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ORIGINAL PAPER

Alcohol use among people who inject drugs living with HIV in Kenya is associated with needle sharing, more new sex partners, and lower engagement in HIV care

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Abstract

We assessed the prevalence and correlates of alcohol use among 870 people who inject drugs living with HIV in Kenya, with attention toward (1) sexual and injecting risk behaviors for HIV transmission and (2) HIV care engagement. We defined *heavy alcohol use* as > 14 drinks/week for men and > 7 drinks/week for women, *moderate alcohol use* as any lesser but non-zero amount, and *any alcohol use* as either moderate or heavy use. Approximately 39% of participants reported any alcohol use and 15% heavy use. In multivariate analysis, any alcohol use compared to no use was associated with needle sharing, > 3 new sex partners in the past 3 months, being unaware of HIV status, never enrolling in HIV care, and not being on ART (all $p < 0.05$). Heavy alcohol use as compared to no use was associated with needle sharing (aOR = 2.72; 95% CI 1.43, 5.13), injection equipment sharing (aOR = 1.80; 95% CI 1.00, 3.16), > 3 new sex partners in the past 3 months (aOR = 1.99; 95% CI 1.12, 3.49), and being unaware of HIV status (aOR = 2.77; 95% CI 1.46, 5.19). There was no association between any measure of alcohol use and unsuppressed viral load. Alcohol use among people who inject drugs living with HIV may carry elevated risk of HIV transmission mediated by sexual and injecting practices and is associated with lower engagement in multiple stages of the HIV care cascade.

Keywords HIV · Alcohol · Injection drug use · HIV risk behaviors · Care engagement · Kenya

Introduction

Globally, there are an estimated 3 million people who inject drugs living with HIV (PWID-LWH) [1]. In addition to sexual transmission, HIV may be transmitted from PWID-LWH to injecting partners. This occurs from sharing needles and other drug equipment and accounts for an estimated 13% of new global HIV infections [2]. PWID-LWH are thus a key population to engage in care and in public health efforts to curtail HIV transmission. This includes in Kenya, where there are an estimated 18,000 PWID living primarily in Nairobi and coastal Kenya and where HIV prevalence is 18.3% among PWID compared to 4.5% in the general population [3–5].

As in other parts of the world, PWID in Kenya are more likely to engage in behaviors which carry HIV transmission risk. PWID in Kenya more commonly have multiple sex partners than the general population [6]. While the availability of needle and syringe programs has reduced the

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frequency of needle sharing, a recent cross-sectional study reported that 29.3% of PWID continued to share needles [7]. Engagement in HIV care among PWID in Kenya is also low; among those aware of their HIV status, 68% of PWID-LWH are receiving ART compared to 96% of people living with HIV (PLWH) overall [3, 8]. To decrease HIV transmission globally and in Kenya, it is necessary to elucidate factors contributing to increased HIV risk behavior and suboptimal care engagement among PWID-LWH.

Alcohol use is one such potential risk factor. Alcohol has well-studied effects of disinhibition and impaired executive function [9]. There is growing evidence on the association between alcohol use and increased HIV transmission risk behaviors among PWID and among PLWH, though with most studies focusing on one population or the other. Among both populations, alcohol use is frequent and has been associated with increased sexual HIV risk behaviors including multiple partners and condomless sex [10–13]. Among PWID, alcohol has also been associated with injection HIV risk behaviors including needle and injection equipment sharing, though with some studies also finding no association [14–16]. Further, alcohol use among PLWH has been associated with poorer outcomes across the HIV care cascade including diagnosis, enrollment in care, and ART uptake [17, 18]. This includes several recent studies in sub-Saharan Africa, including a large analysis of pooled data from 6 countries finding that hazardous alcohol use was associated with lower awareness of HIV-positive status and lower ART uptake, and a population-based HIV testing study in Kenya and Uganda that found similar associations [19, 20]. Some studies have also found an association between alcohol use and lower HIV viral load suppression—though results assessing this relationship remain mixed [17–23].

There are a more limited number of studies that have looked at HIV risk behaviors or care engagement outcomes among PLWH who also inject drugs [24–27], with most completed in North America, Eastern Europe, and Southeast Asia. Compared to PLWH who do not inject drugs, this population may face different transmission risks, particularly from combined injection drug and alcohol use [26]. They may also access HIV care through unique pathways such as needle exchange programs or methadone clinics and face unique barriers to care [28, 29]. There is therefore need for further investigation, particularly in sub-Saharan Africa where HIV is most prevalent and injection drug use is on the rise [30].

