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ORIGINAL

Is the handgrip strength a good nutritional assessment method for people living with HIV?

A força de preensão manual é um bom método para avaliação nutricional de pacientes vivendo com HIV?

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ABSTRACT

Objective

The study aimed to verify the relationship between handgrip strength measurement and classic anthropometric values in HIV positive outpatients.

Methods

This was a cross-sectional study that enrolled HIV-positive outpatients treated at the Gaffrée and Guinle University Hospital, aged between 20 and 60 years and considered to be well-nourished or moderately malnourished, according to the Global Subjective Analysis. The patients' bilateral handgrip strength were assessed (Jamar dynamometer), and classic anthropometry variables (weight, height, body mass index, arm muscle area, arm

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fat area, arm muscle circumference, and triceps skin fold) were measured. The Kolmogorov-Smirnov test, *t*-test, bivariate correlation and regression analysis were used (SPSS 21® software), with a significance level of 5%.

Results

A total of 242 patients were assessed. According to the Global Subjective Analysis, 218 (90.1%) patients were classified as well nourished (Global Subjective Analysis-A) and 24 (9.9%) as moderately malnourished (Global Subjective Analysis-B). The average dominant hand handgrip strength with standard deviation was 30.5±9.5kgf and 24.1±6.1kgf for Global Subjective Analysis-A and Global Subjective Analysis-B patients, respectively. Handgrip values were not influenced by age. The handgrip strength showed in both genders a significant correlation with weight, body mass index, and with anthropometric parameters related to lean body mass (arm muscle circumference and arm muscle area), but without correlation with the non-lean mass parameter (arm fat area). The handgrip strength of the dominant hand was a predictor of the following variables associated with lean body mass, i.e., arm muscle circumference and arm muscle area (R^2=0.194, t=7.7, p<0.001, and R^2=0.192, t=7.6, p<0.001, respectively). However, handgrip strength was not a predictor of arm fat area.

Conclusion

Measurement of handgrip strength was a useful method for nutritional assessment in outpatients with HIV due to a significant relationship with anthropometric parameters associated with lean body mass.

Keywords: Nutritional assessment. HIV. Muscle strength.

RESUMO

Objetivo

Este estudo buscou verificar a relação entre a mensuração da força de preensão manual e os valores das medidas antropométricas clássicas em pessoas vivendo com HIV em acompanhamento ambulatorial.

Métodos

O estudo foi transversal, com inclusão de pessoas vivendo com HIV atendidas no Hospital Universitário Gaffrée e Guinle, entre 20 e 60 anos e consideradas bem nutridas ou desnutridas moderadas, de acordo com Análise Subjetiva Global. Foi mensurada a força de preensão manual bilateralmente (dinamômetro Jamar®) e realizada antropometria clássica: peso, estatura, índice de massa corporal, área muscular do braço, área gordurosa do braço, circunferência muscular do braço e dobra cutânea tricipital. Através do software SPSS 21®, foram utilizados o teste de Kolmogorov-Smirnov, teste t, correlação bivariada e análise de regressão, com nível de significância de 5%.

Resultados

Foram analisados 242 pacientes. Conforme análise de objetivo geral, 218 (90,1%) pacientes foram classificados como bem nutridos (Análise Subjetiva Global-A), e 24 (9,9%), como desnutridos moderados (Análise Subjetiva Global-B). O valor médio com o desvio-padrão da força de preensão manual da mão dominante foi de 30,5±9,5kgf e 24,1±6,1kgf para pacientes Análise Subjetiva Global-A e Análise Subjetiva Global-B, respectivamente. Os valores da força de preensão manual não foram influenciados pela idade. A força de preensão manual apresentou correlação significativa com o peso, com o índice de massa corporal e com parâmetros antropométricos relacionados à massa corporal magra (circunferência muscular do braço e área muscular do braço), mas sem correlação com parâmetro não relacionado à massa magra (força de preensão manual) em ambos os sexos. A força de preensão manual da mão dominante foi preditora das variáveis relativas à massa magra circunferência muscular do braço e área muscular do braço (R^2=0,194, t=7,7; p<0,001; e R^2=0,192, t=7,6; p<0,001, respectivamente). Contudo, a força de preensão manual não foi preditora da área gordurosa do braço.

