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ORIGINAL PAPER

Associations with Unprotected Sexual Behavior Among HIV-Infected Drinkers in Western Kenya

Rebecca K. Papas[1] · Benson N. Gakinya[2] · Michael M. Mwaniki[3] · Xiaotian K. Wu[4] · Hana Lee[4] · Steve Martino[5] · Debra A. Klein[6] · John E. Sidle[7] · Michelle P. Loxley[4] · Alfred K. Keter[3] · Joyce B. Baliddawa[2] · Stephen A. Maisto[8]

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Abstract

Approximately 71% of HIV-infected individuals live in sub-Saharan Africa. Alcohol use increases unprotected sex, which can lead to HIV transmission. Little research examines risky sex among HIV-infected individuals in East Africa who are not sex workers. The study purpose was to examine associations with unprotected sex in a high-risk sample of 507 HIV-infected sexually active drinkers in western Kenya. They were enrolled in a trial to reduce alcohol use. Past-month baseline alcohol use and sexual behavior were assessed using the Timeline Followback. A zero-inflated negative binomial model examined associations with occurrence and frequency of unprotected sex. Results showed heavy drinking days were significantly associated with unprotected sex occurrence across gender, and with unprotected sex frequency among women. Among women, transactional sex, alcohol-related sexual expectations, condom use self-efficacy, drinking-and-protected-sex days and age were associated with unprotected sex occurrence while alcohol-related sexual expectations, depressive symptoms and condom use self-efficacy were associated with unprotected sex frequency. Among men, alcohol-related sexual expectations, condom use self-efficacy, and age were associated with unprotected sex occurrence, while drinking-and-protected-sex days were associated with unprotected sex occurrence and frequency. Findings suggest robust relationships between heavy drinking and unprotected sex. Further research is needed elucidating the temporal relationships between drinking and unprotected sex in this population.

Keywords HIV · Alcohol · Unprotected sex · Transactional sex · Kenya

Introduction

Approximately 71% of the world's 35 million HIV-infected individuals live in sub-Saharan Africa [1]. Several Africa-based studies have demonstrated a high rate of alcohol dependence [2, 3], often involving the consumption of inexpensive local brew with high ethanol content [4]. In Eldoret, Kenya, our work has also shown that an average *chang'aa* drink (locally made spirit) is equal to two US standard drinks [4], and prevalence of hazardous drinking was reported among HIV (53%) and general medicine (68%) outpatients [5]. In Kenya, alcohol use correlates with HIV infection [6, 7] and increases risk of sexually transmitted infections [8].

Alcohol can increase frequency of unprotected sexual behavior (i.e., not using condoms during sexual intercourse) through multiple avenues. People may become disinhibited and more likely to engage in riskier sexual behaviors when drinking than when sober. Also drinking can render

✉ Rebecca K. Papas
Rebecca_papas@brown.edu

1 Department of Psychiatry and Human Behavior, Alpert Medical School of Brown University, Providence, RI, USA

2 School of Medicine, Moi University College of Health Sciences, Eldoret, Kenya

3 Academic Model Providing Access to Healthcare (AMPATH), Eldoret, Kenya

4 Brown University School of Public Health, Providence, RI, USA

5 Yale University School of Medicine, New Haven, CT, USA

6 Right Response LLC, Minneapolis, MN, USA

7 Indiana University School of Medicine, Indianapolis, IN, USA

8 Syracuse University, Syracuse, NY, USA

vulnerability to non-consensual sex or non-consensual unprotected sex, especially among women. Drinking could lead to reduced focus on distant outcomes such as negative health outcomes or consequences and more focus on immediate, salient cues such as sexual arousal, consistent with the alcohol myopia theory [9]. The pattern of drinking is meaningfully associated with risky sex. In a meta-analysis of studies examining the associations between alcohol use and risky sex in Southern Africa, Kalichman and colleagues found that the quantity of alcohol was more influential than the frequency of use [10]. In a study of community residents in South Africa, Morojele et al. found that quantity of alcohol consumed was related to having more sexual partners, while frequency of use was not associated with any reported sexual risk behaviors [11]. Using daily diary monitoring, Kiene and colleagues found that alcohol use was related to unprotected sex among HIV-infected South African men and women in the community but only when alcohol use was moderate or heavy [12]. In a study of 3538 HIV-infected outpatients in Namibia, Tanzania and Kenya, researchers categorized patients by three levels of drinking. They found that highest level of drinking, harmful/likely dependent, was associated with inconsistent condom use, and other high risk behaviors. Binge drinking was also associated with inconsistent condom use [13].

