

Amplified HIV Transmission Risk Among People Living With HIV in Southeast Brazil

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Abstract

This study investigated the factors associated with amplified HIV transmission risk among people living with HIV from a city in southeast Brazil. A cross-sectional study was conducted with 397 people living with HIV recruited in infectious diseases clinics. Data on risk of HIV transmission, sociodemographic characteristics, sexual behaviors, professional counseling, serological HIV status, HIV-related clinical data, and beliefs about risk of HIV transmission were collected through interviews and medical records. Hierarchical ordered multinomial regression analyses were performed. Amplified HIV risk transmission was associated with lower age, alcohol consumption before having sex, illicit drug use before sexual intercourse, and not receiving professional counseling about HIV transmission. The belief that HIV can be transmitted to a partner not living with HIV was associated with lower likelihood of amplified risk for HIV transmission. Our findings suggest the importance of minimizing substance use before having sex, professional counseling, and beliefs about HIV transmission on amplified HIV risk transmission.

Key words: HIV, sexual behavior, health risk behaviors, HIV prevention, HIV seropositivity

According to the Joint United Nations Program on HIV/AIDS (UNAIDS), sexual transmission remains the primary route of HIV transmission, accounting for 70% of new cases of people living with HIV in 2021. In 2021, 1.5 million people have been infected with HIV worldwide (UNAIDS, 2022).

The risk of HIV infection is directly related to the HIV plasma viral load of people living with HIV (LeMessurier et al., 2018). Evidence demonstrates that HIV transmission is very low among people living with HIV taking antiretroviral therapy (ART) and with

undetectable plasma viral load for at least 6 months (Bavinton et al., 2019; Rodger et al., 2016).

People living with HIV taking ART experience low levels of virus circulation, which eventually interrupts the chain of HIV transmission. Consequently, offering ART to people living with HIV is a primary strategy to prevent HIV transmission (Montaner et al., 2014; The Lancet HIV, 2017). The early use of ART among people living with HIV regardless of their CD4 levels has been recommended by the World Health Organization and more than 750 other organizations across the globe (Centers for Disease Control and Prevention [CDC], 2018).

The occurrence of other sexually transmitted infections (STIs; Cohen et al., 2019), suboptimal treatment adherence (Getachew et al., 2020), HIV viral resistance to therapy, and stage of HIV infection (Getachew et al., 2020; Melo et al., 2019) are some of the factors that can influence HIV viral load detection in plasma or in genital secretions despite the effectiveness of ART. For instance, untreated STIs may enhance the risk of HIV transmission due to the local inflammatory process of ulcerative lesions, increasing cellular expression of the main HIV-1 entry receptors (Bertram et al., 2019; Gray et al., 2020; Politch et al., 2014). This process interferes with the suppressive effect of antiretrovirals (Baggaley et al., 2010; Fiscus et al., 2013), resulting in the increase of HIV replication in the genital tract (Mayer & Venkatesh, 2011; Williams-Wietzikoski et al., 2019) even when plasmatic viral load is suppressed (Fiscus et al., 2013; Melo et al.,

Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

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<https://dx.doi.org/10.1097/JNC.0000000000000421>

2019; Ouedraogo et al., 2006). Consequently, diagnosis of STIs among people living with HIV has been associated with a higher risk of HIV transmission (Fiscus et al., 2013; Gray et al., 2020; Melo et al., 2019).

Consistent condom use has been acknowledged as a relevant HIV prevention strategy, mainly among serodiscordant couples whose partner living with HIV has unsuppressed viral load (Davari et al., 2020; LeMessurier et al., 2018) or another untreated STI (Fiscus et al., 2013; Melo et al., 2019). Nevertheless, regular condom use remains challenging, despite the robust evidence of its effectiveness against STIs, including HIV infection (Analogbei et al., 2020).

People living with HIV taking ART who have an unsuppressed viral load, regular condomless intercourse, or present co-occurrence of other STIs are at greater risk of transmitting HIV. Successful HIV prevention strategies, such as treatment as prevention (TasP), require the early identification of individuals who are more likely to transmit HIV, including those with amplified HIV transmission risk (Magidson et al., 2016).

Previous studies have shown relevant variations in the frequency of people living with HIV with amplified HIV transmission risk due to use of different definitions of risk (Horvath et al., 2020). Moreover, few studies have considered the characteristics associated with condomless anal and/or vaginal intercourse with partners with a detectable HIV viral load or with sexually transmitted co-infections, defined throughout as “amplified HIV transmission risk” (Magidson et al., 2016). The aim of this study was to investigate the relationship of sociodemographic characteristics, sexual behaviors, professional counseling, serological HIV status, HIV-related clinical data, and beliefs about risk of HIV transmission with amplified risk of HIV transmission among people living with HIV from a city in southeast Brazil.