In this study, we evaluated the prevalence and correlates of alcohol use among a cohort of PWID-LWH in Kenya, with a focus on (1) sexual and injecting risk behaviors for HIV transmission and (2) HIV care engagement outcomes, including awareness of HIV status, enrollment in care, ART uptake, and viral suppression. We hypothesized that alcohol use would be associated with increased risk behaviors for HIV transmission and lower engagement in care.

Methods

Setting and Population

This study was a secondary analysis of baseline data collected from a prospective cohort study of PWID-LWH in Kenya that has been previously described [31]. Briefly, the primary study was established to assess the effectiveness of assisted partner services to find, test, and link to care the sexual and injecting partners of PWID-LWH. The study population included PWID-LWH attending any of nine needle and syringe programs or methadone clinics in Nairobi and the coastal counties of Mombasa and Kilifi. PWID who were known to be HIV-positive from a prior visit to one of the needle and syringe programs or methadone clinics but not in regular attendance at the site were also located and recruited from the community via peer educators—former PWID in recovery with established relationships among the PWID community. Through these enrolled PWID-LWH, additional potential participants were identified and recruited through assisted partner services. Primary study eligibility criteria included being at least 18 years of age, HIV-positive, injection drug use in the past year, and willing to provide locator information for sexual and injecting partners. Those assessed to be at high risk for intimate partner violence were excluded and provided with resources. This secondary analysis includes the additional criteria of participants who recently injected drugs within the past one month given our interest in examining the impact of alcohol on behaviors of those actively injecting drugs.

Study Procedures

Detailed study procedures are outlined elsewhere [31]. Briefly, study staff identified potential participants as above, explained study procedures, screened potential participants for HIV using rapid testing, and invited PWID whose HIV testing was positive to participate if they met eligibility criteria. At the time of enrollment, study staff administered questionnaires to participants using Open Data Kit software on handheld devices and sent blood samples for HIV viral load testing [32].

Measures

Alcohol use: Participants were asked the following questions with numeric responses required: (1) "In the past

month, how many days did you drink alcohol?", and if a non-zero number, (2) "On a typical day when you are drinking alcohol, how many alcoholic drinks do you have?" Survey administrators were trained to assist participants in defining one drink as a bottle of beer, glass of wine, or shot of spirits. Locally produced traditional brews are also common in Kenya, with numerous varieties and varying alcohol content [33]. One drink of a traditional brew was therefore defined in discussion between participant and survey administrator as that of a typically sized single serving as purchased from a local bar or brewer. Average drinks/week were calculated from these survey responses. *Heavy alcohol use* was defined using CDC and NIH definitions as > 14 drinks/week for men and > 7 drinks/week for females [34, 35]. *Moderate alcohol use* was defined as any non-zero amount of alcohol use within the past month not meeting the heavy alcohol use definition. *Any alcohol use* was defined as drinking either a moderate or heavy amount. In addition, in a check-all-that-apply response, participants reported the type(s) of alcoholic beverages they consumed, including beer, liquor, wine, or other. When selecting other, participants were prompted to provide a write-in response on the other type(s) of alcohol they consumed—e.g., traditional brews. Participants were also asked whether they had ever been enrolled in an alcohol treatment program.

Substance Use Participants were surveyed on other substance use, specifically, if in the past one month they had by any route of ingestion used heroin, marijuana, cocaine, benzodiazepines, and khat—a plant native to East Africa from which leaves are chewed for stimulant effect [36]. Total number of these other substance used within the past month were calculated, excluding alcohol. Other substance use characteristics surveyed included the number of years injecting drugs (dichotomized at 5 years at analysis), daily injection frequency (dichotomized at 3 or more times daily at analysis), and self-report of current enrollment in a methadone program.

HIV Risk Behaviors Participants were surveyed on HIV transmission risk behaviors. Injecting HIV risk behaviors assessed included needle sharing ("In the past month, have you shared needles?") and injection equipment sharing ("In the past month, have you shared other injecting equipment (cookers, cottons, rinses, etc.?"). Sexual HIV risk behaviors assessed included no condom use during the last time having sex, number of new sex partners in the past 3 months (dichotomized at > 3 at analysis), and if they had ever given money or goods for sex ("Have you ever given money, drugs, or other material gain for sex?").

