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ORIGINAL ARTICLE

Psychometric Properties of the Brazilian Portuguese Version of the Assessment of Body Change Distress for People Living with HIV/AIDS

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Abstract

Given the body image impact on people living with HIV/AIDS, the aim of this study was to generate psychometric evidence for the Portuguese Brazilian version of the assessment of body changes distress (ABCD) questionnaire. Data from four hundred participants (44.06 ± 12.35 years old) analyzed with confirmatory factor analysis was used to determine factorial structure, construct validity, and reliability. A bifactorial model for the first part and a second-order factor with two first-order factors for the third part of ABCD demonstrated an adequate fit following the elimination of items, in the case of the latter. The ABCD achieved only weak non-invariance across sex. Satisfactory evidence of convergent validity and reliability were generated, with a lack of discriminant validity. Additional analysis showed difference of means for sex, gender role, and sense of financial security. This version of ABCD expands the possibility of future cross-cultural research.

Keywords Validity · Reliability · Questionnaire · HIV

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Introduction

Body image can be defined as "the picture of our own body, which we form in our own mind" (Schilder 1978, p. 11). This image is a mental representation of the body that encompasses self-perceptions and attitudes regarding both the body's appearance and its function (Cash 2011). The environment surrounding the subject, social interactions, emotions, integrity, and fragility of the body itself are elements of this representation. Hence, social, physiological, and psychological variables are also integrated into body image (Schilder 1978). Body image can be considered to be both a structure and a process, since mental representation of the body forms the foundation of a sense of self, but it is continuously developing, both consciously and unconsciously, along with body experiences (Schilder 1978; Shontz 1969). In other words, body image is dynamic, supported by the mental representation of the body self, always under constant development (Krueger 1990).

Receiving an HIV diagnosis can be a life-changing event and potentially threatens the integrity of body image (Ho and Holloway 2015). First reactions to the diagnosis are linked to the representation of body barriers being disrupted (Alexias et al. 2016). Early depictions of HIV diagnosis are expressed by the body being "at risk," "dangerous," "contaminated," "punished," and so on (Sontag 1989; Rushing 2018). The use of highly active antiretroviral therapy (HAART) has altered the prognosis of the disease and extended the life expectancy of people living with HIV/AIDS. Continuous body image adjustments are not related to immediate death, but with the situation of being a person living with HIV/AIDS (Vella 2015). Following first reactions, people living with HIV/AIDS experience varying changes in their body image related to the myriad of physical, psychological, and social issues related to an HIV/AIDS diagnosis (Blashill et al. 2014a; Dallas et al. 2017; Lu et al. 2019). Perhaps the most impacting change comes with lipodystrophy—or lipodystrophic syndrome, since it makes it difficult to socially deny HIV, exposing the person to the judgment of others and HIV/AIDS-related stigma (Alexias et al. 2016).

Lipodystrophy is characterized by the association of metabolic abnormalities with changes in body fat distribution. For people living with HIV/AIDS, lipodystrophy refers to both lipohypertrophy and lipoathrophy (Imbroll et al. 2017). Lipoatrophy often occurs at the peripheral areas of the body—face, arms, legs, and buttocks—being characterized by the loss of body fat. On the other hand, lipohypertrophy is the abnormal accumulation of fat in central areas—breasts, abdomen, dorsocervical fat pad, and neck (Carr et al. 1998). Facial lipoatrophy, especially, can be psychologically challenging to patients, as it carries higher social stigma (Imbroll et al. 2017). The etiopathogenesis of lipodystrophy being heterogeneous remains unknown, and its cause is probably multifactorial (Guzman and Vijayan 2019). Currently, risk factors for the development of lipodystrophic syndrome are exposure to HAART (mainly protease inhibitors), severe mitochondrial dysfunction, being young, low CD4—a glycoprotein present at immune cells—high viral load, cortisol activation by inflammation response, duration of antiretroviral therapy (ART), and being racially Caucasian (Kumar et al. 2015). However, not all patients using a given ART for a given time developed lipodystrophy and not all patients who developed it showed the same changes, making diagnosis, follow-up, and intervention difficult (Sánchez Vera 2016). There is no consensus on the prevalence or incidence of lipodystrophy in patients living with

HIV/AIDS. The prevalence can vary from 6 to 84% and the incidence from 7.3 to 11.7 per 100 patients per year (Chen et al. 2002; Fuller 2008; Sánchez Vera 2016).

Recent studies suggest that up to 60% of patients living with HIV/AIDS may present moderate to severe changes in body fat distribution, causing body dissatisfaction associated with important outcomes, including increased sexual risk behaviors for HIV transmission, depression, and decreased self-esteem (Blashill et al. 2014b). The following have also been reported: lower self-esteem, poor social relationships, body avoidance, social reclusion, higher embarrassment due to body changes (Imbroll et al. 2017; Njelekela et al. 2017), increased perception of stigma, social rejection, and feelings of guilt and shame (Alexias et al. 2015; Apodaca et al. 2018; Brener et al. 2013; Kalichman et al. 2009), lower self-confidence (Tate and George 2001; Cofrancesco et al. 2004) and life dissatisfaction (Jain and Tiwari 2016), depressive symptons (Martins et al. 2019) a feeling of lack of control over the body in face of the impossibility of HIV denial (Tate and George 2001; Reynolds et al. 2006) with an impact on one's financial life and loving relationships (Abel and Thompson 2018) and methamphetamine use (Jampel et al. 2015). It is important to highlight that the social stigma and negative body image traits, especially the state of dissatisfaction with the body, are associated with low adherence to treatment and general psychological distress (Blashill and Vander Wal 2010; Calabrò et al. 2019). On the other hand, post-traumatic growth was also reported, resulting in a more positive life perspective and a less distressing body change experience (Rzeszutek et al. 2017; Rzeszutek and Gruszczyńska 2018).

