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Does Perceived Life Stress Mediate the Association between HIV Status and Alcohol Use? Evidence from Adults Living in Cape Town, South Africa

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Abstract

South Africa has the highest prevalence of HIV in the world. Because living with HIV is stressful and because alcohol consumption is often used to cope with stress, we examined whether stress mediates the association between HIV status and alcohol use among adults residing in South African townships. Field workers approached pedestrians or patrons of informal alcohol-serving venues (i.e., shebeens) and invited their participation in a survey. Of the 1,717 participants (98% Black, 34% women, mean age = 31), 82% were HIV-negative, 9% were HIV-positive, and 9% did

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not know their test result. Participants living with HIV reported greater perceived life stress compared to participants whose HIV status was negative or unknown. Perceived stress was associated with increased alcohol use (frequency of drinking days, frequency of intoxication, and frequency of drinking in shebeens/taverns). Subsequent analyses showed that stress mediated the association between HIV status and alcohol use. These findings indicate that greater frequency of drinking days, perceived intoxication, and drinking at shebeens was associated with elevated stress levels among participants who were HIV-positive. Perceived life stress mediates the association between HIV status and alcohol use. Programs to enhance stress management among HIV-positive South Africans may help to reduce alcohol consumption which may, in turn, lead to reduced rates of HIV transmission.

Keywords

alcohol; stress; HIV; South Africa; mediation

Rapid social and economic change as well as a raging HIV epidemic has caused considerable psychosocial stress in South Africa. The South African Stress and Health Study, a nationally representative sample of adults found that South Africans experience high rates of trauma (Williams et al., 2007). Research also documents an association between exposure to stressful life events and increased alcohol use (Brook, Rubenstone, Zhang, Morojele, & Brook, 2011). Alcohol use is common among South Africans living with HIV (Kiene et al., 2008) and is often used as an emotion-focused coping mechanism in response to stress (Olley, Zeier, Seedat, & Stein, 2005). Living with a stigmatizing condition, as well as the discrimination that HIV-positive South Africans have experienced, increases their risk for psychological distress (Simbayi et al., 2007; Wingood et al., 2008). Thus environmental and social stressors, as well as the stress associated with living with a chronic disease, may increase alcohol use and undermine health (Kalichman, Simbayi, Jooste, Cherry, & Cain, 2005).

This study tests whether perceived life stress (PLS) mediates the association between HIV status and alcohol use among South African adults. We use an innovative methodological approach to examine the indirect and direct effects of mediation with a multicategorical independent variable (Hayes & Preacher, 2011). Three hypotheses were tested. First, we expected that participants living with HIV would report greater stress than those who tested negative or were unaware of their HIV status. Second, we expected stress to be associated with alcohol use such that participants with elevated stress would consume more alcohol, engage in heavy (binge) alcohol use (defined as consuming five or more drinks at a time at least 1 day in the past 30 days; (Substance Abuse and Mental Health Services Administration, 2010), perceive that they were intoxicated, and drink at shebeens more frequently. Finally, we expected an association between HIV status and alcohol use mediated by stress. Determining whether stress mediates the HIV—alcohol use association will improve understanding of the association, allowing health care providers to develop programs to reduce alcohol consumption, and ultimately HIV transmission, in South Africa.

Method

Participants and Procedures

Baseline data from a randomized community-level study (NIH R01-AA017399, *Multilevel Alcohol-HIV/AIDS Prevention in South Africa*) were used to test our hypotheses.

Participants were 1,717 residents (mean age = 31; 34% women) from one of three Xhosa-speaking townships in Cape Town, who reported having ever been tested for HIV (70% of the sample). Between June 2008 and July 2011, field workers (12 ethnically-matched residents of the communities) used street intercept methods (i.e., a method of obtaining a representative sample within a specific geographical area; (Miller, Wilder, Stillman, & Becker, 1997) to sample from twelve non-contiguous neighborhoods within the townships. Field workers approached pedestrians or shebeen (i.e., informal alcohol-serving venues) patrons and invited them to complete a brief survey, described as “research regarding HIV/AIDS that may benefit your community.” Interested individuals (95% approval rate) provided verbal consent and completed an anonymous survey in exchange for a non-monetary gift (a keychain). Surveys were typically self-administered in the participants’ preferred language; however, if a participant did not possess adequate literacy skills, the surveys were administered by the field worker as an interview (3% of the sample). All procedures were approved by the Institutional Review Boards of participating institutions.

