

# Effect of Different Types of Exercise in HIV + Mozambican Women Using Antiretroviral Therapy

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**Abstract:** The aim of this study was to evaluate and compare the effect of two types of exercises interventions on the regularity and health-related physical fitness in HIV-infected individuals who use antiretroviral therapy (ART). A total of 53 HIV+ African women (mean age=39.5±8.4 years) on ART participated in the study. Subjects were randomly divided into 3 groups, namely, formal exercise (FEG), playful exercise (PEG) and control (CG). During 12 weeks, the exercise groups underwent a program of 1-hour duration with a frequency of 3 times a week. The FEG performed a protocol that included 20 minutes of exercise, cycling at 60 % of  $\dot{V}O_{2peak}$ , increasing to 75 % and 85 % in the 4th and 8th weeks, respectively, and a muscular endurance circuit consisted of 6 exercises at 15 repetitions per minute (RM). The PEG followed a program consisting of active games. Before and after the intervention the participants were submitted to a clinical evaluation including immunological parameters (CD4+), cardiovascular risk factors, physical fitness and anthropometry. Comparison of somatic variables before and after the program showed no exercise effect. Immunological and cardiovascular variables were also independent of the exercise group. The main effect was found in cardiorespiratory fitness: exercise groups increased significantly in  $\dot{V}O_{2peak}$  (FEG=14.7 %; PEG=11.1 %) with no significant differences in CG. The percentage of high attendance was identical between the two groups. It was concluded that there is no contraindication for exercise in this type of population and the beneficial effect was mainly in cardiorespiratory fitness, regardless of the type of exercise performed.

**Keywords:** Africa, exercise, HIV, intervention methods, ARVT, women.

## INTRODUCTION

The acquired immunodeficiency syndrome (AIDS) has, in recent decades, taken a worldwide epidemiological priority with an estimation of 34 million people being HIV positive, while 2.5 million have already developed clinical symptoms of the disease [1]. With some regional variability, HIV positive prevalence in Mozambique is about 11.5%, mainly concentrated among the inactive and the reproductive population, which results in a high negative impact on the Mozambican economy [2].

Although prevention is recognized as the most effective solution for reducing the incidence of HIV/AIDS, for those who are already infected, antiretroviral therapy (ART) has become a widespread intervention, and because of its success, has transformed the condition from a fatal to a chronic disease [3, 4]. However, the use of ART produces collateral effects that affect the quality of life of patients, including metabolic, somatic and psychological disorders [5, 6].

Among the strategies to deal with the direct effects of HIV and the secondary effects of ART, exercise has been shown to provide many health benefits, ranging from increased aerobic capacity to mood improvement [7]. It is expected that people with HIV/AIDS can reap some of the benefits of exercise, as the general population [8, 9]. Although research in this specific topic is limited, therapeutic exercise is becoming an alternative therapy, commonly prescribed for people with HIV/AIDS [3, 10, 11].

Research results on the benefits of exercise for individuals with HIV/AIDS and the secondary effects ART's are conflicting and inconclusive, often due to small sample size and a high percentage of dropout [12]. Due to variability in research methods and the influence of factors such as type, frequency, intensity and duration of exercise, conclusions are less consistent regarding the safety and efficacy of the programs [13]. Associated with this lack of specific findings about exercise and HIV, the recommendations regarding the prescription of exercise for developing and maintaining cardiorespiratory fitness in subjects with HIV/AIDS differs little from that stated for the general populations [11, 14].

A specific problem with exercise programs for subjects with HIV/AIDS is the high dropout rates, as well as the low levels of regularity of exercise participation [15]. In the

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modern world, the so-called “obesogenic environment” limits exercise adherence, which is aggravated in the population infected with HIV/AIDS due to the disease-related symptoms. This calls for specific methodologies that lead to a better retention and regularity of exercise [16, 17].

