Working Title: Prevalence and correlates of harmful alcohol use by gender and HIV status in rural Uganda

Introduction

Harmful alcohol use is a major contributor to mortality and morbidity worldwide,(1) with links to over 200 communicable and non-communicable diseases and injuries.(2) For example, it is estimated that alcohol caused 254,000 deaths from tuberculosis, 33,000 from HIV, and 99,000 from lower respiratory infections globally in 2016.(3) The World Health Organization (WHO) Africa Region bears the largest age-standardized alcohol-attributable burden of disease and injury.(3)

Uganda, the setting for this research, has one of the highest rates of alcohol use in the WHO Africa Region.(3) According to WHO estimates, a substantial proportion of the population abstained from alcohol use in the past year (63.7%); however, among those who drank, 56.9% reported heavy episodic drinking (68.8% among men and 32.6% among women).(3) Further, the prevalence of alcohol use disorders in the general population was 7.1% (12.4% among men and 1.9% among women).(3) While the WHO has provided national averages, there is significant variation across regions and populations. For example, a recent study in the Rakai region of Uganda found the prevalence of alcohol use was 45%.(4) Another study in a public outpatient clinic in rural Uganda, found the prevalence of any alcohol use was 15%.(5) More research is needed to understand regional and population variations in alcohol use in Uganda.

Alcohol use and related outcomes also vary by gender. Compared to men, women are less likely to consume alcohol and have lower risks for problematic alcohol use and alcohol-related harms worldwide.(6) However, women who drink have higher risks for certain alcohol related problems, compared to men. Women who misuse alcohol are more likely to develop alcohol hepatitis,(7) alcohol related heart disease,(3) and brain damage.(8) Studies have also found an association between drinking alcohol and breast cancer(9) and drinking during pregnancy increases risks for physical, cognitive, and behavioral problems in children.(10) Women also may have different risk factors for harmful drinking compared to men,(4) and can face co-occurring conditions, including depression, intimate partner violence, and HIV.(5) Further, previous research in Russia and the United States found that, among people living with HIV, the gender gap in alcohol use converges; however, this

difference was not found in Uganda.(11) Thus, while men are more likely to use alcohol, it is important to also examine the prevalence, risk factors, and alcohol-related outcomes among women.

Alcohol use is also an overlooked factor in the HIV epidemic.(12) Alcohol use can impair decision-making, resulting in riskier sex behaviors,(13-18) and can increase viral replication(19, 20) and reduce receipt of and adherence to ART,(21-25) resulting in increased risk for HIV disease progression and transmission.(19, 26-28) In Uganda, studies have found that the incidence of HIV infections is higher among women compared to men.(29, 30) This research aims to estimate the prevalence of any, harmful, and binge alcohol use in rural, central Uganda stratified by men and women and HIV status. It will also identify differences in correlates of harmful alcohol use between men and women.

Methods

Parent study

This study used baseline data from the PATH/Ekkubo matched-pair, two-arm, cluster randomized trial in rural districts of Butambala, Mpigi, Mityana, and Gomba in central Uganda.(31) Matched villages were randomized to either the standard of care arm or the intervention arm, which included an enhanced linkage to HIV care intervention, and all households within selected villages were included. Eligibility criteria for enrollment at baseline were: adults aged 18 to 59 years old or emancipated minors aged 15 to 17 years, accepting HIV testing, speaking Luganda or English, and residing in a study household. HIV counseling and testing was provided to all eligible and consenting participants. Participants were recruited between ___2015 and December 2020.

Measures

Data were collected from consenting participants using interviewer-administered, computer-based questionnaires, which included questions related to socio-demographic characteristics, alcohol use, and HIV status and care.

Beginning in June 2017, participants were asked about alcohol use, which was assessed using the 3-item Alcohol Use Disorders Identification Test Consumption (AUDIT-C),(32) which estimates the frequency and

quantity of alcohol use over the past year; and ranges from 0 points (non-drinking) to 12 (very high-risk drinking). A score of ≥three for women and ≥four for men is an indicator of harmful drinking.(32) While there is no consensus on what level of alcohol intake constitutes binge drinking, it is typically defined as a single drinking session leading to intoxication.(33) For this analysis, we examined ≥six drinks on one occasion as the threshold for binge drinking. For questions related to alcohol use, participants were asked to consider beer, marwa, waragi, tonto, wine or any beverage that contains alcohol; but to exclude communion wine or wine received at church.

