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Permalink

<https://escholarship.org/uc/item/9zf4w487>

Journal

Drug and Alcohol Dependence, 165

ISSN

0376-8716

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Publication Date

2016-08-01

DOI

10.1016/j.drugalcdep.2016.05.011

Peer reviewed



Published in final edited form as:

Drug Alcohol Depend. 2016 August 01; 165: 29–37. doi:10.1016/j.drugalcdep.2016.05.011.

High prevalence of unhealthy alcohol use and comparison of self-reported alcohol consumption to phosphatidylethanol among women engaged in sex work and their male clients in Cambodia

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Contributors:

Dr. Couture had full access to all the data in the study and takes responsibility for the integrity of the data and accuracy of the data analysis.

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Statistical analysis: Couture

Obtained funding: Couture, Page, Hahn.

Administrative, technical, or material support: Couture, Sansothy, Stein, Vun, Hahn, Page.

Study supervision: Couture, Sansothy, Stein, Vun.

Final approval of the article: Couture, Hahn, Stein, Sansothy, Vun, Page.

Conflict of interest:

For all authors, none declared.

Abstract

Background—In Cambodia, most of the female sex workers (FSW) work in venues where unhealthy alcohol use is ubiquitous and potentially contributing to the HIV epidemic. However, no accurate data exists. We compare self-reported unhealthy alcohol consumption to a biomarker of alcohol intake in Cambodian FSW and male clients, and determine factors associated with unhealthy alcohol use.

Methods—A cross-sectional study was conducted among FSW (n=100) and male clients (n=100) in entertainment and sex work venues in Cambodia. Self-reported unhealthy alcohol use (AUDIT-C) was compared to phosphatidylethanol (PEth) positive ($\geq 50\text{ng/ml}$), a biomarker of alcohol intake. Sociodemographics data was collected. Correlates of self-reported unhealthy alcohol use and PEth positive were determined.

Results—The prevalence of PEth positive in FSW was 60.0%. Self-reported unhealthy alcohol consumption was reported by 85.0% of the women. Almost all women (95.0%) testing PEth positive also reported unhealthy alcohol use. Prevalence of unhealthy alcohol consumption (self-report and PEth positive) was higher in FSW working in entertainment establishments compared to other sex work venues ($p < 0.01$). Among male clients, 47.0% reported unhealthy alcohol consumption and 42.0% had a PEth positive. However, only 57.1% of male clients with PEth positive reported unhealthy alcohol use.

Conclusions—Unhealthy alcohol consumption is prevalent in Cambodian sex work settings. Self-reported unhealthy alcohol use is well reported by FSW, but less by male clients. These findings highlight the urgency of using accurate measures of unhealthy alcohol consumption and integrating this health issue into HIV prevention interventions.

Keywords

unhealthy alcohol use; biomarker; phosphatidylethanol; female sex workers; male clients; HIV risk

1. INTRODUCTION

Crucial progress has been made in reducing the HIV epidemic in Cambodia (Vun et al., 2014), however some populations remain at high risk, notably women working in the entertainment and sex work sectors (Couture et al., 2011; Page et al., 2013). Male clients of female sex workers (FSW) are also at high risk for contracting HIV and have potential to play an important role in the spread of the infection in the general population (Gorbach et al., 2000; Hor et al., 2005; Couture et al., 2008; Goldenberg et al., 2010; Jin et al., 2010). However, little or no data exists on HIV infection among male clients in Cambodia. Unhealthy alcohol use, which includes risky drinking and alcohol-use disorders (Kriston et al., 2008), is universally recognized as an important contributor to the HIV/STI epidemic, notably in settings where alcohol is prevalent, such as in sex work (Li et al., 2010). Systematic reviews and meta-analyses have shown that alcohol use is associated with HIV and STI infections, as well as risky sexual behaviors, including unprotected sex, multiple partnerships and transactional sex (Kalichman et al., 2007; Baliunas et al., 2010; Shuper et al., 2010; Scott-Sheldon et al., 2016).

Worldwide, alcohol use has been shown to be highly prevalent among FSW and their clients, leading to adverse health consequences (Li et al., 2010; Yang et al., 2013; Goodman-Meza et al., 2014; Semple et al., 2015). Alcohol use is often part of the sexual transaction, and both FSW and their clients frequently drink alcohol before sexual intercourse (Wang et al., 2010; Pitpitan et al., 2013; Yang et al., 2013).