HIV Care Engagement Participants were asked if they were aware of their HIV-positive status prior to enrollment with a response of "no" defined hereon as *unaware of HIV status*. Those aware of their HIV-positive status were asked if they had ever in their lifetime been enrolled in HIV care with a response of "no" defined hereon as *never enrolled in HIV care*. Those previously enrolled in HIV care were asked "are you currently taking antiretrovirals for your HIV?" with a response of "no" defined hereon as *not on ART*. Those who were never enrolled in HIV care were also presumptively defined as *not on ART*. HIV viral load was obtained from blood samples at enrollment with > 1000 copies/mL defined hereon as *unsuppressed HIV viral load*, based on the threshold recommended by the World Health Organization and UNAIDS [37, 38].

Demographic and background characteristics were also assessed, including age, sex, marital status, region (Nairobi versus coastal counties of Mombasa or Kilifi), sex work (assessed from a check-all-that-apply question in which participants were asked to select their income sources, including a box labelled "sex work"), and stable vs. unstable housing.

Statistical Analysis

Descriptive statistics were assessed for the overall cohort and stratified by level of alcohol use. Chi-squared tests were used to analyze bivariate associations between alcohol use and demographic characteristics, substance use, HIV risk behaviors, and care engagement outcomes. Given a 3-level independent variable (none, moderate, and heavy alcohol use), when *p*-values from Chi-Square tests were significant ($p < 0.05$), post-hoc pairwise comparison of proportions were used to determine which proportions differed relative to one another.

Primary outcomes for multivariate analysis were (1) sexual and injecting HIV transmission risk behaviors associated with alcohol use in bivariate analysis and (2) care engagement outcomes. Care engagement outcomes were examined among the population or sub-population correlating with the HIV care continuum, including UNAIDS "90-90-90" targets which reference the goal percent of PLWH aware of their HIV status, percent of those aware of HIV status on ART, and percent of those on ART achieving viral suppression [39, 40]. Specifically, the care engagement outcomes we examined were (1) being *unaware of HIV status*, (2) *never enrolled in care* among those who were aware of their HIV status, (3) *not on ART* among those who were aware of their HIV status, (4) *unsuppressed HIV viral load* among those on ART, and (5) *unsuppressed HIV viral load* among the overall study population.

To control for potential confounding, odds ratios were calculated to assess bivariate associations between correlates of alcohol use and primary outcomes. Multivariable logistic regression models were then used to determine whether alcohol use was independently associated with primary outcomes, controlling *a priori* for age, sex, and region, and including additional correlates of alcohol use that held significant association ($p < 0.05$) with primary outcomes in bivariate analysis.

Ethics

The study obtained approval from the Ethics and Research Committee at Kenyatta National Hospital in Kenya and from the University of Washington Institutional Review Board.

Results

Participant Characteristics

Of 989 PWID-LWH who completed surveys in the primary study, 870 participants reported injecting drugs within the past one month and were included in this analysis. The population was balanced between female (49.8%) and male (50.2%), and the median age was 37 (Table I). The population was balanced between those living in Nairobi (55.9%) and coastal counties (44.1%). Many females (41.3%) and a small number of males (1.8%) reported sex work as an income source. Many males (66.8%) and a small number of females (5.5%) had at least once given money or goods for sex. A majority (65.8%) were recruited through needle and syringe programs, but a significant proportion were also recruited from the community by peer educators (16.7%), from assisted partner services (12.3%), and from methadone clinics (5.2%). Within the previous 3 months, 18.6% of participants had more than 3 new sex partners including significantly more females (29.3%) than males (8.0%). Over 42% reported no condom use during the last time having sex, balanced between male and female. Heroin use was nearly universal (98.4%) with many participants injecting drugs more than 3 times daily (51%) and injecting for more than 5 years (39.3%). In the past one month, 7.8% of participants reported needle sharing including significantly more females (11.2%) compared to males (4.6%), and 12.1% reported sharing injection equipment.

HIV Care Engagement

Of all 870 participants, 79 (9.1%) were unaware of their HIV-positive status (Table I). Of 791 participants aware of their HIV status, 40 (5.1%) had never enrolled in HIV care and 82 (10.4%)—inclusive of those never enrolled in care—were not on ART including significantly more females (13.0%) than males (7.8%). Viral load data was obtained from 686 (78.9%) participants overall, of whom 219 (31.9%) had unsuppressed viral load. Of 550 participants on ART from whom viral load data was obtained, 144 (26.2%) had unsuppressed viral load.

