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ORIGINAL PAPER

HIV Stigma and Substance Use Among HIV-Positive Russians with Risky Drinking

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Abstract The link between HIV stigma with substance use is understudied. We characterized individuals with high HIV stigma and examined whether HIV stigma contributes to substance use among HIV-positive Russians reporting risky alcohol use. We analyzed data from HERMITAGE, a randomized controlled trial of 700 people living with HIV/AIDS (PLWHA) with past 6-month risky sex and risky alcohol use in St. Petersburg, Russia (2007–2011). Participants who were female and reported depressive symptoms and lower social support were more likely to endorse high HIV stigma (all p's < 0.001). In adjusted models, high HIV stigma was not significantly associated with the primary outcome unhealthy substance use and was not consistently associated with secondary substance use outcomes. Interventions to enhance social and mental health support for PLWHA, particularly women, may reduce stigma, though such reductions may not correspond to substantial decreases in substance use among this population.

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Resumen El vínculo entre el estigma relacionado al VIH y el uso de sustancias ha sido poco estudiado. En este estudio caracterizamos individuos con elevado estigma relacionado al VIH y examinamos si este estigma relacionado al VIH contribuye al consumo de sustancias entre infectados por el VIH en Rusia con trastorno por uso de alcohol. Se analizaron los datos de HERMITAGE, un estudio randomizado de 700 personas infectadas por el VIH(PVVs) con relaciones sexuales de riesgo y consumo de riesgo de alcohol durante los 6 meses anteriores en San Petersburgo, Rusia (2007–2011). Los participantes que eran de sexo femenino y reportaron síntomas depresivos y un menor apoyo social reportaron valores de estigma relacionado al VIH significativamente mayores (p < 0.001). En los modelos ajustados, elevados valores de estigma asociado al VIH no estaba significativamente asociado con el uso no saludable de cualquier sustancia (análisis primario) y no estaba consistentemente asociado con el uso de sustancias (análisis secundario). Las intervenciones para mejorar los apoyos sociales y la salud mental dirigidas a las PVVs, especialmente las mujeres, pueden reducir el estigma, aunque tales reducciones pueden no corresponder a una disminución sustancial en el consumo de sustancias en esta población.

Keywords Stigma · HIV · Substance use · Russia

Introduction

In Russia, over 1 million people have been diagnosed with HIV. Despite its alarming incidence and prevalence, HIV prevention and treatment services are inadequate. Less than 10% achieve viral suppression, and stigma is pervasive [1–5]. Defined by Goffman as "an attribute that is deeply discrediting," stigma occurs when there is a convergence of labelling, stereotyping, prejudice, separation, and discrimination of individuals with attributes viewed as undesirable by people in positions of social, political, and economic power [6, 7]. As highlighted by Earnshaw's HIV Stigma Framework, HIV stigma may occur via different mechanisms, including: (1) enacted stigma (perceived receipt of prejudice and discrimination); (2) anticipated stigma (expectation of receipt of future prejudice and discrimination); and (3) internalized stigma (self-endorsement of negative feelings and beliefs associated with HIV/AIDS) [8]. Notably, through associations with worse mental health, increased sexual risk behaviors, medication non-adherence, and lack of retention in care, stigma negatively impacts the lives of people living with HIV/AIDS-(PLWHA) and is an important driver of the HIV epidemic [8–12].

HIV stigma may have important effects on another key factor that fuels the HIV epidemic—namely, substance use (i.e., alcohol and drug use). Drawing from the Minority Stress Model, which describes how "stigma, prejudice and discrimination create a hostile and stressful social environmental" leading to negative health outcomes among individuals in a stigmatized social category, substance use may serve as a maladaptive coping mechanism to experiences of HIV stigma [13]. Alternatively, as supported by the social resistance framework, HIV stigma may lead to substance use as a form of opposition to social norms [14]. Specifically, this Framework suggests that unhealthy behaviors, including substance use, occur in response to power relations within society whereby members of a minority group actively engage in "resistance behaviors" to express protest against the dominant group as well as to develop a distinct identity from the dominant group. Notably, a number of studies have consistently documented an association between experiences of stigma and discrimination associated with using substances and being of a minority status [15–19].

