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ORIGINAL PAPER

Alcohol Consumption in Ugandan HIV-Infected Household-Brewers Versus Non-Brewers

Kinna Thakarar[1] · Stephen B. Asiimwe[2,3] · Debbie M. Cheng[4,5] · Leah Forman[6] · Christine Ngabirano[7] · Winnie R. Muyindike[2,8] · Nneka I. Emenyonu[9] · Jeffrey H. Samet[4] · Judith A. Hahn[3,9]

Abstract The brewing of alcohol in Ugandan households is common, yet little is known about its relationship with alcohol consumption in HIV-infected individuals. We performed a cross-sectional analysis to assess the association between household brewing and unhealthy alcohol consumption among 387 HIV-infected adults in a prospective study examining the association between alcohol consumption and HIV-disease progression. Household brewing was defined as participants reporting that they or a household member home-brewed alcohol. Logistic regression was used to assess the association between household brewing and unhealthy alcohol consumption, defined as phosphatidylethanol (PEth) level ≥50 ng/ml or AUDIT-C (modified to measure the prior 3 months) positive. Sixty-six (17.0 %) participants reported household brewing. Household brewers had higher odds of unhealthy alcohol consumption (AOR 2.27, 95 % CI 1.26–4.12). Among HIV-infected individuals, household brewing was associated with unhealthy alcohol consumption. Interventions to reduce alcohol consumption in this population could target household brewers.

Keywords Household brewing · Alcohol · HIV · Africa · Unhealthy alcohol use

✉ Kinna Thakarar
kthakarar@mmc.org

[1] Center for Outcomes Research and Evaluation, Maine Medical Center, Portland, ME, USA

[2] Department of Medicine, Mbarara Regional Referral Hospital, Mbarara, Uganda

[3] Department of Epidemiology and Biostatistics, University of California San Francisco, San Francisco, CA, USA

[4] Clinical Addiction Research and Education (CARE) Unit, Section of General Internal Medicine, Department of Medicine, Boston Medical Center, Boston University School of Medicine, Boston, MA, USA

[5] Department of Biostatistics, Boston University School of Public Health, Boston, MA, USA

[6] Data Coordinating Center, Boston University School of Public Health, Boston, MA, USA

[7] Mbarara University of Science and Technology Grants Office, Mbarara, Uganda

[8] School of Medicine, Mbarara University of Science and Technology (MUST), Mbarara, Uganda

[9] Department of Medicine, University of California, San Francisco, USA

Introduction

Alcohol consumption in Uganda is among the highest in the world. In 2010, the World Health Organization (WHO) reported that the total alcohol per capita consumption (APC) among males and females in Uganda was 25.6 and 19.6 L of pure alcohol, respectively, among drinkers ages 15 years or older [1]. The combined total APC for both sexes among drinkers was 23.7 L, higher than the APC of 22.3 L among male and female drinkers the Russian Federation [1, 2]. The estimated age-standardized death rates for males and females due to liver cirrhosis in Uganda are also high at 67.8 per 100,000 and 50.1 per 100,000. Liver failure is a common cause of death particularly in HIV-infected individuals who drink alcohol, some of whom may be co-infected with hepatitis B which can accelerate liver disease progression [3, 4]. Examining the risks associated with alcohol consumption is therefore important in order to help reduce liver disease progression and mortality in the HIV-infected population. Moreover, alcohol consumption

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has been shown to be a predictor of high-risk sexual behavior [5–9]. In western Uganda, alcohol consumption in HIV- infected adults on antiretroviral therapy (ART) increases the risk of unprotected sex, which has implications for HIV transmission [5]. Alcohol consumption can also adversely affect adherence to and drug interactions with ART [10, 11].

Household brewed alcohol accounts for the highest proportion of alcohol use in many parts of Africa, largely because of its low cost compared to commercially-made alcoholic beverages [12–14]. In the WHO Africa region, 51.7 % of recorded alcohol per capita were "other" beverages, which encompasses household brews (in addition to fortified and rice wines) [1]. Reasons for household alcohol consumption can vary; in an ethnographic study of alcohol use in east Africa, some consumers of household brewed alcohol reported believing that it could prevent HIV transmission, treat typhoid, or that it was a requirement for proper breastfeeding [15]. In this and other investigations, women appear to play a large role in the production and sales of these household brews as a source of income [12, 16, 17].

