Published in final edited form as:

Alcohol Clin Exp Res. 2016 November ; 40(11): 2394–2400. doi:10.1111/acer.13216.

Hazardous Alcohol Use Associated with Increased Sexual Risk Behaviours among People who Inject Drugs

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Abstract

Background—Alcohol is associated with a multitude of severe health consequences. While risk behaviours related to illicit drug use are commonly studied among people who inject drugs (PWID), the role of alcohol use has received substantially less attention in this population. We explored whether drug and sexual risk behaviours as well as experiences of violence were associated with hazardous alcohol use in a cohort of PWID.

Methods—Analyses were conducted using observational data from a prospective cohort of community-recruited HIV-negative PWID in Vancouver, Canada. We used the US National Institute on Alcohol Abuse and Alcoholism definition of hazardous alcohol use (i.e., > 14 drinks/week or > 4 drinks on one occasion for men, and > 7 drinks/week or > 3 drinks on one occasion for women.) We used multivariable generalized estimating equations to identify factors associated with hazardous alcohol use.

Results—Between 2006 and 2012, 1114 HIV-negative individuals were recruited, and 186 (16.7%) reported hazardous alcohol use in the previous six months at baseline. In multivariable GEE analyses, having multiple sex partners (Adjusted Odds Ratio [AOR] = 1.25), history of sexually transmitted infection (AOR = 1.50), experiencing violence (AOR = 1.36) and incarceration (AOR = 1.29) were each independently associated with hazardous alcohol use. Caucasian ethnicity (AOR = 0.56), daily heroin injection (AOR = 0.81) and engagement in addiction treatment (AOR = 0.84) were negatively associated with hazardous alcohol use (all $p < 0.05$).

Conclusions—A considerable proportion of PWID reported hazardous alcohol use, which was independently associated with reporting sexual, but not drug-related, HIV risk behaviours and experiencing recent violence. Findings suggest a need to integrate regular screening and evidence-based alcohol interventions into treatment efforts for PWID.

Keywords

injection drug use; alcohol use; violence; HIV transmission

Introduction

Hazardous alcohol use is ranked among the top risk factors for disease, disability and death and is estimated to account for approximately 6% of all premature deaths worldwide (Lim et al., 2012, 2011, 2014b). Hazardous alcohol use is common among people who inject drugs (PWID), ranging from 11 to 57% across settings (Le Marchand et al., 2013, Stein et al., 2000, Arasteh and Des Jarlais, 2009). However, while risk behaviours related to illicit drug use have been extensively studied among PWID, the impacts of alcohol use in this population have received substantially less attention. This is an important relative gap in the literature given that alcohol has been linked with a range of harms including HIV epidemics globally (Baliunas et al., 2010, Cook and Clark, 2005, Fisher et al., 2007, Kalichman et al., 2007). Poorer outcomes have also been documented for individuals with HIV infection who drink alcohol, including increased risks of suboptimal adherence to antiretroviral therapy and lower rates of HIV RNA viral load suppression (Hendershot et al., 2009, Palepu et al., 2003, Samet et al., 2007, Wu et al., 2011).

Associations between hazardous alcohol use and sexual risk taking behaviours have been observed among PWID in some settings (Stein et al., 2001, Kral et al., 2001, Arasteh et al., 2008, Rees et al., 2001), while associations with injection-related risk behaviours, including sharing used needles, have been observed elsewhere (Matos et al., 2004, Stein et al., 2000). Some studies suggest that the disinhibiting effects of acute alcohol intoxication lead to increased likelihood of engaging in risky sexual and drug use behaviours, independent of potential confounding due to personality factors such as sensation seeking (Rehm et al., 2012, Shuper et al., 2010). There is also evidence to suggest that the disinhibitory effects of acute alcohol ingestion play a role in violent victimisation and perpetration among PWID (Dietze et al., 2013, Marshall et al., 2008). However, earlier meta-analyses examining alcohol use and event-level behaviours such as sex without a condom have shown mixed results (Shuper et al., 2009, Weinhardt and Carey, 2000, Woolf and Maisto, 2009). The substantial heterogeneity of findings pertaining to sexual and drug-related risk behaviours among substance-using populations who drink alcohol may in part be attributed to varied definitions of alcohol use (Braithwaite et al., 2008). Some studies measure quantity and frequency patterns of alcohol use using various threshold cut-offs to define hazardous alcohol use (Dietze et al., 2013). Others use diagnostic criteria such as the Diagnostic Statistical Manual criteria that defines alcohol use disorder in relation to problems experienced as a result of drinking (2014a, Moss et al., 2015). It appears that measures of at-risk drinking based on quantity and frequency calculations of alcohol intake are more useful than quantity measures alone or diagnostic criteria to assess harms (Braithwaite et al., 2008, Martin et al., 2008, Agrawal et al., 2011, Stahre et al., 2006).

Thus, the purpose of this longitudinal study was to examine the prevalence and correlates of hazardous alcohol use among a cohort of HIV-negative PWID in Vancouver, Canada, using

the National Institute on Alcohol Abuse and Alcoholism (NIAAA) threshold definition for hazardous drinking (2007). Particular attention was paid to potentially modifiable HIV-related drug and sexual risk behaviours as well as experiences of violence, given previous studies suggesting links between violence and alcohol use among PWID (Dietze et al., 2013, Marshall et al., 2008, Darke et al., 2010).