Alcohol Use

Among the study population, 39.4% reported any alcohol use within the past month with 24.1% reporting moderate use and 15.3% heavy use (Table 1). Females as compared to males more frequently reported consumption of any alcohol use (48.0% of all females and 30.9% of all males), moderate alcohol use (27.5% of all females compared to 20.8% of all males), and heavy alcohol use (20.6% of all females relative to 10.1% of all males). Among the 343 participants who reported any alcohol use, the greatest number of participants reported consumption of liquor (74.6%), followed by beer (21.3%), other (14.6%), then wine (6.7%). Of 50 participants reporting "other", 36 participants, all living in the coastal region, reported consumption of palm wine—"mnazi" in Swahili—made from coconut sap [41]. Additional "other" responses included local brews such as busaa or muratina (grain-based fermented beer), chang'aa (distilled liquor produced from busaa residue or bananas), and miti ni dawa (fermented herb beverage with honey) [33, 42]. Of participants who reported any alcohol use, only 11 (3.2%) had ever been enrolled in alcohol treatment; 7 of whom reported moderate alcohol use and 4 heavy use.

Associations Between Alcohol Use and Demographic and Substance Use Characteristics

As compared to no alcohol use, moderate and heavy alcohol use were significantly more common among those reporting sex work and among those reporting khat use in the past month (Table II). Those using moderate or heavy alcohol also reported use of a higher number of other substances compared to those not using alcohol, however, after excluding khat there was no significant difference. Heavy and moderate alcohol use were less common among those who reported unstable housing and those reporting current enrollment in a methadone clinic. Compared to those who did not use alcohol, moderate but not heavy alcohol use was associated with living in Nairobi vs. the coastal counties.

Table I Demographics, recruitment, substance use, and HIV risk behaviors and care engagement of study population, stratified by sex

	Total $N=870$ n (%)	Female $N=433$ n (%)	Male $N=437$ n (%)	p-value[a]
Demographics				
Age in years, median (IQR)	37 (31–42)	35 (30–41)	38 (32–44)	**< 0.01**[b]
Region				
Nairobi	486 (55.9)	289 (66.7)	197 (45.1)	**< 0.01**
Coast	384 (44.1)	144 (33.3)	240 (54.9)	
Married or live-in partner	243 (27.9)	107 (24.7)	136 (31.1)	**0.04**
Sex work	187 (21.5)	179 (41.3)	8 (1.8)	**< 0.01**
Unstable housing	113 (13.0)	45 (10.4)	68 (15.6)	**0.02**
Recruitment				
Needle and syringe program	573 (65.8)	271 (62.6)	302 (69.1)	-
Methadone clinic	45 (5.2)	8 (1.8)	37 (8.5)	-
Peer educator	145 (16.7)	100 (23.1)	45 (10.3)	-
Assisted partner services	107 (12.3)	54 (12.5)	53 (12.1)	-
Substance use				
Any alcohol use in past month	343 (39.4)	208 (48.0)	135 (30.9)	**< 0.01**
Moderate use[c]	210 (24.1)	119 (27.5)	91 (20.8)	**< 0.01**
Heavy use[c]	133 (15.3)	89 (20.6)	44 (10.1)	**< 0.01**
Type of alcohol[d]				
Beer	67 (19.5)	32 (15.4)	35 (25.9)	**0.02**
Liquor	191 (55.7)	119 (57.2)	72 (53.3)	0.48
Wine	19 (5.5)	9 (4.3)	10 (7.4)	0.22
Other	48 (14.0)	21 (10.1)	27 (20.0)	**< 0.01**
Ever in alcohol treatment program[d]	11 (3.2)	7 (3.4)	4 (3.0)	0.35
Other substance use in past month				
Heroin	856 (98.4)	426 (98.4)	430 (98.4)	0.99
Marijuana	474 (54.5)	232 (53.6)	242 (55.4)	0.59
Benzodiazepines	139 (16.0)	45 (10.4)	94 (21.5)	**< 0.01**
Khat	115 (13.2)	65 (15.0)	50 (11.4)	0.12
Cocaine	98 (11.3)	38 (8.8)	60 (13.7)	**0.02**
# other substances, mean (SD)	2.93 (0.84)	2.86 (0.76)	3.00 (0.91)	.05[b]
Injecting 5 or more years	342 (39.3)	120 (27.7)	222 (50.8)	**< 0.01**
Injecting 3 or more times daily	444 (51.0)	185 (42.7)	259 (59.3)	**< 0.01**
Currently in methadone program	189 (21.7)	75 (17.3)	114 (26.1)	0.21
HIV transmission risk behaviors				
Needle sharing	68 (7.8)	48 (11.2)	20 (4.6)	**< 0.01**
Injection equipment sharing	105 (12.1)	59 (13.6)	46 (10.5)	0.16
No condom last time having sex	366 (42.1)	175 (40.4)	191 (43.7)	0.11
> 3 new sex partners past 3 months	162 (18.6)	127 (29.3)	35 (8.0)	**< 0.01**
Ever given money or goods for sex	316 (36.3)	24 (5.5)	292 (66.8)	**< 0.01**
HIV care engagement				
Unaware of HIV status	79 (9.1)	42 (9.7)	37 (8.5)	0.53
Never enrolled in HIV care[e]	40 (5.1)	24 (6.1)	16 (4.0)	0.23
Not on ART[e]	82 (10.4)	51 (13.0)	31 (7.8)	**0.01**
Viral load unsuppressed, on ART[f]	144 (26.2)	67 (25.8)	77 (26.6)	0.83
Viral load unsuppressed, overall[f]	219 (31.9)	114 (33.2)	105 (30.6)	0.51

