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Short Communication

Reduction of relative handgrip strength and cardiometabolic risk in individuals with HIV/AIDS

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Abstract

Introduction: Low handgrip strength (HS) is associated with cardiometabolic alterations that have affected people with HIV/AIDS. **Methods:** This was a cross-sectional study performed in adults receiving antiretroviral treatment. HS was evaluated using a dynamometer and divided by body weight to obtain the relative strength. The association between relative HS and overweight, increased waist circumference (WC), high body fat percentage, glycemia, and lipid ratios were assessed using logistic regression. **Results:** Low relative HS was identified in 35% of participants and associated with increased WC (odds ratio = 9.7; 95% confidence interval = 2.8–33.0). **Conclusions:** The prevalence of low HS was high and associated with increased WC.

Keywords: HIV/AIDS. Cardiovascular risk. Muscle strength.

The human immunodeficiency virus (HIV) infects an estimated 36.9 million people globally. In Brazil, 48000 new cases were identified in 2017[1]. Despite the increasing number of individuals with HIV/AIDS, the development of antiretroviral treatment (ART) has provided better prognostics and life expectancy over the last decades[2]. However, an increasing prevalence of cardiovascular diseases (CVDs) has been observed in individuals with HIV/AIDS[2].

Thus, due to the morbimortality related to cardiometabolic diseases, the use of tools that identify risk factors early has become relevant. Studies have demonstrated an inverse correlation between muscle strength and incidence of CVDs, diabetes mellitus, and metabolic syndrome in distinct populations[3-6].

Studies have reported that handgrip strength, when corrected by body weight (relative handgrip strength), shows better association with CVD markers, including blood pressure, lipid profile, and fasting blood glucose, and has been proposed as the most appropriate variable in assessing cardiovascular risk profile[3,4,7].

In view of the cardiometabolic alterations that individuals with HIV/AIDS present with, it is necessary to determine early the cardiovascular risk to prevent cardiometabolic diseases and guide health promotion with control of risk factors. Besides, there are still few studies that relate handgrip strength assessment to cardiometabolic risk in adults with HIV/AIDS[8]. Therefore, this study evaluated the association between relative handgrip strength and cardiometabolic risk factors in individuals with HIV/AIDS.

A cross-sectional study was conducted in the patients of a public outpatient clinic that provides benchmark treatment of HIV/AIDS in the city of Salvador, Bahia. Individuals of both sexes aged 18–59 years diagnosed with HIV, on ART, and selected during outpatient visits from April to November 2011 were enrolled in this study. They were included by consecutive sampling, by order of arrival for regular consultation and after signing the informed consent. The project was approved by the Research Ethics Committee of the Complexo Hospitalar Universitário Professor Edgard Santos (HUPES) (legal opinion no. 87/10). Individuals with edema and/or ascites, on dialysis,

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and with a mental disorder, opportunistic disease, and physical limitation that did not allow anthropometric assessment; pregnant and nursing women; and those who did not undergo laboratory tests in the last 3 months were excluded from the study.

Weight (kg) and height (m) were measured using the standard method, and body mass index (BMI) was calculated. Overweight was defined as a BMI ≥ 25 kg/m² according to the World Health Organization (WHO, 1998). Waist circumference (WC) was measured at the midpoint between the last rib and iliac crest, classified as increased for WC ≥ 94 cm in men and WC ≥ 80 cm in women considering the recommendations of the WHO (2008).

Handgrip strength was assessed using the Baseline® dynamometer with the participant in standing positions, arms extended and parallel to the body, holding the device facing away from the body with the nondominant arm. Three measurements were obtained at 1-min intervals, with the highest value being considered as an absolute measurement. The relative handgrip strength was obtained as follows: relative handgrip strength = handgrip strength (kg)/weight (kg).

