STRENGTH AND ENDURANCE TRAINING IN CYTOKINE AND BODY COMPOSITION OF PEOPLE WITH HIV/AIDS

TREINAMENTO DE FORÇA E RESISTÊNCIA EM CITOCINAS E COMPOSIÇÃO CORPORAL DE PESSOAS COM HIV/AIDS

ENTRENAMIENTO DE FUERZA Y RESISTENCIA EN CITOQUINAS Y COMPOSICIÓN CORPORAL DE PERSONAS CON VIH/SIDA

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ABSTRACT

Introduction: HIV/AIDS is considered one of the great cases of public health, but it is seen that patients who use antiretroviral therapy (ART) and practice strength training promote a promotion of their health. Objectives: Assess the impact of strength and resistance training on cytokines and body composition in people living with HIV/AIDS. Methods: Randomized clinical trial, the sample consisted of 12 patients, 7 from the Strength Group (GF) and 5 from Group 2, Muscular Resistance (MGR). We compared the levels of IL-2, IL-4, IL-6, IL-10 and TNF-α cytokines and body composition in the first and last sessions. The patients completed 36 strength and resistance training sessions over 12 weeks. Results: After 36 sessions of GRM resistance training, there was a significant increase from 4,734 pg/mL to 5,050 pg/mL of IL-10 (p=0.002). Regarding the GFR, no significant results were found. For body composition, there were significant differences in GFR due to the increase in lean mass of the arms from 6,441g to 7,014g (p=0.04), legs from 16,379g to 17,281g (p=0.02) and whole body of 45,640g to 47,343g (p=0.01). In G2 there was a significant decrease in the percentage of fat in the arms from 23,160% to 20,750% (p = 0.04). To assess quality of life, the WHOQOL-HIV-Bref questionnaire was used, where significant improvement was found in all domains, except for the level of independence domain. Conclusion: We conclude that muscular resistance training is effective in increasing IL-10 and decreasing the percentage of fat in the arms, whereas strength training increases lean mass in arms, legs, and the whole body. ***Level of Evidence I; Randomized Clinical Trial.***

Keywords: Physical Exercise; Cytokines; Body Composition; AIDS; Inflammation.

RESUMO

Introdução: O HIV/AIDS é considerado um dos grandes casos de saúde pública, porém verifica-se que pacientes que fazem uso de terapia antirretroviral (TARV) e praticam treinamento de força provocam uma promoção de sua saúde. Objetivos: Avaliar o impacto do treinamento de força sobre a resistência nas citocinas e a composição corporal de pessoas vivendo com HIV/AIDS. Métodos: Ensaio clínico randomizado, a amostra foi composta por 12 pacientes, sendo sete do Grupo Força (TFG) e cinco do Grupo Resistência Muscular (GRM). Comparou-se os níveis das citocinas IL-2, IL-4, IL-6, IL-10 e TNF-α e a composição corporal na primeira e na última sessão. Os pacientes completaram 36 sessões de treinamento de força e resistência ao longo de 12 semanas. Resultados: Após 36 sessões de treinamento resistido GRM, houve um aumento significativo de 4.734 pg/mL para 5.050 pg/mL de IL-10 (p=0,002). Em relação à TFG, não foram encontrados resultados significativos. Para composição corporal, houve diferenças significativas na TFG devido ao aumento da massa magra dos braços de 6.441g para 7.014g (p=0,04), pernas de 16.379g para 17.281g (p=0,02) e corpo inteiro de 45.640g para 47.343g (p=0,01). No GRM houve diminuição significativa do percentual de gordura nos braços de 23.160% para 20.750% (p = 0,04). Para avaliação da qualidade de vida foi utilizado o questionário WHOQOL-HIV-Bref, onde foi encontrada uma melhora significativa em todos os domínios, exceto no domínio nível de independência. Conclusão: Conclui-se que o treinamento de resistência muscular é eficaz em aumentar a IL-10 e diminuir o percentual de gordura nos braços, enquanto o treinamento de força aumenta a massa magra geral. ***Nível de Evidência I; Ensaio Clínico Randomizado.***

Descritores: *Exercício Físico; Citocinas; Composição corporal; AIDS; Inflamação.*

