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Authors

Gamarel, KE
Neilands, TB
Dilworth, SE
et al.

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K.E. Gamarel[1], **T.B. Neilands**[2], **S. E. Dilworth**[2], **J.M. Taylor**[2], and **M.O. Johnson**[2]

[1]Department of Psychiatry and Human Behavior, Alpert Medical School of Brown University

[2]Department of Medicine, University of California, San Francisco

Abstract

High rates of cigarette smoking have been observed among HIV-positive individuals. Smoking has been linked to HIV-related medical complications, non-AIDS defining cancers, and negatively impacts on immune function and virologic control. Although internalized heterosexism has been related to smoking behaviors, little is known about associations between partners' reports of smoking, internalized heterosexism, and HIV medication management in male couples with HIV. A sample of 266 male couples completed baseline assessments for a cohort study examining relationship factors and HIV treatment. A computer-based survey assessed self-reported smoking behaviors, alcohol use, internalized heterosexism, and antiretroviral therapy (ART) adherence. HIV-positive men also provided a blood sample to assess viral load. Approximately 30% of the sample reported currently smoking cigarettes. After adjusting for demographic characteristics, men in a primary relationship with a partner who reported currently smoking had more than five-fold greater odds of reporting smoking. Higher levels of internalized heterosexism and financial hardship were each independently associated with greater odds of reporting smoking. Among HIV-positive men on ART (n = 371), having a partner who reported smoking was associated with almost a three-fold greater odds of having a detectable viral load. Our findings add new support to the evidence of romantic partners influencing each other's health behaviors, and demonstrate an association between smoking and disease management within male couples. Future research should explore the interpersonal and social contexts of smoking in order to develop interventions that meet the unique needs of male couples.

High rates of smoking (40–57%) have been observed in community samples of HIV-positive cohorts (Lifson et al., 2010). Smoking has been associated with an increased likelihood of HIV-related medical complications, including bacterial pneumonia, HIV-related pulmonary emphysema, and AIDS dementia (Humfleet, Hall, Delucchi, & Dilley, 2013). Daily tobacco use has also been shown to negatively impact immune and virologic response and the effect of antiretroviral therapies (ART) (O'Cleirigh et al., 2014). In addition, studies have observed high rates of non-AIDS defining cancers among HIV-positive adults (Grulich, van Leeuwen, Falster, & Vajdic, 2007).

Correspondence regarding this article should be addressed to Kristi E. Gamarel, Department of Psychiatry and Human Behavior, Alpert Medical School of Brown University, Providence, RI 02903 kristi_gamarel@brown.edu.

Available data on smoking cessation among HIV-positive individuals indicate that cessation rates are low (Humfleet et al., 2013). HIV-positive individuals must cope with many demands to manage health and psychological adjustment to HIV. Stressors such as internalization of negative messages about one's sexual identity or expression can lead to maladaptive coping responses such as substance use, and have been associated with tobacco use in samples of men who have sex with men (MSM) (Pachankis, Hatzenbuehler, & Starks, 2014). This internalized heterosexism has also been associated with stimulant use and HIV disease management among HIV-positive MSM (Johnson, Carrico, Chesney, & Morin, 2008).

Coupled partners may influence each other's health behaviors such that an individual's smoking status has a strong effect on their romantic partner's smoking behaviors and cessation success (Christakis, & Fowler, 2008). Couples in which both members smoke (i.e., dual smokers) have lower quit rates and higher relapse rates {Ferguson, Bauld, Chesterman, & Judge, 2005; Garvey, Bliss, Hitchock, Heinold, & Rosner, 1992; Palmer, Baucom, & McBride, 2000), and each person's health risks are amplified due to exposure to their partner's smoking (Reardon, 2007; U.S. Department of Health and Human Services, 2006). The purpose of this study was to (1) investigate the associations between internalized heterosexism and partner's smoking behaviors on one's own smoking behaviors, and (2) examine associations between both partners' internalized heterosexism and smoking behaviors on HIV disease management among male couples.

Methods

Participants and Procedures

Participants were 266 couples (532 men) who completed baseline assessments as part of a longitudinal study examining the role of relationship factors on HIV treatment among HIV-positive men in same-sex couples. Details on sample eligibility and enrollment are reported elsewhere (Johnson et al., 2012). Couples were recruited in the U.S. San Francisco Bay Area using passive recruitment methods. Both partners attended the interview appointment together, but completed consent forms and computerized surveys separately.

