Body image and anthropometric indicators in adolescents living with HIV

Imagem corporal e indicadores antropométricos em adolescentes vivendo com HIV

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Abstract – The aim of this study was to compare body image and anthropometric indicators among adolescents living with HIV and healthy adolescents (control group). In addition, we verified the associations of anthropometric indicators, infection/treatment, sexual maturity, and sociodemographic characteristics with body image in adolescents living with HIV. One hundred and eleven adolescents aged 10 to 15 years were divided into those living with HIV (n = 57) and a control group (n = 54). Body image was investigated using an eight-point body silhouette scale. Body weight, height, circumferences, and skinfolds were measured. Body image dissatisfaction was found in 54.4% of the adolescents living with HIV, with 38.6% of them wishing to increase their body size. Conversely, body image dissatisfaction was due to the desire to reduce body size in the control group (40.7%). No difference between the HIV and control groups was found for the anthropometric indicators analyzed. Gender (β = -0.52), age (β = 0.18), body weight (β = 0.07), body mass index (β = -0.19), and upper arm muscle area (β = -0.08) explained 42% of the variation in the body image score of adolescents living with HIV. Thinness is the main reason for body image dissatisfaction in adolescents living with HIV. Almost half the body dissatisfaction of adolescents living with HIV was explained by demographic and anthropometric variables.

Key words: Adolescent; Anthropometry; Body fat distribution; HIV; Body image.

Resumo – *Objetivou-se comparar a imagem corporal e os indicadores antropométricos entre adolescentes vivendo com HIV e sem o diagnóstico da infecção (grupo controle). Além disso, foram testadas associações entre variáveis antropométricas, infecção / tratamento, maturação sexual e sociodemográficas com a imagem corporal em adolescentes vivendo com HIV. Participaram 111 adolescentes com idade de 10 a 15 anos, divididos em adolescentes que vivem com HIV (n = 57) e controles (n = 54). A imagem corporal foi investigada a partir da escala de oito silhuetas corporais. As medidas antropométricas realizadas foram massa corporal, estatura, perímetros e dobras cutâneas. Foi encontrado que 54,4% dos adolescentes que vivem com o HIV estavam insatisfeitos com a imagem corporal, sendo que 38,6% indicaram insatisfação por magreza. Por outro lado, adolescentes do grupo controle demonstraram insatisfação com a imagem corporal por excesso de peso (40,74%). Não foi encontrada diferença entre o grupo HIV e controle para os indicadores antropométricos analisados. O sexo (β = –0,52), a idade (β = 0,18), a massa corporal (β = 0,07), o índice de massa corporal (β = –0,19) e a área muscular do braço (β = –0,08) explicaram 42% da variação do escore de imagem corporal em adolescentes que vivem com HIV. A insatisfação com a imagem corporal no grupo HIV é apontada pela magreza e no controle pelo excesso de peso. Quase metade da variação da imagem corporal dos adolescentes que vivem com HIV foram explicadas pelas variáveis demográficas e antropométricas.*

Palavras-chave*: Adolescente; Antropometria; Distribuição da gordura corporal; HIV; Imagem corporal.*

INTRODUCTION

Adolescence is characterized as a period of changes in body composition, mostly in fat and muscle tissues, which is influenced by sexual dimorphism and physical development[1]. Furthermore, adolescence is a critical period for body image dissatisfaction[2], which may result in eating disorders and depression[3]. The main determinants of body image dissatisfaction include overweight, late age, female gender, low educational level, and chronic diseases[2,4,5].

Infection with human immunodeficiency virus (HIV) is considered a chronic disease that results in negative physical changes such as growth deficits[6], delay in sexual maturity[7], abnormal body fat distribution[8], and a marked reduction in muscle mass[9]. Thus, abnormalities in growth and body composition may represent additional determinants of body image dissatisfaction in adolescents living with HIV. Moreover, it is unclear whether body image dissatisfaction is greater in adolescents living with HIV compared to adolescents without a diagnosis of HIV. Comparative studies are needed to explore whether dissatisfaction in adolescents living with HIV is due to the desire to reduce or to increase body size.

There is evidence indicating an association of anthropometric indicators such as body mass index (BMI) and waist circumference with body image dissatisfaction in adolescents living with HIV[10]. However, no study has simultaneously tested the association of body image with anthropometric indicators of fat and muscle mass such as skinfolds[2,10] and upper arm muscle area (UAMA)[11], HIV infection/treatment, sexual maturity, or sociodemographic variables in adolescents living with HIV.

