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Prevalence and associated factors related to sarcopenia in people living with HIV/AIDS

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Abstract

Background The use of antiretrovirals has increased the survival of People Living with HIV/AIDS (PLWHA), resulting in an aging population and a rise in the incidence of sarcopenia. The lack of uniformity among the prevalences found in studies may be associated with the use of different diagnostic criteria, highlighting the need for local studies to determine the prevalence of sarcopenia.

Methods Cross-sectional study to estimate the prevalence and associated factors of sarcopenia using the revised criteria of the European Working Group on Sarcopenia in Older People (EWGSOP2). This study included PLWHA of both sexes, aged 40 years or older, who were treated at the infectious disease outpatient clinic of a tertiary hospital from 2019 to 2021. Muscle mass was quantified through electrical bioimpedance, using resistance and reactance to calculate appendicular lean mass (ALM) in kg/m^2. Muscle strength, measured in kg, was assessed using a manual dynamometer, and muscle function was evaluated using the gait speed test (m/s). Numerical variables were analyzed using measures of central tendency and dispersion. The chi-square test was used to assess associations in categorical variables. Odds ratios (OR) and 95% Confidence Intervals (CI) were calculated to evaluate the strength of associations.

Results Among the 218 PLWHA, the prevalence of sarcopenia was 8.7% (95% CI: 5.6 to 13.3). The mean age of the study population was 51.8 ± 8.3 years; 53.7% were male, 72.9% were brown/Black, 97.7% reported not using illicit drugs, and 24.8% were classified as obese. Multivariate analysis showed that the time since HIV diagnosis ($P = 0.022$) and the use of illicit drugs were associated with the diagnosis of sarcopenia.

Conclusion The prevalence of sarcopenia using the EWGSOP2 criteria was low. People with a longer duration of HIV infection and those using illicit drugs were more likely to develop sarcopenia.

Keywords Sarcopenia, AIDS, Prevalence

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Background

The use of potent antiretrovirals has led to increased survival for people living with HIV/AIDS (PLWHA), resulting in an aging population [1–3]. This increased survival, combined with chronic low-grade systemic immune activation, accelerates cellular senescence and physiological decline [4]. Consequently, HIV infection is associated with earlier onset and higher incidence of various conditions, including cardiovascular disease, neurocognitive disorders, geriatric syndromes, and particularly sarcopenia [1–3, 5].

Sarcopenia, a condition characterized by a progressive, generalized loss of muscle mass and function [6], affects more than 50 million people worldwide as of 2010, with projections reaching 200 million by 2050 [7]. There is limited data on the prevalence of sarcopenia in PLWHA. Existing studies have reported prevalence rates of sarcopenia ranging from 4 to 24.1% in this population [8]. However, these studies either involved small sample sizes, were conducted at different stages of HIV infection, or used variable definitions of sarcopenia with differing cutoff points.

There is no single operational consensus definition to characterize sarcopenia in clinical practice. The most commonly used definition is from the European Working Group on Sarcopenia in Older People (EWGSOP), which published the European Consensus on Definition and Diagnosis of Sarcopenia in 2010 [7]. This was revised in 2019 as EWGSOP2 [5]. This revised version identifies muscular strength as the most reliable measure of muscle function and the best predictor of adverse events. It changed the order of investigation for sarcopenia and established new cutoff points. The terms "probable sarcopenia," "confirmed sarcopenia," and "severe sarcopenia" are now used to classify sarcopenia. When muscular strength, the first criterion assessed in this new investigation order, is reduced, it is considered probable sarcopenia. If there is also a confirmed decrease in muscle quantity or quality, sarcopenia is diagnosed. A decrease in muscle function determines the severity of the disease [5].

There are few studies on the prevalence of sarcopenia in PLWHA. In one study, Almeida et al. examined 101 PLWHA aged 50 or older using EWGSOP criteria and found a prevalence of sarcopenia and pre-sarcopenia of 12% and 16.9%, respectively [9]. Nascimento et al. assessed the diagnosis of sarcopenia in northeastern Brazil in 101 PLWHA aged 18 or older and found a prevalence of 18.2% for sarcopenia and 33.3% for severe sarcopenia [10]. Lédo et al. found an occurrence of 5.5% for sarcopenia and 10.2% for pre-sarcopenia among 128 PLWHA aged 18 or older, treated at two infectious disease clinics [11].