RESUMEN

Introducción: El VIH/SIDA es considerado uno de los grandes casos de salud pública, sin embargo, está comprobado que pacientes que hacen uso de la terapia antirretroviral (TARV) y practican entrenamiento de fuerza provoca una promoción de su salud. Objetivos: Evaluar el impacto del entrenamiento de fuerza en la resistencia a las citoquinas y en la composición corporal de las personas que viven con VIH/SIDA. Métodos: Ensayo clínico aleatorizado, la muestra estuvo compuesta por 12 pacientes, siete del Grupo de Fuerza (TFG) y cinco del Grupo de Resistencia Muscular (GRM). Se compararon los niveles de las citocinas IL-2, IL-4, IL-6, IL-10 y TNF-α y la composición corporal en la primera y la última sesión. Los pacientes completaron 36 sesiones de entrenamiento de fuerza y resistencia durante 12 semanas.

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Resultados: Tras 36 sesiones de entrenamiento de resistencia GRM, se produjo un aumento significativo de 4.734 pg/mL a 5.050 pg/mL de IL-10 (p=0,002). En cuanto a la TFG, no se encontraron resultados significativos. En cuanto a la composición corporal, hubo diferencias significativas en la TFG debido al aumento de la masa magra en brazos de 6.441g a 7.014g (p=0,04), piernas de 16.379g a 17.281g (p=0,02) y cuerpo entero de 45.640g a 47.343g (p=0,01). En el GRM hubo una disminución significativa del porcentaje de grasa en los brazos de 23.160% a 20.750% (p = 0,04). Para la evaluación de la calidad de vida se utilizó el cuestionario WHOQOL-HIV-Bref, donde se encontró una mejoría significativa en todos los dominios, excepto en el dominio nivel de independencia. Conclusión: Concluimos que el entrenamiento de resistencia muscular es eficaz para aumentar la IL-10 y disminuir el porcentaje de grasa en los brazos, mientras que el entrenamiento de fuerza aumenta la masa magra total. ***Nivel de Evidencia I; Ensayo clínico aleatorizado.***

Descriptores: *Ejercicio Físico; Citoquinas; Composición Corporal; SIDA; Inflamación.*

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INTRODUCTION

AIDS has become a major global problem and has repercussions on public health policies due to its chronicity. The natural history of the disease is related to a progressive immunodeficiency that, without adequate treatment, causes death [1]. People living with HIV/AIDS (PLWHA) have a chronic inflammation that may determine the onset of diseases such as cardiovascular disease and neoplasia [2].

At the beginning of the PLWHA care line, physical exhaustion caused by exercise could lead to immunological damage, facilitating disease progression and allowing the appearance of opportunistic infections. However, more recent studies point to the importance of regular physical exercise, which is not only recommended, but also essential for the treatment of this population at practically any stage of the disease [3].

The aim of this study is to evaluate the relationship between strength training and muscular resistance with inflammatory and pro-inflammatory cytokines levels, body composition and quality of life in PLWHA undergoing antiretroviral therapy (ART).

MATERIALS AND METHODS

Study design

This is a randomized, controlled and blind clinical trial.

Trainings

The 12 patients were divided into two groups (Table 1), seven in the Strength Group (SG) and five in the Group Muscular Resistance (GMR). The training lasted 12 weeks divided into 36 sessions.

The exercises were divided into two training sessions (A and B), which the patients performed on alternate days: Training A: Straight supine, flexor chair, triceps in the pulley, abductor chair, development, plantar flexion and supra abdominal; Training B: Front pull, legpress, shoulder abduction, extensor chair, bicep threading, adductor and infra-abdominal chair. (Table 1)

Location and protocols

The training sessions were held at the Advanced Laboratory of Physical Education and Health - Laefes – Clinical Hospital - HC, Federal University of Pernambuco - UFPE.

Table 1. Characteristics of the trainings.

Strength Training	Muscle Resistance Training
Frequency: three times a week in alternate days	Frequency: three times a week in alternate days
Intensity: 75% of 1MR	Intensity: 60% of 1MR
Duration: 45 to 60 minutes	Duration: 40 to 60 minutes
Series per exercise: three	Series per exercise: three
Repetitions: eight	Repetitions: 15
Rest: two minutes	Rest: 30 seconds

Cytokines (IL2, IL4, IL6 and IL10) and Tumor Necrosis Factor-α (TNF-α) were determined in whole blood samples by standard fluorescence labeling, followed by flow cytometry analysis (Becton Dickinson - FACS Calibur three color flow cytometer) using fluorescent spheres as the internal standard and processed at the immunology laboratory of the Aggeu Magalhães Institute/FIOCRUZ. The BD™ Cytometric Bead Array - CBA Human Th1/Th2 Cytokine Kit II instrument was used. The Th1/Th2 Human BD CBA CBA Cytokine Kit that uses matrix technology to detect multiple cytokine proteins simultaneously was used in the sample. Six cytokine populations with distinct fluorescence intensities coated with capture antibodies specific for IL-2, IL-4, IL-6, IL-10, TNF-α and circulating T cells ($CD4^+$ and CD^+) and its subsets were searched in the patients' records.