Body fat percentage (BF%) was assessed by tetrapolar bioelectrical impedance (BIA), using the Biodynamics® device. All patients received guidance regarding the preparation for the BIA analysis according to the protocol, adapted to the guidelines proposed by Kyle et al[9]. The BF% was considered high at ≥ 35% in women and ≥ 25% in men.

The laboratory tests presented by the patients during an outpatient visit were as follows: fasting blood glucose, total cholesterol (TC), high-density lipoprotein cholesterol (HDL-c), and triglycerides (TG) (determined according to the HUPES laboratory standard techniques) and low-density lipoprotein cholesterol (LDL-c), calculated using Friedewald's formula (LDL-c = TC-HDL-c - (TG/5)). Inadequate results were defined as follows: TC level ≥ 190 mg/dL, HDL-c level ≤ 40 mg/dL, TG level ≥ 150 mg/dL, and LDL-c level ≥ 130 mg/dL according to the Atualização da Diretriz Brasileira de Dislipidemias e Prevenção da Aterosclerose (2017). For the calculated lipid ratios, we considered the following results: TC/HDL-c level ≥ 5.8 in men and ≥ 5.3 in women, LDL-c/HDL-c level ≥ 3.8 in men and ≥ 3.5 in women, as recommended by Castelli (1983) and TG/HDL-c level > 3.8 in both sexes as recommended by Hanak et al, (2004). The cutoff point for hyperglycemia was a fasting blood glucose level ≥ 100 mg/dL, recommended by the Brazilian Society of Diabetes (2015).

The relative handgrip strength analysis was performed by stratification of the sample in tertiles, considering values lower than the first tertile as low grip strength and greater or equal as normal grip strength. The independent variables considered as risk factors were sex, overweight, increased WC, increased BF%, hyperglycemia, and high lipid ratios.

The Statistical Package for the Social Sciences (SPSS) version 20.0 was used to analyze the data. The relative and absolute frequency distributions and the chi-square or Fisher exact tests were performed.

The association between the variables was obtained by logistic regression, with odds ratio (OR) and its 95% confidence interval (95% CI), adopting two-tailed tests and a significance level of 5%. Initially, bivariate logistic regression was performed to calculate the crude OR, and variables with a P-value ≤ 0.20 were included in the multivariate model. Only those variables with a P-value < 0.05 remained in the final model.

The sample consisted of 80 individuals with HIV/AIDS, predominantly women (56.2%), with a mean age of 43.19 years (standard deviation = 7.45).

Low relative handgrip strength was identified in 35% (n = 28) of the participants, that is, the values of the first tertile (< 0.37 kg of strength/kg of body weight). The prevalence of individuals classified in the second tertile (0.37–0.46 kg of strength/kg of body weight) and third tertile (≥ 0.47 kg of strength/kg of body weight) were 30% (n = 24) and 35% (n = 28), respectively. In women, the prevalence of low relative handgrip strength was identified in 53.3%, which was significantly (p = 0.0001) higher than that in men (11.4%) (**Table 1**).

Of the participants, 40% were overweight, 43.8% had increased WC (abdominal obesity), and 15% had high BF%. The prevalence of hyperglycemia was identified in 37.5%, and 45.0% of the study participants had high TG/HDL-c levels. Participants who were overweight, had abdominal obesity, and high BF% presented higher prevalence of low relative handgrip strength (**Table 1**).

The bivariate analysis showed an association between relative handgrip strength and overweight (OR = 6.3; 95% CI = 2.3–17.4), increased WC (OR = 15.3; 95% CI = 4.7–49.0), and high BF% (OR = 13.8; 95% CI = 2.7–69.5). The multivariate analysis indicated that relative handgrip strength was associated with increased WC (OR = 9.7; 95% CI = 2.8–33.0) (**Table 2**).

In the studied sample, individuals with HIV/AIDS presented high prevalence of low relative handgrip strength, and it was associated with increased WC, an anthropometric indicator of cardiometabolic risk. A study in sub-Saharan Africa showed that HIV-positive adult patients also presented low handgrip strength compared to uninfected patients[10]. In this study, the impairment of handgrip strength was greater in people with more advanced disease. It is worth mentioning that these studies used absolute handgrip strength instead of relative handgrip strength, which was used in this study.

