



## **Effects of 6-Weeks Moderate Intensity Aerobic Exercise on CD4 Count, Bone Mineral Density and Weight of People Living with HIV/AIDS in Alex-Ekwueme Federal University Teaching Hospital Ebonyi State**

**Asogwa, Eucharía Ijego<sup>1</sup>, Obeagu, Emmanuel Ifeanyi<sup>2\*</sup>, Ekine, Rupee Suoton<sup>3</sup>,  
Asogwa, Okwudilichukwu Okwy<sup>4</sup>, Amaeze, Augustine Amaeze<sup>1</sup>,  
Amaeze, Florence Ngozi<sup>5,6</sup>, Kalu, Ochie<sup>7</sup>, Orizu, Ifeoma Ada<sup>8</sup>,  
Abraham, John Chukwuebuka<sup>9</sup> and Odochi, Ogbu Chukwu<sup>10</sup>**

<sup>1</sup>Department of Physiotherapy, College of Health Sciences, Evangel University, Akaeze, Okpoto Campus, Ebonyi State, Nigeria.

<sup>2</sup>Department of Medical Laboratory Science, Imo State University, Owerri, Nigeria.

<sup>3</sup>Department of Arts and Social Science Education, Ebonyi State University, Abakaliki, Ebonyi State, Nigeria.

<sup>4</sup>Alex-Ekwueme Federal University Teaching Hospital, Abakaliki, Ebonyi State (AE-FUTHA), Nigeria.

<sup>5</sup>Department of Medical Rehabilitation, University of Nigeria, Enugu Campus, Nigeria.

<sup>6</sup>Department of Health Education and Human Kinetics, Gregory University, Uturu, Abia State, Nigeria.

<sup>7</sup>Department of Radiography and Radiation Science, College of Health Sciences, Evangel University, Akaeze, Ebonyi State, Nigeria.

<sup>8</sup>Department of Physiology, University of Nigeria, Enugu Campus, Nigeria.

<sup>9</sup>Department of Anatomy, College of Health Sciences, Evangel University, Akaeze, Ebonyi State, Nigeria.

<sup>10</sup>Department of Physiology, College of Health Sciences, Evangel University, Akaeze, Ebonyi State, Nigeria.

### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author AEI designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors OEI, ERS, AOO and AAA managed the analyses of the study. Authors AFN, KO, OIA, AJC and OOC managed the literature searches. All authors read and approved the final manuscript.*

### **Article Information**

DOI: 10.9734/JPRI/2020/v32i2330784

Editor(s):

(1) Dr. Ana Cláudia Coelho, University of Trás-os-Montes and Alto Douro, Portugal.

Reviewers:

(1) Gopal Nambi, Prince Sattam Bin Abdul Aziz University, Saudi Arabia.

(2) Mehdi Khanbabayi, Tabriz University of Medical Science, Iran.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/61031>

## **ABSTRACT**

The main aim of this study was to find out the effects of 6 weeks moderate intensity aerobic exercises on CD4 count, bone mineral density and weight of people living with HIV/AIDS in Alex-Ekwueme Federal University Teaching Hospital, Ebonyi State. The study adopted experimental research design. The study was carried out from year 2019-February 2020. The population of the study was 40 HIV/AIDS patients that attended HIV clinics at AE-FUTHA which formed the sample size after two subjects declined from the control group in the study. Simple random sampling technique was adopted for the study. Flowcytometry (Partec Cyflow counter) Germany, Heel Densitometer (X-rite 331C), and Omron BF 400 were the instrument used for data collection of CD4 counts, BMD and weight respectively. Mean, standard deviation and ANCOVA were used to analyze the data obtained. The instruments were not validated because they are standard. The reliability coefficient obtained from the pilot study was 0.848, 0.835 and 0.994 for CD4, BMD and WEIGHT respectively. The major findings revealed that MIAE had positive effect on CD4 counts and BMD but negative effect on weight.

*Keywords: Moderate intensity aerobic exercise; CD4 count; BMD and weight; HIV.*

## **1. INTRODUCTION**

Moderate Intensity Aerobic Exercises (MIAE) or endurance exercise is defined as a regimen in moderate intensity form, containing aerobic interventions like walking, cycling, rowing, and stair stepping which promotes a significant effect in improving aerobic capacity, endurance and weight; measured by maximal oxygen consumption (Smith et al., 2001; [1]). MIAE are among the numerous forms of therapeutic exercises used in healthcare for patient's management, designed to prevent dysfunctions and improve wellness [2].