Methods

This was a cross-sectional study carried out in health care referral units for treatment of infectious diseases in a city in southeast Brazil. The method of this study was described previously (Antonini et al., 2021; Sousa et al., 2021).

Sample Size Calculation

The sample size of the study was initially calculated to estimate the prevalence of people with active sex life living with HIV in the city ($n = 10,000$), considering an

expected prevalence of 62% (Antonini et al., 2021; Sousa et al., 2021). A prevalence study with a precision estimate of 0.05 and 95% confidence interval (CI) would result in a sample size of 339 participants. The sample was increased to 397 due to a nonresponse rate of 17%. Of them, 97 were excluded due to missing clinical data. The final sample of 300 participants would lend a power of 85% to detect statistically significant effect sizes of at least 0.05 for a multiple regression model with six predictors and 5% level of significance.

Recruitment and Data Collection

People living with HIV were recruited in five referral health care units for prevention and treatment of infectious diseases from May 2016 to May 2017. Included participants were those aged 18 years or older, under clinical outpatient follow-up, who had an active sex life and had a sexual partner in the last 6 months regardless of their partners' HIV status. After signing a written consent, participants responded a standardized questionnaire through face-to-face interviews in private rooms at the health care units conducted by trained nurses.

The questionnaire was developed by the researchers and was evaluated by five health care workers with expertise in HIV infection. After that, some changes were made after the experts' suggestions. The final version of the questionnaire was composed of 64 items. Of these, 24 items were used in this study, which are presented as Supplemental Digital Content 1 (Supplementary File 1, <http://links.lww.com/JNC/A41>). Information on amplified risk of HIV transmission, sociodemographic characteristics, sexual behaviors, use of professional counseling, serological HIV status, HIV-related clinical data, and beliefs about risk of HIV transmission were self-reported. Laboratory and clinical data were confirmed using patient's medical records.

Measures

Outcome. Amplified risk of HIV transmission was the outcome variable, which was composed of the following four measures reported in the past 12 months: (a) detectable HIV viral load, (b) condomless sex, (c) symptoms of STIs, and (d) diagnosis of STIs (Magidson et al., 2016). Detectable HIV viral load information was collected from the medical records (0 = undetectable [HIV RNA plasmatic viral load ≤ 40 copies/ml], 1 = detectable [HIV RNA > 40 copies/ml]). Condom use (0 = yes, 1 = no), symptoms of STIs (e.g., discharge, warts, blisters, and genital ulcers; 0 = no, 1 = yes), and if they have been diagnosed

with any STIs during the past 12 months were recorded (0 = no, 1 = yes). Amplified risk of HIV transmission was measured considering the number of risk factors according to the following groups: 0, 1, 2, and 3–4.

Sociodemographic characteristics. Demographic and socioeconomic characteristics were age, sex (female or male), skin color (white, yellow/indigenous, brown, black), years of schooling (≤ 11 or > 11 years), and employment status (employed, unemployed, housewife, or retired).

Sexual behaviors. Sexual behaviors in the past 6 months assessed sexual orientation (heterosexual women, heterosexual men, or men who have sex with men), number of sexual partners (one or multiple), and type of sexual partners (stable, casual, or both). Participants were asked whether they have used alcohol (no or yes) or illicit drugs (no or yes) before having sex in the last 6 months.

Professional counseling. Receiving counseling about HIV sexual transmission from health professionals was also collected (no or yes).

Serological HIV status. Information regarding disclosure of HIV status to their partners (yes or no), whether the partner has ever tested for HIV (yes or no/do not know), and partner's serological HIV status (negative/unknown or positive) was also collected.

HIV-related clinical data. Clinical data collected were time since HIV diagnosis (< 5 or ≥ 5 years) and use of ART (no or yes).

Beliefs about risk of HIV transmission. Participants' health beliefs on the transmission of HIV were assessed using the following questions: "Do you think there is a risk of transmitting HIV to his/her partner if a person is under ART and with undetectable viral load?," "Does low viral load decrease the risk of HIV transmission?," "Do use and adherence to ART reduce the risk of HIV transmission?," "Does having genital ulcer increase the risk of HIV transmission?," "Does a person living with HIV transmit HIV to a partner who does not live with HIV?." The items of infectiousness beliefs were adapted from previous research (Kalichman et al., 2010). The response options were agree, disagree, or I do not know.

Data Analysis

All variables were computed for each participant and then according to amplified risk of HIV transmission groups. The distribution of continuous and categorical variables was presented through M (SDs) and frequencies, respectively, for the total sample and according to amplified HIV transmission risk groups.