Materials and Methods

Data for this study were collected from the Vancouver Injection Drug Users Study (VIDUS), a prospective cohort of HIV-negative PWID in Vancouver, Canada. Detailed descriptions of sampling and recruitment procedures have been described elsewhere (Strathdee et al., 1998). Data for this analysis were collected from December 2005 – May 2012.

Eligibility criteria at enrolment included: (1) being aged 18 years or older, (2) any injection drug use in the previous month, (3) current residence in the Greater Vancouver Regional District, (4) being HIV-seronegative, and (5) provision of written informed consent. Participants were recruited through extensive street-based outreach and snowball sampling focused on the Downtown Eastside neighbourhood, an area including high levels of HIV infection and injection drug use. Participants completed an interviewer-administered questionnaire at enrollment and semi-annually pertaining to sociodemographic information, drug use patterns, and sexual and drug-related risk behaviours. Blood samples were collected for HIV and HCV serology. Participants received a \$20 CAD monetary compensation at each study visit. The VIDUS cohort was approved by the research ethics board of Providence Health Care and the University of British Columbia.

The primary outcome in our analysis was “hazardous alcohol use” in the previous six months. This was defined in accordance with the NIAAA definition of risky alcohol use, specifically, >14 drinks/week or >4 drinks on one occasion for men <65 years of age, and >7 drinks/week or >3 drinks on one occasion for all women and men ≥ 65 years of age (2007). A standard drink is defined as one 12-ounce bottle of beer, one 5-ounce glass of wine, or 1.5 ounces of distilled spirits (2007).

Socio-demographic explanatory variables of interest included age (treated as a continuous variable), gender (female vs. male), Caucasian ethnicity (yes vs. no), and currently living in unstable housing, defined as staying in a hotel room, shelter/hostel or treatment/recovery house, having no fixed address/sleeping on the street, or residing in jail (yes vs. no). Drug use variables of interest referring to behaviours in the previous six months included non-fatal overdose (yes vs. no), daily crack cocaine smoking (yes vs. no), daily cocaine injection (yes vs. no), daily heroin injection (yes vs. no), and receptive syringe sharing (yes vs. no). Sexual behaviours of interest included self-reported history of any diagnosed sexually transmitted infection (STI) ever in the past (yes vs. no), number of sex partners in the past six months (1 vs. 2-10 vs. >10), having sex with the same gender in the past six months (yes vs. no), and involvement in sex work in the past six months (yes vs. no). Other variables of interest included being a victim of violence, defined as having been attacked or assaulted in the previous six months (yes vs. no), incarceration, defined as being in detention, prison, drunk tank, or jail overnight or longer in the previous six months (yes vs. no), accessing any

kind of alcohol or drug treatment in the previous six months (yes vs. no), and depression at baseline (Center for Epidemiologic Studies Depression Scale [CES-D] score of 16 vs. <16 (Beck et al., 1996).

First, we compared the baseline characteristics of the sample stratified by hazardous alcohol use in the previous six months using logistic regression. Then, for the univariable analyses, we used generalized estimating equations (GEE) to examine relationships between all explanatory variables and hazardous alcohol use. Since analyses of factors potentially associated with hazardous alcohol use included serial measures for each subject, we used GEE for binary outcomes with logit-link for the analysis of correlated data. These methods determine factors associated with hazardous alcohol use throughout the study period and provide standard errors adjusted by multiple observations per person using an exchangeable correlation structure. Therefore, this analysis considered data from every participant follow-up visit. To adjust for potential confounding, all variables that were $p < 0.10$ in univariable GEE analyses were initially included in a full multivariable model. A backward model selection procedure was used to identify the model with the best overall fit, as indicated by the lowest quasiliikelihood under the independence model criterion value (Cui, 2007). Statistical analyses were performed using SAS software version 9.3 (SAS, Cary, NC). All reported p -values are two-sided and considered significant at $p < 0.05$.

In a sub-analysis, we provided descriptive statistics to examine the relationship of the perpetrators among participants who reported both hazardous alcohol use and being a victim of violence. The relationship with the perpetrator was allocated into the following categories: stranger, acquaintance (friend, casual sex partner, family member, inmate or neighbour), police or security guard, drug dealer, partner (husband/wife, boyfriend/girlfriend, common-law partner or regular sex partner), or sex work client.

Results

A total of 1114 participants were recruited into the VIDUS cohort between December 2005 and May 2012. The median number of study visits per person was 6 (interquartile range [IQR]: 3 - 9) visits. Among the 1114 participants, 112 had only one study visit and 1002 had follow-up visits. For the 1002 participants who had follow-up visits, the total follow-up time was 4416 person-years, and the median follow-up time per person was 63.4 (IQR: 35.9 - 70.0) months.

At study entry, the median age was 41 (IQR: 25 - 47) years, 366 (32.8%) were female, 713 (64.0%) were Caucasian, and 750 (67.3%) were currently living in unstable housing (Table I). Overall, 186 (16.7%) participants reported hazardous alcohol use in the previous six months at baseline.

During the study period, 415 (37.2%) ever reported hazardous alcohol use in the previous six months. The overall HIV incidence rate was 6.6 (95% CI = 4.6 - 9.5) cases per 1000 person-years. The HIV incidence rate was not statistically significant between participants who ever had hazardous alcohol use and those who never had hazardous alcohol use during the study period (p -value = 0.373). The overall mortality rate was 2.18 (95% CI = 17.9 -

26.5) cases per 1000 person-years. The mortality rate has no statistically significant difference between participants who ever had hazardous alcohol use and those who never had hazardous alcohol use during the study period (p -value = 0.117).

