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Impact of resistance training on fat distribution in people living with HIV: randomized clinical trial

Impacto do treinamento resistido na distribuição de gordura de pessoas com HIV: ensaio clínico randomizado

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ABSTRACT
To verify the impact of eight weeks of resistance training (RT) on body fat distribution of people living with human immunodeficiency virus (HIV) (PLH). Seventeen randomized PLH participated in two groups: control (CG, n=6) and training (TG, n=11). The protocol of RT consisted of ten exercises. The subjects' triceps, subscapular, abdominal, thigh, and leg skinfolds were assessed before and after the training period. The analysis indicated significant differences ($p<0.05$) between the groups after the period of intervention, with decreased subcutaneous fat in the TG and increased subcutaneous fat in the CG in the areas of the torso (-3.77%, 12.97%) and limbs (-10.28%, 10.08%). By calculating the sum of skinfolds, the TG had an average reduction of 6.43%, while the CG increased by 11.12% after the eight weeks, with significant differences between the groups ($p<0.05$). Eight weeks of RT decreased subcutaneous body fat in PLH.

Keywords: Anthropometry. Exercise. HIV infection. Acquired Immunodeficiency Syndrome.

RESUMO
Verificar o impacto de oito semanas de treinamento resistido (TR) na distribuição de gordura corporal de pessoas vivendo com o vírus da imunodeficiência humana (HIV) (PVH). Participaram 17 PVHs aleatorizadas em dois grupos: controle (GC, n=6) e treino (GT, n=11). O protocolo de TR foi composto por dez exercícios. A avaliação das dobras cutâneas (DC) tricipital, subescapular, abdominal, coxa e perna dos indivíduos foi realizada antes e depois do período de treinamento. As análises indicaram diferenças significantes ($p<0,05$) entre os grupos após o período de intervenção, com diminuição de gordura subcutânea no GT e aumento no GC tanto para as DCs da região do tronco (-3,77%, 12,97%) quanto dos membros (-10,28%, 10,08%). No somatório das DCs, o GT teve uma redução média de 6,43%, enquanto o GC aumentou 11,12% após as oito semanas, com diferenças significantes entre os grupos ($p<0,05$). Oito semanas de TR diminuíram a gordura corporal subcutânea de PVHs.

Palavras-chave: Antropometria. Exercício. Infecção por HIV. Síndrome da Imunodeficiência Adquirida.

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INTRODUCTION

Acquired immunodeficiency syndrome (AIDS), caused by human immunodeficiency virus (HIV) infection, is characterized by compromised immune systems. Although HIV infection still has no cure, antiretroviral therapy (ART) contributes to the stabilization of the infection and a significant increase in the life expectancy of these patients[,2].

However, the prolonged duration of infection and, more specifically, the adverse effects of taking ART over a long period are damaging to people living with HIV (PLH)[3]. Lipodystrophy, associated with the first generation of antiretroviral drugs, has long been the primary concern regarding the effects of ART on body composition. Although the new generation of antiretroviral drugs does not present such exacerbated impacts, it is known that HIV infection affects fat metabolism and adipose tissue provides a reservoir for the virus[4,5]. Besides offering risks to the development of cardiovascular diseases to PLH[6], these body changes tend to increase the dissatisfaction of individuals with their body image, which may result in the discontinuation of the treatment with ART and consequent damage to their health[7-9].

Due to the chronicity of HIV infection, the development of intervention strategies that might contribute to the improvement of health-related physical fitness of this population is an increasing challenge for professionals working in this field[10]. A modality deemed to be very effective is resistance training (RT), which can promote changes in body composition, strength, power, muscle hypertrophy, and motor performance[5,11], in addition to other health benefits for those individuals, such as improvement in immunological parameters[12] and lipodystrophy[13].

Some research shows that RT provides benefits concerning the maldistribution of fat and disproportionate physical appearance14, and they highlight RT as an effective strategy in reducing the adverse effects caused by antiretroviral drugs and HIV infection.