Hierarchical ordered multinomial logistic was used to test the association between independent variables and amplified risk of HIV transmission. The latter was a four-level ordinal variable, namely 0, 1, 2, and 3–4. Ordered *logit* models were used to estimate the cumulative distribution of probabilities of the response category. The reference group was "0." Coefficients estimated on the statistical models indicated likelihood of moving into a higher category of amplified risk of HIV transmission. Variables that presented $p < .20$ in the unadjusted analysis were considered for hierarchical multivariate analysis for adjustments. The stepwise forward selection of predictors in different blocks was used in accordance with the theoretical model hypothesizing the relationship between variables (Figure 1). The results are presented as odds ratios (ORs) with 95% CIs. Five models were tested. The association between sociodemographic characteristics and amplified risk of HIV transmission was tested in Model 1. Sexual behaviors and professional counseling were inserted in Model 2, sequentially, serological HIV status and HIV-related clinical data in Model 3, and HIV transmission beliefs in Model 4. The significance of additional variables was tested in each model. Non-significant variables ($p > .05$) were removed to reach an economic model with relatively few parameters. The final parsimonious model (Model 5) included only variables that remained statistically significant in Model 4. The SPSS version 28.0 (IBM Corporation, Armonk, NY) was used for data analyses.

Results

A total of 397 people living with HIV were interviewed. Of these, 97 were excluded due to missing data in one or more variables related to clinical data and outcome measures.

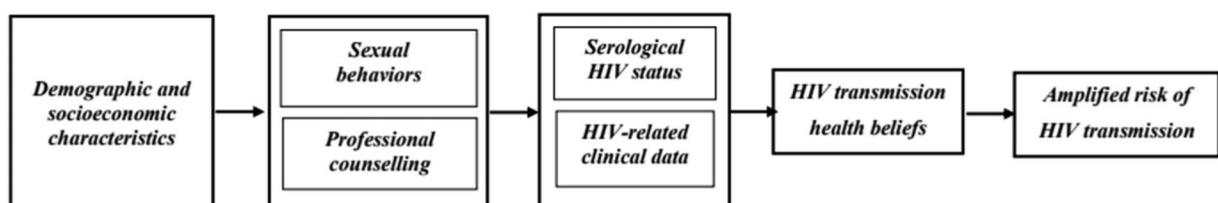


Figure 1. Theoretical model of the hypothesized relationships of sociodemographic characteristics, sexual behaviors, serological HIV status, HIV-related clinical data, and beliefs about risk of HIV transmission with amplified HIV transmission risk.

The final sample included 300 participants with complete data. Two hundred and six participants (68.6%) had one or more factors of amplified risk of HIV transmission. The most common characteristics of amplified risk of HIV transmission were STI diagnosis (34.3%), followed by condomless intercourse (31.0%), detectable HIV viral load (25.3%), and symptoms of STIs (14.7%).

Sociodemographic characteristics and sexual behaviors of the participants and the association between these variables and the amplified risk of transmitting HIV are presented in Table 1. The mean age of the participants was 41.2 years ($SD = 11$). Most participants were men (63.7%), had white skin color (50.0%), with 11 years of education or less (58.0%), and were employed (60.7%). Of the participants, 36.3% were heterosexual women, 69% informed one sexual partner and 64.7% had stable sexual partners. Alcohol consumption and drug using before having sex, and receiving professional counseling about HIV transmission was reported by 37.0%, 16.3%, and 81.3% of the participants, respectively. In the unadjusted analysis, lower age, having multiple sexual partners, use of alcohol consumption before having sex, use of illicit drugs before having sex, and not receiving professional counseling were associated with higher odds of amplified risk of HIV transmission.

Table 2 shows the HIV serological status, HIV-related clinical data, and beliefs about risk of HIV transmission of the sample. Nearly 70% of the participants were aware of the HIV status of their partners and had their partners tested for HIV. Most of the participants' partners were people not living with HIV (72%), 63% received HIV diagnosis 5 years ago or more, and around 94% of participants were under ART. Regarding beliefs about HIV risk transmission, most of the participants believed that HIV is transmissible when people living with HIV are taking ART and have an undetectable viral load (77%), have low viral load (50.7%) and are using ART (63.0%). Only 6% of participants believed that genital ulcer increases the risk of HIV transmission and almost 17% believed there is a risk of HIV transmission to a serodiscordant partner. The unadjusted associations reported that participants who had more than 5 years of HIV diagnosis, those who are under ART, and those who believe that a person living with HIV may transmit HIV to a serodiscordant partner showed lower odds of amplified risk of HIV transmission.

