A Randomized, Clinical Trial to Evaluate the Impact of Regular Physical Activity on the Quality of Life, Body Morphology and Metabolic Parameters of Patients With AIDS in Salvador, Brazil

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Patients with AIDS under antiretroviral therapy often present with metabolic problems associated with HIV infection and its therapy, which can affect their quality of life. The knowledge on the potential benefits of regular physical exercises for HIV-infected patients is limited.

Objective: We conducted a clinical trial to evaluate the impact of regular physical activity on quality of life, anatomic disturbances, and/or metabolic changes in patients with AIDS in the city of Salvador, Brazil.

Methods: Patients were randomly assigned in monthly workshops (1-hour duration) to discuss the importance of physical activity and receive nutritional counseling (control group) or to receive a 1-hour supervised gym class three times a week plus monthly nutritional counseling (intervention group). Before and after intervention, body composition, maximum oxygen consumption, metabolic equivalent, blood count, fasting total cholesterol, high-density lipoprotein, triglycerides, glucose, HIV viral load and CD4/CD8 counts, and resting heart rate were measured. Quality of life was evaluated at baseline and after 24 weeks.

Results: The domains of quality of life, general health, vitality and mental health increased in the exercise group ($P < 0.05$) compared with the control group. In the exercise group, fat mass ($P = 0.04$), the resting heart rate ($P = 0.001$), waist circumference ($P = 0.002$), and glucose ($P = 0.003$) decreased. Muscle mass ($P = 0.002$), $CD4^+$ T cells ($P = 0.002$), metabolic equivalent ($P = 0.014$), and maximum oxygen consumption ($P = 0.05$) increased.

Conclusion: The practice of regular exercise, coupled with nutritional guidance, in individuals with HIV/AIDS significantly improves the quality of life.

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This work was carried out by the Hospital Universitário professor Edgard Santos with technical and financial support of the Ministry of Health/Secretariat of Health Surveillance/Department of STD, AIDS and Viral Hepatitis through the Project of International Technical Cooperation AD/BRA/03/H34 between the Brazilian Government and the United Nations Office on Drugs and Crime–UNODC.

The authors have no conflicts of interest to disclose.

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Key Words: AIDS, physical activity, lipodystrophy, metabolics disorders, quality of life

(*J Acquir Immune Defic Syndr* 2011;57:S179–S185)

INTRODUCTION

Since 1998, a number of anatomic and metabolic disturbances have been described in patients with HIV/AIDS, particularly for those under highly active antiretroviral therapy. These changes were described in a generic way as lipodystrophy and/or lipodystrophy syndrome.[1] HIV infection is also associated with several metabolic complications, especially dyslipidemia and insulin resistance.[2–4] Lipodystrophy is associated with morphologic changes and is characterized by redistribution of body fat. The main risk factors are the use of antiretroviral (ARV) drugs (especially some protease inhibitors and stavudine), age, low $CD4^+$ cell count, high viral load, longer duration of antiretroviral treatment, white race, and female gender.[5,6]

The prevalence of lipodystrophy in users of protease inhibitors is approximately 64% and 10.5%, in men and women, respectively.[7] Despite many studies showing the relationship between protease inhibitor and lipodystrophy, it has been observed that HIV-positive patients not using antiretroviral therapy regimens can also present with these changes, which raised the hypothesis of the existence of other etiologic factors for lipodystrophy in the HIV-infected population.[8]

Besides the metabolic changes that can occur in patients with AIDS, several other factors may negatively impact their quality of life (QOL), including the body and metabolic modifications, the stigma often associated with AIDS, the chronic use of ARV drugs, and the fear of imminent death. Taken together, these problems can affect the physical, social, and psychologic health components, causing a negative impact on their QOL. In this sense, exercise has been considered an important complementary therapy for health promotion of patients with HIV.[8,9]

Ideally, the practice of weight training must be focused and regular and should start earlier in the course of disease.[10,11]

Most of the available studies on physical activity and AIDS have emphasized the biologic perspective and demonstrated its relevance. These earlier studies on this subject were conducted in HIV-positive patients and had a clear concern to modulate the kind of activity and intensity that would not compromise the patient's immune system.[12] A program of aerobic exercise of moderate to high intensity has been demonstrated to improve the functional capacity of HIV-positive subjects but with no detectable significant effect on immunologic parameters, anthropometric, and psychiatrics aspects,[12] whereas another one, focused on aerobic or muscular endurance, significantly improved QOL.[13] Furthermore, the endurance training may be effective in increasing muscle strength and mass in patients with HIV/AIDS presenting with wasting syndrome or lipodystrophy. The moderate physical training can also improve physical, psychologic, and immunologic responses in patients with AIDS.[13]

This randomized study evaluated the impact of an intervention based on regular physical activity on metabolic changes and QOL of patients with HIV/AIDS in Salvador, Brazil.