A review of the global literature has shown that the prevalence of daily alcohol consumption among FSW is 12–78%, and 14–88% of the male clients reported being under the influence of alcohol before purchasing sex (Li et al., 2010). Alcohol use in FSW, especially before sex with clients, is associated with unprotected sex, and higher risk of HIV and STI transmission (Zachariah et al., 2003; Chiao et al., 2006; Wang et al., 2010; Chen et al., 2013; Chersich et al., 2014). Alcohol use among FSW has also been associated with a higher risk of violence victimization (Wang et al., 2010; Zhang et al., 2013; Chersich et al., 2014). Among male clients, alcohol use has been associated with unprotected sex, multiple FSW partners, and HIV and STI infections (Wee et al., 2004; Madhivanan et al., 2005; Pitpitan et al., 2013; Goodman-Meza et al., 2014).

The typology of sex work has undergone significant changes in Cambodia following the promulgation of anti-sex-trafficking and sexual exploitation laws enacted in 2008 that resulted in closure of brothels (Maher et al., 2011; Page et al., 2013). The majority of FSW are now employed in entertainment venues, including bars, clubs and karaoke venues, where alcohol is an underlying construct of their livelihood, as well as sexual transactions (Maher et al., 2011; Page et al., 2013). In previous studies, we found that that self-reported alcohol use was prevalent among Cambodian FSW: 23.7% reported being drunk for more than 20 days the prior month (Couture et al., 2011), a worrisome finding that showed a need for more research on alcohol exposures and health impacts in FSW. Less is known about unhealthy alcohol consumption among male clients of FSW or the general male population in Cambodia. In a recent national survey, 7.9% of the men reported having consumed ≥ 7 alcoholic drinks in the past week, however the prevalence was likely underestimated due to social stigma and social desirability bias (Banta et al., 2013). A more recent report has found that alcohol use is increasing in Cambodia, especially among young people; 58% of those aged between 15 and 25 reported drinking alcohol every day (Eng, 2014).

Measuring unhealthy alcohol consumption is essential to inform effective prevention interventions and treatment. All of the data collected on unhealthy alcohol use in sex work settings in Cambodia and elsewhere have been collected using self-report (Li et al., 2010; Couture et al., 2011; Banta et al., 2013), which may be underestimated as a result of stigma, social desirability and recall biases (Stein et al., 2000; Del Boca and Darkes, 2003; Bajunirwe et al., 2014; Jain et al., 2014).

Direct metabolites of alcohol consumption, such as ethyl glucuronide, ethyl sulfate, phosphatidylethanol (PEth), and fatty acid ethyl esters (Wurst et al., 2015) have recently been developed as objective measures of consumption, each with their own rate of elimination. PEth is formed only in the presence of alcohol, and thus is highly specific, and a useful measure of alcohol consumption because it can be detected for 2–3 weeks after drinking (Wurst et al., 2015). In a study among HIV-positive patients, reporting a range of

drinking from abstaining through very heavy drinking (median 490.6 grams of alcohol over 90 days [Interquartile range (IQR): 267.2, 1,272.7]), the PEth subtype 16:0/18:1 detected using liquid chromatography with tandem mass spectrometry (LC-MS/MS) with a cutoff of ≥ 10 ng/ml had 95% sensitivity and 73% specificity for any heavy alcohol consumption in the prior 21 days (Hahn et al., 2012). Other studies have shown high validity of PEth detected using high performance liquid chromatography (HPLC), with 97–99% sensitivity in alcohol-dependent patients and 100% specificity in abstainers to detect heavy alcohol over a period of 2–3 weeks (Aradottir et al., 2006; Hartmann et al., 2007). A handful of studies have compared PEth results to self-reported alcohol use in diverse populations with varying results (Stewart et al., 2010; Bajunirwe et al., 2014; Jain et al., 2014; Francis et al., 2015). PEth can conveniently be tested from dried blood spots (DBS; Jones et al., 2011) and may be useful to corroborate or supplement results on unhealthy alcohol consumption obtained by self-report from FSW and their male clients.

The goals of this study were 1) to assess unhealthy alcohol use prevalence in FSW and their male clients in Cambodia; 2) to compare self-reported unhealthy alcohol use among FSW and their clients to PEth results; 3) to determine the factors associated with self-reported alcohol use and PEth.

2. MATERIAL AND METHODS

2.1. Study setting

A cross-sectional pilot study was conducted in October, 2011 among FSW and male clients recruited at entertainment/drinking establishments and other sex work venues in Preah Sihanouk province, Cambodia. Participants were surveyed regarding sociodemographics, sexual behaviors, and alcohol and drug consumption. Blood samples were collected to assess biomarkers of alcohol use and to test for HIV. The study protocol was approved by the Cambodian National Ethical Committee on Human Research and the Committee on Human Research at University of California San Francisco.