Research suggests that HIV-infected individuals can get significant physical and physiological benefits from both exercises after some weeks of training if performed three times a week at moderate intensity [3]. More specifically, Terry et al. [3] (2006) recorded that aerobic exercise is associated with improved body composition, significant increases in maximal oxygen consumption ( $VO_{2\max}$ ) and beneficial in lipid changes. Psychological components like fatigue, depression, and anxiety which are the most commonly experienced symptoms in HIV-infected individuals [4], are said to reduce significantly by aerobic exercise training [5] leading to several positive changes in the immune system especially evidence in CD4 count as long as the exercise intensity is between 40% to 60%  $VO_{2\max}$ . (Mackinnon, 1999).

Wallace and Ballard [6] noted that BMD is the amount of mineral per square centimeter of bones and the significance of its reduction is an indirect indicator of osteoporosis and fracture risk in people living with HIV/AIDS (PLWHA). According to the WHO Classification, BMD is commonly reported in terms of DXA T-score from dual X-ray absorptiometry scan (DXA). The results usually correlates with the bone life expectancy; while the peripheral bone density tests commonly used in research because of its portability, measures bone density in the lower arm, wrist, finger or heel and the tests are often used for screening purposes and can help identify people who might benefit from additional bone density testing (National Institute of Health [NIH], 2015). More specifically, subjects were always classified as normal if their T-scores were  $\geq -1$ , osteopenic if their lowest T-scores were between -1 and -2.5 and then osteoporotic if  $\leq -2.5$  [7]. Kisner and Colby [8] recorded reduced BMD and muscle strength in sedentary subjects and patients on prolonged bed rest as a result of deconditioning effects. They however discovered an increased level of muscular strength and muscular hypertrophy which was accompanied by physiological increase in actin, myosin, myofibrils, sarcoplasm and connective tissues like bone of people placed in MIAE which may be applicable to PLWHA.

Surprisingly, the risks associated with weight in PLWHA are rarely taken into considerations by

patients and physicians probably because of initial weight loss resulting from abnormal loss of peripheral subcutaneous fat (lipoatrophy) [9]. MIAE may be used to address unwanted changes in weight and body composition like HIV lipodystrophy in people living with HIV infection. HIV Lipodystrophy is usually caused by abnormal morphological alterations of fat production, distribution and utilization in individuals on antiretroviral therapy (ART) or highly active antiretroviral therapy (HAART) [10]. These abnormalities have been reported to include singularly or in combination; central fat accumulation; evidenced by increased abdominal girth (due to increase in visceral fat); development of a dorsocervical fat pad ("buffalo hump"); breast enlargement leading to abnormal weight gain (lipohypertrophy) and abnormal weight loss (lipoatrophy) in some parts of their bodies [11]. In fact, the study carried out by Guehi et al. [9] discovered that overweight and obesity are highly prevalent in HIV-infected persons with high CD4 cell counts who are on ART or HAART for over 24 months; and it was indicated as a predisposing factor for coronary artery disease in PLWHA [12]. Consequently, there has been suggestions for the use of abacavir or tenofovir in place of zidovudine or stavudine in control of HIV lipodystrophy by medical practitioners; while the study conducted by Siqiang [13] reported that MIAE is also very effective, in that it controls both body fat accumulations, improves insulin utilizations and stimulates muscle building in PLWHA who are on ART.

The main aim of this study was to find out the effects of 6 weeks moderate intensity aerobic exercises on CD4 count, bone mineral density and weight of people living with HIV/AIDS in Alex-Ekwueme Federal University Teaching Hospital, Ebonyi State.

## **2. MATERIALS AND METHODS**

### **2.1 Research Design**

This study adopted an experimental research design with an equivalent (randomized) pre-test and post-test data, utilized to observe the response of the dependent variables (CD4 count, BMD and Weight) of the treatment group (moderate intensity aerobic exercise).

### **2.2 Area of Study**

The setting for this study was at Physiotherapy department of AE-FUTHA in Ebonyi State.