The body composition was evaluated by body densitometry, where the technique of absorciometry with dual energy X-rays (DXA) was performed using the equipment HOLOGIC QDR WI. The radiation dose received by the subjects was less than 1.0 mRem. The equipment performs transverse body scans at 1-cm intervals from head to foot. Such measurement lasts approximately six minutes. The method calculates the body composition by dividing the body into anatomical regions. The results are expressed in grams of lean mass, fat, percentage of body fat and mineral density. To evaluate the distribution of body fat, trunk fat and upper and lower limb fat were considered. This evaluation was carried out at the Complex of Laboratories Plic at the Physical Education Department of UFPE.

The WHOQOL-HIV-Bref instrument has 31 questions distributed between a global perception component and six domains: physical, psychological, level of independence, social relations, environment, spirituality/religion and personal beliefs. This instrument was translated and validated for Brazil, with a reliability and consistency adaptation for the scale and its domains. The WHOQOL-HIV-Bref questions are structured on a Likert scale with five scores depending on the nature of domains and the questions. It was filled by the subjects themselves, except when this was impossible due to difficulties in reading.

Higher results correspond to a better QoL. Following the original indications, the results of the domains and the general question were transformed into a scale of 0-100. Given the multidimensional nature of the QoL concept underlying the questionnaire, the results will always need to be analyzed according to the scores obtained in the six domains that make up the WHOQOL-HIV-Bref, with no "total score" for the instrument.

Experimental subjects and randomization

The sample was determined by convenience. The extent to which individuals agreed to participate in the study was randomized for intervention groups.

Inclusion criteria: PLWHA undergoing ART for more than six months, over 18 years of age, undetectable viral load and CD4+ cell count > 200

cells/μL in the last six months, low risk of ischemic cardiac event by the Framingham score, and adequate physical condition assessed by an attending physician. Exclusion criteria: hospital internment in the last six months, moving problems, pregnancy or breastfeeding, high blood pressure and/or not controlled diabetes (Blood Pressure above 140 x 110 and fasting blood glucose levels above 126 mg/dl), kidney and/or hepatic and/or cardiopulmonary disease, and serious surgery performed up to four months prior to the study. Subjects were randomized into two intervention groups (SG and GMR), and a randomization was performed using the Random Allocation 2.0® software, which generated a random sequence. Identification of the sequence was performed through codes stored in a computer file.

Ethical aspects

The Human Research Ethics Committee of the UFPE Health Sciences Center approved the study. All specific ethical aspects established by the Resolution no. 466/2012 were followed according to guidelines and norms regulating research involving human beings. All individuals signed an Informed Consent prior to the start of data collection. The project is registered in the Brazilian Registry of Clinical Trials (ReBEC) under registration number RBR-9znxcq. The study was conducted according to the standards of CONSORT - Consolidated Standards of Reporting Trials.

Statistical analysis

For the statistical analysis, we used the Software SPSS 20.0 - Statistical Package for the Social Sciences for Windows and Excel, version 2016.

The results are presented in tables with their respective absolute and relative frequencies. The numerical variables are represented by central tendency and dispersion measurements. All tests were applied with a 95% confidence interval and a significance level of $p<0.05$.

To verify normality, the Shapiro-Wilk Normality test was performed. For comparison purposes before and after for a same group, the t test for paired samples (normal distribution) and Wilcoxon test (non-normal) were performed. For comparison between both groups, the t test for independent samples (normal distribution) and the Mann-Whitney test (non-normal) were used. Due to the low number of patients, the effect of Cohen's *d* was obtained using the websites <https://www.uccs.edu/lbecker/> and <http://www.socscistatistics.com/effectsize/Default2.aspx>, and interpreted as follows: < 0.19: null; 0.20-0.49: low; 0.50-0.79: moderate; > 0.80: high [4].

