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Alcohol Consumption as a Barrier to Prior HIV Testing in a Population-Based Study in Rural Uganda

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Abstract Early receipt of HIV care and ART is essential for improving treatment outcomes, but is dependent first upon HIV testing. Heavy alcohol consumption is common in sub-Saharan Africa, a barrier to ART adherence, and a potential barrier to HIV care. We conducted a population-based study of 2,516 adults in southwestern Uganda from November–December 2007, and estimated the relative risk of having never been tested for HIV using sex-stratified Poisson models. More men (63.9 %) than women (56.9 %) had never been tested. In multivariable analysis, compared to women who had not consumed alcohol for at least 5 years, women who were current heavy drinkers and women who last drank alcohol 1–5 years prior, were more likely to have never been tested. Alcohol use was not associated with prior HIV testing among men. HIV testing strategies may thus need to specifically target women who drink alcohol.

Resumen La atención temprana para el VIH y el TARV es esencial para mejorar los resultados de tratamientos, pero esto primero depende de las pruebas del VIH. El consumo pesado de alcohol es común en África subsahariana, lo cual es una barrera para la adhesión al TARV y una barrera potencial para el cuidado del VIH. Conducimos un estudio poblacional de 2,516 adultos en el sudoeste de Uganda de noviembre-diciembre del 2007, y estimamos el riesgo relativo de nunca haberse hecho la prueba del VIH, usando modelos Poisson clasificados por género. Más hombres (63.9 %) que mujeres (56.9 %) nunca se habían hecho la prueba. En un análisis multivariable, a comparación con mujeres que no habían consumido el alcohol durante al menos 5 años, mujeres que eran bebedoras empedernidas actuales y mujeres que habían tomado el alcohol por última vez hace 1-5 años fueron más probables a nunca haberse hecho la prueba. El uso del alcohol no se relacionó con pruebas anteriores del VIH entre los hombres. Puede entonces que las estrategias de pruebas del VIH tengan que concentrarse específicamente hacia mujeres que toman el alcohol.

Keywords Alcohol · HIV testing · Uganda · Barriers · Sub-Saharan Africa

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Introduction

Sub-Saharan Africa accounts for nearly 70 % of the global HIV burden, with an estimated 22.5 million people living with HIV/AIDS in 2009 [1]. In Uganda, the prevalence of HIV has stabilized between 6.5 and 7 % since 2001, with 1.2 million people living with HIV/AIDS in 2009 [1]. Increased access to HIV treatment has led to a decline of AIDS-related deaths in sub-Saharan Africa by 20 % from 2004 to 2009 [2]. Early HIV treatment has been associated with better response to treatment, including decreased progression to AIDS and death [3–7]. Early presentation for HIV care and treatment has also been shown to have additional benefits, including decreased health care costs [8], as well as potentially decreasing the risk of transmission to others [9, 10].

Timely receipt of follow-up HIV care and antiretroviral therapy (ART), however, is dependent upon knowledge of HIV status via testing [11]. In Uganda, HIV counseling and testing (HCT) services have been expanded to include voluntary counseling and testing (VCT), home-based counseling and testing services, as well as opt-out routine testing and counseling, with the goal of universal access [12]. However, while the percentage of Ugandans who have previously tested for HIV has increased over time, it remains low. According to the 2009 World Health Organization (WHO) Progress Report, only 24 % of Ugandans know their HIV status [13]. As "seek, test, and treat" garners more attention as a potential strategy for preventing HIV at both the individual and community level [14, 15], identification and reduction of barriers to HIV testing remains a critical step in improving HIV care and prevention in sub-Saharan Africa.

Alcohol is currently the most widely distributed and commonly used recreational drug in Africa; even the most rural areas have reliable production and distribution systems [16–22]. The total per capita adult (age 15 and over) consumption of pure alcohol is 11.9 l per year in Uganda [23]. In Uganda, 48.6 % of the men and 39.0 % of the women drank in the past year; 33.7 % of these men and 11.2 % of these women drank heavily (60 g or more of pure alcohol on at least one occasion, weekly) [23].

In Africa, older age, less education and household wealth, being single, and no history of pregnancy have often been found to be barriers to HIV testing [24–28]. Additional barriers to testing have also included possessing less knowledge about HIV/AIDS and testing site locations, having less access to media, holding stigmatizing beliefs, fears, or negative attitudes, lacking willingness to discuss HIV/AIDS with others, and lacking willingness to disclose one's own HIV status [26, 28–33]. On the other hand, having poor health has been associated with readiness for VCT among older age groups (25–49 years old, versus 15–24 years) [34]. Sexual behaviors such as never using a condom and having a high-risk sex partner have also been associated with participation in VCT [35, 36]; however, self-perceived risk for HIV infection has been associated with VCT acceptance in some but not all of the studies that examined this issue [34–36].