Despite its potential public health impact [20], however, the impact of HIV stigma on substance use in particular remains under-examined. While qualitative studies reveal that HIV may serve as a trigger for substance use and different stigmatized identities may lead to intensified experiences of stigma (i.e., "double stigma," "multiple stigmas", "interacting stigmas") [11, 21, 22], a recent systematic review of the impact of HIV stigma on a range of health outcomes did not identify any studies focused on substance use [12]. Furthermore, to inform the development of future interventions that may promote resilience to HIV stigma and buffer its harmful effects [23], it is important to understand the role of potentially modifiable factors; social support is one such factor [24]. Social support may come from a range of sources and in different forms, including community and individual sources. When derived from individuals, social support may include emotional/informational support and instrumental/tangible support [24]. The relationship between HIV stigma, substance use, and social support is complex and may vary across subgroups and based on social norms [19, 25]. For instance, on one hand, social support may mitigate (i.e., moderate) the effects of HIV stigma, resulting in less intense substance use depending on perceived substance use norms [19]. That is, the acceptability of different patterns of substance use and understanding of normative behavior may vary across demographics and communities to influence individual behaviors. For example, Elliott and colleagues found that neighborhood norms based on acceptability of adults getting drunk at least once per week predicted number of drinks on heavy drinking occasions [26]. On the other hand, HIV stigma may result in (i.e., mediate) lower perceived social support and increased substance use to cope. Empirical studies in various settings among PLWHA found a dynamic, negatively correlated relationship between social support from various sources and HIV stigma [27–29]. Recent research has started assessing the relationship of HIV stigma and social support specifically in people who use substances. Among people with substance use disorders, high stigma and low social support have been found to be negatively associated with mental health and well-being [30] and social support mediates the association between HIV stigma and mental health and well-being [31]. This body of empirical literature further highlights the potential role of social support as a potentially modifiable factor for mitigating stigma's adverse impact on affected, PLWHA with substance use, which is especially in important in settings such as Russia.

The current environment in Russia and elsewhere, stigmatizes HIV, criminalizes substance use, including "drugs and other psychotropic substances," [32] and limits options for addiction treatment services [33–35]. In such settings, understanding the interplay between HIV stigma, social support, and substance use may be important for informing policy as well as designing community and individual level interventions that might mitigate the effects of stigma on substance use. This may be particularly true among individuals with risky alcohol use given its high prevalence in Russia and its role in contributing to negative health outcomes and HIV transmission [34, 36, 37].

Thus, among a sample of HIV-positive Russians with risky alcohol use, we conducted the current study with the following goals: (1) to describe HIV stigma among people with risky alcohol use; (2) to evaluate the longitudinal association between HIV stigma and substance use; and (3) to examine whether social support mediates the relationship between HIV stigma and substance use.

Methods

Study Design and Participants

We conducted a secondary data analysis of HERMITAGE (HIV's Evolution in Russia—Mitigating Infection Transmission and Alcoholism in a Growing Epidemic), a single-blind randomized controlled clinical trial to evaluate the effectiveness of an adapted secondary HIV prevention intervention, compared to an attention control condition, on sexually transmitted infections and HIV risk behaviors [38]. Between October 2007 and April 2010, the HERMITAGE study recruited 700 HIV-positive heavy drinkers who reported recent unprotected sex from four clinical inpatient and outpatient HIV and addiction sites in St. Petersburg, Russia, including: (1) Botkin Infectious Disease Hospital, (2) the St. Petersburg AIDS Center, (3) Pavlov State Medical University Clinics, and (4) the St. Petersburg State Drug Treatment Clinic. Participants were also recruited from nonclinical sources including a needle exchange program, and through ''snowball recruitment'' and referred to one of the clinical sites for eligibility assessment. Eligible participants included those with: (1) HIV infection; (2) aged 18–70 years old; (3) any risky drinking, as defined by the US National Institute on Alcohol Abuse and Alcoholism (NIAAA) [39] in prior 6 months; (4) anal or vaginal sex without a condom during the past 6 months; (5) free from cognitive impairment or acute illness; (6) not trying to get (partner) pregnant; (7) provision of contact details for self and two confidants to facilitate follow-up; (8) living within 150 km of St. Petersburg; (9) no pending incarceration; and (10) able to provide informed consent. The analytic sample for the current study included those participants with available data on stigma, substance use and social support.

The HERMITAGE study was approved by the Institutional Review Boards of Boston University and First St. Petersburg Pavlov State Medical University. All participants provided written informed consent and were reimbursed 200 rubles (US$7 at the time of the study) for the baseline assessment and 800 (US$28) and 1000 rubles (US$35) at 6- and 12-month follow-up, respectively.