Measures

HIV Status—HIV status was assessed using two items: (a) Have you ever been tested for HIV? (yes, no) and (b) If you have been tested, what were the results of your most recent test? (positive, negative, don’t know, refuse to answer). Responses were used to categorize people into groups based on whether they had ever been tested for HIV (1 = yes, 0 = no) and HIV status (2 = positive, 1 = negative, 0 = unknown/refuse to answer). Only participants who responded to the question regarding their test result were included in the analyses.

Perceived Life Stress

Participants completed the *Perceived Stress Scale* (PSS) which measures the extent to which an individual perceives situations to be stressful during the past month (S. Cohen, Kamarck, & Mermelstein, 1983). We used the 4-item version, a valid and reliable measure of stress (S. Cohen & Williamson, 1988). The PSS has been used to identify individuals’ perceptions of stressful life experiences in number of countries such as South Africa, China, and Mexico (Hamad, Fernald, Karlan, & Zinman, 2008; Liu et al., 2007; Ramirez & Hernandez, 2007). Participants rated each item using a 5-point scale ranging from *never* (0) to *very often* (4). Responses for the positively valenced items were reverse coded. Scores range from 0 to 16; higher scores indicate greater PLS.

Alcohol Use

Participants were asked about their alcohol use using culturally adapted definitions of standard drinks. We first examined whether participants had ever consumed alcohol using two items. Participants were asked if they had “at least 1 drink of any kind of alcohol” in their entire life or within the past year (yes, no). Past 30 day frequency of drinking behaviors

was assessed with four separate questions. Participants were asked about the frequency of (1) drinking days (“how many days did you drink an alcoholic beverage”), (2) heavy drinking (“how many times during the past 30 days did you have 5 or more drinks on an occasion”), (3) perceived intoxication (“how often did you drink enough to feel intoxicated or drunk, that is, when your speech was slurred, you felt unsteady on your feet, or you had blurred vision”), and (4) drinking in shebeens (“how often did you drink in public places such as bars, taverns, or shebeens”). Participants’ responses for the frequency items were assessed using a 7-point scale ranging from *never* (0) to *nearly every day* (6).

Data Management and Analysis

Summary statistics (means, standard deviations, frequencies) were used to describe sample characteristics, PLS, and alcohol use for the overall sample and by sex and HIV status. Differences in HIV status were examined using bivariate analyses (chi-square tests or one-way analysis of variance). Demographic variables that differed significantly by status were included as covariates in subsequent analyses. Pearson’s correlations were calculated to assess the association between perceived stress and the four alcohol consumption measures (frequency of drinking days, heavy drinking, perceived intoxication, shebeen/tavern patronage).

To test our predictions, mediational analyses were conducted. In a simple mediation model (Baron & Kenny, 1986), mediation occurs when the influence of the independent variable (X) on the dependent variable (Y) is through a mediating variable (M). Both the *indirect* and *direct* effects of X are estimated. When X is a multicategorical causal agent, the indirect and direct effects of X cannot be estimated using standard procedures (Hayes & Preacher, 2011). To represent the effects of a categorical X on Y, each group (k) must be represented in the model. This requires dummy coding the groups such that one group is designated as the reference group for $k-1$ groups. In the current study, HIV status is a categorical variable; therefore, we used Hayes and Preacher’s (2011) macro to assess the relative indirect and direct effects of a mediational model with a multicategorical independent variable (see Figure 1). Estimation of the relative indirect and direct effects with a multicategorical variable generates multiple coefficients for $k-1$ groups (i.e., paths a_i and c'_i). Finally, Hayes and Preacher’s macro allows users to more accurately estimate the indirect effect of the mediator by using bootstrapping procedures to repeatedly estimate coefficients (at least 5,000 resamples are recommended) to approximate the sampling distribution.