Only a few studies in sub-Saharan Africa, and even fewer in Uganda, have described household brewing and examined the relationship between household brewing and alcohol consumption, particularly in HIV-infected individuals [18, 19]. Examining household brewing in a rural HIV-infected population could elucidate its association with alcohol consumption, potentially identifying areas for intervention.

In this study, our primary aim was to examine the relationship between household brewing and unhealthy alcohol consumption in an HIV-infected cohort of Ugandan patients who reported any use of alcohol in their lifetimes. We hypothesized that unhealthy alcohol consumption, measured by both self-report and by phosphatidylethanol (PEth, a sensitive and specific alcohol biomarker) blood concentrations [20, 21], would be higher in patients who reported that they or someone in their household brews alcohol, as compared to those who reported that no one in their house brews alcohol (referred to as non- brewers). In addition, we sought to describe the demographic characteristics, patterns of tobacco, alcohol and other drug use, and HIV-related health characteristics in HIV-infected Ugandan patients who reported household brewing of alcohol compared to those who did not. Lastly, we sought to examine whether gender was an effect modifier of the relationship between home brewing and unhealthy alcohol use. In Uganda, per capita alcohol consumption is higher in males compared to females [1]. Based on these data and reports of women home-brewing alcohol often for financial gain rather than consumption [12, 16, 17], we hypothesized that household brewing might have a greater effect on alcohol consumption in males compared to females.

Methods

Study design

We performed a cross-sectional analysis among adult HIV-infected individuals in rural Uganda. Participants were enrollees in the Uganda URBAN ARCH (Uganda Russia Boston Alcohol Network for Alcohol Research Collaboration on HIV/AIDS) study, a prospective study designed to examine the impact of heavy alcohol consumption on HIV disease progression in Mbarara, Uganda.

Inclusion criteria for Uganda ARCH are the following: treatment-naive to antiretroviral therapy (ART) (and not scheduled to start ART within 3 months of entering the study); diagnosis of World Health Organization Stage I or II (asymptomatic or mild disease); and CD4 count of >350 cells/mm^3 (later changed to 500 cells/mm^3 in accordance with national ART guideline changes) [22]; fluency in Runyakole (local language) or English; residence within sixty kilometers or 2 hours of the Immune Suppression Syndrome (ISS) clinic; age 18 or older; and ability to give informed consent. Uganda ARCH study participants are recruited from the ISS clinic in southwestern Uganda, which is the primary municipal clinic for HIV-infected individuals in this area. For this analysis, we used baseline survey and laboratory data from 387 of the 459 Uganda ARCH participants enrolled in the study from May 2012 through March 2015. We excluded lifetime alcohol abstainers (n = 69) and participants who declined to answer questions about lifetime alcohol consumption (n = 3).

Ethical Review

The Institutional Review Boards of the Mbarara University of Science and Technology (MUST), University of California, San Francisco, Boston University, and the Uganda National Council for Science and Technology approved the protocol of this study.

Measurements

Main Independent Variable

The main independent variable was household brewing. During the baseline study survey, participants were asked the following: "do you or any members of your household brew alcohol at home?" Answers were categorized as

"yes" or "no" and could refer to any type of alcohol brewed in the household.

Outcomes

The primary outcome was unhealthy alcohol consumption, defined as phosphatidylethanol (PEth) level ≥50 ng/ml or positive score on the Alcohol Use Disorders Identification Test-consumption (AUDIT-C), which reflects hazardous drinking over the past 1 year [23]. A score on the AUDIT-C of 3 or greater is considered positive in women, 4 or greater for men.

PEth testing was performed using liquid chromatography-tandem mass spectrometry (LC- MS/MS) following extraction into methanol on dried blood spots (DBS) as previously described [24]. The most common PEth homologue (16:0/18:1) was utilized [20]; its lower limit of quantification (LLQ) is 8 ng/mL. In a PEth characterization study in 77 individuals with HIV in Uganda, the LLQ was 88 % sensitive and 89 % specific for detecting any prior 21-day alcohol use [21]. We used a higher cutoff for unhealthy alcohol use; a cutoff of 50 ng/ml was highly sensitive (93 %) and reasonably specific (83 %) for detecting average daily drinking of at least 2 drinks per day in a study of 222 patients with liver disease (S. Stewart, personal communication). This combined measure allowed us to increase the sensitivity (as compared to using one measure alone) of two specific measures.

