

Prevalence and factors associated with lipodystrophy in AIDS patients

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ABSTRACT

Introduction: The published literature shows an increased occurrence of adverse events, such as human immunodeficiency virus (HIV)-associated lipodystrophy syndrome, that are associated with the continuous use of antiretroviral therapy. This study was performed to estimate the prevalence and factors associated with lipodystrophy in acquired immune deficiency syndrome (AIDS) patients. **Methods:** We conducted a cross-sectional study between October 2012 and February 2013. The sample consisted of patients with AIDS who attended the Outpatient Treatment Center for Infectious Diseases at Nereu Ramos Hospital, Florianópolis, State of Santa Catarina, Brazil. We collected information on demographics, lifestyle, HIV infection, and clinical aspects of the disease. Self-reported signs of lipodystrophy and body measurements were used for lipodystrophy diagnosis. **Results:** We studied 74 patients (mean age 44.3±9.2 years; 60.8% men). Among the patients, 45.9% were smokers, 31.1% consumed alcoholic beverages, and 55.4% were sedentary. The prevalence of lipodystrophy was 32.4%, and sedentary subjects had a higher prevalence of lipodystrophy compared with physically active individuals. **Conclusions:** The prevalence of lipodystrophy was 32.4%. Physical activity was considered an independent protective factor against the onset of HIV-associated lipodystrophy.

Keywords: Lipodystrophy. HIV. HIV-associated lipodystrophy syndrome. Acquired immune deficiency syndrome. Prevalence.

INTRODUCTION

The development of antiretroviral drugs and subsequent access to combined antiretroviral therapy contributed to the decline in morbidity and mortality rates associated with acquired immune deficiency syndrome (AIDS), resulting in an increased life expectancy and improved quality of life for people living with human immunodeficiency virus (HIV)^{1,2}.

With the reduction in mortality rates, AIDS has become a chronic and treatable disease. However, along with these advances, findings in the published literature show an increased occurrence of adverse events associated with the continuous use of antiretroviral therapy, such as HIV-associated lipodystrophy syndrome³⁻⁵.

HIV-associated lipodystrophy syndrome is characterized by a set of morphological changes in body-fat distribution and/or metabolic abnormalities, including lipodystrophy, dyslipidemia, insulin resistance, and hyperglycemia⁶⁻⁸.

Lipodystrophy is characterized by a redistribution of body fat in individuals living with HIV and can be classified into three categories: lipohypertrophy, lipoatrophy, and mixed

syndrome. Lipohypertrophy is the accumulation of fat in the abdominal and dorsal-cervical areas and breasts. Lipoatrophy or peripheral atrophy refers to the loss of subcutaneous fat in the face, buttocks, and upper and lower limbs and the possible presentation of prominent blood vessels. Mixed syndrome refers to a combination of lipohypertrophy and lipoatrophy⁷.

The pathogenesis of lipodystrophy in people living with HIV is multifactorial and still not fully understood. This disease is most likely a result of the interaction between antiretroviral therapy, virus infection, genetic factors, and the lifestyle of the individual^{8,9}. The association between lipodystrophy and antiretroviral therapy is well established in the scientific literature, especially when protease inhibitors and reverse transcriptase inhibitors are used^{10,11}. However, some studies have described cases of HIV-positive individuals who were not treated with antiretroviral therapy but had changes in body fat composition¹²⁻¹⁴.

Changes in body fat composition have been characteristic of HIV-infected individuals since the beginning of the epidemic. Weight loss was one of the major signs associated with HIV infection in the era before the emergence of combined antiretroviral therapy. Lipodystrophy has become new physical evidence of HIV infection^{1,15,16}.

HIV-associated lipodystrophy can generate psychological and social problems that arise from dissatisfaction with body image, as well as induce treatment discontinuation. The changes in physical appearance that are associated with lipodystrophy in individuals living with HIV have a negative psychosocial

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Received 9 November 2013

Accepted 28 January 2014

impact, such as causing low self-esteem, social isolation, and depression, that affects the individual's quality of life and may impair adherence to treatment^{16,17}.