Conclusão

A mensuração da força de preensão manual foi um bom método para avaliação nutricional em pacientes ambulatoriais vivendo com HIV com significativa relação com parâmetros antropométricos associados à massa corporal magra.

Palavras-chave: *Avaliação nutricional. HIV. Força muscular.*

INTRODUCTION

Weight loss is common in the course of Human Immunodeficiency Virus (HIV) infection, occurring since the early stages and may precede immunological impairment [1]. In addition to weight, anthropometric indices related to lean body mass are relevant, since loss of muscle mass is associated with increased mortality, length of hospital stay, depression and reduced quality of life [2]. No single clinical or laboratory parameter can be singled out as an accurate indicator of nutritional status; a systematic approach includes clinical and surgical history, clinical signs and physical examination, anthropometry, laboratory indicators, dietary assessment and functional assessment [3].

The measurement of muscle strength is considered a functional and nutritional status indicator in several populations [4]. Among the methods for assessing voluntary muscle strength, the most used and validated in clinical practice is the measurement of Handgrip Strength (HGS), which is able to estimate the overall individual's strength. It is a simple, low-cost instrument, validated in different populations and easily performed in outpatients to assess nutritional risk [5].

Sarcopenia, according to the latest European consensus, 2018, is a muscle disease related to muscle changes that occur throughout life, common among the elderly, but also present in younger adults. It is defined as low values of (1) muscle strength; (2) muscle quantity and quality and (3) physical performance [6]. Low muscle strength is considered a primary parameter, a more reliable measure of muscle function and its detection makes the diagnosis of sarcopenia likely [6].

The literature lacks studies that assess the status and nutritional changes in People Living with HIV (PLHIV) [7]. Although the assessment of HGS has been well validated in other populations as a marker of loss of global muscle strength and the reduction of HGS values has been linked to several negative impacts, there is little information on the value of HGS in PLHIV. In addition, a better understanding of the correlation between classical anthropometric indices and HGS is still sought for this specific population composed of people living with HIV. In other words, if strength reduction resulting from loss of lean body mass is correlated with the values obtained in this functional hand strength test.

Thus, the main objective of this study was to verify the relationship between the measurement of HGS and the values of classic anthropometric measures, performed in the nutritional assessment of PLHIV in outpatient follow-up.

METHODS

Cross-sectional study carried out between June 2017 and June 2018. The sample used was a convenience sample, composed of people living with HIV under medical supervision at the Immunology outpatient clinic of the University Hospital Gaffrée e Guinle (HUGG), a hospital for highly complex procedures, located in the Northeast Zone of Rio de Janeiro. Data collection was carried out by two investigators previously trained to perform this investigation protocol.

Patients of both genders, diagnosed with HIV infection, between 20 and 60 years of age, were included. Patients considered to be severely malnourished, according to the Global Subjective Analysis (GSA-C), were excluded; also those with diagnosis of any active infectious disease or functional alteration that hindered or prevented the performance of dynamometry, impossibility of measuring all anthropometric indicators; diagnosed with neoplastic disease; chronic renal failure, in a hemodialysis program or with any disease (except AIDS) causing malnutrition.

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The nutritional assessment of patients was carried out using the Global Subjective Analysis, classic anthropometry, namely: weight, height, Body Mass Index (BMI), Arm Muscle Area (AMA), Arm Fat Area (AFA), Arm Muscle Circumference (AMC) and Triceps Skinfold (TSF) and measurement of HGS values of both hands. The Arm Circumference (AC) was measured in the middle third of the dominant arm, using a measuring tape and, for the skin folds, the adipometer Lange Skinfold Caliper, brand TBW® was used. The triceps skinfold was measured with the same adipometer. From these two measurements, the values of arm muscle circumference, arm muscle area and arm fat area were obtained. These measurements were performed according to the methods classically described in the literature [8].