Other Subject Characteristics

Demographics Variables included the participant's age, sex, education level (primary school versus no primary school), religion, marital status, and number of children. Socioeconomic status was measured using an asset index, categorized as high asset index (reference group) versus low and middle asset index. The asset index variable incorporates multiple items representing household well-being (quality of housing, ownership of durable goods/items, source of energy, ownership of transportation goods such as motorcycles and cars) using principal components analysis [25, 26]. Other variables measured were: food security (secure versus not secure using the Household Food Insecurity Access Scale) [27] and low social support (categorized as "yes" or "no" using a social support scale) [28, 29].

Substance Use Variables related to alcohol consumption included any use of alcohol in the past 3 months and age of first alcoholic drink. We asked frequency of alcohol consumption over the past 90 days. We obtained quantity estimates for a typical drinking day in the past 90 days by asking about beverage specific volumes, as described previously [30]. The number of drinking days in the past 90 days was calculated using midpoint ranges from the AUDIT-C questionnaire (for example, alcohol consumed 2–3 times in the past month was defined as 7.5 drinking days over the past 90 days). For each subject, we calculated the volume of alcohol consumed over the past 90 days by multiplying the total quantity consumed on a typical drinking day by the number of days spent drinking. We did this for all beverages, and separately for commercial alcohol and for locally brewed/distilled alcohol. Commercial alcohol included glasses of wine, canned or bottled beer, glasses of beer, spirit canisters, plastic packs, and quarter bottles. Locally- brewed/distilled alcohol was defined as locally made beer/brews and/or spirits, including any household brews generally made from a wide range of raw materials including vegetables, fruits, seeds, grain, or palm sap [12, 16, 17].

We also asked about money spent on drinking on a typical drinking day in the prior 90 days. We calculated alcohol expenditures by multiplying the money spent on alcohol on a typical day by the number of drinking days in the past 90 days.

Cigarette use and chewing tobacco use were defined as the use of the substances within the past 90 days. We also created an additional variable called "any drug use" to include use of any marijuana, khat, or cocaine within the past 90 days.

HIV-Disease In order to gain a better understanding of the association between household brewing and HIV-disease, we examined a number of variables. Health service utilization was measured using number of times that the patient visited the HIV clinic within the past 90 days. We collected self-reported health status ("excellent/very good/good" versus "fair/poor"), HIV symptoms (a 9-item questionnaire which includes symptoms such as elevated body temperature, sweats, nausea, vomiting, diarrhea, cough, headache, rash, and enlarged nodes) [31], and the MOS-HIV physical functioning score (a validated scale) [32]. Lab measurements included CD4+ T cell count, analyzed as a continuous variable, and the plasma HIV RNA level (log transformed to gain normality).

Statistical Analysis

Both descriptive and multivariable analyses were performed. In the descriptive analyses, Chi- square and Fisher's exact test statistics were used, as appropriate, to examine differences in proportions when analyzing categorical variables. Two-sample *t* tests or Wilcoxon Rank Sum tests were used, as appropriate, when analyzing continuous variables. Multivariable analyses assessed associations between household brewing and the outcome

(PEth $\geq$ 50 ng/ml or AUDIT-C positive for unhealthy drinking). Based on knowledge from prior literature, potentially confounding variables were included in the model. These included, sex, food security, asset index, self-reported health status, cigarette use, age, age of first alcoholic drink, physical functioning score, and number of HIV symptoms. In order to assess for gender effect modification, additional multivariable analyses (using the same covariates as the primary analyses, with the exception of gender) were performed to examine the interaction between gender and household brewing. We also conducted the primary analyses stratified by gender (male or female), regardless of interaction p value, for descriptive purposes. We corrected for multiple comparisons within sets of analyses (presented separately in each table; for example, demographics by household brewing status, HIV-related characteristics by household brewing status) using the false discovery rate (FDR) [33]. The FDR value was set at the level 0.05 within each table. All analyses were performed in SAS 9.3 (Cary, North Carolina, USA).