This study was performed to estimate the prevalence and factors associated with lipodystrophy in patients with AIDS who were treated at a referral hospital for infectious diseases.

METHODS

This study was approved by the Research Ethics Committee of the University of Southern Santa Catarina (code number 12.171.4.06.III).

This was a cross-sectional, epidemiological study that was conducted between October 2012 and February 2013 in the Infectious Disease Center of Nereu Ramos Hospital, Florianópolis, State of Santa Catarina, Brazil. The population consisted of patients with HIV undergoing antiretroviral therapy who were aged 18 years and over (both genders) and attending the outpatient center. The exclusion criteria were the following: pregnancy, incomplete clinical data (missing lab test values or incomplete medical records), severe disease either associated with or without HIV infection, previous surgery (e.g., liposuction or liposculpture), and the use of methylmethacrylate to correct facial lipoatrophy.

According to the data from the health care center, 350 registered patients, including those who had discontinued treatment, fulfilled the criteria. Study participants were recruited among the patients attending medical appointments for treatment during the study period in one outpatient center (convenience sample). The patients were invited to participate in the study before or after consultation with a physician. Written informed consent was obtained from all participants for this study. Consenting patients were interviewed and underwent physical assessment.

The instrument for data collection consisted of a combination of interviews and data collection forms that included demographic data (gender, age, ethnicity, and education level), lifestyle (smoking, alcohol consumption, and physical activity), and clinical aspects of HIV infection that were obtained from medical records (CD4⁺ T-cell count, viral load, serum lipid profile and fasting glucose, time elapsed since HIV diagnosis, classes of antiretroviral drugs currently used, and duration of antiretroviral therapy). Indicators of lipodystrophy self-perception and anthropometric measurements were also included.

The CAGE questionnaire was administered to the HIV-infected individuals who said that they consumed or had consumed alcohol. The levels of physical activity were obtained during the interview by administering the International Physical Activity Questionnaire - Short Form (IPAQ-SF), version 8. The obtained data were classified according to Sjostrom et al.¹⁸. For this study, we used the following classification: sedentary individuals, i.e., those with a low level of physical activity, and physically active individuals, i.e., those with moderate and/or elevated levels of physical activity whose moderate-to-vigorous-intensity physical activity lasted at least 150min per week.

Right-side anthropometric measurements were taken twice, and the mean value was used in all analyses. The circumference

measurements of the arm, neck, waist, and hip were obtained according to the reference standards suggested by Heyward and Stolarczyk¹⁹. An inelastic measuring tape with a 1-mm resolution was used to perform the measurements.

We used a scientific caliper (Cescor[®], 0.1 mm – Cescor Equipamentos para Esporte Ltda, Porto Alegre, Rio Grande do Sul, Brazil) to measure the skinfold thickness at the following sites: biceps, triceps, subscapular site, iliac crest, midaxilla, abdomen, and calf according to the standards suggested by Guedes²⁰, which were also used in other studies^{12,48,54}. The anthropometric measures were classified using the lowest and highest percentiles (25 and 75, respectively).

A digital scale with a stadiometer (Wiso[®] W721) was used to determine the body mass and height following the anthropometric measurement techniques recommended by Fernandes Filho²¹. Body mass index (BMI) was used to assess the nutritional status at the cutoff points that were established by the World Health Organization²².

Currently, no consensus regarding the reference method for the diagnosis of HIV-associated lipodystrophy exists. Usually, lipodystrophy is self-reported by the HIV patient and is associated with body measurements^{12,14}. We considered patients with lipodystrophy as those who had at least two self-perceived body changes that were consistent with the anthropometric measures in that body area.

The collected data were entered into EpiData version 3.1 (EpiData Association, Odense, Denmark), and statistical analyses were performed using the Statistical Package for Social Sciences[®] (SPSS for Windows v. 18, Chicago, IL, USA).