2.2 Study population and recruitment

Convenience samples of FSW and male clients were recruited directly in entertainment/drinking establishments (karaoke bars, beer gardens, and nightclubs) and other sex work venues (brothels, parks, streets, guest houses) by trained staff from local organizations working in HIV prevention in sex work settings. Inclusion criteria for FSW were: being female, aged ≥ 18 years, understanding of Khmer, reporting at least two different sexual partners in the last month *or* engagement in transactional sex (sex in exchange for money, goods, services, or drugs) within the last three months, and being able to provide voluntary informed consent. The eligibility criteria were carefully worded to be as sensitive as possible to avoid stigmatization and protect the women engaged in sex work, which is criminalized in Cambodia. All of the women participating in the study confirmed receiving money, gifts or goods from at least one partner in the last three months in a subsequent question of our survey, indicating transactional sex. For the male clients the inclusion criteria were: presence at the sex work venue or entertainment/drinking establishment during fieldwork and reporting having a sexual encounter in the last 3 months with a FSW for which the client had

paid in money or goods, aged ≥ 18 years, understanding of Khmer, and able to provide voluntary informed consent.

Entertainment/drinking establishments and sex work venues were mapped by trained field assistants employed by local community partners. FSW and their male clients were recruited directly from these locations by field assistants with the help of collaborating FSW, and managers of venues. Field assistants described the study and conducted a brief eligibility screening. The consent process included an explanation that blood samples would be tested for alcohol use as well as HIV. Eligible participants were asked to come to the Provincial AIDS Office (PAO) the following day. Participants were offered free transportation to the study site and were given US \$5 and condoms following participation.

2.3 Data collection

A structured paper questionnaire was administered in Khmer by trained interviewers in a private room covering sociodemographics, alcohol and drug consumption. Finger pricks were performed to collect DBS to measure PEth (described below). Rapid HIV testing was conducted using Determine HIV 1/2, (Abbott Diagnostic Division, Netherlands) also from DBS. Nonreactive samples were considered seronegative; reactive samples were confirmed with Clairview HIV 1/2 STAT-PAK (Inverness Medical Diagnostics, Waltham, MA). Discordant samples were sent to the Cambodian National Institute of Public Health laboratory for confirmation using Serodia HIV-1/2 (Fujirebio Inc., Tokyo, Japan).

Client-centered risk reduction counseling was provided for all participants. HIV results and referrals were provided for free follow-up medical evaluation for those testing positive.

2.4 PEth

A finger prick was performed and capillary blood deposited on a filter paper (Whatman no. 903; Whatman International, Maidstone, UK). The samples were labeled with study ID numbers and dates, air-dried, and sealed in paper envelope at ambient temperature with a desiccant. The DBS papers were shipped to the U.S. for PEth testing. PEth detection on the DBS samples was conducted by United States Drug Testing Laboratories (USDTL; Des Plaines, IL, US) using a previously published method (Jones et al., 2011), using LC-MS/MS. The most prevalent PEth homolog (16:0/18:1) was measured. The limit of detection was 2 ng/mL, the limit of quantitation was 8 ng/mL. PEth results (≥ 8 ng/mL) were confirmed with a second test using a different DBS on the same paper and the average of the two results were used for the analyses.

2.5 Measures

Self-reported alcohol use was measured using the validated 3-item Alcohol Use Disorders Identification Test Consumption (AUDIT-C) instrument, which produces a score from 0–12 (Bush et al., 1998). In order to improve recall, the time frame was modified to assess alcohol use in the last three months, rather than last year. Cut-off points for women were: scores of 0–2 were considered “No or lower-risk alcohol use” and scores of 3–12 “unhealthy alcohol use”. For male clients, cut-off points were: scores of 0–3 were considered “No or lower-risk alcohol use” and scores of 4–12 “unhealthy alcohol use” (Bradley et al., 2007). An alcohol

drink conversion chart was used to remind participants about standard drink sizes. Alcohol use frequency and number of alcoholic drinks on a typical day in the last three months were measured. Participants were classified as “regular heavy drinkers” if they reported drinking alcohol 2–4 times a month or more *and* if they drank at least 5 or 6 drinks on a typical day. Participants were classified as “heavy episodic drinking” if they reported drinking more than five drinks on one day in the last three months. Participants were categorized as “being drunk or intoxicated recently” if they reported that they became drunk or intoxicated by alcohol in the last three months.

Sociodemographic variables included age, marital status, education, number of children and occupation. Based on sex work activities in the past 30 days, women were classified as working in either 1) entertainment establishments (beer gardens, bars, karaoke, and nightclubs) or 2) working as “freelance” in streets and parks or in brothels. Self-reported amphetamine-type stimulants (ATS) in the last 3 months was measured.