METHODS

Patients and Settings

The study was conducted in 2009 at the AIDS clinics of Federal University of Bahia Hospital (HUPES), a public HIV service in Salvador, Brazil. Patients were recruited in a consecutive basis until reaching the estimated sample size.

Counseling sessions were held in a room at HUPES under the supervision of nutrition/physical training specialists, whereas the physical activities were performed in a fitness center designed for this purpose under the supervision of a cardiologist and a dedicated trainer.

Study Design and Sample Size Calculation

We conducted a randomized study to evaluate the impact of an intervention (regular physical activity) on QOL of patients with HIV/AIDS in comparison with a control (counseling) group. Patients were consecutively invited to enter the protocol. They were randomly assigned to attend the counseling sessions (control group) or physical activities plus counseling sessions (intervention group) following the signature of an informed consent. All counseling sessions included a 50-minute discussion on dietary needs and recommendations, but patients assigned to the control group also received a 30-minute orientation on the importance of regular physical activities and how to include it in their daily routine. They were stimulated to perform activities like running, biking, or walking for 1 hour at least three times per week.

The inclusion criteria were current use of ARV drugs, clinical conditions to practice physical activities, age equal or older than 18 years, and availability to attend the study activities. Exclusion criteria included pregnancy, active opportunistic infections, and age younger than 18 years.

We considered that regular exercise could improve the QOL levels in 35% for patients assigned to intervention group. We used a 95% confidence interval and 80% power to find a minimum sample of 66 individuals (33 in each group). A total of 84 individuals were invited to enter the study: six were ineligible, eight refused, and 70 subjects were randomized into intervention and control groups (35 in each group). Figure 1 summarizes the patients and enrollment process.

The project was approved by the Institutional Ethics Research Committee.

Laboratory Evaluations

Laboratory measurements were made at baseline and at Week 24 and consisted of: white blood cells count, hemoglobin, platelets, fasting total cholesterol, high-density lipoprotein, triglycerides, glucose, and creatinine, HIV viral load, and CD4/CD8 counts.

All evaluations (clinical, laboratory, physical, and QOL) were performed at baseline and after 24 weeks.

Aerobic and Resisted Exercises and Stretching Programs

After randomization, the intervention group was divided into three groups of 11 individuals for ease of guidance and supervision of physical activities. All participants received monthly dietary counseling by a nutrition specialist. Before starting the exercise program all patients had a functional evaluation session, which includes an assessment of any contraindications to perform an exercise program, and definition of the intensity level of exercise. We used some physiological indicators to quantify the intensity of effort, which included the heart rate, oxygen consumption, the subjective perception of exertion, and the ventilatory and lactate thresholds. The training intensity target was approximately 75% of maximum heart rate.