Crude and adjusted prevalence ratios were estimated, and the modified Poisson regression with a robust estimator was used to control over-confounding variables. Confounding factors were selected among the variables associated with physical activity in the bivariate analysis (p -value<0.20) and from those described as such in the literature. The level of confidence was set at 5%.

RESULTS

Of the 97 patients who were initially recruited, 88 were eligible for the study, but 14.8% refused to participate. We studied 74 patients with AIDS who attended the Outpatient Treatment Center for Infectious Diseases at Nereu Ramos Hospital during the study period.

The mean age was 44.3±9.2 years, the ages ranged from 20-64 years, and participants were predominantly Caucasian men. The mean number of years of education was 9.0±3.4 years. **Table 1** shows the sociodemographic characteristics and lifestyle habits of the study participants.

Among the participants who reported consuming alcoholic beverages, 6 (8.1%) were classified as alcoholics according to the CAGE questionnaire. Among the physically active subjects, 28 (37.8%) were engaged in moderate physical activity and 5 (6.8%) were involved in high-level physical activity. **Table 2** shows the clinical characteristics and HIV infection status of the study participants.

TABLE 1 - Sociodemographic characteristics and lifestyles of the study participants (n=74).

Variables	n	%	95% CI
Gender			
male	45	60.8	48.6 - 71.6
female	29	39.2	28.4 - 51.4
Age (years)			
19 - 34	9	12.1	5.5 - 20.3
35 - 50	46	62.2	51.4 - 73.0
> 50	19	25.7	16.2 - 35.1
Ethnicity			
caucasians	68	91.9	85.3 - 97.3
non-caucasians	6	8.1	2.7 - 14.9
Education (years)			
0 - 8	35	47.3	36.5 - 58.1
> 8	39	52.7	41.9 - 63.5
Smoking			
smoker/ex-smoker	34	45.9	35.1 - 58.1
non-smoker	40	54.1	41.9 - 64.9
Alcohol consumption			
yes	23	31.1	20.3 - 41.9
no	51	68.9	58.1 - 79.7
BMI (kg/m²)			
< 18.5	2	2.7	0.0 - 6.8
18.5 - 24.9	45	60.8	50.7 - 71.6
25 - 29.9	18	24.3	14.9 - 35.1
≥ 30	9	12.2	5.4 - 18.9
Physical activity			
physically active	33	44.6	33.8 - 55.4
sedentary	41	55.4	44.6 - 66.2

BMI: body mass index; CI: confidence interval.

According to the date registered in the medical records, the mean time since HIV infection diagnosis was 9.1±5.9 (median 8) years and ranged from 1-22 years.

The mean CD4⁺ T-cell count among the study participants was 491±249 cells/mm³ (median 448 cells/mm³, range 29-1269 cells/mm³). The limit of viral load detection was 50 copies/mL (undetectable), which was reached in 85% of the sample. Considering only those participants with a detectable viral load (n=11), the minimum and maximum viral loads were 448 and 72,416 copies/mL, respectively (average 22,225±29,606 copies/mL; median 4,494 copies/mL).

With regard to drug treatment, the mean duration of antiretroviral therapy was 7.9±5.2 years (median 7 years, range 1-20 years).

The prevalence of self-reported lipodystrophy was 51.4%, whereas the results of anthropometric measurements showed a prevalence of 66.2%. The incidence of lipodystrophy, as defined by at least two changes in body fat distribution as verified by self-reports and objective measurements, was 32.4%. With regard to the classification of lipodystrophy, 62.5% individuals had lipotrophy, 29.2% had a mixed form, and 8.3% had lipohypertrophy.

Table 3 shows the distribution of the investigated variables according to the presence or absence of lipodystrophy.

A statistically significant association was found between physical activity and lipodystrophy. Sedentary subjects had a higher prevalence of lipodystrophy compared with physically active individuals.

There was no difference between the lipid and glycemic profiles related to the presence or absence of lipodystrophy in patients was observed. The results are shown in **Table 4**.