Substance abuse has been found to be a barrier to utilization of general health care services [37], while alcohol consumption and drinking venue attendance have been associated with increased HIV infection and risk behaviors, such as number of sexual partners, unprotected sex, and commercial sex in sub-Saharan Africa [38–42]. However, despite consistent associations of alcohol consumption with HIV infection in sub-Saharan Africa [43], few studies have examined the association between alcohol use and utilization of HIV testing. The small number of studies that have examined the relationship between alcohol consumption and HIV testing in sub-Saharan Africa have had mixed findings. Among pregnant women in South Africa, alcohol use was associated with a decreased odds of participation in post-test counseling and receipt of testing results [44]. Alternatively, women reporting alcohol abuse within the past year were more likely to accept HIV testing offered in a study of high risk South African women, as compared to those without alcohol abuse [45]. In a cross-sectional survey of households in South Africa assessing factors associated with HIV testing, having ever taken alcohol was not significantly associated with testing, among either men or women [28]. Alcohol consumption by sexual partners may also be associated with decreased receipt of HIV test results. Among pregnant women in Tanzania, those who consumed alcohol or who had a partner who consumed alcohol, were less likely to return to receive HIV results within 1 week of testing [46]. The conflicting results from these few studies indicate the need for further research to assess the relationship between alcohol use and HIV testing. Therefore, our main goal was to examine whether alcohol use was associated with decreased HIV testing in a large population-based cross-sectional study conducted in southwestern Uganda.

Methods

Study Population

This study is an analysis of data collected in a cross-sectional population-based survey that was conducted in November and December 2007 as part of a study examining the effect of a voucher program on sexually transmitted infection (STI) treatment [47]. The STI voucher program subsidized non-HIV STI treatment, with the intent of improving the uptake of STI treatment. Survey data were collected from four districts (Mbarara, Ibanda, Isingiro and Kiruhura) where the STI voucher pilot program was active, and a fifth control district (Bushenyi) with no voucher program. The survey had a four-stage design using the 2002 Uganda census. In the first stage, 41 parishes (administrative units of sub-counties within the districts) were sampled with probability proportional to population size from the five districts. In the next stage, a total of 82 villages were selected from the 41 parishes with probability proportional to population size. The third stage consisted of a random sample of 2,952 enumerated households in the selected villages. In the fourth stage, one resident aged 15–49 years was randomly selected from each household for interview. Information on the number of individuals who were not at home and thus not interviewed, and those refusing participation, was not collected. There were 2,516 respondents in 2007 with sufficient data to include in the analysis.

Dependent Variable

The dependent variable was never having been tested for HIV, as reported by the participant.

Independent Variables

The primary predictor variable was alcohol use. Participants were asked when they last took alcohol (if ever). Past drinkers were split into two groups to differentiate those who may have quit drinking recently due to poor health: distant past drinkers were those who had consumed alcohol more than 5 years ago, and recent past drinkers were those who had consumed alcohol 1–5 years ago. "Current drinkers" were defined as participants who had taken any alcohol within the past year. We split current drinkers into heavy and not heavy drinkers to examine whether the level of drinking was associated with having never been tested for HIV. Current drinkers were classified as current heavy drinkers if they reported any of the following (based on the 75th percentile for these questions): ever taking six or more drinks on one occasion in the past year; spending a total of at least 15,000 Ugandan shillings (approximately $10 at the time of the survey) on alcohol taken in the past 30 days; being intoxicated on three or more of the past 30 days. We used these measures rather than the AUDIT-C, a standard measure of self-reported hazardous alcohol consumption [48], because the AUDIT-C presented difficulties in quantifying the number of drinks consumed in an area where non-standard drink sizes and variable alcohol concentration are common [49].

We also examined alcohol consumption by sexual partners within the past year as a potential barrier to HIV testing, categorized as follows: no sex partners took alcohol in the past year; sex partner(s) took alcohol but didn't become intoxicated at least monthly; sex partner(s) took alcohol and became intoxicated at least monthly.