Studies on handgrip strength and cardiometabolic risk factors in individuals with HIV/AIDS are scarce. Crawford et al[8]. found a relationship between low handgrip strength, inflammatory markers, and lipodystrophy in HIV-positive men. These variables were not analyzed in the present study; however, the anthropometric alterations found in this study, such as overweight and abdominal obesity, contribute to a pro-inflammatory state and metabolic dysfunctions, resulting in lower muscle strength[8]. It is worth noting that, although it was not evaluated in the present study, the body composition modifications characteristic of lipodystrophy can compromise muscle mass, besides contributing to metabolic and cardiovascular alterations[8,11].

TABLE 1: Distribution of relative handgrip strength according to sex and cardiometabolic risk variables in individuals with HIV/AIDS, Salvador-BA, 2011

	Total n (%)	Relative handgrip strength		P-value
		Lower grip strength* n (%)	Normal grip strength** n (%)	
Sex				
Female	45 (56.2)	24 (53.3)	21 (46.7)	
Male	35 (43.8)	04 (11.4)	31 (88.6)	0.000[&]
BMI				
No overweight	48 (60.0)	09 (18.8)	39 (81.2)	
With overweight	32 (40.0)	19 (59.4)	13 (40.6)	0.000[#]
WC				
Normal	45 (56.2)	05 (11.1)	40 (88.9)	
Increased	35 (43.8)	23 (65.7)	12 (34.3)	0.000[#]
Body fat%				
Normal	68 (85)	18 (26.4)	50 (73.5)	
High	12 (15)	10 (83.3)	02 (16.7)	0.000[&]
Glycemia				
Normal	50 (62.5)	15 (43.3)	35 (56.7)	
High	30 (37.5)	13 (30.0)	17 (70.0)	0.226[#]
TC/HDL-c				
Normal	66 (82.5)	21 (31.8)	45 (68.2)	
High	14 (17.5)	07 (50.0)	07 (50.0)	0.195[#]
LDL-c /HDL-c				
Normal	70 (87.5)	24 (34.3)	46 (65.7)	
High	10 (12.5)	04 (40.0)	06 (60.0)	0.723[&]
TG/HDL-c				
Normal	44 (55.0)	18 (40.9)	26 (59.1)	
High	36 (45.0)	10 (27.8)	26 (72.2)	0.221[#]

BMI, body mass index**; WC,** waist circumference**; TC,** total cholesterol**; LDL-c,** low-density lipoprotein cholesterol**; HDL-c,** high-density lipoprotein cholesterol**; TG,** triglycerides. *Tertile 1, < 0.37 kg of strength/kg of body weight **Tertile 2 and 3, ≥ 0.37 kg of strength/kg of body weight. #Chi-square test & Fisher exact test

The low relative handgrip strength found mainly in women with HIV/AIDS matches the results of a Brazilian study by Trombeta et al[12]. that showed higher relative handgrip strength in men (0.59 kg of strength/kg of body weight) than in women (0.48 kg of strength/kg of body weight). Nevertheless, the difference was statistically significant only in the assessment of absolute handgrip strength ($p < 0.05$).

It is believed that the difference in muscle strength between men and women, also present in uninfected populations, may be influenced by several factors such as hormonal regulation, differences in muscle fiber type composition, metabolism of energy substrates, and neuromuscular activation, among other variables[13]. Moreover, both men and women may react differently to HIV infection and use of ART, resulting in lower muscle strength in women than men.

Regarding the anthropometric alterations, the prevalence of overweight and increased WC in the present study were lower than those identified in a study by Beraldo et al[14]. in 262 individuals living with HIV/AIDS (51% and 53%, respectively). In this study, the average values of BF%, assessed by dual-energy X-ray absorptiometry, were close to the normal values in women and men. These findings were consistent with the BF% identified in this study, despite being evaluated by BIA.

