

# Association of Syndemic Conditions and Quality of Life among People Living with HIV/AIDS

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## Research Article

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## Abstract

# Background

The syndemics theory seeks to understand the effect of multiple synergic problems in promoting poor health outcomes. To disentangle which and how syndemic conditions affect quality of life (QoL) may be important to improve well-being of people living with HIV/AIDS (PLWHA). This study evaluates the association between syndemic conditions and quality of life among people living with HIV/AIDS.

## METHODS

This was a secondary analysis from data obtained between 2014 and 2017 among PLWHA under care in Rio de Janeiro, Brazil. The outcomes were the six QoL domains (physical, psychological, level of independence, social relationships, environmental, and spirituality) measured through the World Health Organization Quality of Life in HIV infection scale, abbreviated version (WHOQOL-HIV-BREF). The independent variables were demographic and clinical characteristics, syndemic conditions (binge drinking, compulsive sexual behavior, polysubstance use, intimate partner violence, and depression), and syndemics (two or more syndemic conditions simultaneously). Bivariate analysis (t-test and ANOVA) and linear regressions were performed for each quality-of-life domain.

## RESULTS

The analytical sample comprised 1530 participants, mostly male at birth (64%) and with median age of 43 years. The syndemic conditions most frequently observed were binge drinking (56%), IPV (13%), and depression (9%). Both individual syndemic conditions and syndemics were associated with worse QoL. In the multivariate analysis, positive screening for depression was associated with worse QoL in all domains. Polysubstance users presented worse QoL at social and environmental domains. Intimate partner violence was associated with worse QoL at environment domain while binge drinking was associated with worse scores in the physical domain. The presence of syndemics increased the likelihood of worse scores in the psychological, social, and environment domains.

## CONCLUSIONS

Our study expands the understanding of QoL in PLWHA, as it considers a holistic/integral, multifactorial, and synergistic approach to the determinants of QoL. Seeking strategies that target syndemics may be important to improve patient-centered outcomes in health.

## Introduction

The World Health Organization (WHO) defines quality of life (QoL) as “an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns”, a concept that involves physical and psychological well-being, personal beliefs, social relationships, and one's relationship with his or her environment[1]. In turn, health-related quality of life (HRQoL) is related to the physical and mental health of an individual or group, perceived over time, affected or not by a disease, disability, or disorder[2, 3]. From this perspective, it is recommended that the assessment of health include not only assessments of changes in the frequency and severity of diseases but also an estimate of well-being[4], i.e., the degree to which people enjoy the possibilities of their lives and are satisfied with life[5]. To evaluate HRQoL, there are generic questionnaires not related to a specific disease, such as WHOQOL-100 or WHOQOL-BREF, and specific questionnaires, such as the WHOQOL-HIV, which evaluates QoL in people living with HIV/AIDS (PLWHA)[6].

Different sociodemographic and psychosocial factors are related to worse QoL in PLWHA, such as advanced age[7–9], lower income[7], female sex[7–10], death anxiety[11], substance use problems[9, 12, 13], tobacco use[9], and depression[9, 12, 14]. In contrast, younger age, higher educational level[15], and early adherence to combined antiretroviral therapy (cART) have been associated with better QoL[16, 17].

The syndemics theory seeks to understand the effect of multiple synergic problems on the occurrence of worse health outcomes[18]. These problems can be biological, psychological, cultural, and environmental within the biopsychosocial concept of health[18, 19]. For example, environmental factors such as food insecurity, financial instability, low income, and housing instability may be related to non-retention in HIV care and failure to achieve viral suppression[20, 21]. Opportunistic diseases occur when individuals present reduced CD4<sup>+</sup> T cell counts and may decrease QoL[22]. Regarding behavioral factors, the use of alcohol and noninjectable drugs may decrease retention in care[23]. Psychosocial problems that are described as syndemic conditions include alcohol use[24–27], polysubstance use[24–28], smoking[26], use of stimulants[25, 29], compulsive sexual behavior (CSB)[24, 29], psychiatric disorders[24–29], stress[26, 29], intimate partner violence (IPV)[24, 27, 29] childhood sexual abuse[25], and poverty[28]. Their simultaneous occurrence in a given population has been associated with greater risk of HIV infection[25], lower adherence to care and to cART[27], and lack of viral suppression[27].