Covariates

Covariates thought to be potential barriers to health care and HIV testing were also examined, including participant sex, age, marital status, religion, education, self-reported health status, and utilization of general health care services. We created a household wealth index using principal components analysis [50] to group households based on ownership of durable goods, housing quality, and available energy sources. This index score was split into three categories: the bottom 40 % was classified as "poor", the middle 40 % as "middle", and the top 20 % as "rich" [51]. The Household Food Insecurity Access Scale (HFIAS) was used to classify household food insecurity as follows: "food secure", "mildly food insecure access", "moderately food insecure access", and "severely food insecure access" [52]. We also examined two risky sexual behaviors as potential confounders of an association between alcohol consumption and prior HIV testing. These variables were the number of sexual partners in the prior 6 months (0 or 1 partners versus more than 1 partner), and whether or not the participant reported receiving money, goods or favors in the prior 6 months in exchange for sex.

Statistical Analysis

We calculated frequency distributions for categorical variables and medians and inter-quartile ranges for continuous variables. As the overall proportion of participants who had never been tested for HIV was quite high (60.5 %), we estimated the relative risk (RR) of having never tested for HIV (rather than the odds ratio) [53]. Healthcare utilization and HIV testing are consistently found to be higher among women compared to men [24, 28, 32, 54, 55], thus we stratified the analyses by gender in order to allow the correlates of HIV testing to vary by sex. We conducted stratified bivariate and multivariable analyses to estimate the RR and adjusted risk ratio (ARR) for never being tested for HIV. We used Poisson regression models to estimate the RRs, a roughly equivalent approach [56] to using log-binomial models that sometimes failed to converge. Multivariable analysis included all covariates of interest.

Most variables were missing some data points; the range of missingness for each variable was 0–12 %. However, in multivariable models using listwise deletion, 30 % of all observations were missing. We examined the relationships between missing covariates and HIV testing history as well as alcohol use; there were no clear patterns of missingness. The only associations we found were that missing religion was associated with having never been tested for HIV, and that missing marital status was associated with decreased alcohol use. As a certain number of statistically significant associations could be expected due to the multiple testing nature of this exploration, and we did not expect that the observed associations would bias our overall results, we proceeded with multiple imputation, which assumes that the data are missing at random. Multiple imputation allowed us to retain observations with missing values and thereby minimize the loss of power that we would have otherwise encountered had we used listwise deletion [57]. We imputed the missing values using multiple (five) imputations by chained equations in Stata and conducted multivariable analysis of the imputed dataset, using sex-stratified Poisson models to estimate the ARR for never having been tested for HIV as described above. The multivariable results using the imputed dataset did not substantially differ from the results obtained using listwise deletion. Thus, the multivariable results presented below are those from the imputed data.

Table 1 Demographic and behavioral characteristics of participants of the STI Prevalence and Treatment Seeking Behavior in Mbarara Study, November–December 2007

	Total *n* (%)	Female *n* (%)	Male *n* (%)	χ^2 (*p* value)
All	2,516 (100.0)	1,242 (100.0)	1,274 (100.0)	
Demographics				
Age				8.65 (0.01)
15–24 years old	781 (31.1)	416 (33.6)	365 (28.7)	
25–34 years old	993 (39.5)	484 (39.1)	509 (40.0)	
35–49 years old	738 (29.4)	338 (27.3)	400 (31.4)	
Marital status				126.91 (<0.01)
Married/cohabitating	1,636 (66.8)	829 (69.0)	807 (64.6)	
Previously married/separated	256 (10.5)	190 (15.8)	66 (5.3)	
Never married	558 (22.8)	182 (15.2)	376 (30.1)	
Religion				2.00 (0.57)
Protestant	1,379 (55.4)	672 (55.1)	707 (55.7)	
Catholic	828 (33.3)	411 (33.7)	417 (32.9)	
Muslim	230 (9.2)	107 (8.8)	123 (9.7)	
Other	51 (2.1)	29 (2.4)	22 (1.7)	
Highest level of education				14.31 (<0.01)
Secondary school or more	858 (34.4)	387 (31.6)	471 (37.2)	
Primary school	1,359 (54.5)	680 (55.5)	679 (53.6)	
No school/preschool only	275 (11.0)	159 (13.0)	116 (9.2)	
Household wealth				3.59 (0.17)
Rich	449 (20.1)	228 (20.8)	221 (19.4)	
Middle	893 (39.9)	416 (37.9)	477 (41.8)	
Poor	897 (40.1)	454 (41.4)	443 (38.8)	
Household food insecurity access (HFIAS)				15.24 (<0.01)
Food secure	293 (12.0)	126 (10.5)	167 (13.5)	
Mildly food insecure	175 (7.2)	89 (7.4)	86 (6.9)	
Moderately food insecure	1,150 (47.0)	610 (50.6)	540 (43.5)	
Severely food insecure	829 (33.9)	380 (31.5)	449 (36.2)	
Alcohol use				
Alcohol use				187.78 (<0.01)
Never or distant past drinker (>5 years prior)	1,506 (63.7)	891 (75.7)	615 (51.8)	
Past drinker (1–5 years prior)	355 (15.0)	159 (13.5)	196 (16.5)	
Current not heavy drinker	188 (8.0)	64 (5.4)	124 (10.4)	
Current heavy drinker	316 (13.4)	63 (5.4)	253 (21.3)	
Did any sex partners drink alcohol (past year)?				127.86 (<0.01)
No sex partners drank alcohol	1,720 (70.1)	738 (60.7)	982 (79.2)	
Yes, but did not become intoxicated once a month or more	139 (5.7)	62 (5.1)	77 (6.2)	
Yes, and became intoxicated at least once a month	596 (24.3)	415 (34.2)	181 (14.6)	
Sexual risk behaviors				
Number of sexual partners, past 6 months				231.86 (<0.01)
0 or 1 partner	1,998 (80.5)	1,138 (92.8)	860 (68.5)	
More than 1 partner	484 (19.5)	89 (7.3)	395 (31.5)	
Received money, goods or favors, in exchange for sex, past 6 months?				0.50 (0.48)
No	2,156 (87.8)	1,056 (87.3)	1100 (88.2)	
Yes	301 (12.3)	154 (12.7)	147 (11.8)	