### **2.3 Population for the Study**

These include all HIV/AIDS patients that attend HIV clinics at AE-FUTHA between December 2019 to February 2020. The researcher randomly grouped 40 volunteers who were on ART/HAART (anti-retroviral treatment /highly active anti-retroviral treatment) for not less than 24 months into 2 groups (A= aerobic group and B= control group).

### **2.4 Sample and Sampling Technique**

40 participants on ART/HAART who were willing to participate and met the inclusion criteria were randomly assigned to the two groups (A: aerobic, and B: control), using balloting by replacement [14]. However, only 38 subjects completed the study due to drop out by 2 persons from the control group. Thus, the sample size became 38 for the study.

### **2.5 Selection Criteria**

#### **2.5.1 Inclusion criteria**

- Only HIV/AIDS patients within the age range of 18 to 60 years.
- Only HIV/AIDS patients that have started taking their ART/HAART for the duration of 24 months and above, prior to the study, and attend HIV/AIDS clinics.

#### **2.5.2 Exclusion criteria**

- ✚ All subjects with previous history of cardiac and diabetic complications.
- ✚ Subjects that are 18 years, who by law has the right to take decision.
- ✚ Female subjects above 50 years and male above 60 years old, to avoid interference of post-menopausal BMD degeneration and normal old age degeneration, respectively.
- ✚ All pregnant subjects to avoid interference on CD4 count and weight.

### **2.6 Instrument for Data Collection**

The following instruments were used for data collection in this study:

- ✚ Flowcytometry (Partec Cyflow counter), Germany.
- ✚ Heel Densitometer (X-rite 331C) Germany.
- ✚ Omron BF400 weighing scale

## **2.7 Validation of the Instrument**

These instruments [i.e. Flow cytometry, FACS and Heel Densitometer (X-rite 331C)] are standard and used worldwide. Hence, it does not need to be validated.

## **2.8 Reliability of the Instrument**

The obtained data during trial testing was subjected to Pearson Product Moment Correlation Co-efficient and the result was 0.848, 0.835 and 0.994 for CD4, BMD and WEIGHT respectively.

## **2.9 Experimental Procedure**

The procedure for data collection in this research was assisted by 4 field assistants including; a Physiotherapist, a Radiologist, a Nurse, a laboratory Scientist and a medical doctor. The subjects were recruited at AE-FUTHA and informed consent was issued explaining the purpose, procedure, and relevance of the study before the onset of the intervention. All the willing participants were assessed for baseline data, which included age, weight, blood pressure (BP) and heart rate. Randomized control trial technique by balloting was used to divide the willing participants who met the inclusion criteria into two groups (A: aerobic and B: control). The aerobic group (A) had 18 sessions of sub-maximal aerobic exercises on Marshal fitness bicycle ergometer and PA Pro Acting treadmill which consists of four stages: (i) 3 minutes warm up (ii) 3-4 minutes to reach the Target Heart Rate (THR) (iii) 20 minutes holding of the range of the THR, and (iv) 3 minutes cool down. The intensity of the aerobic exercises were increased gradually in this order: 45-50% heart rate reserve during the first 2 weeks, 50-55% heart rate reserve during the second 2 weeks and 55-60% heart rate reserve during the last 2 weeks.

## **2.10 Method of Data Collection**

### **2.10.1 CD4 counts**

Blood samples were drawn venopunctually using syringe into a test-tube. Reagents used were brought to room temperature, 850µl of the count check bead green analyzed to make sure that the cyflow machine was working effectively. The needed numbers of Rohren test tubes were labelled appropriately and placed in a test tube rack. 20 µl of CD4 easy count kits (CD4

Mab-PE) were pipetted into them for the assay. Thereafter, 20 µl of blood samples were also pipetted into each test tube and incubated in the dark for 15 minutes at room temperature after mixing properly followed by the addition of 850 µl easy count. Lyse buffer was not added to each test tube. In order to avoid air bubbles, this was mixed properly and analyzed on the Partec Cyflow. The outcome was displayed and copied from the screen.

