

BMJ Open Cross-sectional comparative study of risky sexual behaviours among HIV-infected persons initiated and waiting to start antiretroviral therapy in rural Rakai, Uganda

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ABSTRACT

Objectives To compare risky sexual behaviours between HIV-positive persons initiated on antiretroviral therapy (ART) (ART-experienced) and persons waiting to start on ART (ART-naive) and assess predictors of risky sexual behaviours among HIV-infected patients in rural Rakai district, Uganda.

Study design This is a cross-sectional study that used data from the Rakai Community Cohort Study (RCCS) database between 2013 and 2014. A structured questionnaire was used for data collection. We used stepwise logistic regression as an index to estimate the adjusted ORs for the association between risky sexual behaviours and ART treatment status.

Study setting This study was conducted in Rakai district, located in south-western Uganda. The data for this study were extracted from the RCCS. RCCS is an open prospective cohort of approximately 15 000 consenting participants aged 15–49 years.

Participants HIV-positive participants aged 18–49 years who had sex at least once a month with any partner prior to the start of the study.

Main outcome measures Inconsistent/no condom use in the last 12 months, alcohol use at last sexual encounter, and two or more sexual partners.

Results ART-naive participants were more likely to report inconsistent condom use (OR=1.74, 95% CI 1.11 to 2.73) and more likely to drink alcohol at last sexual encounter (OR=1.65, 95% CI 1.11 to 2.46), compared with ART-experienced patients. ART treatment status ($p<0.001$) was a significant predictor of risky sexual behaviours. Both marital status ($p=0.016$) and occupation level ($p=0.009$) were positively associated with inconsistent condom use, while sex ($p<0.001$) correlated with alcohol use at last sexual encounter.

Conclusion ART-naive participants were more likely to exhibit risky sexual behaviours than the ART-experienced participants. The intensity of risk reduction counselling should be increased for HIV-positive persons waiting to start ART but already in HIV care.

Strengths and limitations of this study

- The study uses data from a prospective, population-based study cohort, with a high participation rate of over 90%, capturing a representative sample of the sexually active HIV-positive population in 54 surveyed communities. Findings are therefore generalisable and applicable to country-wide policies and interventions.
- Risky sexual behaviours estimates are based on self-reported measures, which are subject to social desirability and recall bias.
- Reporting condom use in the last 12 months may not always accurately characterise participants' overall condom use due to the long periods of measurement.
- This study did not consider the time element, CD4 cell count, calendar years or time on antiretroviral therapy, which may be factors that correlate with risky sexual behaviours.
- The period of observation was restricted to one survey round, which may not necessarily give accurate changes in exposure time measurements.

INTRODUCTION

Improved access to effective antiretroviral therapy (ART) has led to declines in morbidity and mortality rates among people living with HIV (PLHIV).^{1 2} ART is highly effective in reducing plasma levels of HIV RNA and reducing incidence of HIV-related opportunistic infections^{3 4}; hence, people living with HIV and are on ART (ART-experienced) now live longer.^{5 6} Despite the beneficial effects of ART, risk of transmission is not completely eliminated, particularly for those who do not have complete viral suppression, or transmission from those where an undetectable viral load has been documented.^{7 8}

Beneficial effects of ART include slower disease progression and reduced viral load, which have been met with optimism among HIV-positive people, as they no longer perceive HIV as a life-threatening ailment,^{9 10} and many are aware that with treatment, HIV is a chronic manageable disease.^{11 12} This optimism has been associated with an increase in risky sexual behaviours.^{9 13 14} In addition, the general physical health improvement and increased survival that follow ART may be accompanied by an increase in sexual desire and activity,^{15 16} which can lead to onward HIV transmission. There could also be an offset brought about by risky sexual behaviours.¹⁷ Cell-associated genital HIV shedding may occur in people with low HIV viral load,^{18 19} allowing for potential transmission of drug-resistant strains.²⁰ HIV transmission from people on ART will usually depend on the effectiveness of ART in reducing viral load and the efficiency of ART programme in reducing risky sexual behaviours.