Besides drinking pattern, sexual expectations related to drinking are associated with risky sex in sub-Saharan Africa. Alcohol expectancies include the belief that alcohol can result in enhanced or uninhibited sex, or reduced shyness or anxiety around sex [14, 15]. Drinking alcohol may bias an individual to attend to positive sexual cues (e.g., sexual arousal) consistent with expectations instead of attending to contradictory or risky cues such as unprotected sex. For example, in a study of STI clinic patients in Cape Town, South Africa, researchers found that expectations that alcohol will increase sexual desires and sexual pleasure were associated with HIV risk behaviors, predominantly among men [16].

Confidence in one's ability to use condoms has also been associated with condom use in sub-Saharan Africa. Condom use self-efficacy may include confidence to use condoms across several situations such as intoxication or in the face of partner hesitation [17]. In a study of HIV-infected outpatients with regular partners in Uganda, higher condom use self-efficacy was associated with more condom use [18]. In a survey of 1204 young South African women, any use of condoms was associated with higher condom use self-efficacy [19]. In another study of South African women, assertive negotiation and condom use self-efficacy were associated with condom use consistency [20].

Other influences on risky sex include HIV stigma, which is pervasive in Kenya [21]. HIV stigma has been associated with less HIV disclosure and risky sex. In a survey of 1055 HIV-infected community residents in South Africa, Simbayi et al. found that perceived HIV stigma and discrimination were associated with non-disclosure of HIV status to sex partners. In addition, they found that 55% of those who did not disclose HIV status had unprotected vaginal intercourse with partners who were HIV-negative or of unknown status [22]. In a regional study in Kenya of 1073 HIV-infected men and women, nearly 30% of respondents reported experiencing some form of HIV-related stigma or discrimination in the past 12 months. And 49% of Kenyan respondents had not disclosed HIV to their spouse or partner [23].

Another variable that may be associated with risky sex is transactional sex, or offering sex in exchange for receiving money or goods. The practice of transactional sex has been linked to poverty and gender inequality in Kenya and has been reported by sub-Saharan women in the general population who do not identify as sex workers [24, 25]. In western Kenya, Robinson and Yeh found that women engaged in transactional sex to compensate for financial losses during times of household illness [25]. One study showed that women in Kenya who own land engaged in less transactional sex. Using a sample of 5511 women working in the agricultural sector, they found that women's land ownership was associated with fewer sexual partners in the past year and lower likelihood of engaging in transactional sex, but was not associated with unprotected sex [26]. Women appear to have less control to prevent unprotected sex in transactional sexual relationships. In a representative study in Botswana and Swaziland, food insufficiency, or not having enough to eat over the previous 12 months, was associated among 1050 women with transactional sex, lack of control in sexual relationships, inconsistent condom use with their irregular partners, and sexual relations with intergenerational partners [24].

Additionally, use of antiretrovirals (ARVs) to treat HIV illness has been associated with risky sex. Some researchers have found ARV use to be associated with more condom use due to concerns about getting new strains of HIV [27], while others have found ARV initiation to be associated with less condom use due to less concern about the HIV illness [28, 29]. In a prospective study of ARV initiation among 1818 HIV-infected participants in East Africa whose partners were enrolled in the PreP trial, researchers found that condom use increased with serodiscordant partners following ARV initiation. There were no changes to condom use among non-primary partners. Authors concluded that risk compensation did not occur after ART initiation [30].

Finally, depression has been associated with increased sexual risk behavior. In a study of outpatients in rural Uganda, Kiene and colleagues examined the associations between depression, partner violence, and alcohol use and HIV-risk indicators. They found that depression was associated with sexual risk behaviors for men and women

and with HIV infection and STI for women [31]. In a study of 738 patrons of alcohol establishments in South Africa, Sikkema and colleagues found that unprotected sex was associated with depression, anxiety and alcohol use among women [32]. Higher risk behavior may be due to hopelessness about the future, and so less concern about well-being and health.