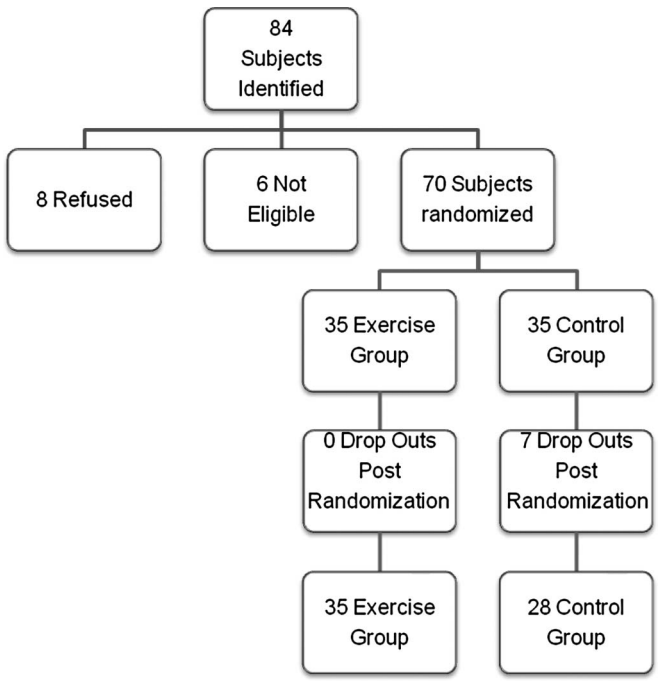

FIGURE 1. Disposition of patients enrolled in the protocol.

Anthropometry

We measured weight, height, calculation of body mass index (BMI), and skin fold. Body weight was measured using a balance accurate to 100 g. Height was measured by a stadiometer with subjects barefoot. BMI was calculated by dividing body weight (kg) by height squared (m^2).We used the digital caliper to evaluate the percentage of lean body mass, fat mass, and muscle mass. The calculation was based on Faulkneŕs skin fold protocol.[14] In addition, we measured the circumference of the chest, waist, waist–hip ratio, abdomen, hips, forearms, arms, thighs, and calves (0 and 6 months). The measurement was performed with the patient standing upright using a flexible tape measure and extendable to one decimal place.[15,16]

Exercise Testing

The exercise testing was performed to evaluate the clinical response; the hemodynamic, electrocardiographic, and metabolic stress; and to customize the exercise prescription and subsequent evaluation of therapeutic intervention under the supervision of a cardiologist. We used the ergometer treadmill. We chose a ramp protocol for the study. Subjects were exercised on a motor-driven treadmill with an initial speed of 3 km/h and a 2% incline. We used continuous increments in speed and incline following a ramp protocol adjusted to the subjects' predicted functional capacity to reach volitional fatigue in approximately 8 to 12 minutes. Blood pressure was measured every 3 minutes using a standard arm sphygmomanometer Twelve-lead electrocardiography was continuously monitored.[17,18]

Quality of Life

Assessment of QOL was performed by applying the SF 36 (Medical Outcomes Study 36-Item Short-Form Health Survey), which is used to cover 36 items in eight dimensions: functional capacity, limitations related to emotions, and perceptions of mental health, and presents a final score of zero to 100, in which zero corresponds to the worst and 100 the best status. This tool was already validated to Brazilian patients.[19]

Statistical Analysis

We used descriptive statistics for analysis of demographic and clinical data. Data of continuous variables were analyzed with measures of central tendency and dispersion and expressed as mean and standard deviation. Categorical or dichotomous variables were analyzed with measures of frequency and expressed as percentages. We performed statistical tests (Shapiro-Wilk and Kolmogorov-Smirnov) to evaluate normality and homogeneity of variance for all variables. Student *t* test or Mann-Whitney test was used to compare the mean differences of variables between the groups. The differences between average values were expressed with a confidence interval of 95%. We used the chi-square test to compare proportions. All survey data were analyzed by using SPSS (Statistical Package for Social Sciences) Version 17.0 (SPSS Inc, Chicago, IL).

RESULTS

A total of 70 patients were randomized (35 in each group). Seven patients did not attend the evaluations, all in the control group. After randomization, the groups had similar characteristics with the exception of a small, but significant, difference in fasting total cholesterol/high-density lipoprotein cholesterol, in which the levels were closer to normality in the control group. Table 1 shows the baseline demographic characteristics of patients in each group.

Educational level was similar for both groups with 45 of 70 (64%) reporting less than 8 years of formal education. Mean familiar income was also comparable; most patients (76.2%) reported a family income equal or lower than three minimum wages (equivalent to $750.00 US).