Since the Brazilian Ministry of Health[12] recommends an integrative health approach for adolescents living with HIV that includes aspects related to body image, the aims of this study were: 1) to compare body image and anthropometric indicators between adolescents living with HIV and healthy adolescents (control group); 2) to verify possible associations of anthropometric indicators, infection/treatment, sexual maturity and sociodemographic characteristics with body image in adolescents living with HIV.

METHODOLOGICAL PROCEDURES

A cross-sectional study was conducted in 2014 in Florianópolis, Santa Catarina, Brazil, on adolescents aged 10 to 15 years, divided into an HIV group and a control group.

Participants

Adolescents living with HIV were recruited from the outpatient clinic of a regional HIV referral center. In 2014, the population of patients infected with HIV by mother-to-child transmission aged 10 to 15 years comprised 70 adolescents. The sample size was calculated with the Epi Info® software, assuming α of 5%, β of 80%, a ratio of 1:1 for composition of the control group and a prevalence of body dissatisfaction of 84% among adolescents living with HIV[10]. Thus, 45 adolescents were the minimum sample size

required in each group. Considering losses and more complex analyses, 20% was added to the final sample. The HIV group consisted of adolescents of both genders infected with HIV by mother-to-child transmission, who lived in Florianopolis and were under clinical follow-up. Eligibility criteria were age between 10 and 15 years, mother-to-child transmission confirmed in the medical records, full capacity to undergo the anthropometric measurements, and clinical and laboratory data available in the medical records. Exclusion criteria were the presence of additional diseases that alter body composition and chronic use of diuretic medications.

Adolescents matched for gender and age to the HIV group were enrolled in the control group at a ratio of 1:1. The control subjects were selected by non-probability sampling from a municipal school in Florianópolis, located in the same area as the Hospital. Adolescents whose parents or legal guardians reported no history of a positive diagnosis of HIV, recurrent infections, malignancies or chronic diseases were included.

The university's Institutional Review Board and the Hospital Ethics Committee approved the study protocol (No. 850.077). Written informed consent was obtained from the parent(s) or legal guardian(s) of the adolescents.

Body Image Assessment

Body image was evaluated using a figure rating scale composed of a set of silhouettes numbered from 1 to 8, which represent a continuum of body shapes ranging from thinness to obesity[13]. The silhouette scale had been validated previously in adolescents from Florianópolis (r = 0.70 [boys]; r = 0.55 [girls])[13]. After observation of the figures, the adolescents were asked to answer the following questions: "Which silhouette best represents your current physical appearance (current silhouette)?" and "Which silhouette would you like to have (ideal silhouette)?" The body image score was calculated as the difference between the ideal and the real silhouette (score = ideal silhouette - real silhouette), considering a variation from -7 to +7. For the definition of body image dissatisfaction, a negative score was classified as "wish to reduce body size" and a positive score as "wish to increase body size". A score of zero was classified as "satisfied with body image".

Anthropometric Measurements

Height, weight, skinfolds (triceps, subscapular, abdominal, calf), and circumferences (arm and waist) were measured according to the standardization of the International Society for the Advancement of Kinanthropometry (ISAK)[14]. Four trained anthropometrists (ISAK Level 1) obtained all measurements in triplicate. Body weight was measured with a Tanita® scale (BF683W, Arlington Heights, USA) to the nearest 100 g. Height was measured with a stadiometer (ES2060®, São Paulo, Brazil) to the nearest 0.1 cm. Arm and waist circumferences were obtained with an anthropometric measuring tape to the nearest 0.1 cm, and skinfolds were measured with a caliper to the nearest 0.1 mm (both from Cescorf®, Porto

Alegre, Brazil). The BMI was obtained as follows: BMI = body weight [kg] / (height [m]*height [m]). The trunk-to-extremity skinfold ratio (TESR) was calculated using the following formula: TESR = (subscapular [mm] + abdominal [mm] / (triceps [mm] + calf [mm]). UAMA was calculated as proposed by Frisancho[11].

Other Assessments

Age, gender and income were obtained in an interview with the adolescent and his/her parents. Sexual maturity was self-reported by the adolescent based on the observation of representative figures of the development of secondary sexual characteristics (breasts or genitals) according to the Tanner criteria[15], after the participants had received instructions from a same-gender researcher.