Worldwide, risky sexual behaviours continue to be reported among PLHIV,^{21–24} increasing chances of transmission of drug-resistant strains from HIV-infected persons with incomplete viral suppression.²⁰ It is estimated that about 7%–17% of newly infected persons in high-income countries²⁵ and 4.8%–6.8% in low-income and middle-income countries²⁶ carry at least one major drug resistance mutation. These resistant strains are not responsive to first-line ART therapy^{20 27} and may require second-line ART regimens, which are prohibitively expensive in low-income countries. In addition, there is a risk of superinfection with drug-resistant strains that has been reported among PLHIV.^{28 29} Therefore, understanding risky sexual behaviours among HIV-positive persons is of great public health importance as it can provide useful insights in preventing further HIV transmission and enable PLHIV to lead healthy lives.

Early sexual debut, multiple sexual partnerships, limited and inconsistent condom use, sex under the influence of alcohol, childhood marriages and transactional cross-generational sex constitute the main risky behaviours currently driving the HIV epidemic in Uganda.^{30–32} In Uganda, ART is provided to all patients with a confirmed HIV diagnosis and CD4 count below 500 cells/mm³, or at time of diagnosis among sex workers, fisherfolk, pregnant mothers, those infected with tuberculosis, children less than 15 years and serodiscordant couples, as per the Ugandan Ministry of Health guidelines.³³ While in Kenya, ART treatment coverage is at 59%,³⁴ Uganda's ART treatment coverage is still suboptimal with only about 775 212 patients out of ~1.5 million infected persons (51%) on ART as of 2015.³⁵ With improvements in access to ART and availability in Uganda, an increasing number of PLHIV are expected to live extended periods and healthier lives, so changes in their risky sexual behaviours could have an impact on HIV transmission.

However, the characteristics and behaviours of ART-naïve persons (waiting to start ART) have received less attention maybe because they are not required to visit clinics more often for HIV care unlike the ART-experienced persons

(those on ART). Most of the reviews done in Uganda have investigated risky sexual behaviours, with a focus on people already enrolled on ART,^{36–38} leaving out those not yet started on ART. The comparison between these two groups remains largely undocumented.

This study therefore compares risky sexual behaviours among ART-naïve and ART-experienced persons and explores the potential predictors of risky sexual behaviours among PLHIV attending an HIV treatment and care programme in rural Rakai.

Conceptual framework

In summary, the conceptual framework (see online supplementary figure 1) illustrates the possible factors for PLHIV to engage in risky sexual behaviours. In understanding these various factors influencing risky sexual behaviours, this model suggests two sets of characteristics: distal factors and proximate factors. The distal factors (age, educational level, occupation, socioeconomic status, gender, Antiretroviral treatment status) and proximate factors (intensity of counselling, frequent health education, medical check-ups) are considered as independent factors affecting risky sexual behaviours, which are the dependent variables (outcomes). Intensity of counselling, frequent health education and continued medical check-ups could predict risky sexual behaviours. This has been seen in studies conducted in other low-income settings that predict intensity of behavioural change counselling and health education,^{39 40} medical check-ups and frequent hospital visits as factors in the reduction of risky sexual behaviours among PLHIV.

Using this conceptual framework, it is hypothesised that ART-experienced persons (those on ART) are more likely to drink alcohol on their last sexual encounter, have multiple sexual partners and use condoms inconsistently with any sexual partner. Thus it is predicted that proximate factors will moderate the differences in the risky sexual behaviours between ART-naïve and ART-experienced persons.