Manipulation of the type of exercise could be a key point in reducing exercise dropout, considering that pleasure may increase exercise adherence [18]. Although the enormous variability in exercise mode does not allow for the classification of all structured forms of exercise programs, experimental studies tend to compare formal and playful practices [19, 20]. The first is characterized by a design where the workload is individually determined and controlled accurately on an individual basis [10], whereas the second is performed in groups, prioritizing interaction and pleasure [21, 22]. Research on the exercise benefits using these different types of intervention for the population with HIV/AIDS has not been systematically studied.

The aim of this study was to evaluate and compare the effect of formal exercise *versus*—playful activity on the exercise regularity and the health-related fitness components of HIV-infected individuals who take ART.

## METHODOLOGY

### Sample

Subjects were volunteers recruited from among the patients who attended Health Center and a community organization, both located in a peri-urban, low socioeconomic area of Maputo. To be accepted, subjects were required to be Mozambican, female, HIV positive, taking ART for at least the last 6 months, aged between 18 to 56 years and be in a stable clinical condition. Subjects were required to have a CD4+ count above 200 cells/mm<sup>3</sup>, not be involved in regular exercise for the last 6 months and to not have any clinical condition that may impair performance of regular exercise.

Initially there were 80 volunteers, from which 12 did not meet the qualifying conditions and were eliminated. Another 13 individuals were excluded after the initial test battery due to their physical limitations, leaving 55 subjects, of which 53 finished the study.

All participants agreed to voluntarily participate in the study and signed informed consent. The study was approved by the National Bioethics Committee on Health (ref: 180/CNBS/ 11) of the Ministry of Health of Mozambique.

### Clinical Evaluation

Physical assessment was performed before and after the intervention program. All study participants underwent a structured interview and clinical assessment, including a resting ECG, performed by a physician and a cardiologist.

### Blood Samples

An 8 ml blood sample was obtained by venipuncture to measure CD4+T cell count, HIV-1 viral load, hematology, glycaemia and blood lipids. The blood samples were collected and analyzed following biosafety procedures. The

CD4+T cell count was performed on whole blood using a FACS-Calibur<sup>TM</sup> instrument with MultiTest reagents, TruCOUNT tubes and MultiTEST software (all from Becton Dickinson, USA). HIV-1 viral load was determined using a COBAS<sup>®</sup> TaqMan system 48 Analyser with COBAS<sup>®</sup> TaqMan HIV-1 test reagents (Roche Diagnostics, Germany) for automated amplification and detection of nucleic acid with limit of detection above 20 copies/ml. Haematological parameters were measured within six hours after blood sample collection using an automated hematology analyser, the Sysmex KX21 (Sysmex Corporation, Japan), and glycaemia and lipid profiles were analyzed by using the Selectra Junior (Vital Scientific NV, The Netherlands). All testing were performed at the laboratory of the Instituto Nacional de Saúde, Ministry of Health, Mozambique.

### Anthropometry

Anthropometric measurements to determine body composition, included height, weight, waist circumference and body fat folds.

Height was measured using a digital stadiometer SECA model 2421814009 with the subject barefoot and heels together. Weight and percent body fat were evaluated by bioimpedance with a digital TANITA scale (BF350 model) with a maximum capacity of 200 kg and an accuracy of 100 grams. The subjects were weighed wearing light clothing and no shoes. The waist circumference was measured at the level of the umbilical region with the subject in the anatomical position, breathing normally, with the tape placed parallel to the ground, and minimal pressure exerted on the body. Two measures were made, and the average score was recorded.

The skinfolds included triceps, subscapular, supra iliac, abdominal, thigh and calf using a Harpenden Caliper (model 10931) with a 0.2 mm scale and constant pressure of 10 g/mm<sup>2</sup>. With the exception of the abdominal, all skinfolds were performed on the right side at each location. The measures were taken twice and in the case where the first two measures were not equal a third measurement was taken. The average of the three values was recorded. The sum of the skinfolds was used as a second indicator for comparing changes in body fat.

### Physical Fitness

Health-related physical fitness tests were carried out immediately after the anthropometric assessments. Sit and reach was used for measuring lower back and hamstring flexibility, and curl ups for abdominal endurance using the Fitnessgram Protocol [23]. Handgrip strength was evaluated using the EUROFIT protocol [24] with a handgrip dynamometer GRIP-D (TKK 5401).