Clinical information about HIV infection and antiretroviral treatment was obtained from the medical records. Antiretroviral treatment was categorized as previously exposed to nucleoside analogue reverse transcriptase inhibitor (NRTI), non-nucleoside reverse transcriptase inhibitor (NNRTI) and/or protease inhibitor (PI). CD4+ T lymphocyte count and viral load were also obtained from the medical records, previously measured by flow cytometry (FACScalibur® Multitest, San Jose, USA) and HIV-1 RNA quantification (Abbott RealTime® HIV-1, Rungis, France), respectively. The median CD4+ T lymphocyte count and HIV viral load of the last two years were considered for each patient. The clinical categories of HIV infection were established according to the Centers for Disease Control and Prevention (CDC)[16].

Statistical Analysis

Measures of central tendency, dispersion and frequencies were calculated for presentation of the data. Normality of the data was tested by the Kolmogorov-Smirnov test and analysis of histograms. The chi-square test and Fisher's exact test were used to evaluate the association between body image categories ("wish to reduce body size" / "wish to increase body size" vs. "satisfied with body image") and between groups (HIV vs. control). The Student t-test and Mann-Whitney U test were used to compare anthropometric indicators and body image between groups. Furthermore, analysis of covariance adjusting for gender and age was performed to compare anthropometric indicators between the body image categories in the HIV group.

The association of anthropometric indicators, sexual maturation, clinical / treatment variables, and socioeconomic variables with body image score (outcome) in the HIV group was tested by multiple linear regression analysis. A conceptual framework was considered, and a hierarchical organization was used for analysis. Forward procedures were performed manually and in blocks. Gender, age and income were included at the distal level, followed by sexual maturity (intermediate level). HIV infection and treatment variables (time and type of antiretroviral therapy, disease clas-

sification, median viral load, and median CD4 count) were included at the second intermediate level. At the proximal level, the anthropometric indicators (height, body weight, skinfolds [triceps, subscapular, abdominal, calf], sum of skinfolds, waist and arm circumference, BMI, TESR, and UAMA) were analyzed. Variables with a p value ≤ 0.20 or supported by the conceptual framework remained in the final model.

All analyses were performed with the IBM® Statistical Package for the Social Sciences (SPSS) v.20.0, adopting a level of significance of 5% (95% confidence interval) for two-tailed tests.

RESULTS

The sample consisted of 111 adolescents ranging in age from 10 to 15 years (HIV group [n = 57] and control group [n = 54]). The mean age was 13.0 years (standard deviation [SD] = 1.5) in the HIV group and 12.8 years (SD = 2.3) in the control group.

The proportion of girls was similar among adolescents living with HIV (56.1%) and in the control group (51.9%). In the HIV group, adolescents were mainly exposed to NRTIs (n = 49; 86.0%), followed by NNRTIs (n = 30; 52.6%) and PIs (n = 39, 68.4%), as antiretroviral therapy. The mean duration of exposure to antiretroviral therapy was 116.7 months (SD = 44.0). Eight adolescents in the HIV group had no immunological or virological criteria for the introduction of antiretroviral therapy according to the 2014 Guidelines of the Brazilian Ministry of Health[10]. The mean CD4+ T lymphocyte absolute and relative count was 791.3 cells.mm^{-3} and 30.4%, respectively (SD = 280.7 cells.mm^{-3} and 7.5%, respectively). All but one adolescent living with HIV had an undetectable viral load (< 40 copies.mL^{-1}). Most adolescents were classified in the early stages of HIV infection (stage 1 = 59.6% [34/57] and stage 2 = 35.1% [20/57]), while three (stage 3 = 5.3% [3/57]) showed signs and symptoms compatible with acquired immunodeficiency syndrome.

Male adolescents living with HIV were shorter and had a lower body weight, arm circumference, skinfolds (abdominal and subscapular) and TESR compared to controls (Table 1). Female adolescents living with HIV had a shorter stature than controls. In general, adolescents living with HIV were concentrated in the early stages of sexual maturity when compared to the control group (HIV group [stage I = 8, II = 16, III = 17, IV = 13, V = 1] vs. control group [stage I = 2, II = 4, III = 20, IV = 24, V = 4]).