The current weight was obtained on an electronic anthropometric scale of the Welmy brand, platform type, with 0.1kg precision, with the individual barefoot and with minimal clothing. The height was determined using the mobile stadiometer of this same scale, with an accuracy of 0.5cm. Nutritional diagnosis by BMI was defined according to the World Health Organization [8].

The handgrip strength was measured using an analog Jamar® dynamometer. The individual remained seated with his/her back against the chair, forming a 90º angle with the thigh, his/her feet flat on the floor, adducted shoulders, without supporting the arms, elbow at a 90º angle, keeping the forearm varying from 0º to 30º in relation to the horizontal plane. After verbal instructions given to the patient before the test started, in response to the voice command, the patient pressed the Jamar® dynamometer with maximum force with the palm of his hand. After three consecutive measurements, with an interval of 15 seconds, the arithmetic mean of the measurements was considered as being the HGS value (in kgf); the procedure was adopted in both hands. The measurement of HGS took place according to established protocols [9].

For statistical analysis, the SPSS 21® software was used. The results were expressed as mean, standard deviation, median, interquartile ranges or proportions. The distribution of variables was analyzed by histogram and Kolmogorov-Smirnov Normality test. To compare independent samples, Student's *t* test was used for continuous variables with normal distribution or the non-parametric Mann-Whitney test for continuous variables without normal distribution. The value of $p<0.05$ was considered significant.

Pearson's correlation coefficient was used to analyze the degree of association between quantitative variables and normal distribution. Spearman's correlation coefficient was used to measure the degree of association of quantitative variables that did not have a normal distribution.

Simple linear regression analyses were performed to verify the relationship between the measurement of the HGS of the dominant and non-dominant hands (predictor variables) and the following anthropometric variables: AMC, AMA, and AFA (dependent variables).

This investigation project was submitted to and approved by the Research Ethics Committee of the HUGG (CAE: 65383617.8.000.5258). All the necessary material was provided by the investigator and by the investigation project supervisor.

RESULTS

Out of 269 patients living with HIV initially evaluated, after applying the inclusion and exclusion criteria, 242 patients participated in this study, 17 of whom were excluded for not agreeing to sign the Free and Informed Consent form, 7 for being over 60 years of age and 3 for being considered severely malnourished (GSA-C), as shown in Figure 1.