### **2.10.2 BMD**

The first step to data collection with X-rite heel densitometer is Nulling or zeroing the instrument. The instrument is nulled each time is to be used or each time is removed from patient's body, by pressing the 'null button'. With the subjects on standing position, his/her right toe is positioned at the center (90°) to the film area directly over the aperture under the 'reading arm'. The light table is then illuminated before measurement to locate film spots to be measured. The 'reading arm' is lowered on the body part while holding the 'null button' and the 'measurement button' is also pressed with the right index finger of the researcher and captures the reading. Both buttons are held down by the researcher until the reading displayed on screen was stable. The results are displayed in D (mg/cm<sup>3</sup>) and then converted to T-Score.

### **2.10.3 Weight**

The steps in data collection with Omron BF400 weighing scale started by setting the machine to display kilograms by adjusting the switch at the base, followed by placing it on the tile floor. The center of the scale was then pressed lightly with the researcher's foot to turn on the scale. The subjects were then asked to step onto the scale without their foot wears and heavy objects on them, placing their both feet side-by side on the feet prints land mark. However, the readings were displayed on screen and the records taken with the subject still standing still and upright on the scale.

## **2.11 Method of Data Analysis**

The data obtained (i.e. CD4, BMD and WEIGHT) in the main study were analyzed using mean, standard deviation and analysis of covariance (ANCOVA).

### **3. DATA ANALYSIS, PRESENTATION, AND INTERPRETATIONS OF RESULTS**

The result in the Table 1 above revealed that the participants in experimental group who took part in the MIAE had higher pre-test observed mean in CD4 counts before the onset of the intervention compared to their counterparts in the control group with 500.95 and 461.28 respectively. Participants in aerobic exercise had the mean value of 566.80 while subjects in control group had 384.61 after 6 weeks experiments, with (posttest -pretest) differences of 65.85 and -76.67 for the MIAE and control groups respectively. However, the mean difference between the two groups (MIAE and control) before and after 6 weeks experiments are 39.67 and 182.19 respectively; showing a positive therapeutic gain of  $(182.19 - 39.67 = 142.52)$  in favor of the aerobic group. However, the difference in standard deviation between pre-test and post-test data is heterogeneous for both groups (i.e. no similarity) as the STD  $(13.27 - \{-12.16\} = 25.43)$  is above 0.9.

The result in the Table 2 above revealed that the participants in experimental group who took part in the moderate intensity exercise (MIAE) had higher pretest observed mean in BMD compared to their counterparts in the control group. Those who were exposed to MIAE had mean value of 0.89 while those in control group had 0.68 for the pre-test. While the participants in MIAE had a mean value of 1.37 and the control group had 0.44 post-tests. However, the difference in observed mean for each groups after 6 weeks' intervention are 0.48 and -0.24 for MIAE and Control groups respectively. More so, the mean difference between the two groups (MIAE and control) are 0.21 and 0.93 for both pre-test and post-test values respectively; showing a positive therapeutic mean gain of  $(0.93 - 0.21 = 0.72)$  in favor of subjects in the intervention group (i.e. those who participated in MIAE). However, the difference in standard deviation values between pretest and posttest is homogeneous for both groups (i.e. there is similarity) as the STD  $(-0.61 + 0.26 = -0.35)$  is less than 1.

The result in the Table 3 above revealed that the participants in experimental group who took part

in the MIAE had higher pre-test observed mean in weight before the onset of the intervention compared to their counterparts in the control group with 70.83 and 67.08 respectively. Participants in MIAE group had the mean value of 69.93 while subjects in control group had 67.57 after 6 weeks experiments, with (posttest - pretest) differences of -0.9 and 0.49 for the MIAE and control groups respectively. However, the mean difference between the two groups (MIAE and control) before and after 6 weeks experiments are 3.75 and 2.36 respectively; showing a positive therapeutic gain of  $(2.36 - 3.75 = -1.39)$  in favor of the aerobic group. However, the difference in standard deviation values between pretest and posttest for both groups is homogeneous (i.e. there is similarity) as the STD  $(-0.12 - \{-0.22\} = 0.10)$  is less than 1.

The result in the Table 4 is on the effect of aerobic exercise on CD4 count of subjects. The table shows a probability value (significant value) of 0.000 for Aerobic and control groups. The significant value in the Table 4 for groups is less than the alpha level of 0.05. Then, the earlier stated null hypothesis is not accepted. Thus, there is a significant difference after 6 weeks' moderate intensity aerobic exercises on CD4 count of people living with HIV/AIDS.