HIV status was assessed by health workers using a finger stick capillary blood sample and for an HIV rapid test assay (Alere/Abbott Laboratories, Chiba, Japan). If non-reactive, an HIV-negative result was reported. If reactive, a second test, HIV ½ STAT-PAK (Chembio Diagnositc Systems, Medford, NY, USA) was performed. If the second test was reactive, the result was reported as HIV positive. If the STAT-PAK was non-reactive, then both tests were performed again. Any further discrepancies were assessed using Uni-Gold HIV (Trinity Biotech, Bray, Ireland) and participants with reactive tests were re-tested after 14 days. Among those identified as HIV positive, CD4 cell count and viral load were assessed via venous blood draws.

Socio-demographic information was collected, including gender, age, tribe, educational level, occupation, income, religion, marital/partnership status, and socioeconomic status (measured using a wealth index). Age was a continuous variable collapsed into three categories: 14-24, 25-34, and 35+ years. Marital status was assessed using the question "Are you currently married, separated, widowed, divorced, or have you never been married?" using the participant's own definition of marriage. We collapsed responses into never married, divorced, widowed, and currently married. Highest education level was based on responses to the question "What is the highest level of school you completed?" In the survey, religion was defined as "What is your religion?" with the following responses: Protestant (Anglican, Lutheran, Church of Uganda), Catholic, Muslim, Seventh Day Adventist, Saved/Pentecostal, None, and Other. We collapsed the categories into Protestant, Catholic, Muslim and Other. Participants were asked, "What is your occupation?" We included the most common categories, which were peasant famer, fisherman, casual worker, and not employed; and we combined salaried workers with businesspersons. We also included occupations previously identified as

increasing the risk for harmful alcohol use, such as restaurant and bar workers.(4, 34) Data from the remaining occupations were too sparse for analysis. The wealth index was created using factor analyses based on household characteristics, including whether the household had electricity, television, or a sofa set; and roof and floor materials.

Depression symptoms were assessed using a modified 20-item version of the Center for Epidemiological Studies Depression (CESD) scale,(35) which has been shown to be reliable in a rural Ugandan sample (α = 0.90).(36) We used a threshold of 14 to identify those at risk for depression.

Statistical analysis

First, we examined participant characteristics by gender. Next, we estimated the prevalence of any alcohol use (AUDIT-C score $\geq$1); harmful alcohol use (AUDIT-C score $\geq$3 for women; $\geq$4 for men); and binge drinking (Any response to "How often do you have $\geq$6 drinks on one occasion" other than 0/Never) stratified by HIV status, including new and known HIV positive, and gender. Exact binomial 95% confidence intervals were calculated for each prevalence estimate.

Finally, we assessed correlates of harmful alcohol using multivariable logistic regressions for the entire sample and stratified by gender. Covariates were included in the model based on a conceptual framework developed by Shuper et al.,(37) previous literature on the prevalence of alcohol use in other regions of Uganda,(4, 34) and the availability of data from the PATH/Ekkubo baseline questionnaire.

Ethics

The study received ethical approval by International Review Boards in the U.S. and Uganda and by the National Council for Science and Technology, and participants provided written informed consent for HIV testing and study participation. The University of California, San Diego, approved these secondary analyses using de-identified data.

Results

A total of 18,461 men and women were included in our analytical sample. Table 1 displays sociodemographic characteristics, CESD scores, and HIV status for the total population and stratified by gender. In our full sample, most participants were female (61%), married (63%), and had achieved primary or less education (67%). In terms of occupations, most were peasant farmers (41%), followed by salaried or business employees (16%), and casual workers (9%). The most common occupation reported in the "other" category was housewife/househusband (8%). Only 16 women reported being commercial sex workers. Most participants were in the lower levels of the wealth index, members of the Catholic religion, and part of the Muganda tribe. In terms of depression, 11% reported a CESD score of 14 or higher and the HIV prevalence was 5%. Women were more likely to be younger, married, have a CESD score of 14 or higher, and be living with HIV.

Alcohol use

Overall, 32.5% (95% CI: 31.8-33.2%) reported any alcohol use, 16.4% (95% CI: 15.9-17%) reported harmful alcohol use, and 15.0% (95% CI: 14.5-15.5%) reported binge drinking. Compared to women, men were more likely to report any (40% vs. 27%), harmful (22% vs. 13%), and binge (21% vs. 11%) alcohol use.