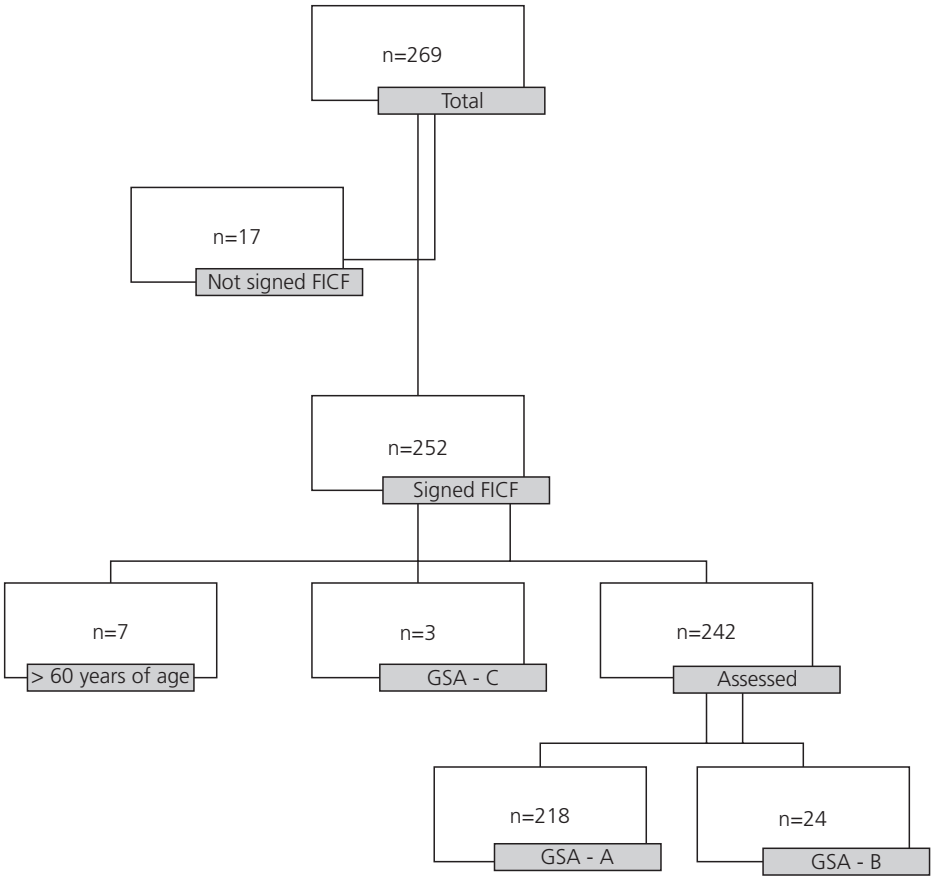

Figure 1. Descriptive analysis of the sample: flowchart of patients assessed.

Note: FICF: Free Informed Consent Form; GSA-A: Global Subject Analysis A (Well-nourished); GSA-B: Global Subject Analysis (Moderately malnourished); GSA-C: Global Subject Analysis (Severely malnourished).

In the sample studied, there was a predominance of males (53.9%) over females (46.1%). The age varied between 20 and 60 years (mean: 46.3 years; Standard Deviation: 12.0 years). The age of men and women was 42.7±9.6 years and 42.4±9.1 years, respectively, with p=0.78.

The time since diagnosis of HIV infection was 11.1±6.5 years, with no significant difference between genders. The investigation subjects were classified according to the Subjective Global Analysis into two groups: well-nourished (GSA-A) – with 218 individuals living with HIV –, and moderate malnourished (GSA-B) – composed of 24 individuals living with HIV –, all on outpatient follow-up.

As shown in Table 1, when comparing the two groups (GSA-A and GSA-B), the anthropometric parameters were higher in the group considered well-nourished (GSA-A). The BMI average value was in the range considered as overweight in GSA-A and normal in GSA-B.

The HGS, obtained from the arithmetic mean of 3 measurements, was assessed bilaterally [9]. The HGS of the dominant hand in males and females was significantly higher (p<0.001) in those patients belonging to the GSA-A group (35.9±8,3kgf and 26.7±7.1kgf, respectively) compared to the GSA-B group (23.6±5.9kgf and 22.1±4.5kgf, respectively). Same outcome was found in the HGS values of the non-dominant hand (p<0.001). Bilateral HGS was significantly higher in males when compared to females (p<0.001).

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Table 1. Comparison between anthropometric parameters and handgrip strength, according to the classification of the Global Subjective Analysis. *Rio de Janeiro,* (RJ), 2017-2018.

Anthropometric Parameter	GSA-A (n=218)	GSA-B (n=24)	*p* value
	Mean±SD	Mean±SD	
Weight (kg)	76.13±16.75	53.36±8.16	<0.001
Stature (m)	1.66±0.09	1.62±0.08	0.040
BMI (kg/m^2)	27.47±5.51	20.31±2.91	<0.001
AC (cm)	31.16±4.56	24.06±2.45	<0.001
TSF (mm)	14.87±9.58	9.45±4.10	<0.001
AMC (cm)	26.52±4.49	21.09±2.47	<0.001
AMA (cm^2)	57.50±19.66	35.88±8.54	<0.001
AFA (cm^2)	16.60±9.31	9.01±3.32	<0.001
Dominant HGS (kgf)	30.48±9.52	24.11±6.16	<0.001
Non dominant HGS (kgf)	29.16±9.30	22.43±8.16	0.001

Note: AC: Arm Circumference; AFA: Arm Fat Area; AMA: Arm Muscle Area; AMC: Arm Muscle Circumference; BMI, Body Mass Index; GSA: Global Subjective Analysis; GSA-A, Well Nourished; GSA-B, Moderately Malnourished; HG: Handgrip Strength; M: Mean; SD, Standard Deviation; TSF: Triceps Skin Fold.