RESULTS

In the SG, all participants were male; in GME, only one of five individuals was a woman. The average age of the participants was 41 years. The majority was unmarried, with complete high school, and half of them were defined as brown-skinned (Table 2 and Figure 1).

There was a significant increase in IL-10 levels (p=0.02) in the GMR. In the comparison between the other cytokines, there was no significant difference and no large effect was found according to the Cohen's *d* value. In the GMR, mean effect values were found for IL-2 (*d*=0.60) and IL-10 (*d*=0.73). In both groups, no significant values were found for TCD4+ cell count and TCD4/TCD8 ratio, as well as no changes in viral load undetectability. (Table 3).

In the comparison between the groups at the post-training moment, no significant differences were found between the variables of the immune system, as expressed in Table 4. However, SG had a mean low TCD4 + (681.00 cell/μl) compared to RML (979.20 cell/μl). For the other variables, regarding the mean between groups, there were no different values.

There were no significant changes in body weight and body mass index between both groups. The comparison of the anthropometric profile, through DXA, found significant differences in SG for the variables lean body mass of arms (p=0.04), legs (p=0.02) and whole body (p=0.01). As for the extent of the effect, there was a large effect on the increase of the total arm mass (*d*=0.81) and total leg mass (*d*=1.46). For the GMR, a significant difference was observed in the percentage of fat in arms (p=0.04) (Table 5).

The table 6 compares, on average, standard deviation and p-value of domains and self-assessment of QoL of people living with HIV/AIDS according to the WHOQOL-HIV questionnaire in the Bref version.

Table 2. Distribution of the frequency of patients participating in the research according to biological and demographic variables, Clinical Hospital – UFPE.

Variables	Groups		
	Strength	Muscle Resistance	Total
	n (%)	n (%)	N (%)
Gender			
Male	7 (100%)	4 (80.0%)	11 (91.7%)
Female	0 (0.00%)	1 (20.0%)	1 (8.3%)
Age			
25 - 30	3 (42.9%)	0 (0.00%)	3 (25.0%)
31 - 35	1 (14.3%)	0 (0.00%)	1 (8.3%)
40 - 45	1 (14.3%)	1 (20.0%)	2 (16.7%)
46 - 50	2 (28.6%)	1 (20.0%)	3 (25.0%)
> 50	0 (0,00%)	3 (60.0%)	3 (25.0%)
Mean ± SD	35 (±9.9)	50.4 (±7.8)	41.4 (±11.8)
Race			
White	2 (28.6%)	2 (40.0%)	4 (33.3%)
Black	2 (28.6%)	0 (0.00%)	2 (16.7%)
Brown	3 (42.9%)	3 (60.0%)	6 (50.0%)
Marital status			
Single	6 (85.7%)	3 (60.0%)	9 (75.0%)
Married	1 (14.3%)	1 (20.0%)	2 (16.7%)
Widow	0 (0.00%)	1 (20.0%)	1 (8.3%)
Education level			
Incomplete Elementary School	0 (0.00%)	1 (20.0%)	1 (8.3%)
Incomplete High School	2 (28.6%)	2 (40.0%)	4 (33.2%)
Complete High School	4 (57.1%)	2 (40.0%)	6 (50.2%)
Incomplete Higher Education	0 (0.00%)	0 (0.00%)	0 (0.00%)
Complete Higher Education	1 (14.3%)	0 (0.00%)	1 (8.3%)

DISCUSSION

People living with HIV/AIDS have increased their life expectancy. However, important metabolic complications that may affect quality of life have been reported. Studies have pointed out that especially physical exercise, strength training and muscle resistance training may contribute significantly to reducing fat percentage, increasing lean mass and reducing the inflammatory process.

The study of Th1/Th2 panel evidenced an IL-10 increase in GMR after 36 sessions of the protocol (p=0.02). There is evidence that physical activity is capable of promoting an increase in anti-inflammatory cytokines, decreasing the effects of the inflammatory process activated by the virus.[5,6] In addition, IL-10 has been implicated in inhibiting the synthesis of some pro-inflammatory cytokines, such as IFN-γ, IL-2, IL-12 and TNF-β.[7]

In relation to IL-2, we found a tendency of increase in its values after 36 sessions for the GMR, although without a statistical significance (p=0.06). Perhaps the increase in the number of sessions could better express these results. According to the study by Steenberg et al. (2007)[7], the number of cytotoxic T cells producing IL-2 decreases after exercise and, beyond this decrease, there is a transformation and an increase in the production of IL-4, IL10 and IL-12, which corroborates this study.