Figure 1 displays the prevalence of any, harmful, and binge alcohol use stratified by gender, HIV status, and new and known HIV positive diagnosis. For both men and women, people living with HIV were more likely to report any, harmful, and binge alcohol use compared to those who were HIV negative. Across all HIV stratifications, men were more likely to report higher levels of drinking; however, this difference was not statistically significant at the $p \leq 0.05$ level among those newly diagnosed. Differences in alcohol use between newly HIV diagnosed and those with a known HIV diagnosis were not found among men. However, among women, those who were newly diagnosed were more likely report harmful and binge alcohol use.

Correlates of harmful alcohol use

Table 2 provides the results of multivariable logistic regressions for correlates of harmful alcohol use for the entire sample and stratified by men and women. In the model with all participants, older age, marital status (being divorced, widowed, or married compared to never married), being a fisherman, restaurant/bar worker, market vender, or casual worker (compared to being a peasant farmer); having a CESD score of ≥ 14 ; and living

with HIV were associated with harmful alcohol use. Female sex decreased the odds of harmful alcohol use, compared to male; as did having a higher level of education, and being a member of the Muslim or other (Seventh Day Adventist, Saved/Pentecostal, None) religions (compared to being Protestant). In terms of wealth, there was no clear trend between an increased score on the wealth index and harmful alcohol use; however, compared to the lowest level, having a wealth index score of two, four, or five decreased the odds of harmful alcohol use.

Correlates of harmful alcohol use among women

Similar to the full model, older age, being divorced, widowed or married (compared to never married), being a salaried or business professional, working in a restaurant or bar, being a casual worker (compared to a peasant farmer); being at risk for depression, and living with HIV were all associated with increased odds for harmful alcohol use among women. Having a higher education, being a member of the Muslim or other religions (compared to Protestant), and having higher wealth were associated with decreased odds of harmful alcohol use. Being a fisherman was not associated with harmful alcohol use as few women were employed in this occupation.

Correlates of harmful alcohol use among men

Correlates of harmful alcohol use were similar to women; however, education, depression score, and HIV status were no longer associated with harmful alcohol use at a $p \leq 0.05$ level. In terms of occupation, being a fisherman increased the odds and being unemployed decreased the odds of harmful alcohol use, compared to being a peasant farmer.

Discussion

In a large sample of individuals living in rural, central Uganda, we found the prevalence of any and binge alcohol use was similar to the WHO 2018 Global Status report estimate for Uganda.(3) However, when stratified by gender, the percentages of any and binge alcohol use were lower among men and higher among women compared to the WHO estimates. People living with HIV were more likely to report any, harmful, and

binge alcohol use, compared to those who were HIV negative, among both men and women. Among women living with HIV, those who were newly diagnosed were more likely to report harmful alcohol use and binge drinking compared to those with a previous HIV diagnosis; however, this relationship was not statistically significant among men. Among those newly diagnosed with HIV, the differences in alcohol use between women and men were not statistically significant. In multivariable analysis, older age, being previously or currently married, being employed in certain occupations, being at risk for depression, and living with HIV were associated with harmful alcohol use; while female gender, higher education, increasing wealth, and certain religions were associated with decreased odds. Models stratified by gender showed that, among men, education was no longer protective and depression score and HIV status were no longer associated with harmful alcohol use.

The correlates of harmful alcohol use found in our study were similar to those found in previous research. The WHO Global Status Report on Alcohol and Health found that older age and male gender were associated with increased alcohol use globally.(3) Studies in Rakai also found that marital status, religion, and older age were associated with alcohol use.(4, 34) Additionally, working in the fishing industry increased the odds of alcohol use among men; and working in a bar or restaurant increased the odds of alcohol use among women. Services to address harmful alcohol use could be tailored to women working in restaurants and bars and men working in the fishing industry.