Table 5 presents the results of the multivariate analysis performed to control for confounding factors. Physical activity was an independent, protective factor against the onset of lipodystrophy in patients with AIDS.

TABLE 2 - Clinical characteristics and HIV infection status of the study participants (n=74).

Variables	n	%	95% CI
Time since diagnosis (years)			
<3	8	10.8	4.1 - 17.6
3 - 5	17	23.0	13.5 - 32.4
> 5	49	66.2	55.4 - 77.0
Time on ART (years)			
<3	12	16.2	8.1 - 24.3
3 - 5	18	24.3	14.9 - 33.8
> 5	44	59.5	48.6 - 70.3
ART regimens			
2 NRTIs + 1 NNRTI	35	47.3	36.5 - 58.1
2 NRTIs + 1 PI	32	43.2	32.4 - 54.1
Other	7	9.5	2.7 - 17.6
CD4⁺ T-cells			
< 350 cells/mm ³	22	29.7	20.3 - 40.5
≥350 cells/mm ³	52	70.3	59.5 - 79.7
Viral load			
undetectable	63	85.1	77.0 - 93.2
detectable	11	14.9	6.8 - 23.0

ART: antiretroviral therapy; CD4⁺ T-cells: T lymphocytes with surface CD4 receptors; CI: Confidence interval. NRTIs: nucleoside analog reverse-transcriptase inhibitors; NNRTIs: non-nucleoside reverse transcriptase inhibitors; PI: protease inhibitor.

TABLE 3 - Distribution of the investigated variables according to the presence or absence of lipodystrophy (n=74).

Variables	Lipodystrophy				PR (95% CI)	P-value
	presence (n=24)		absence (n=50)			
Gender						0.204
male	17	70.8	28	56.0	1.15 (1.09-1.49)	
female	7	29.2	22	44.0	1.0	
Age groups (years)						0.039
19 - 34	4	16.6	5	10.0	1.0	
35 - 50	10	41.7	36	72.0	0.80 (0.56-1.13)	
> 50	10	41.7	9	18.0	1.09 (0.73-1.61)	
Ethnicity						0.291
whites	23	95.8	45	90.0	1.19 (0.86-1.63)	
non-whites	1	4.2	5	10.0	1.0	
Education (years)						0.499
0 - 8	10	41.7	25	50.0	0.93 (0.75-1.15)	
> 8	14	58.3	25	50.0	1.0	
Smoking						0.137
yes	14	58.3	20	40.0	1.18 (0.95-1.46)	
no	10	41.7	30	60.0	1.0	
Alcohol abuse						0.366
yes	3	12.5	3	6.0	1.21 (0.80-1.83)	
no	21	87.5	47	94.0	1.0	
Physical activity						0.001
physically active	4	16.7	29	58.0	0.69 (0.57-0.84)	
sedentary	20	83.3	21	42.0	1.0	
Time since diagnosis (years)						0.311
<3	6	12.0	2	8.3	1.0	
3 - 5	14	28.0	3	12.5	0.71 (0.15-3.43)	
> 5	30	60.0	19	79.2	1.55 (0.44-5.42)	
Time on ART (years)						0.415
<3	9	18.0	3	12.5	1.0	
3 - 5	14	28.0	4	16.7	0.89 (0.24-3.28)	
> 5	27	54.0	17	70.8	1.55 (0.54-4.41)	
ART regimens						0.939
2 NRTIs + 1 NNRTI	12	50.0	23	46.0	1.06 (0.73-1.53)	
2 NRTIs + 1 PI	10	41.7	22	44.0	1.03 (0.71-1.49)	
Other	2	8.3	5	10.0	1.0	
CD4 ⁺ T-cells						0.644
<350 cells/mm ³	8	33.3	14	28.0	1.0	
≥350 cells/mm ³	16	66.7	36	72.0	0.95 (0.75-1.20)	
Viral load**						0.768
≤ 50 copies/mL	20	83.3	43	86.0	0.96 (0.70-1.30)	
> 50 copies/mL	4	16.7	7	14.0	1.0	

ART: antiretroviral therapy; NRTIs: nucleoside analog reverse-transcriptase inhibitors; NNRTIs: non-nucleoside reverse transcriptase inhibitors; PI: protease inhibitor; CD4⁺ T-cells: T lymphocytes with surface CD4 receptors; BMI: Body mass index.