It is importante for clinical practice to assess the presence of sarcopenia and its associated factors. Recognizing this condition early and intervening appropriately can prevent the loss of Independence among these individuals and minimize adverse events such as frailty, functional disability, falls, and reduced quality of life.

The aim of this study is to estimate the prevalence of sarcopenia and its associated factors using the new criteria established by the EWGSOP2 in PLWHA.

Methods

This was a descriptive, cross-sectional, analytical study conducted at the infectious diseases outpatient clinic of a tertiary hospital in Recife, in the northeast of Brazil.

Eligibility criteria

From August 2019 to August 2021, PLWHA of both sexes, aged 40 years or older, who were being treated at the infectious disease outpatient clinic of a tertiary hospital specializing in HIV/AIDS care, were invited to voluntarily participate in the study during their routine appointments. Twelve patients declined to participate. Those who agreed to participate signed an Informed Consent Form (ICF), which was approved by the Research Ethics Committee of the Health Sciences Center.

Were excluded from the research pregnant patients, physically disabled patients, patients diagnosed with: acute infection (any infection during the 15 days prior to the interview), chronic kidney disease (defined by creatinine clearance below 90 ml/min/1.73 m^2 for more than three months), cancer, heart failure (characterized by an ejection fraction lower than 40%), Parkinson's disease and people with prostheses or orthoses.

Data collection

After participants had signed the ICF, the interviewer filled out a questionnaire with information taken from the patient's medical records, such as age, gender, use of antiretroviral therapy (ART), time of HIV diagnosis, the nadir and current serum CD4 T lymphocytes count, and the current viral load. Data were requested from the participant regarding education, race, use of illicit drugs, alcohol, medications in use, protein supplementation, physical activity, diagnoses of diabetes and hypertension. After this, each patient underwent anthropometry, a handgrip strength test, blood collection, bioelectrical impedance and a gait speed test.

With the anthropometry, body weight was measured using a digital scale and height was measured using a stadiometer. The hand grip strength (HGS) was measured using a hydraulic hand dynamometer, through an average of three measurements in the dominant hand. The participant remained seated on a chair with no armrests, with

an erect spine, keeping the knee flexion angle at 90°, the shoulder positioned in adduction and neutral rotation, the elbow flexed at 90°, with the forearm in half pronation and neutral wrist. The arm was suspended in the air with the dominant hand positioned on the dynamometer and the three measurements were taken [12].

A blood sample was subsequently obtained through venipuncture to measure total and free testosterone and vitamin D. After this step, each participant was submitted to bioelectrical impedance (BIA), in order to measure the muscle mass. With the patient in the supine position, a pair of electrodes was connected to the dorsal region of the right hand and another pair to the dorsal region of the right foot so as to perform the reading. A BIA tetrapolar Sanny® was used, which is registered at National Health Surveillance Agency under No. 81540240002, operates at a monofrequency of 50 Khz (Kilohertz) and provides resistance and reactance values in ohms. The appendicular lean mass index (ALMI) was calculated by dividing the appendicular lean mass (ALM) by the height squared. To obtain the ALM, the Kyle's equation was used (−4.211 + (0.267×height^2/strength) + (0.095×weight) + (1.909×sex (man=1, woman=0)) + (−0.012×age) + (0.058×reactance) [13] and, in those over 60 years of age, confirmed with the Sergi equation (−3.964 + (0.227 x height^2/resistance) + (0.095 x weight) + (1.384 x gender) + (0.064 x reactance) [14].

Finally, the gait speed (GS) test was performed by measuring the time during which the participant walked at a normal speed, on a flat surface, for a distance of four meters [15].