The result in the Table 5 is on the effect of aerobic exercise on BMD of subjects. The table shows a probability value (significant value) of 0.016 for Aerobic and control groups. The significant value in the Table 5 for groups is less than alpha level of 0.05. This means that the hypothesis earlier stated is rejected. Thus, there is a significant difference after 6 weeks' moderate intensity aerobic exercises on BMD of people living with HIV/AIDS.

The result in the Table 6 is on the effect of aerobic exercise on WEIGHT of participants in this study. The table shows a probability value (significant value) of 0.750 for Aerobic and control groups. The significant value in the Table 6 for groups is above the alpha level of 0.05. This means that the hypothesis earlier stated is accepted. Thus, there is no significant difference after 6 weeks' moderate intensity aerobic exercises on WEIGHT of people living with HIV/AIDS.

**Table 1. Effects of 6 (six) weeks moderate intensity aerobic exercise (MIAE) on CD4 count of people living with HIV/AIDS**

<b>Group</b>	<b>N</b>	<b>Pre-test Mean</b>	<b>Post-test Mean</b>	<b>Differences in Mean (Post-Pre)</b>	<b>Pre-test Standard Deviation</b>	<b>Post-test standard deviation</b>	<b>Differences in STD (Post-Pre)</b>
MIAE	20	500.95	566.80	65.85	225.25	212.47	-12.78
Control	18	461.28	384.61	-76.67	237.41	199.20	-38.21
Difference in Mean Effect		39.67	182.19		-12.16	13.27	

**Table 2. Effects of 6 (six) weeks moderate intensity aerobic exercise on BMD of people living with HIV/AIDS**

<b>Group</b>	<b>N</b>	<b>Pre-test Mean</b>	<b>Post-test Mean</b>	<b>Differences in Mean (Post-Pre)</b>	<b>Pre-test standard deviation</b>	<b>Post-test Standard deviation</b>	<b>Differences in STD (Post-Pre)</b>
MIAE	20	0.89	1.37	0.48	0.60	0.27	-0.61
Control	18	0.68	0.44	-0.24	0.86	0.88	0.02
Difference in Mean Effect		0.21	0.93		-0.26	-0.61	

**Table 3. Effects of 6 (six) weeks moderate intensity exercise on weight of people living with HIV/AIDS**

<b>Group</b>	<b>N</b>	<b>Pre-test Mean</b>	<b>Post-test Mean</b>	<b>Differences in mean (Post-Pre)</b>	<b>Pre-test standard deviation</b>	<b>Post-test standard deviation</b>	<b>Differences in STD (Post-Pre)</b>
MIAE	20	70.83	69.93	-0.9	17.62	17.03	-0.59
Control	18	67.08	67.57	0.49	17.84	17.15	-0.69
Difference in Mean Effect		3.75	2.36		-0.22	-0.12	

**Table 4. There will be no significant difference after 6 weeks' moderate intensity aerobic exercises (MIAE) on CD4 count of people living with HIV/AIDS**

Dependent Variable: Posttest					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1401821.269 <sup>a</sup>	2	700910.634	55.130	.000
Intercept	88284.754	1	88284.754	6.944	.012
<b>Group (MAIE/CONTROL)</b>	<b>218197.567</b>	<b>1</b>	<b>218197.567</b>	<b>17.162</b>	<b>.000</b>
Pretest CD4	1087363.247	1	1087363.247	85.527	.000
Error	444978.231	35	12713.664		
Total	10620249.000	38			
Corrected Total	1846799.500	37			

a. R Squared = .759 (Adjusted R Squared = .745)

**Table 5. There will be no significant difference after 6 weeks moderate intensity aerobic exercises (MIAE) on BMD of people living with HIV/AIDS**

Dependent Variable: Posttest					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	372420.630 <sup>a</sup>	2	186210.315	4.420	0.019
Intercept	3242846.926	1	3242846.926	76.981	0.000
<b>Group (MAIE/CONTROL)</b>	<b>271143.253</b>	<b>1</b>	<b>271143.253</b>	<b>6.437</b>	<b>0.016</b>
PretestBMD	57962.608	1	57962.608	1.376	0.249
Error	1474378.870	35	42125.111		
Total	1.062E7	38			
Corrected Total	1846799.500	37			

a. R Squared = .202 (Adjusted R Squared = .156)