To our knowledge, this is the first study evaluating the effect of syndemics on QoL. The main hypothesis of the study is that individuals presenting multiple syndemic conditions would have worse QoL. Thus, the main objective of the present study is to evaluate the association between the presence of syndemics and QoL among PLWHA.

## Methods

### Study design

A secondary analysis of the data collected in the project "Quality of life in a cohort of people living with HIV/AIDS" was performed[9, 30]. Briefly, the project was a cross-sectional study conducted between 2014 and 2017. It included a convenience sample (n = 1588) of adults under care for HIV at the Evandro Chagas National Institute of Infectious Diseases, Oswaldo Cruz Foundation, Rio de Janeiro, Brazil.

### Outcomes

QoL was assessed using the WHOQOL-HIV-BREF[31, 32]. Developed by the WHO, this scale is widely used[1] and validated for use in Brazil[33, 34]. The WHOQOL-HIV-BREF has 31 questions with response options ranging from 1 to 5 (Likert scale) and divided into six domains: physical, psychological, level of independence, social relationships, environment, and spirituality/religion/personal beliefs[31]. The score for each domain is calculated according to the formulas provided by the WHO[35] and ranges from 0 to 20. The higher the score, the better the QoL. In the present analysis, each WHOQOL-HIV-BREF domain was considered an outcome.

### Independent variables and respective measurement criteria

Demographic characteristics included age group (dichotomized around the median age of the sample: 43 years), sex, race, educational level, and marital status (living with a partner or not). Transmission routes were categorized as homosexual, heterosexual and other (injectable drug use, blood transfusion, and other/non-specified). Self-rated health (SRH) was assessed according to the National Health Survey (5-point Likert scale ranging from very poor to very good)[36]. The clinical variables included the self-reported HIV stage (asymptomatic or symptomatic/AIDS), viral load (VL) (dichotomized into undetectable (less than or equal to 50 copies per ml) and detectable[37]), and CD4<sup>+</sup> T cell count (CD4) (categorized into 200 cells per mm<sup>3</sup>, 200–500 cells per mm<sup>3</sup>, and greater than or equal to 500 cells per mm<sup>3</sup>[37]). The VL and CD4 closest to the project interview were used within a  $\pm$  365 days window. If there was no VL or CD4 within this window, we considered the data missing, and excluded those individuals from the analysis.

Binge drinking, CSB, polysubstance use, IPV, and positive screening for depression were considered syndemic conditions. Binge drinking (consumption of four doses of alcohol by women or five doses by men within approximately 2 hours) was measured according to the National Institute on Alcohol Abuse and Alcoholism (NIAAA)[38]. CSB was measured using the Sexual Compulsivity Scale[39, 40], which has been validated in Brazil[41] and whose positive cutoff point was set at 24. Polysubstance use was assessed using the Alcohol, Smoking and Substance Involvement Screening Test developed by the World Health Organization (WHO-ASSIST)[42, 43]. The use of two or more substances was considered polysubstance use. IPV was considered present when the answer was positive to one of the following questions: Has a sexual partner tried to or physically hurt you? and Has a partner used physical force or verbal threats to force sexual relations? Screening for depression was considered positive with a score greater than or equal to 3 on the Patient Health Questionnaire-2 (PHQ-2)[44].

Each of the above conditions was given a score of 0 (absent) or 1 (present), and the values were added to indicate the number of syndemic conditions presented by each individual. The subjects were then dichotomized into individuals with zero or one vs. two or more syndemic conditions, and the latter were considered the syndemic group.

