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Impact of Progressive Resistance Training in Brazilian HIV Patients with Lipodystrophy

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Abstract

Background: The objective of the present study was to evaluate the impact of progressive resistance training on the body composition of HIV/AIDS-seropositive patients with lipodystrophy.

Methods: The sample consisted of ten individuals with lipodystrophy submitted to a training program. Lean mass and fat mass levels were determined by double energy X-ray absorptiometry (DXA) before and after 36 sessions (12 weeks) of training divided into a preparatory phase (six sessions with three series of 15 repetitions), a transitory phase (six sessions with three series of 15 repetitions with 40 to 50% of maximum muscle strength), and a specific phase (24 sessions with three series of eight repetitions with 70 to 80% of maximum muscle strength). Data were analyzed statistically by the paired sample test.

Results: The results showed a significant increase in total lean mass (P=0.039) in the upper limbs (P=0.004) and in the trunk (P=0.019).

Conclusions: On this basis, we conclude that progressive resistance training promotes an increase in lean mass and can be useful for the complementary treatment of lipodystrophy by improving the body harmony and quality of life of patients with HIV/AIDS.

Keywords: HIV; AIDS; Progressive resistance training; Lipodystrophy; Strength; Exercise

Introduction

After the advent of highly active antiretroviral therapy (HAART), the course of infection with human immunodeficiency virus (HIV) has suffered drastic changes culminating in increased survival, reduced morbidity-mortality and a consequent improvement of quality of life of persons living with HIV/AIDS [1]. However, HAART did not succeed in eliminating HIV infection, with the need of continuous and long-lasting maintenance of this therapeutic regimen for the control of viral replication [2]. As a consequence, side effects have been associated with the prolonged use of antiretroviral agents, among them the lipodystrophy syndrome [3-5].

Lipodystrophy syndrome can affect up to 80% of the patients [6]. Its manifestations include metabolic changes, dyslipidemias and changes in body composition [3,4,7]. Body changes have been characterized as lipoatrophy and lipohypertrophy. Lipoatrophy involves the loss of subcutaneous fat in the face, the glutei and the upper and lower limbs. In contrast, lipohypertrophy involves an increase of fat in the abdominal and dorsocervical regions, gynecomasty in men and enlarged breasts in women [5,7,8]. In general, the changes in body composition do not pose substantial risks to health but have been associated with the stigma and social exclusion created by the disease, representing a stress factor with various affective-emotional implications such as dissatisfaction with one's body image [9,10], mood changes manifesting as anxiety or unhappiness, problems with sexual relations, reduced self-esteem, and depression [9,10].

Complementary therapies for the relief or even the suppression of the adverse effects of the use of HAART have become an important source of investigation. Regular physical exercise has shown an improved redistribution of body fat [11-14] and different training protocols are currently being investigated. However, these studies have not yet elucidated the development of new strategies that will permit a greater efficacy of the alternative treatment. On this basis, the present study describes contributions regarding the impact of progressive resistance training in Brazilian HIV patients with lipodystrophy.

Subjects and Methods

Participants

The sample consisted of ten individuals of both sexes aged on average 49.30 ± 6.36 years, who are monitored in the Nutrition and Dyslipidemia outpatient clinic of the Special Unit of Treatment of Infectious-Contagious Diseases (UETDI) of the University Hospital, Faculty of Medicine of Ribeirão Preto, University of São Paulo (HCFMRP/USP).

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Inclusion criteria were as follows: individuals of both sexes and over the age of 18, a stable weight (less than 10% change in weight within the last 6 months). All HIV-infected patients had a positive serology for HIV-1 and a CD4 cell count of more than 200 copies/mm^3 and all had been under antiretroviral therapy that was unchanged for at least 6 months. Practicing no regular physical training for at least three months; declaring that they agreed with the study by giving written informed consent; and having a medical certificate that declared them to be fit for the practice of progressive resistance training. Patients who presented clinical changes during the training period or who failed to attend more than 25% of the training session during the study (9 sessions) were excluded from the investigation.

The exclusion criteria were the presence of acute AIDS-related events, the use of glucocorticoids in the last year, or serious alterations in cardiac, lung, liver, kidney, or thyroid function.