Abbreviations: IQR, interquartile range; SD, standard deviation; ART, anti-retroviral therapy

[a]Chi-Square test unless noted

[b]Wilcoxon rank sum test

[c]Heavy use: > 14 drinks/week for men or > 7 for females; moderate: any lesser non-zero amount

[d]Of the total, female, and male participants who reported any alcohol use in past month, respective to column

[e]Among those aware of their HIV status

[f]Viral load from 686 participants overall (550 on ART); unsuppressed is > 1000 copies/mL

Table II Demographics, substance use, and HIV risk behaviors and care engagement of study population, stratified by alcohol use

	No alcohol use $N=527$ n (%)	Moderate alcohol use[a] $N=210$ n (%)	Heavy alcohol use[a] $N=133$ n (%)	p-value[b]
Demographics				
Age in years, median (IQR)	36 (30–42)	37 (32–43)	37 (32–42)	0.10[c]
Region				
Nairobi	272 (51.6)	134 (63.8)	80 (60.2)	**< 0.01**
Coast	255 (48.4)	76 (36.2)	53 (39.8)	
Married or live-in partner	156 (29.6)	49 (23.3)	38 (28.6)	0.23
Sex work	85 (16.1)	52 (24.8)	50 (37.6)	**< 0.01**
Unstable housing	87 (16.5)	17 (8.1)	9 (6.8)	**< 0.01**
Substance use				
Type of alcohol[d]				
Beer	-	35 (16.7)	32 (24.1)	0.09
Liquor	-	119 (56.7)	72 (54.1)	0.65
Wine	-	9 (4.3)	10 (7.5)	0.20
Other	-	20 (9.5)	28 (21.1)	**< 0.01**
Ever in alcohol treatment program[d]	-	7 (3.3)	4 (3.0)	0.87
Other substance use in past month				
Heroin	518 (98.3)	206 (98.1)	132 (99.2)	0.80
Marijuana	274 (52.9)	115 (54.8)	85 (63.9)	0.05
Benzodiazepines	91 (17.3)	32 (15.2)	16 (12.0)	0.33
Khat	40 (7.6)	39 (18.6)	36 (27.1)	**< 0.01**
Cocaine	68 (12.9)	21 (10.0)	9 (6.8)	0.11
# other substances, mean (SD)	2.88 (0.83)	2.97 (0.85)	3.10 (0.87)	**0.04[c]**
# other substances excluding khat, mean (SD)	2.81 (0.78)	2.78 (0.75)	2.82 (0.71)	0.80[c]
Injecting 5 or more years	217 (41.2)	82 (39.0)	43 (32.3)	0.16
Injecting 3 or more times daily	276 (52.4)	111 (52.3)	57 (42.9)	0.12
Currently in methadone program	137 (26.0)	32 (15.2)	20 (15.0)	**< 0.01**
HIV transmission risk behaviors				
Needle sharing	27 (5.1)	18 (8.6)	23 (17.3)	**< 0.01**
Injection equipment sharing	51 (9.7)	30 (14.3)	24 (18.0)	**0.02**
No condom use last time having sex	225 (44.2)	80 (38.1)	62 (46.6)	0.19
> 3 new sex partners past 3 months	68 (12.9)	50 (23.8)	44 (33.1)	**< 0.01**
Ever given money or goods for sex	200 (38.0)	77 (36.6)	39 (29.3)	0.17
HIV care engagement				
Unaware of HIV status	31 (5.9)	27 (12.9)	21 (15.8)	**< 0.01**
Never enrolled in HIV care[e]	19 (3.8)	15 (8.2)	6 (5.4)	0.07
Not on ART[e]	42 (8.5)	25 (13.7)	15 (13.4)	0.07
Viral load unsuppressed, on ART[f]	99 (28.8)	31 (23.3)	14 (19.2)	0.17
Viral load unsuppressed, overall[f]	134 (32.9)	57 (31.5)	28 (28.6)	0.72