The hierarchical ordered multinomial logistic analysis is presented in Table 3. The ordinal model estimates cumulative response probabilities, and the proportional odds (cumulative *odds*) combine the categories 1, 2, and 3–4 of amplified risk of HIV transmission and compare with no

risk of HIV transmission. In Models 1 and 2, the amplified risk of HIV transmission was associated with lower age, alcohol and drugs consumption before having sex, and not receiving professional counseling about HIV sexual transmission. The odds of greater amplified risk of HIV transmission were lower in participants under use of ART in Model 3 and among those who believed in the transmission of HIV to a serodiscordant partner in Model 4. In the final model (Model 5), younger participants ($OR = 0.96$; 95% $CI: 0.94–0.98$), alcohol consumption before sexual intercourse ($OR = 1.84$; 95% $CI: 1.12–3.02$), use of illicit drugs before having sex ($OR = 2.40$; 95% $CI: 1.27–4.55$), and lack of professional counseling about HIV sexual transmission ($OR = 1.82$; 95% $CI: 1.05–3.15$) remained associated with higher amplified risk of HIV transmission. Participants who believed that a person living with HIV could transmit HIV to a serodiscordant partner ($OR = 0.54$; 95% $CI: 0.30–0.97$) showed lower odds for higher amplified risk of HIV transmission.

Discussion

Successful efforts to control the HIV epidemic should consider the identification and prevention of factors that may increase the risk of HIV transmission. A better understanding of these factors along with the expansion of ART may enhance the risk management of people living in the HIV context. The present study investigated the factors associated with amplified risk of HIV transmission among people attending health care referral units for treatment of infectious diseases. The main findings of this study suggest that the amplified risk of HIV transmission is influenced by several factors, including sociodemographic characteristics, health-related behaviors, professional counseling, and beliefs about risk of HIV transmission. In the studied sample, a greater number of participants (68.6%) had condomless intercourse with nonsuppressed plasmatic viral load or with STI in the last 6 months. Therefore, they experienced an amplified risk of HIV transmission to their partners despite being under ART.

Our findings demonstrated that amplified risk of HIV transmission may be associated with complex characteristics, including those that are not essentially connected with the individual's biological condition, such as diagnosis of STI or HIV viral load. Instead, it can be linked to relevant factors related to living in a society, such as behaviors, beliefs, and access to specialized health services for people living with HIV. Thus, the results of this study indicate that strategies to tackle the HIV epidemic may be

Table 1. Distribution of Sociodemographic Characteristics and Sexual Behaviors and Estimated Unadjusted Odds Ratio (OR) for Amplified HIV Transmission Risk Groups (*n* = 300)

Variables	Total	Amplified HIV Transmission Risk				OR ^a	CI 95%	p-Value
		0	1	2	3–4			
<i>Sociodemographic characteristics</i>								
Age, <i>M</i> (<i>SD</i>)	41.2 (11.0)	44.9 (11.1)	39.9 (10.8)	40.4 (10.4)	34.9 (9.0)	0.96	0.94–0.98	<.001
Sex, <i>n</i> (%)								
Female	109 (36.3)	38 (40.4)	41 (34.2)	24 (36.9)	6 (28.6)	1		
Male	191 (63.7)	56 (59.6)	79 (65.8)	41 (63.1)	15 (71.4)	1.21	0.79–1.87	.380
Skin color, <i>n</i> (%)								
White	150 (50.0)	45 (47.9)	64 (53.3)	31 (47.7)	10 (47.6)	1		
Yellow/indigenous	12 (4.0)	5 (5.3)	5 (4.2)	2 (3.0)	0 (0.0)	0.58	0.19–1.73	.326
Brown	99 (33.0)	35 (37.2)	36 (30.0)	20 (30.8)	8 (38.1)	0.91	0.57–1.44	.678
Black	39 (13.0)	9 (9.6)	15 (12.5)	12 (18.5)	3 (14.3)	1.49	0.78–2.84	.222
Schooling, <i>n</i> (%)								
>11 years	126 (42.0)	38 (40.4)	59 (49.2)	21 (32.3)	8 (38.1)	1		
≤11 years	174 (58.0)	56 (59.6)	61 (50.8)	44 (67.7)	13 (61.9)	1.18	0.77–1.79	.449
Employment status, <i>n</i> (%)								
Employed	182 (60.7)	60 (63.8)	69 (57.5)	38 (58.5)	15 (71.4)	1		
Unemployed	72 (24.0)	17 (18.1)	35 (29.2)	17 (26.2)	3 (14.3)	1.16	0.70–1.91	.338
Housewife	14 (4.6)	3 (3.2)	5 (4.2)	4 (6.2)	2 (9.5)	1.90	0.71–5.11	.205
Retired	32 (10.7)	14 (14.9)	11 (9.1)	6 (9.2)	1 (4.8)	0.62	0.31–1.25	.184
<i>Sexual behaviors</i>								
Sexual orientation, <i>n</i> (%)								
Women heterosexual	109 (36.3)	38 (40.4)	41 (34.2)	24 (36.9)	6 (28.6)	1		
Man heterosexual	98 (32.7)	30 (31.9)	40 (33.3)	23 (35.4)	5 (23.8)	1.31	0.79–2.18	.294
Man who has sex with man	93 (31.0)	26 (27.7)	39 (32.5)	18 (27.7)	10 (47.6)	1.13	0.68–1.86	.636
Number of sexual partners, <i>n</i> (%)								
One	207 (69.0)	75 (79.8)	83 (69.2)	39 (60.0)	10 (47.6)	1		
Multiple	93 (31.0)	19 (20.2)	37 (30.8)	26 (40.0)	11 (52.4)	2.21	1.40–3.48	.001
Type of sexual partners, <i>n</i> (%)								
Stable	194 (64.7)	68 (72.3)	73 (60.8)	41 (63.1)	12 (57.1)	1		
Casual	96 (32.0)	25 (26.6)	44 (36.7)	20 (30.8)	7 (33.3)	1.28	0.81–2.00	.289
Both	10 (3.3)	1 (1.1)	3 (2.5)	4 (6.2)	2 (9.6)	4.20	1.31–13.50	.016
Alcohol consumption before having sex, <i>n</i> (%)								
No	189 (63.0)	70 (74.5)	78 (65.0)	32 (49.2)	9 (42.9)	1		
Yes	111 (37.0)	24 (25.5)	42 (35.0)	33 (50.8)	12 (57.1)	2.31	1.49–3.58	<.001