Overall, this literature among individuals in sub-Saharan Africa suggests a well-established association between alcohol use and risky sex. Other potential risk factors for unprotected sex include alcohol-related sexual expectations, HIV stigma, condom use self-efficacy, transactional sex, ARV use and depression. However, little is known about risk factors for unprotected sex among individuals who are not sex workers in East Africa. HIV-infected drinkers in Kenya, particularly single heterosexual women, are a high-risk population due to the syndemics of HIV and alcohol use and increased risk of HIV transmission. Studying risk and protective factors associated with unprotected sex may be useful for tailoring risk reduction strategies. For example, single HIV-infected women drinkers may benefit from interventions reducing underlying needs for sexual risk by promoting empowerment or financial opportunities. Alternatively, interventions may be tailored toward promoting education and enhancing assertiveness among those without regular partners. Hence, the purpose of this study was to examine associations with unprotected sex among a sample of 507 HIV-infected sexually active women and men drinkers in western Kenya. Based on the literature reviewed, we hypothesized that heavy drinking would be positively associated with occurrence and frequency of unprotected sex across gender.

Methods

Collaboration

This trial was performed within the clinical services of the US Agency for International Development—Academic Model Providing Access to Healthcare (AMPATH) partnership, initially established in 2001 between Moi Teaching and Referral Hospital, Moi University School of Medicine, and a consortium of universities from North America in response to the HIV epidemic in Kenya [33, 34]. AMPATH delivers care, provides education, and performs research in networks of urban and rural Ministry of Health hospitals, health centers, and dispensaries in western Kenya. AMPATH currently provides care for more than 85,000 HIV-infected patients in 22 sub-counties of 8 counties in western Kenya.

Participants

Participants were 507 HIV-infected sexually active drinkers in western Kenya who were enrolled in a randomized clinical trial of a cognitive-behavioral therapy intervention to reduce alcohol use. Study inclusion criteria were: age $\geq$ 18 years, enrollment as an AMPATH HIV-infected patient attending any of four HIV clinics, hazardous or binge drinking criteria (score $\geq$ 3 on the Alcohol Use Disorders Identification Test (AUDIT-C) [35, 36] or $\geq$ 6 drinks per occasion at least monthly), alcohol use in the past 30 days, verbal working knowledge of Kiswahili and living within 1-h travel distance from the Eldoret AMPATH clinic, where the study was conducted. Participants also reported at least one event of sexual intercourse in the past 30 days at baseline. Exclusion criteria were active psychosis or active suicidality, which were assessed through screening. Any positive screens were followed with a referral to psychiatrists in the mental health services department. One-hundred and six participants in the study were not sexually active at baseline and were excluded from the study. One case was excluded as an outlier with 165 sexual events which represented 12.4 SD from the mean.

Study Procedures

Recruitment of participants occurred between July 2012 and September 2015. Clinic patients were approached by same-sex research staff and asked for verbal consent for a brief interview to describe a health behavior study and to determine eligibility. Written informed consent was obtained from all eligible and interested participants. All participant interviews were audio-taped and conducted by same-sex research staff in a private setting using a computer survey interface. The current study presents measures administered at baseline prior to the intervention. The institutional review boards of the participating research organizations approved the study protocols.

Instruments

All instruments were culturally and linguistically adapted using WHO-modified methods [37]. Instruments were translated into Kiswahili, the national language of Kenya. We conducted forward and back translations by local experts, with review by a multidisciplinary panel of health experts and alcoholics in recovery. Measures were then pre-tested, reviewed during focus groups and subsequently revised. Our adaptation methods are described elsewhere [38]. Seven-day test–retest reliability was estimated among 36 study trial participants following recruitment into the study. Retest analyses (see below) were conducted using Pearson correlation for continuous variables and kappa statistics for dichotomous variables.

Alcohol Use

We measured alcohol use two ways at baseline—days on which heavy drinking occurred ("heavy drinking" days) and days on which any drinking and protected sexual activity co-occurred ("drinking-and-protected-sex" days). We measured "protected" sex (versus any sex) to minimize correlation with the outcome variable, unprotected sex. Alcohol use was assessed using the adapted Timeline Followback (TLFB) for the past 30 days at baseline. TLFB is a well-established, reliable and valid retrospective calendar-based measure employing memory cues to assess alcohol use [39–42]. Based on our previous work [4], we adapted the TLFB to estimate use of local brew (*chang'aa*, spirit, and *busaa*, maize beer) by asking participants how much money they spent on personal consumption. Commercial drink was assessed by asking volume drunk for the respective time-periods. Reported cost and volume were then converted into grams of ethanol and divided by 14 g to achieve equivalence to a US standard drink. Seven-day test–retest reliability using the adapted TLFB was 0.88 for percent drinking days and 0.92 for drinks per drinking day [43]. Heavy drinking days were calculated as the number of days in the past 30 days on which men consumed ≥ 5 drinks and women consumed ≥ 4 drinks [44]. Days on which an individual reported both alcohol use and protected sexual activity in the past 30 days were obtained from participants' TLFB reports and were summed.