**Table 6. There will be no significant difference after 6 weeks' moderate intensity aerobic exercises (MIAE) on weight of people living with HIV/AIDS**

Dependent Variable: Posttest					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1494.157 <sup>a</sup>	2	747.079	2.875	0.070
Intercept	4303.885	1	4303.885	16.561	0.000
<b>Group (MAIE/CONTROL)</b>	<b>26.733</b>	<b>1</b>	<b>26.733</b>	<b>.103</b>	<b>0.750</b>
Pretest WEIGHT	1417.597	1	1417.597	5.455	0.025
Error	9095.789	35	259.880		
Total	189303.940	38			
Corrected Total	10589.947	37			

a. R Squared = .141 (Adjusted R Squared = .092)

#### 4. DISCUSSION

In Table 1, the findings revealed that the mean difference of CD4 counts between the groups after 6 weeks intervention is 142.52 in favor of subjects in the treatment group (i.e. those who participated in MIAE). The difference in observed mean after 6 weeks' intervention of the aerobic group is 65.85 while that of control is -76.67, showing positive therapeutic benefits in favor of the aerobic group. However, the difference in standard deviation between pretest and posttest

is heterogeneous for both groups (no similarity) as it is above 0.9. Thus, the finding shows that MIAE had positive effect on CD4 counts of people living with HIV/AIDS and it is in agreement with the findings of Pederson and Toft [15] which states that MIAE increases T cells (CD4, CD8 and B cells). The finding is also in line with Baker et al. [16] which asserted that MIAE benefits the immune system. In a similar study conducted by Maduagwu et al. [17], the author observed that MIAE had an increase on CD4 cells of HIV patients too. However, this

finding is not in agreement with that of Ibeneme et al. [18] which reported contrary in their experiment that 6 weeks' MIAE has no significant effect on CD4 counts of patients living with HIV/AIDS. Though, the finding did not agree with Ibeneme et al. [18], yet the works done by Ezema et al. [19] and Tiozzo et al. [20] agreed with the finding of this study which discovered that MIAE had statistical significant increase effect on CD4 count of PLWHA.

In Table 2, the findings revealed that the mean difference between the groups is 0.72 in favour of subjects in the intervention group (i.e. those who participated in MIAE). The difference in observed mean after 6 weeks intervention of the MIAE group is 0.48 while that of control is -0.24, showing a positive therapeutic increase in favour of the MIAE group. However, the difference in standard deviation values between pretest and posttest is homogeneous for both groups (there is similarity) the value is less than 1. The result shows that there was an increase in BMD of people living with HIV/AIDS who participated in MIAE. Thus, this finding is in line with Alghadir et al. [21] who reported that MIAE resulted to an increase in BMD of PLWHA (people living with HIV/AIDS). On the contrary, Ibeneme et al. [18] found no significant increase in BMD of PLWHA who participated in MIAE. However, the result of this study shows a significant increase on BMD of PLWHA and does not concur with Ibeneme et al. [18]. Moreover, this finding agrees with Alghadir et al. [21] who equally observed that MIAE brought about a significant increase in BMD of PLWHA.

In Table 3, the findings revealed that the difference in observed mean between the groups after 6 weeks intervention is -1.39 in disfavor of MIAE group. The mean difference of weight in MIAE group is -0.9 while that of control is 0.49, showing a weight loss for the MIAE group and a slight WEIGHT gain for participants in the control group at the end of 6 weeks. However, the difference in standard deviation values between pretest and posttest for both groups is homogeneous (i.e. there is similarity) as it is less than 1. This result is in agreement with studies according to Aktas et al. [22] who observed in their study that MIAE brought about reduction in the weight of people living with HIV/AIDS. In the same vein, Suman [23] found in his study that aerobic exercise is considered as one of the best exercises to reduce body weight. Though the reduction shows no significant difference after 6 weeks moderate intensity aerobic exercises on

weight of people living with HIV/AIDS. This finding is similar with that of Aktas et al. [22] who observed a reduction that does not have statistical significant effect on the weight of people living with HIV/AIDS. On the contrary, the finding is not in agreement with Suman [23] who reported a statistical significant reduction of weight on MIAE group.