Univariable and multivariable GEE analyses of factors associated with hazardous alcohol use are presented in Table II. In multivariable GEE analysis, past history of a STI (Adjusted Odds Ratio [AOR] = 1.41, 95% Confidence Interval [CI] = 1.11 – 1.80), 2-10 sex partners (vs. 0 or 1 partner) in the last six months (AOR = 1.25, 95% CI = 1.04 – 1.51), incarceration in the last six months (AOR = 1.24, 95% CI = 1.04 – 1.49), and being a victim of violence in the last six months (AOR = 1.33, 95% CI = 1.13 – 1.55) were independently and positively associated with hazardous alcohol use. Caucasian ethnicity (AOR = 0.59, 95% CI = 0.47 – 0.75), daily heroin injection use in the last six months (AOR = 0.72, 95% CI = 0.59 – 0.88) and enrolment in any addiction treatment in the last six months (AOR = 0.83, 95% CI = 0.71 – 0.97) were negatively associated with hazardous alcohol use.

In the sub-analysis, the relationship with the perpetrator among those who reported both hazardous alcohol use and experiencing violence in the previous six months was most often a stranger (40%) or acquaintance (29%) (Table III).

Discussion

We observed that 16.7% of our sample of PWID met the NIAAA definition for hazardous drinking at baseline. After intensive covariate adjustment, hazardous alcohol use was independently associated with HIV-related sexual risk behaviours, including past history of having a STI and increased number of sex partners, but not injection-related HIV risk behaviours. Hazardous alcohol use was also associated with other markers of vulnerability including being a victim of physical violence.

We found independent associations between hazardous drinking and two measures of sexual risk, both increased number of sex partners and acquisition of STIs. Past research has demonstrated that the acute intoxicating effects of alcohol may alter inhibition, self-regulation, and increase sexual arousal, negatively impacting ability to adhere to or negotiate safe sex and consistent condom use (Ehrendstein et al., 2004, MacDonald et al., 2000, Stone et al., 1999). The ALIVE cohort of PWID in Baltimore, USA, demonstrated a dose-response relationship between alcohol consumption and subsequent HIV acquisition (Howe et al., 2011). Though not directly studied here, the observed associations with both number of sex partners and past history of STIs do suggest that PWID with hazardous alcohol use in our setting may have increased vulnerability to HIV-infection via increased sexual, rather than injection-related, risk behaviours. Alcohol use and risky sexual behaviour are known to co-occur among individuals with risk-taking personality characteristics (Trobst et al., 2000). In fact, one study examining event-level associations among HIV-uninfected PWID found that prior drug and sexual risk behaviours were associated with *subsequent* hazardous alcohol use (Sander et al., 2010) (Ehrendstein et al., 2004, MacDonald et al., 2000). Additionally, it should be noted that we did not find a significant association between hazardous alcohol use and very high numbers of sex partners (i.e., greater than 10 in the last six months). It may be individuals who had very high numbers of sex partners were more likely to be engaged in

sex work, an activity that was not found to be associated with hazardous alcohol use in our study. Further, sexual risk may be mitigated among those with multiple partners if condoms are used more frequently. Event-level associations between alcohol use and engagement in HIV-related risk behaviours in our setting warrant further exploration.

The association observed here between hazardous alcohol use and experiences of physical violence are in keeping with previous studies of PWID linking alcohol use with violent victimization and perpetration (Dietze et al., 2013, Marshall et al., 2008, Chermack and Blow, 2002, Darke et al., 2010). Among those who reported both hazardous drinking and being a victim of violence, the perpetrator was most often a stranger or an acquaintance. The association with violent victimization is notable given that we controlled for important confounders such as gender and other substance use, in particular cocaine use. Acute cocaine use is known to be independently associated with violent perpetration and victimization, both alone and in combination with acute alcohol use (Chermack and Blow, 2002, Chermack et al., 2010, Kraanen et al., 2014). Our findings demonstrating a strong association of violence with hazardous alcohol use underscores the need to screen for trauma and incorporate trauma-informed care approaches in the treatment of PWID who drink alcohol (Killeen et al., 2015, Mills et al., 2012, 2014c). Understanding the interplay between alcohol use, experiences of violence, and ability to negotiate sexual risk, will be important to understanding the risk environment for PWID who drink.

Concurrent use of central nervous system depressants, such as alcohol in combination with opioids, has been associated with both fatal and non-fatal overdose (Gossop et al., 2002, Buxton et al., 2009, Pollini et al., 2006). However, there was no significant association between hazardous alcohol use and non-fatal overdose in our study. Hazardous alcohol users were less likely to use heroin daily, suggesting that concomitant at-risk drinking and frequent opioid use, known to predispose to fatal overdose (Dietze et al., 2005, Darke and Zador, 1996), may not be a common risk pattern in our setting. In some settings in North America, heavy drug use and homelessness, but not alcohol use, have been shown to be major predictors of all-cause mortality in PWID (Walley et al., 2008, Evans et al., 2012, Morrison, 2009). Of note, binge alcohol use was associated with elevated all-cause mortality in our setting, with one quarter of these deaths due to accidental poisonings (Johnson et al., 2015). Though the NIAAA criteria offer a robust definition of hazardous alcohol use by including both quantity and frequency measures of drinking, dedicated studies examining relationships between specific patterns of alcohol and drug use with overdose and all-cause mortality warrant further investigation.