Criteria for lipodystrophy syndrome HIV-infected individuals were included if a loss in subcutaneous fat was self-reported by the patient and detected during physical examination of the arms, legs, and face by the primary investigator [15-17]. This loss in subcutaneous fat was with or without an increase in the abdomen or breast size, or the development of a buffalo humps [15]. The diagnosis was confirmed objectively by using an accurate, reproducible dual-energy X-ray absorptiometry method (Hologic QDR 4500A scanner; Hologic Inc., Waltham, MA, USA).

The study was conducted at the Center of Guidance and Education of Adults and Elderly Persons of the Nursing School of Ribeirão Preto, University of São Paulo (EERP/USP), was financed by "Fundação de Amparo à Pesquisa do Estado de São Paulo" (FAPESP), protocols 2011/07300-4 and 2011/03136-5, and was approved by the Research Ethics Committee of HCFMRP/USP, according to resolution 196/96 which regulates "research involving human beings", protocol 6692/2010.

Body composition

Body weight was measured with a Welmy® electronic scale with a stadiometer, with readings of 0.1 kg and 0.5 cm for weight and corpulence, respectively. The measurements were made with the individual standing up and wearing only a smock.

Height was measured with the stadiometer with the mobile cursor of the Welmy® scale, with a precision scale of 0.1 cm. Specifically, the individual stood up without moving, with his arms along the body and barefoot, trying to touch the measuring scale with the occipital, thoracic, sacral, back thigh and heel regions. The head was supported on the horizontal plane in an elongated manner for the recording of height in cm.

The quantities of fat mass and lean mass were determined by the total body scanning (TBS) method using double-energy X-ray absorptiometry (DXA) with a Hologic® instrument, model Discovery CI/WI (QDR4500W software, version QDR 11.2). For the TBS procedure, the individual wore a smock and lay in dorsal and centralized decubitus on the table of the DXA scanner using the central line of the table as reference, with hands open, palms resting on the examining table and arms and legs extended. The procedure lasted about 20 minutes.

Body composition was evaluated using body weight and the quantities of whole body and segmented (trunk, upper and lower limbs) fat mass and lean mass. All data were collected before and after training.

Maximum muscle strength

The 1 maximum repetition test (1RM) was used to determine maximum muscle strength (MMS) by means of the recording of the maximum amount of weight, with the individual completing a repetition of an exercise with complete movement amplitude, with a second repetition not being permitted, with a maximum of six attempts for each exercise and 90 second intervals between attempts [18,19]. MMS was evaluated by the 1RM test, which was the parameter used to determine the intensity of training.

Training protocol

The progressive resistance training protocol consisted of 36 sessions (12 weeks) with a mean duration of 40 minutes held every Monday, Wednesday and Friday, i.e., at intervals of 48 to 72 hours [18]. The 36 sessions were divided into three consecutive phases: 1) preparatory, six sessions with three series of 15 repetitions and 60 second intervals between exercises [18], with intensity being determined with the subjective effort scale of Borg [20], from 11 (relatively easy) to 13 (slightly tiring); 2) transitory, six sessions with three series of 15 repetitions and 60 second intervals between exercises, with intensity from 40 to 50% of MMS [18]; 3) specific, 24 sessions with three series of eight repetitions and 90 second intervals, with intensity of 70 to 80% of MMS [18]. Using as reference the basic principles of training and of prescription of physical exercise [21], and due to the natural process of adaptation to exercise, at the end of 12 sessions of the specific period (24 training sessions) a new MMS test was applied to readapt the intensity of the training load.

Progressive resistance training consisted of the following exercises in the order indicated: warm-up (active stretching), bench press, lat pull-down, leg extension, leg flexion, elbow flexion, elbow extension, abdominal exercise, plant flexion and return to rest (active stretching). The order of exercise application was planned by giving priority to work of the major muscles [18].

Before each training session, the individuals were questioned about their general health status and their vital signs were measured (arterial pressure, heart rate, respiratory rate, and oxygen saturation). If an individual presented any clinical instability, he was excused from training and referred to the UETDI of HCFMRP/USP for medical care. An Athletic Way instrument station with two independent columns of 180 kg each was used for progressive resistance training.

Statistical analysis

Data were submitted to descriptive statistical analysis with previous determination of outliers within the normalities (Shapiro-Wilk test). The paired sample test was used to determine the difference between the periods before and after training, with the level of significance set at $P<0.05$.