Nine patients (14%) had a previous diagnosis of diabetes mellitus (three of them in the exercise group) and eight (13%) of hypertension (six in the exercise group). Twenty-six (41%) patients, 17 of them in the exercise group, reported smoking. According to clinical observations and/or self-reports,

TABLE 1. Demographic, Physical, and Clinical Characteristics of the Two Groups at Baseline

	Exercise Group (N = 35)	Control Group (N = 28)
Age (years)	42.06 ± 7.45	44.25 ± 11.45
Gender (male:female)	17:18	17:11
Ethnicity (white:nonwhite)	15:20	14:14
Time since diagnosis (less than 5 years:more than 5 years)	10:25	06:22
Body weight (kg)	63.07 ± 9.69	63.54 ± 12.95
Muscle mass	55.36 ± 10.87	54.98 ± 10.19
Body mass index (kg/m^{-2})	22.66 ± 3.95	23.33 ± 3.02
Hip	96.84 ± 7.98	94.25 ± 6.48
Waist-to-hip ratio	0.84 ± 0,06	0.85 ± 0,09
Body fat (%)	21.46 ± 8.84	19.92 ± 7.27
CD4+ ($cells/mm^{-3}$)	571.89 ± 275.0	499.54 ± 311.78
Maximum oxygen consumption ($mL/kg^{-1}/min^{-1}$)	31.55 ± 7.58	31.98 ± 7.62
Metabolic equivalents	8.79 ± 2.05	8.91 ± 2.27
Triglycerides (mg/dL^{-1})	186.61 ± 110.1	184.92 ± 95.4
Total cholesterol (mg/dL^{-1})	221.27 ± 72.56	189.27 ± 46.68*
High-density lipoprotein cholesterol (mg/L^{-1})	53.88 ± 22.8	41.96 ± 12.56*
Glucose (mg/dL^{-1})	90.15 ± 18.0	90.26 ± 11.36
Hemoglobin (g/dL^{-1})	13.62 ± 1.43	13.63 ± 1.65
SF-36 Subscale		
Functional capacity	71.43 ± 23.93	70.71 ± 27.54
Physical limitation	85.71 ± 25.92	75.89 ± 35.67
Pain	43.14 ± 9.27	41.21 ± 9.88
General health	64.71 ± 17.96	56.36 ± 23.03
Vitality	57.57 ± 16.15	58.57 ± 15.22
Social aspects	79.67 ± 23.02	81.7 ± 19.13
Emotional limitation	79.06 ± 34.87	77.05 ± 30.03
Mental health	58.97 ± 10.14	61.71 ± 15.83

Data are reported as mean ± standard deviation.
*Significant difference between groups (*P* values: 0.001, 0.01, and 0.02, respectively).

35 (54%) patients had signs of lipodystrophy (20 in the exercise group). A total of 17 (27%) patients reported regular ingestion of alcohol (more than three daily doses).

After 24 weeks, we detected an improvement in all laboratory and anthropometric parameters, but it reached statistical significance only for muscle mass ($P = 0.001$), resting heart rate ($P = 0.001$), hip circumference ($P = 0.001$), $CD4^+$ cell count ($P = 0.001$), and metabolic equivalents ($P = 0.01$) for patients in the intervention group. We also observed a marginally significant increase in maximum oxygen consumption ($P = 0.05$), again, only for the intervention group. There were no changes in lipodystrophy in patients enrolled in the study. The control group presented with a significant improvement only in BMI, hip circumference (decrease), and $CD4^+$ cell count. Tables 2 and 3 display the results of Week 24 evaluation and the comparison between baseline and Week 24 values for both groups.

On the other hand, both groups showed similar improvement in all but pain QOL domains (Fig. 2). However, it was significantly higher for patients in the exercise group concerning general health, vitality, and mental health. The only major discrepancy in the comparison between groups was detected in the pain domain, which improved in both groups but reached statistical significance only in the control group, as shown in Table 4.

TABLE 2. Demographic, Physical, and Clinical Characteristics of Patients at Week 24