TABLE 4 - Metabolic profile of the study participants according to the presence or absence of lipodystrophy (n =74).

	Total	Variation	Lipodystrophy		P-value*
			presence (n=24)	absence (n=51)	
Cholesterol	183.5 (48.9)	67 - 399	173.9	188.1	0.178
HDL	53.1 (32.1)	21 - 270	53.7	52.8	0.930
LDL	105.1 (46.1)	24 - 321	99.2	108.0	0.389
Triglycerides	153.4 (87.6)	33 - 608	155.5	153.1	0.895
Blood glucose	91.7 (17.1)	44 - 204	90.6	92.2	0.649

*Student's t-test. SD: standard deviation; HDL: high-density lipoprotein; LDL: low-density lipoprotein.

TABLE 5 - Multivariate analysis controlling for the confounding factors associated with lipodystrophy (n=74).

Variables	PR* (95% CI)	P-value
Gender	1.66 (0.84 - 3.28)	0.147
Age (years)	1.01 (0.97 - 1.04)	0.708
Smoking	1.10 (0.58 - 2.08)	0.770
Physical activity	0.27 (0.10 - 0.75)	0.012
Time since diagnosis (years)	1.02 (0.98 - 1.07)	0.287

PR: prevalence ratio, CI: confidence interval; HIV: human immunodeficiency virus; *Modified Poisson regression with robust estimator.

DISCUSSION

The prevalence of lipodystrophy in this study was 32.4%. Brazilian studies that estimated the prevalence of lipodystrophy in AIDS patients undergoing antiretroviral therapy revealed that the prevalence ranged from 32.4-67.9%^{23,24}. In a systematic review of Brazilian studies on lipodystrophy, the weighted average of the prevalence of people living with HIV was 53.5%²⁵. Tien and Grunfeld²⁶ conducted a review of international studies on lipodystrophy in people living with HIV and found that the prevalence ranged from 30-62%. The large variability in the prevalence rates may be attributed to the use of different diagnostic methods and the lack of consensus on the characterization of lipodystrophy, as well as heterogeneity within the study population.

The determination of the prevalence and incidence of HIV-associated lipodystrophy is complex because no universal consensus regarding the criteria for its diagnosis exists and lipodystrophy is described differently throughout the literature. Imaging tests, such as ultrasound, dual-energy X-ray absorptiometry (DEXA), computed tomography (CT), and nuclear magnetic resonance imaging, are also used in the diagnosis of HIV-associated lipodystrophy. However, they are costly and difficult to access in the public health care system.

In this study, the diagnosis of lipodystrophy was based on agreement between the patient self-report and anthropometric measurements, which are criteria that were also used in other studies^{12,36,48,54}. The prevalence of HIV-associated lipodystrophy was found to be 51.4% when only the patients' self-reports were considered. Studies conducted by Sanches et al.¹⁶, Smith²⁷, and De Carvalho et al.²⁸ also used the patients' self-reports as the single method for diagnosis of HIV-associated lipodystrophy and revealed prevalences of 47.6%, 40.5%, and 50.9%, respectively. It is important to emphasize the subjectivity of the self-report method because it depends on the patient's perception. When the prevalence of lipodystrophy was determined using anthropometric measurements, 66.2% of the study participants showed changes in body fat distribution. Studies investigating the prevalence of HIV-associated lipodystrophy using anthropometry combined with other methods were found, but they did not mention the incidence of lipodystrophy that was found by each method, only the overall result^{12,29}. The different methods that are used for lipodystrophy diagnosis do not allow for reproducible studies and/or comparison of the data obtained by the different techniques.