Table 1 continued

	Total *n* (%)	Female *n* (%)	Male *n* (%)	χ^2 (*p* value)
Health and health care utilization				
History of HIV testing				12.78 (<0.01)
Never been tested for HIV	1,521 (60.5)	707 (56.9)	814 (63.9)	
Ever been tested for HIV	995 (39.6)	535 (43.1)	460 (36.1)	
Health status (self-rated)				6.25 (0.04)
Excellent/very good	547 (22.1)	251 (20.5)	296 (23.7)	
Good	869 (35.1)	420 (34.4)	449 (35.9)	
Fair/poor	1,057 (42.7)	551 (45.1)	506 (40.5)	
Sought healthcare services, past 6 months?				12.31 (< 0.01)
Not ill, past 6 months	1,143 (48.3)	520 (44.7)	623 (51.7)	
Ill, but did not seek care	243 (10.3)	123 (10.6)	120 (10.0)	
Ill, and sought care	982 (41.5)	521 (44.8)	461 (38.3)	

Results

Sample Characteristics

Approximately half the 2,516 participants were female. Sixty percent of participants had never before been tested for HIV, and more men than women reported never testing for HIV (63.9 % compared to 56.9 %, $\chi^2(1) = 12.78$, $p < 0.01$). Among the participants who had ever been tested for HIV, 96 % reported receiving their test results, with 12 % receiving HIV-positive test results.

Nearly two-thirds of all participants were lifetime abstainers or distant past drinkers, and 15.0 % of participants were recent past drinkers. Thirteen percent of all participants were current heavy drinkers, and 8.0 % were current but not heavy drinkers (Table 1). A much higher proportion of men (21.3 %) were current heavy drinkers, as compared to women (5.4 %) ($\chi^2(1) = 129.83$; $p < 0.01$).

Bivariate and Multivariable Results

Alcohol Use

In bivariate analysis among women, compared to lifetime abstainers and distant past drinkers, current heavy drinkers and recent past drinkers were significantly more likely to have never been tested for HIV. This association persisted in multivariable analysis among the women (Table 2); compared to lifetime abstainers and distant past drinkers, current heavy drinkers (ARR: 1.32, 95 % CI: 1.10–1.58) and recent past drinkers (ARR: 1.20, 95 % CI: 1.05–1.37) were more likely to have never been tested for HIV. Current not heavy drinkers had increased risk of having never been tested, but this did not reach statistical significance (ARR: 1.20, 95 % CI: 0.98–1.47). Alcohol use by sexual partners was not associated with HIV testing among women.

Among men, neither alcohol use by the participant nor by their sexual partner(s) was associated with HIV testing in bivariate or multivariable analyses (Table 3).