Diagnostic criteria

Sarcopenia was diagnosed according to the cutoff points (Fig. 1) and algorithm below (Fig. 2):

The first item to be assessed was muscular strength. Patients with normal strength were considered as not having sarcopenia. Those with reduced muscular strength, although with normal muscle mass (calculated by the ALMI), were considered pre-sarcopenic. Patients with reduced muscular strength and a low ALMI were diagnosed with sarcopenia. Lastly, the GS of patients with sarcopenia was analyzed. Those with a reduced GS were considered to have severe sarcopenia.

Statistical analysis

In this study, Stata version 14.0 was used for analysis. The results were calculated considering only valid responses, excluding those that were missing, and were presented in a table showing the corresponding absolute and relative frequencies. Numerical variables were analyzed using measures of central tendency and dispersion. To analyze associated factors, patients were categorized into two groups: with sarcopenia and without sarcopenia. The sarcopenia group included those with sarcopenia, probable sarcopenia, and severe sarcopenia. To assess associations in categorical variables, the Pearson chi-square test was used. A multivariate model was proposed using logistic regression to minimize confounding bias. The method applied in the model was a stepwise forward. The inclusion criteria of the variables in the model was a p-value<0.1 and the exclusion criteria was a p-value<0.05. Odds ratios (OR) and 95% confidence intervals (95% CI) were calculated to assess the strength of associations.

Results

Using the EWGSOP2 criteria, 91.3% of the 218 PLWHA did not have sarcopenia, 7.3% had probable sarcopenia, two people had confirmed sarcopenia, and one person had severe sarcopenia. The prevalence, when regrouped

CRITERION	MEASUREMENT METHOD	CUTOFF POINT	CLASSIFICATION OF SARCOPENIA
MUSCULAR STRENGTH	DYNAMOMETER	Men < 27 Kg Women < 16 Kg	Strength ↓: Probable sarcopenia
MUSCULAR MASS (ALMI[b])	BIOIMPEDANCE	Men: <7.0Kg/m2 Women:<5.5 Kg/m2	Strength ↓ and ALMI ↓: Sarcopenia
MUSCULAR FUNCTION	GAIT SPEED	< 0.8 m/s	Strength ↓, ALMI ↓ and Function↓: Severe sarcopenia

Fig. 1 Cutoff points for case definition according to the EWGSOP2[a]. [a] European Working Group on Sarcopenia in Older People. [b]Appendicular Lean Mass Index