Patients report that dealing with lipodystrophy may be more difficult than with HIV itself, since the subjective experience with appearance may be more challenging than the objective reality itself (Cash 2011). Hence, it is not important how much the body's appearance and function are changing, but the fact that they are changing and the need for recognition of this fact (Reynolds et al. 2006). For people with chronic illness, we emphasize body image deals both with actual body experience and also with its interpretation (Vamos 1993) and justify the need for the monitoring of changes in body image during treatment.

Based on the central idea that body change distress encompasses both objective reality and subject experiences, the AIDS Clinical Trials Group created the assessment of body changes distress (ABCD), a measure specifically designed to assess the objective changes of the body and the psychosocial impact of body changes in patients living with HIV/AIDS (Neidig et al. 2002). The ABCD was initially described as a three-part scale—lipodystrophy (items 1 to 6), body satisfaction (item 7), and body change distress in body image (items 8A to 8T). However, Neidig et al. (2002) did not present any statistical evidence of validity and reliability for ABCD on its development study, just the scale itself. ABCD was created by the AIDS Clinical Trials Group after the advent of HAART, and it therefore addresses morphological changes observed in lipodystrophy considering actual treatment protocols. The items are about specific changes in people living with HIV/AIDS and the subject experience of it, evidencing the essence of the theoretical approach of body image considered here, as including both actual body experience and its interpretation (Vamos 1993). This measure was created specifically to capture body image traits of patients living with HIV/AIDS, and to the extent of our knowledge, has been used with this population. To cover the scarcity of psychometrics evidence for ABCD, cultural adaptations and methodological

studies of the ABCD have already been conducted in France (Duracinsky et al. 2004), Italy (Guaraldi et al. 2006), and Colombia (Sánchez Vera 2016).

In France, Duracinsky et al. (2004) worked with the first and the third parts of ABCD. An exploratory factor analysis (EFA) yielded a two-factor solution for the first part, called lipoatrophy (items 3, 4, and 5) and lipoaccumulation (items 1, 2, and 6). For the third part, a four-factor solution was confirmed with confirmatory factor analysis (CFA) testing a model with a second-order factor, and the four first-order factors. Distress is the second-order factor, having four first-order factors: (1) coping with appearance—items 8A, 8B, 8C, 8D, 8E, 8F, 8G, 8H, and 8Q; (2) social and affective impact—items 8J, 8L, 8M, 8N, 8O, and 8P; (3) fear of future—items 8I, 8K, and 8R; and (4) compliance with treatment—items 8S and 8T. Internal consistency was high for the reference sample in France ($\alpha = 0.94$ for all items). Evidence of convergent validity came from the high correlations among ABCD and quality of life measures—health distress and social component of Medical Outcome Study (MOS)—HIV ($r > .60$) and SF36 Health Survey ($r = .65$). Discriminant validity evidence was generated by the evidence of ABCD score variance among groups according to the number of lipodystrophy sites and with the acceptance of cosmetic surgery.

In Italy, Guaraldi et al. (2006) did not conduct an EFA or a CFA, thus no evidence of a structural model was generated. Internal consistency for items 8A–8T was high ($\alpha = .94$), and significant correlations were found among the third part of ABCD and item 7 ($r = -.66$): pain ($r = -.21$), physical function ($r = .23$), role function ($r = .21$), social function ($r = .31$), mental health ($r = .50$), vitality ($r = .43$), health distress ($r = .56$), cognitive function ($r = .36$), quality of life ($r = -19$), physical health ($r = .23$), and mental health ($r = .53$).

The Colombian version of ABCD (Sánchez Vera 2016) tested only the third part of the scale as a unifactorial structure—without running an EFA or a CFA—with no mention of the first part of the role of item 7. Item-total correlations of items 8a–8t ranged from $r = .43$ to $r = .82$. Cronbach alpha for all items was $\alpha = .94$. Positive and strong correlations were found between ABCD and total score of MOS-HIV ($r_s = .77$)—MOS-HIV physical health score ($r_s = .63$) and MOS-HIV mental health score ($r_s = .75$). Differences for the ABCD score were found in groups regarding anxiety state and depression state (for both, $p < .001$).

A revision of the scale in the USA was also made, once again, focusing only on the third part of the scale. This version proposed a shortened version for this part, with only 10 of the 20 items (Blashill et al. 2014b). The authors first conducted an EFA with the 20 items (8a–8t), using principal component analysis with oblimin rotation. Four factors emerged: (1) Negative affect—items 8A, 8D, 8G, 8H, 8M, 8N, 8O, 8P, 8Q, and 8R; (2) HIV stigma—items 8I, 8J, 8K, and 8L; (3) ART—items 8S and 8T; and (4) eating and exercise—items 8E and 8F. Items 8B and 8C were eliminated in this analysis. Items with greater factor loading ($\lambda > .50$) were retained for the short form, and when a content overlap between items was found, the authors selected only one item to evaluate a given part of the construct. Subsequently, a Bayesian CFA was conducted to confirm the structural validity for the original and short forms of the third part of ABCD, and the data fit the model well (posterior predictive p value = .50). The study also generated convergent validity evidence correlating scores from the ABCD short form with body image and quality of life measures.

Given the body image impact on people living with HIV/AIDS related to actual body change caused by lipodystrophy and the body experience related to it, and the lack of a psychometric sound scale to evaluate this impact in Brazil, this study aimed to generate psychometric evidence for the Brazilian Portuguese version of ABCD in a sample of Brazilian people living with HIV/AIDS.

Methods

Participants

This is a methodological study with non-probabilistic sampling. The sample size should be 5–10 (k) participants per parameter evaluated (Hair et al. 2018). Considering that the ABCD has 62 parameters (27 observable variables, 27 errors, 6 latent variables of the first order, and 2 latent second-order variables in the largest model tested) and $k = 6$, the minimum sample number needed for this study was 372 participants.