### Statistical analysis

The scores of each WHOQOL-HIV-BREF domain were summarized using the mean and standard deviation and compared between the categories of each of the independent variables using Student's t-test for independent samples or ANOVA.

For each outcome (domain), two linear regressions were performed. The first included each of the syndemic conditions individually (binge drinking, CSB, polysubstance use, IPV, and depression). The second contained the dichotomized syndemic variable and the variables that, given their P-value < 0.2 in the bivariate analysis, were included as possible confounding factors. Before this, the presence of multicollinearity was tested by inspecting the correlation coefficients and tolerance values (variance inflation factor). For each model, the goodness of fit was measured by the F test of global significance, the R<sup>2</sup>, the independence of the residuals (Durbin-Watson test), and graphical analysis of the residuals. The data were analyzed with SPSS Statistics version 19.

## Results

Of the 1588 individuals interviewed, 58 were excluded because they had no VL or CD4 measured within 365 days from the date of the interview. Thus, analytical sample included 1530 participants.

Being male was associated with higher WHOQOL-HIV-BREF scores (i.e., better QoL) in all domains except the spiritual domain. The following variables were associated with higher scores in the psychological, social, and environment domains: homosexual transmission and "other" transmission routes, age up to 43 years, and educational level of secondary and up. Individuals who lived with a partner had higher scores in the independence, social, and environment domains. Good and very good SRH were associated with higher scores in all domains (all p < 0.001), as well as the asymptomatic stage (does not apply to the physical domain). Regarding the clinical variables, undetectable VL was associated with higher QoL scores in the psychological, independence, social, and environment domains. CD4 < 200 was associated with higher scores in the physical domain and lower scores in the spiritual domain.

Of the syndemic variables, depression was associated with lower scores (i.e., worse QoL) in all domains, with the exception of the spiritual domain, which showed the opposite pattern. Binge drinking and CSB were associated with lower QoL scores in the physical domain. Polysubstance use and IPV were associated with lower scores in the psychological, social, and environment domains. The presence of syndemics (two or more syndemic conditions simultaneously) was associated with worse QoL scores in the psychological, social, environment, and independence domains (Table 1).

Table 1  
WHOQOL-HIV-BREF domains by sample characteristics and associated syndemic conditions. N = 1530 people living with HIV/AIDS seen at Evandro Chagas National Institute of Infectious Diseases from 2014–2017.