	Exercise Group (N = 35)	Control Group (N = 28)
Body weight (kg)	61.60 ± 8.3	60.25 ± 8.93
Muscle mass	59.67 ± 9.01	56.01 ± 10.07
Body mass index (kg/m^{-2})	22.31 ± 2.83	21.68 ± 2.64
Hip	96.74 ± 7.04*	92.7 ± 6.10
Waist-to-hip ratio	0.85 ± 0,09	0.84 ± 0,08
Body fat (%)	19.99 ± 6.49	21.53 ± 13.77
$CD4^+$ ($cells/mm^3$)	646.53 ± 289.12	574.36 ± 338.81
Maximum oxygen consumption ($mL/kg^{-1}/min^{-1}$)	31.41 ± 6.1	30.36 ± 7.55
Metabolic equivalents	9.29 ± 1.77	8.70 ± 2.15
Triglycerides (mg/dL^{-1})	172.06 ± 81.8	204.32 ± 234.47
Total cholesterol (mg/dL^{-1})	203.72 ± 63.02	186.79 ± 47.61
High-density lipoprotein cholesterol (mg/dL^{-1})	53.69 ± 20.61	47.79 ± 14.49
Glucose (mg/dL^{-1})	87.56 ± 19.05	86.72 ± 9.96
Hemoglobin (g/dL^{-1})	13.82 ± 1.52	13.51 ± 1.73
SF-36 Subscale		
Functional capacity	90.57 ± 17.22	83.8 ± 23.81
Physical limitation	87.86 ± 25.27	91 ± 21.50
Pain	49.89 ± 12.74	45.72 ± 7.82
General health	85.47± 17.82*	68.26 ± 18.28
Vitality	74.71± 14.08*	65.56 ± 13.02
Social aspects	91.81 ± 17.57	94 ± 10.89
Emotional limitation	84.89 ± 31.62	91.28 ± 25.18
Mental health	74.86 ± 12.21*	66.72 ± 14.17

Date are reported as mean ± standard deviation and between groups.
*$P < 0.05$ for comparison between groups.

In the comparison of improvement in the evaluated parameters according to the level of adherence to the activities, we found that patients attending a minimum of 60% of sessions were more likely to obtain better results in terms of body fat reduction, CD4+ cell count gain, and a decrease in mean resting heart rate (data not shown). In terms of QOL analysis, social aspects and vitality were significantly higher for the group who attended 60% or more of the sessions.

DISCUSSION

Our results demonstrate that a simple intervention was able to improve QOL for patients with AIDS under ARV therapy. However, although we have detected an overall improvement in all clinical and metabolic parameters, for both intervention and control groups, the only significant changes were observed in muscle mass ($P = 0.001$), resting heart rate ($P = 0.001$), hip circumference ($P = 0.001$), $CD4^+$ cell count ($P = 0.001$), and metabolic equivalents ($P = 0.01$). These improvements were observed only for patients undergoing an exercise program coupled with nutritional counseling.

This study evaluated the impact of regular physical activity on QOL of patients with HIV/AIDS and anatomic/metabolic disorders compared with guidance on physical activity. A literature review provides scarce reports on clinical trials involving HIV-infected patients and regular physical activity. Exercise in HIV-infected individuals, if properly prescribed, is safe and beneficial. It is already demonstrated that a regular physical training program makes it possible to delay disease progression while allowing an increase in functional capacity and QOL. These benefits are more likely to be perceived if the training program starts early in the course of disease.[20,21]

Although our results have shown a significant change in only some metabolic parameters for the intervention group, we observed an overall improvement in all the other measured variables. The values of total cholesterol were above the limits of the National Cholesterol Education Program III before intervention, but the mean values were within the normal range after 6 months. In addition, fasting serum glucose levels, functional capacity, and resting heart rate also showed improvement. In contrast, other studies have shown significant reductions in triglyceride levels and increase in functional capacity.[22,23] We observed that the level of triglycerides increased in the control group, although no changes were seen in total cholesterol or glucose levels. There was also a slight increase in high-density lipoprotein level, but these changes did not reach statistical significance. These data suggest that the exercise program was the main cause of these observed changes once all patients received the same dietary counseling, a finding already observed by other authors.[23–25]

The main findings of our study suggest the intervention promoted significant modifications in parameters of clinical interest; the increase in muscle mass and the reduction infasting glucose, BMI, body fat, and hip circumference indicates a decrease in the risk of diabetes, and dislipidemia. Moreover, we also detected a decrease in low-density lipoprotein cholesterol and triglycerides for the intervention group, although it did not reach statistical significance. Taken together, these changes reinforce the potential benefits of such intervention on patients'

TABLE 3. Demographic, Physical, and Clinical Characteristics of Groups Before (baseline) and After (24 weeks) Intervention