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Table 1. (continued)

Variables	Total	Amplified HIV Transmission Risk				OR ^a	CI 95%	p-Value
		0	1	2	3–4			
Illicit drugs use before having sex, <i>n</i> (%)								
No	251 (83.7)	89 (94.7)	101 (84.2)	47 (72.3)	14 (66.7)	1		
Yes	49 (16.3)	5 (5.3)	19 (15.8)	18 (27.7)	7 (33.3)	3.46	1.95–6.14	<.001
Professional counseling, <i>n</i> (%)								
Yes	244 (81.3)	84 (89.4)	93 (77.5)	53 (81.5)	14 (66.7)	1		
No	56 (18.7)	10 (10.6)	27 (22.5)	12 (18.5)	7 (33.3)	1.79	1.05–3.04	.048

The coefficients estimated indicated likelihood of moving into a higher category of amplified HIV transmission risk.

^a ORs were estimated using ordered multinomial cumulative logit model. The reference group was “amplified HIV transmission risk = 0.”

jeopardized if exclusively guided by individual biological risk factors.

Previous research has shown that the amplified risk of HIV transmission was greater among those with higher rates of STIs and who were regular users of psychoactive drugs (van den Berg et al., 2019). A multicenter study carried out in Brazil, Thailand, and Zambia showed that 29% of people living with HIV were at higher risk of amplified HIV transmission (Magidson et al., 2016). The lowest rate was observed in the United Kingdom, where 4.2% of people with HIV diagnosis were at a higher risk of HIV transmission (Daskalopoulou et al., 2017). The variation in the risk of HIV transmission may be related to health policies and different HIV preventive strategies in each country, such as the implementation of pre-exposure prophylaxis (PrEP) and HIV testing programs. For instance, Norway is the third country in the world with more people using PrEP per 100 new cases of HIV infections, which decreased the incidence of HIV by 63% in the last 10 years (UNAIDS, 2022, 2023). However, health services in some countries have not been reaching people at risk for HIV or supporting the acceptance of strategies aimed to increase HIV prevention. In Brazil, ART has been made available to all people living with HIV through the public health system since 1996 (Dourado et al., 2006). However, the viral suppression rate is relatively low considering the total number of people living with HIV in the country (Brasil, Ministério da Saúde, 2022). Consequently, a growing number of new cases of HIV infection remains in Brazil since the outbreak of the epidemic (Brasil, Ministério da Saúde, 2022).

Age seems to have a relevant role among the investigated factors, possibly linked to amplified risk of HIV transmission. Between 2011 and 2021, a total of

52,513 people living with HIV and aged from 15 to 24 years in Brazil developed AIDS, highlighting the importance of strategies to manage HIV infection in this age group (Brasil, Ministério da Saúde, 2022). According to our findings, the likelihood of having a higher amplified risk of HIV transmission was inversely associated with age. This may be explained by the fact that changes in habits and behaviors that increase the risk of HIV transmission are less pronounced as the individual ages. A recent study in the United States found that the risk of HIV transmission was relatively lower among a group of older people than younger ones (van den Berg et al., 2019). The older group was also the least involved in adopting harmful behaviors such as regular alcohol consumption and use of illicit drugs in the long term (van den Berg et al., 2019).