Regarding age, two groups were separated, one composed of patients aged between 20 and 40 years of age and the other with patients aged between 41 and 60 years; no significant difference in HGS was observed between these two age groups.

An assessment of the correlation between the HGS measurement value of the dominant and non-dominant hands and the assessment of the following variables was performed: Weight, BMI, AMC, AMA, AFA (Table 2).

When controlling for the variables gender, age and GSA, a significant positive correlation was observed between measurement of the HGS of the dominant and non-dominant hand with the values of the following anthropometric variables: weight, BMI, AMC and AMA. No correlation was observed between HGS (bilaterally) and AFA.

In the simple linear regression analysis, the HGS of the dominant hand (predictor variable) was significantly associated to the dependent variables related to lean mass, that is, AMC and AMA (R^2=0.194, t=7.7; p<0.001; and R^2=0.192, t=7.6; p<0.001, respectively) (Figures 2 and 3). Through the same regression analysis, the HGS values of the non-dominant hand were also considered predictors of AMC and AMA measurements (R^2=0.166, t=6.8; p<0.001 and R^2=0.163, t=6.7; p<0.001; respectively). The HGS values (bilaterally) were not predictors of AFA measures.

Table 2. Correlation between handgrip strength values of the dominant and non-dominant hand with body weight, BMI, AMC, AMA, AFA. *Rio de Janeiro,* (RJ), 2017-2018.

Handgrip Strength	Weight (kg)	BMI (kg/m^2)	AMC (m)	AMA (cm^2)	AFA (cm^2)
HGSd (kgf);					
Correlation (*r*)	*r*=0.42	*r*=0.16	*r*=0.44	*r*=0.44	*r*=-0.01
p value	*p*<0.001	*p*=0.01	*p*<0.001	*p*<0.001	*p*=0.99
HGSnd (kgf)					
Correlation (*r*)	*r*=0.41	*r*=0.16	*r*=0.41	*r*=0.41	*r*=0.01
p value	*p*<0.001	*p*=0.01	*p*<0.001	*p*<0.001	*p*=0.94

Note: *r*: Pearson correlation coefficient; AFA: Arm Fat Area; AMA: Arm Muscle Area; AMC: Arm Muscle Circumference, in meters (m); BMI: Body Mass Index; HGSd: Dominant Handgrip Strength; HGSnd: Non-Dominant Hand Grip Strength.

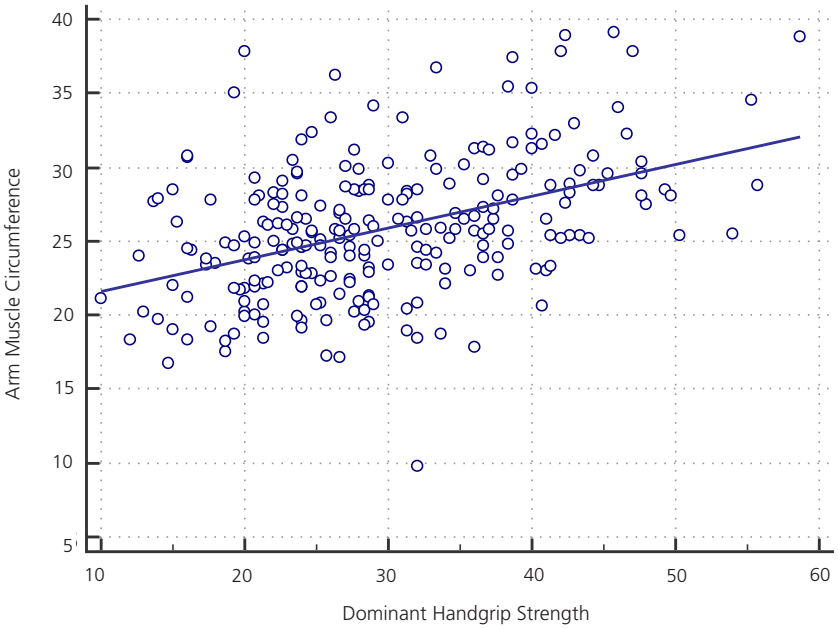

Figure 2. Dispersion between HGS values of the dominant hand and the muscular circumference of the arm. *Rio de Janeiro,* (RJ), Brazil 2017-2018.