Anatomical redistribution of body fat occurred in the following decreasing order of predominance: lipoatrophy, mixed-form, and lipohypertrophy. This finding is in agreement with the studies by Trinca et al.²⁹, Gasparotto et al.³⁰, and Signorini et al.³¹.

Lipoatrophy is more frequent than lipohypertrophy in patients with HIV-associated lipodystrophy. In a study by Cabrero et al.³², lipoatrophy, followed by lipohypertrophy, was the most common alteration reported by individuals with lipodystrophy. Hendrickson et al.³³ found that lipoatrophy was one of the most common metabolic changes associated with antiretroviral therapy. Lipohypertrophy is linked to the accumulation of abdominal fat, especially intra-abdominal fat, and is associated with metabolic problems, such as insulin resistance and metabolic syndrome, which increase the risk of cardiovascular disease and diabetes mellitus^{34,35}.

In this study, no difference in the lipid profile between the groups of patients with and without lipodystrophy was observed. This finding could be due to the limited sample size, coupled to the fact that the majority of patients in this study had levels of total and fractionated cholesterol, triglycerides, and blood glucose within the normal range.

The prevalence of lipodystrophy that was found in this study was higher in the 35-50- and >50-year age groups. This finding is similar to that found in the published literature, in which the highest frequency of lipodystrophy was reported in older age groups^{14,19,36}. It is known that changes in body composition among older, HIV-negative individuals are related to the aging process, which results in decreased subcutaneous adipose tissue and increased body fat in the central region. Although subcutaneous fat decreases, the total fat mass tends to increase with age, and lean mass decreases concomitantly with an increase in body fat^{22,37}. It should be noted that, in HIV-infected individuals, aging may be related to the AIDS classification and duration of antiretroviral therapy, which is a known risk factor for the onset of lipodystrophy^{14,38}. The research design that was used for this study does not allow inferences to be made regarding correlations between HIV-related lipodystrophy and aging.

Changes in body fat distribution in patients with AIDS are among the major complications of the use of antiretroviral therapy. Among the antiretroviral therapy components, protease inhibitors and reverse transcriptase inhibitors, as well as the exposure time to antiretroviral therapy^{6,10}, have been implicated as the cause of HIV-associated lipodystrophy. In the present study, no association was found between the presence of lipodystrophy in HIV-infected individuals and length of antiretroviral therapy. Segatto et al.³⁹ investigated the association between the use of antiretroviral therapy and the presence of lipodystrophy and found that the longer-duration treatment group had a higher proportion of lipodystrophy. Signorini et al.³¹ evaluated the body fat content in HIV-infected individuals according to the duration of antiretroviral therapy and found that the group that had undergone more than one year of treatment had 11 mm of additional fat in the visceral compartment content compared with those who had undergone less than one year of treatment. Similarly, other studies have reported an association between the presence of lipodystrophy and longer exposure to antiretroviral therapy, suggesting a temporal relationship between the use of pharmacological therapy and the emergence of lipodystrophy^{13,40}.

This study showed a higher frequency of lipodystrophy in individuals who had been diagnosed with HIV for a longer

period of time. These data are consistent with the published literature, which states that patients with a longer duration of HIV infection had higher prevalence rates of lipodystrophy^{12,13,39,40}. The deleterious effects of HIV infection that are related to the onset of lipodystrophy correspond to permanent activation of inflammatory cytokines and increased oxidative stress, which are responsible for promoting apoptosis of T-cells and involved in the induction mechanism of tumor necrosis factor-alpha (TNF- α)⁴¹⁻⁴³.

The influence of the use of antiretroviral therapy on the onset of lipodystrophy in HIV-infected individuals could not be analyzed in this study because all sampled patients were undergoing antiretroviral therapy. Changes in body fat distribution have been reported in HIV-infected individuals who were not exposed to antiretroviral therapy. In a study conducted by Diehl et al.¹³, lipodystrophy was observed in 27% of HIV-infected individuals who had never undergone antiretroviral therapy (ART). Similar results were obtained in a study by Alencastro et al.¹². Not all surveyed patients had HIV-associated lipodystrophy, which suggests that the onset of lipodystrophy varies with respect to the therapeutic regimen, treatment duration, and factors related to lifestyle, such as physical activity.