Because of that, this study aims to verify the impact of an eight-week resistance training protocol on body fat distribution in PLH.

METHODS

POPULATION AND SAMPLE

The study participants were recruited at the Centro de Testagem e Aconselhamento (Center for Testing and Counseling) in Maringá, State of Paraná (PR), between August 2017 and August 2018. Those who agreed to participate and met the following criteria were included: a) to be at least 18 years old; b) did not participate in regular physical activity programs in the six months before the study; c) present a stabilized clinical condition, with stable viral load quantification; d) follow ART treatment for at least six months; e) do not present acute or chronic limitations for exercise; f) to be medically cleared by the infectious disease physician to participate in the RT program. After being informed of the research details and procedures, the volunteers were asked to sign the Informed Consent Form, authorizing access to medical chart information on the HIV infection, period of using ART, and TCD4+ and TCD8+ cell count. This research was conducted following the Declaration of Helsinki and submitted to the research ethics committee of the State University of Maringá, approved under number 2.282363. It has registered in the Clinical Trial under NTC03879993.

EXPERIMENTAL DESIGN

This randomized clinical trial had a 10-week design. The first and last weeks were dedicated to the evaluations. The TG subjects underwent a training period from the second to the ninth week, while the CG participants received instructions to maintain their usual routine. The participants were randomized into the control group (CG) and the training group (TG). The groups' randomization was performed using Excel software by an experienced researcher unaware of the evaluations and who did not participate in the training sessions. Subjects not attending at least 85% of the training sessions and/or did not participate in the reevaluations were excluded from the analysis. The final sample of intervention participants was 17 PLH of both genders, 6 in the CG and 11 in the TG.

ANTHROPOMETRY

Body mass (BM) was measured using a digital scale (Tanita BF-679); individuals wore light clothing and were barefoot. Height was measured with a wall-mounted stadiometer (EST-221, Balmak), adopting the Frankfurt position and with the participants barefoot. We used the ratio of body mass (kg) to height (m) squared to calculate the body mass index (BMI).

The skinfold measurements were made with a Lange® adipometer by an experienced examiner. Three non-consecutive measurements were taken in each location (triceps skinfold, subscapular, abdominal, thigh, and leg); and the mean value of the three measurements was adopted as reference for the analysis, following the standardization recommended in the literature[15].

TRAINING PROTOCOL

The training protocol was based on the guideline for prescribing exercises for people with HIV/AIDS[16] and lasted eight weeks, with workouts executed three times a week on alternate days (Mondays, Wednesdays, and Fridays). The training protocol included the following exercises: bench press, leg press 45º, lat pulldown, leg extension, dumbbell front raise, leg curl machine, triceps pulley, seated calf raise, biceps curl, and seated crunch. Three sets of 8 to 12 repetitions were performed for each exercise, except the seated calf raise (three sets of 15 to 20 repetitions) and the seated crunch (isometric training, with three sets of 30 seconds to one minute). The rest interval between sets was 30 to 60 seconds, and the rest between exercises was 90 to 120 seconds.

A weight test by maximum repetitions was performed weekly to determine the initial load and make load adjustments. In the third session of the week, the subjects performed two series at the lower limit of eight repetitions and the third series, with the maximum number of repetitions possible. For series with more than 12 repetitions was applied the equation $FL = WL + ER$ for lower limbs and the formula $FL = WL + (ER/2)$ for upper limbs, where FL refers to the final load in kg, WL refers to the workload of the test in kg, and ER is the number of repetitions exceeded in relation to the upper limit[17].