The percentage of adolescents reporting body image dissatisfaction was 54.4% and 66.7% in the HIV group and control group, respectively (p = 0.118). Moreover, adolescents in the HIV group were more dissatisfied with their body image due to the "wish to increase body size" than those in the control group (p = 0.014). Group analysis showed that body image dissatisfaction in adolescents living with HIV could be divided into those who "wish to reduce body size" (15.8%) and those who "wish to increase body size' (38.6%). Conversely, most adolescents in the control group were

dissatisfied due to the desire to reduce body size (40.7%), while 25.9% wished to increase body size. Analysis according to gender showed an association of body image dissatisfaction with male gender (p = 0.009). In this respect, male adolescents who "wished to increase their body size" were associated with the HIV group, while male adolescents who "wished to reduce body size" were associated with the control group. No association between body image dissatisfaction and group was observed among female adolescents (p = 0.285).

Table 1. Anthropometric measurements of adolescents living with HIV and controls.

	Male			Female		
	HIV (n = 25)	Control (n = 26)	p	HIV (n = 32)	Control (n = 28)	p
Weight (kg) *	42.22 (11.68)	52.06 (12.34)	0.005	42.48 (9.07)	46.90 (8.75)	0.063
Height (cm) †	150.62 (12.15)	161.56 (8.22)	0.002	149.87 (9.83)	156.39 (4.98)	0.005
BMI (kg.m^{-2}) *	18.31 (2.66)	19.80 (3.61)	0.104	18.73 (2.59)	19.05 (2.68)	0.637
Triceps skinfold (mm)†	9.67 (4.51)	12.15 (7.35)	0.309	12.80 (4.94)	12.76 (2.78)	0.475
Subscapular skinfold (mm)†	7.81 (4.42)	10.37 (6.11)	0.023	10.55 (5.40)	9.68 (3.58)	0.671
Abdominal skinfold (mm) *	11.12 (8.46)	17.86 (7.90)	0.032	16.60 (8.67)	16.38 (5.10)	0.903
Calf skinfold (mm) *	10.81 (4.04)	15.55 (5.44)	0.153	13.98 (5.35)	12.04 (4.56)	0.144
Σ4 Skinfold (mm)*	39.37 (20.27)	55.87 (27.80)	0.058	53.90 (22.79)	50.84 (13.33)	0.537
TESR *	0.90 (0.25)	1.05 (0.25)	0.038	1.00 (0.24)	1.07 (0.24)	0.293
Arm circumference (cm) *	21.93 (3.35)	24.22 (3.91)	0.030	22.20 (2.41)	22.92 (3.42)	0.350
Waist circumference (cm) *	64.80 (6.26)	66.46 (10.84)	0.510	65.39 (6.44)	63.03 (6.59)	0.171
UAMA (cm^2) *	28.94 (8.10)	33.74 (9.20)	0.054	26.55 (4.84)	29.13 (8.34)	0.147

Values are the mean (standard deviation). p-value: † Mann-Whitney test; * independent *t*-test. BMI = body mass index; Σ4 = sum of subscapular, abdominal, calf, and triceps skinfold thickness; TESR: trunk-to-extremity skinfold ratio; w/u = without unit; UAMA = upper arm muscle area.

Table 2 shows the anthropometric indicators of adolescents in the HIV
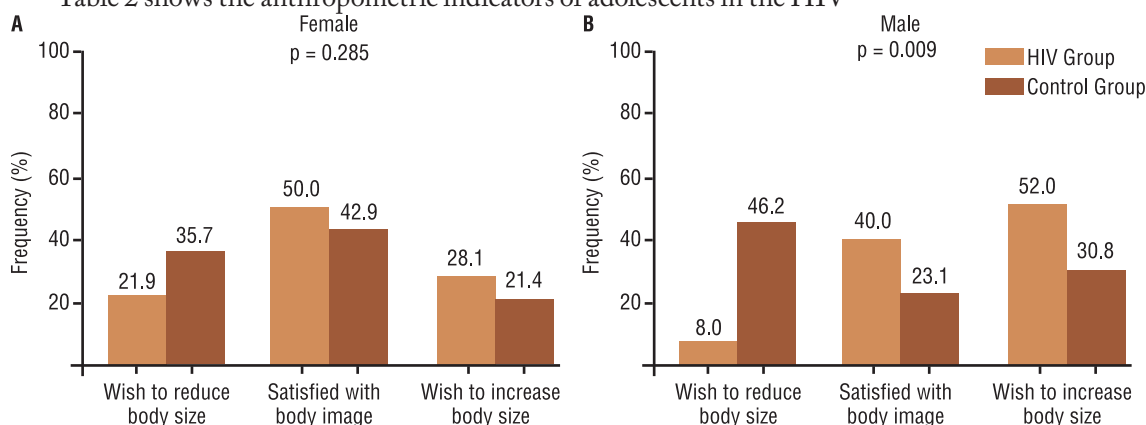
Figure 1. Body image of adolescents living with HIV and controls stratified according to gender. A, female; B, male.

group according to body image category. The TESR was significantly lower in adolescents who "wish to increase body size" compared to adolescents who are "satisfied with body image". Among adolescents who "wish to reduce body size", all anthropometric indicators analyzed were higher when compared to participants who "wish to increase body size".