Covariates

Among women, in bivariate analysis, the likelihood of having never been tested for HIV decreased with age, and increased for those who reported having received money or goods in exchange for sex in the past 6 months and those who had been ill in the past 6 months but had not sought care, but these associations were no longer statistically significant after adjusting for other covariates in the multivariable analysis (Table 2). Lower level of education, lower household wealth, and single marital status were associated with decreased HIV testing in bivariate and multivariable analyses. In bivariate analysis, women from mildly and moderately food insecure households were significantly less likely to have never been tested for HIV compared to those from food secure households, while in multivariable analysis, women from moderately and severely food insecure households were significantly less likely to have never been tested for HIV.

Among men, those who had been ill in the past 6 months but who had not sought care, compared to men who had not been ill, were less likely to have ever been tested for HIV in bivariate analysis; however, this association was no longer significant after adjusting for other covariates in the multivariable model (Table 3). Lower education level, lower household wealth, and being Catholic versus Protestant were associated with decreased HIV testing among men in both bivariate and multivariable analyses.

Table 2 Factors associated with having never been tested for HIV among women

	Never tested for HIV (%)	Bivariate relative risk (95 % confidence interval)	Bivariate poisson regression z-statistic (*p* value)	Adjusted relative risk (95 % confidence interval)	Multivariable poisson regression *t*-statistic (*p* value)
All	56.9				
Demographics					
Age					
15–24 years old	61.3	1.00		1.00	
25–34 years old	55.0	0.90 (0.80, 1.00)	−1.93 (0.05)	0.93 (0.82, 1.05)	−1.16 (0.25)
35–49 years old	53.9	0.88 (0.78, 1.00)	−2.04 (0.04)	0.89 (0.77, 1.03)	−1.56 (0.12)
Marital status					
Married/cohabitating	54.8	1.00		1.00	
Previously married/separated	51.1	0.93 (0.80, 1.09)	−0.90 (0.37)	0.89 (0.76, 1.05)	−1.39 (0.17)
Never married	70.9	1.29 (1.16, 1.45)	4.52 (<0.01)	1.19 (1.04, 1.37)	2.54 (0.01)
Religion					
Protestant	57.4	1.00		1.00	
Catholic	57.7	1.00 (0.90, 1.12)	0.07 (0.94)	0.98 (0.88, 1.08)	−0.41 (0.68)
Muslim	47.7	0.83 (0.67, 1.02)	−1.75 (0.08)	0.90 (0.73, 1.12)	−0.96 (0.34)
Other	48.3	0.84 (0.57, 1.23)	−0.89 (0.37)	0.79 (0.55, 1.15)	−1.23 (0.22)
Highest level of education					
Secondary school or more	53.0	1.00		1.00	
Primary school	56.5	1.07 (0.95, 1.20)	1.09 (0.28)	1.06 (0.94, 1.19)	0.90 (0.37)
No school/preschool only	67.3	1.27 (1.10, 1.47)	3.27 (<0.01)	1.30 (1.10, 1.53)	3.14 (<0.01)
Household wealth					
Rich	44.3	1.00		1.00	
Middle	54.1	1.22 (1.03, 1.45)	2.30 (0.02)	1.22 (1.04, 1.44)	2.44 (0.02)
Poor	65.4	1.48 (1.26, 1.73)	4.77 (<0.01)	1.49 (1.26, 1.76)	4.67 (<0.01)
Household food insecurity access (HFIAS)					
Food secure	65.9	1.00		1.00	
Mildly food insecure	51.7	0.78 (0.62, 0.99)	−2.01 (0.05)	0.82 (0.65, 1.03)	−1.69 (0.09)
Moderately food insecure	53.6	0.81 (0.70, 0.94)	−2.77 (<0.01)	0.79 (0.68, 0.91)	−3.15 (<0.01)
Severely food insecure	60.0	0.91 (0.78, 1.06)	−1.22 (0.22)	0.84 (0.72, 0.97)	−2.29 (0.02)
Alcohol use					
Alcohol use					
Never or distant past drinker (>5 years prior)	54.7	1.00		1.00	
Past drinker (1–5 years prior)	65.4	1.20 (1.05, 1.36)	2.75 (<0.01)	1.20 (1.05, 1.37)	2.69 (<0.01)
Current not heavy drinker	60.9	1.11 (0.91, 1.37)	1.04 (0.30)	1.20 (0.98, 1.47)	1.80 (0.07)
Current heavy drinker	73.0	1.34 (1.14, 1.57)	3.51 (<0.01)	1.32 (1.10, 1.58)	3.00 (<0.01)
Did any sex partners drink alcohol (past year)?					
No sex partners drank alcohol	57.2	1.00		1.00	
Yes, but did not become intoxicated once a month or more	61.3	1.07 (0.87, 1.32)	0.66 (0.51)	1.00 (0.81, 1.23)	−0.04 (0.97)
Yes, and became intoxicated at least once a month	55.7	0.97 (0.88, 1.08)	−0.50 (0.62)	0.92 (0.82, 1.03)	−1.46 (0.15)
Sexual risk behaviors					
Number of sexual partners, past 6 months					
0 or 1 partner	56.9	1.00		1.00	
More than 1 partner	59.6	1.05 (0.88, 1.25)	0.51 (0.61)	0.91 (0.75, 1.12)	−0.88 (0.38)
Received money, goods or favors, in exchange for sex, past 6 months?					
No	55.8	1.00		1.00	
Yes	65.6	1.18 (1.04, 1.33)	2.51 (0.01)	1.09 (0.96, 1.25)	1.31 (0.19)
Health and health care utilization					
Health status (self-rated)					
Excellent/very good	57.0	1.00		1.00	
Good	57.1	1.00 (0.88, 1.15)	0.04 (0.97)	0.97 (0.85, 1.11)	−0.38 (0.70)
Fair/poor	57.5	1.01 (0.89, 1.15)	0.15 (0.88)	0.95 (0.83, 1.09)	−0.70 (0.48)