### $\dot{V}O_{2max}$

Cardiopulmonary assessment was conducted using a maximal oxygen uptake test ( $\dot{V}O_{2max}$ ) on a treadmill. An adapted Balke protocol was applied to all subjects, before and after the intervention. Speed remained constant, as in the original protocol (5.3 km h<sup>-1</sup>), but the incline increased 2% per minute instead of 1%. During the pilot tests, this

increment has been found to be optimal to complete the test in 8 to 12 minutes for this specific population. In the case where subjects were unfamiliar with the treadmill, they performed a walk in the pre-test. Oxygen uptake was measured *via* breath-by-breath sampling using a K4-Cosmed device. Blood pressure was assessed at rest and during every second exercise stage for subjects at risk, using auscultation. Rating of perceived exertion (RPE) was assessed at all exercise stages using the Borg scale of 11 points for perceived exertion [25].

The test was interrupted based upon a respiratory quotient (RQ) >1.0, a heart rate (HR) higher than the predicted maximal HR (220-age) and a value of 10-11 for the Borg scale. In all cases, the absence of an increase in O<sub>2</sub> consumption from one stage to another or a decision by the subject to stop determined the cessation of the test.

### Training Groups

Using a computer function for randomization, subjects were randomly split into three groups, namely formal exercise group (FEG; n=19), playful exercise group (PEG; n=18) and control group (CG; n=16). After randomization, the variables between the study groups were tested to ensure that groups were statistically homogeneous.

### Exercise Program

The exercise program lasted 13 weeks with a frequency of participation of three times per week of one-hour duration. The day and place of exercise participation were the same for both groups.

### Formal Exercise

The FEG performed aerobic training for 20 minutes on a Monark stationary bike, followed by circuit weight training, with free weights and stretching exercises.

The intensity of aerobic exercise was based on the percentage of maximum HR, evaluated from the maximal exercise test, using a Polar (FS1 model) cardio-frequency meter. HR reserve/ $\dot{V}O_2$  curves were calculated for each individual. The intensity was maintained at 60%, 75% and 80-85%  $\dot{V}O_2$  peak for weeks 1- 4, 5-8 and 8-12, respectively. These exercise intensities were adjusted with the subject using the Borg scale to enable the subject to maintain the prescribed exercise intensity for 20 minutes.

The circuit weight training consisted in a circuit of six exercises with one set of 15 repetitions, namely (1) horizontal bench press, (2) horizontal row, (3) arm flexion, (4) arm extension, (5) squat and (6) curl up. For the exercises with dumbbells, the 15 repetition maximum (RM) was estimated and adopted, and reevaluated every 4 weeks.

### Playful Exercise

The PEG performed a program that consisted of a warm-up period of 15 minutes, a main session for 40 minutes and a cool-down for 5 minutes. The main session consisted of a large variety of aerobic activities, mainly performed as a group, including activities such as dancing, skipping and a

large variety of pre-sports games. Conventional equipment was used including balls, baskets, flags, cans, bottles with sand, buckets and ribbons. For each class, games were selected which required high energy and coordination skills, while encouraging socialization and psychological skills, such as attention and concentration.

### Control Group

The CG participated in the evaluation, but did not exercise for 13 weeks. Every two weeks, subjects from the CG came into the exercise center to maintain contact with the researchers, but did not participate in any type of formal exercise.

### Statistical Analysis

All data were entered independently and in duplicate. The two records were compared using the File Compare of the EpiInfo software (version 3.5.4). All non-matching values were rechecked and corrected. Statistical analysis started by checking normality of the distributions and was inspected for possible outliers. Due to the absence of any violations of normality, the extreme values were kept. Comparisons between groups were performed using one-way ANOVA. For intragroup comparison of pre and post values, a paired t-test was performed. The analysis was performed using the SPSS program (version 20.0) and the level of significance was set at p<0.05.

## RESULTS

Baseline descriptive values for the sample are shown in Table 1.