2.6 Statistical analyses

Descriptive statistics including median, IQR, and frequencies were calculated. The proportion with PEth positive (≥ 50 ng/ml) and PEth negative (< 50 ng/ml) was calculated overall and compared to self-reported alcohol use (AUDIT-C scores). This cutoff has been used to define unhealthy alcohol in the prior three months among HIV-positive patients (Carrico et al., 2015; Hahn et al., 2016). Sensitivity analyses were performed where PEth results were compared to other self-reported measures of alcohol: alcohol frequency, number of drinks on a typical day, being drunk or intoxicated recently, recent heavy episodic drinking, and regular heavy drinking. Chi-square and Fishers exact (when expected cells sizes were ≤ 5) tests were performed to compare proportions and identify correlates of: (1) self-reported unhealthy alcohol use, and (2) PEth positivity (≥ 50 ng/ml). Statistical analyses were conducted with STATA 13.0 (STATA, College Station, TX, USA).

3. RESULTS

The median age was similar for FSW (median=24; IQR=22–28) and the male clients (median=25; IQR=21–29) (Table 1). A higher proportion of women were widowed, divorced or separated compared to male clients (median=9; IQR=7–12). Most (71.0%) women were working in the entertainment sector, including beer gardens, karaoke, night clubs or massage parlors. Male clients reported several types of occupations, including being construction workers (20.0%), drivers (19.0%), students (11.0%) and fisherman/port workers (10.0%). The prevalence of HIV was significantly higher in FSW (9.0%) compared to male clients (2.0%; $p < 0.05$) (Table 1).

AUDIT-C results showed that 85.0% of FSW self-reported unhealthy alcohol use (Table 2). The prevalence of PEth positive (≥ 50 ng/ml) among women was 60.0%, and 88.0% of them had a positive PEth (≥ 50 ng/ml) *or* were AUDIT-C positive. Most of the women did not report drinking alcohol frequently: 30.0% drank alcohol ≥ 4 times a week in the last three months. However, the amount reported was high: 76.0% of the FSW reported drinking ≥ 5 drinks on a typical day of drinking. Moreover, 81% reported ever being drunk and 83.0% had recent heavy episodic drinking. Among male clients, 47.0% reported unhealthy alcohol

consumption using the AUDIT-C. The PEth biomarker showed similar proportions: 42.0% of the men tested positive (Table 2). Overall, 65.0% of male clients had a positive PEth (≥ 50 ng/ml) or were AUDIT-C positive. Similar to the women, men did not report drinking alcohol frequently, but drank several alcohol drinks on a typical day of drinking. More than half of the male clients (56.0%) reported ever being drunk and 60.0% had recent heavy episodic drinking.

Among women, 95.0% of the PEth positives (≥ 50 ng/ml) also reported unhealthy drinking (Table 3). However, only 57.1% of male clients who were PEth positive reported unhealthy alcohol use. The proportions reporting unhealthy use among those with negative PEth (< 50 ng/ml) were 70.0% and 39.7%, among the women and men, respectively. We also performed sensitivity analyses and compared PEth to other self-reported measures of alcohol use (Table 3). The majority of women with PEth positive results also reported “having 5 or more drinks on a typical day” (93.3%), “being drunk or intoxicated recently” (90%) and a “recent heavy episodic drinking” (93.3%). Among men, PEth positive was associated only with reporting “being drunk or intoxicated recently”.

Table 4a shows correlates of self-reported unhealthy alcohol consumption (AUDIT-C) and correlates of PEth positive among women. Self-reported unhealthy alcohol use was significantly higher in FSW working in entertainment venues (93.0%) compared to those working freelance or in brothels (65.5%; $p < 0.01$). A higher proportion of women with children reported unhealthy consumption (93.2%) than women without children (78.2%; $p < 0.05$). HIV-uninfected women reported more unhealthy alcohol use than HIV-infected (89.0% and 44.4% respectively; $p < 0.01$). Positive PEth results were also associated with working in entertainment/drinking establishments. The prevalence of PEth positive was higher in FSW who reported secondary or more level of education (80.0%) compared to women with less education (55.0%; $p < 0.05$).

Contrary to FSW, only education was associated with self-reported unhealthy alcohol consumption among male clients: 52.6% of men with secondary or more level of education reported unhealthy alcohol compared to 27.3% of those with less ($p < 0.05$) (Table 4b). Clients who had children were more likely to test positive (92.3%) compared to those without children (69.9%; $p < 0.05$). The prevalence of PEth positive was lower among single men.