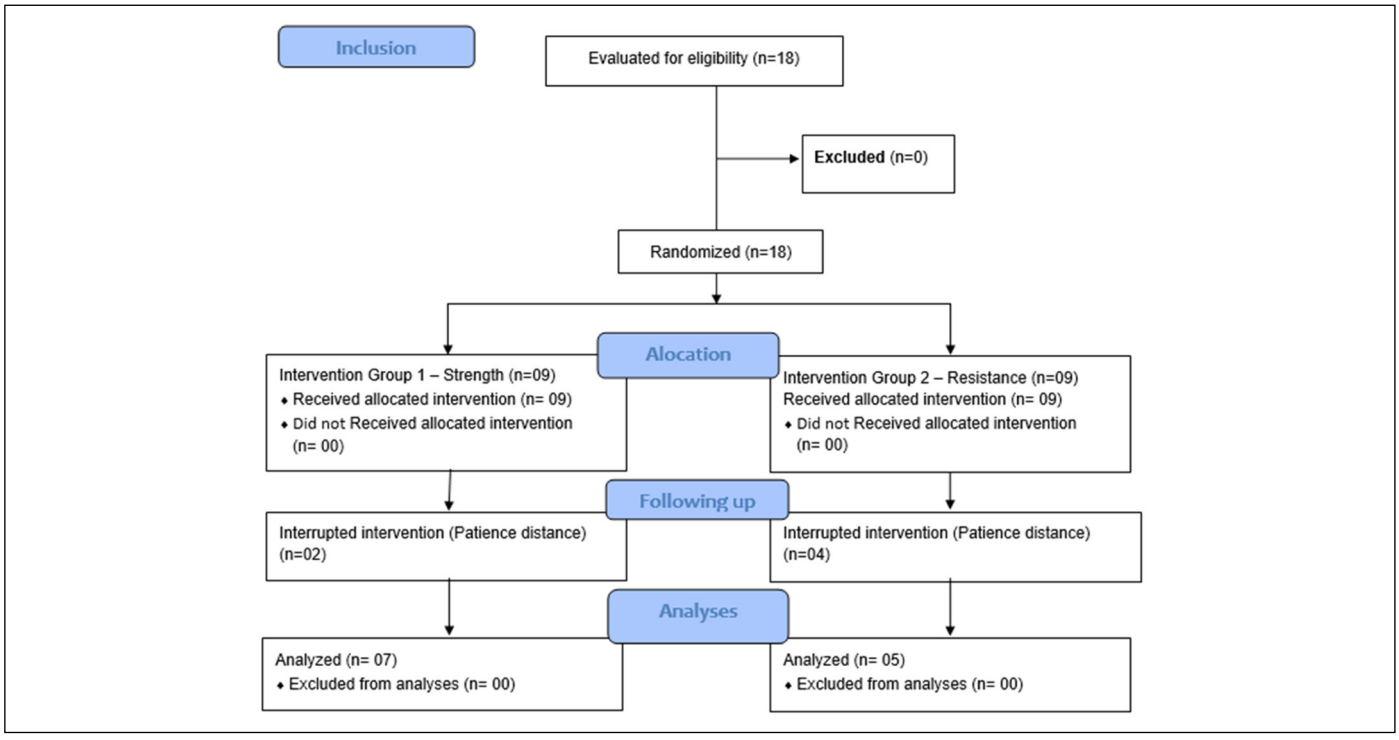

Figure 1. Allocation of project participants; n: number

Table 3. Comparison of inflammatory and anti-inflammatory cytokines levels, TCD4 cell count, TCD4/TCD8 ratio, detection of HIV viral load before and after strength training and muscle resistance training.

