Title

Hazardous alcohol consumption among young adult IDU and its association with high risk behaviors

Journal

Drug and Alcohol Dependence, 127(1-3)

ISSN

0376-8716

Authors

Le Marchand, Chloe

Evans, Jennifer

Page, Kimberly

et al.

Publication Date

2013

DOI

10.1016/j.drugalcdep.2012.06.024

Peer reviewed

Published in final edited form as:
Drug Alcohol Depend. 2013 January 1; 127(0): 143–149. doi:10.1016/j.drugalcdep.2012.06.024.

Hazardous alcohol consumption among young adult IDU and its association with high risk behaviors*

Chloe Le Marchand[**,1], **Jennifer Evans**[1], **Kimberly Page**[1], **Peter J. Davidson**[2], and **Judith A. Hahn**[1]

[1]University of California, San Francisco

[2]University of California, San Diego

Abstract

Background—Heavy alcohol consumption has been associated with risk-taking behaviors in intravenous drug users (IDU). However, limited information exists on the relationship between alcohol use and injecting and sexual risk in young adult IDU (<30 years) who are at risk for hepatitis C virus (HCV) and HIV infection.

Methods—We conducted a cross-sectional study of young adult IDU in San Francisco (2006-2012) who had not previously tested positive for HCV. Participants completed a structured interview and HCV testing. We examined whether hazardous drinking (Alcohol Use Disorders Test – Consumption [AUDIT-C] 3-9 for women and 4-9 for men) and probable dependent drinking (AUDIT-C 10-12) levels were associated with injecting and sexual risk behaviors and HCV status, indicated by adjusted odds ratios (AOR) in separate models adjusted for potential confounders.

Results—Of the 326 participants, 139 (42.6%) were hazardous drinkers and 82 (25.2%) were probable dependent drinkers; thus over two-thirds evidenced problem drinking. Being a hazardous drinker was significantly associated with injecting drug residue from another's drug preparation equipment (AOR 1.93). Probable dependent drinking was significantly associated sharing non-sterile drug preparation equipment (AOR 2.59), and inversely, with daily/near daily injecting (AOR 0.42). Both heavy drinking levels were associated with having ≥2 sexual partners (AOR 2.43 and 2.14). Drinking category was not associated with HCV test results.

Conclusion—The young adult IDU reported consuming alcohol at very high levels, which was associated with some unsafe sexual and injecting behaviors. Our study demonstrates the urgent need to intervene to reduce alcohol consumption in this population.

*Supplementary material can be found by accessing the online version of this paper at http://dx.doi.org and by entering doi:…

**Corresponding Author: Chloe Le Marchand, UCSF Medical Student Services, 513 Parnassus Avenue, S-245, School of Medicine, chloelemarchand@gmail.com, Phone: 808 284 6160.

Contributors: Authors Page, Hahn and Davidson designed and implemented the UFO Study and wrote the protocol. Author Hahn led the sub-analyses for this manuscript and Authors Le Marchand and Evans undertook the statistical analysis. Author Le Marchand undertook the literature search and wrote the first draft of the manuscript. All authors contributed to critical revisions of the manuscript and have contributed and approved the final version.

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

Keywords

Young Intravenous Drug Users; Alcohol; Alcohol Dependence; Injecting Risk Behaviors

1. Introduction

Heavy alcohol use has the potential to exacerbate conditions such as HIV and hepatitis C virus (HCV) infection that are prevalent among intravenous drug users (IDU). In particular, heavy alcohol use is associated with increased risk of cirrhosis in those infected with HCV (Pol et al., 2012), and may accelerate HIV disease progression (Hahn and Samet, 2010). The prevalence of heavy alcohol consumption by IDU has been reported to range from 11% to 57%, with heavy drinking defined as exceeding various thresholds for the number of drinks per week (Arasteh and Des Jarlais, 2009a; Arasteh et al., 2008; Hahn et al., 2008) or month (Howe et al., 2011), meeting Diagnostic and Statistical Manual of Mental Disorders criteria for alcohol abuse or dependence (Mackesy-Amiti et al., 2012; Stein et al., 2000), or scoring above a standard cutoff for problem drinking on the Alcohol Use Disorders Identification Test (AUDIT; Campbell et al., 2006; Costenbader et al., 2007).

Heavy alcohol consumption by IDU might also be a risk factor for the acquisition of HIV and HCV infection. In several studies of adult IDU, heavy alcohol consumption was associated with sharing needles/syringes, having multiple sex partners, and engaging in unprotected sex (Arasteh and Des Jarlais, 2009b; Arasteh et al., 2008; Stein et al., 2000), behaviors which are known risk factors for HCV and HIV. Young adult IDU are a sub-population that engage in injecting and sexual risk behaviors more commonly than older IDU (Becker Buxton et al., 2004; Garfein et al., 1998; Hahn et al., 2001; Kral et al., 2000; Thorpe et al., 2000b), have a lower prevalence of HCV infection due to their shorter injecting histories (Hahn et al., 2001; Lorvick et al., 2001), and therefore are a key population for interventions to prevent HCV and HIV infections. We are unaware of any studies that examined the association between alcohol use and sexual risk behavior in young adult IDU, while one study exists of young adult IDU focused on heavy alcohol consumption in relation to injecting risk behavior (Campbell et al., 2006). This study, conducted by Campbell et al in three U.S. cities among young adult IDU who had previously tested HCV antibody positive, found that 38% reported problem drinking in the past year (AUDIT score >8). Injecting speedballs (a mix of heroin and cocaine) and injecting with previously used needles were associated with problem drinking (Campbell et al., 2006). These results, if confirmed in studies with greater evidence for causality, suggest that interventions to reduce alcohol consumption among young adult IDU infected with HCV may in turn reduce risk behaviors, and, in turn, reduce onward transmission of the virus.