Participant Assessments

Assessments were collected at baseline, 6 and 12 months. These were collected primarily via face-to-face interview with a research assistant, with approximately 10% self-administered for especially sensitive questions, including stigma. Instruments were translated from English to Russian for this study, unless translated versions already existed [40]. At baseline, a medical chart review was also performed when available.

Independent Variable: HIV Stigma

HIV stigma was determined using the abbreviated Berger HIV-related stigma scale [41], a measure that was originally developed and validated in a diverse sample of PLWHA, including individuals with substance use [42]. The subscales (personalized stigma, disclosure concerns, negative self-image, and concern with public attitudes) measure each of the different stigma mechanisms [8] (Box 1). These specific subscales map onto different mechanisms: personalized stigma subscale measures enacted stigma; disclosure concerns subscale measures anticipated stigma; negative self-image subscale measures internalized stigma; and concern with public attitudes subscale measures anticipated stigma [8].

To promote ease of interpretation, in the primary analysis, the overall HIV stigma score was dichotomized as low vs. high stigma, where high HIV stigma was defined as a score ≥75th percentile consistent with our prior published manuscript [43]. In post hoc exploratory analyses, we also categorized the overall HIV stigma score in quintiles and separately examined the HIV stigma subscale scores as binary variables. HIV stigma was measured at baseline, 6 and 12 months and modeled as a time-dependent variable.

Box 1 HIV stigma subscales: example items [41]

Subscale	Item
Personalized stigma	1. I have been hurt by how people reacted to learning I have HIV.
Disclosure concerns	2. I am very careful who I tell that I have HIV.
Negative self-image	3. I feel that I am not as good a person as others because I have HIV.
Concern with public attitudes	4. Most people think that that a person with HIV is disgusting.

Outcome: Substance Use

The primary outcome, unhealthy past 30 day substance use, was a composite variable based on presence (yes vs. no) of past 30 day self-reported use of (1) heroin or stimulant use [assessed by the Risk Behavior Survey [44, 45] modified for the Russian setting] or (2) risky alcohol use (assessed by the timeline follow back [46] and defined as >14 drinks per week or more than four drinks on a single occasion for men and more than seven drinks per week or more than three on a single occasion for women [39]. Secondary outcomes included presence (yes vs. no) of (1) any past 30 day heroin or stimulant use; (2) past 30 day risky alcohol use; and (3) past 12 month substance use disorder (drug or alcohol dependence, assessed by the CIDI-SF 12 month survey [47]). These outcomes were assessed at baseline, 6 and 12 months, except substance use disorder, which was assessed only at baseline and 12 months.

Covariates

Our analyses included the following baseline covariates, which may be potential confounders of the relationship between HIV stigma and substance use: sociodemographic characteristics [i.e., age, gender, marital status (married or living with a partner vs. not married or living with a partner), and education (≤9th grade or >9th grade consistent with completion of secondary school in Russia); time since HIV diagnosis (<3.9 vs. ≥ 3.9 years, based on the median duration)]; CD4 count by chart review (<350 cells/mm^3 vs. ≥350 cells/mm^3); randomization group and time. Additionally, we included time-varying measures of self-reported current antiretroviral therapy use (yes vs. no); and depressive symptoms in the past 2 weeks (assessed by the Beck Depression Inventory-II, defined as a score >13) [48]. Overall social support score [assessed by the medical outcomes study (MOS) Social Support Survey, standardized to a 0–100 scale where higher scores indicate more social support] was also included to assess whether it was either a potential mediator or moderator [49]. This measure includes four scales to measure social support based on emotional/informational support, tangible support, affectionate support, and positive social interaction and has been previously used to ascertain the association between stigma and social support [12]. These variables are consistent with and supported by the existing literature, which have identified the role of demographics (e.g., gender), a new HIV diagnosis, depressive symptoms and social support as impacting the relationship between stigmatizing experiences and substance use [18, 21, 22, 50–53].