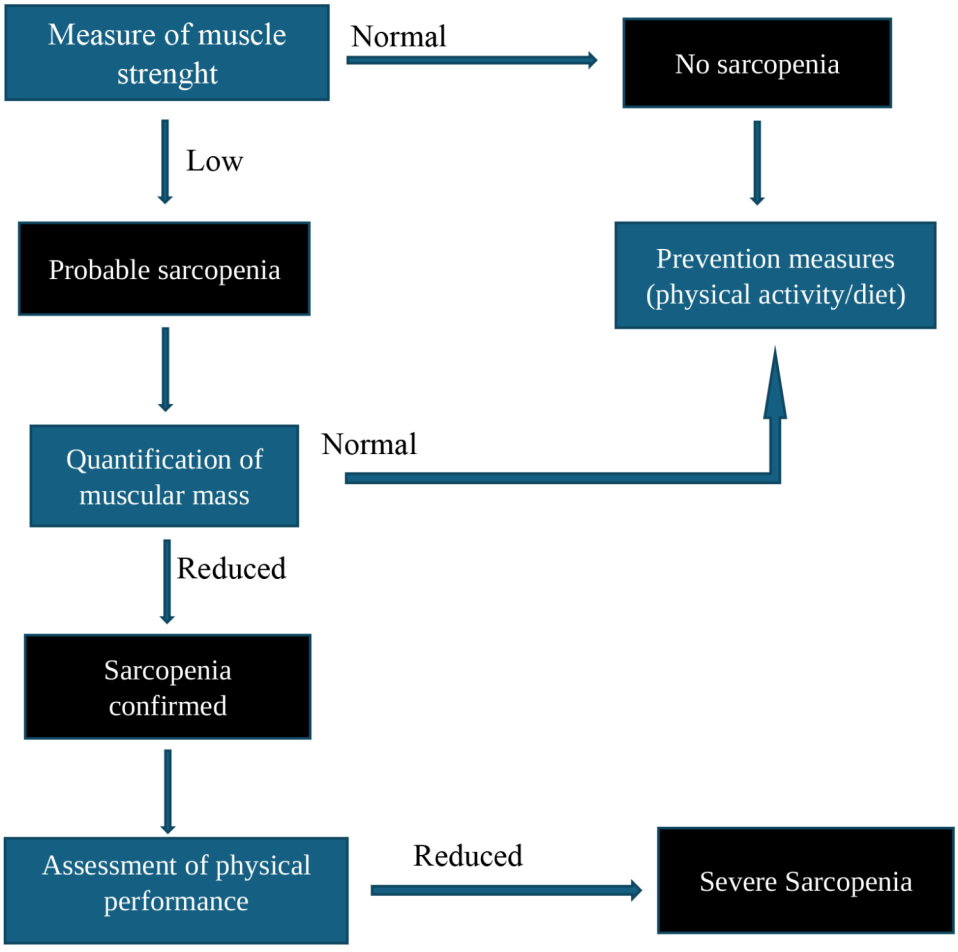

Fig. 2 Algorithm for case definition. Adapted [5]

into with or without sarcopenia, was 8.7% (95% CI: 5.6 to 13.3). The mean age of the patients was 51.8±8.3 (range 40–78) years; 53.7% were male, 50% were unemployed, 72.9% were brown/Black, 97.7% reported not using illicit drugs, 24.8% were classified as obese, and 38.1% engaged in some form of physical activity (Table 1).

Table 2 shows the HIV-related characteristics of the study population. The median duration of HIV infection diagnosis was 10 (5–15) years; 98.2% were using antiretroviral therapy, 84.9% had an undetectable HIV viral load, and 53.3% had a CD4 nadir below 200 cells/mm³.

Sarcopenia was more prevalent among patients with a longer duration of HIV/AIDS diagnosis (P=0.046) and those who used illicit drugs (P=0.031) (Tables 3 and 4). To assess the strength of the association, a multivariate analysis using logistic regression was performed, and the duration of HIV infection diagnosis and illicit drug use remained associated with sarcopenia diagnosis (Table 5). For each additional year of HIV diagnosis, the likelihood of sarcopenia prevalence increased by 7%, and illicit drug use increased the likelihood of sarcopenia diagnosis by approximately eight times.

Discussion

The present study found a prevalence of sarcopenia of 8.7% among PLWHA. This finding is similar to what is reported in the literature when using the EWGSOP2 criteria. In two systematic reviews on sarcopenia in PLWHA [6, 16], the authors reported a general prevalence of sarcopenia in this population ranging from 0 to 24.1%, according to the criteria used among various studies. The two studies in this systematic review that, like ours, used the updated EWGSOP2 criteria also found a low prevalence of sarcopenia [17, 18].

A possible explanation for this difference in prevalence when using the EWGSOP2 criteria might be the change in the investigation flow of the updated criteria. The main modification was using muscular strength as the first criterion to assess and as the primary marker for defining sarcopenia, unlike other guidelines which begin by quantifying muscle mass as the main parameter [5, 19–21]. Changing the order to start with strength rather than muscle mass might explain the large differences in sarcopenia diagnosis between studies. This divergence was

Table 1 Sociodemographic characteristics, related habits, and comorbidities of the 218 people living with HIV/AIDS