The actual sample consisted of 400 participants (male = 63%, n = 252). The participants' ages ranged from 19 to 77 years (M = 44.06 ± 12.35). Of the total, 61.8% (n = 247) declared themselves as men and the other participants (n = 153, 38.3%) as women. In relation to marital status: 47% (n = 144) were single, 41.3% (n = 165) were married, 6.5% (n = 26) were divorced, and 5.3% (n = 21) were widowers. In terms of schooling, 140 (35%) participants had completed elementary education, 174 (45.5%) had completed secondary high school, and 86 (21.5%) had completed higher education.

Instruments

Brazilian version of assessment of body change distress (Neidig et al. 2002) The ABCD is a 27-item scale developed by the Outcomes Committee of the NIAID/AIDS Clinical Trials Group (ACTG). The scale is divided into three parts; the first six items are yes/no questions to identify symptoms of lipodystrophy. Higher score are an indicator of more lipodystrophy symptoms. The second part consists only of item 7, which addresses satisfaction with body appearance in a 5-point Likert-type scale (1 = highest satisfaction, 5 = highest dissatisfaction); higher score means higher body dissatisfaction. The third part (items 8A to 8T) assesses the psychosocial consequences of body changes in the last 4 weeks. The answers are arranged on a 5-point Likert-type scale (1 = all of the time, 5 = none of the time). Higher score indicates less frequency of body negative experience. The description of the procedures for the formulation of the Brazilian version of the instrument has already been described (Pessôa et al. 2017), rigorously following the recommendations of Beaton et al. (2002). In summary, the ABCD was first independently translated into Brazilian Portuguese by two native Portuguese speakers, and two different translations (T_1 and T_2) were created. Second, a synthesis version (T_{12}) was drawn up by the two translators and a neutral judge. Third, from the synthesis, two back-translations (BT_1 and BT_2) were created by two translators (English-speaking natives with Brazilian Portuguese proficiency) who had no knowledge of the original instruments or aspects of body image. Fourth, all versions (T_1, T_2, T_{12}, BT_1, BT_2) were forwarded to an Expert Committee, consisting of the two

translators, the two back-translators, the synthesis judge, a psychoanalyst, a methodologist, and a linguist. This committee examined the versions of each questionnaire and discussed the items to ensure a clear pre-test version, equivalent to the original in terms of semantics, language, culture, and concept (Herdman et al. 1998). Finally, the ABCD was submitted to a pre-test, proving to be clear, easy to understand, and having a favorable layout.

Demographics For the present study, a demographic questionnaire was proposed. Participants self-reported their demographic information, namely: age, perception of financial security, educational level, sex, and gender role.

Procedures

The research was approved by an Ethical Committee from a private Brazilian University and following the ethical procedures related to human research. The recruitment of participants was non-probabilistic, and the researchers visited the Municipal Program of STI/AIDS and Viral Hepatitis of São Bernardo do Campo and orally invited the patients of this service to participate in the research, using an individualized approach. The package of questionnaires with a Free and Informed Consent Term were given only to those who agreed to participate voluntarily. Completion of the questionnaires was done inside the institution itself, in chairs and in a private space provided for data collection. Participants completed the instruments individually, taking 10–15 min to fill out the survey. All participants took part on a voluntary basis and were not remunerated for participation.

Models

For the first part of ABCD, only one structural solution emerged so far, as a two-factor solution: lipoatrophy—items 3, 4, and 5; and lipohypertophy—items, 1, 2, and 6 (Duracinsky et al. 2004). This model was tested entirely separated from the third part of ABCD (Duracinsky et al. 2004). Here, it is called model A.

Two different structural models were already proposed for the third part of the ABCD. The French solution, with a second-order factor—distress—and four first-order factors (1) coping with appearance—items 8A, 8B, 8C, 8D, 8E, 8F, 8G, 8H, and 8Q; (2) social and affective impact—items 8J, 8L, 8M, 8N, 8O, and 8P; (3) fear of future—items 8I, 8K, and 8R; and (4) compliance with treatment—items 8S and 8T. This is the model 1 in the present study.

Blashill et al. (2014a, 2014b) retained the second-order factor from Duracinsky et al. (2004) with 18 items divided in four new first-order factors: (1) Negative affect—items 8A, 8D, 8G, 8H, 8M, 8N, 8O, 8P, 8Q, and 8R; (2) HIV stigma—items 8I, 8J, 8K, and 8L; (3) ART—items 8S and 8T; and (4) eating and exercise—items 8E and 8F. Here, it is called model 2.

These two previous models share a common issue, which is at least one factor with less than three indicators. In this condition, they may not capture actual phenomenon thoroughly. Factors with only two indicators must have uncorrelated errors, and either the two indicators' factorial loadings must be equal or the two indicators must correlate with a third one from a different factor, but neither of the two indicators' error with the

error of that third indicator. A failure in these parameters may cause a model identification problem (Kenny et al. 1998).

In lieu of these models, we tested a new one. Each item had its content analyzed by the two first authors, to cluster items with similar contents. This work was conducted with the understanding that body image for people with HIV/AIDS includes not only subjective experiences with the body caused by diseases (lipodystrophy) but also changes in social relationships, bodily functions, and the impact of the treatment itself, due to the circumstances of the disease (Vamos 1993; Cash 2011; Blashill et al. 2014a, b; Vella 2015; Alexias et al. 2015). Some of the items are related to daily struggles with clothes, relationships, beliefs, humor fluctuation, and self-worth. Those are indicators of the first factor, general impact—items 8A, 8B, 8C, 8D, 8E, 8F, 8G, 8H, 8M, 8M, 8N, 8O, 8P, 8Q, and 8R. Fewer items—8I, 8J, 8K , 8L, 8S, and 8T—are specially concerned with the impact on HIV itself, this being the second first-order factor. A second-order factor, called distress, as the synthesis of these two different impacts, was proposed. This is model 3.