Although the specific types of drug and alcohol treatment accessed by participants in our study were not examined, the finding that hazardous alcohol use was negatively associated with accessing addiction treatment highlights the urgent need to implement efficacious evidence-based interventions for alcohol use in our setting. Furthermore, given the association between hazardous alcohol use and the risk factors described herein, assessment of alcohol use and integration of alcohol-specific interventions into addiction treatment and HIV prevention programs should be undertaken. Specifically, our findings indicate that the Alcohol Use Disorders Identification Test (AUDIT) or other well-validated standard screening techniques should be routinely performed to ascertain which individuals require

such interventions (Saunders et al., 1993, Clark and Moss, 2010). The use of screening and brief intervention (SBIRT) for hazardous alcohol use is endorsed by the NIAAA (NIAAA, 2004/2005). Addiction treatment services should also adopt the use of evidence-based relapse prevention medications that have demonstrated effectiveness in reducing problematic alcohol use but are currently underutilized (Swift and Aston, 2015).

Our study has several limitations. First, this sample was not recruited at random, which may limit the generalizability of the findings. Second, our data were compiled from self-reported information of behaviours participants may have felt were sensitive in nature. Thus, socially desirable reporting among our sample is possible. If this source of bias were present, however, the expected effect would be to underestimate the true prevalence of risk behaviours and bias our findings towards the null. Use of self-report to measure alcohol intake may also be subject to problems of recall. However, previous studies have found phosphatidylethanol (PEth) measurement as a biomarker for alcohol consumption to be well correlated with self-reported measures of alcohol consumption among PWID (Jain et al., 2014). Third, given the observational nature of this study, we cannot infer causal links between hazardous alcohol use and the injecting and sexual behaviours we studied.

Our findings indicate that hazardous alcohol use is associated with serious adverse harms, including experiencing physical violence and increased sexual risk practices. Given that risky alcohol use is frequently overlooked among this high-risk population, these findings lend support for the incorporation of alcohol-specific addiction treatment and public health interventions into HIV prevention programs for PWID. Among hazardous drinkers, sexual risk behaviour screening and intervention is important to HIV prevention efforts for PWID.

Acknowledgements

The authors thank the study participants for their contribution to the research, as well as current and past researchers and staff. The study was supported by the US National Institutes of Health (R01DA011591, U01DA038886). This research was undertaken, in part, thanks to funding from the Canada Research Chairs program through a Tier 1 Canada Research Chair in Inner City Medicine which supports Dr. Evan Wood. Dr. Kanna Hayashi is supported by the Canadian Institutes of Health Research New Investigator Award (MSH-141971).

References

- Helping Patients Who Drink Too Much: A Clinician's Guide. National Institute on Alcohol Abuse and Alcoholism, National Institutes of Health; Bethesda MD: 2007.
- The global status report on alcohol and health 2011. World Health Organization; Geneva: 2011.
- Diagnostic and statistical manual of mental disorders. 5th. Washington, DC: 2014a.
- The global status report on alcohol and health 2014. World Health Organization; Geneva: 2014b.
- SAMHSA's concept of trauma and guidance for a trauma-informed approach. Substance Abuse and Mental Health Services Administration; Rockville, MD: 2014c.
- AGRAWAL A, HEATH AC, LYNSKEY MT. DSM-IV to DSM-5: the impact of proposed revisions on diagnosis of alcohol use disorders. *Addiction*. 2011; 106:1935–43. [PubMed: 21631621]
- ARASTEH K, DES JARLAIS DC. At-risk drinking and injection and sexual risk behaviors of HIV-positive injection drug users entering drug treatment in New York City. *AIDS Patient Care STDS*. 2009; 23:657–61. [PubMed: 19591610]
- ARASTEH K, DES JARLAIS DC, PERLIS TE. Alcohol and HIV sexual risk behaviors among injection drug users. *Drug Alcohol Depend*. 2008; 95:54–61. [PubMed: 18242009]