	Exercise Group			Control Group		
	Before	After	*P*	Before	After	*P*
Body mass index (kg/m^{-2})	22.98 ± 3.97	22.32 ± 2.83	0.06	23.00 ± 2.67	22.68 ± 2.64	0.02
Muscle mass	56.60 ± 9.18	59.67 ± 9.02	0.001	54.29 ± 10.36	56.01 ± 10.08	0.09
Body fat (%)	21.57 ± 8.77	19.99 ± 6.50	0.04	20.11 ± 7.38	21.54 ± 13.78	0.55
Resting heart rate	74.09 ±7.09	70.30 ± 6.44	0.001	71.40 ± 6.38	70.52 ± 7.39	0.28
Hip	82.03 ± 9.23	80.82 ± 8.11	0.001	78.78 ± 8.12	77.98 ± 7.86	0.001
Waist	97.08 ± 7.99	96.74 ± 7.05	0.50	93.68 ± 5.99	92.70 ± 6.10	0.15
Hemoglobin (g/dL^{-1})	13.621±1.44	13.82 ± 1.52	0.21	13.49 ± 1.62	13.51 ± 1.74	0.83
Total cholesterol (mg/dL^{-1})	222.72 ± 73.24	203.72 ± 63.03	0.06	189.75 ± 48.81	186.79 ± 47.61	0.72
HDL cholesterol (mg/dL^{-1})	53.88 ± 23.17	53.69 ± 20.61	0.92	42.38 ± 12.99	44.79 ± 14.50	0.22
LDL cholesterol (mg/dL^{-1})	126.09 ± 42.00	114.81± 43.67	0.24	107.62 ± 38.17	105.08 ± 37.64	0.69
Triglycerides (mg/dL^{-1})	190.22 ± 110.07	172.06 ± 81.80	0.12	187.40 ± 95.65	204.32 ± 234.48	0.65
Glucose (mg/dL^{-1})	90.28 ± 18.28	87.56 ± 19.05	0.04	89.52 ± 11.50	86.72 ± 9.97	0.21
CD4$^+$ (cells/mm^3)	574.91 ± 278.58	646.53 ± 289.13	0.001	499.54 ± 311.79	574.36 ± 338.81	0.04
Maximum oxygen consumption (mL/kg^{-1}/min^{-1})	30.5928 ± 7.34	31.17 ± 6.41	0.05	30.23 ± 6.87	30.37 ± 7.56	0.91
Metabolic equivalents	8.4866 ± 1.92	9.22 ± 1.87	0.01	8.21 ± 2.01	8.71 ± 2.15	0.32

All values are expressed as mean ± standard deviation and *P* values.
Data are reported as mean ± standard deviation.
*$P < 0.05$ for comparison between groups.

health and, ultimately, the potential reduction in cardiovascular risk. The gains were even greater in the QOL domains. It is important to note that all patients received a clear benefit in terms of QOL evaluation, even those who were assigned to counseling sessions only. This fact suggests that the simple participation in an educational activity can promote a significant increase in QOL of patients with AIDS. However, the measured benefits in terms of metabolic changes were present only among patients who participated in the exercise group.

The average adherence to the activities was 70%, and it was similar for both groups. Considering the fact that most of these patients had to come from suburban areas of the city, and faced many other limitation in their daily lives, we consider this rate quite satisfactory. It was similar to that found in other Brazilian study based on varied stimuli and an aerobic training intervention, which had 78% average patients compliance.[26] The choice of 3 days per week made adherence easier than a daily one as a result of the costs of transportation and free time of the patients. In addition, a previous study demonstrated a better clinical outcome in patients who exercised 3 to 4 days per week compared with those who had daily activities.[27] There was a significant improvement in some specific parameters (body fat reduction, resting heart rate, CD4$^+$ cell increase, vitality, and social aspects) that seem to be dependent on the level of adherence (minimum of 60% participation in the sessions).