STATISTICAL ANALYSIS

Statistical analysis was performed with the SPSS 20.0 software. The sample was characterized through descriptive statistics. Data distribution was verified using the Shapiro-Wilk test. The comparison of the groups in the pre-intervention moment and the absolute values of change (Δ) were made with the t-test for independent samples for data with normal distribution; and the Mann-Whitney U test for non-parametric data. Repeated-measures analysis of variance (ANOVA) with Bonferroni post hoc was used to compare the groups for the post-intervention outcomes. The magnitude of the differences was demonstrated by Cohen's effect size[18], following the classification: below 0.15, insignificant effect; 0.15 to 0.40, small effect; 0.40 to 0.75, medium effect; above 0.75, large effect. In the analysis of the loads, the paired t-test was used for samples with normal distribution and the Wilcoxon test for non-parametric samples. The values of $p < 0.05$ were considered significant.

RESULTS

Figure 1 shows the flowchart of the study participants. We approached 126 people, 49 of whom agreed to participate and met the inclusion criteria. The CG consisted of 24 subjects, while the TG had 25 participants. After the period of intervention and evaluation, 6 people in the CG and 11 in the TG were considered for analysis.

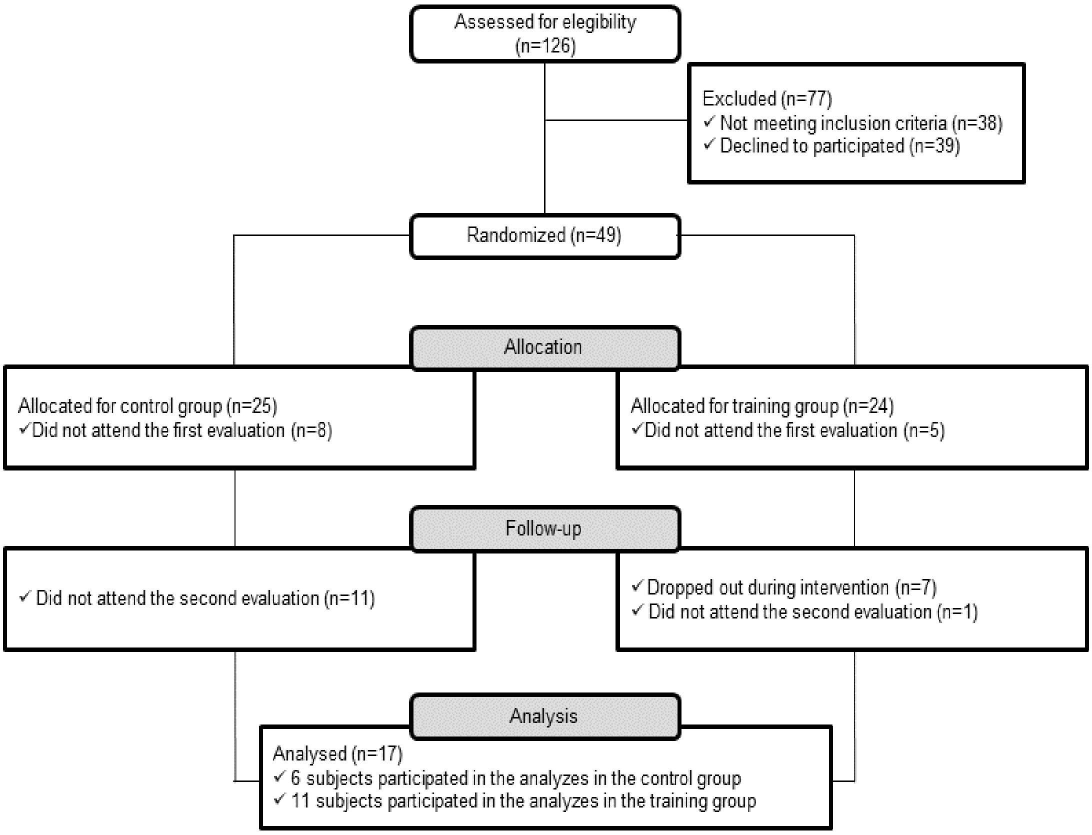

Figure 1. Flowchart of the study participants.

Table 1 displays the characterization of the sample. The statistical analysis did not show significant differences between the groups in the pre-intervention moment, indicating uniformity.