Most participants reported no alcohol intake or drug use before sexual intercourse. Nonetheless, those who reported such behaviors had a significantly greater likelihood of amplified risk of HIV transmission. Studies have reported an increase in the consumption of psychoactive substances before or during sexual intercourse in different countries. The use of these substances has been associated with lower social inhibition, increase of pleasure, and greater sexual engagement (Díaz et al., 2019; Hampel et al., 2020; Scott-Sheldon et al., 2016; Xu et al., 2020). The inability to communicate properly and set up safety rules before having sex under the effect of such substances may lead to unprotected sexual intercourse and increased risk of HIV transmission (Koff et al., 2017; Woolf-King & Maisto, 2011; Xu et al., 2020). Furthermore, use of psychoactive substances has been consistently associated with nonadherence to ART among people living with HIV, which in turn influences the suppression of HIV viral load

Table 2. Distribution of Serological HIV Status, HIV-Related Clinical Data, and Beliefs About Risk of HIV Transmission and Estimated Unadjusted Odds Ratio (OR) for Amplified HIV Transmission Risk Groups (n = 300)

Variables	Total	Amplified HIV Transmission Risk				OR ^a	CI 95%	p-Value
		0	1	2	3–4			
<i>Serological HIV status</i>								
Disclosure HIV partner status, n (%)								
Yes	209 (69.7)	69 (73.4)	79 (65.8)	45 (69.2)	16 (76.2)	1		
No	91 (30.3)	25 (26.6)	41 (34.2)	20 (30.8)	5 (23.8)	1.08	0.69–1.69	.746
Partner tested for HIV, n (%)								
Yes	207 (69.0)	64 (68.1)	82 (68.3)	46 (70.8)	15 (71.4)	1		
No	93 (31.0)	30 (31.9)	38 (31.7)	19 (29.2)	6 (28.6)	0.91	0.58–1.43	.685
Partner's HIV status, n (%)								
Negative	216 (72.0)	72 (76.6)	89 (74.2)	41 (63.1)	14 (66.7)	1		
Positive	84 (28.0)	22 (23.4)	31 (25.8)	24 (36.9)	7 (33.3)	1.54	0.97–2.44	.069
<i>HIV-related clinical data</i>								
Time since HIV diagnosis, n (%)								
<5 years	110 (36.7)	21 (22.3)	48 (40.0)	28 (43.1)	13 (61.9)	1		
≥5 years	190 (63.3)	73 (77.7)	72 (60.0)	37 (56.9)	8 (38.1)	0.44	0.28–0.68	<.001
Use of ART, n (%)								
No	19 (6.3)	0 (0.0)	8 (6.7)	7 (10.8)	4 (19.0)	1		
Yes	281 (93.7)	94 (100)	112 (93.3)	58 (89.2)	17 (81.0)	0.22	0.09–0.52	.001
<i>Beliefs about risk of HIV transmission</i>								
Under ART and undetectable viral load, n (%)								
No	69 (23.0)	21 (22.3)	25 (20.8)	16 (24.6)	7 (33.3)	1		
Yes	231 (77.0)	73 (77.7)	95 (79.2)	49 (75.4)	14 (66.7)	0.82	0.50–1.34	.431
Low viral load, n (%)								
No	148 (49.3)	39 (41.5)	61 (50.8)	36 (55.4)	12 (57.1)	1		
Yes	152 (50.7)	55 (58.5)	59 (49.2)	29 (44.6)	9 (42.9)	0.66	0.44–1.00	.053
Use and adherence ART, n (%)								
No	111 (37.0)	36 (38.3)	40 (33.3)	26 (40.0)	9 (42.9)	1		
Yes	189 (63.0)	58 (61.7)	80 (66.7)	39 (60.0)	12 (57.1)	0.93	0.61–1.43	.749
Genital ulcer increases the risk, n (%)								
No	281 (94.0)	86 (91.5)	113 (94.2)	62 (96.9)	20 (95.2)	1		
Yes	18 (6.0)	8 (8.5)	7 (5.8)	2 (3.1)	1 (4.8)	0.54	0.22–1.31	.174

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Table 2. (continued)

Variables	Total	Amplified HIV Transmission Risk				OR ^a	CI 95%	p-Value
		0	1	2	3–4			
Transmission to non-HIV partner, <i>n</i> (%)								
No	250 (83.3)	74 (78.7)	98 (81.7)	60 (92.3)	18 (85.7)	1		
Yes ^a	50 (16.7)	20 (21.3)	22 (18.3)	5 (7.7)	3 (14.3)	0.56	0.32–0.99	.047

Note. The reference group was 'Amplified HIV transmission risk = 0'. The coefficients estimated indicated likelihood of moving into a higher category of Amplified HIV transmission risk. ART = antiretroviral therapy.