**Table 1. Baseline values for mean (X), standard deviation (SD), minimal (Min) and maximal (Max) values of the 53 Mozambican HIV positive women who participated in the study.**

Variable	X± SD	Min	Max
Age (years)	39.5±8.4	25.0	56.0
Weight (kg)	61.8±12.0	42.0	105.0
Body Mass Index (kg·m <sup>-2</sup> )	24.1±4.5	17.5	37.9
Waist (cm)	83.8±11.5	64.0	116.0
Body Fat (%)	30.2±8.1	13.3	47.5
Curl-up (rpm)	2.7±4.6	0.0	20.0
Sit and reach (cm)	40.6±6.9	19.0	49.0
$\dot{V}O_2$ peak (ml·kg <sup>-1</sup> ·min <sup>-1</sup> )	32.5±7.1	15.2	47.0
Systolic Blood Pressure (mm Hg)	121.2±15.2	90.0	159.0
Diastolic Blood Pressure (mm Hg)	78.2±9.9	56.0	96.0
Total Cholesterol (mg/dl)	162.8±37.6	39.0	237.0
HDL (mg/dl)	50.9±13.1	25.7	80.7
Triglycerides (mg/dl)	80.3±39.7	31.0	215.0
Glycemia (mg/dl)	74.4±16.4	6.1	104.0
CD4+ (cells/mm <sup>3</sup> )	473.6±188.9	223.0	1061.0

Mean frequency of participation for the 36 exercise sessions in the two groups was similar and statistically non-significant, either in absolute ( $p=0.23$ ) or relative ( $p=0.57$ ) values (Table 2). In both groups, the participation was very high namely, 92.2% and 90.0% for the FEG and PEG groups, respectively.

**Table 2. Means of subject's attendance at the sessions by exercise group in absolute and relative terms; values for p are from one way ANOVA.**

Group	n	Absolute (Days)		Relative (% Sessions)	
		X±SD	P	X±SD	p
Formal	19	33.2±2.7	0.23	92.2%±0.1	0.57
Playful	18	31.4±9.4		90.0%±0.2	

Table 3 shows the pre and post intervention results by each group. Mean weight and BMI increased in all groups (1.8 to 2.8%) and was statistically significant for CG ( $p=0.006$ ). Waist reduced significantly in PEG (-3.7%;  $p=0.008$ ) while skinfolds reduced only in in CG ( $p=0.01$ ).

Mean values for health-related physical fitness test variables for each group are shown in Table 4. With the exception of peak  $\dot{V}O_2$ , there were no changes between the pre- and post-intervention measures. In the case of peak  $\dot{V}O_2$ , differences were significant in the exercise groups, indicating a positive effect (FEG=14.8%,  $p=0.008$ ; PEG=11.2%,  $p=0.01$ ). Mean values in the control group did not change significantly (0.6%,  $p=0.85$ ).

Table 5 demonstrates the results of pre- and post-exercise comparison in relation to risk factors for cardiovascular disease, as well as CD4+ count. With the exception of cholesterol, which increased in the exercise groups, no differences were founded in all other variables.

## DISCUSSION

This study aimed to evaluate and compare the effect of two types of exercise interventions on the regularity of exercise participation and health related physical fitness of African HIV-positive women using ART. To accomplish this goal, 53 Mozambican women aged 25-56 years from low socioeconomic areas of Maputo underwent a training program for a period of three months using two different exercise protocols, with a control group. Thus, the study simultaneously examined for exercise retention and the health benefits of exercise.

The first observation was that the frequency of exercise participation was very high, but was not significantly different between exercise groups. Attendance rates reported in the literature were substantially lower [13, 18, 20]. However, it must be taken into account that the study duration was very short (12 weeks) and the specific conditions of the participants were different from the natural environment. Moreover, it being the first time that the participants participated in such a program, they had high expectations related to the effects of the program on their health and well-being. These factors have been suggested as possible limitations when generalizing the results in this type of study [26].