Variables	Total N (%) <sup>a</sup>	Physical Mean (SD)	Psychological Mean (SD)	Level of independence Mean (SD)	Social relationships Mean (SD)	Environment Mean (SD)	Spirituality/Religion/Personal Beliefs Mean (SD)
<b>DEMOGRAPHIC AND CLINICAL CHARACTERISTICS</b>							
<b>Sex</b>							
Male	985(64.4)	12.0(2.5)*	15.1(2.2)***	15.5(2.6)*	17.0(2.9)***	16.4(2.7)***	9.8(2.9)***
Female	545(35.6)	11.6(2.7)*	14.5(2.6)***	15.2(2.7)*	16.2(3.0)***	15.6(2.9)***	10.4(3.1)***
<b>Form of transmission</b>							
Other	112(7.4)	11.9(2.8)	15.1(2.2)***	15.4(2.3)	16.9 (2.9)**	16.4(2.8)***	10.1(2.8)
Heterosexual	841(55.6)	11.9(2.6)	14.7(2.4)***	15.3(2.6)	16.5(3.0)**	15.9(2.9)***	10.0(3.0)
Homosexual	560(37.0)	11.6(2.5)	15.2(2.2)***	15.5(2.3)	17.0(2.8)**	16.5(2.6)***	9.9(2.9)
<b>Age</b>							
< 43 years	752(49.2)	11.7(2.5)	15.2(2.3)***	15.5(2.4)	17.0(2.9)***	16.4(2.8)**	10.2(3.1)*
≥ 43 years	777(50.8)	12.0(2.7)	14.7(2.4)***	15.3(2.7)	16.4(3.0)***	16.0(2.8)**	9.8(2.8)*
<b>Race</b>							
White	716(46.8)	11.8(2.6)	15.0(2.3)	15.4(2.5)	16.7(2.9)	16.3(2.7)	9.9(2.8)
Mixed/Other	548(35.8)	11.6(2.5)	14.8(2.4)	15.3(2.5)	16.6(2.9)	16.0(2.8)	10.1(3.1)
Black	265(17.3)	12.0(2.5)	14.9(2.4)	15.5(2.6)	16.7(3.0)	16.0(2.9)	10.0(3.0)
<b>Education</b>							
≥Secondary	1016(66.4)	11.8(2.5)	15.2(2.1)***	15.6(2.3)***	17.1(2.7)***	16.6(2.5)***	10.0(2.9)
<Secondary	514(33.6)	11.9(2.8)	14.4(2.7)***	14.9(2.8)***	16.0(3.2)***	15.2(3.0)***	10.1(3.1)
<b>Do you live with a partner?</b>							
Yes	552(36.1)	11.9(2.7)	15.0(2.3)	15.7(2.6)**	17.3(2.8)***	16.4(2.8)**	10.1(3.0)
No	978(63.9)	11.8(2.5)	14.9(2.4)	15.2(2.5)**	16.4(3.0)***	16.0(2.8)**	10.0(3.0)
<b>How is your health?</b>							
Good/very good	1243(81.45)	12.0(2.5)***	15.4(2.0)***	15.8(2.1)***	17.2(2.5)***	16.7(2.5)***	9.9(2.8)***
Very poor/poor/neither poor nor good	283(18.55)	11.4(2.8)***	13.0(2.9)***	13.6(3.2)***	14.5(3.7)***	13.9(3.0)***	10.7(3.5)***
<b>HIV stage</b>							
Asymptomatic	1477(97.2)	11.9(2.6)	15.0(2.3)***	15.4(2.5)***	16.8(2.9)***	16.2(2.7)***	10.0(3.0)*
Symptomatic/AIDS	43(2.8)	11.6(2.4)	12.5(3.2)***	13.1(2.9)***	13.5(4.4)***	13.3(3.4)***	11.2(2.9)*
<b>Viral load</b>							
Undetectable	1222(79.9)	11.9(2.6)	15.1(2.2)***	15.5(2.4)**	16.9(2.8)***	16.4(2.7)***	10.0(2.9)
Detectable	308(20.1)	11.8(2.6)	14.4(2.8)***	14.9(2.9)***	15.8(3.4)***	15.3(3.2)***	10.2(3.1)
<b>TCD4 lymphocyte count</b>							
≥ 500	118(7.65)	11.2(1.9)***	15.1(2.3)	15.7(2.6)	16.9(2.3)	16.3(2.8)*	11.0(3.1)**
200–500	601(39.31)	11.5(2.4)***	15.0(2.3)	15.5(2.4)	16.8(2.8)	16.3(2.6)*	10.0(3.0)**

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001 (t-test for independent variables or ANOVA). <sup>a</sup>Some variables do not assume values among the 1530 PLWHA due to lack of data; <sup>1</sup>Sexual Compulsivity Scale; <sup>2</sup>victim of physical or sexual violence; <sup>3</sup>categorized PHQ-2 score.