	SG				GMR			
Variables	**Before**	**After**	**p-value**	**Cohen's d**	**Before**	**After**	**p-value**	**Cohen's d**
	Mean (±)	**Mean (±)**			**Mean (±)**	**Mean (±)**		
TNF-α (pg/mL)	4.06±0.474	4.07±0.417	0.95$^{\theta}$	0.02	4.262±0.473	3.920±0.508	0.25$^{\theta}$	0.72
IL-2 (pg/mL)	0.73±0.882	0.51±0.822	0.17$^{\theta\theta}$	0.25	0.394±0.559	0.058±0.095	0.06$^{\theta\theta}$	0.60
IL-4 (pg/mL)	2.92±0.397	3.11±0.439	0.23$^{\theta}$	0.48	2.672±0.325	2.842±0.457	0.50$^{\theta\theta}$	0.52
IL-6 (pg/mL)	6.04±1.190	5.11±0.471	0.05$^{\theta}$	0.77	5.546±0.565	5.504±0.764	0.91$^{\theta}$	0.07
IL-10 (pg/mL)	4.84±0.334	5.00±0.183	0.16$^{\theta}$	0.46	4.734±0.428	5.050±0.504	0.02$^{\theta*}$	0.73
TCD4+ (cel/µl)	640.57±207.79	681.00±23.39	0.25$^{\theta}$	0.19	977.80±465.79	979.20±273.00	0.99$^{\theta}$	0.00
TCD4/TCD8	0.727±0.225	0.681±0.232	0.35$^{\theta}$	0.20	0.782±0.22	0.740±0.271	0.63$^{\theta}$	0.19
Viral Load HIV	Undetectable	Undetectable			Undetectable	Undetectable		

Captions: TNF-α: Tumor Necrosis Factors-α; IL: Interleukin. $^{\theta}$ T test for paired sample; $^{\theta\theta}$ Wilcoxon test; ^{5}: Large effect size; *: p <0.05.

Table 4. Comparison between the groups at the moment between the groups regarding immunological variables.

Variables	**Before**			**After**		
	SG	**RML**	**p-value**	**SG**	**RML**	**p-value**
	Mean (SD)	**Mean (SD)**		**Mean (SD)**	**Mean (SD)**	
TNF-α (pg/mL)	4.061±0.474	4.262±0.154	0.38$^{\theta}$	4.073±0.417	3.920±0.508	0.58$^{\theta}$
IL-2 (pg/mL)	0.734±0.882	0.394±0.559	0.63$^{\theta\theta}$	0.513±0.823	0.058±0.095	0.43$^{\theta\theta}$
IL-4 (pg/mL)	2.924±0.397	2.672±0.325	0.27$^{\theta}$	3.11±0.439	2.842±0.457	0.32$^{\theta}$
IL-6 (pg/mL)	6.044±1.190	5.546±0.565	0.63$^{\theta\theta}$	5.119±0.471	5.504±0.764	0.30$^{\theta}$
IL-10 (pg/mL)	4.846±0.334	4.734±0.428	0.62$^{\theta}$	5.001±0.183	5.050±0.504	0.53$^{\theta\theta}$
TCD4+ (cel/µl)	640.571±207.79	977.80±465.79	0.06$^{\theta}$	681.00±233.39	979.20±273.00	0.15$^{\theta}$
TCD4/CD8	0.727±0.225	0.782±0.22	0.68$^{\theta}$	0.681±0.232	0.740±0.271	0.70$^{\theta}$

Captions: TNF-α: Tumor Necrosis Factors-α; IL: Interleukin. SD: Standard deviation. $^{\theta}$: t test for independent samples; $^{\theta\theta}$: Mann Whitney test. Confidence interval: 95%

There was no statistically significant change in TNF-α, IL-4 and IL-6 values before and after the training protocol in each of the groups, as well as between groups. Our data suggest that the effects of localized muscle resistance training seems to have contributed to the increase in IL-10.

The present study had similar results with the other study[8] on the effect of physical exercise on PLHIV. It was observed that exercise does not influence the effect of IL-4, IL-6 and TNF-α. However, in the study Pedro et al., (2017)[8] a significant effect was found in IL-8, while in our study it was found in IL-10. IL-10 is an important anti-inflammatory and immunosuppressive cytokine that is produced by a variety of immune cells, including T and B lymphocytes, monocytic cells, Natural Killer cells, dendritic cells, eosinophils and neutrophils[9]. Salim and Xavier (2014)[10], adds that the deficiency or abnormal expression of IL-10 can increase the inflammatory response to the microbial challenge, lead to the development of inflammatory bowel disease and a series of autoimmune disorders. This being explained due to the difference between methods, intensity and volume of executions, with that further studies with the same training methods are needed to verify the real effect of physical exercise.

Table 5. Comparison of body composition through dual energy X-ray absorptiometry (DXA) before and after strength training and muscular resistance training.