[a]Heavy use: >14 drinks/week for men or > 7 for females; moderate: any lesser non-zero amount

[b]Chi-square test unless noted

[c]Wilcoxon rank sum test

[d]Of those who reported moderate or heavy alcohol use, respective to column

[e]Among those aware of their HIV status

[f]Viral load from 686 participants overall (550 on ART); unsuppressed is > 1000 copies/mL

Associations Between Alcohol Use and HIV Transmission Risk Behaviors

In bivariate analysis, moderate and heavy alcohol use as compared to no use were significantly more common among those with > 3 new sex partners in the past 3 months (Table II). As compared to no alcohol use, heavy but not moderate use was also significantly more common among those who reported needle sharing and those who reported sharing injection equipment. In multivariate analyses, variables of age, sex, and region were included as controls *a priori*. The variables of sex work, khat use in the past

Table III Associations between alcohol use and HIV risk behaviors

	> 3 new sex partners in past 3 months *N* = 162/870	Needle sharing *N* = 68/870	Injection equipment sharing *N* = 105/870
	Adjusted Odds Ratio[a] (95% Confidence Interval)		
No alcohol use	1 (ref)	1 (ref)	1 (ref)
Moderate use[b]	**1.75 (1.06, 2.90)**	1.28 (0.66, 2.44)	1.28 (0.75, 2.13)
Heavy use[b]	**1.99 (1.12, 3.49)**	**2.72 (1.43, 5.13)**	**1.80 (1.00, 3.16)**
Any use[b]	**1.88 (1.21, 2.92)**	**1.81 (1.05, 3.14)**	1.46 (0.93, 2.30)

[a]Multivariate logistic regression models controlled for age, sex, region, sex work, khat use in the past month, and current enrollment in a methadone program

[b]Heavy use: > 14 drinks/week for men or > 7 for females; moderate use: any lesser non-zero amount; any use: moderate or heavy use

month, and current enrollment in a methadone clinic were also included to control for potential confounding given their associations ($p < 0.05$) with moderate and heavy alcohol use and HIV risk behavior outcomes in bivariate analysis (Table II and Supplemental Table 1). These adjusted analyses showed that heavy alcohol use was associated with needle sharing, injection equipment sharing, and > 3 new sex partners in 3 months (Table III). Moderate use was associated with > 3 new sex partners in 3 months, but not needle or injection equipment sharing. In pooled analysis, any alcohol use was associated with needle sharing and > 3 new sex partners in 3 months.

Associations Between Alcohol use and HIV Care Engagement

In bivariate analysis, moderate and heavy alcohol use as compared to no use were significantly more common among those unaware of HIV status (Table II). In multivariate analyses, variables of age, sex, and region were included as controls *a priori*. The variables of khat use and current enrollment in a methadone clinic were also included to control for potential confounding given their associations ($p < 0.05$) with moderate and heavy alcohol use and one or more care engagement outcomes in bivariate analysis (Table II and Supplemental Table 2). In adjusted analyses, both moderate and heavy alcohol use were significantly associated with being unaware of HIV status (Table IV). Moderate but not heavy use was associated with never being enrolled in care among those aware of their HIV status. Neither moderate nor heavy use were associated with not being on ART among those aware of their HIV status. In pooled analysis, any alcohol use was associated with unawareness of HIV status, and among those were aware of their HIV status was associated with never being enrolled in care and not being on ART. There was no significant association between unsuppressed HIV viral load and heavy, moderate, or any alcohol use; neither among those on ART nor overall.

Discussion

This study found that alcohol use among PWID-LWH in Kenya was associated with HIV transmission risk behaviors including needle sharing, injection equipment sharing, and more new sex partners, and was associated with lower engagement in care at several stages of the HIV care cascade. There was a strong association between alcohol use