To our knowledge, no study has yet investigated the association of alcohol consumption with injecting risk behaviors among young adult IDU not yet infected with HCV or unaware that they are infected with HCV, despite the fact that this population is vital for HCV prevention. Therefore, to fill this gap, we sought to characterize alcohol consumption among young adult IDU who were being screened for a prospective study of incident HCV infection, who reported that they had not previously tested positive for HCV infection. We used a common measure of heavy alcohol consumption, the AUDIT-C, an abbreviated version of the AUDIT score used in the Campbell et al study (Meneses-Gaya et al., 2010). The goal was to determine whether high levels of alcohol consumption were associated with risky injecting behaviors. We focused on several injecting risk exposures that have been previously associated with risk for acquiring HCV and HIV infection, such as frequency of injection, sharing non-sterile drug preparation equipment, injecting the residue from

someone else's cooker (i.e., a container in which drugs are dissolved) or cotton (used to filter drugs before injecting), injecting with someone else's previously used needle/syringe, pooling money with other people in order to buy drugs to inject, and injecting with (but not necessarily shared needles/syringes or equipment) multiple persons (Garfein et al., 1998; Hahn et al., 2002; Kral et al., 2000; Metsch et al., 2007; Suh et al., 1997; Thiede et al., 2007; Thorpe et al., 2000a). In order to fill the gap in studies of heavy alcohol consumption and sexual risk behavior in young adult IDU, we also examined several sexual risk behaviors that have been previously associated with HIV transmission in IDU, such as having multiple sexual partners, trading sex for money or goods, inconsistently using condoms, and engaging in male-male sex (Kral et al., 2001; Rondinelli et al., 2009). We controlled the analyses for travel out of the metropolitan area of the study, which we previously found to be independently associated with injecting risk behaviors, sexual risk behaviors, and heavy alcohol consumption among young adult IDU. (Hahn et al., 2008).

2. Methods

2.1 Study Population

From March 2006 through December 2007 and April 2010 through March 2012, young adult IDU under the age of 30 were recruited to participate in the UFO study ('U Find Out'), a prospective cohort study examining risk for and incidence of HCV infection in San Francisco. The UFO study has been previously described (Evans et al., 2009; Hahn et al., 2010; Page et al., 2009). A convenience sample was created by street-based outreach workers, who recruited potential participants using fliers, community providers, and word of mouth. Eligibility criteria for participation in the baseline study visit required participants to be under age 30, to have reported injecting drugs in the prior month, to speak English as their primary language, to plan to remain in the San Francisco Bay Area for at least one month, and to report not previously testing HCV positive to enrich the sample for HCV uninfected persons. Some participants were infected with HCV without their knowledge. At the baseline visit, eligible participants gave informed consent, were interviewed by research assistants, and were counseled and tested for HCV antibody and HCV RNA. We considered a participant HCV positive if they tested positive either for HCV antibody or HCV RNA. Participants were encouraged to return for their results, post-test counseling and medical and social referrals one week later. Participants were compensated $10 for the baseline visit and $20 when they returned for results. Baseline data were used for these analyses. All study procedures were approved by the Institutional Review Board of the University of California, San Francisco.

2.2 Instrument

A structured 45–minute long questionnaire was administered via face-to-face interview with participants. Data were collected directly using a handheld PDA with Techneos Entryware software. Questionnaire topics included socio-demographic characteristics, injection and sexual risk behaviors, and alcohol consumption, as described below.

2.3 Laboratory testing

While participants self-reported at study screening that they had not had a previous positive HCV test, we determined their actual HCV status at the study visit. Prior to April 2007, HCV antibodies (anti-HCV) were detected using a second-generation enzyme immunoassay (EIA-2.0; Ortho Diagnostics Systems, Raritan, New Jersey) that was confirmed using HCV recombinant immunoblot assay 3.0 test system (Novartis Vaccines and Diagnostics, Emeryville, CA). From April 2007 onward, anti-HCV was detected using EIA-3 (Ortho Clinical Diagnostics, Raritan, NJ). HCV RNA testing was conducted in all years using the discriminatory HCV transcription-mediated amplification assay component of the Procleix

HIV-1/HCV assay. We did not conduct HIV testing. However, we previously found that the prevalence of HIV in young adult IDU in San Francisco was 5.3% (Shafer et al., 2002).

2.4 Measures

2.4.1 Main predictor variable of interest—We elicited alcohol consumption using the 3-item Alcohol Use Disorders Test-Consumption (AUDIT-C), which results in a score from 0-12 points. The AUDIT-C has been validated in the general population, in veterans, and in HCV-infected populations as an instrument to screen for problem drinking and alcohol use disorders (Bradley et al., 2003, 2009; Bush et al., 1998; Dawson et al., 2005). The scale was modified to measure the alcohol consumption in the prior month rather than the past year, to improve recall. A meta-review found that a 30-day recall period for drug use behavior items was most reliable when compared to three- and six-month recall periods (Napper et al., 2010).