Hence, we tested these three models for the third part of the ABCD and the one model already tested for the first part of the ABCD. The models from the first and third parts of the ABCD should be run separately since they have different measurement levels. Also, the second part, item 7, should be correlated with those scores.

Statistical analysis

In order to prepare the data for CFA analysis in the PRELIS^{TM2} version of the LISREL® system, listwise deletion criterion was adopted for missing data—resulting in the elimination of cases with missing answers (Jöreskog et al. 2016). After generating the PRELIS file, the SIMPLIS model was used, which is an encoding of the LISREL® system. CFA was then conducted, making it possible to evaluate the parameters of the construct validity of the measuring model. Given the fact that our data were not normally distributed, to estimate the models, the unweighted least square method was used because it is not sensitive to lack of multivariate normality (Li 2016). The CFA was computed using LISREL® 8.51.

We considered the following fit indices for the adjustment of models: Goodness-of-Fit Index (GFI), Adjusted Goodness-of-Fit Index (AGFI), Normed Fit Index (NFI), Non-normed Fit index (NNFI), and Comparative Fit Index (CFI). According to the literature (Hair et al. 2018), these indices should be equal to or above .90. Also considered was the Root Mean Square Error of Approximation (RMSEA), whose established value of acceptance is below .08. In order to compare models, three parsimony fit indices were considered: Akaike's Information Criterion (AIC), Parsimony Normed Fit Index (PNFI), and Parsimony Goodness-of-Fit Index (PGFI). There are no reference values for those indices, but smaller AIC and greater PNFI and PGFI are preferable (Hair et al. 2018). For models with initial poor adjustment, factorial loadings, item residuals, and LISREL modification indices were considered for further adjustments.

To analyze the measurement model, construct validity (discriminant and convergent) and internal consistency were examined. To establish the latter, the Kuder-Richardson coefficient (KR-20) was measured for items 1 to 6. Cronbach's alpha (α) was calculated and for items 8A to 8T and composite reliability was measured for all items. Values greater than or equal to 0.70 are preferable, but above .60 are also acceptable for

composite validity and Cronbach's alpha (Vaske et al. 2017; Hair et al. 2018). KR-20 results were rated as follows: (i) for KR-20 < .50, the reliability is low, (ii) for .50 < KR-20 < .80, the reliability is moderate, and (iii) for KR-20 > .80, the reliability is high (Salvucci et al. 1997).

The investigation of validity was made under the model of analysis proposed by Anastasi and Urbina (2000), Marôco (2014), and Hair et al. (2018). Here, construct validity is understood as having three subcomponents: factorial validity, convergent validity, and discriminant validity. According to these references, factorial validity is investigated by means of the verification of the scale model itself, evaluating the adjustment of the model through the indexes of adjustment, earlier mentioned (Marôco 2014).

Convergent validity is established when the observable variables (items) of a specific latent variable (factor) presents positive and higher correlations, meaning that they converge satisfactorily to represent this specific part of the construct, as theoretically designed. To establish the convergent validity, the average variance extracted (AVE) and the factorial loads of observable variables were analyzed. Item factorial loads greater than 0.50 were acceptable and greater than .75 were preferable (Hair et al. 2018). Also, AVE greater than or equal to 0.50 is acceptable.

Discriminant validity, on the other hand, is established when the factors of the models have no considerable correlations, that is, when it represents distinct aspects of the construct (Marôco 2014). To evaluate discriminant validity, Fornell and Larcker (1981) suggest a comparison between the AVE for each factor and the shared variance (squared correlations) of each pair of factors. AVE should be greater than .50 and greater than the value of all shared variance.

The factorial invariance of women and men also was assessed. The invariance test was performed by multigroup analysis using the Chi-square difference ($\Delta\chi^2$) between the model with free factorial weights and the model with equal weights fitted to sample. To assess the invariance in sexes, the total sample was divided into two subgroups (female: n = 163, males: n = 167) and the test was performed considering analysis of factorial weights (λ), intercepts (I), and residues' variance/covariance (cov/res). Support for metric (weak) invariance was supported if $p\Delta\chi^2_\lambda$ was > .05. Metric and scalar (moderate) invariance was found if $p\Delta\chi^2_\lambda$ and $p\Delta\chi^2_I$ were > .05 and was supported if $p\Delta\chi^2_\lambda$, $p\Delta\chi^2_I$, and $p\Delta\chi^2_{cov/res}$ were > .05 (Marôco 2014).

Finally, we worked with the factors' mean scores to provide information regarding the sample to enlighten the body change distress and lipodystrophy. The mean scores were normally distributed and independent, and hence, independent t test and one-way ANOVA with Tuckey post hoc test were conducted, considering α = .05. SPSS 21 was used for these final analyses.

Results

Structural models

First part of ABCD: items 1 to 6

A satisfactory fit for model A was achieved at the first estimation, χ^2/df = 3.96, RMSEA = .081, CFI = .99, NFI = .97, NNFI = .97, GFI = .98, and AGFI = .98,

thus confirming the model (Duracinsky et al. 2004). Model A was then used to verify validity and reliability evidences for the first part of the ABCD (Fig. 1; Table 1).

Third part of ABCD: items 8A to 8T

The first estimation of model 1 showed some indices with poor adjustment, χ^2/df = 6.7, RMSEA = .12, CFI = .99, NFI = .98, NNFI = .99, GFI = .98, and AGFI = .97. All items had factorial loads above the acceptable value. Regarding the residues, high ones were associated to items 8B, 8C, 8E, 8F, 8G, 8L, 8M, 8N, 8O 8Q, 8P, and 8S,without theoretical justification to accept covariances of the errors. Thus, we proceed with the elimination of the items with the largest residues, one by one, in the following order: 8F, 8Q, 8J, 8O, 8N, 8G, and 8A. With the elimination of these seven items, a better adjustment was obtained, χ^2/df = 3.78, RMSEA = .084, CFI = 1, NFI = .98, NNFI = .99, GFI = .99, AGFI = .98, AIC = 291.01, PNFI = .77, and PGFI = .66 (Table 1).