Table 2 continued

	Never tested for HIV (%)	Bivariate relative risk (95 % confidence interval)	Bivariate poisson regression z-statistic (*p* value)	Adjusted relative risk (95 % confidence interval)	Multivariable poisson regression *t*-statistic (*p* value)
Sought healthcare services, past 6 months?					
Not ill, past 6 months	57.7	1.00		1.00	
Ill, but did not seek care	67.5	1.17 (1.01, 1.35)	2.15 (0.03)	1.14 (0.98, 1.32)	1.64 (0.10)
Ill, and sought care	53.9	0.93 (0.84, 1.04)	−1.22 (0.22)	0.96 (0.86, 1.07)	−0.73 (0.47)

STI Prevalence and Treatment Seeking Behavior in Mbarara Study, November–December 2007

Discussion

While Uganda has increased efforts to expand access to HIV testing and care, we found that 60 % of participants in this study of the general population near Mbarara, Uganda, had never before tested for HIV in 2007. This figure is comparable to current estimates by the WHO, which reports that only 24 % of Ugandans know their current HIV status [13]. Similar to other studies [28, 29], more women than men in our study (43.1 vs. 36.1 %) reported having ever been tested for HIV. This difference may be due in part to HIV testing during pregnancy via participation in prevention of mother to child transmission (PMTCT) programs, or may be due to the higher rates of healthcare utilization often seen among women [55].

Alcohol use was associated with decreased HIV testing among women. Women who were current heavy drinkers, and those who had last consumed alcohol 1–5 years ago, were more likely to have never been tested for HIV compared to distant past drinkers and abstainers. There was a similar association of lack of HIV testing among women reporting current but not heavy drinking, but this association did not reach statistical significance. These results suggest that alcohol use by women may be associated with decreased utilization of HIV testing services. As health behaviors often tend to cluster together, it may be that women who participate in activities with potentially adverse health effects, such as alcohol consumption, may also be less likely to engage in positive health behaviors, including HIV testing. Alcohol use among women could also be a barrier to HIV testing if these women are spending limited resources on alcohol, rather than using this money to access health services such as HIV testing. It is also possible that women who had recently consumed alcohol could have been hesitant to seek HIV testing if they feared their healthcare provider might hold stigmatizing beliefs or negative attitudes towards alcohol consumption by women. Transactional sex has been associated with gender-based violence as well alcohol abuse [42]; it may be that women who drink alcohol have little relationship power, and for this reason are less able to access health services. Alcohol use is consistently associated with risky sexual behavior in sub-Saharan Africa [38–42] (and was associated with an increased number of sexual partners, and receipt of money or goods for sex in our study, data not shown), and thus may be expected to be associated with increased likelihood to test for HIV due to higher perceived risk for HIV infection. However, sexual risk behavior was not significantly associated with HIV testing in multivariable analysis, nor did it alter the association between testing and alcohol use, indicating that it was not a confounder of this association among women. Alcohol use among men was not associated with HIV testing, nor was drinking by the participants' sexual partners.