METHODS

This cross-sectional study was conducted among HIV-positive persons in Rakai, a rural district located in southwestern Uganda. Rakai district has a population of 518 008, with 80% of the population being agriculturalists.⁴¹ The data for this study was extracted from the Rakai Community Cohort Study (RCCS). RCCS is a prospective cohort, which has been described previously.^{42 43} It is an open, population-based cohort of approximately 15 000 consenting participants aged 15–49 years with an overall adult HIV prevalence of 13%.⁴⁴ Within this cohort, serosurveys have been conducted every 12–20 months since 1994. Structured interviews are administered by same-sex interviewers and participants provide blood samples for HIV serology and diagnosis of other sexually transmitted infections. Interviews establish information on sociodemographic characteristics, sexual behaviours, health and

contextual characteristics. In this cross-sectional study, the data used was derived from round 15 (2013–2014).

Eligibility criteria

Participants were eligible to participate in the study if they had tested HIV-positive, were on ART or were ART-naïve but in care, and had sex at least once a month with any partner (sexually active) prior to the start of the study. Only HIV seroconcordant persons were included in this study, irrespective of marital status.

Variables

The outcome variables in this study were risky sexual behaviours. Risky sexual behaviours in this study are described as any sexual behaviour that increases the likelihood of contracting Sexually Transmitted Infections or HIV. In this study, two or more sexual partners, alcohol use at last sexual encounter and inconsistent condom use (in the last 12 months) are all described as risky sexual behaviours. The independent variables included sociodemographics and ART treatment status.

Dependent/outcome variables

Inconsistent/no condom use was defined from a question about frequency of condom use in the last 12 months. The response alternatives were dichotomised as consistent condom use and inconsistent/no condom use for those who responded that they ‘sometimes’ or ‘never’ used condoms. *Alcohol use at last sex* was dichotomised as ‘yes’ or ‘no’. *Two or more sexual partners* was defined as having either serial or concomitant partners within the past 12 months. Risky sex was described as those participants who either used condoms inconsistently, drank alcohol at last sex, or had two or more sexual partners in the last 12 months.

Independent variables

Previous studies^{45–47} identified several predictors associated with risky sexual behaviours among PLHIV. In this study, these variables were expected to correlate with risky behaviours among PLHIV: *ART treatment status*, which was recorded as ART-naïve; people diagnosed as HIV-positive and referred for HIV care but are not yet started on antiretroviral treatment or ART-experienced status; people already enrolled on ART. *Education level* was classified as primary school level/did not attend school or secondary level or higher. *Current marital status* was categorised as currently married or unmarried. *Age* was grouped into three categories: 18–24, 25–34 and 35–50 years. *Occupation* was dichotomised into agriculture or any other occupation.

Ethical consideration

The Rakai Community Cohort Study was approved by the Research and Ethics Committee of the Uganda Virus Research Institute, the Uganda National Council of Science and Technology, and US-based Western Institutional Review Board. . Written informed consent was obtained from all research participants. For this study, no

additional consent was needed as it is a secondary data analysis.

Statistical methods

IBM SPSS Statistics V.21 for Windows was used for statistical analysis. Contingency tables were used for bivariate analysis to examine associations between outcome variables (sexual behaviours) and covariates, and χ^2 tests were used for statistical inference. All covariates statistically significant in bivariate analyses were included in the multivariable analysis. Multivariable logistic regression was used to estimate adjusted ORs (adjOR) and 95% CIs using stepwise selection, and statistical significance was based on a p value less than 0.05.

RESULTS

Table 1 describes the characteristics of the study participants stratified by ARV treatment status. This study had 341 (66%) women and 176 (34%) men. The majority of participants were married (67.5%), agriculturalists (55.7%), had primary or no education (72.9%), and 55.7% were between 35–50 years of age. The mean age of the respondents was 35.6 years (SD=6.67).

ART-naïve participants reported a higher percentage of inconsistent or no condom use (85.8%) compared with ART-experienced (78.1%), and the difference was statistically significant ($p=0.031$). Alcohol use at last sex was reportedly lower in ART-experienced (22.5%) compared to ART-naïve participants (32.5%; $p=0.012$). Having two or more sexual partners was almost similar among ART-experienced (19.4%) and ART-naïve persons (18.3%) ($p=0.756$), while somewhat more ART-naïve participants did not use condoms at last sex compared with ART-experienced participants (72.1% vs 64.7%, respectively; $p=0.081$).