Unprotected Sex

Unprotected sex was also assessed using the TLFB. On each day of the calendar, participants were asked the number of times they had engaged in sex and in unprotected sex, and the number of different partners. Participants were asked to endorse sex if they had engaged in vaginal or anal but not oral sex. The total number of unprotected sex events in the past 30 days was summed. Seven-day test–retest reliability in this study was $r = 0.87$.

Clinical and Demographic Variables

We asked each participant his/her age. For relationship status, we asked whether participant was: (1) married and living with spouse, (2) married and not living with a spouse, (3) not married and living with a partner and (4) not married and not living with a partner. We combined the first two items into a "married" variable and the last two items into a "single" variable. We used medical records to determine whether participants were taking ARVs and compared these results to participant self-report. Viral load was considered undetectable if plasma HIV RNA concentration was < 40 copies/ml. Forty-six viral load samples were missing for the following reasons: 6 did not agree to the optional consent and 40 were missing from the lab.

HIV-Related Stigma

An 11-item stigma scale was used to measure a participant's perception of HIV-related stigma in the past 30 days. This valid, reliable scale consists of four factors: public attitudes toward HIV infection, feeling ostracized for HIV, discrimination, and personal life disruption [45, 46]. The measure includes items about non-disclosure of HIV. For example, "Felt that keeping my HIV status a secret is important," and, "Feared that I would lose my friends if they learned my HIV status," and "Avoided a certain situation because I was worried about people knowing that I have HIV." Seven-day test–retest reliability for the total score in this study was $r = 0.83$.

Sexual Expectations Related to Alcohol Use

This 13-item scale is a reliable and valid measure of sexual expectations about alcohol use. It consists of three factors: alcohol will (1) enhance sex, (2) decrease nervousness around sex, and (3) increase risky behaviors around sex [14, 15]. Seven-day test–retest reliability for the total score in this study was $r = 0.67$.

Transactional Sex

We assessed whether income was earned in the past year from "having sex with someone (even if occasionally)." We did not assess receipt of any other forms of remuneration such as goods. Seven-day test–retest reliability in this study was $\kappa = 0.81$.

Depression

The 9-item The Patient Health Questionnaire depression scale assessed depressive symptoms over the past 2 weeks [47]. This scale has been tested for validity and reliability in HIV-infected adults in western Kenya [48]. Seven-day test–retest reliability in this study was $r = 0.79$.

Condom Use Self-Efficacy

The 15-item Condom Use Self-Efficacy scale measures the extent to which an individual feels confident in using condoms with a partner. Aspects of this valid, reliable scale include condom use mechanics, assertiveness, partner concerns, and intoxication [17, 49]. Following pre-testing in this study, three items with double negative tenses were simplified, and a "lead-in" statement was added: "The following

three questions refer to being nervous about using condoms with a new partner for various reasons. Please give us your opinions." Seven-day test–retest reliability in this study was $r = 0.85$.

Statistical Analyses

We examined baseline demographic and clinical characteristics and sexual risk behavior separately by gender. To assess differences by gender, we used Pearson Chi square test for dichotomous variables and used Wilcoxon rank sum test for continuous variables. Distribution of age was symmetric and therefore we used a t test to assess gender differences. In multivariate models, outcome was defined by the number of times engaged in unprotected sex in the past 30 days. Most participants reported zero days of engaging in unprotected sex resulting in highly skewed distribution with excessive zeros. To account for the preponderance of zero values, we used a zero-inflated negative binomial (ZINB) model for analysis of the outcome using R software version 3.4.3. The ZINB analysis examined two models: zero-inflated model and count model. Results from the zero-inflated model estimate the effect of covariates on a zero versus non-zero component of the outcome which are represented using an odds ratio (OR). With the zero-inflated model, we examined the effects of covariates on the outcome of *not* engaging in unprotected sex (i.e., we modeled the zero outcome using non-zero as a reference). Results from count model estimate the effect on a "count" or frequency portion of the response "unprotected sex" (e.g., 1, 2, 3, etc.), among only those who engaged in unprotected sex. Count results are represented using an incidence rate ratio (IRR). Interpretation of an IRR of 1.023 can be illustrated as follows: the expected number of events of unprotected sex among participants with higher sexual expectations is 1.023 times that for participants with lower expectations. The Vuong test [50] was conducted to ensure that the ZINB model fit observed data significantly better than ordinary negative binomial models.