4. DISCUSSION

This is the first study to assess both self-report and biomarker measures of unhealthy alcohol use in FSW and their male clients. We found that unhealthy alcohol use was highly prevalent, especially among FSW; more than 88.0% of the women and 65.0% male clients had a positive PEth or AUDIT-C indicating unhealthy alcohol consumption. A higher prevalence of unhealthy alcohol among women compared to male is rare in the literature and is particular to this specific population (Li et al., 2010). The high levels of alcohol use observed in FSW also support our previous findings (Couture et al., 2011). Not surprisingly, higher levels of alcohol use were observed among women who worked at entertainment establishments where alcohol consumption is an underlying part of their job. Other studies

have observed that unhealthy alcohol consumption differs according to sex work settings and was higher among women working at entertainment establishments (Li et al., 2010; Page et al., 2013). Heavy alcohol consumption by FSW and their male clients, as well as demands by intoxicated clients for unprotected sex, have been identified in our qualitative interviews as a critical occupational risk factors for HIV/STI infections by women in working entertainment venues (Maher et al., 2011). Alcohol use has been rising in general in Cambodia (Eng, 2014), as well as the numbers of FSW working in entertainment establishments (NCHADS, 2009). Unhealthy alcohol use and its intrinsic role in the Cambodian “entertainment culture” (Maher et al., 2011) raises concerns due to associations with risky sexual behaviors (Kalichman et al., 2007; Shuper et al., 2010), HIV/STI transmission (Baliunas et al., 2010) and violence victimization (Wang et al., 2010; Zhang et al., 2013; Chersich et al., 2014). In this study, we observed that unhealthy alcohol was higher among HIV-negative women compared to those who were HIV-positive. A possible explanation is that women who work in entertainment venues are more likely to drink alcohol, but also less likely to be infected with HIV, whereas, women working “freelance” or in brothels are more likely to instead use drugs and be HIV infected (Page et al., 2013).

Women had high levels of self-reported unhealthy alcohol use and PEth positive results. Almost all women who tested positive for PEth (95.0%) also reported unhealthy alcohol consumption. We have found similar results when comparing self-reported ATS use to urine toxicology testing in Cambodian FSW (Kab et al., 2012). These studies have been conducted in collaboration with trusted organizations working with FSW in Cambodia, as a consequence, women probably felt comfortable reporting their actual behaviors. Participants who also knew that their blood would be tested for alcohol use have been shown to be less likely to underreport their consumption (Hahn et al., 2012) and could explain the high prevalence of self-reported alcohol use among FSW. These findings, together with the high participations rates and the willingness to answer surveys we have routinely observed in our studies among Cambodian FSW, are important from a public health perspective. The positive disposition women have towards participation in health related research could play a critical role in mobilizing prevention interventions in this population.

Unhealthy alcohol consumption was also common among male clients where 65.0% self-reported unhealthy use or tested positive for PEth. In Cambodia, transactional sex often co-exists with alcohol use; occasions with excessive drinking with friends often include visits to FSW (Rammage, 2002; Smith, 2007; Sok et al., 2008). Other studies have shown that excessive alcohol consumption is common among male clients of FSW and men are also more likely to visit sex workers concurrently with alcohol consumption (Celentano et al., 1993; Li et al., 2010; Yang et al., 2013; Goodman-Meza et al., 2014). Cambodian FSW who worked in entertainment venues reported that men were near-universally intoxicated (Maher et al., 2011). This is an important cause of concern since studies have shown that alcohol use by male clients has been associated with unprotected sex, multiple FSW partners, as well as HIV and STI infections (Madhivanan et al., 2005; Goodman-Meza et al., 2014; Ramanathan et al., 2014; Rastogi et al., 2014). These results highlight the importance of addressing unhealthy alcohol use in this at-risk population and integrating this public health issue into HIV/STI prevention interventions not only targeting FSW, but also their male clients.

Men were more likely to under-report unhealthy alcohol consumption than women. Among the men who tested positive for PEth, only 57.1% reported unhealthy alcohol use. Recent study among HIV-infected patients in Uganda also reported that men were more likely to underreport their alcohol consumption compared to women (Bajunirwe et al., 2014). It is unclear if men deliberately underreported their alcohol use, or had difficulties assessing or remembering their consumption. In some studies, Cambodian men reported losing their memory or becoming unconscious while drunk, which could affect their recall of their alcohol use (Rammage, 2002; Smith, 2007).