We found that people living with HIV had higher percentages who drank any and harmful levels of alcohol, compared to those who were HIV negative. This finding is in line with the broader literature that individuals who drink are more likely to engage in risky sex behaviors and be HIV-positive than those who abstain or drink at lower levels.(5, 38-40) A recent study in fishing villages in Central Uganda found that having problematic alcohol use increased the rate of unprotected sex acts with all partners.(41) Another study found that, among a sample of fisherman, fish sellers, alcohol sellers, and commercial sex workers in Central Uganda; harmful alcohol use was associated with both known and unknown HIV infection.(40) A study among fishing communities around Lake Victoria found that alcohol use was associated with incident HIV infections among both men and women,(42) and the population attributable fraction of incident HIV infections due to alcohol was

64.1% (95% CI: 23.5-83.1%).(42) Thus, our research provides more support for the growing calls to address harmful alcohol use in order to reduce HIV transmissions.(43)

We also found differences in the correlates of harmful alcohol use by gender. In the multivariable models, living with HIV and higher depression scores were associated with harmful alcohol use among women, but not among men. This difference has not been seen in the few studies that assessed the relationships between harmful alcohol use, HIV, and depression stratified by gender. Wagman et al. found that lower socioeconomic status was associated with reduced odds of alcohol use among women, but not men.(4) However, HIV status was not associated with alcohol use; perhaps because the alcohol use measure included those with low level alcohol consumption. Although Kiene et al. did not assess correlates of harmful alcohol use, the authors found that screening positive for depression increased the odds of testing positive for HIV or an STI among women, but not among men.(5) More research is needed to improve understanding of how the relationships harmful alcohol use and HIV differ by gender.

We also found that any, harmful, and binge alcohol use were higher in women who had a new HIV diagnosis compared to those who had been previously diagnosed. Similarly, a study among female sex workers in Malawi found that harmful drinking and alcohol use disorders were more prevalent among women who were unaware of their HIV-positive status compared to those who had been previously diagnosed.(42) Puryear et al. found that among participants in rural Uganda and Kenya, those living with HIV who were undiagnosed prior to enrollment were more likely to report drinking alcohol (32% compared to 47%).(44) A study among people living with HIV in three fishing communities in Uganda, found that those with co-occurring hazardous consumption and alcohol-related problems had greater odds of unknown HIV status (adjOR 3.35, 95% CI 1.52-7.42), compared to non-drinkers.(40) Further, this study found that alcohol use adversely impacted the cascade of care beyond testing as those who drank were less likely to be on antiretroviral treatment and less likely to be virally suppressed, compared to those who did not drink alcohol. While HIV testing is widely available in Uganda,(30) increased services may be needed to ensure individuals who consume harmful amounts of alcohol, particularly women, receive HIV testing and linkage to care.

Our study has several limitations. First, the alcohol use measure is based on self-report, which may have resulted in underreporting of true behaviors as a result of social desirability and recall biases.(46) Second, non-standard drink sizes and alcohol concentrations may cause misclassification of harmful alcohol use and binge drinking. However, the AUDIT-C metric is a common, validated measure(32) that has been widely used in Sub-Saharan Africa, which allows for comparison across multiple settings. Third, some previous studies have found that the social environment, such as the alcohol intake of family members, friends, and partners; is an important risk factor for harmful alcohol use;(45) however, these variables were not available for analysis and should be considered for future research. Finally, this analysis used cross-sectional data and we were unable to assess causation between harmful alcohol use and correlates.

This study estimated the prevalence and correlates of harmful alcohol use in rural, Central Uganda. Our prevalence estimates of any alcohol use and binge drinking were similar to national estimates determined by the WHO; however, men in our sample were less likely and women were more likely to consume alcohol and binge drink. People living with HIV were more likely to report any, harmful, and binge alcohol use, compared to those who were HIV negative. Among women living with HIV, those who were newly diagnosed were more likely to report harmful alcohol use and binge drinking compared to those with a previous HIV diagnosis. In multivariable analysis, older age, being previously or currently married, being employed in certain occupations, being at risk for depression, and living with HIV were associated with harmful alcohol use; while female gender, higher education, increasing wealth, and certain religions decreased the odds. Models stratified by gender showed that, among men, being at risk for depression and living with HIV were no longer associated with harmful alcohol use. In conclusion, more research is needed to improve understanding of how the relationships between harmful alcohol use and HIV differ by gender and to identify acceptable and feasible services to ensure individuals who consume harmful amounts of alcohol, particularly women, receive HIV testing and linkage to care. Our research provides support for the growing calls to address harmful alcohol use in order to reduce HIV transmissions and mortality.

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