## **5. CONCLUSION**

The major findings show that MIAE has a positive therapeutic benefit on PLWHA who are on ARV therapy. This is trending with the recorded evidences of MIAE on improving immune system which CD4 cells is most considerable in PLWHA. Moreover, MIAE group in another finding also revealed higher increase in BMD when compared with subjects in the control group. Furthermore, MIAE group revealed slight decrease in WEIGHT than subjects in the control group. This was expected because aerobic exercises are generally meant for cardiovascular fitness and are considered to have tendency in weight reduction. The revealed significant difference of moderate intensity aerobic exercises on CD4 count and BMD of people living with HIV/AIDS shows that MIAE has a positive therapeutic benefit on immune system and osteoblastic activity and ultimately bone remodeling. The no significant difference in moderate intensity aerobic exercises on WEIGHT of people living with HIV/AIDS was because aerobic exercises generally improve weight reduction.

## **6. LIMITATIONS OF THE STUDY**

1. Refusal of many subjects to participate resulted to few number of subjects.
2. The economic situation of the country led to financial difficulties on both intervention group and the researchers.

## **7. RECOMMENDATION**

The followings are the recommendations based on the findings of the study:

1. Awareness should be created by Physiotherapists, Exercise Physiologists, Physicians, Counselors and Health Educationists to the government in order to adjunct aerobic exercise compulsorily in the management of PLWHA.

2. Physiotherapists, Exercise Physiologists, Health Educationists, Physicians and counselors should endeavor to educate PLWHA, encouraging them to participate in activities involving aerobic exercise in order to obtain better immune system and BMD.
3. Health educators and health care givers should encourage PLWHA who are obese with abnormal fat distribution to take part in aerobic exercise as it may help them in weight reduction.

## 8. SUGGESTIONS FOR FURTHER STUDY

1. The duration of further studies should be increased for optimal result
2. Equipment that should monitor physiological responses of MIAE on CD4 counts, BMD and Weight should be used to conduct another study in order to appreciate the mechanism of actions.

## CONSENT AND ETHICAL APPROVAL

With a well detailed research proposal and a letter of introduction from the Head of Department, Consent form and an application letter were submitted to the Head, Health Research and Ethics Committee of the Institution was met. After their meetings and thorough perusal of the protocols of the research, an ethical approval was given for the study. Participants' written consent has been collected and preserved by the author(s).

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. O'Brien K, Nixon S, Tynan AM, Glazier RH. Effectiveness of aerobic exercise in adults living with HIV/AIDS: Systematic review. *Med Sci Sports Exerc.* 2004;36(10):1659-66.
2. American Physical Therapy Association. Guide to physical Therapist practice, 2<sup>nd</sup> ed. *Phys Ther.* 2001;81:9-744.
3. Terry L, Sprinz E, Ribeiro JP. Moderate and high intensity exercise training in HIV-1 seropositive individuals: A randomized trial. *Int J Sports Med.* 2006;20:142-146.
4. Ciccolo JT, Jowers EM, Bartholomew JB. The benefits of exercise training for quality of life in HIV/AIDS in the Post-HAART Era (1<sup>st</sup> ed). *Comprehensive Clinical Psychiatry.* 2004;34(8):487-99.
5. Schlenzig C, Jager H, Rieder H. Supervised physical exercise leads to psychological and immunological improvement in pre-AIDS patients. *Proceedings of the 5<sup>th</sup> International AIDS Conference, Montreal, Canada; 1989.*
6. Wallace LS, Ballard JE. Osteoporosis and fracture risk in elderly women. *Journal of clinical Endocrinology and Metabolism.* 2000;8(1):4118-4124.
7. Kanis JA, Johnell A, Oden A, Dawson C, Laet DC, Jonsson B. Ten year probabilities of osteoporotic fractures according to BMD and diagnostic thresholds. *National Library Medicine; 2001.* Available: <https://www.ncbi.nlm.nih.gov>
8. Kisner C, Colby LA. *Therapeutic exercise foundations and techniques.* 6<sup>th</sup> ed: Arch street Philadelphia, PA. 2012;19103. Available: <http://davisplus.fadavis.com>
9. Guehi C, Badjé A, Gabillard D, Ouattara E, Koulé SO, Moh R, Ekouevi D, Ahibo H, N'Takpé JB, Menan K, Deschamps N, Lecarrou J, Eholié S, Anglaret X, Danel C. High prevalence of being overweight and obese HIV-infected persons, before and after 24 months on early ART in the ANRS 12136 Temprano Trial. *AIDS Res Ther.* 2016;12(13). DOI: 10.1186/s12981-016-0094-y Department of Infectious Diseases, Treichville Hospital, Abidjan, Côte d'Ivoire.
10. Mashinya F, Alberts M, Colebunders R, Geertruyden VJP. Weight status and associated factors among HIV-infected people on antiretroviral therapy in rural Dikgale, Limpopo, South Africa. *Afr J Prm Health Care Fam Med.* 2016;8(1):a1230.
11. Chou R, Huffman LH, Fu R, Smits AK, Korthuis PT. Screening for HIV: A review of the evidence for the U.S. preventive services task force. *Annual of Internal Medicine.* 2005;143(1):55-73.
12. Mupere E, Malone L, Zalwango S, Chiunda A, Okwera A, Parraga I. Lean tissue mass wasting is associated with increased risk of mortality among women with pulmonary tuberculosis in urban Uganda. *Ann Epidemiol. Uganda.* 2012;22:466-73.
13. Siqiang G. Experimental study of aerobic exercise on the weight loss effect of obese female college students. *Biomedical*