Four separate mediational models tested our hypothesis that PLS would mediate the association between HIV status and the four alcohol consumption measures. In each model, we controlled for demographic variables that differed by HIV status. All continuous predictor variables were mean centered to reduce the possibility of multicollinearity among predictors; the multicategorical independent variable and dichotomous variables were dummy (D) coded to ease interpretation of the findings (J. Cohen, Cohen, West, & Aiken, 2003). As shown in Figure 1, D_1 represents participants who reported an unknown HIV status, D_2 represents participants who reported an HIV negative status, and participants reporting an HIV positive status were the reference group (coded as zero on both D_1 and D_2). To obtain estimates of the indirect effects, we used bootstrapping procedures based on

10,000 resamples. Statistical significance was determined using 95% confidence intervals (CIs). A significant indirect effect is found if the CIs exclude zero.

Results

Characteristics of the Sample

Analyses were restricted to the 1,717 (out of 2,469) men and women who reported their most recent test result. (Of the 1,723 participants who had been tested for HIV, 6 men did not provide the results of their most recent test and were excluded from subsequent analyses.) As shown in Table 1, most participants identified as Black African and were men (66%) with a mean age of 31 years ($SD = 8$, range = 18 to 54 years). Twenty percent were married; most (79%) reported having at least one child; (54%) was employed; 55% reporting having at least a high school education. Most (95%) had perceived some stress in the past month ($M = 6.40$, $SD = 2.86$; range = 0 to 15). Participants reported consuming alcohol at least once in the past year (77%); on average, they drank once a week in the past month ($M = 2.90$, $SD = 2.01$) and reported heavy consumption twice in the past 30 days ($M = 2.10$, $SD = 1.97$). Fewer participants reported feeling intoxicated in the past month ($M = 1.19$, $SD = 1.61$). On average, participants reporting drinking in public places 2–3 times per week in the past month ($M = 2.57$, $SD = 2.03$).

HIV Status

Differences in study characteristics by HIV status were examined (see Table 1). Most participants reported receiving a negative (82%) test result; 9% were HIV-positive while 9% reported not knowing their HIV test result and/or refusing to answer. There were no differences among HIV status groups on marital status, number of children, or employment. People living with HIV were significantly older than people with an HIV-negative or unknown status. Compared to participants with a negative or unknown status, HIV-positive participants were more likely to be female but less likely to be Black African or report having a high school education. Therefore, we controlled for age, sex, ethnicity, and education in the mediation models.

Associations between HIV Status, Perceived Life Stress, and Alcohol Use

Preliminary analyses tested whether (1) participants living with HIV reported greater stress than those who tested negative or were unaware of their HIV status (Hypothesis 1) and (2) PLS was associated with alcohol use (Hypothesis 2). These analyses were followed by tests of mediation. Statistical mediation with a multicategorical independent variable was used to test our hypothesis that PLS mediates the association between HIV status and alcohol use (Hypothesis 3).

Hypothesis 1—Results from the ANOVA revealed significant differences on perceived stress scores by HIV status. As shown in Table 1, post hoc tests using Scheffé method (1953) indicated that participants living with HIV reported significantly more stress than participants who were HIV negative or were unaware of their HIV status, $ps < .02$.

Hypothesis 2—An association between PLS and alcohol use was determined using correlation coefficients (Pearson r). Perceived stress scores were positively associated with frequency of drinking days ($r = 0.07, p = .004$), perceived intoxication ($r = 0.17, p < .001$), and shebeen/tavern patronage ($r = 0.05, p = .044$). Perceived stress was not associated with the frequency of heavy episodic drinking ($r = -0.03, p = .222$).