Results

Ten individuals (eight men, 80%) aged on average 51.00 ± 6.36 years, with a median body weight of 68.07 ± 18.29 kg and height of 171.00 ± 7.28 cm participated in the study. Median time of HIV infection was 15.50 ± 4.61 years, median time of HAART use was 13.50 ± 5.17 years, medianTCD4+ cell count was 479.50 ± 269.43 cells/µl, and median viral load was 69.00 ± 41.55 copies/µl. Eighty percent of the patients used protease inhibitors, 90% used reverse transcriptase nucleoside inhibitors, and 70% used reverse transcriptase non-nucleoside inhibitors (Table 1).

After progressive resistance training the patients showed an increase of 7.11 ± 4.73 kg in body weight, a reduction of -1.16 ± 0.46 kg in total fat mass, and a significant increase of 1.85 ± 1.68 kg in total lean mass (p=0.039, Table 2).

Variable (n=10)	*median ± SD*
Age (years)	51.00 ± 6.36 (38.00-56.00)
Men, n (%)	8/10 (80%)
Women, n (%)	2/10 (20%)
Weight (kg)	68.07 ± 18.29 (51.07-111.23)
Height (cm)	171.00 ± 7.28 (151.00-185.00)
Time of HIV infection (years)	15.50 ± 4.61 (5.00-17.00)
Use of HAART (years)	13.50 ± 5.17 (2.00-17.00)
CD4+ cells (cells/μL)	479.50 ± 269.43 (160.00-867.00)
Viral load (copies/μL)	69.00 ± 41.55 (<50.00-110.00)
Use of PI, n (%)	8 (80%)
Use of de RTNI, n (%)	9 (90%)
Use of RTNNI, n (%)	7 (70%)

PI – Protease inhibitors

RTNI – Reverse transcriptase nucleoside inhibitors

RTNNI – Reverse transcriptase non-nucleoside inhibitors

Table 1: Characterization of the patients included in the study according to age, body weight, height, time of HIV infection, time of use of highly active antiretroviral therapy (HAART), number of T-CD4+ cells, viral burden and medication class at the time of the study.

	Pre-training (kg) n=10 median ± SD	*Post-training (kg) n=10 median ± SD*	*Pre and post variation (kg) n=10 median ± SD*
Bodyweight	68.07 ± 18.29 (51.07-111.23)	75.18 ± 17.24 (49.61-105.65)	7.11 ± 4.73 (*P*=0.302)
Total fat mass	13.51 ± 14.12 (7.88-53.50)	14.66 ± 12.90 (6.69-49.24)	-1.16 ± 0.46 (*P*=0.43)
Total lean mass	47.69 ± 6.59 (37.23-58.94)	49.54 ± 6.97 (36.93-58.60)	1.85 ± 1.68 (*P*=0.039)*

* paired sample test *P*<0.05.

Table 2: Comparison of body weight. fat mass and total lean mass between the periods before and after training

In the evaluations according to body segment, fat mass (Table 3) showed a reduction in all segments. Specifically, a reduction of 0.09 ± 0.11 kg in the upper limbs, of 0.74 ± 0.40 kg in the trunk, and of 0.20 ± 0.03 kg in the lower limbs. On the other hand, lean mass (Table 4) was increased in all segments, with a statistically significant increase of 0.42 ± 0.24 kg (*P*=0.004), in the upper limbs, of 1.10 ± 1.11 kg in the trunk (*P*=0.019), and of 0.75 ± 0.06 kg in the lower limbs.

Discussion

The abnormalities associated with lipodystrophy, such as changes in body composition and dyslipidemia, have become a source of generalized concern due to their link to an increased risk of cardiovascular disease and a reduction of quality of life.

Several studies have evaluated progressive resistance training in HIV-infected patients with lipodystrophy, using different parameters such as biochemical, hormonal and anatomical data.

