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## The association between substance use and sub-optimal HIV treatment engagement among HIV-infected female sex workers in Lilongwe, Malawi

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### Abstract

Female sex workers (FSW) have a high prevalence of substance use and HIV, but the impact of substance use on HIV treatment engagement is not well established. We evaluated the association between alcohol and marijuana use and sub-optimal HIV treatment engagement outcomes among HIV-infected FSW in Lilongwe, Malawi. We enrolled FSW using venue-based recruitment into a cross-sectional evaluation assessing substance use and HIV treatment engagement. Seropositive FSW, identified through HIV rapid testing, received rapid CD4 count and viral load testing. We used Poisson regression with robust variance estimates to ascertain associations of alcohol and marijuana use with sub-optimal HIV treatment outcomes: (1) lack of ART use among previously diagnosed, ART-eligible FSW and (2) viral nonsuppression among FSW on ART. Of previously diagnosed, ART-eligible FSW ( $n = 96$ ), 29% were not using ART. Patterns of hazardous drinking were identified in 30%, harmful drinking in 10%, and alcohol dependence in 12%. ART-eligible FSW with harmful drinking or alcohol dependency were 1.9 (95% CI: 1.0, 3.8) times as likely to not use ART compared to FSW without harmful or dependent drinking. Among those on ART, 14% were virally nonsuppressed. The prevalence ratio for viral nonsuppression was 2.0 (95% CI: 0.6, 6.5) for harmful drinkers and alcohol-dependent FSW. Over 30% of ART-eligible FSW reported using marijuana. Marijuana-using FSW were 1.9 (95% CI: 0.8, 4.6) times as likely to not use ART compared to FSW who were not using marijuana. Given the high prevalence of alcohol

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use and its association with lack of ART use, ART uptake and alcohol reduction strategies should be tailored for alcohol-using FSW in Malawi.

## Keywords

FSW; alcohol; marijuana; antiretroviral therapy; viral suppression

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## Introduction

Substance use is prevalent among female sex workers (FSW) globally (Abdool Karim et al., 2010; El-Bassel, Witte, Wada, Gilbert, & Wallace, 2001; Shakarishvili et al., 2005; Strathdee et al., 2010; Tegang et al., 2010; Wechsberg et al., 2009; Wechsberg, Luseno, Lam, Parry, & Morojele, 2006). FSW use substances to facilitate soliciting clients and to cope with stigma and stress related to sex work (Abdool Karim et al., 2010; Chersich et al., 2007; de Graaf, Vanwesenbeeck, van Zessen, Straver, & Visser, 1995; El-Bassel et al., 2001; Gupta, Raj, Decker, Reed, & Silverman, 2009). Substance-using FSW have low condom usage, commonly experience sexual abuse, and are at high risk for HIV acquisition (Agha & Chulu Nchima, 2004; Greenberg et al., 2009; Wechsberg et al., 2006; Wechsberg, Luseno, & Lam, 2005).

The global HIV prevalence among FSW is 12%, with a prevalence of 37% among FSW in Sub-Saharan Africa (Baral et al., 2012). The HIV prevalence among Malawian FSW is one of the highest globally – approximately 70% live with HIV (Lancaster et al., 2016). To improve health outcomes and reduce ongoing transmission risk, HIV-infected FSW must use antiretroviral therapy (ART) and become virally suppressed. But engagement in HIV treatment appears to be a particular challenge among FSW in Sub-Saharan Africa (Chersich et al., 2013; Mountain et al., 2014; WHO UNAIDS UNICEF, 2010).

For FSW, one potential barrier to engagement in HIV treatment is substance use. Heavy use of alcohol and/or marijuana, the most commonly used substances in Malawi, severely affects cognitive functions, such as decision-making and memory (Azar, Springer, Meyer, & Altice, 2010; Bolla, Brown, Eldreth, Tate, & Cadet, 2002; Curran, Brignell, Fletcher, Middleton, & Henry, 2002; Korthuis et al., 2012). Substance users with impairment of these cognitive skills may experience difficulty managing their HIV treatment (Azar et al., 2010; Chitwood, McBride, French, & Comerford, 1999; Korthuis et al., 2012; Sohler et al., 2007; Tucker, Burnam, Sherbourne, Kung, & Gifford, 2003). Hence, the impact of substance use on engagement in HIV treatment among FSW must be understood.