Hypothesis 3—We tested a mediation model with a multicategorical independent variable (Figure 1), controlling for age, sex, ethnicity, and education. Results for frequency of drinking days, heavy episodic drinking, perceived intoxication, and drinking at shebeens are presented in Table 2. For each model (except for the frequency of heavy episodic drinking), all relative direct and total effects for comparisons between participants with an unknown vs. HIV-positive status are significantly different from zero (all $ps < .05$). These findings indicate participants with an unknown HIV status, compared with participants who were HIV-positive, reported more frequent alcohol use, regardless of perceived stress levels. For all dependent variables, people with an unknown HIV status reported *less* perceived stress (approximately 1 point lower on the PSS4) than those with an HIV positive status. HIV-negative participants also experienced less stress than HIV-positive participants (approximately 1.5 points lower on the PSS4). Controlling for HIV status, participants who reported more perceived stress also reported *more* frequent drinking days ($\beta = 0.05, p = .005$), perceived intoxication ($\beta = 0.09, p < .001$), and drinking at shebeens ($\beta = 0.03, p = .045$). Perceived stress did not impact the frequency of heavy episodic drinking ($\beta = -0.24, p = .111$). The bootstrapping tests of the relative indirect effects (based on 10,000 resamples and 95% confidence intervals) indicated that perceived stress mediated the association between HIV status and alcohol use. Relative to participants with an HIV positive status, having an HIV unknown status indirectly *decreases* the frequency of drinking days (95% CI = $-0.10, -0.01$), perceived intoxication (95% CI = $-0.16, -0.04$), and drinking at shebeens (95% CI = $-0.08, -0.01$) but not the frequency of heavy episodic drinking (95% CI = $-0.01, 0.07$) through perceived stress. The same pattern of results was found when comparing HIV-negative with HIV-positive participants: perceived stress mediated the association between HIV-status and frequency of drinking days (95% CI = $-0.12, -0.02$), perceived intoxication (95% CI = $-0.19, -0.08$), and drinking at shebeens (95% CI = $-0.11, -0.01$) but not the frequency of heavy episodic drinking (95% CI = $-0.01, 0.09$).

DISCUSSION

South Africans experience high rates of alcohol use, HIV, and psychological trauma (Peltzer, Davids, & Njuho, 2011; UNAIDS, 2010; Williams et al., 2007). Widespread poverty, rapid social restructuring and economic changes, and a persistent HIV epidemic conspires to elevate stress among South Africans. In this study, we examined whether PLS mediates the association between HIV status and alcohol use among South African adults. We found that (a) South Africans living with HIV report greater stress, (b) perceived stress is associated with alcohol use, and (c) PLS mediates the association between HIV status and alcohol use. HIV-positive South Africans reported more stressed than those with an unknown or negative HIV status and this stress was indirectly associated with an increase in the frequency of drinking days, perceived intoxication, and drinking at shebeens/taverns.

South Africans living with HIV experience significant levels of emotional distress, trauma, and diminishing quality of life (Olley, Seedat, & Stein, 2006; Olley et al., 2005; Young, 2011). Consistent with these findings, our research showed that participants with an HIV-positive status experienced *more* stress than participants who were HIV-negative or unaware of their HIV status. Regardless of participants' HIV status, perceived stress was associated with greater alcohol use. Consistent with prior research (Kalichman, Simbayi, Kaufman, Cain, & Jooste, 2007), our study shows that alcohol is commonly used as a means of coping with stress and that uncertainty regarding one's HIV status increased alcohol use regardless of participants' level of stress. Prior research in South Africa, the United States, and Uganda shows that people who consume alcohol are less likely to have been tested for HIV (Fatch et al., 2012; Fenton, Leggio, Kenna, & Swift, 2010; Peltzer, Mlambo, & Phaweni, 2010), suggesting that novel approaches to increase testing among South Africans who consume alcohol should be implemented. Those promoting testing will need to consider the possibility that testing positive for HIV may lead to increased distress and negative health outcomes.

Alcohol consumption has been associated with higher rates of sexual risk behaviors that increase the risk of HIV (Kalichman et al., 2007). Identifying factors that increase alcohol consumption among people living with HIV is a priority. Research also shows that consuming alcohol is a common coping mechanism for a variety of psychosocial stressors, including stress associated with living with HIV (Sikkema et al., 2011; Thompson, Nanni, & Levine, 1996). Findings from our study suggest that programs to enhance stress management among HIV-positive South Africans may help to reduce alcohol consumption which may, in turn, lead to reduced rates of HIV. A number of stressors, in addition to HIV, such as unemployment and community violence, may impact the risk for HIV (Kalichman, Simbayi, Kagee, Toefy, Cain, et al., 2006). Of course, because HIV is not the only stressor that South African's may be experiencing, interventions for people living with HIV should address multiple stressors at the individual, community, and structural levels (Kalichman, 2010; Kalichman, Simbayi, Kagee, Toefy, Jooste, et al., 2006).