It is important to note that several participants reported unhealthy alcohol consumption but had a negative PEth; 70.0% of the women and 39.7% of the men. PEth has been shown to be more effective in detecting unhealthy alcohol use in the last 21 days, and our study measured self-reported alcohol use in the last three months. It is possible that some participants who reported unhealthy alcohol use were in fact accurately reporting their behaviors, but self-report reflected alcohol consumption beyond the window of detectable PEth. While PEth is theoretically highly specific for alcohol consumption, sensitivity for detecting unhealthy alcohol use has varied across studies (Bajunirwe et al., 2014; Jain et al., 2014; Francis et al., 2015). Lastly, PEth is a relatively new biomarker and it is still not clear if PEth measures any alcohol use or heavy alcohol drinking (Isaksson et al., 2011). In this study, we opted for a more conservative approach and used PEth ≥ 50 ng/ml as a measure of unhealthy alcohol consumption, including moderate at-risk drinking and alcohol-use disorders. This decision is supported by recent studies showing that PEth can distinguish moderate to heavy alcohol drinkers from light drinkers or those who are abstinent (Stewart et al., 2014; Kechagias et al., 2015).

Other limitations should be considered when interpreting the results. This was a pilot study with a small sample size, which reduced the statistical power of the study and the precision of our estimates, and limited our ability to use multivariate models. The study also used a convenience sample and the findings might not be generalizable to the populations of FSW and male clients in Cambodia. However, efforts were made to recruit FSW and male clients from all the different sex work settings in Preah Sihanouk province, Cambodia, which increased the representativeness of our sample. Finally, it is also possible that men and FSW who participated in our study were different than those who did not participate.

Despite these limitations, our findings show that self-reported unhealthy alcohol is well reported by FSW. The high level of self-reported unhealthy alcohol use in FSW is consistent with our results for ATS use and supports the use of self-report measures in FWS for surveillance. However, the results obtained among clients suggest that combining self-reported alcohol use and PEth might be a more effective strategy to accurately monitor unhealthy alcohol consumption in this population. Our findings add to the growing literature regarding a high prevalence of unhealthy alcohol use in settings where sex and entertainment mix, potentially fuelling transmission of HIV and STI. So far, they are few, if any, treatment options and support for people with alcohol use problems in Cambodia. Our study highlights a need for evidence-based education and prevention regarding unhealthy alcohol use targeting FSW and their male clients within a broad ecological framework: individually, interpersonally, and structurally – at establishments, and within communities. Effective

interventions to reduce unhealthy alcohol consumption in these populations should also take into considerations the social context of alcohol drinking, the “risk environment” of the entertainment establishments, as well as the unique cultural norms and institutional policy. In conclusion, these findings can contribute to the development and implementation of appropriate prevention and treatment interventions addressing excessive alcohol use in the context of HIV/STI transmission among FSW and their male clients in Cambodia.

Acknowledgments

The authors would like to acknowledge the coordinated efforts and dedication of the local field teams from Population Services International (PSI), Reproductive Health Association Cambodia (RHAC) and Community United for Development (CUD). The authors thank Dr. Vonthanak Saphonn at the University of Health Sciences Cambodia for his support and scientific advices. The authors are indebted to all the Cambodian women who agreed to participate in this study and grateful for the privilege to work with them.

Role of the Funding Source:

This pilot study was supported by the University of California San Francisco (UCSF) Resource Allocation Program (RAP)- Pilot Award Program in HIV/AIDS by the UCSF-Gladstone Institute for Virology and Immunology, Center for AIDS Research (CFAR). The RAP awards were supported by a grant from the National Institutes of Health, University of California, San Francisco-Gladstone Institute of Virology & Immunology Center for AIDS Research, P30-AI027763.

The funding sources had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation review or approval of the manuscript; and decision to submit the manuscript for publication.

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Highlights

Unhealthy alcohol use is prevalent in Cambodian sex work settings

Unhealthy alcohol use is higher in women working in entertainment establishments

Self-reported unhealthy alcohol use is accurately reported by female sex workers

Male clients are more likely to under-report unhealthy alcohol consumption

Unhealthy alcohol use should be integrated into HIV prevention interventions.

Table 1

Sociodemographic characteristics, drug use and HIV infection in FSW and their male clients in Preah Sihanouk, Cambodia