Results

Descriptive Data

Women were somewhat younger than men (37.1 vs 40.0 years, $p < 0.001$). Fewer women than men were married (29.2% vs 82.5%, $p < 0.001$). Most women and men were prescribed ARVs (85.0% vs 85.5%, $p = 0.991$). Far more women than men reported engaging in past-year transactional sex (70.4% vs 14.5%, $p < 0.001$). In the past 30 days, women reported more unprotected sex events (8.9 vs 6.1, $p = 0.003$) and drinking-and-protected-sex days (3.8 vs 2.6, $p < 0.001$) than men. Baseline data suggest that 2% ($n = 2$) of sexually active participants reported both anal sex and vaginal sex in the past 30 days, and only one person reported only anal sex. Hence, most reported that sexual events were associated with vaginal sex (data not shown). Number of heavy drinking days in the past 30 days was similar between men and women (10.2 vs 9.1, $p = 0.135$). Women reported somewhat higher alcohol-related sexual expectations (21.6 vs 19.5, $p = 0.047$) and more depressive symptoms (13.3 vs 9.4, $p < 0.001$) than men. Endorsement of condom use self-efficacy was similar between women and men (39.8 vs 39.2, $p = 0.426$). Percent of detectable viral load in the sample was 39.7%. There were no significant gender differences in percent detectable or mean viral load (Table 1). We compared percent of detectable viral load using available samples between sexually active participants ($n = 461$, 39.7%) and sexually inactive participants ($n = 95$, 38.9%), who were excluded from the study. These differences were not significant ($\chi^2 = 0.0$, $p = 0.984$).

Regression Models

Zero-Inflated Model

The zero-inflated model showed which behaviors or characteristics were significantly associated with a participant *not* engaging in any unprotected sex in the past 30 days (i.e., increased or decreased probability of *not* engaging in protected sex). For women, the OR indicated that women who reported engaging in transactional sex, compared to those who did not, had a higher probability of engaging in any unprotected sex. Similarly, women who reported more heavy drinking days and higher alcohol-related sexual expectations had a higher probability of engaging in any unprotected sex than those reporting fewer heavy drinking days or lower sexual expectations. Women who reported higher condom use self-efficacy, more drinking-and-protected-sex days and were older had a lower probability of engaging in any unprotected sex. For men, a higher number of heavy drinking days and higher alcohol-related sexual expectations in the past 30 days were associated with a higher probability of engaging in any unprotected sex. Men who reported higher condom use self-efficacy, a higher number of drinking-and-protected-sex days and were older had a lower probability of engaging in any unprotected sex (Table 2). Note that heavy drinking and drinking-and-protected-sex day variables were correlated at $r = 0.36$, indicating low overlap between these two variables.

Count Model

Among those who did engage in unprotected sex in the past 30 days, the count model indicated variables associated with the frequency of unprotected sexual activity using IRR. For

Table 1 Baseline characteristics

Variables	Mean (SD) or N (%)			
	Total (N = 507)	Female (N = 273, 53.9%)	Male (N = 234, 46.1%)	Test statistic[a] for gender difference (p value)
In past 30 days				
Number of unprotected sex events[b]	7.6 (12.6)	8.9 (14.8)	6.1 (9.4)	36,798.5 (0.003)
Number of heavy drinking days[b]	9.7 (8.4)	10.2 (8.6)	9.1 (8.2)	34,523.0 (0.135)
Number of drinking-and-protected-sex days[b]	3.2 (3.9)	3.8 (4.2)	2.6 (3.4)	37,658 (< 0.001)
Age	38.0 (8.0)	37.1 (7.3)	40 (8.2)	25,233.5 (< 0.001)
Married	273 (53.7%)	80 (29.2%)	193 (82.5%)	142.0 (< 0.001)
On ARVs	433 (85.2%)	233 (85.0%)	200 (85.5%)	0.0 (0.991)
Transactional sex in past year	227 (44.7%)	193 (70.4%)	34 (14.5%)	157.4 (< 0.001)
Detectable viral load n = 461	183 (39.7%)	102 (40.8%)	81 (38.4%)	0.2 (0.666)
Mean viral load (Log Base 10) (copies/ml) n = 183	3.7 (1.2)	3.6 (1.1)	3.8 (1.2)	− 1.1 (0.285)
Alcohol-related sexual expectations	20.6 (10.7)	21.6 (11)	19.5 (10.2)	35,327.0 (0.047)
Condom use self-efficacy	38.6 (7.3)	39.8 (9.5)	39.2 (7.9)	33,371.0 (0.426)
Depressive symptoms	11.5 (7.3)	13.3 (7.4)	9.4 (6.5)	42,084.0 (< 0.001)
HIV stigma	29.8 (12.4)	33.6 (12.1)	25.5 (11.2)	44,048.0 (< 0.001)