**Table 3. Mean (X)± standard deviation (SD) and p values from comparison between pre and post-intervention for anthropometric variables.**

Group	FEG (n=19)			PEG (n=18)			CG (n=16)		
	Pre	Post	p	Pre	Post	p	Pre	Post	P
	X±SD	X±SD		X±SD	X±SD		X±SD	X±SD	
Weight (kg)	63.4±15.0	64.9±14.6	0.006*	61.6±12.0	62.3±11.3	0.200	59.9±7.1	61.3±7.5	0.010*
BMI (kg m <sup>-2</sup> )	24.6±5.2	25.3±4.9	0.180	24.1±4.8	24.4±4.5	0.210	23.4±2.9	23.9±3.1	0.010*
Waist (cm)	82.6±13.4	82.9±13.1	0.880	84.1±12.6	81.0±10.6	0.008*	84.4±83.0	84.9±8.3	0.500
Skinfolds (mm)	134.0±53.6	123.1±35.4	0.140	126.4±53.3	116.0±37.8	0.170	123.3±35.8	107.3±30.0	0.010*
Body Fat (%)	30.8±9.1	31.5±8.6	0.260	30.5±8.2	29.05±9.7	0.070	29.1±7.1	30.0±7.4	0.230

\*Indicates statistical significance ( $p<0.05$ ).

**Table 4. Mean (X) ± Standard deviation (SD) and p values from comparisons between pre- and post-intervention fitness values.**

Group	Formal (n= 19)			Playful (n=18)			Control (n=16)		
	Pre	Post	p	Pre	Post	p	Pre	Post	P
	X±SD	X±SD		X±SD	X±SD		X±SD	X±SD	
Curl up (rpm)	2.3±4.0	3.1±3.9	0.380	3.2±5.7	2.1±2.5	0.390	2.8±3.9	1.1±1.8	0.070
Sit and reach (cm)	38.6±11.2	41.7±6.6	0.180	40.1±8.1	41.7±7.5	0.190	41.0±4.5	41.0±5.5	0.940
Handgrip (kg)	34.8±7.5	33.9±6.3	0.240	32.1±5.4	32.1±5.4	0.900	31.6±4.2	33.0±3.7	0.200
$\dot{V}O_2$ peak (ml kg <sup>-1</sup> min <sup>-1</sup> )	33.2±5.5	38.1±7.1	0.008*	31.3±9.1	34.8±9.9	0.010*	33.0±5.5	33.2±3.9	0.850

\*Indicates statistical significance ( $p<0.05$ ).

**Table 5. Mean (X) ± standard deviation (SD) and p values between pre- and post-intervention cardiovascular risk factors.**

Factor	FEG (n=19)			PEG (n=18)			CG (n=16)		
	Pre	Post	P	Pre	Post	P	Pre	Post	P
	X± SD	X± SD		X± SD	X± SD		X± SD	X± SD	
SBP (mm Hg)	125.0±13.4	124.7±14.4	0.440	118.2±15.1	118.2±15.2	0.660	120.4±17.2	119.8±17.3	0.330
DBP (mm Hg)	79.1±8.6	78.2±8.7	0.330	77.3±11.3	77.1±11.3	0.330	78.4±10.0	78.47±10	-----
Chol (mg/dl)	174.3±40.9	183.9±43.5	0.030*	150.9±40.0	174.6±39.5	0.004*	177.4±34.1	180.7±30.7	0.580
HDL (mg/dl)	52.3±16.3	54.2±14.7	0.570	50.7±19.1	56.8±19.6	0.060	48.7±11.3	50.4±18	0.580
Trig (mg/dl)	84.2±40.5	93.5±46.2	0.230	81.7±55.8	88.4±40.4	0.410	91.1±37.1	106.0±31.3	0.130
BldGluc (mmol/l)	81.0±23.3	74.2±17.3	0.310	71.9±16.8	84.1±13.7	0.007*	74.2±37.4	78.3±7.7	0.670
CD4+ (cells/mm <sup>3</sup> )	524.5±186.8	525.5±200	0.970	444.8±182.0	446.2±124.4	0.970	458.7±205.8	570.0±234.4	0.060

SBP=Systolic Blood Pressure; DBP= Diastolic Blood Pressure; Chol= Cholesterol; Trig= Triglycerides, Bld.Glu=Blood Glucose.