^aOR were estimated using ordered multinomial cumulative logit model.

(Cook et al., 2017; Detsis et al., 2017; González-Álvarez et al., 2017). Despite the increased risk of HIV transmission, the importance of the use of these substances has been underestimated by health professionals (Hampel et al., 2020). Therefore, enhancing the knowledge of health professionals involved in the management of people living with HIV can potentially improve treatment adherence and retention of care.

The majority of study participants (83.3%) believed that there is no risk of HIV transmission to a serodiscordant partner. This finding may be attributed to two different reasons. First, these participants might have understood that HIV infection is not transmitted between serodiscordant couples if the person living with HIV has an undetectable viral load. Second, nearly half of the sample believed that low viral load decreases HIV risk transmission, so they may not understand the TasP mechanism. This generates concerns because 72% of participants had a partner not living with HIV and the likelihood of amplified risk for HIV transmission was lower among those who acknowledged the risk. The lack of awareness and knowledge that undetectable viral load reduces the risk of HIV transmission reveals that the preventive benefits of TasP have a limited impact on this subgroup, which is consistent with previous studies that showed little knowledge and disbelief in TasP (Bor et al., 2021; Paschen-Wolf et al., 2020; Torres et al., 2020).

The use of TasP may reduce HIV-associated fear and guilt and improve self-esteem, facilitating the dissemination of knowledge to sexual partners and social networks among people living with HIV (Calabrese & Mayer, 2019). Hence, professional counseling for couples is very important in the context of HIV. Our finding on the association between lack of professional HIV prevention counseling and amplified risk of HIV transmission underlies the importance of this professional work. However, despite the existence of protocols and guidelines for the management of people with HIV or those at risk for STIs, communication among health professionals about

TasP and HIV risk transmission is still limited. The knowledge and support of health professionals for HIV preventive strategies other than use of condoms is still incipient (Bavinton et al., 2019).

Informing people living with HIV about factors that amplify the risk of HIV transmission should be considered an essential health care component to optimize the efforts of risk management among couples living in the HIV context. This can be accomplished during routine appointments for people living with HIV by health care providers. Thus, health care authorities and health services administrators should provide and support the training for health care providers of HIV services. Interventions for people living with HIV must surpass individual aspects because although this population strives to adhere to ART, there are aspects that go beyond individual factors, such as the stigma of the disease and barriers to access treatment (Rintamaki et al., 2019).

Limitations

Our findings should be interpreted considering the following limitations. Behaviors were self-reported measures and therefore social desirability bias may have influenced participants' responses, mainly those related to sensitive questions such as sexual behaviors and use of illicit drugs. Moreover, the participants were receiving ART at referral health care units for prevention and treatment of infectious diseases when they agreed to participate in the study. So, our findings may not be generalizable to those who are not taking ART. In addition, the interpretation of our findings depends on acceptance of the temporal relationships proposed by the theoretical model because of the cross-sectional nature of the study.

Conclusions

The amplified risk of HIV transmission was influenced by multiple factors and was significantly associated

Table 3. Ordered Multinomial Regression of the Relationship of Sociodemographic Characteristics, Sexual Behaviors, Serological HIV Status, HIV-Related Clinical Data, and Beliefs About Risk of HIV Transmission With Amplified HIV Transmission Risk

Variables	Model 1 ^b		Model 2 ^b		Model 3 ^b		Model 4 ^b		Model 5 ^b	
	OR ^a	CI 95%	OR ^a	CI 95%	OR ^a	CI 95%	OR ^a	CI 95%	OR ^a	CI 95%
<i>Sociodemographic characteristics</i>										
Age	0.96	0.94–0.98 ^c	0.96	0.94–0.98 ^c	0.97	0.95–0.99 ^c	0.96	0.94–0.98 ^c	0.96	0.94–0.98 ^c
Employment status										
Employed	1									
Unemployed	1.11	0.67–1.84								
Housewife	1.97	0.73–5.32								
Retired	0.89	0.43–1.83								
<i>Sexual behavior</i>										
Number of sexual partners										
One			1							
Multiple			1.51	0.82–2.79						
Type of sexual partners										
Stable			1							
Casual			0.98	0.54–1.77						
Both			2.26	0.62–8.29						
Alcohol consumption before having sex										
No			1		1		1		1	
Yes			1.83	1.11–3.00 ^c	1.83	1.12–3.00 ^c	1.83	1.11–3.02 ^c	1.84	1.12–3.02 ^c
Illicit drug use before having sex										
No			1		1		1		1	
Yes			2.12	1.11–4.06 ^c	2.51	1.32–4.78 ^c	2.28	1.20–4.34 ^c	2.40	1.27–4.55 ^c
Professional counseling										
Yes			1		1		1		1	
No			2.09	1.19–3.69 ^c	1.70	1.07–2.97 ^c	1.84	1.06–3.18 ^c	1.82	1.05–3.15 ^c
<i>Serological HIV status</i>										
Partner's HIV status										
Negative					1					
Positive					1.56	0.97–2.52				
<i>HIV-related clinical data</i>										
Time since HIV diagnosis										
<5 years					1					
≥5 years					0.77	0.47–1.27				

