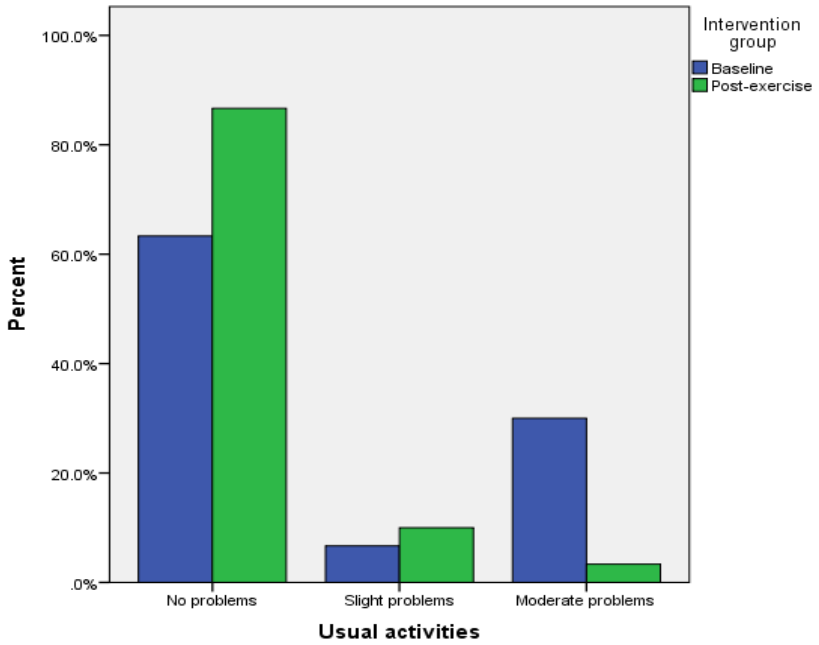

Fig 3: Changes in proportion of response in usual activities at baseline and at 8-week within the intervention group.

Figure 3 shows that more participants recorded moderate problems in usual activities at baseline. Majority of the participants recorded "no problems" and a lesser number recorded "slight problems" and moderate problems after the 8-week exercise intervention.

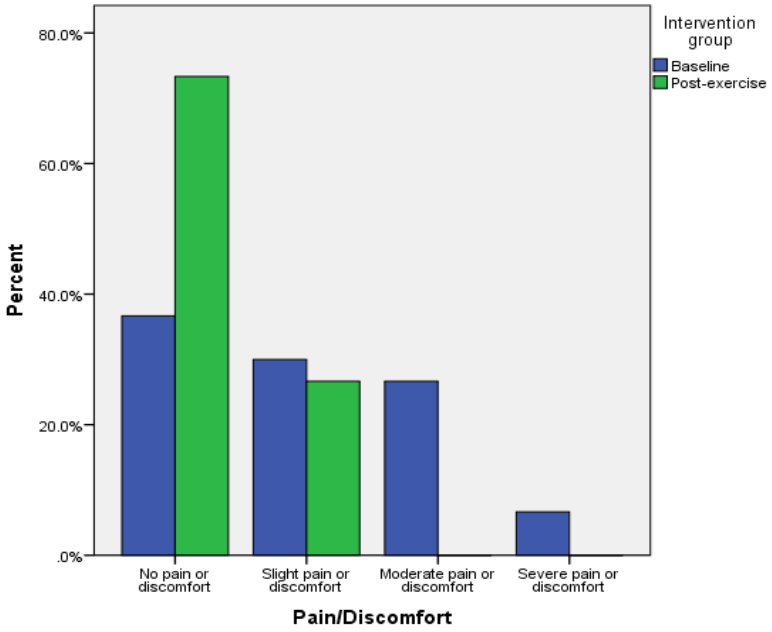

Fig 4: Changes in proportion of response in pain/discomfort at baseline and at 8-week within the intervention group.

Figure 4 shows that participants recorded only "no pain or discomfort" and "slight pain or discomfort" after 8-week exercise intervention.