Characteristics	Statistics
Age	
Mean ± SD (Minimum – Maximum)	51.8 ± 8.3 (40–78)
Sex: Male	117 (53.7%)
Education	
Illiterate	42 (19.3%)
Literate	160 (73.4%)
Higher education	16 (7.3%)
Employment Status	
Employed	82 (37.6%)
Unemployed	109 (50.0%)
Retired	27 (12.4%)
Race	
White	59 (27.1%)
Brown	118 (54.1%)
Black	41 (18.8%)
Habits	
Smoking	39 (17.9%)
Alcohol use	75 (65.6%)
Illicit drug use	5 (2.3%)
Physical activity	83 (38.1%)
Comorbidities	
Depression	22 (10.1%)
Obesity (BMI > 30 kg/m^2)	54 (24.8%)
Hypertension	64 (29.4%)
Diabetes	23 (10.5%)
Protein supplementation	6 (2.8%)
Low total testosterone level	42 (19.3%)
Low free testosterone level	41 (18.8%)
Vitamin D: Median (P25 – P75)	28.6 (23.8–36.7)

Table 2 HIV-related characteristics of the 218 people living with HIV/AIDS

Characteristics	Statistics
Duration of HIV diagnosis (in years)	
Median (P25 – P75)	10 (5–15)
Use of ARV therapy	217 (98.2%)
CD4 Nadir	
< 200 cells	80 (53.3%)
200 to 350 cells	36 (24.0%)
> 350 cells	34 (22.7%)
Current CD4	
Median (P25 – P75)	612 (411–895)
Current Viral Load	
< 40 copies	185 (85.3%)
41 to 500 copies	17 (7.8%)
> 500 copies	15 (6.9%)

Table 3 Association of sociodemographic characteristics, related habits, and comorbidities in people living with HIV/AIDS

Characteristics	Sarcopenia (*n* = 19)	No Sarcopenia (*n* = 199)	OR (95% CI)	*p*-value
Age				
Mean ± SD	53.5 ± 7.5	51.6 ± 8.3	1.03 (0.97–1.08)	0.339
Sex:				
Male	8 (42.1%)	109 (54.8%)	Reference	-
Female	11 (57.9%)	90 (45.2%)	1.67 (0.64–4.31)	0.294
Education				
Illiterate	2 (10.5%)	40 (20.1%)	Reference	-
Literate	17 (89.5%)	159 (79.9%)	2.14 (0.47–9.63)	0.322
Employment Status				
Employed/Retired	8 (42.1%)	101 (50.8%)	Reference	-
Unemployed	11 (57.9%)	98 (49.2%)	1.42 (0.55–3.67)	0.473
Race				
White	11 (57.9%)	89 (44.7%)	Reference	-
Brown/Black	8 (42.1%)	110 (55.3%)	0.59 (0.23–1.53)	0.275
Habits				
Smoking	4 (21.0%)	35 (17.6%)	1.25 (0.39–4.00)	0.707
Alcohol use	6 (31.6%)	69 (34.7%)	0.87 (0.32–2.39)	0.786
Illicit drug use	2 (10.5%)	3 (1.5%)	7.69 (1.20–49.2)	0.031
Physical activity	12 (63.2%)	123 (61.8%)	1.06 (0.40–2.80)	0.908
Comorbidities				
Depression	3 (15.8%)	19 (9.5%)	1.78 (0.47–6.65)	0.394
Obesity	5 (26.3%)	49 (24.6%)	1.09 (0.37–3.19)	0.870
Hypertension	2 (10.5%)	62 (31.2%)	0.26 (0.06–1.16)	0.077
Diabetes	1 (5.3%)	22 (11.1%)	0.45 (0.06–3.51)	0.444
Protein supplementation	0 (0%)	6 (3.0%)	Not estimated	-
Low total testosterone level	13 (68.4%)	163 (81.9%)	0.48 (0.17–1.34)	0.162
Low free testosterone level	13 (68.4%)	164 (82.4%)	0.46 (0.16–1.30)	0.144
Vitamin D:				
Median (P25 – P75)	29.1 (25.1–36.8)	28.5 (23.7–36.7)	1.00 (0.96–1.05)	0.893

also noted in other studies comparing these criteria [18, 22–26].

There has been a change in the understanding of sarcopenia. This muscle disease (muscle failure) is primarily characterized by a reduction in strength rather than muscle quantity [5]. Thus, with muscle strength being the best predictor of physical function [27, 28], as proposed by EWGSOP2, the use of this protocol may provide a more accurate diagnosis of sarcopenia in clinical practice, potentially correcting an overestimation by other criteria.