(continued on next page)

Table 3. (continued)

Variables	Model 1 ^b		Model 2 ^b		Model 3 ^b		Model 4 ^b		Model 5 ^b	
	OR ^a	CI 95%	OR ^a	CI 95%	OR ^a	CI 95%	OR ^a	CI 95%	OR ^a	CI 95%
Use of ART										
No					1		1			
Yes					0.40	0.16–0.98 ^c	0.38	0.16–0.92 ^c	0.37	0.15–0.88 ^c
Beliefs about risk of HIV transmission										
Low viral load (Ref: no)										
Yes							0.74	0.48–1.14		
Genital ulcer (Ref: no)										
Yes							0.69	0.27–1.72		
Transmission to non-HIV partner (Ref: no)										
Yes							0.58	0.32–0.98 ^c	0.54	0.30–0.97 ^c

Note. OR = odds ratio; ART = antiretroviral therapy.

^a OR were estimated using ordered multinomial cumulative logit model. The reference group was 'Amplified HIV transmission risk = 0'. The coefficients estimated indicated likelihood of moving into a higher category of Amplified HIV transmission risk.

^b Variables adjusted for all other variables in the model.

^c Values are significant at 5% or less.

with sociodemographic characteristics, sexual behaviors, professional counseling, and beliefs about risk of HIV transmission. The amplified risk of HIV transmission is not merely related to the individual biological condition, such as the STI diagnosis or viral load. Different dynamic aspects of societal life, including behaviors, beliefs, and provision of health services are relevant for amplified risk of HIV transmission and should be considered in health care planning for people living with HIV. Therefore, risk factors that amplify the risk of HIV transmission and the strategies to tackle the HIV epidemic should take a multifactorial perspective.

Conflict of Interest

The authors declare that they have no conflict of interest.

Consent to Participate

Consent to participate in the study was given in writing by all participants. They signed the Informed Consent Form. It is a document with specific information about the research containing the main objectives, possible risks and benefits, and information about confidentiality, privacy, and information about the research coordinators.

Ethics Approval

This study followed all the guidelines of the Declaration of Helsinki. It was approved by the Ethics in Research Committee of the Ribeirão Preto College of Nursing, following the recommendations of the National Health Council Resolution 466/12.

Funding

Funding for this project came from the São Paulo Research Foundation (FAPESP) under grant number 2015/23008-2. The content is solely the responsibility of the authors and does not necessarily represent the official views of the FAPESP or any of the other funders.

Author Contributions

All authors on this paper meet the four criteria for authorship as identified by the International Committee of Medical Journal Editors; all authors have contributed to the drafting or been involved in revising it, reviewed the final version of this manuscript before submission, and agree to be accountable for all aspects of the work.

Specifically, using the CRediT taxonomy, the contributions of each author is as follows: Conceptualization

and methodology: R. K. Reis, L. R. M. Sousa, and E. Gir; Data collection and management: R. K. Reis, M. Antonini, and L. R. M. Sousa; Formal analysis: R. K. Reis, M. Antonini, G. R. O. N. Ferreira, and M. V. Vettore; Funding acquisition: R. K. Reis; Investigation: R. K. Reis, M. Antonini, L. R. M. Sousa, K. A. A. Rocha, G. R. O. N. Ferreira, M. V. Vettore, and E. Gir. Methodology: R. K. Reis, M. V. Vettore, and E. Gir; Original manuscript draft: R. K. Reis, M. Antonini, L. R. M. Sousa, K. A. A. Rocha, and M. V. Vettore. Critical review and revisions: all coauthors. All coauthors reviewed and approved the final manuscript.

KEY CONSIDERATIONS

- Almost 70% of the participants had at least one factor that amplified the risk of HIV transmission.
- The amplified risk of HIV transmission was related to multiple factors, including sociodemographic characteristics, sexual behaviors, professional counseling, and beliefs about risk of HIV transmission.
- Alcohol consumption and use of illicit drugs before having sex must be considered as potential factors for amplified risk of HIV transmission.
- Tackling the HIV epidemic through reducing the exposure to risk factors for amplified risk of HIV transmission should take a multifactorial perspective.

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