Consistent with prior studies, less education was associated with a decreased likelihood of HIV testing [25, 27, 28], as was lower household wealth [25–27]. These results were consistent in men and women, suggesting that less educated and economically disadvantaged individuals may be less aware of and/or less able to access HIV testing services, and may thus be key targets for education and outreach related to these services. Surprisingly, however, moderate and severe household food insecurity were associated with a significantly increased likelihood of ever having been tested among women, indicating that the association with socioeconomic factors and HIV testing may not be clear cut. Severe food insecurity was associated with increased hospitalizations and opportunistic infections in rural Uganda [58]; thus, it is possible that the association seen in this study was due to poorer health and increased exposure to healthcare services, including HIV testing, among these groups. While we did adjust for self-rated health status and recent healthcare utilization in the multivariable model, these questions may not have been detailed enough to capture the full relationship in our data. Additionally, as many non-governmental organizations such as The AIDS Support Organization, which has a service center in Mbarara [59], embrace comprehensive approaches to HIV patient care, their services may be particularly attractive to those in need of other basic

Table 3 Factors associated with having never been tested for HIV among men

	Never tested for HIV (%)	Bivariate relative risk (95 % confidence interval)	Bivariate poisson regression z-statistic (*p* value)	Adjusted relative risk (95 % confidence interval)	Multivariable poisson regression *t*-statistic (*p* value)
All	63.9				
Demographics					
Age					
15–24 years old	67.1	1.00		1.00	
25–34 years old	63.3	0.94 (0.85, 1.04)	−1.19 (0.24)	0.94 (0.84, 1.05)	−1.07 (0.28)
35–49 years old	61.8	0.92 (0.83, 1.02)	−1.55 (0.12)	0.89 (0.78, 1.02)	−1.70 (0.09)
Marital status					
Married/cohabitating	62.7	1.00		1.00	
Previously married/separated	69.7	1.11 (0.94, 1.31)	1.24 (0.22)	1.10 (0.93, 1.30)	1.10 (0.27)
Never married	65.4	1.04 (0.95, 1.14)	0.92 (0.36)	1.04 (0.93, 1.16)	0.63 (0.53)
Religion					
Protestant	61.8	1.00		1.00	
Catholic	68.6	1.11 (1.02, 1.21)	2.34 (0.02)	1.11 (1.02, 1.21)	2.38 (0.02)
Muslim	57.7	0.93 (0.79, 1.10)	−0.83 (0.41)	0.99 (0.84, 1.17)	−0.07 (0.95)
Other	68.2	1.10 (0.82, 1.48)	0.66 (0.51)	1.13 (0.85, 1.49)	0.82 (0.41)
Highest level of education					
Secondary school or more	55.2	1.00		1.00	
Primary school	68.6	1.24 (1.13, 1.37)	4.45 (<0.01)	1.20 (1.09, 1.32)	3.60 (<0.01)
No school/preschool only	70.7	1.28 (1.11, 1.48)	3.40 (<0.01)	1.24 (1.07, 1.44)	2.90 (<0.01)
Household wealth					
Rich	56.6	1.00		1.00	
Middle	61.2	1.08 (0.94, 1.24)	1.14 (0.25)	1.06 (0.92, 1.23)	0.85 (0.40)
Poor	71.1	1.26 (1.10, 1.43)	3.45 (<0.01)	1.19 (1.02, 1.37)	2.31 (0.02)
Household food insecurity access (HFIAS)					
Food secure	64.7	1.00		1.00	
Mildly food insecure	55.8	0.86 (0.69, 1.07)	−1.32 (0.19)	0.87 (0.70, 1.08)	−1.26 (0.21)
Moderately food insecure	64.6	1.00 (0.88, 1.14)	−0.01 (0.99)	0.96 (0.84, 1.09)	−0.64 (0.52)
Severely food insecure	63.0	0.97 (0.85, 1.11)	−0.38 (0.70)	0.94 (0.82, 1.08)	−0.85 (0.40)
Alcohol use					
Alcohol use					
Never or distant past drinker (>5 years prior)	62.1	1.00		1.00	
Past drinker (1–5 years prior)	66.3	1.07 (0.95, 1.20)	1.10 (0.27)	1.07 (0.94, 1.21)	1.01 (0.32)
Current not heavy drinker	66.9	1.08 (0.94, 1.24)	1.06 (0.29)	1.08 (0.93, 1.25)	1.05 (0.30)
Current heavy drinker	66.0	1.06 (0.95, 1.18)	1.10 (0.27)	1.08 (0.96, 1.22)	1.35 (0.18)
Did any sex partners take alcohol (past year)?					
No sex partners drank alcohol	64.8	1.00		1.00	
Yes, but did not become intoxicated once a month or more	59.7	0.92 (0.76, 1.11)	−0.84 (0.40)	0.94 (0.78, 1.14)	−0.61 (0.54)
Yes, and became intoxicated at least once a month	62.4	0.96 (0.85, 1.09)	−0.59 (0.56)	0.98 (0.86, 1.11)	−0.35 (0.73)
Sexual risk behaviors					
Number of sexual partners, past 6 months					
0 or 1 partner	65.4	1.00		1.00	
More than 1 partner	60.3	0.92 (0.84, 1.01)	−1.70 (0.09)	0.93 (0.85, 1.03)	−1.37 (0.17)
Received money, goods or favors, in exchange for sex, past 6 months?					
No	64.6	1.00		1.00	
Yes	57.8	0.90 (0.78, 1.04)	−1.49 (0.14)	0.90 (0.78, 1.05)	−1.37 (0.17)
Health and health care utilization					
Health status (self-rated)					
Excellent/very good	61.2	1.00		1.00	
Good	64.8	1.06 (0.95, 1.19)	1.00 (0.32)	1.03 (0.92, 1.16)	0.59 (0.59)
Fair/poor	65.2	1.07 (0.95, 1.19)	1.14 (0.26)	1.02 (0.91, 1.14)	0.27 (0.79)