Table IV Associations between alcohol use and HIV care engagement outcomes

	Unaware of HIV status *N* = 79/870	Never enrolled in HIV care[a] *N* = 40/791	Not on ART[a] *N* = 82/791	Unsuppressed HIV viral load, on ART *N* = 144/550	Unsuppressed HIV viral load, overall *N* = 219/686
	Adjusted Odds Ratio[b] (95% Confidence Interval)				
No alcohol use	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)
Moderate use[c]	**2.30 (1.29, 4.09)**	**2.35 (1.11, 4.90)**	1.73 (0.98, 3.00)	0.77 (0.47, 1.23)	0.96 (0.65, 1.43)
Heavy use[c]	**2.77 (1.46, 5.19)**	1.46 (0.50, 3.77)	1.66 (0.82, 3.21)	0.61 (0.30, 1.14)	0.83 (0.49, 1.40)
Any use[c]	**2.48 (1.50, 4.16)**	**2.02 (1.02, 4.04)**	**1.71 (1.04, 2.81)**	0.71 (0.46, 1.09)	0.90 (0.64, 1.28)

[a]Among those aware of their HIV status

[b]Multivariate logistic regression models controlled for age, sex, region, khat use in the past month, and current enrollment in a methadone program

[c]Heavy use: > 14 drinks/week for men and > 7 drinks/week for females; moderate use: any lesser non-zero amount; any use: moderate or heavy use

and being unaware of HIV status at all levels of drinking assessed. The association of alcohol use with undiagnosed HIV is concerning given the potentially elevated risk of HIV transmission prior to ART initiation, which could be amplified by the increased HIV transmission risk behavior also seen with alcohol use. We did not find an association between alcohol use and unsuppressed viral load. However, our cohort had a high rate of unsuppressed viral load overall (32%) including in alcohol users (30%), indicating that the heightened HIV transmission risk behaviors among alcohol users likely translates to increased HIV transmission risk at the population level.

Among those who were aware of their HIV status, any alcohol use or moderate use were associated with never enrolling in HIV care. The association between heavy alcohol use and never enrolling in HIV care was not significant, though this may have been due to power. Our findings suggest a possible impact of alcohol use on linkage to care after diagnosis and contribute to a limited number of studies in sub-Saharan Africa examining the relationship between alcohol and this stage of the HIV care cascade. One study in South Africa found that alcohol use was a predictor of those failing to establish care at an urban HIV clinic following referral [43], while another in South Africa did not find an association between alcohol use and linkage to care after home-based HIV testing [44]. We hypothesize that alcohol use could negatively impact linkage to care through greater difficulty adhering to appointments, though further research is warranted to assess barriers to entering care among those drinking, including if alcohol-related stigma could be a factor. Among those aware of their HIV status, we also found that any alcohol use was associated with not being on ART. The association was not significant among sub-categories of those with moderate or heavy use, though odds ratios were high suggesting this may have been due to limited power. This is consistent with several systematic reviews which have found that alcohol is reliably associated with lower ART uptake and/or adherence among PLWH, including in sub-Saharan Africa [17, 18, 45].

Findings have been mixed in previous studies on whether there is a link between alcohol use and unsuppressed viral load, including among recent studies in sub-Saharan Africa [19–23]. Our finding of no association between any level of alcohol use and unsuppressed viral load—particularly when examined among the overall study population—was somewhat surprising given the negative associations we found between alcohol use and care engagement at all other stages of the HIV care continuum examined. A recent study among PLWH in Kenya and Uganda found an association between alcohol use and unsuppressed viral load, though only when looking at viral suppression overall and not when restricted to those on ART, with the authors suggesting the association with unsuppressed viral load may be mediated through lower awareness of HIV status and lower ART uptake [20]. Among our cohort, despite similar associations between alcohol use and lower awareness of HIV status and ART uptake, our finding of no association with unsuppressed viral load may have been due to limited power, both from limited viral load data (79% of participants) and low *N* of heavy alcohol users. Alternatively, our study population of PWID-LWH relative to PLWH overall may engage in more substance use and high-risk injecting behaviors, and alcohol use could be associated with protective behaviors relative to non-alcohol users. For example, though not statistically significant differences, in our study alcohol users were injecting less frequently, injecting for less years, and using cocaine less (Table II)—factors which when more frequent in the comparator group of non-alcohol users, could conceivably dampen the relative effect of alcohol use on care cascade outcomes including unsuppressed viral load.

We also found associations between alcohol use and injection HIV risk behaviors including needle and injection equipment sharing. It is notable that we found a lower needle-sharing rate among PWID-LWH compared to PWID from prior studies in Kenya [7], which may reflect the expansion of needle and syringe programs and/or be a result of high recruitment numbers in our study from needle and syringe programs and methadone clinics (72% of participants). The association of alcohol use with needle sharing was consistent with two other studies among PWID-LWH in New York and Russia [25, 26]. Like a similar study in Vietnam [27], we also found an association between alcohol use and more new sex partners among PWID-LWH, including after controlling for sex work. Our study is among the first to our knowledge examining these associations among PWID-LWH in sub-Saharan Africa.