For this study, we examined the association between alcohol and marijuana use and sub-optimal HIV treatment engagement among HIV-infected FSW in Lilongwe, Malawi.

## Methods

### Study design

In this study, we analyzed data from a cross-sectional study of FSW in Lilongwe, Malawi, who were recruited using venue-based sampling in 2011. Detailed study method has been

described previously (Lancaster et al., 2016). Briefly, consented FSW received a behavioral survey seeking detailed information on alcohol and marijuana use, and HIV testing and treatment engagement. CD4 measurements and plasma HIV-RNA levels were obtained from all HIV-seropositive FSW.

### **Substance use assessment**

We measured alcohol use using the World Health Organization's (WHO) Alcohol Use Identification Test (AUDIT) (Allen, Litten, Fertig, & Babor, 1997; Saunders, Aasland, Babor, de la Fuente, & Grant, 1993; World Health Organization (WHO), 2000), an internationally validated screening tool that measures alcohol-use behaviors and alcohol-use disorder symptoms (Parry et al., 2005; Woolf-King & Maisto, 2011). An AUDIT score of 0–6 was considered indicative of abstinence or nonhazardous drinking, 7–15 of hazardous drinking, 16–19 of harmful drinking, and ≥20 of alcohol dependency (World Health Organization (WHO), 2000).

Marijuana use was assessed by reports of lifetime marijuana and number of days using marijuana within the past 30 days. We defined current marijuana use as FSW who reported using marijuana at least one day within the prior 30 days.

### **HIV treatment engagement assessments**

We asked the date and results of their most recent HIV test to determine new versus previous diagnosis. We defined a new HIV diagnosis as FSW who were seropositive, based on HIV rapid testing, and self-reported being HIV negative at their most recent HIV test, previously tested but did not receive their results, or never tested previously.

We assessed reported current ART use among all previously diagnosed, ART-eligible FSW. ART eligibility was defined as those reporting current ART use, a CD4 ≥500 cells/mm<sup>3</sup> following the Malawi national guidelines, currently pregnant or breastfeeding, or any pregnancy after implementation of Option B+ policy (World Health Organization, 2010) in July 2011. FSW who answered no to the question “Are you currently on ART?” were classified as not using ART.

We measured HIV-1 RNA concentration for viral suppression. FSW were classified as nonsuppressed with an HIV-1 RNA >5000 copies/mL, the WHO's recommended threshold when using fingerstick dried blood spots (Arredondo et al., 2012; Rutstein et al., 2014; World Health Organization, 2012).

### **Covariates**

Based on the literature, we identified a parsimonious set of covariates: age, education, marital status, housing, gravidity, financial dependents, probable depression measured by the Patient Health Questionnaire-9 (Cholera et al., 2014; Monahan et al., 2009; Pence et al., 2012), and treated for an STI in the prior 12 months, years in sex work, location for soliciting clients, weekly number of clients, condom use during vaginal sex with clients in prior 7 days, client ever demanded not using a condom for vaginal sex, and alcohol use prior to last vaginal sex with client.

## Statistical analysis

We conducted separate analyses for the associations of alcohol and marijuana use with two primary treatment engagement outcomes: (1) lack of ART use among those previously diagnosed and ART-eligible at the time of survey and (2) viral nonsuppression among those on ART. Poisson regression with robust variance estimates was used to estimate bivariable and, when sample size permitted, multivariable prevalence ratios (PRs) with 95% confidence intervals (CIs) (Barros & Hirakata, 2003; Zou, 2004).

We assessed potential confounders and retained them in the final adjusted multivariable models if removal resulted in a >10% change in estimate. Interactions were only considered for variables of interest that met positivity assumptions and were considered to have public health relevance; they were retained in final adjusted multivariable models if they reached statistical significance at  $\alpha = 0.10$ . All analyses were conducted using SAS 9.3 (SAS Institute, Cary, NC, USA).

## Results

Among the 200 enrolled FSW, 111 (56%) were previously diagnosed and confirmed HIV infected. Of those previously diagnosed, 96 (86%) were considered eligible for ART, with the median age of 26 years (IQR: 23–30).