Measures

Sociodemographics—Participants reported their age, sexual identity, race and ethnicity, HIV serostatus (positive or negative), education level and income level. Participants also provided the duration of the primary relationship (in years) and HIV-positive partners reported length of time since initiating ART (in years).

Internalized Heterosexism—Internalized heterosexism was assessed via four items used in prior studies with MSM and demonstrated reliability within this sample (Cronbach's alpha or $\alpha = 0.75$) (Johnson et al., 2008; Nungesser, 1983).

Smoking—Participants reported their current smoking status and the number of cigarettes they typically smoke per day. These data were recoded and dichotomized as smokers (1) and non-smokers (0).

Alcohol Use—Alcohol use was assessed with the 10-item Alcohol Use Disorders Identification Test (AUDIT) (Saunders, Aasland, Babor, de la Fuente, & Grant, 1993).

Stimulant Use—Participants reported how often they used powder cocaine, crack, or methamphetamine in the past three months. Reponses ranged from 0 (not at all) to 7 (daily) and were recoded to indicate any stimulant use (1) versus no stimulant use (0).

Depressive Symptoms—The 20-item Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff, 1977) was used to measure depressed mood in the past week ($\alpha = 0.91$).

HIV Disease Management—ART adherence was assessed using two self-report measures. The AIDS Clinical Trials Group (ACTG) measure provides the percentage of ART medications taken over the course of the prior three days (Chesney, Morin, & Sherr, 2000). The Visual Analog Scale (VAS) measures the proportion of ART medications taken in the past 30 days (Walsh, Sundhuya, Gazzard, 2002). Adherence was dichotomized to indicate 100% adherence (1) versus less than 100% adherence (0).

HIV Viral Load—HIV viral load assays were performed to detect HIV RNA at or above 20 copies/mL (Roche Molecular Systems, Inc.). Viral load was dichotomized as detectable (1) versus undetectable (0).

Statistical Analyses

Models examining the association between internalized heterosexism, smoking, and HIV disease management were conceptualized using the Actor-Partner Interdependence Model (APIM) (Kenny, Kashy, & Cook, 2006). To examine correlates of smoking, internalized heterosexism was included as a predictor of smoking behavior (i.e., actor effects). Smoking behavior and internalized heterosexism of the primary partner were included as predictors of the actor's smoking behavior (i.e., partner effects). Because alcohol use and depressive symptoms have been consistently associated with tobacco use and poorer ART adherence (Gonzalez, Batchelder, Psaros, & Safren, 2011; O'Cleirigh et al., 2014), they were also included as predictors. Smoking, internalized heterosexism, and relevant covariates (i.e., age, income, depressive symptoms, and alcohol use) were included for actor and partner in models examining correlates of ART adherence and HIV viral load. Estimation of APIM models was performed via generalized estimating equations (GEE), with an exchangeable correlation structure and robust standard errors to properly account for the correlated nature of the outcomes of partners who are members of the same couple. For all analyses, missing data were negligible (<5%) and listwise deletion was employed. For each model, we report the adjusted odds ratio (AOR), representing the change in odds of the outcome relative to the reference group per unit change in the independent variable; the 95% confidence interval (CI) for the odds ratio; and the p-value testing the null hypothesis that the odds ratio = 1.00 (i.e., the null hypothesis of no association). All analyses were performed with SAS version 9.3.

Results

The majority of the participants were HIV-positive (78%), Caucasian (56%), and middle-aged (M = 45.8 years, SD = 10.4). Participants had been in their current primary relationship for 6.6 (SD = 6.8) years and a little over half of the sample (56%) were in HIV-positive seroconcordant relationships. Approximately one-third of participants (n = 168, 31.6%) reported currently smoking cigarettes, with a range of 1 to 90 cigarettes smoked per day (M = 11.70, SD = 13.61). Almost one-quarter of the sample consisted of couples in which both partners smoked (n = 62 couples) and one in five couples consisted of only one member of the couple smoking (n = 53 couples). HIV-positive participants (n = 414) had been diagnosed an average of 13.4 (SD = 8.0) years, had been taking ART for 9.6 (SD = 7.0) years on average, and half had a detectable HIV viral load.