We categorized alcohol consumption as follows: participants with scores of 0-2 for women and 0-3 for men were considered low risk drinkers, participants with scores 3-9 for women and 4-9 for men were considered hazardous drinkers, and participants with scores of 10-12 were considered probable dependent drinkers. The first level of cutoffs, i.e., ≥3 for women and ≥4 for men, was based on guidelines developed by the Department of Veteran Affairs of several studies conducted in the general population (2011). These cutoffs have shown 99.0% and 96.3% sensitivity and 79.1% and 79.5% specificity in male and female prior year drinkers in the general population respectively for detecting risky drinking, defined as follows: >14 drinks per week or >4 drinks at least one day per month in males and >7 drinks per week or >3 drinks in a day at least one day per month in females (Dawson et al., 2005). We based our second cutoff level of ≥10 for probable dependence based on research demonstrating that AUDIT- C scores of 10-12 are good predictors of alcohol dependence, as defined by a DSM-IV diagnosis (Rubinsky et al., 2010). This cutoff yielded positive likelihood ratios of over 20 for both male and female family medicine patients for identifying alcohol dependence, as well as 97.7% and 99.9% specificity in men and women, respectively; but low sensitivity (25.5% and 13.0% in males and female patients respectively; Rubinsky et al., 2010). One-quarter of the study sample scored at or above this cutoff, therefore we used this high cutoff despite previous low sensitivity, in order to be very conservative in classifying young adult IDU as probable dependent drinkers. While cutoffs for the full AUDIT scale for determining hazardous alcohol consumption and alcohol dependence have been examined in high risk populations such as persons admitted to emergency departments (Morini et al., 2010; Suesse et al., 2011, 2010) and at a sexually transmitted diseases clinic (Jones et al., 2011), cutoffs for the 3-question AUDIT-C have not been validated in high risk populations such as young adult IDU. We therefore conducted sensitivity analyses to determine if our results were robust to our chosen cutoffs (see statistical analyses).

2.4.2 Outcome variables—We examined engaging in the following injecting risk behaviors in the prior three months (yes/no): borrowing needles/syringes, defined as injecting with someone else's previously used needle/syringe; lending needles/syringes to others, defined as allowing someone else to inject with one's own used needle/syringe; sharing non-sterile drug preparation equipment in the prior three months, defined as using a cooker or container for dissolving drugs that may have been previously used by someone else; injecting the residue from someone else's cooker or cotton (the material used to filter drugs before injecting); and pooling money with other people in order to buy drugs to inject. Injecting risk behaviors in the past month (yes/no) included: injecting daily or nearly daily, defined as injecting 25 days or more in the prior month; and injecting with three or more

people in the past three months, but not necessarily sharing needles/syringes or equipment with them.

Sexual risk behaviors in the past three months (yes/no) included: male-male sex; having two or more sexual partners; trading sex for money or goods; and inconsistently using condoms.

We considered a positive result on either EIA or RNA test as evidence of HCV infection.

2.4.3 Socio-demographic and other potential confounding variables—We examined several socio-demographic and behavioral variables as potential confounders. We grouped our sample in 5-year age groupings: 15-19 years, 20-24 years, and 25-29 years. We used the United States Government 2010 definition which defines a homeless person as "an individual who lacks a fixed, regular, and adequate night-time residence" (United States Government, 2010) and therefore categorized those who predominantly lived in a shelter, squat, outside (in a park, under a freeway, in a doorway), or in a vehicle as homeless in the past three months. We categorized those who stayed predominantly in a home, apartment, halfway house, foster house, boarding house, group home, hotel, or motel or institution as not homeless. We created a three-level variable representing itinerancy from two questions: one that ascertained travel outside of the San Francisco Bay Area in the prior three months and one that ascertained intending to travel out of the area in the next three months. Thus the created variable was categorized as past and planned travel, past travel but no planned travel, and no past travel, regardless of planned travel. In the latter category, most (158/167) did not plan to travel. We defined non-injected multidrug use in the past three months as using two or more of the following drugs in ways other than injecting: cocaine, heroin, speed, crack and opiates. We dichotomized age of first injection drug use at age 21 because this cutoff differentiates between adolescence and adulthood (Berham et al., 1996; Fuller et al., 2001) and we also examined prior HCV testing.

2.5 Statistical analysis

We first examined associations between the socio-demographic variables and other potential confounders and the alcohol consumption categories using the chi-square test. This was followed by a calculation of the odds ratio and 95% confidence interval and chi-square test of association of alcohol consumption category with each behavior outcome and HCV status. We then ran logistic regression analyses for each outcome variable, including the socio-demographic variables that were associated ($p<0.05$) with alcohol consumption in the above analyses, in order to adjust for possible confounding. These variables were: homelessness and itinerancy. We included sex in the models because it is a common confounder. Because itinerancy has not previously been examined as a confounder in analyses such as these, we additionally ran the regressions without including it in the model, to determine its impact as a confounder.

In order to investigate the sensitivity of our results to the cutoff levels for the drinking categories we used, we conducted logistic regression analyses for each injecting and sexual risk behavior variable separately, using the AUDIT-C variable as follows: (1) with cutoffs *decreased* by 1 point; (2) with cutoffs *increased* by one point; (3) with cutoffs reflecting the 50^{th} and 85^{th} percentiles of scores within each gender, and (4) as a continuous variable. The odds ratios for these sensitivity analyses were adjusted for homelessness, itinerancy, and sex as above.

3. Results

Of 1297 individuals who were pre-screened for the UFO study, 540 were eligible (41.6%) and 131 of those (24.3%) were enrolled in another study that precluded co-enrolment. Of the

remaining 409, 390 (95.4%) completed a baseline interview for this study and 19 (4.6%) declined or left. Overlapping reasons for ineligibility included not injecting in the prior month (n=288), age 30 and older (n=314), self-reporting a prior positive HCV test (n=220), and planning to travel outside of the San Francisco Bay Area in the coming month (n=237). Sixty-four observations were later dropped from the analysis due to later discoveries of ineligibility (n=47) and missing values for the AUDIT-C questionnaire (n=17), leaving 326 records for analysis.

The median age in our sample was 23.8 years, the majority of participants were white and non-Hispanic (73.3%) and male (69.9%); see Table 1. The majority of participants (73.3%) reported being predominantly homeless in the past three months, 17.8% had both traveled outside of the San Francisco Bay Area in the prior three months and planned to leave within the next three months, while 31.0% had travelled outside the San Francisco Bay Area but had no plans to leave. Forty percent (39.6%) had never been tested for HCV, and upon testing in this study, one third (32.2%) were HCV positive.