Variables	Total N (%) <sup>a</sup>	Physical Mean (SD)	Psychological Mean (SD)	Level of independence Mean (SD)	Social relationships Mean (SD)	Environment Mean (SD)	Spirituality/Religion/Personal Beliefs Mean (SD)
< 200	811(53.04)	12.2(2.7)***	14.8(2.4)	15.3(2.6)	16.6(3.2)	16.0(2.9)*	9.9(2.9)**
<b>SYNDEMIC CONDITIONS AND SYNDEMICS</b>							
<b>Binge drinking</b>							
No	664(43.7)	12.0(2.6)*	14.9(2.5)	15.3(2.7)	16.7(3.0)	16.3(2.9)	10.0(2.9)
Yes	856(56.3)	11.7(2.6)*	14.9(2.3)	15.5(2.4)	16.7(2.9)	16.1(2.8)	10.1(3.0)
<b>Compulsive sexual behavior<sup>1</sup></b>							
< 24	1505(98.4)	11.9(2.6)*	14.9(2.4)	15.4(2.5)	16.7(2.9)	16.1(2.8)	10.0(2.9)**
≥ 24	25(1.6)	10.7(3.2)*	14.5(2.2)	14.8(2.7)	15.9(3.8)	15.1(2.9)	11.9(3.6)**
<b>Polysubstance use</b>							
< 2 substances	1494(97.65)	11.8(2.6)	14.9(2.4)*	15.4(2.5)	16.8(2.9)***	16.2(2.8)***	10.0(3.0)
≥ 2	36(2.35)	12.1(2.9)	14.1(2.6)*	14.6(3.2)	14.7(3.8)***	14.6(3.5)***	10.1(3.2)
<b>Intimate partner violence<sup>2</sup></b>							
No	1333(87.1)	11.9(2.5)	15.0(2.3)**	15.4(2.5)	16.8(2.9)*	16.3(2.8)***	9.9(2.9)***
Yes	197(12.9)	11.8(3.0)	14.4(2.5)**	15.3(2.7)	16.2(3.2)*	15.2(2.9)***	10.6(3.3)***
<b>Depression<sup>3</sup></b>							
< 3	1390(91.2)	11.9(2.5)**	15.1(2.2)***	15.5(2.4)***	16.9(2.8)***	16.3(2.7)***	9.9(2.9)***
≥ 3	134(8.8)	11.2(3.4)**	13.6(3.0)***	14.4(3.2)***	15.1(3.9)***	14.3(3.2)***	11.0(3.4)***
<b>Syndemic score</b>							
0	562(36.2)	12.0 (2.5)**	15.1(2.3)***	15.4(2.5)	16.8(3.0)***	16.5(2.7)***	9.8(2.8)***
1	706(46.8)	11.7(2.4)**	15.0(2.2)***	15.5(2.3)	16.9(2.6)***	16.2(2.7)***	9.9(2.9)***
2	195(12.9)	11.9(3.0)**	14.4(2.5)***	15.1(2.8)	16.0(3.4)***	15.2(2.9)***	10.8(3.2)***
3	40(2.6)	10.7(3.3)**	14.2(2.5)***	15.0(3.1)	15.6(3.5)***	14.5(2.9)***	10.4(3.4)***
4	6(0.4)	10.7(4.0)**	12.9(3.7)***	14.7(1.6)	12.2(6.0)***	13.9(3.7)***	11.3(3.9)***
5	0(0.0)	.	.	.	.	.	.
<b>Syndemic category</b>							
< 2 associated syndemics	1268(82.9)	11.8(2.5)	15.1(2.3)***	15.5(2.4)*	16.9(2.8)***	16.4(2.7)***	9.9(2.9)***
≥ 2 associated syndemics	241(15.9)	11.7(3.1)	14.3(2.6)***	15.0(2.9)*	15.8(3.6)***	15.0(3.0)***	10.8(3.3)***
*p < 0.05, **p < 0.01, ***p < 0.001 (t-test for independent variables or ANOVA). <sup>a</sup> Some variables do not assume values among the 1530 PLWHA due to lack of data; <sup>1</sup> Sexual Compulsivity Scale; <sup>2</sup> victim of physical or sexual violence; <sup>3</sup> categorized PHQ-2 score.							

The results of the fitted linear regressions that included the syndemic conditions separately are shown in Table 2. Binge drinking was associated with worse QoL in the physical domain; polysubstance use with worse scores in the social relationship and environment domains; IPV with worse scores in the environment domain; and depression with worse scores in all domains except the spiritual domain.

Table 2

Associations between syndemic conditions and WHOQOL-HIV-BREF domains evaluated by linear regression. N = 1530 people living with HIV/AIDS seen at Evandro Chagas National Institute of Infectious Diseases from 2014–2017.