Table 2. Anthropometric indicators and body image categories in adolescent living with HIV.

	"Wish to increase body size" (n = 21)	"Satisfied with body image" (n = 25)	"Wish to reduce body size" (n = 9)	p
BMI (kg.m^{-2})	17.51 (0.51)	18.44 (0.44)	22.57 (0.85)	<0.001‡†
Triceps skinfold (mm)	9.93 (0.99)	10.80 (0.88)	17.35 (1.76)	0.002‡†
Subscapular skinfold (mm)	8.02 (0.98)	8.27 (0.87)	15.88 (1.74)	<0.001‡†
Abdominal skinfold (mm)	12.91(1.60)	11.55 (1.42)	26.79 (2.83)	<0.001‡†
Calf skinfold (mm)	10.84 (1.00)	12.19 (0.89)	18.40 (1.77)	0.002‡†
Σ4 Skinfold (mm)	41.65 (4.26)	42.79 (3.78)	78.38 (7.53)	<0.001‡†
TESR (w/u)	1.02 (0.04)	0.85 (0.04)	1.13 (0.08)	0.030‡*
Arm circumference (cm)	20.68 (0.49)	22.11 (0.44)	26.25 (0.87)	<0.001‡†
Waist circumference (cm)	62.71 (1.92)	64.68 (1.70)	68.90 (3.39)	0.287
UAMA (cm^2)	40.40 (1.96)	41.37 (1.69)	55.06 (3.26)	<0.001‡†

Values are adjusted means (standard error of the mean). Analysis of covariance adjusted for gender and age. BMI = body mass index; Σ4 = sum of subscapular, abdominal, calf, and triceps skinfold thickness; TERS = trunk-to-extremity skinfold ratio; w/u = without unit; UAMA = upper arm muscle area. * Difference between "Wish to increase body size" and "Satisfied with body image". † Difference between "Wish to increase body size" and "Wish to reduce body size". ‡ Difference between "Wish to reduce body size" and "Satisfied with body image".

Gender, age, subscapular skinfold, UAMA, weight and BMI accounted for 42% of the variation in the body image score (F = 7.01; p < 0.001) of adolescents living with HIV. The BMI was the variable exhibiting the highest explanatory coefficient (Table 3).

Table 3. Multiple linear regression analysis of the association between body image score (figure rating scale) and sociodemographic, anthropometric and clinical variables in adolescent living with HIV.

	Regression coefficients		
	β	β $_{standardized}$	r $_{partial}$
Constant	2.05		
Gender (male; female)	-0.52	-0.24	-0.29
Age (years)	0.18	0.26	0.28
Median HIV RNA (copies.mL^{-1})	0.01	0.17	0.22
Subscapular skinfold (mm)	-0.06	-0.31	-0.19
UAMA (cm^2)	-0.08	-0.54	-0.33
Weight (kg)	0.07	0.70	0.33
BMI (kg.m^{-2})	-0.19	-0.47	-0.24

R^2 $_{adjusted}$ = 0.44; *p* < 0.001 (F = 7.011); standard error of estimate = 0.799. Median of the last two years. RNA: ribonucleic acid; UAMA = upper arm muscle area; BMI = body mass index.

DISCUSSION

The main finding of this study is the significant body image dissatisfaction among adolescents living with HIV, expressed by the "wish to increase

body size", particularly in males. The main differences in anthropometric indicators were found between adolescents with HIV who wish to increase body size and those who wish to reduce body size. Furthermore, gender, age, body weight, BMI and UAMA explained almost half the variation in the body image score of adolescents living with HIV.

Our results corroborate an earlier study conducted in Brazil, which found a prevalence of 42.1% of body image dissatisfaction due to the desire to increase body size among children and adolescents living with HIV[10]. Body image dissatisfaction due to the desire to increase body size may be explained by the visible manifestations of the disease and the adverse effects of treatment, such as weight loss and reduced muscle mass. Likewise, there is evidence of the negative effects of the mass media approach to the disease and its transmission on the perception of body image in patients with HIV[17]. This is a matter of concern since people living with HIV who are dissatisfied with their body image are five times more likely to have poor adherence to antiretroviral theraphy[18].