Approximately one third of the participants (32.2%) were classified as low risk drinkers, 42.6% were classified as hazardous drinkers, and 25.2% were classified as probable dependent drinkers. Almost all (85.4%) of the probable dependent drinkers reported drinking six or more drinks on one occasion daily or almost daily, while the rest of this group, 14.6%, drank this much weekly.

There were significant differences ($p<.05$) between the alcohol consumption groups and homelessness and itinerancy. The associations between drinking category and sex and multidrug use reached borderline statistical significance ($0.05<p<0.10$).

Alcohol consumption was associated with several risk behaviors (Table 2). Probable dependent drinking was associated with sharing non-sterile drug preparation equipment (AOR: 2.59; 95% CI 1.35-4.95) and, inversely, with daily/near daily injecting (AOR: 0.42; 95% CI: 0.22-0.81). Hazardous drinking was associated with injecting the residue from someone else's cooker or cotton (AOR 1.93; 95% CI 1.11-3.36). Both hazardous and probable dependent drinking were associated with 2 or more sexual partners in the past three months (hazardous drinking: AOR: 2.43; 95% CI: 1.42-4.20, probable dependent drinking: AOR: 2.14; 95% CI: 1.13-4.06). Hazardous drinking was associated with borrowing needles/syringes in bivariate but not multivariable analyses. When the itinerancy variable was not included in the multivariate models, the results were largely the same. The only result that changed was that without itinerancy in the model, the association between hazardous drinking and needle/syringe borrowing was statistically significant (AOR: 1.78; 95% CI: 1.03-3.09).

We examined the robustness of these results to the level of the cutoffs we used for defining hazardous and probable dependent alcohol consumption, as well as the relationship between the odds of engaging in the selected risk behaviors and the AUDIT-C as a continuous variable. Overall, there were no major changes in the results (see Supplemental Table[1]). Minor differences in the results were as follows: (1) when we used higher cutoffs for the AUDIT-C, the associations between medium level alcohol consumption and sharing non-sterile drug preparation equipment and HCV status became statistically significant; (2) when we used higher cutoffs for the AUDIT-C, grouped the AUDIT-C by percentile, and used the AUDIT-C as a continuous variable, the level of alcohol consumption was no longer associated with injecting the residue from someone else's cooker or cotton; (3) when we grouped alcohol consumption using the 50^{th} and 85^{th} percentiles within each gender, the

[1]Supplementary material can be found by accessing the online version of this paper at http://dx.doi.org and by entering doi:…

association between high risk drinking and having 2 or more sexual partners was attenuated and no longer reached statistical significance.

4. Discussion

Our analyses show that young adult IDU who had not previously tested positive for HCV engage in extremely high levels of alcohol consumption. Almost 70% of the sample was classified as having hazardous drinking behavior or probable dependence, and over 25% were considered probable dependent drinkers. Almost all of the probable dependent drinkers reported drinking six or more drinks per occasion on daily or almost daily basis. This level of hazardous and probable dependent alcohol consumption far exceeds prior reports of alcohol consumption in young adults and in young adult IDU in particular. For example, national surveys of young adults report that the prevalence of heavy drinking (≥5 drinks per occasion on ≥5 days in the past thirty days) is 15.1% in young adults aged 18-25 (US Government HHS, 2005) and the proportion of HCV positive young adult (age 18-35) IDU who reported hazardous alcohol consumption (AUDIT score ≥8) was 37% (Campbell et al., 2006).

We also found that hazardous and probable dependent alcohol consumption was associated with some important injecting and sexual risk behaviors among young adult IDU who had not previously tested positive for HCV. These behaviors included injecting the residue from someone else's cooker or cotton, sharing potentially non-sterile drug equipment, and having two or more sexual partners in the prior three months. The latter two associations were quite robust to the cutoffs used to define the levels of drinking. These results are consistent with the overall findings that heavy alcohol use was associated with increased injecting and sexual risk behaviors in several studies conducted in older IDU (>30 years; Arasteh and Des Jarlais, 2009a; Arasteh et al., 2008; Stein et al., 2000) as well as a sample of young adult (age 18-35) IDU who knew they were HCV antibody positive (Campbell et al., 2006). Thus, this study extends previous findings to an important population in need of intervention to prevent the spread of HCV and HIV, i.e., young adult IDU who are either at risk for HCV or unaware that they are infected with HCV.

4.1 Limitations

Our study had several limitations, including a modest sample size that limited the statistical power to detect small effects. In addition, as with all cross-sectional studies, we cannot assume causal links between heavy alcohol use and the injecting and sexual behaviors we studied. However, a recent prospective study found that risky drug and sexual behaviors influence subsequent drinking, suggesting a bidirectional relationship between alcohol consumption and risk behavior (Sander et al., 2010). Lack of temporality may explain why alcohol consumption was not positively associated with HCV status, because HCV infection may have occurred at any time during prior injecting careers, while alcohol consumption was elicited for the prior month. Another limitation is that the variables used in these analyses were self-reported measures and under-report due to social desirability bias is therefore possible. This may especially be the case for the behaviors which have been the target of HIV prevention campaigns, such as needle/syringe sharing and condom use. Non-differential under-report of these variables would cause bias toward the null, which might explain the lack of significant findings for these two variables. Another limitation is that alcohol consumption was assessed for the prior month, whereas all other outcomes, except for daily/near daily injecting, were reported for a three-month period. Both IDU drug consumption behavior and alcohol consumption have been shown to change over time; therefore the reported alcohol consumption may have changed over the three-month period used for other behaviors (Howe et al., 2011; Lucas et al., 2002). However, our shorter 30-day recall period may have improved the accuracy of the reported alcohol consumption

(Napper et al., 2010). Finally, our study was limited by lack of validation in young adult IDU of the AUDIT-C score cutoffs that we used to determine hazardous and probable dependent alcohol consumption, however, our cutoff, especially for probable dependent drinking, was very conservative and our findings were fairly robust to changes in these cutoffs in sensitivity analyses.