Data Analysis

To achieve the first goal of the study, we calculated descriptive statistics to characterize the baseline demographic and clinical characteristics of participants overall and stratified by the main independent variable, HIV stigma. For descriptive purposes, baseline characteristics were compared based on HIV stigma using t-tests for continuous variables and Chi square or Fisher's exact test for categorical variables. Bivariate correlations between independent variables and covariates were calculated and no pair of variables had a Spearman's correlation >0.40. To achieve the second goal of the study, we first examined bivariate (unadjusted) longitudinal associations between HIV stigma, evaluated as a binary characteristic, and each substance use outcome by fitting separate unadjusted generalized estimating equations (GEE) logistic regression models. We then constructed a series of multivariable models to adjust for potential confounding. In the first set of models, we adjusted for the following baseline covariates: age, gender, marital status, education, time since HIV diagnosis, CD4 count, randomization group and time. In addition, we included time-varying measures of antiretroviral therapy use and depressive symptoms. This model was considered the main analysis. Additionally, we evaluated the association between HIV stigma when categorized in quintiles and the HIV stigma subscales (as a binary characteristic) and our primary outcome (unhealthy past 30 day substance use). In subsequent models, we included the overall social support score as a time-varying covariate. To achieve the third goal of the study, in exploratory analyses, we used structural equation models [54] to assess social support as a potential mediator of the relationship between HIV stigma and each of the substance use outcomes. A separate model was fit for each outcome. Models included a direct effect of HIV stigma on each substance use outcome, an indirect effect via social support, and controlled for covariates and baseline values of both social support and substance use. Then in post hoc analyses, we tested whether social support moderates the relationship between HIV stigma and unhealthy substance use by including, an interaction term (HIV stigma*social support) in the models. Lastly, in post hoc sensitivity analyses, we excluded depressive symptoms from the adjusted models because we thought this measure may be part of the causal pathway (i.e., mediator) between HIV stigma and substance use outcomes. We used an independence working correlation and reported results using empirical standard errors and report odds ratios and 95% confidence intervals (CI). The missing-indicator method was used to account for missing CD4 count values, which had similar proportions in each HIV stigma group. Data for all other included variables were complete at 100% with the following

exceptions: marital status was missing for 3, time since HIV diagnosis for 4, and overall social support was missing for 18. All analyses were conducted using two-sided tests and a significance level of 0.05. The statistical analyses were performed using SAS version 9.4 (SAS Institute, Inc., NC, USA) and MPlus (version 7.4, copyright 1998–2015, Muthen and Muthen).

Results

Participant Baseline Characteristics

Among the 700 participants, the mean age was 30 years, and 41% were female (Table 1). Thirty-six percent were married or living with a partner, and the majority had received at least a 9th grade education (78%). Participants had been diagnosed with HIV for a median of 3.9 years, only 15% were on antiretroviral therapy, and only 36% had a documented CD4 count $\geq$350 cells/mm^3 (CD4 count $<$350 cells/mm^3 and CD4 count not available: 34 and 30%, respectively). The mean overall social support score was 68 [standard deviation (SD) 22].

Compared to low HIV stigma, those with high HIV stigma appeared to be older [mean (SD) = 30 years (5) vs. 31 years (6), p = 0.04] and more likely to be female (37 vs. 51%, p < 0.001). In addition, there appeared to be a higher proportion reporting depressive symptoms (83 vs. 57%, p < 0.001) and lower social support [mean (SD) = 63 (22) vs.

70 (21), p < 0.0001] for those with high versus low HIV stigma.

HIV Stigma and Substance Use

In bivariate and multivariable analyses, HIV stigma, as a binary characteristic, was not significantly associated with the primary outcome of unhealthy substance use [unadjusted odds ratio (OR) 95% CI 0.95 (0.74, 1.21), p = 0.65 and adjusted odds ratio (AOR) 95% CI 0.81 (0.63, 1.04), p = 0.09, respectively) (Table 2). In secondary analyses, HIV stigma was negatively associated with any heroin or stimulant use (i.e., increased HIV stigma was associated with decreased drug use): AOR 95% CI 0.77 (0.60, 0.99), p = 0.04; but was not significantly associated with risky alcohol use: AOR 95% CI 0.83 (0.65, 1.07), p = 0.15, or substance use disorder: AOR 95% CI 1.15 (0.81, 1.63), p = 0.44 (Table 3). The overall HIV stigma score, when categorized into quintiles, was also not significantly associated with the primary outcome of unhealthy substance use (Supplementary Table I). Similarly, none of the HIV stigma subscale scores were significantly associated with the primary outcome in bivariate or multivariable analyses (Supplementary Table II).