Among those previously diagnosed and ART eligible, over half (58%) were living at a bar or bottle shop (Table 1). Almost all had a previous pregnancy (92%). The median time exchanging sex for money was 3 years (IQR: 1–6) and the number of clients per week was 20 (IQR: 10–35).

Approximately 30% ( $n = 28$ ) reported using alcohol prior to their last vaginal sex act with a client (Table 1). Overall, over half (52%;  $n = 50$ ) had AUDIT scores  $\geq 7$ . Nearly one-third had patterns of hazardous drinking. Over 20% were heavily consuming alcohol. Twenty one percent of all ART-eligible FSW reported current marijuana use.

Twenty-five percent were not using ART. FSW not using ART had a lower median CD4 count (391, IQR: 261–474) and higher median viral load (86,345, IQR: 26,319–337,689) when compared to FSW who were using ART (Figure 1).

The prevalence of ART nonuse was 38% among those who were harmful drinkers or alcohol dependent and 21% among those who were not harmful or dependent drinkers (Table 2). In adjusted multivariable analyses, FSW who were harmful drinkers or alcohol dependent were 1.9 (95% CI: 1.0, 3.8) times as likely to not use ART compared to FSW who were not harmful or dependent drinkers.

Among the FSW using ART, 14% were nonsuppressed. Among ART users who were harmful drinkers or alcohol dependent, the prevalence of viral nonsuppression was 23%, compared to a viral nonsuppression prevalence of 12% among ART users who were not harmful drinkers or alcohol dependent. In adjusted multivariable analyses, FSW who were harmful drinkers or alcohol dependent were 1.71 (95% CI: 0.5, 5.5) times as likely to be virally nonsuppressed compared to FSW who were not harmful or dependent drinkers.

The prevalence of ART nonuse was 35% among current marijuana users. FSW who were currently using marijuana were 1.9 (95% CI: 0.8, 4.6) times as likely to not use ART compared to FSW who were not currently using marijuana.

## Discussion

We found that harmful drinking or alcohol dependence is associated with sub-optimal engagement in HIV treatment among HIV-infected FSW. FSW who were harmful drinkers or alcohol dependent were more likely to not use ART. Among the proportion of FSW on ART, increased alcohol use was also associated with viral non-suppression. Current marijuana use was uncommon but was associated with not using ART among FSW in our study.

The high level of ART use is likely a result of scaled-up ART coverage in Malawi. ART coverage has expanded in Malawi due public and private partnerships to implement Option B+ beginning in July 2011 and earlier initiation of ART (CD4 count  $> 500$  cells/mm<sup>3</sup>) in April 2014 (Malawi Ministry of Health, 2014). For the ART-eligible FSW who were previously diagnosed but not using ART, we were unable to determine the timing for ART eligibility. Our study began shortly after the expanded ART guidelines were implemented in Malawi. FSW we identified as ART-eligible may have previously been ineligible to initiate ART due to a high CD4 count (Lancaster et al., 2015).

The adverse influence of alcohol use on ART use has been well documented (Chander, Lau, & Moore, 2006; Kalichman et al., 2014; Palepu, Horton, Tibbetts, Meli, & Samet, 2004). Alcohol impairs memory, organizational skills, judgment, and other cognitive abilities, likely resulting in delayed ART initiation or treatment interruptions (Azar et al., 2010; Bolla et al., 2002; Curran et al., 2002; Kalichman et al., 2014; Korthuis et al., 2012). Health-care providers may withhold providing ART to heavy alcohol users, despite eligibility, because individuals perceived to be alcohol users are viewed as incapable of competently using ART (Hahn & Samet, 2010). There are beliefs that ART medications should not be mixed with alcohol, and therefore should not be used when consuming alcohol (Kalichman et al., 2009; Sankar, Wunderlich, Neufeld, & Luborsky, 2007). The mechanisms underlying the relationship between alcohol and ART use are unknown among ART-eligible FSW in Malawi.

This study is one of the first to examine alcohol use and viral suppression among FSW in Sub-Saharan Africa. Alcohol use among HIV-infected persons in Sub-Saharan Africa predicts viral nonsuppression. Alcohol may have a direct effect on viral nonsuppression by increasing HIV viral replication (Bagasra et al., 1996; Bagasra, Kajdacsy-Balla, Lischner, & Pomerantz, 1993; Liu, Zha, Nishitani, Chen, & Zack, 2003).