Variables	SG				GMR			
	Before	After	p-value	Cohen's d	Before	After	p-value	Cohen's d
	Mean (±)	Mean (±)			Mean (±)	Mean (±)		
Weight (kg)	68.243±12.267	68.000±11.208	0.78$^{\theta}$	0.01	63.680±14.411	63.000±13.369	0.32$^{\theta}$	0.04
BMI	22.995±4.417	22.916±4.096	0.85$^{\theta}$	0.01	23.852±4.975	23.587±4.503	0.22$^{\theta\theta}$	0.05
% fat - arms	19.229±3.687	18.600±4.288	0.35$^{\theta}$	0.17	23.160±9.401	20.750±7.813	0.04$^{\theta*}$	0.25
% fat - legs	25.100±3.413	24.014±2.625	0.15$^{\theta\theta}$	0.31	27.100±11.328	25.840±11.257	0.30$^{\theta}$	0.11
% fat - trunk	23.957±7.792	22.671±8.377	0.28$^{\theta}$	0.16	29.340±12.480	28.370±10.766	0.30$^{\theta}$	0.07
% fat - total	23.671±4.966	22.685±4.949	0.23$^{\theta\theta}$	0.19	27.680±10.658	26.700±9.724	0.11$^{\theta}$	0.09
Lean mass (g) - arms	6.441±0.937	7.014±1.040	0.04$^{\theta*}$	0.61	4.987±1.383	5.650±1.935	0.08$^{\theta}$	0.47
Lean mass (g) - legs	16.379±2.548	17.281±2.721	0.02$^{\theta*}$	0.35	13.621±3.607	14.132±4.476	0.28$^{\theta}$	0.14
Lean mass (g) - trunk	23.765±3.761	24.107±3.327	0.24$^{\theta}$	0.09	22.243±4.221	22.267±4.106	0.94$^{\theta}$	0.00
Lean mass (g) - total	45.640±9.583	47.343±10.103	0.01$^{\theta*}$	0.17	43.854±8.738	44.703±9.823	0.22$^{\theta}$	0.09
Total mass (kg) - arms	8.367±1.262	9.399±1.215	0.05$^{\theta}$	0.81^{5}	6.920±1.827	7.340±2.143	0.22$^{\theta}$	0.22
Total mass (kg) - legs	22.8886±3.570	28.1057±10.968	0.06$^{\theta\theta}$	1.46^{5}	20.020±6.267	20.200±6.552	0.77$^{\theta}$	0.02
Total mass (kg) - trunk	32.391±6.826	32.777±7.393	0.50$^{\theta}$	0.05	32.660±6.897	32.800±7.950	0.76$^{\theta}$	0.02
Total mass (kg) - total	68.391±11.607	70.294±13.067	0.17$^{\theta}$	0.16	64.020±14.769	64.020±15.281	1.00$^{\theta}$	0.00

$^{\theta}$ T test for paired sample; $^{\theta\theta}$ Wilcoxon test; *: p=0.05; ^{5}: Large effect size. Captions: BMI: Body mass index; g: gram; ±: Standard Deviation

Table 6. Comparison of quality of life according to the WHOQOL-HIV Bref of all patients participating in the project, Recife – PE.

Domains	n=12		
	Before Mean (±)	After Mean (±)	p-value
Physical	46.35±12.37	54.17±13.58	0.03*$^{\theta}$
Psychological	52.60±14.52	61.97±14.52	0.00*$^{\theta}$
Level of independence	65.10±17.72	68.23±17.24	0.16**
Social relationships	64.06±13.04	70.31±13.04	0.02*$^{\theta}$
Environment	39.22±18.55	49.48±14.87	0.00*$^{\theta}$
Spirituality/religion/personal beliefs	49.48±5.70	55.21±3.54	0.02*$^{\theta}$
Self-assessment of QoL	53.12±8.04	69.79±8.61	0.00**$^{\theta}$

Caption: QoL: Quality of Life. * Test T for paired sample; ** Wilcoxon test; $^{\theta}$: p <0.05; Confidence Interval: 95%.