Table 4 Association of sociodemographic characteristics, related habits, and comorbidities in people living with HIV/AIDS

Characteristics	Sarcopenia (*n* = 19)	No Sarcopenia (*n* = 199)	OR (95% CI)	*p*-value
Duration of HIV infection (in years)				
Median (P25 – P75)	15 (8–19)	10 (5–15)	1.07 (1.01–1.14)	0.046
Use of ARV therapy				
No	0 (0%)	4 (2.0%)	Reference	-
Yes	19 (100%)	195 (98.0%)	Not estimated	-
CD4 Nadir				
> 200 cells	2 (20.0%)	68 (48.6%)	Reference	-
< 200 cells	8 (80.0%)	72 (51.4%)	3.78 (0.78–18.4)	0.100
No information	9	59	-	-
Current CD4				
Median (P25 – P75)	611 (414–1,004)	614 (401–895)	1.00 (0.99–1.01)	0.832
Current Viral Load				
Undetectable	4 (21.0%)	28 (14.1%)	Reference	-
Detectable	15 (79.0%)	170 (85.9%)	0.62 (0.19–2.00)	0.421

Table 5 Multivariate analysis of the association of Sarcopenia in people living with HIV/AIDS

Characteristics	Crude OR (95% CI)	Adjusted OR (95% CI)	*p*-value
Duration of HIV infection (in years)			
Median (P25 – P75)	1.07 (1.01–1.14)	1.07 (1.01–1.15)	0.037
Illicit Drug Use			
No	Reference	Reference	-
Yes	7.69 (1.20–49.2)	8.51 (1.24–55.9)	0.026

Regarding the studied variables, after multivariate analysis, the duration of HIV diagnosis and the use of illicit drugs showed an association with sarcopenia. Each additional year of HIV infection increased the likelihood of sarcopenia diagnosis by 7%. This association may be explained by the well-recognized role that chronic inflammatory diseases play in the development of sarcopenia [5], as well as by the use of antiretrovirals, which may promote aging-related phenomena, leading to cellular senescence [29].

Regarding the use of illicit drugs, this population often has health-damaging lifestyle habits, which would justify the finding of this study. It is worth noting that this information was self-reported, and there may have been omissions of this data by the participants.

The main limitations of this study are that it is a cross-sectional study conducted at a single center. On the other hand, the strengths of the study include the use of the updated EWGSOP2 criteria and the fact that the participants span a wide age range. Since the PLWHA ages earlier, we might have identified sarcopenia at an earlier stage in this population.

With this change in understanding sarcopenia as a disease of muscle function and the update of the EWGSOP criteria, more research is needed to define the true prevalence of sarcopenia and determine the most appropriate cutoff points for each population. It is important to identify individuals at high risk of developing the disease or those in its early stages, and to implement prevention programs capable of maintaining or improving their physical performance, such as physical activity and proper nutrition.

Conclusion

The sarcopenia prevalence using the EWGSOP2 criteria was low. People with a longer duration of HIV infection and those who reported using illicit drugs were more likely to develop sarcopenia. The best method for diagnosing sarcopenia is still a subject of debate.

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Author contributions

LCM: main author, conception and design of the study, acquisition of data, drafting the article, analysis and interpretation of data, final approval of the version to be submitted; MPOS: co-author, acquisition of data, final approval of the version to be submitted; ACOS: co-author, article review, acquisition of data, final approval of the version to be submitted; VMS co-author, conception and design of the study, final approval of the version to be submitted; PSRA: co-author, analysis and interpretation of data, final approval of the version to be submitted, final approval of the version to be submitted. All authors reviewed and approved the final version submitted for publication.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the Research Ethics Committee of the Health Sciences Center of the Universidade Federal de Pernambuco (CAAE: 18710919.6.0000.8807). The informed consent statement was signed by literate participants who agreed to participate in the research. These forms were read aloud to illiterate participants who understood, agreed to participate in the research and signed with their thumb. These forms are also available from the author and can be requested by email: lu_upe@hotmail.com.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interest.

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