[a]Chi square test was used for dichotomous variables; Wilcoxon rank sum test was used for non-dichotomous variables except for viral load (t test was used for mean viral load variable)

[b]Calculated from the 30-day timeline follow back

Table 2 Odds ratio (OR), 95% confidence interval (CI), and associated p values for variables associated with not engaging in unprotected sex in past 30 days

	OR	95% CI	p value
Women (n = 273)			
In past 30 days			
Number of heavy drinking days	**0.928**	**0.876, 0.983**	**0.011**
Number of drinking-and-protected-sex days	**1.152**	**1.042, 1.272**	**0.006**
Age	**1.070**	**1.018, 1.126**	**0.008**
Married	0.418	0.166, 1.05	0.064
On ARVs	1.807	0.55, 5.938	0.330
Transactional sex in past year	**0.318**	**0.137, 0.738**	**0.008**
Alcohol-related sexual expectations	**0.953**	**0.916, 0.992**	**0.019**
Condom use self-efficacy	**1.089**	**1.029, 1.152**	**0.003**
Depressive symptoms	0.959	0.901, 1.021	0.188
HIV stigma	1.013	0.975, 1.052	0.507
Men (n = 234)			
In past 30 days			
Number of heavy drinking days	**0.924**	**0.875, 0.977**	**0.005**
Number of drinking-and-protected-sex days	**1.193**	**1.069, 1.331**	**0.002**
Age	**1.087**	**1.032, 1.145**	**0.002**
Married	1.237	0.456, 3.357	0.676
On ARV	0.432	0.158, 1.178	0.101
Transactional sex in past year	0.412	0.129, 1.313	0.134
Alcohol-related sexual expectations	**0.945**	**0.91, 0.981**	**0.003**
Condom use self-efficacy	**1.053**	**1.001, 1.109**	**0.048**
Depressive symptoms	0.991	0.922, 1.066	0.815
HIV stigma	1.008	0.966, 1.052	0.709

Bold values indicate the significance level of p <.05

women, a higher frequency of unprotected sex events was associated with more heavy drinking days, higher alcohol-related sexual expectations and more depressive symptoms in the past 30 days. A lower frequency of unprotected sex events was associated with higher condom use self-efficacy. For men, a lower frequency of unprotected sex events was associated with more drinking-and-protected-sex days in the past 30 days. There were no other significant variables in the men's model (Table 3).

Discussion

This study examined risk factors for unprotected sex in a high-risk population of HIV-infected drinkers in Kenya. We hypothesized that heavy drinking days would be positively associated with occurrence and frequency of unprotected sex across gender. This hypothesis was partially supported. Results showed heavy drinking days were significantly associated with unprotected sex occurrence across gender, and with frequency of unprotected sex among women. These results are consistent with previous research indicating that quantity of alcohol use is predictive of unprotected sex [10]. We did not find an association between frequency of unprotected sex and heavy drinking for men. It seems that engaging in heavy drinking is associated with the decision to engage in unprotected sex but not the frequency of this behavior, suggesting that once this arrangement has been established, there is little deviation from this risky behavior. Our results are generally consistent with studies examining contextual aspects of drinking and sexual activity. For example, Shuper et al. found significant effects for alcohol use in the prediction of unprotected sex in a meta-analysis of studies conducted in developed and resource-limited settings; the largest effect for alcohol use was when it preceded or co-occurred with sexual activity [51]. Our findings suggest robust relationships between alcohol use and unprotected sex among HIV-infected drinkers in Kenya.

In the model identifying whether women engaged in any unprotected sex, five variables besides heavy drinking days were significant: engaging in past-year transactional sex, alcohol-related sexual expectations, drinking-and-protected-sex days, age, and endorsing condom use self-efficacy.