- BALIUNAS D, REHM J, IRVING H, SHUPER P. Alcohol consumption and risk of incident human immunodeficiency virus infection: a meta-analysis. *Int J Public Health*. 2010; 55:159–66. [PubMed: 19949966]
- BECK, AT.; STEER, RA.; BROWN, G. Manual for the Beck Depression Inventory-II. Psychological Corporation; San Antonio, TX: 1996.
- BRAITHWAITE RS, CONIGLIARO J, MCGINNIS KA, MAISTO SA, BRYANT K, JUSTICE AC. Adjusting alcohol quantity for mean consumption and intoxication threshold improves prediction of nonadherence in HIV patients and HIV-negative controls. *Alcohol Clin Exp Res*. 2008; 32:1645–51. [PubMed: 18616666]
- BUXTON JA, SKUTEZKY T, TU AW, WAHEED B, WALLACE A, MAK S. The context of illicit drug overdose deaths in British Columbia, 2006. *Harm Reduct J*. 2009; 6:9. [PubMed: 19480677]
- CHERMACK ST, BLOW FC. Violence among individuals in substance abuse treatment: the role of alcohol and cocaine consumption. *Drug Alcohol Depend*. 2002; 66:29–37. [PubMed: 11850133]
- CHERMACK ST, GROGAN-KAYLOR A, PERRON BE, MURRAY RL, DE CHAVEZ P, WALTON MA. Violence among men and women in substance use disorder treatment: a multi-level event-based analysis. *Drug Alcohol Depend*. 2010; 112:194–200. [PubMed: 20667666]
- CLARK DB, MOSS HB. Providing alcohol-related screening and brief interventions to adolescents through health care systems: obstacles and solutions. *PLoS Med*. 2010; 7:e1000214. [PubMed: 20231870]
- COOK RL, CLARK DB. Is there an association between alcohol consumption and sexually transmitted diseases? A systematic review. *Sex Transm Dis*. 2005; 32:156–64. [PubMed: 15729152]
- CUI J. QIC program and model selection in GEE analyses. *State Journal*. 2007; 7:209–220.
- DARKE S, TOROK M, KAYE S, ROSS J, MCKETIN R. Comparative rates of violent crime among regular methamphetamine and opioid users: offending and victimization. *Addiction*. 2010; 105:916–9. [PubMed: 20148788]
- DARKE S, ZADOR D. Fatal heroin 'overdose': a review. *Addiction*. 1996; 91:1765–72. [PubMed: 8997759]
- DIETZE P, JENKINSON R, AITKEN C, STOOVÉ M, JOLLEY D, HICKMAN M, KERR T. The relationship between alcohol use and injecting drug use: impacts on health, crime and wellbeing. *Drug Alcohol Depend*. 2013; 128:111–5. [PubMed: 22989499]
- DIETZE P, JOLLEY D, FRY C, BAMMER G. Transient changes in behaviour lead to heroin overdose: results from a case-crossover study of non-fatal overdose. *Addiction*. 2005; 100:636–42. [PubMed: 15847621]
- EHRENSTEIN V, HORTON NJ, SAMET JH. Inconsistent condom use among HIV-infected patients with alcohol problems. *Drug Alcohol Depend*. 2004; 73:159–66. [PubMed: 14725955]
- EVANS JL, TSUI JI, HAHN JA, DAVIDSON PJ, LUM PJ, PAGE K. Mortality among young injection drug users in San Francisco: a 10-year follow-up of the UFO study. *Am J Epidemiol*. 2012; 175:302–8. [PubMed: 22227793]
- FISHER JC, BANG H, KAPIGA SH. The association between HIV infection and alcohol use: a systematic review and meta-analysis of African studies. *Sex Transm Dis*. 2007; 34:856–63. [PubMed: 18049422]
- GOSSOP M, STEWART D, TREACY S, MARSDEN J. A prospective study of mortality among drug misusers during a 4-year period after seeking treatment. *Addiction*. 2002; 97:39–47. [PubMed: 11895269]
- HENDERSHOT CS, STONER SA, PANTALONE DW, SIMONI JM. Alcohol use and antiretroviral adherence: review and meta-analysis. *J Acquir Immune Defic Syndr*. 2009; 52:180–202. [PubMed: 19668086]
- HOWE CJ, COLE SR, OSTROW DG, MEHTA SH, KIRK GD. A prospective study of alcohol consumption and HIV acquisition among injection drug users. *AIDS*. 2011; 25:221–8. [PubMed: 21099668]
- JAIN J, EVANS JL, BRICEÑO A, PAGE K, HAHN JA. Comparison of phosphatidylethanol results to self-reported alcohol consumption among young injection drug users. *Alcohol Alcohol*. 2014; 49:520–4. [PubMed: 24939855]