In the present study, male adolescents living with HIV were more dissatisfied with their body image due to the desire to increase body size, while male adolescents in the control group were more dissatisfied due the desire to reduce body size. These results demonstrate the distinct scenario of HIV infection that may be characterized lipoatrophy and wasting syndrome in adolescents living with HIV, due to lower subcutaneous fat depots and reduced muscle mass. An association between body image dissatisfaction and lipodystrophy has been reported in adults[19]. However, subjective evaluation impairs the diagnosis of lipodystrophy in children and adolescents[20], and objective assessments such as skinfold measurements are therefore preferred[21]. Furthermore, male adolescents frequently wish to be stronger and more muscular because of the beauty ideal advocated by the media. Thus, the greater body image dissatisfaction due to excessive thinness found in adolescents living with HIV may be explained in part by the direct effect of HIV infection on the inhibition of the synthesis of anabolic hormones[9]. Conversely, the body image dissatisfaction due to the desire to reduce body size found in the control group may be explained by the nutritional transition experienced by general populations worldwide[22].

Age, gender, weight, BMI and UAMA explained 42% of the variation in the body image score of HIV-infected adolescents in the present study. Moreover, BMI was the anthropometric indicator that showed the highest association with body image, similar to evidence in adolescents without the diagnosis of HIV infection[2,23]. From a practical perspective, BMI can be modified by aerobic and strength exercises[24], as well as by healthy eating patterns[25]. Although gender and age are not modifiable, they deserve attention since evidence indicates a high prevalence of dissatisfaction in girls and that late adolescents are usually dissatisfied due to the desire to increase body size[10,26,27]. This information can help establish actions designed to improve the body image of HIV-infected patients under clinical follow-up. In a similar study testing factors associated with body image

dissatisfaction, Graup et al.[28] found that, respectively, 22% and 27% of the body image variation in boys and girls are explained by age, body fat percentage and BMI[28]. Therefore, the monitoring of anthropometric variables during clinical follow-up may assist health professionals to evaluate body image and to propose approaches designed to reduce dissatisfaction.

We found that male adolescents living with HIV had lower ~~scores of~~ body weight, height, abdominal skinfold, arm circumference, TESR and UAMA than controls. These results corroborate the findings of Chantry et al.[9] who observed low body fat and muscle mass in children and adolescents living with HIV compared to data from the National Health and Nutrition Examination Survey. Moreover, a large study conducted in Europe[6] found differences in growth, demonstrated by lower weight and height, among children living with HIV compared to uninfected children.

Adolescents living with HIV and dissatisfied due to the desire to increase body size had lower skinfolds, TESR and arm circumference than adolescents satisfied with their body image. On the other hand, adolescents satisfied with their body image showed lower measurements compared to adolescents dissatisfied due to the desire to reduce body size. These results support the view that body image dissatisfaction in adolescents living with HIV may be the result of perceptible physical manifestations of HIV infection. Furthermore, these results corroborate an earlier study[10] in which adolescents living with HIV and with higher triceps skinfold and BMI were more dissatisfied due to the desire to reduce body size, while patients who exhibited lower measurements were more dissatisfied due to the desire to increase body size[10].

Taken together, these findings highlight the concern about body image dissatisfaction in adolescents living with HIV, demonstrating the need for monitoring and developing interventions. Furthermore, the assessment of body image in the clinical context of HIV may help anticipate and reduce the negative effects of body image dissatisfaction, such as eating disorders, abandonment of antiretroviral therapy and social reclusion. Further studies focusing on body image interventions that can deconstruct the beauty ideal disseminated by the media are needed, as well as interventions designed to change body composition by physical activity and healthy eating as part of a healthy lifestyle.

The limitations of this study include its cross-sectional design, which does not allow inferences about the causality of the effect of HIV infection on body image, and the analysis of body composition based on anthropometry. On the other hand, this study has some strengths such as the control group matched for gender and age to the HIV group and the representative sample of adolescents living with HIV followed up at a regional HIV referral center.

CONCLUSION

Male adolescents living with HIV are more dissatisfied due to the desire

to increase body size compared to controls. Moreover, adolescents living with HIV who are dissatisfied due to the desire to increase body size had lower anthropometric indicators, especially when compared to their peers dissatisfied due to the desire to reduce body size. Gender, age, weight, BMI and UAMA account for almost half the variation in the body image score of adolescents living with HIV.

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