Most women in our study (70.4%) reported engaging in transactional sex in the past year, which resulted in increased probability of engaging in any unprotected sex. It should be noted that our sample consisted of HIV clinic patients, not sex workers, although we cannot rule out that some

Table 3 Incidence rate ratio (IRR), 95% confidence interval (CI), and associated p values for variables associated with number of days having unprotected sex among only those who had unprotected sex

	IRR	95% CI	p value
Women (n = 273)			
In past 30 days			
Number of heavy drinking days	**1.039**	**1.02, 1.059**	**<0.001**
Number of drinking-and-protected-sex days	0.967	0.932, 1.003	0.076
Age	0.992	0.972, 1.012	0.415
Alcohol-related sexual expectations	**1.023**	**1.01, 1.038**	**0.001**
Condom use self-efficacy	**0.973**	**0.956, 0.991**	**0.004**
Depressive symptoms	**1.027**	**1.003, 1.052**	**0.026**
Transactional sex in past year	0.892	0.631, 1.262	0.519
Married	1.036	0.757, 1.418	0.823
On ARVs	0.761	0.526, 1.101	0.147
HIV stigma	0.993	0.978, 1.008	0.365
Men (n = 234)			
In past 30 days			
Number of heavy drinking days	1.019	0.997, 1.041	0.086
Number of drinking-and-protected-sex days	**0.922**	**0.881, 0.965**	**<0.001**
Age	1.000	0.975, 1.025	0.972
Alcohol-related sexual expectations	1.012	0.994, 1.03	0.199
Condom use self-efficacy	0.981	0.961, 1.003	0.087
Depressive symptoms	1.002	0.97, 1.035	0.895
Transactional sex in past year	1.146	0.75, 1.75	0.530
Married	1.186	0.765, 1.837	0.445
On ARVs	0.727	0.455, 1.162	0.183
HIV stigma	1.006	0.988, 1.024	0.500

Bold values indicate the significance level of p <.05

participants identified as sex workers. The proportion of transactional sex was higher than reported in similar clinic samples, such as 21.1% among outpatient women with non-primary partners in South Africa [52]. In our pilot study, women who engaged in transactional sex reported that requesting condom use can signal disease status. They were hence reluctant to request or use condoms due to potential discrimination as well as limited success of securing a transactional relationship [38]. In transactional sex relationships more generally, women may have less control to prevent unwanted sex [24]. It is noteworthy that transactional sex was a powerful risk factor of whether a woman engaged in any unprotected sex but was not associated with the frequency of the activity. One possible explanation may be little variation in condom use. That is, transactional sexual activities may demand little to no condom use due to concerns about suspicion of HIV, clearly an obstacle to a successful transaction. Given our clinical sample and assessment of "even occasional" activity, it is possible that the number of transactional sexual activities was limited. Women reported on average 2.8 different sexual partners in the past 30 days. Alcohol-related sexual expectations were also significantly associated with occurrence of unprotected sex among women. Since a majority of women reported engaging in transactional sex, it may be possible that women engaged in drinking at times to enhance this transactional activity.

Our study identified protective factors for engagement in unprotected sex including condom use self-efficacy, drinking-and-protected-sex days, and older age. Women who were confident in negotiating condom use with a male partner across various situations were less likely to engage in unprotected sex. This indicated that some women have learned how to negotiate with their partners to use condoms even in the context of stigma and gender inequality for women in Kenya [53], thereby reducing risk. Similarly, the inverse association of drinking-and-protected-sex days with unprotected sex occurrence suggests a protective factor with increased number of days on which a partner employs condoms. Older age was associated with less risk for women, suggesting women may decline to engage in risky behavior with age.

When examining variables in the count model that confer higher frequency of unprotected sex among women who endorsed engaging in unprotected sex, more heavy drinking days and depressive symptoms were associated with more frequent unprotected sex. Our findings related to depression are consistent with other research in sub-Saharan Africa [31, 32]; more depression may signify less self-care or less hope about the future. Protective factors were condom use self-efficacy and drinking-and-protected-sex days. These results show that women who have learned how to negotiate with their partners to use condoms can affect whether they use condoms and the frequency of condom use.