	Total n=200 n (%)	FSW n=100 n (%)	Clients n=100 n (%)	p-value
Age (years)				0.322
18–24	101 (50.5)	54 (54.0)	47 (47.0)	
25 and older	99 (49.5)	46 (46.0)	53 (53.0)	
Marital status				< 0.01
Single	103 (51.5)	36 (36.0)	67 (67.0)	
Married/living together	37 (18.5)	16 (16.0)	21 (21.0)	
Widowed/Divorced/Separated	60 (30.0)	48 (48.0)	12 (12.0)	
Education (years)				< 0.01
None-Primary (1–6 years)	102 (52.0)	80 (80.0)	22 (22.0)	
Secondary (7+ years)	98 (49.0)	20 (20.0)	78 (78.0)	
Has children				< 0.01
No	128 (64.3)	55 (55.0)	73 (73.0)	
Yes	70 (35.4)	44 (44.0)	26 (26.0)	
Type of sex work (last 30 days)				
Entertainment/drinking establishments		71 (71.0)	--	
Freelance/brothels		29 (29.0)	--	
Occupation				
Fisherman/port worker		--	10 (10.0)	
Seller/vendor/restaurant or bar worker		--	8 (8.0)	
Driver		--	19 (19.0)	
Laborer or manual/farmer or agriculture/factory worker		--	4 (4.0)	
Construction worker		--	20 (20.0)	
Student		--	11 (11.0)	
Other		--	28 (28.0)	
Income (\$US, per month)				< 0.05
0–100\$	80 (40.0)	32 (32.0)	48 (48.0)	
> 100\$	120 (60.0)	68 (68.0)	52 (52.0)	
ATS use (last 3 months)				0.535
No	173 (86.5)	85 (85.0)	88 (88.0)	
Yes	27 (13.5)	15 (15.0)	12 (12.0)	
HIV result				< 0.05
Negative	188 (94.5)	91 (91.0)	97 (97.9)	
Positive	11 (5.5)	9 (9.0)	2 (2.0)	

FSW: Female sex workers

ATS: Amphetamine-type stimulants

Table 2

Prevalence of PEth and self-reported alcohol consumption in FSW and their male clients in Preah Sihanouk, Cambodia

	Total n=200 n (%)	FSW n=100 n (%)	Clients n=100 n (%)	<i>p-value</i>
PEth (≥50 ng/ml)				< 0.01
Negative	98 (49.0)	40 (40.0)	58 (58.0)	
Positive	102 (51.0)	60 (60.0)	42 (42.0)	
AUDIT-C (last 3 month)				< 0.01
Abstinence or lower risk use	68 (34.0)	15 (15.0)	53 (53.0)	
Unhealthy alcohol use	132 (66.0)	85 (85.0)	47 (47.0)	
Alcohol use frequency (last 3 months)				< 0.01
Never/less than once a month	102 (51.0)	60 (60.0)	42 (42.0)	
2–4 times a month	50 (25.0)	10 (10.0)	40 (40.0)	
2 or more times a week	48 (24.0)	30 (30.0)	18 (18.0)	
Number drinks on typical day (last 3 months)				< 0.01
1–2 drinks	27 (14.1)	7 (7.3)	20 (20.8)	
3–4 drinks	50 (26.0)	13 (13.5)	37 (38.5)	
5 or more drinks	115 (59.9)	76 (79.2)	39 (40.6)	
Being drunk or intoxicated recently (last 3 months)				< 0.01
No	63 (31.5)	19 (19.0)	44 (44.0)	
Yes	136 (68.5)	81 (81.0)	56 (56.0)	
Heavy episodic drinking (last 3 month)				< 0.01
No	57 (28.5)	17 (17.0)	40 (40.0)	
Yes	143 (71.5)	83 (83.0)	60 (60.0)	
Regular heavy drinking				0.877
No	141 (70.5)	71 (71.0)	70 (70.0)	
Yes	59 (29.5)	29 (29.0)	30 (30.0)	

FSW: Female sex workers

PEth: phosphatidylethanol

AUDIT-C: Alcohol Use Disorders Identification Test Consumption

Table 3

Concordance between self-reported unhealthy alcohol consumption and PEth biomarker among FSW and clients in Preah Sihanouk, Cambodia

Measures of alcohol	FSW		Clients	
	PEth results		PEth results	
	Positive (≥50 ng/ml) n (%)	Negative (< 50 ng/ml) n (%)	Positive (≥ 50 ng/ml) n (%)	Negative (< 50 ng/ml) n (%)
Self-report alcohol use (AUDIT-C)				
Abstinence or lower risk use	3 (5.0)	12 (30.0)	18 (42.9)	35 (60.3)
Unhealthy alcohol use	57 (95.0) **	28 (70.0)	24 (57.1)	23 (39.7)
Alcohol use frequency (last 3 months)				
Never/less than once a month	40 (66.7)	20 (50.0)	16 (38.1)	26 (44.8)
2–4 times a month	3 (5)	7 (17.5)	14 (33.3)	26 (44.8)
2 or more times a week	17 (28.3)	13 (32.5)	12 (28.6)	6 (10.3)
Number drinks on typical day (last 3 months)				
1–2 drinks	1 (1.7)	6 (16.7)	7 (16.7)	13 (24.1)
3–4 drinks	3 (5.0)	10 (27.8)	16 (38.1)	21 (38.9)
5 or more drinks	56 (93.3) **	20 (55.6)	19 (45.2)	20 (37.0)
Being drunk or intoxicated recently (last 3 months)				
No	6 (10.0)	13 (32.5)	14 (33.3)	30 (51.7)
Yes	54 (90.0) **	27 (67.5)	28 (66.7) *	28 (48.3)
Recent alcohol bingeing (last 3 month)				
No	4 (6.7)	13 (32.5)	13 (31.0)	27 (46.6)
Yes	56 (93.3) **	27 (67.5)	28 (69.1)	31 (53.5)
Regular heavy drinking				
No	41 (68.3)	30 (75.0)	27 (64.3)	43 (74.1)
Yes	19 (31.7)	10 (25.0)	15 (35.7)	15 (25.9)