Table 3 continued

	Never tested for HIV (%)	Bivariate relative risk (95 % confidence interval)	Bivariate poisson regression z-statistic (*p* value)	Adjusted relative risk (95 % confidence interval)	Multivariable poisson regression *t*-statistic (*p* value)
Sought healthcare services, past 6 months?					
Not ill, past 6 months	61.8	1.00		1.00	
Ill, but did not seek care	70.8	1.15 (1.01, 1.31)	2.05 (0.04)	1.09 (0.95, 1.25)	1.24 (0.22)
Ill, and sought care	64.0	1.04 (0.94, 1.14)	0.74 (0.46)	1.02 (0.93, 1.12)	0.39 (0.69)

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services in addition to HIV testing and care, including food for their households. For this reason, people from food insecure households may be more likely to seek out and participate in such programs, and thus be more likely to have previously been tested for HIV.

A limitation of this study is the cross-sectional study design, preventing us from making any conclusions regarding the temporal relationships between HIV testing and these factors. Additionally, as participants were simply asked whether or not they had ever been tested in their lifetime, there may have been misclassification if participants forgot past testing. We also have no information on reasons for HIV testing (for example, if participants voluntarily sought testing, if they were tested because of illness, or as part of a PMTCT program), which may potentially further elucidate some of the differences observed between men and women. Only approximately 20 % of all participants reported taking alcohol in the past year, which is much lower than the WHO estimates for Uganda (44 %), but closer to the overall estimates for Africa (29.2 %) [23]. This suggests the possibility that alcohol consumption was under-reported in this study, which could cause bias to the null. Another possibility may be that people who drink heavily were less willing to participate in the survey; however, information on participation refusals was not collected and therefore cannot be examined. As expected, however, more men than women reported heavy drinking in the past year, with 21.3 % of men and only 5.4 % of women classified as current, heavy drinkers. Finally, we had a large number of observations with missing data, which would have led us to exclude $\sim$30 % of our observations in multivariable analysis; therefore, we conducted multiple imputation. While it is not possible to know whether the assumptions of multiple imputation were met [57], we were reassured that the results from the multivariable analysis using imputed data were similar to those from the multivariable analysis deleting all cases with any missing value.

The strength of this study is that it was conducted among a large random sample of persons aged 15–49 in rural Uganda, and thus provides a preliminary assessment of the factors associated with having never been tested for HIV. The high overall percentage of participants who had never before been tested for HIV demonstrates that a key step in achieving universal access to HIV care and services will be further identification and reduction of barriers to HIV testing. We found that alcohol use among women was associated with decreased HIV testing. Given that alcohol consumption is also a risk factor for HIV infection, this is problematic: female drinkers may be infected without their knowledge, and at high risk of transmitting HIV to others. HIV testing programs should target women who drink alcohol, and measures to prevent the transmission of HIV among drinkers should also be increased. These findings add to the growing body of literature suggesting that attention to heavy alcohol consumption as a critical part of HIV prevention, diagnosis and treatment efforts is greatly needed [60, 61].

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