- JOHNSON C, DONG H, AHAMAD K, HAYASHI K, MILLOY MJ, KERR T, WOOD E. Impact of binge alcohol on mortality among people who inject drugs. *Addict Behav Rep.* 2015; 2:28–32. [PubMed: 26097893]
- KALICHMAN SC, SIMBAYI LC, KAUFMAN M, CAIN D, JOOSTE S. Alcohol use and sexual risks for HIV/AIDS in sub-Saharan Africa: systematic review of empirical findings. *Prev Sci.* 2007; 8:141–51. [PubMed: 17265194]
- KILLEEN TK, BACK SE, BRADY KT. Implementation of integrated therapies for comorbid post-traumatic stress disorder and substance use disorders in community substance abuse treatment programs. *Drug Alcohol Rev.* 2015; 34:234–41. [PubMed: 25737377]
- KRAANEN FL, VEDEL E, SCHOLING A, EMMELKAMP PM. Prediction of intimate partner violence by type of substance use disorder. *J Subst Abuse Treat.* 2014; 46:532–9. [PubMed: 24365101]
- KRAL AH, BLUTHENTHAL RN, LORVICK J, GEE L, BACCHETTI P, EDLIN BR. Sexual transmission of HIV-1 among injection drug users in San Francisco, USA: risk-factor analysis. *Lancet.* 2001; 357:1397–401. [PubMed: 11356437]
- LE MARCHAND C, EVANS J, PAGE K, DAVIDSON PJ, HAHN JA. Hazardous alcohol consumption among young adult IDU and its association with high risk behaviors. *Drug Alcohol Depend.* 2013; 127:143–9. [PubMed: 22819868]
- LIM SS, VOS T, FLAXMAN AD, DANAEI G, SHIBUYA K, ADAIR-ROHANI H, AMANN M, ANDERSON HR, ANDREWS KG, ARYEE M, ATKINSON C, BACCHUS LJ, BAHALIM AN, BALAKRISHNAN K, BALMES J, BARKER-COLLO S, BAXTER A, BELL ML, BLORE JD, BLYTH F, BONNER C, BORGES G, BOURNE R, BOUSSINESQ M, BRAUER M, BROOKS P, BRUCE NG, BRUNEKREEF B, BRYAN-HANCOCK C, BUCELLO C, BUCHBINDER R, BULL F, BURNETT RT, BYERS TE, CALABRIA B, CARAPETIS J, CARNAHAN E, CHAFE Z, CHARLSON F, CHEN H, CHEN JS, CHENG AT, CHILD JC, COHEN A, COLSON KE, COWIE BC, DARBY S, DARLING S, DAVIS A, DEGENHARDT L, DENTENER F, DES JARLAIS DC, DEVRIES K, DHERANI M, DING EL, DORSEY ER, DRISCOLL T, EDMOND K, ALI SE, ENGELL RE, ERWIN PJ, FAHIMI S, FALDER G, FARZADFAR F, FERRARI A, FINUCANE MM, FLAXMAN S, FOWKES FG, FREEDMAN G, FREEMAN MK, GAKIDOU E, GHOSH S, GIOVANNUCCI E, GMEL G, GRAHAM K, GRAINGER R, GRANT B, GUNNELL D, GUTIERREZ HR, HALL W, HOEK HW, HOGAN A, HOSGOOD HD, HOY D, HU H, HUBBELL BJ, HUTCHINGS SJ, IBEANUSI SE, JACKLYN GL, JASRASARIA R, JONAS JB, KAN H, KANIS JA, KASSEBAUM N, KAWAKAMI N, KHANG YH, KHATIBZADEH S, KHOO JP, KOK C, LADEN F, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet.* 2012; 380:2224–60. [PubMed: 23245609]
- MACDONALD TK, MACDONALD G, ZANNA MP, FONG GT. Alcohol, sexual arousal, and intentions to use condoms in young men: applying alcohol myopia theory to risky sexual behavior. *Health Psychol.* 2000; 19:290–8. [PubMed: 10868774]
- MARSHALL BD, FAIRBAIRN N, LI K, WOOD E, KERR T. Physical violence among a prospective cohort of injection drug users: a gender-focused approach. *Drug Alcohol Depend.* 2008; 97:237–46. [PubMed: 18487025]
- MARTIN CS, CHUNG T, LANGENBUCHER JW. How should we revise diagnostic criteria for substance use disorders in the DSM-V? *J Abnorm Psychol.* 2008; 117:561–75. [PubMed: 18729609]
- MATOS TD, ROBLES RR, SAHAI H, COLÓN HM, REYES JC, MARRERO CA, CALDERÓN JM, SHEPARD EW. HIV risk behaviors and alcohol intoxication among injection drug users in Puerto Rico. *Drug Alcohol Depend.* 2004; 76:229–34. [PubMed: 15561474]
- MILLS KL, TEESSON M, BACK SE, BRADY KT, BAKER AL, HOPWOOD S, SANNIBALE C, BARRETT EL, MERZ S, ROSENFELD J, EWER PL. Integrated exposure-based therapy for co-occurring posttraumatic stress disorder and substance dependence: a randomized controlled trial. *JAMA.* 2012; 308:690–9. [PubMed: 22893166]
- MORRISON DS. Homelessness as an independent risk factor for mortality: results from a retrospective cohort study. *Int J Epidemiol.* 2009; 38:877–83. [PubMed: 19304988]