Table 1. General characteristics of the study participants before the intervention (n = 17)

	GC (n = 6)	TG (n = 11)	*p*
Age (Years)	45.83 ± 10.70	40.00 ± 10.39	0.29
Body Mass (kg)	74.08 ± 19.70	68.61 ± 15.23	0.53
BMI (kg/m²)	26.25 ± 5.23	23.91 ± 4.59	0.35
Time of Infection (months)	105.33 ± 87.77	135.36 ± 103.99	0.56
Time on ART (months)	104.33 ± 88.42	105.64 ± 78.40	0.98
CD4 (cells/µl)	761.17 ± 455.59	843.91 ± 352.39	0.68
CD8 (cells/µl)	988.83 ± 413.22	898.09 ± 263.11	0.59

Note: Data presented as mean and standard deviation. CG – control group; TG – training group; BMI: body mass index. *p < 0,05. t-test for independent samples.

Figure 2 shows the training loads in the leg press a 45º and bench press exercises in the first and last week of intervention of the TG subjects. There was a significant difference in the average load of both exercises, with an increase of 75% in the load of the leg press 45º (pre: 80.00 ± 34.93; post: 140.00 ± 78.79) and 92.23% in the bench press load (pre: 11.73 ± 8.39; post: 22.55 ± 13.95), indicating the effectiveness of the RT.

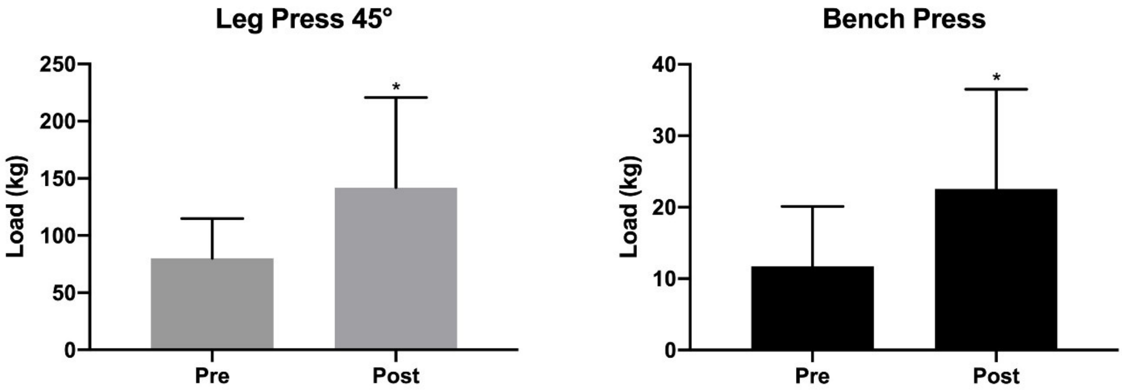

Figure 2. Training loads in the leg press a 45º and bench press exercises in the first and last week of training (n = 11).
Note: *p < 0,05.

Table 2 shows the skinfold measurements of the CG and TG subjects before and after the eight weeks of intervention. In the central region of the body, we obtained a significant difference (p < 0.05) between the groups only in the abdominal skinfold, which decreased in the TG (-8.67%) and increased in the CG (10.76%) after the intervention period. In the subscapular skinfold, there was a mean increase of 19.61% in the CG and 6.69% in the TG, with no statistically significant differences. The results showed a reduction in the triceps skinfold in the group receiving RT (-11.36%) and an increase in the CG (13.70%), with a significant difference between the groups (p < 0.05). There were significant differences (p < 0.05) in lower limbs; the thigh skinfold increased 7.89% in the CG and decreased by -9.77% in the TG. The leg skinfold had a reduction in the TG (-7.23%) and an increase in the CG (12.01%). The analysis of the sum of the folds after eight weeks of RT intervention also showed a significant difference between the groups (p < 0.05), with a mean reduction of 6.43% in the TG and an increase of 11.12% in the CG subjects.