\*Indicates statistical significance (p<0.05).

Dropout rates have been described in the literature as a key issue affecting exercise adherence and overall health [17, 27]. The dropout rates disclosed in previous studies vary considerably from 0% [20] to 52% [11]. In the present study, the dropout rate was 7.8% in the formal group, 10% in the playful group and 29% in the control group. Thus, there was an overall exercise adherence of 85%, which may be very high considering the type of population recruited.

An average increase in body mass in all groups was observed. This increase was significant in the FEG and CG groups but not in the PEG. However, after the intervention, the difference in body fat measured by waist and skinfolds were not statistically different in two groups and lower in one. This suggests that the subjects, on average, increased their body mass, but not body fat. Although intervention studies with individuals with HIV and ART show different results, there is a trend towards a consistent loss of body mass.

Roubenoff *et al.* [28] observed similar results in two different studies. First, in a study done with 10 adult males who performed progressive resistance training with an aerobic component for 16-weeks, three times a week, they recorded a reduction in body fat with no change in muscle mass. In another study carried out with 25 adult men during 8 weeks of high-intensity progressive resistance training, they observed a significant increase in lean body mass and a decrease in body fat [29]. The same observation was described by Grinspoon *et al.* [30] who found that an intervention of progressive resistance three times a week for twelve weeks provided a significant reduction in BMI, adiposity and waist circumference in HIV individuals.

Some studies applied different types of programs in order to test and compare different exercise methodologies. Terry *et al.* [31] compared two groups of HIV-infected individuals who performed aerobic exercise and stretching for 12 weeks. Body weight, body fat and waist-hip ratio decreased significantly and similarly in both groups. In a study with HIV+ African women on ART and with manifestations of lipodystrophy [6], a significant reduction in waist circumference and body fat folds was observed after 6 months of cardiorespiratory exercise. The magnitude of fat change was much higher than in weight.

Although some studies do not find any effect of exercise [3], the loss of fat that was not accompanied by a loss in

weight observed in this intervention is similar to many of the studies described in the literature. This may be caused by the fact that exercise may simultaneously promote a loss of fat and an increase in muscle mass. This phenomenon is more pronounced when subjects begin exercise from a sedentary condition and with poor physical fitness. Prior to beginning this intervention, the subjects were not involved in any regular exercise program. However, a study with this population, using accelerometers, showed that women of low socioeconomic status were very active given that their activities related to their survival. Although this could be an important factor, there is not enough information to assess the extent to which this may have influenced the results.

Weight gain and fat reduction was expected in the exercise groups but not in the control group. Contact with the research project may have altered the behavior of all involved, including the CG, which may have led them to make some changes in a positive direction. Quite noteworthy was that 37.7% of the subjects were either overweight or obese. However, the percentage of subjects who increased their weight was significantly higher in those with normal or low weight than those overweight or obese. Thus, the increase in weight may be seen as a positive effect. Although it cannot be confirmed, but it may be that the patients were taking medication more regularly and eating better, simply because they had contact with the project, which involved regular consultations, strategic testing and motivational counseling.

Unlike the fat values measured by skinfolds, the average body fat measured by bioimpedance indicated a 58.5% increase, ranging from 40 to 77.8%. This result may be considered contradictory, due to two essential reasons. Firstly, the fact that there are no studies on African women in order to confirm the algorithms that estimate fat mass for the research technique used. The few studies available suggest ethnic differences as the reason for incorrect estimation of fat mass, but do not present solutions [8]. Secondly, due to operational shortcomings, the measurement of bioimpedance in our study did not observe some procedures described in the protocol, such as a fasted state and monitoring of the hormonal cycle of the participants. These two aspects may have interfered with the validity and reliability of the values between the two measurements for each subject.

In the context of physical fitness, the most significant result was observed at  $\dot{V}O_2$  peak. As the exercise groups improved and the CG did not, it may be suggested that there was an effect of exercise on this component regardless of the type of activity. In general, studies show that individuals with HIV may increase their maximum  $\dot{V}O_2$  with exercise, similar to the general population [20, 27, 28, 32].