In the sequence, we tested model 2. The first estimation had only RMSEA above the acceptance value with all other indices with a good fit, χ^2/df = 3.99, RMSEA = .087, CFI = 1, NFI = .99, NNFI = 1, GFI = .99, and AGFI = .99. All items had $\lambda >$ .50. In order to improve RMSEA, we examined the residuals and found higher values among items 8D, 8F, 8G, 8K 8L 8M, and 8N. To achieve a better fit, items 8D and 8O were eliminated one at a time, in this order. After these changes, the indices showed evidence of a fitted model, χ^2/df = 2.71, RMSEA = .077, CFI = 1, NFI = 1, NNFI = 1, GFI = .99, AGFI = .99, AIC = 408.72, PNFI = .82, and PGFI = .73 (Table 1).

Finally, model 3 presented a poor adjustment in the first rotation, χ^2/df = 6.37, RMSEA = .116, CFI = .99, NFI = .97, NNFI = .98, GFI = .98, and AGFI = .97. Items 8S and 8T had factorial loads below the ideal (λ = .47 and λ = .39). There were high residuals between items 8A, 8B, 8C, 8E, 8F, 8S, and 8t. The LISREL modification index did not indicate covariance errors that could be accepted, and the decision was to eliminate items 8T, 8O, 8R, 8F, 8C, and 8Q, in this order, one

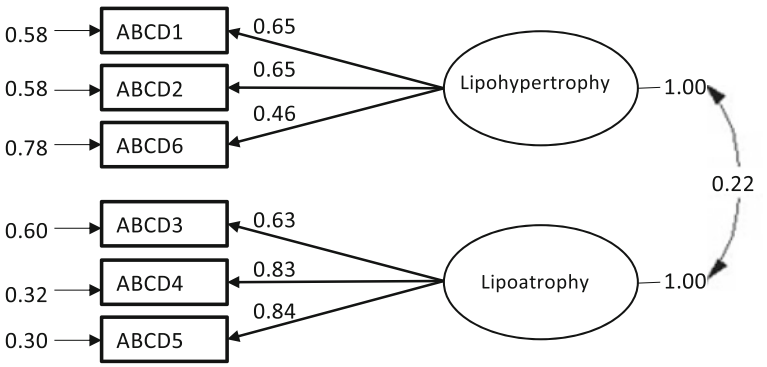

Fig. 1 Adjusted ,model A. Created by LISREL®

Table 1 Psychometric indicators of Brazilian version of assessment of body change distress (ABCD) questionnaire

Model	<λ	>λ	χ^2/df	CFI	NFI	GFI	RMSEA	α/KR20*	CC	AVE	R^2
A. Fitted	.46	.84	3.96	.99	.97	.98	.081	.60–.81*	.62–.81	.35–.59	.05
1. Initial	.56	.83	6.7	.99	.98	.98	.12	.62–.91	.58–.91	.42–.52	.26–.90
1. Fitted	.57	.85	3.78	1	.98	.99	.084	.62–.86	.58–.86	.42–.56	.23–.90
2. Initial	.55	.91	3.99	.99	1	.99	.087	.62–.92	.59–.93	.42–.77	.18–.55
2. Fitted	.54	.91	2.71	.99	1	.99	.077	.62–.90	.59–.90	.42–.77	.18–.55
3. Initial	.39	.81	6.37	.97	.99	.98	.116	.88–.93	.80–.93	.41–.50	.65
3. Fitted	.44	.84	2.62	.99	1	.99	.064	.81–.90	.75–.90	.50	.60

Note: <λ, lower factorial load; >λ, higher factorial load; χ^2/df, normed Chi-square; *CFI*, Comparative Fit Index; *NFI*, Normed Fit Index; *RMSEA*, Root Mean Square Error of Approximation; α, Cronbach's alpha; *CC*, construct reliability; *AVE*, average variance extracted; R^2, shared variance; *KR20*, Kuder-Richardson formula 20

by one, in subsequent new rotations. After these changes, a satisfactory fit was achieved, χ^2/df= 2.62, RMSEA = .064, CFI = 1, NFI = .98, NNFI = .99, GFI = .99, AGFI = .98, AIC = 256.56; PNFI = .81, and PGFI = .71 (Table 1).

All models achieved a satisfactory fit, being model 1 at the limit. Model 3 has a better AIC index (256.56) than model 2 (408.72) and model 1 (291.01). On the other hand, model 2 had better PNFI and PGFI indexes (.82 and .73, respectively) than model 3 (PNFI = .81 and PGFI = .71) and model 1 (PNFI = .77 and PGFI = .66), which are also indicators of parsimony. Model 1 lost seven observable variables, model 2 lost two and model 3 lost six. Hence, model 2 has the chance to keep the conceptual validity of the scale, while it holds more observed variables.

Given these parameters, model 2 seems to be adequate for our data. However, the examination of factors exercise and ART, both with two indicators, showed some problems: they do not have the same factorial loads for the two indicators, and neither the error of their indicators is uncorrelated with the error of a third indicator (8G and 8E; 8T and 8G). Hence, these two factors had identification problems. In the face of that, model 3 seems to be the most adequate choice, having more parsimony than model 1, with all factors in order. Because of this and the issues pointed on models 1 and 2, the researchers made the decision to choose model 3 as the one most appropriate to the data and to proceed with the evaluation of validity and reliability (Fig. 2).

Correlations among first, second, and third part of the ABCD

Since the ABCD was created as a three part scale, item 7 being the second part, it is worth verifying that it is coherent with the rest of the scale. Item 7, which measures the level of body dissatisfaction, should be correlated with the factors scores of the first and third parts, in order to show dependence on them.