4.2 Conclusions

We found an extremely high level of alcohol consumption as well as robust associations of alcohol consumption with risk behaviors in an important population for HCV and HIV prevention, i.e., young adult IDU at risk for HCV or unaware that they are infected with HCV. These findings underscore that interventions to reduce alcohol consumption in this population are urgently needed. Interventions to reduce alcohol consumption in young adult IDU may not only improve the overall health of this population, but may also reduce behaviors that put them at risk for acquiring and transmitting HCV and HIV. A small number of studies have shown that reducing alcohol consumption is possible in IDU, although these studies were less successful in decreasing injecting risk behaviors. One small (n=187) randomized study of motivational interviewing found a significant decrease in the number of drinking days and a non-significant decrease in the frequency of heroin use (p=0.07) (Stein et al., 2002); a large randomized study (n=851) found a significant effect of motivational interviewing on alcohol consumption but not on injecting or sexual risk behaviors (Zule et al., 2009); a third study reported increased alcohol abstinence in HCV positive IDU over the study period but no difference between the enhanced HCV focused behavioral counseling arm a general behavioral counseling control (Drumright et al., 2011). None of these studies focused on young adult IDU, who engage in increased injecting and sexual risk behaviors and are more likely to be homeless compared to older IDU (Kral et al., 2000). Thus, more work is vastly needed to develop effective and feasible interventions to reduce alcohol consumption and to address the co-occurring injecting and sexual risk behaviors in young adult IDU. Alcohol-reducing measures might be paired with other interventions, such as needle/syringe exchange and injecting equipment and condom distribution, to potentially reduce injecting risk and sexual risk behaviors and future morbidities in this population (Hurley et al., 1997). We recognize the goal of reducing alcohol consumption in this population is a very challenging one, especially considering the high degree of alcohol consumption and risk behavior coupled with homelessness and itinerancy. However, the data point to a clear need that should not be ignored.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The authors would like to acknowledge and thank the UFO study participants for their time. We also would like to thank the UFO field staff for their work in conducting the study.

Role of Funding Source: This study was funded by NIH grants R01DA016017-08 (Page) and K01DA023365 (Hahn), P30 DK026743 (UCSF Liver Center, Page), and UL1 RR024131 (NIH/NCRR UCSF-CTSI, Page), NIH 5T32DA023356 (Davidson). The NIH had no role in study design; in the collection, analysis and interpretation of data; in the writing of the report; or in the decision to submit the paper for publication.

References

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. 2009a; 23:657–661. [PubMed: 19591610]

Arasteh K, Des Jarlais DC. HIV testing and treatment among at-risk drinking injection drug users. J Int Assoc Physicians AIDS Care (Chic). 2009b; 8:196–201. [PubMed: 19414827]

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]

Becker Buxton M, Vlahov D, Strathdee SA, Des Jarlais DC, Morse EV, Ouellet L, Kerndt P, Garfein RS. Association between injection practices and duration of injection among recently initiated injection drug users. Drug Alcohol Depend. 2004; 75:177–183. [PubMed: 15276223]

Berham, R.; Kliegman, R.; Arvin, A.; Nelson, W. Nelson Textbook of Pediatrics. W.B. Saunders Company; Philadelphia: 1996.

Bradley KA, Bush KR, Epler AJ, Dobie DJ, Davis TM, Sporleder JL, Maynard C, Burman ML, Kivlahan DR. Two brief alcohol-screening tests From the Alcohol Use Disorders Identification Test (AUDIT): validation in a female Veterans Affairs patient population. Arch Intern Med. 2003; 163:821–829. [PubMed: 12695273]

Bradley KA, Kivlahan DR, Williams EC. Brief approaches to alcohol screening: practical alternatives for primary care. J Gen Intern Med. 2009; 24:881–883. [PubMed: 19495888]

Bush K, Kivlahan DR, McDonell MB, Fihn SD, Bradley KA. The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. Ambulatory Care Quality Improvement Project (ACQUIP). Alcohol Use Disorders Identification Test. Arch Intern Med. 1998; 158:1789–1795. [PubMed: 9738608]

Campbell JV, Hagan H, Latka MH, Garfein RS, Golub ET, Coady MH, Thomas DL, Strathdee SA. High prevalence of alcohol use among hepatitis C virus antibody positive injection drug users in three US cities. Drug Alcohol Depend. 2006; 81:259–265. [PubMed: 16129567]

Costenbader EC, Zule WA, Coomes CM. The impact of illicit drug use and harmful drinking on quality of life among injection drug users at high risk for hepatitis C infection. Drug Alcohol Depend. 2007; 89:251–258. [PubMed: 17320314]

Dawson DA, Grant BF, Stinson FS, Zhou Y. Effectiveness of the derived Alcohol Use Disorders Identification Test (AUDIT-C) in screening for alcohol use disorders and risk drinking in the US general population. Alcohol Clin Exp Res. 2005; 29:844–854. [PubMed: 15897730]

Drumright LN, Hagan H, Thomas DL, Latka MH, Golub ET, Garfein RS, Clapp JD, Campbell JV, Bonner S, Kapadia F, Thiel TK, Strathdee SA. Predictors and effects of alcohol use on liver function among young HCV-infected injection drug users in a behavioral intervention. J Hepatol. 2011; 55:45–52. [PubMed: 21145862]

Evans JL, Hahn JA, Lum PJ, Stein ES, Page K. Predictors of injection drug use cessation and relapse in a prospective cohort of young injection drug users in San Francisco, CA (UFO Study). Drug Alcohol Depend. 2009; 101:152–157. [PubMed: 19181458]

Fuller CM, Vlahov D, Arria AM, Ompad DC, Garfein R, Strathdee SA. Factors associated with adolescent initiation of injection drug use. Public Health Rep. 2001; 116(1):136–145. [PubMed: 11889281]