This study established a high prevalence of alcohol consumption among PWID-LWH in Kenya, with 39.4% reporting any alcohol use and 15.3% reporting heavy use. This is higher than the prevalence of alcohol consumption reported in the overall Kenyan population at 12.2% [46]. While we did not find any previous estimate for heavy alcohol use in Kenya by the same definition, the prevalence found here among PWID-LWH is higher than that of hazardous or harmful alcohol consumption reported among the general population in Kenya at 6.7% based on AUDIT survey scores [47]. We also found that liquor was the most common type of alcohol consumed among this cohort; whereas among the general Kenyan population by litres of pure alcohol per capita, beer is consumed the most (40%) followed by 'other' (37%), spirits (21%), and wine (2%) [48].

This study had several limitations. Both substance use and care engagement indicators were self-reported, introducing the possibility of recall and social desirability biases.

This could have resulted in underreporting of alcohol use and overreporting of care engagement. In self-report of number of alcoholic drinks participants consumed, general guidance was provided to participants to define "one drink" based on the type and amount of alcohol they consumed (i.e., bottle of beer, glass of wine, shot of spirits, or serving of traditional brew) though precise volume and alcohol content was not assessed due to practical limitations, introducing inter-reporter variability. Among traditional brews, there can also be significant variation in alcohol content which may not be known or accurately quantifiable by participants [33]. For example, estimates for alcohol content of palm wine in Kenya range from 5.5 to 7.5% while those for chang'aa which is distilled range from 16.2 to 31.5% [42, 49]. Despite the range of error from self-quantification of drinks, stratified analysis of moderate and heavy alcohol use within the past month provided a quantitative measure of use correlating closely with the time period over which HIV risk behaviors were assessed and demonstrated a recurrent pattern of heavy alcohol use having stronger association with HIV risk behaviors than moderate use. We notably did not assess binge drinking, which may differentially impact HIV risk behaviors and care outcomes. Another limitation is that our recruitment methods included many participants from needle and syringe programs or methadone clinics (72%) resulting in a study population which may be more engaged in care compared to the overall population of PWID-LWH in Kenya. The measured associations between alcohol, HIV risk behaviors, and care engagement may differ among a less-engaged population. Despite limitations, this study is among the first to our knowledge in sub-Saharan Africa reporting on alcohol use and its associations with HIV risk behaviors and care engagement among the key population of PWID-LWH.

Given the associations identified between alcohol use, HIV risk behaviors, and lower care engagement, efforts are warranted to engage more PWID-LWH in both alcohol treatment and HIV care. Alcohol use is a modifiable risk factor with counselling and/or medication [50], though only 4 of 133 participants drinking heavily in this cohort had ever been enrolled in an alcohol treatment program despite significant growth in the number of alcohol and addiction rehabilitation centers in Kenya [51]. Alcohol treatment among PLWH is also associated with improved HIV outcomes including ART adherence and suppressed viral load [52], providing further benefit to PWID-LWH. Methadone clinics and needle exchange programs are potential sites to upscale alcohol treatment and referrals to alcohol treatment programs. HIV testing and linkage to care could also be upscaled at methadone clinics, needle exchange programs, and alcohol treatment programs to improve care engagement among PWID-LWH who are drinking.

Conclusion

Alcohol use among PWID-LWH in Kenya is associated with increased sexual and injecting HIV risk behaviors, lower awareness of HIV status, and lower engagement in care. Increased alcohol treatment and HIV care engagement of PWID consuming alcohol—particularly through increased testing and linkage to care—are needed next steps in efforts to achieve HIV epidemic control goals among PWID in Kenya. Possible sites to scale up these interventions for PWID-LWH consuming alcohol might occur at alcohol treatment programs, needle exchanges, and methadone clinics.

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Data Availability The datasets generated and/or analyzed during the current study are not publicly available because the local ethics review committee requires oversight of use of research data but are available from the corresponding author on reasonable request.

Code Availability Not applicable.

Declarations

Conflicts of Interest/Competing Interests The authors declare that they have no competing interests.

Ethics Approval All study procedures and materials were approved by the University of Washington Institutional Review Board (Seattle, WA, USA) and the Kenyatta National Hospital/University of Nairobi Ethical Review Committee (Nairobi, Kenya). This study was carried out in accordance with the Declaration of Helsinki.

Consent to Participate Informed consent was obtained from all study participants.

Consent for Publication Not applicable.

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