Limitations

Four limitations should be kept in mind when interpreting these findings. First, data were gathered from self-reports; to minimize socially desirable responding, field staff emphasized that all data were anonymous. Second, the PSS measures generalized perceptions of stress rather than specific stressors (e.g., housing) that have been shown to impact South Africans' alcohol use (Kalichman, Simbayi, Kagee, Toefy, Jooste, et al., 2006). We used the PSS in our research because it is a brief measure with good reliability and validity with international samples. Research might examine the HIV-alcohol association with more fine-grained measures. Third, the respondents sampled may not be representative of the larger community; however, we used a methodology that provides access to a wide range of community members and minimizes the self-selection bias often seen with clinical recruitment (Miller et al., 1997). Fourth, cross-sectional data cannot support causal inferences. Longitudinal data can provide stronger evidence regarding the impact of stress on alcohol consumption among people living with HIV.

Conclusions

The current study showed that PLS mediates the association between HIV status and alcohol use. These results extend the findings from prior research to show that PLS mediates the association between HIV other alcohol-related behaviors (i.e., perceptions of intoxication, shebeen patronage) in South Africans. Stress management interventions, which have been shown to improve mental health and quality of life among HIV-positive adults (Crepaz et al., 2008; Scott-Sheldon, Kalichman, Carey, & Fielder, 2008), should be a priority in emerging health care delivery systems in South Africa.

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Figure 1.

The mediational model used to test our prediction that perceived stress mediates the association between HIV serostatus and alcohol use. *D* represents the dummy variables for HIV-status. Subscripts represent the dummy coded contrasts between participants reported status of HIV-unknown (1) and HIV-negative (2) versus HIV-positive. Path *a* represents the direct association between HIV status and perceived stress, path *b* represents the direct association between perceived stress and alcohol use, and path *c'* represents the relative direct effect of HIV status on alcohol use controlling for perceived stress.

Table 1

Characteristics of the Sample Overall and by HIV Status

Variables	Overall (N = 1,717)	HIV-positive (n = 150)	HIV-negative (n = 1,413)	HIV-unknown (n = 154)	Test for Differences
Demographics					
Age	30.64 (8.16)	32.83 (8.10) ^{ab}	30.50 (8.26) ^a	29.76 (6.91) ^b	$F(2, 1713) = 6.57, p = .001$
Sex (% women)	34%	46%	34%	27%	$\chi^2(2) = 12.47, p = .002$
Ethnicity (% Black)	98%	96%	99%	99%	$\chi^2(2) = 6.75, p = .034$
Married (% yes)	20%	16%	21%	18%	$\chi^2(2) = 2.03, p = .363$
Children (% 1 child)	79%	87%	78%	77%	$\chi^2(2) = 5.73, p = .057$
Employed (% yes)	54%	48%	55%	48%	$\chi^2(2) = 5.14, p = .077$
Education (% high school)	55%	44%	57%	45%	$\chi^2(2) = 15.02, p = .001$
Perceived Stress Scale					
	6.40 (2.87)	7.70 (2.46) ^{ab}	6.22 (2.90) ^{ac}	6.78 (2.58) ^{bc}	$F(2, 1714) = 19.90, p < .001$
Alcohol Consumption					
Lifetime (% ever used)	82%	89%	80%	88%	$\chi^2(2) = 9.91, p = .007$
Current (% in past year)	77%	73%	76%	85%	$\chi^2(2) = 6.77, p = .034$
Drinking days (frequency)	2.90 (2.01)	2.81 (2.17) ^a	2.83 (2.00) ^b	3.69 (1.80) ^{ab}	$F(2, 1696) = 12.88, p < .011$
Heavy episodic drinking (frequency)	2.10 (1.97)	2.15 (2.11) ^a	2.01 (1.93) ^b	2.84 (1.96) ^{ab}	$F(2, 1652) = 12.33, p < .001$
Perceived intoxication (frequency)	1.19 (1.61)	1.33 (1.68) ^a	1.09 (1.55) ^b	1.92 (1.90) ^{ab}	$F(2, 1687) = 19.07, p < .001$
Shebeen patronage (frequency)	2.57 (2.04)	2.34 (2.06) ^a	2.50 (2.03) ^b	3.38 (1.92) ^{ab}	$F(2, 1927) = 6.38, p = .002$