Table 2. Skinfold thickness before and after the eight-week resistance training intervention (n = 17)

	CG (n = 6)	TG (n = 11)	EFECTS	*p*	ES
Subscapular (mm)			ANOVA		
PRE	29.22 ± 6.20	28.51 ± 4.95	Group	0.80	
POST	32.55 ± 5.85	29.21 ± 4.73	Time	0.29	
			Group × Time	0.49	0.39
Δ	3.33 ± 2.72	0,.0 ± 8.67		0.37†	
Abdominal (mm)			ANOVA		
PRE	38.17 ± 6.42	37.09 ± 5.26	Group		
POST	42.00 ± 6.57	34.97 ± 5.16	Time	0.62	
			Group × Time	**0.02**	2.06
Δ	3.83 ± 3.44	-2.94 ± 3.54		**< 0.01***†	
Triceps skinfold (mm)			ANOVA		
PRE	16.44 ± 2.26	16.00 ± 2.17	Group	0.38	
POST	18.78 ± 2.99	13.52 ± 1.64	Time	0.94	
			Group × Time	**0.02**	1.43
Δ	2.33 ± 2.40	-2.48 ± 4.05		**< 0.01***#	
Thigh (mm)			ANOVA		
PRE	22.44 ± 2.76	22.82 ± 3.95	Group	0.75	
POST	24.17 ± 3.02	20.30 ± 3.51	Time	0,73	
			Group × Time	0.08	1.01
Δ	1.72 ± 1.54	-2.52 ± 5.35		**0.03***†	
Leg (mm)			ANOVA		
PRE	12.39 ± 2.21	11.45 ± 2.09	Group	0.54	
POST	13.94 ± 2.70	10.67 ± 2.07	Time	0.45	
			Group × Time	**0.03***	1.28
Δ	1.56 ± 1.63	-0.79 ± 2.09		**0.02***†	
Sum of skinfolds (mm)			ANOVA		
PRE	118.67 ± 17.24	116.97 ± 15.40	Group	0.61	
POST	131.44 ± 18.81	108.67 ± 13.72	Time	0.45	
			Group × Time	**< 0.01***	1.83
Δ	12.77 ± 5.87	-8.03 ± 14.26		**< 0.01***†	

Note: Data presented as mean and standard deviation . (Δ) Variation of skinfolds : thickness measurement after the training period – pre-training thickness measurement . CG – control group; TG – training group; TE – Cohen's effect size . *$p < 0,05$. (†) Analyzed using t-test for independent samples. (#) Analyzed by Mann-Whitney U-test . Two-way ANOVA .

The comparison between groups, according to the area of the body, also showed significant differences (p < 0.05) after the period of intervention (Figure 3). There was a 10.28% mean reduction in the TG (Δ-5.79 ± 9.46) and a 10.08% increase in the CG (Δ10.08 ± 5.10) in the subcutaneous fat of the limbs (triceps + thigh + leg). In the area of the torso (subscapular + abdominal), the average reduction for the TG was 3.77% (Δ-2.24 ± 10.06), while the CG increased by 12.97% (Δ7.77 ± 3.06).