A bivariate correlation analysis showed that item 7 is correlated with lipoatrophy, r = .38, p < .001; lipohypertrophy, r = .21, p < .001; general impact, r = −.51, p < .001; and HIV impact, r = −.30, p < .001 (Table 2).

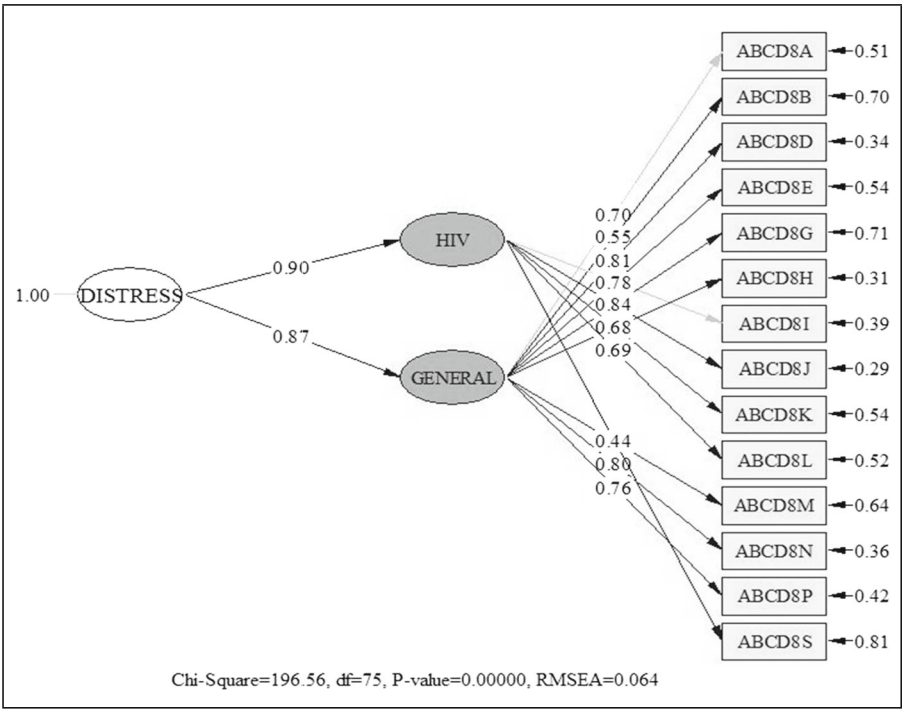

Fig. 2 Adjusted model 3. Created by LISREL®

Construct validity and internal consistency of models 3 and A

Regarding the convergent validity, the AVE, values for the factors lipoatrophy (AVE = .59), general impact (AVE = .50), and HIV impact (AVE = .50) showed acceptable values, being above the cutting point, while the AVE value of lipohypertrophy (AVE = .35) was below. Following these results, we moved to the second indicator of convergent validity, the factorial loads. Only item 6 obtained a factorial load below 0.50 (λ = .46), but still close enough to be considered. Finally, all t values were above 1.96. Those last two indicators generate evidence of convergent validity, less robust than the AVE, but still considerable.

Table 2 Association of the three parts of ABCD

	Item 7	lipoatrophy	lipohypertrophy	General	HIV
Body satisfaction (item 7)	–				
Lipoatrophy	.38**	–			
Lipohypertrophy	.21**	.15**	–		
General impact	−.51**	−.44**	−.28**	–	
HIV impact	−.30**	−.36**	−.08	.66**	–

**Correlation is significant at the 0.01 level

With regard to discriminant validity, although lipohypertrophy reached lower AVE, the value was still shown to be higher of shared variance (r^2 = .05) with lipoatrophy. On the other hand, no evidence of discriminant validity could be generated for general impact and HIV impact, since their shared variance was .60 and both AVEs were .50.

Composite reliability values were adequate for lipoatrophy (CR = .81), general impact (CR = .90), HIV impact (CR = .86), and acceptable for lipohypertrophy (CR = .62). Cronbach's alpha values were adequate and high for general impact (α =.90) and HIV impact (α = .81). The KR-20 test showed strong evidence of internal reliability for lipoatrophy (KR-20 = .81), and a moderate one for lipohypertrophy (KR-20 = .60).

Sex invariance

For model A and model 3, only metric invariance (weak) was held, $\Delta\chi^2_\lambda(4) = 1.32$, p = .86 and $\Delta\chi^2_\lambda(14) = 21.32$, p = .094, respectively (Table 3).

Additional analysis

There was a significant difference between male (n = 252, M = 5.50 ± .76) and female samples (n = 148, M = 5.04 ± 1.01), $t(398) = 5.11$, p <.001 regarding the lipohypertophy factor, on which males reported more problems than females. Body dissatisfaction also showed that males (M = 3.38 ± 1.12) were more satisfied with their bodies than females (M = 3.11 ± 1.16), $t(398) = 2.55$, p = .025. There was no significant difference in any of the other factors.