Social Support and Substance Use

For all multivariable models, the association between HIV stigma and each substance use outcome remained

Table 1 HERMITAGE participants: baseline characteristics, n = 700

Characteristic	Overall (n = 700)	Low HIV stigma (n = 503)	High HIV stigma (n = 197)	p value
Age, mean (SD)	**30 (5)**	**30 (5)**	**31 (6)**	**0.04**
Gender (female)	**285 (40.7%)**	**184 (36.6%)**	**101 (51.3%)**	**<0.001**
Marital status, married or living with a partner	251 (35.9%)	182 (36.3%)	69 (35.0%)	0.76
Education, $\geq$9th grade	544 (77.7%)	393 (78.1%)	151 (76.6%)	0.67
Years since HIV diagnosis, $\geq$3.9 years	351 (50.3%)	262 (52.3%)	89 (45.2%)	0.09
CD4 count				0.67
$<$350 cells/mm^3	237 (33.9%)	166 (33.0%)	71 (36.0%)	
$\geq$350 cells/mm^3	254 (36.3%)	187 (37.2%)	67 (34.0%)	
Missing value	209 (29.9%)	150 (29.8%)	59 (29.9%)	
Current antiretroviral therapy, yes	108 (15.4%)	79 (15.7%)	29 (14.7%)	0.75
Depressive symptoms	**451 (64.4%)**	**288 (57.3%)**	**163 (82.7%)**	**<0.001**
Overall social support, mean (SD)	**68 (22)**	**70 (21)**	**63 (22)**	**<0.001**
Any substance use (heroin, stimulant or risky alcohol use), past 30 days	608 (86.9%)	437 (86.9%)	171 (86.8%)	0.98
Any heroin or stimulant use, past 30 days	292 (41.7%)	206 (41.0%)	86 (43.7%)	0.52
Risky alcohol use, past 30 days	570 (81.4%)	416 (82.7%)	154 (78.2%)	0.17
Drug or alcohol dependence, past 12 months	587 (83.9%)	416 (82.7%)	171 (86.8%)	0.19

Bold text indicates statistical significance at p < 0.05 level

Table 2 Longitudinal analyses evaluating the association between HIV stigma and primary substance use outcome of unhealthy substance use (heroin, stimulant or risky alcohol use), past 30 days, among HERMITAGE participants (n = 700)

Characteristic	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)*	Adjusted odds ratio (95% CI)**
HIV stigma (time-varying)	0.95 (0.74, 1.21)	0.81 (0.63, 1.04)	0.78 (0.60, 1.00)
Overall social support, per 10 point increase (time-varying)			**0.87 (0.82, 0.93)**
Age		0.98 (0.96, 1.00)	0.98 (0.95, 1.00)
Female		**0.59 (0.45, 0.77)**	**0.57 (0.43, 0.75)**
Married or partnered		1.19 (0.90, 1.57)	1.32 (0.99, 1.77)
>9th grade education		0.72 (0.51, 1.00)	**0.70 (0.50, 0.99)**
≥3.9 years since HIV diagnosis		0.82 (0.62, 1.07)	0.83 (0.63, 1.08)
CD4 count ≤ 350 cells/mm^3		1.29 (0.78, 2.13)	1.31 (0.79, 2.19)
Current antiretroviral therapy (time-varying)		0.72 (0.40, 1.30)	0.75 (0.41, 1.37)
Depressive symptoms (time-varying)		**2.14 (1.66, 2.75)**	**1.85 (1.42, 2.41)**
Randomization group, control		1.05 (0.80, 1.38)	1.07 (0.82, 1.40)

Bold text indicates statistical significance at p < 0.05 level. Time included as covariate in both unadjusted and adjusted models. Asterisk (*) indicates all models adjusted for age, gender, marital status, education, time since HIV diagnosis, CD4 count, current antiretroviral therapy, depressive symptoms, randomization group and time. Double asterisk (**) indicates models additionally adjusted for overall social support

Table 3 Longitudinal analyses evaluating the association between HIV stigma and secondary substance use outcomes among HERMITAGE participants (n = 700)*