For the bivariate analyses (**table 2**), inconsistent/no condom use was higher among the ART-naïve compared with the ART-experienced participants (OR=1.69, 95% CI 1.04 to 2.73), and inconsistent/no condom use was more frequent among women compared with men (65.9% vs 34.1%; $p=0.932$). Agriculturalists were more likely to report no/inconsistent condom use than any other occupations (OR=1.80, 95% CI 1.15 to 2.80). Additionally, ART-naïve participants had higher odds of drinking alcohol at last sexual encounter compared with ART-experienced participants (OR=1.65, 95% CI 1.11 to 2.46) (**table 3**). Men were more likely to drink alcohol at last sexual encounter compared with women (OR=3.40, 95% CI 2.26 to 5.12) (**table 3**).

Three predictor variables (**table 2**) were significantly associated with inconsistent condom use: ART treatment status ($p=0.031$), marital status ($p=0.016$) and occupation level ($p=0.009$). **Table 3** shows both sex ($p<0.001$) and ART treatment status ($p=0.013$) as significant predictors in drinking alcohol at last sex.

In the final multivariate model (**table 4**), the association between inconsistent condom use and ART treatment

Table 1 Baseline sociodemographic and sexual behaviour characteristics of 517 participants in a longitudinal cohort study of people living with HIV in a rural district, Rakai, Uganda

Characteristics	Overall (%)	ART-naïve (%)	ART-experienced (%)	p Value*
Overall		197 (38.1)	320 (61.9)	
Sex				
Female	341 (66.0)	130 (66.0)	211 (65.9)	0.990
Male	176 (34.0)	67 (34.0)	109 (34.1)	
Age (years)				
Mean (SD)	35.55 (6.48)	36.34 (6.25)	34.27 (6.60)	<0.001
Median (IQR)	35.0 (31–40)	37 (30–41)	34 (30–39)	
Age group (years)				
18–24	23 (4.4)	13 (6.6)	10 (3.1)	0.004
25–34	206 (39.8)	91 (46.2)	115 (35.9)	
35–50	288 (55.7)	93 (47.2)	195 (60.9)	
Marital status				
Married	349 (67.5)	137 (69.5)	212 (66.3)	0.438
Not married	168 (32.5)	60 (30.5)	108 (33.8)	
Main occupation				
Agriculture/housework	288 (55.7)	113 (57.4)	175 (54.7)	0.552
Other occupation	229 (44.3)	84 (42.6)	145 (45.3)	
Education level				
Primary or lower	377 (72.9)	137 (69.5)	240 (75.0)	0.175
Secondary or higher	140 (27.1)	60 (30.5)	80 (25.0)	
Alcohol use at last sexual encounter				
Yes	136 (26.3)	64 (32.5)	72 (22.5)	0.012
No	381 (73.7)	133 (67.5)	248 (77.5)	
Condom use in the last 12 months				
Consistent	98 (19.0)	28 (14.2)	70 (21.9)	0.031
Inconsistent	419 (81.0)	169 (85.8)	250 (78.1)	
Number of sexual partners				
1 partner	419 (81.0)	161 (81.7)	258 (80.6)	0.756
2 or more partners	98 (19.0)	36 (18.3)	62 (19.4)	
Condom use at last sexual encounter				
Yes	168 (32.5)	55 (27.9)	113 (35.3)	0.081
No	349 (67.5)	142 (72.1)	207 (64.7)	

*p Value from χ^2 test.

ART, antiretroviral therapy.

status remained statistically significant after adjusting for age, occupation and marital status (adjOR=1.47 95% CI 0.90 to 2.41, model 4). Age and sex were significantly associated with alcohol consumption: adjOR=3.47, 95% CI 2.30 to 5.23 for sex, and OR=3.34, 95% CI 0.74 to 15.03 for age (table 5).