FSW: Female sex workers

PEth: phosphatidylethanol

AUDIT-C: Alcohol Use Disorders Identification Test Consumption

**
p<0.01

*
p<0.05

Table 4

a Correlates of self-reported unhealthy alcohol use and PEth biomarker among FSW in Preah Sihanouk, Cambodia				
	Unhealthy alcohol use (AUDIT-C)	p-value	PEth ≥50ng/ml	p-value
	n (%)		n (%)	
All	85 (85.0)		60 (60.0)	
Age (years)		0.613		0.870
18–24	45 (83.3)		32 (59.3)	
25 and older	40 (87.0)		28 (60.9)	
Marital status		0.116		0.414
Never married	28 (77.8)		19 (52.8)	
Married-living together	16 (100.0)		9 (56.3)	
Widowed/Divorced/Separated	41 (85.4)		32 (66.7)	
Education (years)		0.161		<0.05
None- Primary (1–6 years)	66 (82.5)		44 (55.0)	
Secondary (7+ years)	19 (95.0)		16 (80.0)	
Have children		<0.05		0.252
No	43 (78.2)		30 (54.6)	
Yes	41 (93.2)		29 (65.9)	
Type of sex work (last 30 days)		<0.01		<0.01
Entertainment/drinking establishments	66 (93.0)		50 (70.4)	
Freelance/brothels	19 (65.5)		10 (34.5)	
Income		0.187		0.431
0–100\$ US	25 (78.1)		21 (65.6)	
> 100\$ US	60 (88.2)		39 (57.4)	
ATS use (last 3 months)		0.170		0.09
No	74 (87.1)		54 (63.5)	
Yes	11 (73.3)		6 (40.0)	
HIV result		<0.01		0.089
Negative	81 (89.0)		57 (62.6)	
Positive	4 (44.4)		3 (33.3)	

b Correlates of self-reported unhealthy alcohol use and PEth biomarker among male clients in Preah Sihanouk, Cambodia

	Unhealthy alcohol use (AUDIT-C)	p-value	PEth ≥50ng/ml	p-value
	n (%)		n (%)	
All	47 (47.0)		42 (42.0)	
Age (years)		0.215		0.129
18–24	19 (40.4)		16 (34.0)	
25 and older	28 (52.8)		26 (49.1)	
Marital status		0.560		<0.05

b Correlates of self-reported unhealthy alcohol use and PEth biomarker among male clients in Preah Sihanouk, Cambodia

	Unhealthy alcohol use (AUDIT-C)	p-value	PEth ≥50ng/ml	p-value
	n (%)		n (%)	
Never married	32 (47.8)		22 (32.8)	
Married-living together	11 (52.4)		13 (61.9)	
Widowed/Divorced/Separated	4 (33.3)		7 (58.3)	
Education (years)		<0.05		0.389
None- Primary (1–6 years)	6 (27.3)		11 (50.0)	
Secondary (7+ years)	41 (52.6)		31 (39.7)	
Have children		0.970		<0.01
No	34 (46.6)		24 (32.8)	
Yes	12 (46.2)		18 (69.2)	
Income		0.070		0.200
0–100\$ US	18 (37.5)		17 (35.4)	
> 100\$ US	29 (55.8)		25 (48.1)	
ATS use (last 3 months)		0.468		0.383
No	42 (47.7)		36 (40.9)	
Yes	5 (41.7)		6 (50.0)	
HIV result		0.727		0.671
Negative	46 (47.4)		41 (42.3)	
Positive	1 (50.0)		1 (50.0)	

FSW: Female entertainment and sex workers

ATS: Amphetamine-type stimulants

PEth: phosphatidylethanol

AUDIT-C: Alcohol Use Disorders Identification Test Consumption

ATS: Amphetamine-type stimulants

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AUDIT-C: Alcohol Use Disorders Identification Test Consumption