Variables	Physical B (SE)	Psychological B (SE)	Level of independence B (SE)	Social relationships B (SE)	Environment B (SE)	Spirituality/Religion/Personal Beliefs B (SE)
<b>DEMOGRAPHIC AND CLINICAL CHARACTERISTICS</b>						
Female sex	-0.612 (0.169)***	-0.325 (0.119)**	-	-0.514 (0.149)**	-0.484 (0.138)***	0.582 (0.160)***
Form of transmission: Heterosexual or Other	0.533 (0.168)**	-	-	-	-	-
Age ≥ 43 years	-	-0.354 (0.113) **	-	-0.441 (0.141)**	-	-0.461 (0.152)**
Education ≥ secondary	-	0.320 (0.123)**	0.391 (0.132)**	0.442 (0.153) **	0.996 (0.140) ***	-
Does not live with partner	-	-	-0.423 (0.127)**	-0.790 (0.143)***	-0.390 (0.132)**	-
Rated health as neither poor nor good to very poor	-	-1.960 (0.151)***	-1.889 (0.166)***	-2.124 (0.190)***	-2.144 (0.173) ***	0.521 (0.204)**
Symptomatic HIV stage	-	-1.475 (0.340)***	-1.265 (0.374)**	-1.947 (0.426)***	-1.648 (0.390)***	0.950 (0.462)*
Detectable viral load	-	-	-	-0.366 (0,179)*	-	-
TCD4 lymphocyte count < 200	0.789 (0.134)***	-	-	-	-	-
<b>SYNDEMIC CONDITIONS</b>						
Binge drinking present	-0.358 (0.135)**	-	-	-	-	-
Compulsive sexual behavior ≥ 24	-	-	-	-	-	1.725 (0.608)**
Polysubstance use ≥ 2	-	-	-	-1.719 (0.463)***	-1.108 (0.427)*	-
Intimate partner violence present	-	-	-	-	-0.529 (0.192)**	-
Depression present ≥ 3	-0.505 (0.237)*	-0.801 (0.200)***	-0.453 (0.220)*	-1.007 (0.249)***	-1.109 (0.231)***	0.790 (0.274)**
Constant	12.853 (0.298)***	19.253 (0.521)***	19.012 (0.521)***	23.366 (0.685)***	20.233 (0.596)***	8.241 (0.570)***
Adjusted R <sup>2</sup>	0.047	0.184	0.131	0.202	0.230	0.038
*p < 0.05; **p < 0.01; ***p < 0.001						

The presence of syndemics was associated with worse QoL in the psychological, social relationship, and environment domains and better QoL in the spirituality domain (Table 3).

Table 3

Associations between syndemics and WHOQOL-HIV-BREF domains evaluated by linear regression. N = 1530 people living with HIV/AIDS see at Evandro Chagas National Institute of Infectious Diseases from 2014–2017.