In relation to the gender, a difference was found for the lipohypertrophy factor, $t(398) = 5.03$, p <0.001, which pointed to a smaller presence of this issue for men (n =

Table 3 Invariance of models A and 3 for sex

Model	Adjust	χ^2	*df*	RMSEA	NFI	CFI	$\Delta\chi^2$	Δdf	$p\Delta\chi^2$
A	Male sample	21.35	8	.082	1	1	N/A	N/A	N/A
	Female sample	21.14	8	.106	1	1	N/A	N/A	N/A
	Configural	42.42	16	.091	1	1	N/A	N/A	N/A
	Metric	43.74	20	.077	1	1	1.32	4	.86
	Scalar	161.82	30	.149	.98	1	118.08	10	<.001
	Strict	209.89	39	.148	.98	1	48.07	9	<.001
3	Male sample	163.72	75	.069	.95	.96	N/A	N/A	N/A
	Female sample	120.72	75	.064	.93	.96	N/A	N/A	N/A
	Configural	307.02	158	.069	.94	.96	N/A	N/A	N/A
	Metric	328.34	172	.068	.95	.92	21.32	14	.094
	Scalar	677.95	198	.11	.84	.86	349.61	26	<.001
	Strict	800.32	200	.12	.83	.85	122.37	2	<.001

Note: χ^2, Chi-square; *df*, degrees of freedom; *RMSEA*, Root Mean Square Error of Approximation; *NFI*, Normed Fit Index; *CFI*, Comparative Fit Index; $\Delta\chi^2$, delta Chi-square; Δdf, delta degrees of freedom; $p\Delta\chi^2$, significance for Chi-square test; *N/A*, not applicable

247, $M = 5.50 \pm .76$) than in women ($n = 153$,$M = 5.05 \pm 1$). Body satisfaction was higher for men ($M = 3.37 \pm 1.11$) than for women ($M = 3.13 \pm 1.17$), $t(398) = 2.35$, $p = .046$. On its turn, the general impact factor, $t(398) = -2.04$, $p = 0.04$, showed less distress for men ($M = 17.91 \pm 8.09$) than for women ($M = 19.69 \pm 8.63$). Once again, no significant difference was found in any of the other factors.

Regarding financial security, there were variance on the scores of Lipoatrophy $F(3, 396) = 2.69$, $p = .028$, body dissatisfaction, $F(3, 396) = 5.08$, $p = .002$, general impact, $F(3, 396) = 78.4$, $p < .001$ and HIV impact, $F(3, 396) = 6.37$, $p < .001$. The Tuckey post hoc showed that those who feel safe ($M = 5.27 \pm .91$) report more lipoatrophy symptoms than those who feel financially unsafe ($M = 4.97 \pm .96$). Regarding body dissatisfaction, differences were between those who feel financially safe ($M = 3.44 \pm 1.10$) and very unsafe ($M = 2.85 \pm 1.21$), $p = .016$, and those who feel very safe ($M = 4 \pm .85$) and very unsafe. The financially very unsafe persons are the less satisfied with their bodies. For the general impact of body changes, differences are also between those who feel safe ($M = 16.54 \pm 7.7$) and unsafe ($M = 19.78 \pm 8.35$), $p = .001$; for those who feel safe and very unsafe ($M = 22.42 \pm 9.02$), $p < .0001$; and for those who feel financially very unsafe and very safe (15.33 ± 7.01). In general, unsafe and very unsafe persons are more impacted by the body changes. Finally, for the HIV impact factor, there were also differences between those who feel safe ($M = 10.67 \pm 5.47$) and unsafe ($M = 12.75 \pm 5.55$), $p = .017$ and for those who feel safe and very unsafe ($M = 13.55 \pm 5.25$), $p = .003$. Once again, the unsafe and very unsafe persons seem to be more impacted by specific HIV-related body changes.

Discussion

The aim of this study was to generate psychometric evidence for the Brazilian Portuguese version of the ABCD in a sample of Brazilian persons living with HIV/AIDS. Our results showed a satisfactory fit to the theoretical structure already proposed for the first part of the scale. Data also showed the association of the second part of the scale, item 7, with the first and third parts. Regarding the last part, results suggested that a more parsimonious model was desirable and the present one may be, since it has no model identification issues as the previous solutions (Duracinsky et al. 2004; Blashill et al. 2014a, b). Furthermore, we observed that the fitted models for the first and third parts of the ABCD were weak invariant across sex, suggesting that ABCD may be useful for assessing lipodystrophy and body change distress in both women and men.

Concerning the first part of the ABCD, evidence of convergent validity was generated for factors, lipoatrophy, and lipohypertophy. For the last, it was supported only by the adequacy of *t* values, with the main indicator, the AVE, below the cut-off point. This may be explained by the low factorial loading for item 6. The frequency of the answers for this item showed that 90.5% of the participants answered "no" to it. This same pattern of answers was also observed in Italy (Guaraldi et al. 2006) and a low factorial loading emerged at the French study (Duracinsky et al. 2004). So, the item could express, in our sample and those others, an obvious truth, that fat accumulation on the neck is not a problem for them. However, the exclusion of this item would create a problem with model identification, and since these first 6 questions help to identify the symptoms of lipodistrophy, so they all matter and should be asked. So the decision

was to keep the factors on their original factor structure. Regarding discriminant validity, despite the low AVE for lipohypertophy, the shared variance was extremely low, not being able to correctly assume that the factors indeed evaluate different aspects of lipodistrophy. About internal consistency, values of KR-20 and composite reliability were shown to be, at least, acceptable. The present study advances the previous literature in using a specific internal consistency test for dichotomous items, the KR-20, instead of Cronbach's alpha, more adequate for polytomous scales (Tan 2009).

Item 7, which is the second part of the scale, evaluates body satisfaction, with higher scores meaning higher dissatisfaction (Neidig et al. 2002). Its score should be associated to the other two parts of the ABCD, in order to be considered a part of it. According to Hinkle et al.' (2003) pattern of interpretation for an association of attitudinal variables, our results showed positive and low correlation with lipoatrophy and lipohypertrophy, negative and moderate correlation with general impact factor, and low and negative correlation with HIV impact. These results showed that item 7 is, at least somewhat, coherent with parts 1 and 3. This was the first time that this evidence is being shown for the ABCD, suggesting that the conception of a three-part scale for the ABCD is theoretically sound in Brazil.