According to previously published studies and the recommendations of the Ministry of Health, physical activity and exercise are among the therapeutic interventions that can be used to prevent and treat the symptoms and complications of chronic HIV infection and the adverse events that are associated with the use of ART⁴⁴⁻⁴⁷.

Florindo et al.⁴⁸ studied the relationship between physical activity, as assessed using the Baecke questionnaire, and body fat in people living with HIV undergoing ART and found that physical activity aids in preventing the accumulation of central fat. Ramírez-Marrero et al.⁴⁷ conducted a study in HIV-infected individuals undergoing ART and found an association between physical activity and body composition. Their findings revealed that physically active individuals exhibited lower central body fat and total body fat compared with sedentary subjects.

This study showed that there was a high incidence of sedentary lifestyle among the study population. The physical activity levels were measured by the IPAQ; however, according to a systematic review by Schuelter-Trevisol et al.⁴⁹, physical activity levels vary according to the measurement method used. They found that HIV-positive patients showed inactivity or sedentary lifestyle percentages ranging from 19-73%. Despite the wide range of direct and indirect methods for measuring physical activity, it is believed that the IPAQ that was used in this study is one of the most appropriate tools for epidemiological studies and has been validated in several countries, which allows for comparison with other studies and reproducibility of the method. The IPAQ was designed to measure physical activity throughout an entire day, including leisure time, work, travel, and domestic chores. Moreover, it has the benefit of being inexpensive and easy to use and is recommended by the World Health Organization^{17,50}.

Studies have demonstrated the beneficial effects of regular physical activity, including improved metabolic profile⁵⁰, body composition, and quality of life^{51,52}, in HIV-infected individuals.

In the present study, physical activity was shown to be an independent protective factor against the onset of lipodystrophy in AIDS patients. Furthermore, sedentary subjects had a higher incidence of lipodystrophy compared with physically active individuals. It was observed that 58% of subjects in the non-lipodystrophic group were physically active, whereas only 16.7% were physically active in the lipodystrophic group. This finding is in agreement with the studies by Domingo et al.⁵³, Segatto et al.³⁹, and Schuelter-Trevisol et al.⁵⁴, who investigated the association between physical activity and lipodystrophy in HIV-infected individuals and found a statistically significant association between physical activity levels and lipodystrophy, with physically active individuals exhibiting a lower incidence of lipodystrophy than those living a sedentary lifestyle. According to Segatto et al.³⁹, physically active HIV-infected individuals were 79% less likely to have lipodystrophy than sedentary individuals.

It should be noted that daily physical activity could also result in significant energy expenditure. Individuals with regular physical activity at work, at home, and during leisure time that requires caloric expenditure are also considered physically active. Thus, a sedentary lifestyle is not just related to a lack of regular physical exercise.

The Ministry of Health⁴⁴ recommends performing at least 30min of moderate physical activity five times a week or 20min of vigorous physical activity three times a week for people living with HIV and AIDS.

During the period of data collection, a smaller number of patients attended the outpatient center than the estimated number that was based on registered records, which limited the sample size and, consequently, the statistical analysis. The external validity of this study is limited because it was an observational study of a sample of patients who attended the outpatient treatment center. In addition, the cross-sectional design does not prove causality. However, the findings from this study may be used for comparison, evaluation, and monitoring of individuals living with HIV in clinical practice.

The overall prevalence of lipodystrophy was 32.4% among the participants in this study. Physical activity was considered an independent protective factor against the onset of HIV-associated lipodystrophy.

In conclusion, the findings from this study suggest that physical activity should be recommended as a therapeutic strategy for the prevention and treatment of lipodystrophy in people living with HIV and AIDS.

FINANCIAL SUPPORT

Support Fund for the Maintenance and Development of Higher Education (FUMDES) for granting a Master's scholarship.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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