The observed prevalence of heavy alcohol use may be driven by FSW living at alcohol-serving venues (Abdool Karim et al., 2010; Chersich et al., 2007; de Graaf et al., 1995; El-Bassel et al., 2001; Gupta et al., 2009). In similar studies, FSW who worked at alcohol-serving venues were more likely to consume alcohol or binge drink when compared to FSW

not working in alcohol-serving venues (Abdool Karim et al., 2010; Agha & Chulu Nchima, 2004; Chersich et al., 2007).

Marijuana use was less common than alcohol use, which was unexpected given reported high prevalence of marijuana use among FSW in the region (Parry et al., 2009; Wechsberg et al., 2009). The pathways of both alcohol and marijuana use affecting HIV treatment are analogous (Azar et al., 2010; Bolla et al., 2002; Curran et al., 2002; Korthuis et al., 2012; Palepu et al., 2004). Heavy or severe marijuana use does negatively affect ART adherence and viral suppression (Bonn-Miller, Oser, Bucossi, & Trafton, 2014; Tucker et al., 2003). More thorough examinations of the frequency, potency, duration, and dependent symptoms of marijuana use and longitudinal assessments of viral load among FSW would provide insight on the impact of heavy marijuana use, along with concurrent alcohol use, on HIV treatment outcomes.

Although this study contributes to the currently limited understanding of the effects of substance use on HIV treatment engagement among FSW in Sub-Saharan Africa, the size of our sample is small and does not represent all HIV-infected FSW in Malawi. Our modest sample size resulted in decreased estimate precision, limited power to detect small differences, and decreased ability to control confounding in multivariable analyses.

Among HIV-infected FSW in Malawi, harmful or dependent alcohol use is common and associated with lack of ART use. To improve HIV treatment engagement, targeted interventions for HIV-infected FSW should prioritize the reduction of alcohol use, along with other substances. ART uptake strategies are critically needed for alcohol-using, ART-eligible FSW to induce viral suppression, improve health outcomes, and reduce transmission.

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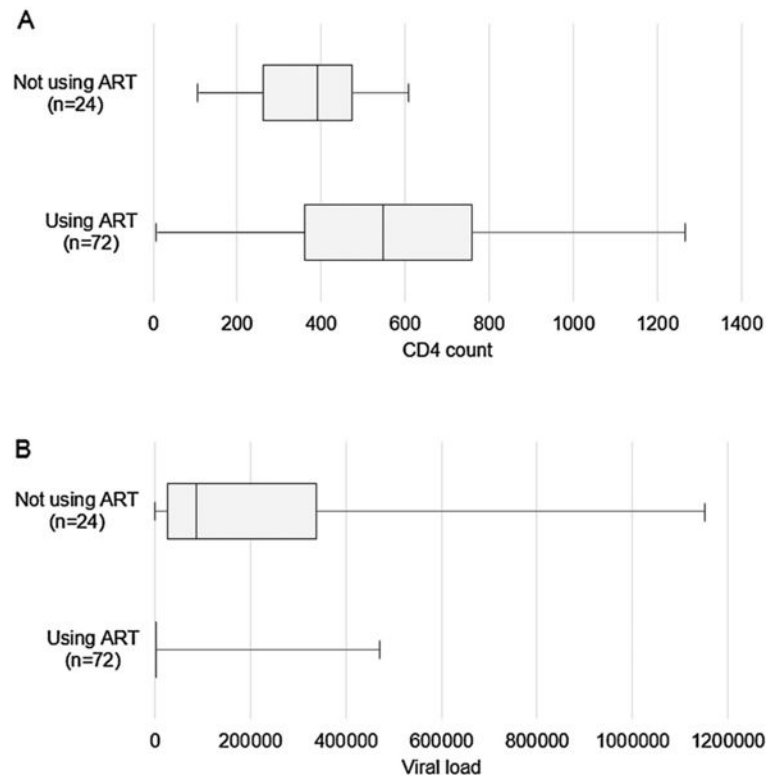
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**Figure 1.** CD4 count (a) and viral loads (b) at the time of cross-sectional survey by reported ART use among ART-eligible HIV-infected FSW ( $n = 96$ ); box plots showing median (line), interquartile range (IQR; box), minimum (lower whiskers), and maximum (upper whiskers). ART = antiretroviral therapy

**Table 1**

Characteristics and substance use of previously diagnosed, ART-eligible FSW in Lilongwe, Malawi, July–September 2014 ( $N=96$ ).