Characteristic	Any heroin or stimulant use, past 30 days		Risky alcohol use, past 30 days		Substance use disorder, past 12 months	
	Adjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)**	Adjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)**	Adjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)**
HIV stigma (time-varying)	**0.77 (0.60, 0.99)**	**0.72 (0.55, 0.93)**	0.83 (0.65, 1.07)	0.83 (0.65, 1.07)	1.15 (0.81, 1.63)	1.08 (0.76, 1.53)
Overall social support, per 10 point increase (time-varying)		**0.82 (0.77, 0.87)**		0.97 (0.91, 1.03)		**0.85 (0.79, 0.91)**
Age	0.98 (0.95, 1.01)	0.98 (0.95, 1.00)	0.99 (0.97, 1.01)	0.99 (0.97, 1.01)	**0.96 (0.94, 0.99)**	**0.96 (0.93, 0.99)**
Female	0.96 (0.72, 1.27)	0.94 (0.70, 1.26)	**0.61 (0.47, 0.79)**	0.61 (0.47, 0.78)	**0.53 (0.38, 0.74)**	**0.52 (0.37, 0.73)**
Married or partnered	**0.67 (0.49, 0.90)**	0.78 (0.58, 1.07)	**1.36 (1.05, 1.77)**	**1.41 (1.08, 1.84)**	0.80 (0.58, 1.11)	0.89 (0.64, 1.24)
>9th grade education	0.83 (0.59, 1.16)	0.84 (0.59, 1.19)	0.86 (0.64, 1.15)	0.86 (0.64, 1.15)	0.69 (0.46, 1.04)	0.68 (0.45, 1.03)
≥3.9 years since HIV diagnosis	1.19 (0.91, 1.57)	1.23 (0.93, 1.63)	**0.74 (0.58, 0.95)**	**0.74 (0.58, 0.95)**	0.79 (0.58, 1.08)	0.84 (0.61, 1.15)
CD4 count ≤350 cells/mm^3	**1.60 (1.06, 2.42)**	**1.60 (1.05, 2.44)**	1.02 (0.66, 1.60)	1.03 (0.66, 1.60)	0.75 (0.46, 1.22)	0.74 (0.45, 1.21)
Current antiretroviral therapy (time-varying)	**0.28 (0.16, 0.49)**	**0.29 (0.16, 0.52)**	0.96 (0.56, 1.65)	0.97 (0.56, 1.67)	**0.58 (0.34, 0.99)**	0.60 (0.34, 1.04)
Depressive symptoms (time-varying)	**2.99 (2.32, 3.85)**	**2.54 (1.95, 3.31)**	**1.43 (1.12, 1.82)**	**1.38 (1.08, 1.77)**	**3.48 (2.55, 4.76)**	**3.10 (2.26, 4.25)**
Randomization group, control	1.08 (0.82, 1.44)	1.13 (0.85, 1.50)	0.98 (0.76, 1.25)	0.98 (0.77, 1.26)	0.94 (0.69, 1.29)	0.95 (0.69, 1.30)

Bold text indicates statistical significance at p < 0.05 level. Asterisk (*) indicates all models adjusted for age, gender, marital status, education, time since HIV diagnosis, CD4 count, current antiretroviral therapy, depressive symptoms, randomization group and time. Double asterisk (**) indicates models additionally adjusted for overall social support

consistent after adding overall social support to the models, suggesting social support may not be a mediator of the relationship between HIV stigma and substance use (Table 2 and 3). These results were confirmed using structural equation models where tests of mediation were not statistically significant (p-values for test of mediation: 0.29 [Unhealthy substance use]; 0.61 [Any heroin or stimulant use]; 0.22 [Risky alcohol use]; 0.13 [Substance use disorder]). Additionally, social support did not appear to be a moderator of the relationship between HIV stigma

and unhealthy substance use (p value for interaction = 0.99). Findings were consistent in sensitivity analyses when we excluded depressive symptoms from the models.

Discussion

Our study, conducted in a unique cohort of HIV-positive Russians with risky alcohol use, serves to complement and extend the existing literature. First, in bivariate analyses, high HIV stigma appeared to be significantly associated with older age, female gender, depressive symptoms and lower social support, however, these analyses did not control for confounding factors. Second, contrary to our hypothesis, in this cohort HIV stigma does not appear to be associated with unhealthy substance use and also was not a consistent contributor to substance use. Third, social support does not appear to be a mediator or moderator of the relationship between HIV stigma and substance use.