- MOSS HB, GOLDSTEIN RB, CHEN CM, YI HY. Patterns of use of other drugs among those with alcohol dependence: Associations with drinking behavior and psychopathology. *Addict Behav.* 2015; 50:192–8. [PubMed: 26151585]
- NIAAA. Screening and Brief Intervention Part 1: An Overview. *Alcohol Research & Health.* 2004/2005:28.
- PALEPU A, TYNDALL MW, LI K, YIP B, O'SHAUGHNESSY MV, SCHECHTER MT, MONTANER JS, HOGG RS. Alcohol use and incarceration adversely affect HIV-1 RNA suppression among injection drug users starting antiretroviral therapy. *J Urban Health.* 2003; 80:667–75. [PubMed: 14709714]
- POLLINI RA, MCCALL L, MEHTA SH, VLAHOV D, STRATHDEE SA. Non-fatal overdose and subsequent drug treatment among injection drug users. *Drug Alcohol Depend.* 2006; 83:104–10. [PubMed: 16310322]
- REES V, SAITZ R, HORTON NJ, SAMET J. Association of alcohol consumption with HIV sex- and drug-risk behaviors among drug users. *J Subst Abuse Treat.* 2001; 21:129–34. [PubMed: 11728786]
- REHM J, SHIELD KD, JOHARCHI N, SHUPER PA. Alcohol consumption and the intention to engage in unprotected sex: systematic review and meta-analysis of experimental studies. *Addiction.* 2012; 107:51–9. [PubMed: 22151318]
- SAMET JH, CHENG DM, LIBMAN H, NUNES DP, ALPEREN JK, SAITZ R. Alcohol consumption and HIV disease progression. *J Acquir Immune Defic Syndr.* 2007; 46:194–9. [PubMed: 17667330]
- SANDER PM, COLE SR, OSTROW DG, MEHTA SH, KIRK GD. Determinants of alcohol consumption in HIV-uninfected injection drug users. *Drug Alcohol Depend.* 2010; 111:173–6. [PubMed: 20547014]
- SAUNDERS JB, AASLAND OG, BABOR TF, DE LA FUENTE JR, GRANT M. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption--II. *Addiction.* 1993; 88:791–804. [PubMed: 8329970]
- SHUPER PA, JOHARCHI N, IRVING H, REHM J. Alcohol as a correlate of unprotected sexual behavior among people living with HIV/AIDS: review and meta-analysis. *AIDS Behav.* 2009; 13:1021–36. [PubMed: 19618261]
- SHUPER PA, NEUMAN M, KANTERES F, BALIUNAS D, JOHARCHI N, REHM J. Causal considerations on alcohol and HIV/AIDS--a systematic review. *Alcohol Alcohol.* 2010; 45:159–66. [PubMed: 20061510]
- STAHERE M, NAIMI T, BREWER R, HOLT J. Measuring average alcohol consumption: the impact of including binge drinks in quantity-frequency calculations. *Addiction.* 2006; 101:1711–8. [PubMed: 17156170]
- STEIN MD, ANDERSON B, CHARUVASTRA A, FRIEDMANN PD. Alcohol use and sexual risk taking among hazardously drinking drug injectors who attend needle exchange. *Alcohol Clin Exp Res.* 2001; 25:1487–93. [PubMed: 11696669]
- STEIN MD, HANNA L, NATARAJAN R, CLARKE J, MARISI M, SOBOTA M, RICH J. Alcohol use patterns predict high-risk HIV behaviors among active injection drug users. *J Subst Abuse Treat.* 2000; 18:359–63. [PubMed: 10812309]
- STONE E, HEAGERTY P, VITTINGHOFF E, DOUGLAS JM, KOBLIN BA, MAYER KH, CELUM CL, GROSS M, WOODY GE, MARMOR M, SEAGE GR, BUCHBINDER SP. Correlates of condom failure in a sexually active cohort of men who have sex with men. *J Acquir Immune Defic Syndr Hum Retrovirol.* 1999; 20:495–501. [PubMed: 10225233]
- STRATHDEE SA, PALEPU A, CORNELISSE PG, YIP B, O'SHAUGHNESSY MV, MONTANER JS, SCHECHTER MT, HOGG RS. Barriers to use of free antiretroviral therapy in injection drug users. *JAMA.* 1998; 280:547–9. [PubMed: 9707146]
- SWIFT RM, ASTON ER. Pharmacotherapy for alcohol use disorder: current and emerging therapies. *Harv Rev Psychiatry.* 2015; 23:122–33. [PubMed: 25747925]

- TROBST KK, WIGGINS JS, COSTA PT, HERBST JH, MCCRAE RR, MASTERS HL. Personality psychology and problem behaviors: HIV risk and the five-factor model. *J Pers.* 2000; 68:1233–52. [PubMed: 11130739]
- WALLEY AY, CHENG DM, LIBMAN H, NUNES D, HORSBURGH CR JR. SAITZ R, SAMET JH. Recent drug use, homelessness and increased short-term mortality in HIV-infected persons with alcohol problems. *AIDS.* 2008; 22:415–20. [PubMed: 18195568]
- WEINHARDT LS, CAREY MP. Does alcohol lead to sexual risk behavior? Findings from event-level research. *Annu Rev Sex Res.* 2000; 11:125–57. [PubMed: 11351830]
- WOOLF SE, MAISTO SA. Alcohol use and risk of HIV infection among men who have sex with men. *AIDS Behav.* 2009; 13:757–82. [PubMed: 18236149]
- WU ES, METZGER DS, LYNCH KG, DOUGLAS SD. Association between alcohol use and HIV viral load. *J Acquir Immune Defic Syndr.* 2011; 56:e129–30. [PubMed: 21532918]

Table I

Baseline characteristics stratified by hazardous alcohol use (n = 1114).

Characteristic	<u>Hazardous alcohol use^a</u>		OR ^b (95% CI ^c)	p-value
	Yes n (%) 186 (16.7)	No n (%) 928 (83.3)		
Median age (IQR^d)	41 (33-47)	41 (35-47)	0.99 (0.97 – 1.01)	0.199
Gender				
Female	70 (37.6)	296 (31.9)	1.29 (0.93 – 1.79)	0.129
Male	116 (62.4)	632 (68.1)		
Caucasian ethnicity				
Yes	100 (53.8)	613 (66.1)	0.60 (0.43 – 0.82)	0.002
No	86 (46.2)	315 (33.9)		
Currently in unstable housing				
Yes	109 (58.6)	641 (69.1)	0.62 (0.45 – 0.86)	0.004
No	77 (41.4)	282 (30.4)		
STI				
Yes	89 (47.8)	351 (37.8)	1.51 (1.10 – 2.07)	0.011
No	97 (52.2)	577 (62.2)		
Number of sex partners^a				
> 10	11 (5.9)	32 (3.4)	1.92 (0.95 – 3.92)	0.071
2-10	47 (25.3)	169 (18.2)	1.56 (1.07 – 2.26)	0.020
1	127 (68.3)	711 (84.8)		
Sex with same gender^a				
Yes	12 (6.5)	32 (3.5)	1.93 (0.98 – 3.82)	0.059
No	174 (93.5)	896 (96.5)		
Sex work involvement^a				
Yes	33 (17.7)	121 (13.0)	1.44 (0.94 – 2.19)	0.091
No	153 (82.3)	807 (87.0)		
Daily heroin injection^a				
Yes	47 (25.3)	297 (32.0)	0.71 (0.50 – 1.02)	0.065
No	139 (74.7)	627 (67.6)		
Daily cocaine injection^a				
Yes	22 (11.8)	86 (9.3)	1.32 (0.80 – 2.16)	0.280
No	163 (87.6)	838 (90.3)		
Daily crack smoking^a				
Yes	77 (41.4)	385 (41.5)	0.99 (0.72 – 1.36)	0.946
No	109 (58.6)	539 (58.1)		
Receptive syringe sharing^a				
Yes	20 (10.8)	79 (8.5)	1.32 (0.78 – 2.21)	0.300