In the model identifying whether men engaged in any unprotected sex, four variables besides heavy drinking days were significant: alcohol-related sexual expectations, drinking-and-protected-sex days, age, and endorsing condom use self-efficacy. The association between higher expectations for sexual enhancement and higher sexual risk is consistent with other research among men in sub-Saharan Africa [16]. Protective factors included condom use self-efficacy, older age and drinking-and-protected-sex days. Men who felt confident negotiating condom use with a female partner across various situations were less likely to engage in any unprotected sex. This result is somewhat surprising given that men in Kenya are socially in control in the power structure. It may be that because most men in our sample were married and HIV-infected, risk negotiation may have become part of their relationships. Similarly, the inverse association of drinking-and-protected-sex days with unprotected sex suggests a protective factor with more days of condom use. Results also indicated that older men may engage in less risky behavior than younger men. When examining variables in the count model that conferred risk (i.e., solely among men who endorsed engaging in unprotected sex), only more drinking-and-protected-sex days were inversely associated with more unprotected sex. This suggests that actual condom use with a partner is a stronger indicator of behavior than perception of condom use self-efficacy once condom use has been initiated.

Overall, these findings add to a growing body of literature suggesting robust relationships between heavy drinking and risky sex in resource-limited settings. These findings have implications for future research. While the co-occurrence of drinking and sexual activity on the same day was significant in most models, we have yet to understand the temporal relationship of drinking and risky sex on the same day [54]. Although it is commonly assumed that alcohol consumption preceded risky sex, it is also possible that people drank after risky sex, perhaps in reaction to having engaged in risky sex. Or that both sequelae can occur. Hence, more studies that sequentially analyze identified risk factors can provide further information about these relationships. Real-time interventions made available by use of ecological momentary assessment methods could be useful in this regard.

Our results also pointed to possible protective factors for sexual risk behavior. Condom use self-efficacy or engagement in protected sex were associated with reduced occurrence or frequency of unprotected sex for women and men. Teaching more condom negotiation skills in the clinic setting, as well as improving motivation to use condoms, may be beneficial in lowering risk of unprotected sex among high-risk women and men in Kenya.

Other interventions focusing on the underlying causes of risk among women such as transactional sex, in the face of limited income-generating opportunities, may be helpful.

Research in sub-Saharan Africa has generally shown positive results from providing microfinance loans and business skills training. A microfinance intervention consisting of loans for small business activities, business skills training and promotion of a savings culture was provided to female sex workers in Nairobi, Kenya. By the completion of the study at 18–23 months, two-thirds of women had developed operational business and nearly half had stopped sex work [55]. In another IMAGE study, group microfinance interventions were coupled with gender equity and HIV training among 1409 South African women. Results showed that after 2 years, both the microfinance-only condition and microfinance-plus-training condition showed economic improvements relative to the control group. However, only the microfinance-plus-training condition demonstrated consistent improvement across domains with regard to women's empowerment, intimate partner violence and HIV risk behavior including unprotected sex with non-spousal partners [56]. Generating alternative sources of steady income through microfinance loans and business training may empower Kenyan women to eliminate transactional sex.

Strengths and Limitations

Strengths of our study include the focus on a relatively large high-risk sample in a resource-limited setting, including single HIV-infected women drinkers. Also, our interviews to estimate both alcohol and sexual risk behavior were culturally tailored and comprehensive. Limitations of our study include that it employed a cross-sectional and observational design and therefore cannot infer causality. Our study was not designed to be representative and may not be generalizable to other HIV-infected drinkers in the region or country. Our measurement of drinking-and-protected sex days examined whether alcohol and protected sexual behavior occurred on the same day but not the temporal relation between alcohol consumption and sexual behavior on a given day. Additionally, because our interviews were conducted face-to-face, there may have been underreporting of socially undesirable behaviors. There was also a potential for recall bias in our measures.

Conclusions

Findings from this study suggest that HIV-infected drinkers in Kenya, including single women, are at risk of engaging in unprotected sex due to multiple factors including heavy drinking, transactional sex, depression and alcohol-related sexual expectations. Furthermore, our data suggests the need for incorporating contextual level factors such as co-occurring drinking and sexual behavior to predict sexual risk behavior. Further research is needed among this high-risk population to understand the interplay and development of risks.

Our findings have implications for HIV prevention interventions that can target these risk factors. Together with the results of this and other studies showing that condom use self-efficacy is a protective factor against sexual risk, multifaceted interventions promoting condom use self-efficacy, alcohol reduction techniques and financial empowerment may provide benefits.

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Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflicts of interest.

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.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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