- Research, Special Issue: S193-S196. College of Physical Education and Health, Zhaoqing University, Zhaoqing 526061, Guangdong, PR China; 2018.
14. Mohar D, Dulbarg CS. Statistical power, sample size, and their reporting in randomized controlled trials. *JAMA*. 1994; 272:122–4.
  15. Pederson BK, Toft AD. Effects of exercise on lymphocytes and cytokines. *British Journal of Sports Medicine*. 2000;34(4): 246-251.
  16. Baker JV, Peng G, Rapkin J. CD4+ count and risk of non-AIDS diseases following initial treatment for HIV infection. *AIDS*. 2008;22:841–8.
  17. Maduagwu SM, Sokunbi GO, Bwala MP, Akanbi OA, Jajere AM. Work-related musculoskeletal disorders among self-employed sewing machine operators in Maiduguri, Nigeria. *Occup Med Health Aff*. 2015;3:219.
  18. Ibeneme CS, Irem OF, Iloanusi IN, Ezuma DA, Ezenwankwo EF, Okere CP, Nnamani OA, Ezeofor NS, Dim RN, Fortwengel G. Impact of physical exercises on immune function, bone mineral density, and quality of life in people living with HIV/AIDS: A systematic review with meta-analysis. *BMC Infectious Diseases*. 2019;19:340.
  19. Ezema CI, Onwunali AA, Lamina S, Ezugwu UA, Amaeze AA, Nwankwo MJ. Effect of aerobic exercise training on cardiovascular parameters and CD4 cell count of people living with human immunodeficiency virus/acquired immune deficiency syndrome: A randomized controlled trial. *BMC Infectious Diseases*. 2014;17(5):543–8.
  20. Tiozzo E, Jayaweera D, Rodriguez A, Konefal J, Melillo AB, Adwan S, Chen L, Parvus C, Figueroa M, Hodgson N, Woolger JM, Kanka R, Perry A, Lewis JE. Short-term combined exercise training improves the health of HIV-infected patients. *J AIDS HIV Res*. 2013;3(5):80–94.
  21. Alghadir, A. H., Aly, F. A., & Gabr, S. A. (2014). Effect of moderate aerobic training on bone metabolism indices among adult humans. *Pak J Med Sci.*, 30(4):840-844.
  22. Aktas S, Ozdil G, Bagis O Guven F. The effects of 8-week aerobic training on body weight among sedentary females. *Turkish Journal of Sport and Exercise*. 2016;18(2): 113-116.
  23. Suman C. Aerobic exercise programme and reduction in body weight and Body Mass Index (BMI). *Galore International Journal of Health Sciences and Research*. 2016;1(1):2456-9321.

---

© 2020 Ijego et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

*Peer-review history:*  
*The peer review history for this paper can be accessed here:*  
<http://www.sdiarticle4.com/review-history/61031>