The positive correlation with lipodystrophy factors and negative correlation with body change distress factors is also meaningful since a positive association is expected between more symptoms of lipodystrophy and body dissatisfaction. On the other hand, higher body dissatisfaction is evident in more frequent body change distress experiences (Blashill and Vander Wal 2010). Also, as the association found here was moderate only for item 7 and general impact, and hence, more meaningful, we can point that the subjective experience is more evident for body dissatisfaction. A future study should investigate if body dissatisfaction (measured with a full measure) is a moderate factor between lipodystrophy and body change distress. Still in regard to the correlation among the factors, it is worth mentioning the absence of a significant correlation of the lipohypertrophy factor and the HIV impact factor. The loss of body fat on the face, arms, and legs constitute a social representation of HIV, marked by emaciation of the body, common until 1980, but still happening (Herek et al. 2013). This could explain why only this factor was not associated with HIV impact and moderately associated with general impact.

Our results showed a more parsimonious factor structure for the third part of the scale, body change distress. The internal reliability and construct validity for this new structural model was evidenced for convergent validity, but there is a lack of discriminant validity. Even with these results, the new theoretical model for the third part of the ABCD seems to be more adequate for our data, since the other two previous models showed problems with model identification. It is worth mentioning the elimination of items 8T, 8O, 8R, 8F, 8C, and 8Q. The cultural adaptation of the ABCD into the Brazilian Portuguese language was carried with rigor by Pessôa et al. (2017), following recommendations by Beaton et al. (2002). So, the elimination seems not to be caused by item bias nor originate on content deviation or lack of clarity of the items (Van de Vijver and Poortinga 2004). It may be a reflection of cultural differences among the source and target samples, indicating that in Brazil the living experience of having HIV/AIDs is different in the USA. This also may be a reflection of differences in AIDS/HIV treatment, which has a direct impact on body image, quality of life, and lipodystrophy.

As suggested by Sabin et al. (2008), Vance et al. (2010), and Gagnon and Holmes (2016), among others, the financial security of people living with HIV/AIDS may play a central role in treatment adherence, quality of life, and emotional balance. In Brazil, universal provision of ART has been guaranteed free of charge to eligible HIV-positive patients since 1996 (Luz et al. 2016). However, the program is still vulnerable, even being exemplary among low- and middle-income countries (Greco and Simao 2007). The differences in the level of financial security found here could be explained by the vulnerability of the program, since Brazilian patients are always faced with the possibility of lack of free medicines and medical assistance, making the identity integrity process during the course of treatment more challenging for those who are financially insecure.

The difference between males and females should be represented with care, since the first and third parts of ABCD are only weak non-invariants. Regarding gender, the results confirmed scientific literature, which describes women as more emotionally vulnerable to changes in appearance than men (Murnen and Don 2012). Finally, the weak and correlations among age and lipoatrophy, lipohypertrophy, and HIV must not lead us to interpret the elderly as less concerned with the impact of body change distress or watchful to lipodystrophy symptoms. In fact, we must not ignore that older persons also suffer with their appearance and changes along with loneliness, decreased social support, neurological changes, declining health, fatigue, and financial distress, which are all factors that contribute to depression and suicidal ideation in aging adults (Vance et al. 2008).

A number of limitations must also be highlighted. An important limitation is the fact that we were reliant on a scale developed for use, initially at least, in US English-speaking populations. Had we purposely designed items using standard-scale development procedures (Beaton et al. 2002), it is possible that we might have uncovered additional content related to body change distress related to lipodistrophy that is specific to Brazil.This is the first psychometric study of the ABCD in Brazilians, and it is limited to a non-probabilistic sample, so it does not represent the whole population. Future work with Brazilians and people from other cultures could offer a better understanding of body image in people living with HIV/AIDS. Other psychometric properties such as stability, time, predictive validity, and other evidence of construct validity—even following other statistical protocols from classical psychometrics theory such as the one proposed at the Standards for Educational and Psychological Testing or using the item-response theory approach—should be investigated in future research to generate more evidence of validity and reliability. For developing countries, creating a reduced version of the scale would be interesting to ensure interviews with illiterate and operationally literate persons. As a group of additional risk, financially underprivileged persons need specific actions to facilitate their process of identity reconstruction.

Despite the limitations, the ABCD is an important tool for research in the health area and can be used by Brazilian psychologists, physicians, nurses, physiotherapists, and other professionals who work with people living with HIV/AIDS. Brazil represents the largest number of people living with HIV in Latin America and accounts for 49% of all new infections in the region. In 2017, 48,000 people in Brazil were newly infected with HIV. The Brazilian government took the decision to make antiretroviral treatment universally available regardless of the CD4 count—providing dolutegravir, the most effective ARV available—and specialized care services (SAE) dedicated to reducing

the impact of HIV and its treatment, offering physiotherapy, speech therapy, nutritional counseling, plastic surgery, among other services (AVERT 2018). So, having an attitudinal measure towards HIV/AIDS and its consequences to measure and follow the rehabilitation results related to body image and quality of life will give Brazilian physicians and other health professionals an insight into the impact of the prescribed treatment on their patient's identity. In the global scenario, having Brazilian data for transcultural studies could provide researchers with evidence of the impact of different treatment programs.

Code Availability Not applicable.

Author Contribution KVOP: project design, data collection, manuscript writing, and discussion. JAC: manuscript revision and discussion. CAO: project design and data collection. WHM: project design, data collection, and manuscript revision. MHS: project design and data collection. MAM: project design and data collection. ANN: project design, data analysis, manuscript writing, and discussion.**Data Availability** Data may be asked directly from the last author.

Declarations

Ethics approval and consent to participate The research was approved by the Human Ethics Committee from Faculdade de Medicina do ABC\Fundação do ABC – FMABC. This approval can be seen here: http://plataformabrasil.saude.gov.br/login.jsf;jsessionid=7EF8B5D47A99891EBFAF3D6E12564BC4.server-plataformabrasil-srvjpdf131. All authors agree to participate and approved the text presented on the manuscript

Consent for Publication All authors agree to publish the manuscript, conditioned to its approval by the peer reviews and journal editors.

Conflict of Interest The authors declare no conflict of interest.

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