Note. Unadjusted means (SD) are provided. Means that share subscripts within each row are significantly different at $p < .05$ using Scheffé's method.

Table 2
Perceived Stress as a Mediator of the Association between HIV Status and Alcohol Use (N = 1,717)

Dependent Variable		Mediator Estimate (SE)	Total Effect Estimate (SE)	Direct Effect Estimate (SE)	Indirect Effect Estimate (95% CI)
Drinking days (frequency)	Constant	2.43 (0.61)	2.68 (0.42)	2.57 (0.42)	
	D ₁ a ₁	-1.01 (0.33)	0.68 (0.23)	c' ₁ 0.73 (0.02)	a ₁ b -0.05 (-0.10, -0.01)
	D ₂ a ₂	-1.45 (0.25)	c ₂ -0.09 (0.17)	c' ₂ -0.03 (0.17)	a ₂ b -0.07 (-0.12, -0.02)
	Perceived Stress		b	0.05 (0.02)	
Heavy episodic drinking (frequency)	Constant	2.41 (0.61)	2.07 (0.42)	2.14 (0.42)	
	D ₁ a ₁	-1.00 (0.33)	0.61 (0.23)	c' ₁ -0.03 (0.02)	a ₁ b 0.03 (-0.01, 0.07)
	D ₂ a ₂	-1.44 (0.25)	c ₂ -0.20 (0.17)	c' ₂ 0.58 (0.23)	a ₂ b 0.04 (-0.01, 0.09)
	Perceived Stress		b	-0.24 (0.17)	
Perceived intoxication (frequency)	Constant	2.26 (0.61)	1.15 (0.34)	0.95 (0.34)	
	D ₁ a ₁	-1.03 (0.33)	0.49 (0.18)	c' ₁ 0.58 (0.18)	a ₁ b -0.09 (-0.16, -0.04)
	D ₂ a ₂	-1.47 (0.25)	c ₂ 0.28 (0.14)	c' ₂ -0.15 (0.14)	a ₂ b -0.13 (-0.19, -0.08)
	Perceived Stress		b	0.09 (0.01)	
Drinking at shebeens (frequency)	Constant	2.24 (0.62)	1.88 (0.43)	1.80 (0.43)	
	D ₁ a ₁	-1.03 (0.33)	0.80 (0.23)	c' ₁ 0.84 (0.23)	a ₁ b -0.03 (-0.08, -0.01)
	D ₂ a ₂	-1.47 (0.25)	c ₂ 0.01 (0.17)	c' ₂ 0.06 (0.17)	a ₂ b -0.05 (-0.11, -0.01)
	Perceived Stress		b	0.03 (0.02)	

Note. Unstandardized regression coefficients and corresponding standard errors from each mediator model are presented. Sex (1 = men, 0 = women), age (mean centered), ethnicity (1 = Black, 0 = other), and education (1 = high school or more, 0 = lower than high school) were included as covariates in the models. Consistent with Figure 1, *a* represents the direct association between HIV status and perceived stress, *b* represents the direct association between perceived stress and alcohol use, *c* represents the relative total effect of HIV status and alcohol use (perceived stress excluded), and *c'* represents the relative direct effect of HIV status and alcohol use, controlling for perceived stress. *D* represents the dummy variables for HIV-status. Subscripts represent the dummy coded contrasts between participants reported status of HIV-unknown (1) and HIV-negative (2) versus HIV-positive. Bold coefficients are significant at the *p* < .05 level.