Characteristic	Hazardous alcohol use ^a		OR ^b (95% CI ^c)	<i>p</i> -value
	Yes <i>n</i> (%) 186 (16.7)	No <i>n</i> (%) 928 (83.3)		
No	155 (84.4)	816 (83.9)		
Non-fatal overdose^a				
Yes	16 (8.6)	63 (6.8)	1.29 (0.73 – 2.29)	0.382
No	168 (90.3)	854 (92.0)		
Incarceration^a				
Yes	39 (21.0)	164 (17.7)	1.23 (0.83 – 1.82)	0.304
No	145 (78.0)	749 (80.7)		
Addiction treatment^a				
Yes	67 (36.0)	459 (49.5)	0.56 (0.41 – 0.78)	0.001
No	118 (63.4)	454 (48.9)		
Victim of violence^a				
Yes	59 (31.7)	195 (21.0)	1.71 (1.21 – 2.42)	0.002
No	126 (67.7)	713 (76.8)		
Depression^a				
CES-D score ≥ 16	105 (56.5)	529 (57.0)	1.16 (0.80 – 1.68)	0.439
CES-D score < 16	48 (25.8)	280 (30.2)		

Note: Column percentages may not necessarily sum to 100% due to missing data or rounding error;

^a Denotes activities in the previous six months;

^b OR = Odds Ratio;

^c CI = Confidence Interval;

^d IQR = interquartile range

Table II

Univariable and multivariable GEE^a analyses of factors associated with hazardous alcohol use^b among VIDUS participants ($n = 1114$).

Characteristic	Odds Ratio (95% CI ^c)	<i>p</i> - value	Adjusted Odds Ratio (95% CI ^c)	<i>p</i> - value
Age				
Per year older	0.99 (0.98 – 1.00)	0.176		
Caucasian ethnicity				
(yes vs. no)	0.56 (0.45 – 0.71)	< 0.001	0.59 (0.47 – 0.75)	< 0.001
Gender				
(female vs. male)	1.17 (0.92 – 1.51)	0.203		
Currently in unstable housing				
(yes vs. no)	1.02 (0.87 – 1.19)	0.838		
STI				
(yes vs. no)	1.50 (1.18 – 1.91)	0.001	1.41 (1.11 – 1.80)	0.005
Number of sex partners^e				
(2-10 vs. 1)	1.35 (1.12 – 1.62)	0.001	1.25 (1.04 – 1.51)	0.019
(> 10 vs. 1)	1.54 (0.95 – 2.47)	0.078	1.41 (0.85 – 2.33)	0.181
Sex with same gender^e				
(yes vs. no)	1.46 (1.03 – 2.07)	0.034	1.30 (0.92 – 1.82)	0.136
Sex work involvement^e				
(yes vs. no)	1.15 (0.88 – 1.50)	0.308		
Daily heroin injection^e				
(yes vs. no)	0.81 (0.67 – 0.98)	0.026	0.72 (0.59 – 0.88)	0.001
Daily cocaine injection^e				
(yes vs. no)	0.96 (0.74 – 1.24)	0.751		
Daily crack smoking^e				
(yes vs. no)	1.10 (0.95 – 1.26)	0.216		
Receptive syringe sharing^e				
(yes vs. no)	1.31 (0.98 – 1.77)	0.073	1.30 (0.96 – 1.77)	0.095
Non-fatal overdose^e				
(yes vs. no)	1.10 (0.87 – 1.39)	0.421		
Incarceration^e				
(yes vs. no)	1.30 (1.09 – 1.54)	0.004	1.24 (1.04 – 1.49)	0.019
Addiction treatment^e				
(yes vs. no)	0.84 (0.72 – 0.98)	0.028	0.83 (0.71 – 0.97)	0.021
Victim of violence^e				
(yes vs. no)	1.36 (1.16 – 1.58)	< 0.001	1.33 (1.13 – 1.55)	0.001

Characteristic		Odds Ratio (95% CI) ^c	<i>p</i> - value	Adjusted Odds Ratio (95% CI) ^c	<i>p</i> - value
Depression^e					
CES-D score	16 vs. < 16	1.15 (0.88 – 1.51)	0.303		

Note:

^a GEE = Generalized Estimating Equations;

^b hazardous alcohol use = > 14 drinks/week or > 4 drinks on one occasion for men, and > 7 drinks/week or > 3 drinks on one occasion for women;

^c CI = Confidence Interval;

^e Denotes activities in the previous 6 months.

Table III

Relationship to perpetrator among participants who reported being victims of violence and hazardous alcohol use (n = 270).

Relationship to perpetrator	N (%)
Stranger	109 (40.4)
Acquaintance ^a	78 (28.9)
Police or security guard	41 (15.2)
Drug dealer	26 (9.6)
Partner ^b	21 (7.8)
Sex work client	8 (3.0)

Note:

^a Acquaintance includes friend, casual sex partner, family member, inmate or neighbour;

^b Partner includes husband/wife, boyfriend/girlfriend, common-law partner or regular sex partner.