Results

Descriptive Results

Sixty-six (17.0 %) of the 387 participants reported household brewing, whereas 321 participants were non-brewers. We did not identify important clinical differences in demographics between household-brewers and non-brewers (Table 1). However, several apparent differences in alcohol consumption and cigarette smoking between the two groups emerged. Household brewers appeared more likely to have their first alcoholic drink at a younger age compared to non-brewers (median ages 16.5 vs. 18.0, FDR-corrected p value = 0.03). Over past 90 days, median alcohol consumption volume estimates among household brewers was 3750 mL versus 750 mL in non-brewers (FDR-corrected p value = 0.06), and median commercial alcohol volume estimates among household brewers was 3000 versus 0 mL compared to non-brewers (FDR-corrected p value = 0.08). Unhealthy alcohol consumption was higher in household brewers compared to non-brewers (66.7 vs. 47.4 %, FDR-corrected p value = 0.02). Mean alcohol consumption on a typical day appeared also higher in household brewers versus non-brewers (mean typical daily consumption 71.1 vs. 36.5 mL, data not shown). There did not appear to be a difference in median local alcohol consumption between the two groups (Table 2). HIV-related characteristics did not appear to be different in household brewers compared to non-brewers for the physical functioning scale (median 17.0, vs. 18.0, FDR-corrected p value = 0.15) (Table 3).

Unhealthy Alcohol Consumption

In this study cohort of ever-drinkers, household brewers were more likely to have unhealthy alcohol consumption (66.7 vs. 47.4 %, FDR-corrected p value = 0.02). Household brewers had higher odds of unhealthy alcohol consumption (AOR 2.27, 95 % CI 1.26–4.12) compared to non-brewers. Cigarette use (AOR 5.78, 95 % CI 2.39–13.96) was also significantly associated with unhealthy alcohol consumption (Table 4). We also examined the association between household brewing and *any* alcohol consumption (defined as PEth $>$ 8 ng/ml or AUDIT-C positive score); household brewing was associated with any alcohol consumption (AOR 2.25, 95 % CI 1.08–4.71). In post hoc analyses, we also examined unhealthy alcohol consumption defined by 1) positive AUDIT-C alone and 2) PEth $\geq$ 50 ng/mL alone. In this study, there were 41 participants classified as unhealthy alcohol consumers based on AUDIT-C scores alone. There were 57 participants classified as unhealthy alcohol consumers based on PEth level $\geq$ 50 ng/mL alone. In addition, although we excluded lifetime non-drinkers in the original analysis, we performed a secondary, confirmatory analysis excluding non-current drinkers. There were 108 non-current drinkers [defined as participants who drank (1) more than 5 years ago (2) 1–3 years ago or (3) 3 months–1 year ago]. In the bivariate analysis, the AOR for unhealthy alcohol use was 2.00 (95 % CI 0.92–4.36, p = 0.08). In the multivariable analysis, household brewing was not significantly associated with unhealthy alcohol use (AOR 1.69, 95 % CI 0.73–3.93, p = 0.22; data not shown).

Gender was not an effect modifier in separate multivariable analyses (p value for interaction = 0.59). When the multivariable analyses were stratified by gender, the adjusted odds that male household brewers (compared to male non-brewers) had unhealthy alcohol consumption was 2.69 (95 % CI 0.93–7.76). In females, the adjusted odds that household brewers had unhealthy alcohol consumption was 2.15 (95 % CI 1.00–4.64).

Discussion

Among adult HIV-infected individuals in Uganda, who were from predominantly rural settings, we assessed the association between household alcohol brewing and alcohol consumption among patients who reported ever having drank alcohol. Household brewing was fairly common and was significantly associated with unhealthy alcohol

Table 1 Demographics of household brewers versus non- brewers among ever-drinkers