Garfein RS, Doherty MC, Monterroso ER, Thomas DL, Nelson KE, Vlahov D. Prevalence and incidence of hepatitis C virus infection among young adult injection drug users. J Acquir Immune Defic Syndr Hum Retrovirol. 1998; 18(1):S11–19. [PubMed: 9663618]

Hahn JA, Evans JL, Davidson PJ, Lum PJ, Page K. Hepatitis C virus risk behaviors within the partnerships of young injecting drug users. Addiction. 2010; 105:1254–1264. [PubMed: 20491725]

Hahn JA, Page-Shafer K, Ford J, Paciorek A, Lum PJ. Traveling young injection drug users at high risk for acquisition and transmission of viral infections. Drug Alcohol Depend. 2008; 93:43–50. [PubMed: 17980513]

Hahn JA, Page-Shafer K, Lum PJ, Bourgois P, Stein E, Evans JL, Busch MP, Tobler LH, Phelps B, Moss AR. Hepatitis C virus seroconversion among young injection drug users: relationships and risks. J Infect Dis. 2002; 186:1558–1564. [PubMed: 12447730]

Hahn JA, Page-Shafer K, Lum PJ, Ochoa K, Moss AR. Hepatitis C virus infection and needle exchange use among young injection drug users in San Francisco. Hepatology. 2001; 34:180–187. [PubMed: 11431749]

Hahn JA, Samet JH. Alcohol and HIV disease progression: weighing the evidence. Curr HIV/AIDS Rep. 2010; 7:226–233. [PubMed: 20814765]

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; 25:221–228. [PubMed: 21099668]

Hurley SF, Jolley DJ, Kaldor JM. Effectiveness of needle-exchange programmes for prevention of HIV infection. Lancet. 1997; 349:1797–1800. [PubMed: 9269214]

Jones J, Jones M, Plate C, Lewis D. The detection of 1-palmitoyl-2-oleoyl-sn-glycero-3-phosphoethanol in human dried blood spots. Anal Methods. 2011; 3:1101–1106.

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; 357:1397–1401. [PubMed: 11356437]

Kral AH, Lorvick J, Edlin BR. Sex- and drug-related risk among populations of younger and older injection drug users in adjacent neighborhoods in San Francisco. J Acquir Immune Defic Syndr. 2000; 24:162–167. [PubMed: 10935692]

Lorvick J, Kral AH, Seal K, Gee L, Edlin BR. Prevalence and duration of hepatitis C among injection drug users in San Francisco, Calif. Am J Public Health. 2001; 91:46–47. [PubMed: 11189823]

Lucas GM, Gebo KA, Chaisson RE, Moore RD. Longitudinal assessment of the effects of drug and alcohol abuse on HIV-1 treatment outcomes in an urban clinic. AIDS. 2002; 16:767–774. [PubMed: 11964533]

Mackesy-Amiti ME, Donenberg GR, Ouellet LJ. Prevalence of psychiatric disorders among young injection drug users. Drug Alcohol Depend. 2012; 124:70–78. [PubMed: 22226707]

Meneses-Gaya C, Zuardi AW, Loureiro SR, Hallak JE, Trzesniak C, de Azevedo Marques JM, Machado-de-Sousa JP, Chagas MH, Souza RM, Crippa JA. Is the full version of the AUDIT really necessary? Study of the validity and internal construct of its abbreviated versions. Alcohol Clin Exp Res. 2010; 34:1417–1424. [PubMed: 20491736]

Metsch LR, Pereyra M, Purcell DW, Latkin CA, Malow R, Gomez CA, Latka MH. Correlates of lending needles/syringes among HIV-seropositive injection drug users. J Acquir Immune Defic Syndr. 2007; 46(2):S72–79. [PubMed: 18089987]

Morini L, Zucchella A, Polettini A, Politi L, Groppi A. Effect of bleaching on ethyl glucuronide in hair: an in vitro experiment. Forensic Sci Int. 2010; 198:23–27. [PubMed: 19962258]

Napper LE, Fisher DG, Reynolds GL, Johnson ME. HIV risk behavior self-report reliability at different recall periods. AIDS Behav. 2010; 14:152–161. [PubMed: 19475504]

Page K, Hahn JA, Evans J, Shiboski S, Lum P, Delwart E, Tobler L, Andrews W, Avanesyan L, Cooper S. Acute hepatitis C virus infection in young adult injection drug users: a prospective study of incident infection, resolution, and reinfection. J Infect Dis. 2009; 200:1216. [PubMed: 19764883]

Pol S, Vallet-Pichard A, Corouge M, Mallet VO. Hepatitis C: epidemiology, diagnosis, natural history and therapy. Contrib Nephrol. 2012; 176:1–9. [PubMed: 22310776]

Rondinelli AJ, Ouellet LJ, Strathdee SA, Latka MH, Hudson SM, Hagan H, Garfein RS. Young adult injection drug users in the United States continue to practice HIV risk behaviors. Drug Alcohol Depend. 2009; 104:167–174. [PubMed: 19559543]

Rubinsky AD, Kivlahan DR, Volk RJ, Maynard C, Bradley KA. Estimating risk of alcohol dependence using alcohol screening scores. Drug Alcohol Depend. 2010; 108:29–36. [PubMed: 20042299]

Sander PM, Cole SR, Ostrow DG, Mehta SH, Kirk GD. Determinants of alcohol consumption in HIV-uninfected injection drug users. Drug Alcohol Depend. 2010; 111:173–176. [PubMed: 20547014]

Shafer KP, Hahn JA, Lum PJ, Ochoa K, Graves A, Moss A. Prevalence and correlates of HIV infection among young injection drug users in San Francisco. J Acquir Immune Defic Syndr. 2002; 31:422–431. [PubMed: 12447014]