The high degree of compliance demonstrates that this type of intervention is feasible and provides a unique opportunity to educate patients on the benefits of a healthy diet and regular physical activities. However, the high dropout rate in the control group points out the importance of a more attractive program that better fits patients' needs. It also

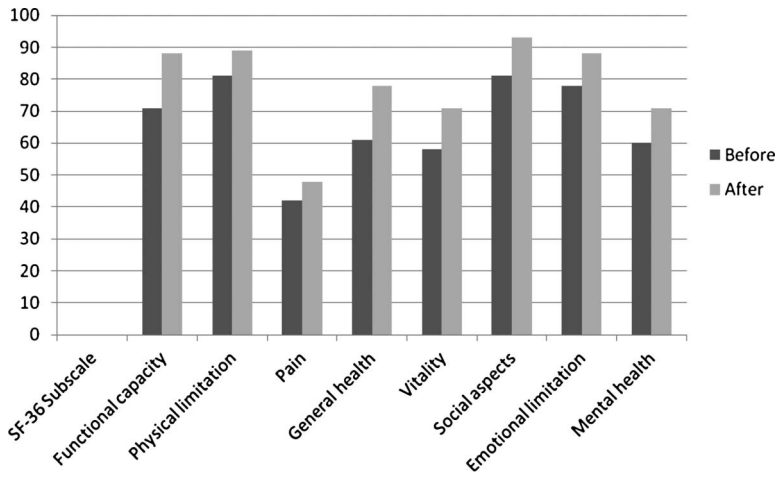

FIGURE 2. Comparison of the quality of life domains in the groups before and after the intervention.

TABLE 4. Quality of Life Domain Scores of Groups at Baseline and at 24 Weeks

	Control Group			Exercise Group		
	Before Intervention	After Intervention	*P*	Before Intervention	After Intervention	*P*
SF-36 subscale						
Functional capacity	70.7 ± 27.5	83.8 ± 23.8	0.001	71.4 ± 23.9	90.6 ± 17.2	0.004
Physical limitation	75.9 ± 35.7	91.0 ± 21.5	0.002	85.7 ± 25.9	87.9 ± 25.3	0.002
Pain	41.2 ± 9.8	45.7 ± 7.8	0.005	43.1 ± 9.3	49.9 ± 12.7	0.156
General health	56.4 ± 23.0	68.3 ± 18.3	0.001	64.7 ± 18.0	85.5± 17.8	0.001
Vitality	58.6 ± 15.2	65.6 ± 13.0	0.001	57.6 ± 16.1	74.7± 14.1	0.001
Social aspects	81.7 ± 19.1	94.0 ± 10.9	0.001	79.7 ± 23.0	91.8 ± 17.6	0.001
Emotional imitation	77.0 ± 30.0	91.3 ± 25.2	0.002	79.1 ± 34.9	84.9 ± 31.6	0.001
Mental health	61.7 ± 15.8	66.7 ± 14.2	0.001	59.0 ± 10.1	74.9 ± 12.2	0.008

All values are expressed as mean ± standard deviation and *P* values.

demonstrates that any additional therapeutic intervention, even a simple one such as routine dietary and physical activities counseling, is able to promote a beneficial change in QOL of such individuals.

One open question regards the sustainability of the observed effects of the study over time; it is likely that the results obtained with regular physical activities lasts only during the period patients keep exercising. It is unclear if the benefits observed on QOL for both intervention and control groups would persist after study termination. It would be necessary to follow these patients for a longer period of time to define the duration of such effects and the need of a periodical "booster" to keep the benefits over time. An ongoing study was designed to clarify some of these questions.

The low cost of such an intervention is an attractive point favoring its use in a public health setting; the total cost for the entire study was as low as $50.00 US per patient-month on average. If we consider the overall improvement observed in QOL and the potential reduction in the need of expensive interventions to treat depression, lipid disturbances, and other common complications in patients with HIV, it probably would prove to be cost-effective.

The present study has some clear limitations: the sample size was low, and it could compromise our power to detect difference between groups. In addition, the high rate of dropouts in the control group could even decrease it. This was minimized by the inclusion of some extra patients per group, but the 20% loss of control subjects is still high enough to potentially affect our capability to detect difference between groups. However, some changes (QOL scores, metabolic equivalents, glucose levels) were so impressive that they surely were not affected by that fact. On the other hand, even considering such limitations, the study was able to provide clear evidence that regular physical exercise can improve QOL and some metabolic parameters, and even monthly counseling sessions were able to have a similar effect on QOL.

In summary, the practice of regular exercise, coupled with nutritional guidance, in individuals with HIV/AIDS is able to improve QOL. Future studies with larger sample size and longer follow-up are essential to confirm these benefits of physical activity on the health and welfare of such a population.

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