DISCUSSION

Findings from this study reveal ART-naïve participants having slightly increasing odds of practising risky sexual behaviours compared with participants on ART. This is similar to other studies done that showed ART-naïve

patients were more likely to practise risky sexual behaviours than the ART-experienced patients.^{15 48} These differences could be attributed to the variability in counselling intensity, health education and follow-ups given to patients on ART, compared with ART-naïve patients (patients on ART are required to visit the clinic more frequently than those on ART).

Sex and age are significant predictors of risk sexual behaviours among HIV-positive patients in this study. This is related to studies done before that have either identified sex or age as significant predictors of risky sexual behaviours.^{45 48 49}

Table 2 Association (crude ORs, 95% CIs) between sociodemographic factors, ART treatment status and inconsistent condom use in a sample of 517 HIV-positive patients in Rakai: results of logistic regression

	Consistent, n (%)	Inconsistent/no condom use, n (%)	Crude ORs (95% CI)	p Value*
ART treatment status				
ART-naïve	28 (28.6)	169 (40.3)	1.69 (1.04 to 2.73)	0.031
ART-experienced	70 (71.4)	250 (59.7)	1 (ref group)	
Sex				
Male	33 (33.7)	143 (34.1)	1.02 (0.64 to 1.62)	0.932
Female	65 (66.3)	276 (65.9)	1 (ref group)	
Age				
25–34	26 (26.5)	180 (43.0)	0.32 (0.041 to 2.43)	0.268
35–50	71 (72.4)	217 (51.8)	0.13 (0.02 to 1.04)	0.056
18–24	1 (4.3)	22 (5.3)	1 (ref group)	
Marital status				
Married	56 (57.1)	293 (69.9)	1.74 (1.11 to 2.73)	0.016
Not married	42 (42.9)	126 (30.1)	1 (ref group)	
Education level				
Primary level	68 (69.4)	309 (73.7)	1.23 (0.76 to 2.00)	0.383
Secondary level	30 (30.6)	110 (26.3)	1 (ref group)	
Occupation level				
Agriculture/housework	43 (43.9)	245 (58.5)	1.80 (1.15 to 2.80)	0.009
Other occupation	55 (56.1)	174 (41.5)	1 (ref group)	

*p Value from χ^2 test.
ART, antiretroviral therapy.

Almost 81% of participants within the study reported inconsistent condom use, which indicates high prevalence of unsafe sex among HIV-positive people. This highlights the dangers of continued HIV transmission despite the increasing ART roll-out. Therefore, these findings call for increasing awareness and motivation for condom use among HIV-positive patients. Additionally, inconsistent condom use was more likely among ART-naïve patients, a finding similar to earlier studies in Uganda,¹⁵ Kenya⁵⁰ and South Africa.⁴⁸ These findings could be due to more secondary HIV prevention programmes given to ART-experienced patients as they visit ART clinics often for refills and medical check-ups.

Inconsistent condom use was higher among women than in men (65.9% vs 34.1%) in this study. This is similar to studies done in Italy that showed almost 44.3% of HIV-positive women were inconsistent condom users.⁵¹ This could reflect the limitations of female bargaining power within sexual relationships. A central feature of Ugandan society is gender inequality, with women occupying subordinate roles both in economic activities and in decision-making. Women are not culturally empowered to negotiate sexually related issues, and this pattern of male control of sexual decision-making was also noted in Uganda and Rwanda.^{52 53} However, inconsistent condom use in this group could also be attributed to the desire to have children. Studies^{54 55} have shown reproductive

desires play a significant role in the lives of HIV-positive women. Therefore, these gender differences highlight a need of incorporating gender dynamics in secondary prevention strategies in order to meet the specific needs of both women and men.