Variables	Physical B (SE)	Psychological B (SE)	Level of independence B (SE)	Social relationships B (SE)	Environment B (SE)	Spirituality/Religion/Personal Beliefs B (SE)
<b>DEMOGRAPHIC AND CLINICAL CHARACTERISTICS</b>						
Female sex	-0.564 (0.278) **	-0.347 (0.120) **	-	-0.493 (0.150) **	-0.512 (0.138) ***	0.567 (0.159) ***
Form of transmission: Heterosexual or Other	0.547 (0.135) **	-	-	-	-	-
Age ≥ 43 years	-	-0.361 (0.114) *	-	-0.403 (0.142) **	-	-0.444 (0.152) **
Education ≥ secondary	-	0.313 (0.124) *	0.383 (0.132) **	0.415 (0.155) **	0.985 (0.141) ***	-
Does not live with partner	-	-	-0.411 (0.128) **	-0.816 (0.145) ***	-0.393 (0.134) **	-
Rated health as neither poor nor good to very poor	-0.645 (0.174) ***	-1.985 (0.150) ***	-1.921 (0.165) ***	-2.252 (0.190) ***	-2.292 (0.173) ***	0.681 (0.197) **
Symptomatic HIV stage	-	-1.481 (0.341) ***	-1.305 (0.375) **	-1.891 (0.429) ***	-1.592 (0.392) ***	-
Detectable viral load	-	-	-	-0.365 (0.181) *	-	-
CD4 T lymphocyte count < 200	0.785 (0.135) ***	-	-	-	-	-
<b>SYNDEMICS</b>						
Syndemic category ≥ 2	-0.062 (0.182)	-0.462 (0.154) **	-0.087 (0.169)	-0.790 (0.192) ***	-0.915 (0.177) ***	0.762 (0.208) ***
Constant	12.622 (0.278) ***	19.391 (0.524) ***	19.070 (0.522) ***	23.461 (0.691) ***	20.364 (0.601) ***	9.001 (0.364) ***
Adjusted R <sup>2</sup>	0.043	0.178	0.124	0.195	0.224	0.034
*p < 0.05; **p < 0.01; ***p < 0.001						

## Discussion

In this cross-sectional study that evaluated QoL and syndemics among 1530 PLWHA under treatment, the syndemic conditions most frequently observed were binge drinking (56%), IPV (13%), and depression (9%). According to our hypothesis, both individual syndemic conditions and syndemics were associated with worse QoL. Positive screening for depression was associated with worse scores in all domains; polysubstance use, IPV, and binge drinking were associated with worse scores in specific domains. The presence of syndemics led to worse scores in the psychological, social, and environment domains.

When considering the syndemic conditions separately, the environment domain was the most affected, and worse QoL in this domain was reported among individuals experiencing IPV, multiple-drug use, and depression. The environmental domain includes questions about safety, physical environment, financial resources, and opportunities for acquiring new information and skills. In previous studies conducted in Brazil, this domain was also one of the most affected [45–48]. Some authors explain that these low scores (in the environmental domain) are influenced by socioeconomic factors, low income, and less education [45, 46]. A study in Burkina Faso, a country in which 46.5% of people live below the poverty line, found the lowest scores in the environment domain [49], and the same was found in Ethiopia [50, 51]. In addition, another study showed that half of the PLWHA experienced income reduction after an HIV diagnosis, which was associated with lower QoL in this domain [52]. In the present multivariate analysis, not living with a partner was associated with worse QoL in the environment domain, which may be related to lower financial resources and security than when sharing a family income. Conversely, a secondary education or above was associated with better QoL, which may be related with better occupations and employability [53, 54].

Polysubstance use and depression were negatively associated with the score on the social relationship domain, which includes questions about social inclusion, personal relationships, sexual activity, and social support. In the present study, not living with a partner, age 43 or older, and symptomatic disease stage were also associated. This findings may be associated with situations of stigma and discrimination faced by PLWHA[52, 55, 56]. Furthermore, loneliness and lack of support from relatives were associated with a lower global QoL score in the study conducted in Burkina Faso[49]. Older age has also been associated with fewer social interactions and a smaller social network[57]. Feeling alone, social stigma and being discriminated against are associated with depression and substance abuse[52]. Family counseling[52] and the strengthening of the social support network[56] may be important strategies to improve the care of these patients.

The psychological domain covers negative and positive feelings, concentration, self-esteem, and self-image. The presence of depression was the only syndemic condition associated with worse QoL in this domain, being the domain that best negatively correlates with the Beck Depression Inventory[34, 58]. In a study conducted in Sweden, a country with one of the best HIV treatment outcomes, hopelessness, a component associated with depression, negative self-image and social stigma were associated with lower QoL[59]. Although HIV symptoms are decreased by cART, stigma, discrimination and uncertainties remain, affecting PLWHA psychologically[60]. In addition, depression, anxiety, and other psychological factors are associated with adherence to HIV treatment[14], so providing adequate screening and treatment for these patients might improve their QoL.