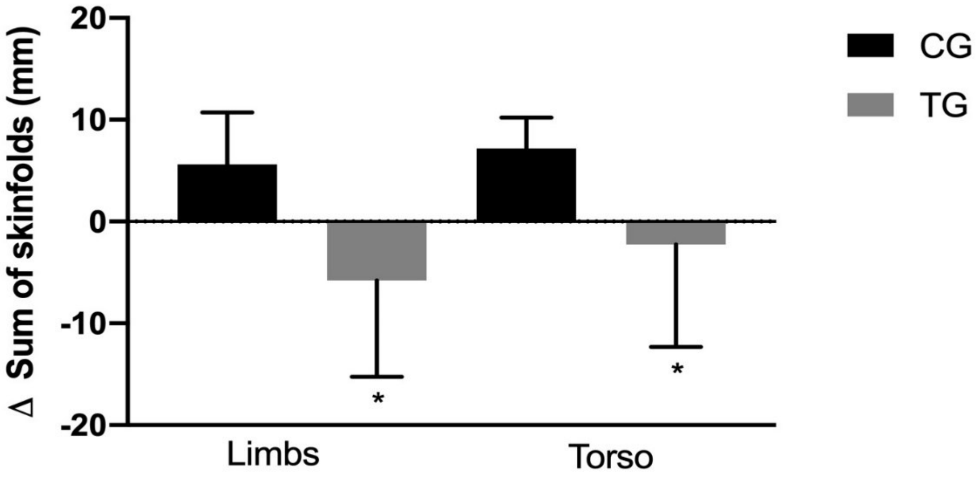

Figure 3. Comparison of the difference in the sum of skinfolds according to the area of the body (limbs and torso) (n = 11).
Note: *p < 0,05.

DISCUSSION

The objective of our study was to verify the impact of an eight-week resistance training protocol on the distribution of body fat in PLH, with the hypothesis that there would be a reduction in subcutaneous fat after the period of intervention. Our findings demonstrate that a resistance training (RT) program may be an efficient strategy to fight one of the adverse effects caused by the recurrent use of ART, which is the increase and irregular distribution of body fat. The reduction in subcutaneous fat, indicated by the fold thickness measurement obtained in our study, is similar to the results found by Spence et al.[19], Bessa et al.[20], and Brito-Neto et al.[21], who also evaluated the effect of an RT program on anthropometric measures of skinfolds. However, although conducted before the era of ART, the studies by Spence et al.[19] and Bessa et al.[20] included a sample only of males, which differed, therefore, from the participants in our study, who were of both genders. The survey by Brito-Neto et al.[21] also considered subjects of both genders; however, the time of intervention was 12 weeks.

Our results point out that a shorter intervention time is enough to reduce subcutaneous fat. Generally speaking, the reduction of this parameter in the TG can be explained by the enhanced caloric expenditure caused by the training session and by the increase in lipid metabolism for glycogen generation[22]. The subscapular skinfold was the only one that did not show a reduction in the TG. And although the CG increased, on average, more than the TG, that difference was not significant. Even so, we obtained a substantial reduction in fat in the torso area, indicated by the analysis of the sum of the subscapular and abdominal skinfolds. However, as a limitation of our research, it is worth pointing out that we did not perform nutritional control on the subjects, a variable that can directly influence the study results. Another limitation is the sample size; even though we obtained significant results with large effect sizes in the analysis, a more considerable number of subjects would possibly make our results even more robust. However, the literature already demonstrates that a notable sample loss is typical in exercise interventions with PLH[3].

Despite the knowledge of the risks that increased body fat can cause in PLH[5,24] and the benefits of exercise to this population[4,12,14] it is not always possible for professionals to follow the evolution of such patients during clinical practice. That happens because the tests required for body composition assessment may be expensive and may require previous preparation of the individuals to ensure the reliability of the results[6,24]. Thus, anthropometric measurements stand out for being a strategy with a good correlation with high standard methods, low cost, and easy applicability as long as executed by a trained evaluator; therefore, they are characterized as a good tool in the clinical assessment of changes in body composition in PLH[25].

There is already a consensus in the literature that systematized physical exercise benefits PLH. However, reductions in body fat levels are more associated with aerobic training programs than resistance training programs[14,26]. Nevertheless, the results of our study highlight that an RT program can also provide benefits to this population in addition to its initial purpose, which is to increase lean body mass and muscle strength[11]. The lean mass was not the focus of analysis in this study, but we proved the increase in strength by observing the results of the evolution of the exercise loads over the eight weeks of intervention.

Therefore, it is worth emphasizing the importance of including an RT program to treat PLH due to its benefits to this population for reducing subcutaneous fat and gaining strength. As a result, there is an improvement in the activities of daily living and adherence to ART treatment, which is related to the increased life expectancy of those patients.

CONCLUSION

Eight weeks of resistance training might decrease subcutaneous fat from the areas of the torso and limbs in people living with HIV.

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