We observed almost 26% of HIV-positive patients consumed alcohol before sex. This is a health concern because alcohol consumption among HIV-positive persons has been associated with decreased adherence to ARV,^{56 57} reducing the patient's ability to practise safer sex.⁵⁸ Additionally, ART-naïve participants were more likely to consume alcohol at their last sexual encounter compared with ART-experienced participants. This could be explained by the fact that once people are started on ART, they are advised not to drink or certainly take limited amounts of alcohol in order to preserve the integrity of their liver,^{59 60} so that the ARVs are well processed in the body. Another reason could be the guidelines and adherence support counselling given by health workers when on ART. These findings are aligned with a study that reported decreased alcohol consumption after ART initiation⁶¹ and higher odds of alcohol consumption during the pre-ART period.²¹

In this study, men were three times more likely to drink alcohol at their last sexual encounter. This could be attributed to the common social values and the acceptance of male drinking in society. A Ugandan study

Table 3 Association (crude ORs, 95% CI) between sociodemographic factors, ART treatment status and alcohol use at last sexual encounter in a sample of 517 HIV-positive patients in Rakai: results of logistic regression

	Alcohol use Yes, n (%)	Alcohol use No, n (%)	Crude ORs (95% CI)	p Value*
ART treatment status				
ART-naive	64 (47.1)	133 (34.9)	1.65 (1.11 to 2.46)	0.013
ART-experienced	72 (52.9)	248 (65.1)	Ref	
Sex				
Male	75 (55.1)	101 (26.5)	3.40 (2.26 to 5.12)	<0.001
Female	61 (44.9)	280 (73.5)	Ref	
Age				
35–50	82 (60.3)	206 (54.1)	4.18 (0.95 to 18.22)	0.057
25–34	52 (38.2)	154 (40.4)	3.54 (0.80 to 15.63)	0.095
18–24	2 (1.5)	21 (5.5)	Ref	
Marital status				
Married	92 (67.6)	257 (67.5)	1.0 (0.66 to 1.53)	0.967
Not married	44 (32.4)	124 (32.4)	Ref	
Education level				
Primary level	106 (77.9)	271 (71.1)	1.43 (0.90 to 2.27)	0.126
Secondary level	30 (22.1)	110 (28.9)	Ref	
Occupation level				
Agriculture/housework	70 (51.5)	218 (57.2)	0.79 (0.53 to 1.17)	0.247
Other occupation	66 (48.5)	163 (42.8)	Ref	

*p value from χ^2 test. ART, antiretroviral therapy.

reported 41% of men consume alcohol before sex.⁶² It is recommended that addressing alcohol abuse should be a key focus in secondary prevention interventions. Healthcare providers should screen their patients with HIV for alcohol use problems and initiate interventions that can

reduce alcohol-related problems among PLHIV. More research is needed to find and test different behavioural, social and biomedical interventions for alcohol-related problems among PLHIV.

Table 4 Association (adjusted OR, 95% CI) between inconsistent/no condom use and ART treatment status among 517 HIV-positive patients in Rakai: results of multivariate logistic regressions

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
ART treatment status				
ART-naive	1.69 (1.04 to 2.73)	1.51 (0.92 to 2.46)	1.48 (0.90 to 2.42)	1.47 (0.90 to 2.41)
ART-experienced	Ref	Ref	Ref	Ref
Age				
35–50		0.15 (0.02 to 1.15)	0.15 (0.02 to 1.21)	0.16 (0.02 to 1.23)
25–34		0.33 (0.43 to 2.55)	0.34 (0.04 to 2.72)	0.35 (0.04 to 2.77)
18–24		Ref	Ref	Ref
Occupation level				
Agriculture/housework			1.79 (1.14 to 2.81)	1.71 (1.00 to 2.53)
Other occupation	Ref	Ref	Ref	Ref
Marital status				
Married				1.59 (1.00 to 2.53)
Not married				Ref

Model 1: unadjusted model.

Model 2: adjusted for age.