Correlates of Smoking

As shown in Table 1, a logistic regression model was conducted to examine whether partners' smoking status and internalized heterosexism were associated with smoking status, statistically adjusting age, income, education, relationship length, both partners' reports of alcohol and stimulant use, and depressive symptoms. Having a smoking partner was associated with over a 5-fold greater odds of reporting smoking (Adjusted Odds Ratio [AOR] = 5.56, 95% confidence interval [CI]= 2.65, 11.69, p < 0.001). Higher internalized heterosexism was also associated with an increase in the odds of reporting smoking (AOR = 1.11, 95% CI = 1.01, 1.21, p < 0.05). Lower income (AOR = 3.73, 95% CI = 1.79, 7.78, p < 0.001) was associated with a greater odds of reporting smoking and older age was associated with a lower odds of reporting smoking (AOR = 0.95, 95% CI = 0.91, 0.99, p < 0.05).

Correlates of ART adherence and HIV viral load

Table 2 presents models examining the associations between both partners' reports of smoking and internalized heterosexism on 30-day and 3-day ART adherence and viral load. Each model adjusted for couple HIV status, time on ART, age, income, relationship length, and both partners' reports of depressive symptoms and alcohol use. Having a smoking partner was associated with more than a two-fold greater odds of having a detectable HIV viral load (AOR = 2.97, 95% CI = 1.18, 3.30, p < 0.01). Higher alcohol use was associated with lower odds of reporting perfect 30-day ART adherence (AOR = 0.92, 95% CI = 0.86, 0.98, p < 0.01) and a greater odds of having a detectable HIV viral load (AOR = 1.05, 95% CI = 1.01, 1.09, p < 0.05). On the other hand, having a partner who used more alcohol was associated with a greater odds of reporting perfect 3-day ART adherence (AOR = 1.18, 95% CI = 1.06, 1.32, p < 0.01) and a lower odds of having a detectable HIV viral load (AOR = 0.96, 95% CI = 0.93, 0.99, p < 0.05). No other variables were associated with 30-day or 3-day ART adherence or viral load.

Discussion

We found moderate rates of smoking in our sample, such that more than 1 in 3 men reported currently smoking cigarettes. Further, nearly a quarter of the men were in couples in which both members smoked. Despite public health efforts directed at smoking cessation, the

prevalence of smoking among male couples mirrors those of national averages, suggesting research is warranted to better understand how to effectively intervene on smoking behaviors. Importantly, our study showed that intimate partners' smoking behaviors were associated with over 5-fold greater odds of being a smoker. This is consistent with prior research suggesting that partners have a strong influence on each other's smoker behaviors (Pacek, Latkin, & Knowlton, 2014). Our study expands this picture, suggesting that internalized heterosexism affected smoking behaviors, and partners' smoking behaviors also affected their partner's viral load.

Internalized heterosexism was associated with smoking behaviors (actor effects), suggesting that the internalization of negative messages about one's sexual identity may cause stress and maladaptive coping responses, such as smoking, to cope with stigma. While there were no significant partner effects, we found marginally significant trends, suggesting that a partner's internalized heterosexism may have a cross-over effect on his partner's smoking behaviors. In contrast to other studies (Johnson et al., 2008), internalized heterosexism was not associated with HIV medication management. There may be other stressors – such as financial hardship, enacted stigma and HIV stigma – that must be accounted for to understand how couples manage stress and its impact on health behaviors.

While smoking behaviors were not directly associated with ART adherence or viral suppression, we found that having a smoking partner was associated with increased odds of having a detectable viral load. Notably, higher alcohol use was associated with having a detectable viral load and less than perfect ART adherence; whereas partners' higher alcohol use was associated with reporting perfect ART adherence and having an undetectable viral load. These findings are particularly important, as prior research suggests that smokers with a non-smoking partner have greater cessation intentions (Rüge et al., 2008) and are more likely to achieve cessation than those with a partner who also smokes (McBride et al., 1998). Family interventions have proved to be effective for many substance use problems, including alcohol and other drug use (Edwards, & Steinglass, 1995); however, trials of partner support for smoking have not yielded beneficial results (Park, Tudiver, & Campbell, 2012). To date, one of the most promising couples-based smoking cessation studies consisted of dual-smoker couples receiving a one-time face-to-face message about smoking cessation which highlighted communal aspects of quitting (Lipkus et al., 2013) Future research that elucidates the interpersonal mechanisms underlying the association between partners' smoking behaviors, alcohol use, and HIV disease management could yield novel messages and interventions for couples. For example, if the association between partners' smoking and having a detectable viral load means that individuals are more concerned about their partner's cigarette smoking than their own health, one could possibly use such concerns to help transform motivation to quit smoking (Lewis et al., 2006). Due to the cross-sectional nature of these data, it is also possible that individuals smoke cigarettes to cope with their partner's health condition(s).