Level of independence covers questions on activities of daily living, mobility, dependence on medication, and work capacity. Brazilian studies have associated the level of independence with the side effects of treatment and the presence of opportunistic diseases[45, 46, 61]. Our results did not show association of the level of independence with any syndemic condition or syndemics. It is possible that this domain more closely represents problems related to physical comorbidities, since individuals reporting a symptomatic AIDS stage or worse SRH presented lower scores in this domain. It is noteworthy that SRH and the symptomatic stage of AIDS are associated with mortality[36, 62], which may indicate that the level of independence QoL is a sensitive domain to severe disease.

Many studies have found similar associations with demographic characteristics with the ones found in the present analysis. Female sex and advanced age have been widely associated with lower QoL[7–9]. Regarding advanced age, this association may be mediated by multiple comorbidities (and polypharmacy), physiological frailty, and cognitive dysfunction that are common in this population group[63]. In contrast, a secondary education or above was associated with better QoL. In a previous study, this level of schooling reduced syndemic effects on HIV prevalence, making it a resilience factor[64]. It can be inferred, as indicated by other studies, that interventions to improve education could improve the QoL of PLWHA[65].

The limitations of this study include the non-probabilistic nature of the sample, which prevents the generalization of data to other populations of PLWHA. Some participants were excluded because they did not have VL or CD4 information near enough to the date of the interview, and there is a strong possibility that this lack of tests is not random. However, a small proportion of participants were in this situation, mitigating any selection bias. Given the cross-sectional design, it is not possible to infer causality, and it is not possible to discard reverse causality. For example, worse QoL in the environment domain could be the cause of depression and not the reverse. Although we used validated instruments, the data are self-reported, and there may have been measurement and social desirability biases. Lastly, the instruments that evaluate mental health are only screening tools, and a more detailed evaluation would be necessary to diagnose psychiatric disorders. This limitation may have led us to overestimate the prevalence of depression and substance abuse in this sample.

Despite these limitations, there is evidence that a better QoL may influence patient adherence to care and thus viral suppression achievement [66, 67], which are necessary conditions for survival among PLWHA. Our results show that syndemic conditions mostly relate to psychological, social, and environment domains of QoL. This is an important regarding patient -centered outcomes and should be considered when designing health care and public health interventions targeting PLWHA.

## Abbreviations

Human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS)

World Health Organization (WHO)

Quality of life (QoL)

Health-related quality of life (HRQoL)

People living with HIV/AIDS (PLWHA)

Combined antiretroviral therapy (cART)

Intimate partner violence (IPV)

Evandro Chagas National Institute of Infectious Diseases, Oswaldo Cruz Foundation (INI/FIOCRUZ)

Self-rated health (SRH)

Viral load (VL)

CD4 cell count (CD4)

National Institute on Alcohol Abuse and Alcoholism (NIAAA)

Compulsive sexual behavior (CSB)

Alcohol, Smoking and Substance Involvement Screening Test developed by the World Health Organization (WHO-ASSIST)

Patient Health Questionnaire-2 (PHQ-2)

## Declarations

### *Ethical aspects and consent to participate in the study*

The project was approved by the Research Ethics Committee of Evandro Chagas National Institute of Infectious Diseases, Oswaldo Cruz Foundation (INI/FIOCRUZ) (CAAE 17844113.2.0000.5262). All participants were explained about the study verbally, read and signed an informed consent form before answering the research questionnaire. The procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

### *Consent for publication*

Not applicable.

### *Availability of data and materials*

Raw data in the format of .csv file may be obtained with Dr. Castro upon reasonable request.

### *Competing interests*

The authors declare that there are no conflicts of interest.

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### *Authors' contributions*

MOG and RBDB conceived the study. MOG analyzed the data and wrote the first draft. JCM, RC and RBDB supervised data analysis. All authors contributed providing important intellectual content and approved the final version of the manuscript.

### *Recognition*

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