Variable	Total study population n = 387 n (%)	Household brewers n = 66 n (%)	Non-brewers n = 321 n (%)	Uncorrected *p* value	FDR-corrected *p* value
Age					
Median (25th, 75th)	32.0 (27, 40)	32.5 (28, 41)	32.0 (27, 40)	0.98	0.98
Gender					
Male	136 (35.1)	27 (40.9)	109 (34.0)		
Female	251 (64.9)	39 (59.1)	212 (66.0)	0.28	0.73
Education					
Primary or less	266 (68.7)	40 (60.6)	226 (70.4)		
Above primary	121 (31.3)	26 (39.4)	95 (29.6)	0.12	0.73
Religion					
Other	19 (4.9)	3 (4.5)	16 (5.0)		
Moslem	21 (5.4)	2 (3.0)	19 (5.9)		
Catholic	152 (39.3)	26 (39.4)	126 (39.3)		
Protestant/Anglican	195 (50.4)	35 (53.0)	160 (49.8)	0.81	0.91
Marital status					
Married	192 (49.6)	31 (47.0)	161 (50.2)		
Unmarried	195 (50.4)	35 (53.0)	160 (49.8)	0.64	0.82
Number of children					
Median (25th, 75th)	2.0 (1, 3)	2.0 (0, 4)	2.0 (1, 3)	0.46	0.73
Asset index					
Highest asset index category	77 (19.9)	10 (15.2)	67 (20.9)		
Middle asset index category	161 (41.6)	31 (47.0)	130 (40.5)		
Lowest asset index category	149 (38.5)	25 (37.9)	124 (38.6)	0.48	0.73
Food security					
Not secure	323 (83.5)	57 (86.4)	266 (82.9)		
Secure	64 (16.5)	9 (13.6)	55 (17.1)	0.49	0.73
Social support					
Low social support	113 (29.4)	19 (25.7)	96 (30.1)		
Normal/high social support	272 (70.6)	49 (74.2)	223 (69.9)	0.48	0.73

consumption. Previous research on household brewing in Africa has largely focused on non-HIV infected individuals, particularly adolescents. In adolescents, easy access to household brewed alcohol as well as home environments that experienced violence or crime has been associated with any alcohol consumption [19, 34].

In this study, household brewers consumed more alcohol compared to non-brewers among ever-drinkers. One explanation for increased unhealthy alcohol consumption among household brewers is easy access; that is, individuals who report household brewing—even if they do not brew the alcohol themselves—have easier access to alcohol given its location within the household, facilitating the consumption of alcohol. While licensing boards exist, regulation of household brews has been challenging, enabling access to unlicensed sales of household brews in local communities [12]. Providing other avenues for financial stability, for example through microfinancing projects for household brewers, could provide people with alternative sources of income, thereby reducing the need for household brewing and reduce alcohol consumption in this population [35]. Enforcing regulation and sales of household brewing, in addition to interventions using strategies to reduce alcohol consumption among individuals with easy access to alcohol in the household, could be useful. Interestingly, in the post hoc analysis limited to current drinkers, the relationship between household brewing and unhealthy alcohol consumption was attenuated, possibly due to recall bias and/or smaller sample size.

In this study, household brewing did not have a greater effect on alcohol consumption in males compared to females, that is, gender was not an effect modifier.

Table 2 Alcohol, tobacco, and drug use in household brewers versus non- brewers among ever-drinkers

Variable	Total study population n = 387	Household brewers n = 66 n(%)	Non-brewers n = 321 n(%)	Uncorrected *p* value	FDR-corrected *p* value
Median age in years first drink (25th, 75th)	18.0 (15, 23)	16.5 (11, 20)	18.0 (15, 23)	0.009	0.03
Last alcoholic drink[a]					
More than 3 months ago	135 (34.9)	14 (21.2)	121 (37.7)		
Within the last 3 months	252 (65.1)	52 (78.8)	200 (62.3)	0.01	0.03
Alcohol expenditures (in Ugandan shillings), past 90 days					
Median (25th, 75th)	0.0 (0, 7000)	2000 (0, 20,000)	0.0 (0, 4000)	0.18	0.23
Total alcohol volume (ml) consumed, past 90 days					
Median (25th, 75th)	1500 (0, 7500)	3750.0 (563, 19,000)	750.0 (0, 7500)	0.03	0.06
Total commercial alcohol volume (mL) consumed, past 90 days[a]					
Median (25th, 75th)	0.0 (0, 4500)	3000.0 (0, 7500)	0.0 (0, 3750)	0.04	0.08
Total locally brewed/distilled alcohol volume (mL) consumed, past 90 days					
Median (25th, 75th)	0.0 (0, 0)	0.0 (0, 0)	0.0 (0, 0)	0.19	0.23
PEth $\geq$ 50 ng/mL[a]					
Yes	155 (40.3)	33 (50.0)	122 (38.2)		
No	230 (59.7)	33 (50.0)	197 (61.8)	0.08	0.12
AUDIT-C positive[b]					
Yes	138 (35.9)	34 (52.3)	104 (32.6)		
No	246 (64.1)	31 (47.7)	215 (67.4)1	0.003	0.02
Recent unhealthy alcohol use (PEth $\geq$ 50 ng/ml or AUDIT-C positive)					
Yes	196 (50.6)	44 (66.7)	152 (47.4)		
No	191 (49.4)	22 (33.3)	169 (52.6)	0.004	0.02
Any cigarette past 90 days					
Yes	47 (12.1)	6 (9.1)	41 (12.8)		
No	340 (87.9)	60 (90.9)	280 (87.2)	0.40	0.40
Any drug use past 90 days[c]					
Yes	6 (1.6)	2 (3.0)	4 (1.3)		
No	380 (98.4)	64 (97.0)	316 (98.8)	0.29	0.32