Stein MD, Charuvastra A, Maksad J, Anderson BJ. A randomized trial of a brief alcohol intervention for needle exchangers (BRAINE). Addiction. 2002; 97:691–700. [PubMed: 12084138]

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; 18:359–363. [PubMed: 10812309]

Suesse S, Pragst F, Mieczkowski T, Selavka CM, Elian A, Sachs H, Hastedt M, Rothe M, Campbell J. Practical experiences in application of hair fatty acid ethyl esters and ethyl glucuronide for detection of chronic alcohol abuse in forensic cases. Forensic Sci Int. 2011; 218:82–91. [PubMed: 22036309]

Suh T, Mandell W, Latkin C, Kim J. Social network characteristics and injecting HIV-risk behaviors among street injection drug users. Drug Alcohol Depend. 1997; 47:137–143. [PubMed: 9298335]

Susse S, Selavka CM, Mieczkowski T, Pragst F. Fatty acid ethyl ester concentrations in hair and self-reported alcohol consumption in 644 cases from different origin. Forensic Sci Int. 2010; 196:111–117. [PubMed: 20061102]

Thiede H, Hagan H, Campbell JV, Strathdee SA, Bailey SL, Hudson SM, Kapadia F, Garfein RS, Team DS. Prevalence and correlates of indirect sharing practices among young adult injection drug users in five U.S. cities. Drug Alcohol Depend. 2007; 91(1):S39–47. [PubMed: 17466464]

Thorpe L, Ouellet L, Hershow R, Bailey S, Williams I, Monerosso E. The multiperson use of non-syringe injection equipment and risk of hepatitis c infection in a cohort of young adult injection drug users, Chicago 1997-1999. Ann Epidemiol. 2000a; 10:472–473. [PubMed: 11018406]

Thorpe L, Ouellet L, Hershow R, Bailey S, Williams I, Monterosso E. The multiperson use of non-syringe injection equipment and risk of hepatitis C infection in a cohort of young adult injection drug users, Chicago 1997-1999 [poster]. Ann Epidemiol. 2000b; 10:472–473. [PubMed: 11018406]

United States Government. Federal Definition of Homeless. U.S. Department of Housing and Urban Development; Washington, DC: 2010.

US Government HHS. Results from the 2004 National Survey on Drug Use and Health: National Findings. Substance Abuse and Mental Health Services Administration, US Department of Health and Human Services; Washington, DC: 2005.

Wu ES, Metzger DS, Lynch KG, Douglas SD. Association between alcohol use and HIV viral load. J Acquir Immune Defic Syndr. 2011; 56:e129–130. [PubMed: 21532918]

Zule WA, Costenbader EC, Coomes CM, Wechsberg WM. Effects of a hepatitis C virus educational intervention or a motivational intervention on alcohol use, injection drug use, and sexual risk behaviors among injection drug users. Am J Public Health. 2009; 99(1):S180–186. [PubMed: 19218179]

Drug Alcohol Depend. Author manuscript; available in PMC 2014 January 01.

Table 1

Demographic and behavioral characteristics of young adult IDU (age<30) in San Francisco who had not previously tested positive for hepatitis C virus (HCV), by level of alcohol consumption (n=326).

Characteristic	n overall (col %)	n Low Risk Drinking[a] (row %)	n Hazardous Drinking[b] (row %)	n Probable Dependent Drinking[c] (row %)	p-value (chi-square)
Alcohol consumption level	326 (100)	105 (32.2)	139 (42.6)	82 (25.2)	
Age					0.51
19 and under	52 (16.0)	13 (25.0)	25 (48.1)	14 (26.9)	
20-24	146 (44.8)	44 (30.1)	65 (44.5)	37 (25.3)	
25 and over	128 (39.3)	48 (37.5)	49 (38.3)	31 (24.2)	
Race/ethnicity					0.86
White/Caucasian	239 (73.3)	76 (31.8)	101 (42.3)	62 (25.9)	
Other	87 (26.7)	29 (33.3)	38 (43.7)	29 (23.0)	
Sex					0.06
Male	228 (69.9)	74 (32.5)	89 (39.0)	65 (28.5)	
Female	98 (30.1)	31 (31.6)	50 (51.0)	17 (17.4)	
Education					0.49
Less than high school	134 (41.2)	42 (31.3)	52 (38.8)	40 (29.9)	
High school Degree	106 (32.6)	36 (34.0)	45 (42.5)	25 (23.6)	
More than high school	85 (26.2)	27 (31.8)	41 (48.2)	17 (20.0)	
Spent time in jail or prison in the past 3 months					0.53
No	242 (75.6)	77 (31.8)	106 (43.8)	59 (24.4)	
Yes	78 (24.4)	26 (33.3)	29 (37.2)	23 (29.5)	
Homeless in the past 3 months					0.01
No	86 (26.7)	26 (30.2)	48 (55.8)	12 (14.0)	
Yes	236 (73.3)	76 (32.2)	90 (38.1)	70 (30.0)	
Itinerancy, past 3 months					<0.01
No past travel	167 (51.2)	68 (40.7)	73 (43.7)	26 (15.6)	
Past but no planned travel	101 (31.0)	28 (27.7)	44 (43.6)	29 (28.7)	
Past and planned travel	58 (17.8)	9 (15.5)	22 (37.9)	27 (46.6)	
Age first injected					0.63

Characteristic	n overall (col %)	n Low Risk Drinking[a] (row %)	n Hazardous Drinking[b] (row %)	n Probable Dependent Drinking[c] (row %)	p-value (chi-square)
< 21 years	237 (77.7)	73 (30.8)	103 (43.5)	61 (25.7)	
≥ 21 years	68 (22.3)	25 (36.8)	26 (38.2)	17 (25.0)	
Non-injecting multidrug use in the past 3 months					0.07
No	139 (42.8)	54 (38.9)	54 (38.9)	31 (22.2)	
Yes	186 (57.2)	50 (26.9)	85 (45.7)	51 (27.4)	
Prior HCV testing					0.72
Never	124 (39.6)	35 (28.2)	58 (46.8)	31 (25.0)	
Ever, but >3 months prior	126 (40.3)	42 (33.3)	49 (38.9)	35 (27.8)	
Ever in the past 3 months	63 (20.1)	21 (33.3)	28 (44.4)	14 (22.2)	

[a] Low disk drinking defined as AUDIT-C scores of 0-2 for women and 0-3 for men.