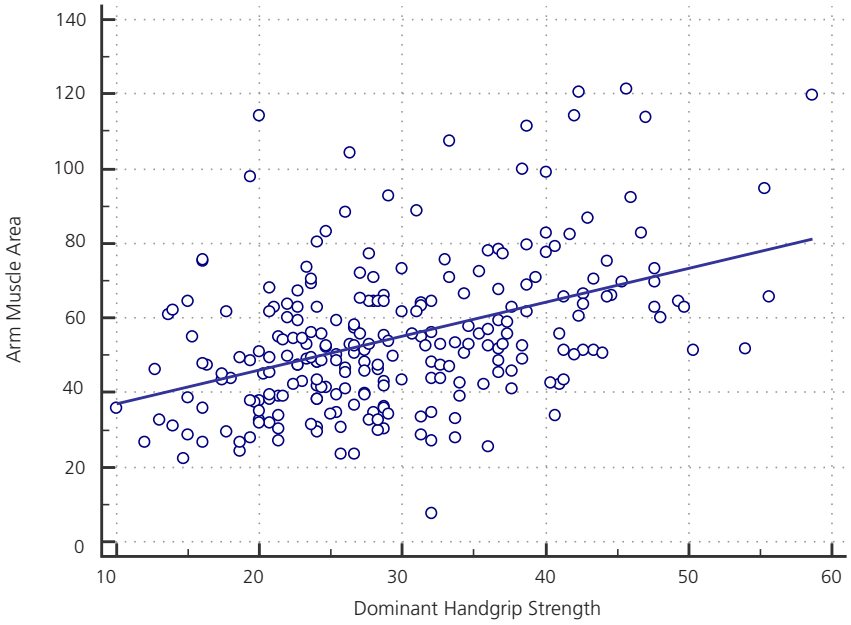

Figure 3. Dispersion between the values of handgrip strength of the dominant hand and the muscular area of the arm. *Rio de Janeiro,* (RJ), Brazil, 2017-2018.

DISCUSSION

In view of the importance of the nutritional assessment in PLHIV, HGS values were considered predictors only of variables related to lean body mass. In addition, handgrip strength was significantly greater in patients considered to be well-nourished according to the GSA.

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GSA has been considered a nutritional assessment scale useful in the diagnosis and prognosis of inpatients and outpatients, capable of identifying patients at higher risk of complications on account of their nutritional status and those patients who would benefit from nutritional therapy [10].

In our sample, in which severely malnourished patients were excluded, the majority (90.1%) was considered to be well nourished (GSA-A). The lower number of GSA-B individuals could possibly be explained by the change in the nutritional patterns of PLHIV, with a lower prevalence of malnutrition, as demonstrated by the study by Silva *et al.* in 2010 [11].

In the present study, all classic anthropometric parameters (weight, height, BMI, AMC, AMA and AFA) were higher in the group of well-nourished patients compared to the moderately malnourished group.

In a work published by Budziarecke *et al.* [12], the relationship of HGS values and anthropometric variables in a healthy (n=300) and well-nourished (GSA-A) Brazilian population was studied. The average age of the participants in this study was 44.9±18.5 years and the HGS value obtained in the dominant hand, without differentiating by gender, was 30.4±11.7kgf. In the present study, patients living with HIV included in the GSA-A group exhibited HGS values in the dominant hand similar to the values found in the work performed by Budziarecke *et al.*

In 2014, Policarpo *et al.* [13] evaluated HGS in 336 Portuguese patients, living with HIV and being followed up on an outpatient basis. The average age was 46.4 years. The HGS values were close to those obtained in our study, 38.0±7.9kgf in men and 22.9±6.2kgf in women.