Our findings compare and contrast with prior data examining factors associated with high HIV stigma in different study populations. For example, a meta-analysis of 24 studies conducted and published in North America between 2000 and 2007 found that HIV stigma was consistently and significantly associated with younger age, poor mental health and lack of social support [55]. In the current study, while those participants with high HIV stigma were found to be statistically significantly older, the mean age of the groups among those with low versus high stigma were not meaningfully different. In addition, differences in the observed findings may relate to the fact that our sample includes a relatively young, Russian cohort with risky alcohol use. Consistent with our findings, in clinic-based samples of PLWHA, women consistently report higher HIV stigma scores [56, 57]. Similarly, in a sample of US-based PLWHA with current non-injection drug use and antiretroviral therapy diversion (i.e., unlawful sale and trading of medications), depressive symptoms and lower social support scores also correlated with high HIV stigma [58]. Our findings reinforce previous findings that efforts to address HIV stigma should account for gender differences between men and women and address both depressive symptoms and social support to be maximally effective. Although addressing HIV stigma may not directly translate into reduced substance use among HIV-positive Russians with risky alcohol use, prior research supports the importance of HIV stigma reduction interventions to promote health and use of HIV services [59].

Unexpectedly, we did not observe a consistent association between HIV stigma and the measures of substance use despite use of a longitudinal design, incorporating both time-varying measures of HIV stigma and repeated measures of substance use. These findings may be explained by several factors. First, our sample included individuals who engage in risky behaviors; however, the association between HIV stigma and substance use may be different among PLWHA who do not engage in risky behaviors. Second, the Berger HIV-related stigma scale was developed in U.S.-based populations and may not capture stigma experiences with the appropriate language of individuals living in Russia [42] as it was not cross-culturally adapted to ensure cultural and linguistic relevance [60]. Additionally, unlike some prior research which has evaluated stigma scores as a continuous measure [61, 62], we dichotomized scores at the 75th percentile to promote ease of interpretation. However, the findings of this approach were confirmed in supplementary analyses when we categorized the overall HIV stigma score in quintiles. Third, we focused specifically on HIV stigma and not other stigma-related experiences, (e.g., substance use stigma [63]), which has been found to have important interactive effects in the Russian context [22]. Fourth, since these individuals were recruited from hospitals and other clinical settings with opportunity for education about HIV and harms associated with substance use, HIV stigma may have not have manifested in substance use. Lastly, we did not examine whether the association between HIV stigma and substance use varies by mode of substance use (e.g., injection vs. non-injection).

Our findings notwithstanding, recent studies illustrate the negative impact of HIV stigma among PLWHA living in Russia. In a cross-sectional study of HIV-positive Russians with recent injection drug use (n = 381), higher HIV stigma was associated with poor self-reported health status and symptoms, CD4 cell count less than 350 cells/mm^3, and a lower probability of regular HIV and addiction treatment [22, 50]. These investigators also examined the interactive effects of substance use stigma and reported that those with both high internalized HIV stigma and substance use stigma had the highest symptom counts, yet were least likely to report regular HIV or addiction treatment [22]. Recent qualitative analyses conducted in Russia highlight the dramatic and adverse effects of HIV stigma and substance use stigma, alike, on hindering access to appropriate HIV and addiction treatment services [33, 64].

Our study has several limitations. First, our findings may not be generalizable to PLWHA who do not report risky alcohol use. Second, we relied on self-reported measures of substance use. Third, our assessment of HIV stigma, the abbreviated Berger scale [41, 42], was developed with U.S.-based populations and may not capture the experiences of PLWHA in Russia. Fourth, our measure of social support does not account for community-based social support. Lastly, our sample may not be generalizable to PLWHA who are unwilling to participate in a randomized

controlled trial focused on promoting healthy relationships. These concerns are mitigated by the fact that only 3% (29/921) of screened individuals refused enrollment [38].

Despite these limitations, our study has important implications. First, our study suggests that interventions designed to decrease HIV stigma should carefully account for gender and address both depressive symptoms and social support. Although high quality interventions to address HIV stigma have been conducted in diverse international settings, such efforts have been lacking in Russia [59]. Second, our findings suggest that HIV stigma's role on substance use among people with risky drinking may benefit from qualitative study to provide an in-depth understanding of these complex relationships. Lastly, given the interactive effects of stigma identities on each other, future studies should examine the longitudinal associations of HIV and substance use stigma among PLWHA in Russia to inform the gravely needed political and social changes to promote the update of HIV and addiction services in this high risk population.

Compliance with Ethical Standards

Conflicts of interest The authors have no conflicts of interest to disclose.

Ethical Approval All procedures performed in studies involving human participants 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. The HERMITAGE study was approved by the Institutional Review Boards of Boston University and First St. Petersburg Pavlov State Medical University. All participants provided written informed consent.

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