[b] Hazardous drinking defined as AUDIT-C scores 3-9 for women and 4-9 for men.

[c] Probable dependent drinking defined as AUDIT-C scores of 10-12.

Table 2

Bivariate and multivariable analyses of Injecting and sexual risk behaviors by alcohol consumption categories[a].

	n Reporting Outcome (%)	Odds Ratio (95% CI)	Adjusted Odds Ratio[b] (95% CI)
Almost daily injection in the past 30 days			
Low Risk Drinking (n=99)	51 (49.0)	1.00	1.00
Hazardous Drinking (n=136)	64 (46.0)	0.89 (0.53-1.48)	0.85 (0.50-1.43)
Probable Dependent Drinking (n=80)	24 (29.3)	0.43 (0.23-0.79) *	0.42 (0.22-0.81) *
Shared non-sterile drug preparation equipment in the past 3 months			
Low Risk Drinking (n=99)	34 (34.3)	1.00	1.00
Hazardous Drinking (n=136)	63 (46.3)	1.65 (0.97-2.82)	1.51 (0.87-2.61)
Probable Dependent Drinking (n=80)	46 (57.5)	2.58 (1.41-4.75) *	2.59 (1.35-4.95) *
Injected the residue from someone else'scooker or cotton in the past 3 months			
Low Risk Drinking (n=103)	30 (29.1)	1.00	1.00
Hazardous Drinking (n=137)	62 (45.3)	2.01 (1.17-3.46) *	1.93 (1.11-3.36) *
Probable Dependent Drinking (n=82)	31 (37.8)	1.48 (0.80-2.74)	1.39 (0.73-2.68)
Borrowed needles/syringes in the past 3 months			
Low Risk Drinking (n=104)	32 (30.8)	1.00	1.00
Hazardous Drinking (n=136)	60 (44.1)	1.78 (1.04-3.04) *	1.70 (0.98-2.97)
Probable Dependent Drinking (n=80)	34 (42.5)	1.66 (0.91-3.06)	1.56 (0.81-3.01)
Pooled money to buy drugs			
Low Risk Drinking (n=103)	79 (79.7)	1.00	1.00
Hazardous Drinking (n=138)	116 (84.1)	1.60 (0.84-3.05)	1.35 (0.69-2.63)
Probable Dependent Drinking (n=82)	71 (86.6)	1.96 (0.90-4.29)	1.53 (0.67-3.52)
Injected with 3 or more partners in the past 3 months			
Low Risk Drinking (n=97)	64 (66.0)	1.00	1.00
Hazardous Drinking (n=132)	93 (70.5)	1.23 (0.70-2.16)	1.11 (0.62-1.98)
Probable Dependent Drinking (n=81)	58 (71.6)	1.30 (0.69-2.47)	1.01 (0.51-2.01)
Male-male sex (among men)			
Low Risk Drinking (n=74)	19 (25.7)	1.00	1.00
Hazardous Drinking (n=89)	21 (23.6)	0.89 (0.44-1.82)	0.89 (0.43-1.84)
Probable Dependent Drinking (n=65)	10 (15.4)	0.53 (0.22-1.23)	0.60 (0.25-1.45)
2 or more sexual partners in the last 3 months			
Low Risk Drinking (n=99)	34 (34.3)	1.00	1.00

	n Reporting Outcome (%)	Odds Ratio (95% CI)	Adjusted Odds Ratio[b] (95% CI)
Hazardous Drinking (n=136)	78 (57.4)	2.57 (1.50-4.39) *	2.43 (1.42-4.20) *
Probable Dependent Drinking (n=81)	44 (54.3)	2.27 (1.24-4.15) *	2.14 (1.13-4.06) *
Sold sex for money or goods in the last 3 months			
Low Risk Drinking (n=99)	19 (19.2)	1.00	1.00
Hazardous Drinking (n=136)	28 (20.6)	1.09 (0.57-2.09)	1.08 (0.56-2.09)
Probable Dependent Drinking (n=81)	20 (24.7)	1.38 (0.68-2.81)	1.54 (0.73-3.28)
Irregular condom use in the last 3 months			
Low Risk Drinking (n=100)	61 (61.0)	1.00	1.00
Hazardous Drinking (n=136)	92 (67.7)	1.34 (0.78-2.29)	1.09 (0.62-1.92)
Probable Dependent Drinking (n=81)	55 (67.9)	1.35 (0.73-2.50)	1.12 (0.57-2.20)
HCV positive (baseline testing)			
Low Risk Drinking (n=102)	39 (38.2)	1.00	1.00
Hazardous Drinking (n=136)	39 (28.7)	0.65 (0.38-1.12)	0.72 (0.40-1.28)
Probable Dependent Drinking (n=82)	25 (30.5)	0.71 (0.38-1.31)	0.85 (0.43-1.67)

[a] Alcohol consumption categories: Low Risk Drinking (AUDIT-C scores of 0-2 for women and 0-3 for men); Hazardous drinking (AUDIT-C scores 3-9 for women and 4-9 for men); Probable dependent drinking (AUDIT-C scores of 10-12).

[b] Adjusted for: age, sex, non-IDU multidrug use, homeless in the past three months, past and planned travel out of the Bay Area in the prior/next 3 months.

* p<.05

** p<.001