In the revised guidelines of the European Sarcopenia consensus, two HGS cut-off points are suggested to identify and characterize sarcopenia. These values are different for men and for women, but independent of the age range (HGS <27kgf and <16kgf, respectively) [6]. In our study, if we take into account the mean HGS of the dominant hand for both genders in the GSA-A group (35.9±8.3kgf and 26.7±7.1kgf) the values would not fit the definition of sarcopenia; however, in the GSA-B group, the mean HGS found among male patients (23.6±5.9kgf) was lower than the established cut-off value, which was not found in females (22.1±4.5kgf).

We found a significant percentage of patients considered well-nourished with reduced HGS values, a criterion of potential sarcopenia, suggesting that it is an early marker in patients living with HIV. As it is a parameter that is easy and quick to obtain, it can be a valuable tool for inferring body mass and screening for sarcopenia in these outpatients.

In several studies, HGS measurements showed an increase until the fourth decade of life, with a subsequent drop in these values in older individuals [14]. Schlüssel *et al.* [14] showed a slight increase in HGS proportional to the age of the population between 20 and 40 years; however, after 40, a significant negative correlation was observed between age and HGS. In our study, HGS did not correlate with age and when separating patient groups into two age groups, between 20 and 40 years and between 41 and 60 years, there was no significant difference in the HGS values of the dominant hand between these two age groups.

Guerra *et al.* [15] carried out a study looking for an association between handgrip strength and nutritional status – including classic anthropometric parameters. In their results, a positive correlation was obtained between HGS and AMC. In this study by Guerra *et al.* [15], the correlation between HGS with AMA and AFA was not reviewed, while in our study a significant positive correlation between HGS and AMC and AMA (both related to lean body mass), but not related to AFA, was found.

Policarpo *et al.* [13] in a study with a PLHIV population, found a positive correlation between HGS and weight, AMC and AMA with $p<0.001$. In the present study, there was a positive and significant correlation between the measurement of HGS and the anthropometric variables specifically related to lean body mass, that is, AMC and AMA. However, this was not observed with an anthropometric variable not associated with lean mass, represented by the estimate of the fatty area of the arm, which in the opposite way showed a negative correlation, but without statistical significance. Among these anthropometric variables, the measurement of HGS was considered a predictor only of the AMC and AMA values. These results suggest that HGS may be related to lean body mass and not to body fat mass.

This study, conducted with PLHIV in outpatient follow-up, investigated the association of HGS with nutritional status. Most patients were in good nutritional status and HGS showed higher values in the group of well-nourished patients. Measurements of handgrip strength were positively associated to anthropometric parameters related to lean body mass.

In the last European consensus, greater importance was given to the reduction of muscle strength as an indicator of sarcopenia. With lower handgrip strength, the diagnosis of sarcopenia is highly probable [6]. The clinical relevance of our work is the applicability of this parameter in a population in which changes in body composition are common and are associated with a worse prognosis.

After reviewing the literature, this is the first study in patients living with HIV undergoing outpatient follow-up, whose HGS values were associated with lean body mass, but not with fat mass.

As limitations of this study, it can be pointed out that despite the anthropometric measurements and the measurement of the HGS being performed by two previously trained examiners, an inter-observer reliability test was not applied. Despite being extensively described in the literature, another limitation of this study was to infer body mass only through classical anthropometric assessment. Other techniques for analyzing body composition, such as bioimpedance, could contribute towards a better assessment of body mass.

CONCLUSION

In this study, most people living with HIV in outpatient follow-up, were in a good nutritional status and the handgrip strength showed significantly higher values in the group of well-nourished patients. The measurement of HGS correlated only with anthropometric measurements associated to lean body mass, suggesting that hand grip dynamometry is specifically related to muscle mass in PLHIV patients in outpatient follow-up. With this study, the possibility of expanding our understanding and applicability of measuring handgrip strength in nutritional assessments and clinical monitoring of patients living with HIV is envisaged.

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CONTRIBUTORS

RM ELARRAT and JC TOLENTINO contributed to the development of the experimental approach, data collection, creation of tables, result discussion, and conception of the manuscript. AF CORTEZ and ALT GJORUP contributed to data collection, result discussion and manuscript. revision. JH DUARTE and GT FERNANDES contributed to data collection and result discussion.

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