In the present study, we evaluated the impact of progressive resisted training on body composition, showing a reduction of fat mass and an increase of total lean mass in different body segments. Specifically, there was a significant increase in total lean mass (*P*=0.039) in the upper limbs (*P*=0.004) and in the trunk (*P*=0.019). Other studies using different protocols also demonstrated the benefits of progressive resistance training for the body composition in HIV-infected patients with lipodystrophy. Roubenoff et al. [12], using a protocol of eight weeks of training, showed that progressive resistance training reduced the total fat mass and increased the total lean mass, although they did not evaluate changes in the body segments. Lidengaard et al. [22] also obtained similar results with a protocol of 16 weeks of training. Over an even longer training period of 64 sessions, Yarasheski et al. [23] showed an increase of total lean mass with no changes in fat mass. In contrast, in a study of HIV-seropositive elderly subjects aged 62 to 71 years using a protocol of one year of training, Souza et al. [24] detected no changes in lean mass but observed a significant reduction of fat mass in the upper and lower limbs. Robinson et al. [25] reported that 16 weeks of training caused a significant reduction of fat mass, especially in the trunk. Mendes et al. [13], studying women infected with HIV, also reported that regular exercise training improved physical fitness and was effective and safe in mitigating changes associated with lipodystrophy.

In this study, even though a small and non significant loss of fat was detected in the trunk and upper and lower limbs, a fact that might emphasize peripheral lipoatrophy, the patients showed a significant increase in lean mass in these segments. These results suggest that progressive resisted training can be effective for the reduction of visceral adiposity and the increase in muscle mass.

Data reported in the literature, like those obtained here, indicate that progressive resistance training has an impact, with changes in the body composition in HIV-infected patients with lipodystrophy. The main alterations are due to the reduction of visceral fat mass and the increase of lean mass, with improved body harmony.

Although, on the one hand, it is clear that HAART has promoted a reduction of mortality and of the incidence of opportunistic infections, on the other hand, the use of this therapy has led to the emergence of secondary complications such as lipodystrophy syndrome. The drastic changes in body image faced by these patients can have marked consequences for affective-emotional health and, even considering the benefits of HAART, in a contradictory manner they seem to reduce the quality of life. Undoubtedly, the lipodystrophy syndrome represents an important aspect that touches the daily life of HIV-infected people [26-30]. Within this context, the changes in body composition can reduce the self-esteem of these individuals, causing difficulties in their personal and social relationships.

	Pre-training(kg) n=10 median ± SD	*Post-training(kg) n=10 median ± SD*	*Pre and post variation (kg) n=10 median ± SD*
Upperlimbs	1.72 ± 2.11 (0.67-7.80)	1.63 ± 1.87 (0.64-7.01)	-0.09 ± 0.11 (*P*=0.207)
Trunk	8.39 ± 6.76 (4.71-26.39)	9.13 ± 5.96 (4.12-23.64)	-0.74 ± 0.40 (*P*=0.291)
Lower limbs	3.23 ± 5.47 (1.94-19.31)	3.43 ± 5.32 (1.81-18.59)	-0.20 ± 0.03 (p=0.881)

* paired sample test *P*<0.05

Table 3: Comparison of fat mass in different body segments before and after training.

	Pre-training(kg) n=10 median ± SD	*Post-training(kg) n=10 median ± SD*	*Pre and post variation (kg) n=10 median ± SD*
Upperlimbs	5.51 ± 0.77 (4.61-7.33)	5.93 ± 0.87 (4.85-7.72)	0.42 ± 0.24 (*P*=0.004)*
Trunk	26.12 ± 3.66 (19.45-31.50)	27.22 ± 3.71 (20.10-32.02)	1.10 ± 1.11 (*P*=0.019)*
Lower limbs	15.64 ± 2.38 (13.17-20.11)	16.39 ± 2.60 (11.99-19.93)	0.75 ± 0.06 (*P*=0.804)

* paired sample test *P*<0.05

Table 4: Comparison of lean mass in different body segments before and after training.

With the onset of the lipodystrophy syndrome, the possibility also arose that the new body image might reveal the condition of being infected with HIV, with the new body shape being described by the patients as a "trade mark", with stigmatizing repercussions that result in the same social exclusion as observed at the beginning of the epidemic [9,31].

Since appearances are not deceiving [32], some interventions are being currently made in order to lighten the effects of the lipodystrophy syndrome on body composition. The present study supports these prior findings and shows that the use of progressive resistance training results in increased lean mass and reduced body fat, improving the body harmony and possibly affecting the quality of life, reducing the stigma due to body composition as a "marker" of HIV/AIDS.

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