[a] PEth data available for 385 of the 387 study participants

[b] Audit C data available for 384 of the 387 study participants

[c] Any drug use defined as any marijuana, cocaine, or khat use within the past 90 days

However, we confirmed prior findings that males in this study population were more likely to consume unhealthy amounts of alcohol compared to females [1, 36, 37].

Our results also have important implications with regards to HIV transmission, treatment and disease progression. The link between alcohol consumption and risky sexual behaviors, specifically HIV transmission, has been well established [5, 6]. A recent study in Uganda showed that alcohol use among HIV-infected participants was associated with non-disclosure of HIV seropositive status to sexual contacts [38]. Moreover, alcohol consumption can adversely affect adherence to and drug interactions with antiretrovirals [10, 39]. As participants in this study were treatment naïve upon enrollment, we did not assess adherence to ART. However, patients in Uganda are now starting ART earlier in their disease course, therefore of the association of household brewing with ART adherence could be a potential area for additional research. Our findings suggest that HIV-infected household brewers and/or their household members who brew alcohol at home might benefit from a targeted intervention to reduce alcohol consumption. There are limited data regarding brief alcohol interventions in resource-limited settings, but some studies have shown that risk-reduction counseling is useful [40]. Interventions to address harmful alcohol consumption have been found to be cost-effective, however uptake of such interventions has been slow particularly in resource-limited settings [41]. In addition to addressing unhealthy

Table 3 HIV-related characteristics in household brewers versus non- brewers among ever-drinkers

Variable	Total study population n = 387	Household brewers n = 66 n (%)	Non-brewers n = 321 n (%)	Uncorrected *p* value	FDR-corrected *p* value
Median number of times visited HIV clinic in past 90 days (25th, 75th)	2.0 (1, 2)	2.0 (1, 2)	2.0 (1, 2)	0.18	0.22
Self-reported health status					
Good/very good/excellent	289 (74.7)	51 (77.3)	238 (74.1)		
Fair/poor	98 (25.3)	15 (22.7)	83 (25.9)	0.59	0.59
Number of HIV symptoms (SD)					
Median (25th, 75th)	1.0 (0,2)	1.0 (0, 2)	1.0 (0, 2)	0.06	0.15
Mean physical functioning scale (SD)[a]					
Median (25th, 75th)	18.0 (16, 18)	17.0 (16, 18)	18.0 (17, 18)	0.06	0.15
Greater than or equal to median	218 (56.3)	29 (43.9)	189 (58.9)		
PFS					
Less than median PFS	143 (37.0)	35 (53.0)	108 (33.6)	0.01	0.07
Missing PFS	26 (6.7)	2 (3.0)	24 (7.5)		
Median CD4 count in cells/mm^3 (25th, 75th)	546 (418, 673)	521.5 (391, 618)	552.0 (426, 685)	0.19	0.22
Median HIV viral load (log 10)[b] (25th, 75th)	3.9 (3, 4)	3.8 (3, 5)	3.9 (3, 4)	0.16	0.22

PFS Physical functioning scale

[a] Physical Functioning Scale available for only n = 361 patients (n = 64 household brewers, n = 297 non-brewers)

[b] HIV viral load data available for only n = 241 patients (n = 32 household brewers, n = 209 non-brewers)

alcohol consumption, interventions around developing alternative means for economic growth should be explored for household brewers.