Stringer *et al.* [33] observed that 6 weeks of a moderately intense exercise program, practiced three times a week for 1 hour, significantly improved  $\dot{V}O_{2max}$  and lactic threshold, apparently without any deleterious effect on the immune system. Macarthur *et al.* [34] verified in 25 HIV-infected individuals who performed a 24-week physical training program, a significant increase in maximal oxygen uptake ( $\dot{V}O_{2max}$ ) occurred, as well as a positive physiological response to submaximal exercise. In Africa, Mutimura *et al.* [35] found that after 6 months of training,  $\dot{V}O_{2max}$  increased significantly. The same results were observed in several studies with different experimental designs, which allows for the generalization that aerobic exercise improves cardiorespiratory fitness in individuals with HIV [27, 28, 29].

The results of the tests for strength and endurance did not indicate any change in performance after intervention. Opposite to our findings, change in muscle strength and endurance is described in the literature by several authors. Roubenoff *et al.* [36] found that after 16 weeks of progressive resistance training, performed three times week, increased strength significantly. The same increase was observed in a study in Caucasian males diagnosed as seropositive for HIV-1 virus, with an exercise regimen that included 35 minutes of strength training and flexibility for 12 weeks [37]. Replication of these results is observed in other studies in different age groups [26, 38].

In view of these results, the absence of an increase in strength observed in this study was not expected. Whereas FEG was subjected to endurance training with controlled loads, including intensity and volume, significant changes were expected. The measure of strength by no specific tests, like Handgrip and Leg Curl, or a low load of the program was perhaps not enough to produce changes and could account for the lack of any observed improvement.

The change in metabolic indicators with exercise is controversial and not linear [27]. The studies vary in methodology with regard to intensity, type and duration of training, as well as evaluation methods, making it difficult to generalize the conclusions [32]. In this study, there were no changes in metabolic risk factors with the exception of cholesterol, which showed increases in all groups, including the controls. A literature review found conflicting results on this topic. For example, triglycerides decreased in several studies [4, 11, 12], but increased in others [3, 19, 39, 40].

In the case of cholesterol, our results are opposite to other studies of patients with HIV [5, 8, 15, 19, 25, 41]. No explanation could be found for the increased cholesterol levels. However, it must be noted that all the subjects remained within the limits considered acceptable, which means that the changes do not have clinical significance.

Most intervention studies with exercise have found no changes in the levels of CD4 +, the only immunological

indicator used in this study [6, 7, 21]. Thus, the lack of change is not surprising. The concern that exercise could affect the immune system negatively does not seem justified. The depletion of the immune system with exercise has been observed previously, but only in athletes who perform high-intensity workloads [42].

The present results contribute to the findings that clinically-controlled exercise for HIV patients on antiretroviral therapy is safe and beneficial for cardiovascular health, regardless of the type of exercise. The absence of changes in several key indicators is not a specific hallmark of this specific population, since this has also been observed in studies with healthy subjects. The search for effective responses requires further studies which manipulate the intensity, volume, frequency and duration of exercise.

This study had some methodological limitations. First, the lack of evaluation of quality of life and well-being of the subjects before and after the intervention. The absence of a validated instrument to measure quality of life in African women is the reason this variable was not measured. Also, the decision about what type of exercise promotes effective changes in wellness. Lastly, control of exercise intensity in the playful group was not possible for practical reasons.

In conclusion, this study showed that there is no physiological advantage from either one of the two exercise methods used, and both types are safe with no apparent contraindications for HIV patients on ART.

## LIST OF ABBREVIATIONS

AIDS	=	Acquired Immunodeficiency Syndrome
ART	=	Antiretroviral therapy
Bld.Glu	=	Blood glucose
CG	=	Control group
Chol	=	Cholesterol
DBP	=	Diastolic blood pressure
FEG	=	Formal exercise group
HIV	=	Human immunodeficiency virus
PEG	=	Playful exercise group
RM	=	Repetitions per minute
SBP	=	Systolic blood pressure
Trig	=	Triglycerides

## CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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