The low relative handgrip strength identified in the study sample was more prevalent among individuals with HIV/AIDS who presented anthropometric factors of cardiometabolic risk based on clinically relevant data, although no statistical significance was observed in the adjusted analysis, a result that may have been influenced by the small sample size.

Few studies have assessed the possible mechanisms associated with loss of muscle strength and metabolic and cardiovascular dysfunctions. However, it is known that excessive adiposity can result in accumulation of lipids within the muscle fibers, negatively affecting mitochondrial and muscle function. Furthermore, abdominal obesity contributes to the increase in proinflammatory cytokines, such as TNF-α and IL-6, resistance, and lipid changes, resulting in atherosclerosis, muscle degradation, and low synthesis of muscle proteins, which may negatively affect muscle strength[11].

The fact that some studies used relative handgrip strength and others used absolute handgrip strength may justify the different associations found between handgrip strength and cardiometabolic risk factors. Recent studies have shown that absolute handgrip strength can be influenced by body weight and that overweight and obese individuals tend to have higher handgrip strength, which may make body weight a confounding

TABLE 2: Bivariate and multivariate odds ratios of the association between relative handgrip strength and cardiometabolic risk indicators in individuals with HIV/AIDS, Salvador-BA, 2011.

Variables	Bivariate OR (95% CI)	P-value	Multivariate* OR (95% CI)	P-value
BMI				
No overweight	1		----------	
With overweight	6.3 (2.3–17.4)	0.000		
WC				
Normal	1		1	
Increased	15.3 (4.7–49.0)	0.000	9.70 (2.8–33.0)	0.000
BODY FAT %				
Normal	1		---------	
High	13.8 (2.7–69.5)	0.001		
GLYCEMIA				
Normal	1		---------	
High	1.7 (0.6–4.5)	0.228		
TC/HDL-c				
Normal	1		---------	
High	1.2 (0.6–6.8)	0.201		
LDL-c /HDL-c				
Normal	1		---------	
High	1.2 (0.3–4.9)	0.724		
TG/HDL-c				
Normal	1		---------	
High	0.5 (0.2–1.4)	0.223		

OR: odds ratio; **95% CI**, 95% confidence interval; **BMI,** body mass index; **WC,** waist circumference; **TC,** total cholesterol; **LDL-c,** low-density lipoprotein cholesterol; **HDL-c,** high-density lipoprotein cholesterol; **TG,** triglycerides. *Adjusted by sex

factor[15]. Therefore, some authors have suggested that relative handgrip strength is a more reasonable predictor of metabolic profile and disease than absolute handgrip strength, allowing comparisons between different people and being negatively associated with cardiometabolic risk[3,4,7].

Some limitations of this study are the lack of cutoff point in the literature to define low relative handgrip strength using the dynamometer adopted in the study, which may have underestimated or overestimated the reduction of handgrip strength in individuals with HIV/AIDS. Another limitation was the non-evaluation of lipodystrophy, which contributes to overweight and abdominal obesity, which may be associated with low muscle strength.

Additionally, the small sample size was possibly insufficient to determine statistically significant differences in lipid variables and glycemia in relation to relative handgrip strength. However, this is one of the first studies to assess the association between relative handgrip strength and cardiometabolic risk indicators in individuals with HIV/AIDS. It also highlights the fact that the employed model considered handgrip strength with adjustment by the main variable pointed out in the literature, body size.

Therefore, our findings showed that individuals with HIV/AIDS with low relative handgrip strength had a higher prevalence of anthropometric factors of cardiometabolic risk compared to those with normal relative handgrip strength, and the reduction in relative handgrip strength was associated with increased WC. Future studies are needed to better understand handgrip strength as a predictor of cardiometabolic morbidities in individuals with HIV/AIDS, which may contribute to the creation of strategies to prevent CVD in order to improve their quality of life.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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