There are limitations to the study. First, all of the HIV-positive partners were prescribed an ART medication regimen, which means that these findings may not be generalizable to couples who don't have access to HIV care and medications. Second, measures were based on self-report and the study was cross-sectional. Additionally, while this study suggests

important directions for both research and intervention efforts, we did not assess specific motivations for smoking, quit attempts, and ways in which men within couples influence each other's health behaviors.

This study supports the need for couples-based research and interventions for smoking cessation among male couples with HIV. Framing messages to emphasize smoking cessation as a shared goal may be especially powerful for dual smoker couples. Additionally, tailored interventions targeting specific extra-dyadic stressors and dyadic coping strategies may be particularly helpful to address both smoking and HIV-related outcomes. Instead of focusing solely on individuals, researchers must explore the interpersonal context in which health behaviors occur and develop interventions that meet the unique needs of male couples.

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Table 1

Correlates of self-reported smoking dependence (N = 532)

	AOR	95% CI
Age	0.95[*]	0.91, 0.99
Concordant HIV-positive	1.36	0.55, 3.33
Lower income	3.73[***]	1.79, 7.78
Lower education	0.30	0.06, 1.62
Relationship length	1.01	0.99, 1.01
Actor Effects		
Internalized heterosexism	1.11[*]	1.01, 1.21
Alcohol use	0.99	0.92, 1.06
Stimulant use	2.00	0.92, 4.38
Depressive symptoms	1.01	0.97, 1.04
Partner Effects		
Internalized heterosexism	1.06	0.99, 1.14
Alcohol use	1.02	0.96, 1.08
Stimulant use	0.87	0.41, 1.88
Depressive symptoms	0.98	0.95, 1.02
Smoking dependence	5.56[***]	2.65, 11.69

[*]
p<0.05;

[**]
p<0.01;

[***]
p<0.001;

AOR=adjusted odds ratio; CI=confidence interval

Table 2

Correlates of HIV adherence and viral load (N = 371 HIV-positive men on ART)

	Perfect VAS 30-day ART adherence		Perfect ACTG 3-day ART adherence		Detectable Viral Load	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Concordant HIV+	0.69	0.38, 1.25	0.55	0.27, 1.10	0.67	0.41, 1.08
Time on ART	0.93**	0.89, 0.97	0.99	0.94, 1.03	1.00	0.96, 1.04
Relationship length	1.01	0.97, 1.06	0.99	0.94, 1.05	0.96*	0.92, 0.99
Actor Effects						
Lower Income	1.08	0.63, 1.83	1.18	0.62, 2.25	1.32	0.84, 2.08
Depressive symptoms	0.98	0.95, 1.00	0.99	0.96, 1.02	1.01	0.99, 1.03
Age	1.00	0.97, 1.03	1.00	0.96, 1.04	1.01	0.98, 1.04
Internalized heterosexism	1.02	0.95, 1.10	1.01	0.92, 1.09	1.00	0.95, 1.06
Alcohol use	0.92**	0.86, 0.98	0.96	0.90, 1.03	1.05*	1.01, 1.09
Smoking dependence	1.13	0.56, 2.26	1.19	0.50, 2.79	1.37	0.77, 2.44
Partner Effects						
Depressive symptoms	0.99	0.97, 1.02	1.00	0.97, 1.03	1.00	0.98, 1.02
Internalized heterosexism	0.93	0.87, 1.01	1.00	0.93, 1.08	1.03	0.98, 1.09
Alcohol use	1.03	0.98, 1.08	1.18**	1.06, 1.32	0.96*	0.93, 0.99
Smoking dependence	1.38	0.71, 2.68	2.22	0.98, 5.03	2.97*	1.18, 3.30

*
$p < 0.05$;

**
$p < 0.01$;

***
$p < 0.001$;

AOR=adjusted odds ratio; CI=confidence interval