	<i>n</i>	(%)
Age (years)		
18–24	37	(39)
25–29	32	(34)
30	27	(28)
Education		
Never attended or only primary school	66	(69)
Any secondary or more school	30	(31)
Marital status		
Never married	10	(10)
Married or co-habiting	3	(3)
Separated, divorced, or widowed	83	(87)
Housing		
Private house	13	(14)
Bar or bottle shop	56	(58)
Guesthouse or hotel	27	(28)
Number of pregnancies		
0	8	(8)
1	88	(92)
Number of financial dependents		
0	4	(4)
1	92	(96)
Depression		
No probable depression	87	(91)
Probable depression	9	(9)
Treated for an STI in prior 12 months		
No	72	(75)
Yes	24	(25)
Duration of sex work (years)		
<1.0	15	(16)
1.0–1.9	17	(18)
2.0–2.9	53	(55)
3.0		
Location for soliciting clients		
Bar or bottle shop	11	(11)
Other	85	(89)
Number of clients per week <sup>a</sup>		
<10	19	(20)
10–19	22	(23)

	<i>n</i>	(%)
20–29	27	(28)
30	27	(28)
Condom use with client in prior 7 days		
Inconsistent	22	(23)
Consistent	74	(77)
Ever had a client demand not using a condom during vaginal sex		
No	40	(42)
Yes	56	(58)
Alcohol use prior to last vaginal sex with client		
No	68	(71)
Yes	28	(29)
<i>Substance use</i>		
Alcohol use (AUDIT)		
Nonhazardous drinking (score 0–6)	46	(48)
Hazardous drinking (score 7–15)	29	(30)
Harmful drinking (score 16–19)	10	(10)
Alcohol dependent (score 20)	11	(12)
Marijuana use		
No current marijuana use	76	(79)
Current marijuana use <sup>b</sup>	20	(21)

Note: AUDIT = Alcohol Use Disorder Identification Test.

<sup>a</sup>Missing data due to not knowing or refused to answer: number of clients in past 7 days:  $n = 1$ .

<sup>b</sup>Current use defined as reported use in past 30 days.

Table 2

Prevalence and association of alcohol and marijuana use with sub-optimal HIV treatment engagement (not using ART and virally nonsuppressed) among HIV-infected FSW in Lilongwe, Malawi.

	Reported ART use (N = 96)		Not using ART		Viral suppression (N = 72)		Virally nonsuppressed	
	Not using ART (n = 24)	Using ART (n = 72)	Unadjusted PR (95% CI)	Adjusted PR (95% CI)	Virally nonsuppressed (n = 10)	Virally suppressed (n = 62)	Unadjusted PR (95% CI)	Adjusted PR (95% CI)
<i>Alcohol use (AUDIT)</i>								
Nonharmful/alcohol dependence (score 15)	16 (21)	59 (79)	1.0	1.0	7 (12)	52 (88)	1.0	1.0
Harmful/alcohol dependence (score 16)	8 (38)	13 (62)	1.8 (0.9, 3.6)	1.9 (1.0, 3.8) <sup>b</sup>	3 (23)	10 (77)	2.0 (0.6, 6.5)	1.71 (0.5, 5.5) <sup>c</sup>
<i>Marijuana use</i>								
No current marijuana use	17 (23)	59 (78)	1.0	1.0	9 (15)	50 (85)	1.0	1.00
Current marijuana use <sup>a</sup>	7 (35)	13 (65)	1.5 (0.8, 3.2)	1.9 (0.8, 4.6) <sup>c</sup>	1 (8)	12 (92)	–	–

Note: ART = antiretroviral therapy; PR = prevalence ratio; CI = confidence interval; AUDIT = Alcohol Use Disorder Identification Test.

<sup>a</sup> Current use defined as reported use in past 30 days.

<sup>b</sup> Adjusted for number of clients per week, housing, and duration in sex work (years).

<sup>c</sup> Adjusted for treatment for an STI in the prior 12 months.