There are some limitations to our study. We asked about household home brewing in order to avoid social desirability bias, however by doing so we were unable to determine whether or not the study participant was the household brewer. Asking individuals specifically about their household brewing habits may be helpful moving forward in order to better determine the appropriate target population for alcohol screening and harm reduction interventions for HIV-infected individuals. Inquiring about motivation for household brewing, specifically if it is done primarily for financial gain, would be helpful for future studies. Also, some variables, specifically the locally brewed/distilled alcohol volume, may underestimate the actual amount of alcohol consumed. Because household brews are often consumed in various container sizes, quantifying the amount of locally brewed/distilled alcohol consumed is particularly challenging [21]. Finally, due to the cross-sectional design of this study, we cannot establish causality between household brewing and unhealthy alcohol consumption. Furthermore, alcohol consumption is often under-reported when using self-report measures; the reasons for such underreporting may include recall bias and social desirability [33, 42]. While the use of PEth as a biomarker mitigates the concerns just noted, it has its own limitations. PEth has been shown to be a useful measure of alcohol consumption in situations when self-report data are unreliable, however PEth is not completely sensitive and specific [21]. However, the use of PEth in combination with self-report data has been shown to increase the detection of alcohol consumption, which is why the combination of PEth and self-report data were used in this study [43, 44].

Conclusions

We conclude that in this cohort of HIV-infected individuals in rural Uganda, household brewing of alcohol is common and is associated with unhealthy alcohol consumption. Future work on harm reduction strategies to reduce

Table 4 Bivariate and multivariable regression model of unhealthy alcohol consumption (PEth ≥ 50 ng/ml or AUDIT-C positive) among ever-drinkers

Independent variable	Bivariate models			Multi-variable model[a]		
	OR (95 % CI)	Uncorrected *p* value	FDR-corrected *p* value	AOR (95 % CI)	Uncorrected *p* value	FDR-corrected *p* value
Household brewing[b]						
Household brewers	2.22 (1.27–3.88)	0.005	0.02	2.27 (1.26–4.12)	<0.01	0.03
Non-brewers	Ref			Ref		
Sex						
Male	2.31 (1.51–3.56)	0.001	0.006	1.74 (1.07–2.82)	0.02	0.07
Female	Ref			Ref		
Food security						
Not food secure	0.96 (0.56–1.64)	0.87	0.87	1.05 (0.58–1.90)	0.88	0.95
Food secure	Ref			Ref		
Asset index						
Lowest asset index	1.26 (0.72–2.18)	0.42	0.66	0.94 (0.51–1.74)	0.85	0.95
Middle asset index	0.92 (0.53–1.58)	0.76	0.86	0.85 (0.47–1.54)	0.60	0.95
Highest asset index	Ref					
Self-reported health status						
Fair/poor	1.08 (0.68–1.70)	0.75	0.86	1.04 (0.60–1.81)	0.88	0.95
Good/very good/excellent	Ref			Ref		
Cigarette use past 90 days						
Yes	6.74 (2.94–15.47)	<0.01	<0.01	5.78 (2.39–13.96)	<0.01	<0.01
No	Ref					
Age (10 year increase)	1.13 (0.93–1.38)	0.22	0.48	1.01 (0.81–1.30)	0.95	0.95
Age of first alcoholic drink						
Less than median age	1.24 (0.82–1.85)	0.31	0.57	0.96 (0.62–1.51)	0.87	0.95
Greater than or equal to median age	Ref			Ref		
Physical functioning score (PFS)[b]						
Greater than or equal to median PFS	0.94 (0.62–1.43)	0.78	0.86	0.89 (0.55–1.44)	0.63	0.95
Less than median PFS	Ref			Ref		
Number of HIV symptoms	1.10 (0.96–1.27)	0.17	0.47	1.04 (0.87–1.23)	0.68	0.95

Ref referant group

[a] Multivariable model was adjusted for all variables listed

[b] Physical Functioning Scale missing for 26 patients (n = 2 household brewers, n = 24 non-brewers)

unhealthy alcohol consumption and its associated risks in the household brewing population should be considered.

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Compliance with Ethical Standards

Conflict of interest All authors state that they have no conflict of interest to declare.

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