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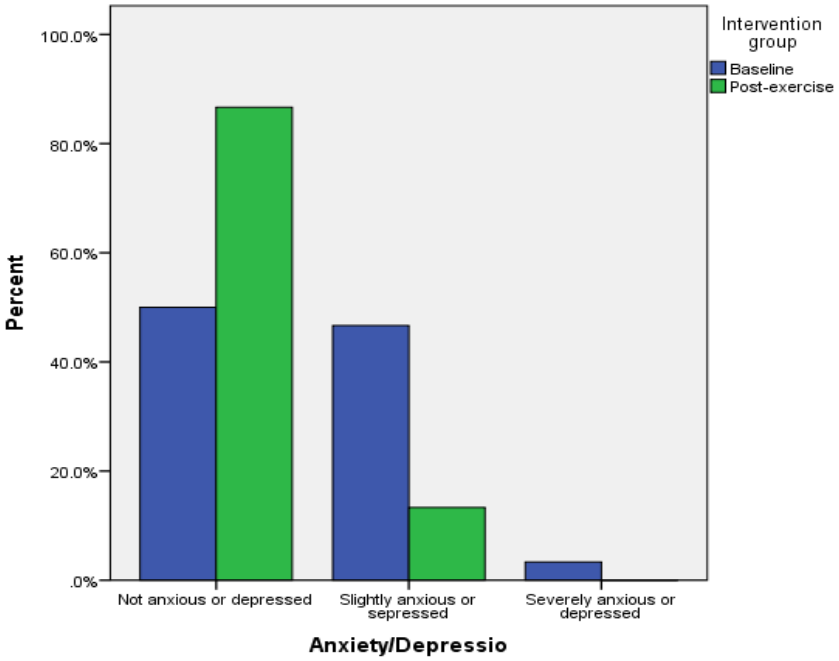

Fig 5: Changes in proportion of response in anxiety/depression at baseline and at 8-week within the intervention group.

Figure 5 shows that participants recorded "no anxiety/depression", and "slight anxiety and depression after the 8-week exercise intervention.

DISCUSSION

Findings from this study revealed significant improvement in the cardiorespiratory fitness/aerobic capacity (VO_{2max}) within the intervention group, and between the groups after 8-week exercise intervention. This result is in tandem with the report of O'Brien et al [16], that a community-based exercise intervention had a significant effect on $\dot{V}O_2$peak (0.56 ml/kg/min; 95% CI: -1.27, 2.39). The result is in agreement with findings of Ibeneme et al [17] that carried out a systematic review with meta-analysis which reported a significant improvement in VO_2 max following exercise intervention in people living with HIV. The result of the present study is also in agreement with the findings of a previous study [18], that there was significant improvement in aerobic fitness (VO_{2max}) in experimental group after 6-week moderate intensity exercise intervention in PLWH. Only very few studies have utilized circuit exercise design similar to the present study in HIV population. Findings from the present study is in tandem with the results a similar study [19] that reported significant improvement in aerobic capacity (VO_2 max) in experimental HIV and control normal group as compared to control HIV group after circuit exercise training. People infected with HIV have abnormally low cardiorespiratory fitness, expressed as lowered capacity to utilize oxygen ($VO_{2\ max}$) and perform physical work [4]. People living with HIV may have up to 9% lower VO_{2max} values, compared to age-matched healthy individuals [20]. People whose VO_{2max} falls below 27 ml/kg/min have a 40% higher probability of mortality than those with values greater than 27 ml/kg/min **[21]**. With an additional 70% reduction in all-cause mortality for improving VO_{2max} up to 38.5 ml/kg/min **[21].** From the present study the post exercise VO_{2max} of the asymptomatic (37.57 mL/kg/min) may represent a 40% reduction in mortality for HIV individuals. The VO_{2max} is implicated in health, and performance, with lower bounds of maximal oxygen consumption tied to higher risk of mortality and the upper bounds tied to elite level performance [21].

Findings from this study shows significant improvement in health status within the intervention group, and between the groups. The result of the present study is in concordance with the findings of a previous study [22], which reported a significant improvement in the score of health status in the exercise group compared to the control group among HIV population in Kano, Nigeria. The result of the present study is in disagreement with the findings of Perna et al [23], which reported no group significant

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difference in health status between compliant exercisers, non-compliant exercisers and the control group. Result from this study shows that 8-week circuit exercise intervention brought about improvement in the five domains used to ascertain the health status namely: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. In all the domains of health status (Figure 1 -5), following exercise intervention, the majority of the participants recorded "no problems" while a small proportion recorded "slight problems" except in the domain of usual activity where participants also recorded "moderate problems". Usual activity is associated with work, study, house work, and family or leisure activities. Greater attention should be given to other ways of improving usual activities in PLWH. It is worthy of note that the participants recorded "severe problems" in the domain of "pain/discomfort", and "anxiety/depression" at baseline., but after the exercise intervention they recorded "no problems", and "slight problems" only. People infected with HIV receiving HAART experience negative physical and physiological changes in addition to psychological responses such as anxiety, depression, agitation, confusion, nightmares, and mania, which collectively impact negatively on their health status and Qol. Participation in adequate physical activity generally tends to be associated with two main types of benefits such as physical benefits (reduced risk for ill-health conditions, improved fitness levels) and psychological benefits (mental **s**imulation during participation, improved psychological health)[24,25]. Therefore, the improvement in the health status in the present study may be as a result of positive effects of circuit exercise on the physical and psychological health of PLWH.

CONCLUSION

From the result of the study, 8-week circuit exercise intervention had a significant positive effect on the cardiorespiratory fitness and health status of PLWH.

Conflict of interest

The authors declare that there is no potential conflict of interest

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