The mean of TCD4+ was 640.5 cells/mm^3 in SG and 977.8 cells/mm^3 in GMR at the study admission. There was no increase in TCD4+ cell count and the TCD4/TCD8 ratio after the protocols used in this study. In part, this can be justified by the low number of participants. In the meta-analysis of O'Brien et al. (2017)[11], who compared 20 studies performing resistance exercises, no significant difference was found in the comparison of TCD4+ cells between the group exercising and the control group. Poton; Polito; Farinatti (2017)[12] also reported in meta-analysis that there was a tendency to increase TCD4+ cells in two studies, whereas in seven other studies no changes occurred. There are gaps in the literature that may clarify the actual effects of physical exercise on TCD4+ cell counts (O'BRIEN et al., 2017)[11]. All participants had an undetectable CV (<40copies/mL) before and after the training protocols.

Due to the side effects of ART, body composition in PLWHA is an important factor for health levels. The large number of atheroma plaques may lead to an increase in fat in some regions of the body, characterized as lipodystrophy. Therefore, the evaluation by DXA for PLWHA is an important factor for the diagnosis of lipodystrophy, since this technique evaluates each region of the body with a greater accuracy.

Anthropometric data, such as weight and BMI, did not change after the protocols for both groups. This corroborates the studies by Fitch et al. (2012)[13], Ogalha et al. (2011)[14], Tiozzo, (2011)[15] and Webel et al. (2017)[16]. It is possible that the short period of this study prevented from detecting changes in these variables. Besides, there was no evaluation of other factors that may have interfered with these measurements, such as PLWHA nutrition and sleep.

The evaluation of body composition through DXA, after the exercise protocols, found an increase in lean mass of arms in SG (p=0.04) and in GMR (p=0.08) and an increase in lean mass of legs (p=0.02) and whole body (p=0.01) in SG. Other studies [17–20] that evaluated the effects of physical exercise on PLWHA found similar results: an increase in lean body mass through DXA. In these studies, subjects received ART, signaling that strength training can positively influence lean mass gain. In another study in Denmark[21], two types of exercises (aerobic and strength) were compared. The group that underwent strength training achieved a significant gain in lean mass (p=0.003).

Reduction of fat in arms (p=0.04) was recorded in GMR. A similar result was found in the study by Aghdassi et al. (2010)[22]. We found no reduction in the percentage of fat in arms, trunk and whole body in the SG. This can be partly be justified because PLWHA undergoing ART present a low lipolytic response and lipid oxidation in the skeletal muscle in response to moderate exercise due to the inability to mobilize free fatty acids from adipose tissue stores[23].

One of the main goals of physical activity for PLWHA is to improve their quality of life, enabling better patient well-being. Nowadays, in the literature, it is already proven that physical exercise improves QoL.

All domains had averages below 70.00 before training and, after the training, the domain of social relations reached 70.31. In the Physical (p=0.03), Psychological (p=0.00), Social Relations (p=0.02), Environment (p=0.00) and Spirituality/religion/personal beliefs (p=0.02) domains, there was a significant increase after training. Only level of independence was insignificant.

The results expressed in QoL corroborated with several studies[24,25,34,26–33]. This can be explained due to the space factor: there was care, leisure and a health environment for PLWHA. They met other people with the same pathology, exchanged experiences, and reduced stigma and discrimination, which benefits physical functioning and adherence to treatment. The release of enkephalins, beta-endorphin or other neuropeptides by the nervous system during exercise has the benefit of relieving stress and depression. No significant value was found for the domain level of independence. This can be explained due to the constant infection that PLWHA suffer, causing muscle inflammations and decreasing the cardiac and pulmonary function. In the study by Chandra et al. (2006)[35], the worst QoL scores were found for patients with a viral load above one million copies. In our study, before and after physical exercise sessions, patients maintained the CV undetectable.

This article is important in the field of sports medicine, since people living with HIV/Aids have long been prohibited from practicing any type of physical activity, where it was thought that this practice weakened the immune system. The results come with the purpose of characterizing which type of physical exercise, in comparison to the two exercises performed, where it was seen that the training of localized muscular

resistance has a significant result in the improvement of the immune system, whereas the training of hypertrophic force increases the levels of lean body mass index. However, the real message of this research study is to demonstrate the importance of physical exercise for this population, both for recreational and sports purposes, without impairing the immune system. Subsequent research should investigate the influence of other types of physical exercise and with a larger population to further characterize the type, frequency, intensity and other important factors in physical training for people living with HIV/Aids.

CONCLUSIONS

The results suggest an association between muscular resistance training for PLWHA, with an increase in IL-10 and a decrease in the percentage of fat in arms. Strength training promoted a gain of lean mass of arms, legs and whole body. The data also pointed to the possibility of improvement in some domains of QoL.

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