Model 3: adjusted for age and occupation.

Model 4: adjusted for age, occupation and marital status.

ART, antiretroviral therapy.

Compared with other studies in sub-Saharan Africa,^{63–65} this study found that participants with primary or lower level education were more likely to use condoms inconsistently. This could be explained by the fact that participants with higher education are more likely to have higher knowledge of HIV and are more informed.

Methodological considerations

The use of data from a population-based prospective cohort study with a high participation rate of over 90% that captured a representative sample of the sexually active HIV-positive population in 54 surveyed communities in rural Rakai communities makes the findings generalisable and applicable to country-wide policies and interventions. However this study had limitations. First, this was a cross-sectional study and could not derive causal inferences. Second, risky sexual behaviour estimates are based on self-reported measures, which are subject to social desirability and recall bias. However, a study done in Uganda showed large cohort studies have correlations between behavioural self-reported measures and HIV infection, thus suggesting that recall bias does not necessarily conceal key associations.⁶⁶ It is therefore less likely that these potential biases would impact differences between the two groups. Third, reporting condom use in the last 12 months may not always accurately characterise patients' overall condom use due to the long periods of measurement. The frequency of condom use as well as recalling sexual encounters in the last 12–18 months since the last survey done might affect people's ability to accurately answer and remember details of sexual encounters. However, findings from other shorter time periods do not necessarily differ from the findings of this study, which may be a minor factor.⁶⁷ Fourth, this study did not consider the time element; CD4 cell count and calendar years as well as time on ART may be factors that correlated with risky sexual behaviour. In addition,

the period of observation was restricted to one survey round, which may not necessarily give accurate changes in exposure time measurements.

CONCLUSION

This study indicates that ART-naive participants have slightly increased odds of risky sexual behaviours compared with participants on ART. These differences may be attributed to the variability in counselling intensity, health education and follow-ups offered to patients on ART. Although findings reveal higher odds of risky sexual behaviours among ART-naive persons, rates of risky behaviour are high for both groups, and positive prevention programmes should be able to target both groups.

Focused interventions such as risk reduction counselling and education programmes are required to be incorporated in HIV care and treatment programmes, and emphasis should be laid on counselling to avoid reinfections and alcohol abuse. The roll-out of ART should not be considered as a single preventive intervention, but should be facilitated with other elements such as psychosocial support, gender dynamics, mental health services, nutrition and family planning to ensure a successful HIV fight. Better understanding of the underlying mechanisms and correlations of such high-risk sexual behaviour among persons living with HIV remains a priority for researchers and public health professionals alike.

Contributors LJV conceptualised the study, designed, analysed and drafted the first version of the manuscript. BOA and GN were involved in the analysis, interpretation and critical review of the manuscript. JK, FN, DS and NS were involved in revising the article critically for important intellectual content. RM edited and approved the final version to be published. AN was involved in the acquisition of data, data analysis and interpretation of the data.

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Competing interests None declared.

Table 5 Association (adjusted OR, 95% CI) between alcohol use at last sexual encounter and ART treatment status among 517 HIV-positive patients in Rakai: results of multivariate logistic regression

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
ART treatment status			
ART-naive	1.65 (1.11 to 2.46)	1.72 (1.14 to 2.61)	1.80 (1.18 to 2.74)
ART-experienced	Ref	Ref	Ref
Sex			
Male		3.47 (2.30 to 5.23)	3.29 (2.17 to 4.99)
Female		Ref	Ref
Age			
35–50			3.34 (0.74 to 15.03)
25–34			2.95 (0.65 to 13.35)
18–24			Ref

Model 1: unadjusted model.

Model 2: adjusted for sex.

Model 3: adjusted for age and sex.

ART, antiretroviral therapy.

Ethics approval Research and Ethics Committee of the Uganda Virus Research Institute, the Uganda National Council of Science and Technology, and US-based Western IRB.

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Data sharing statement The data sets used for this study are available on request from the Rakai Community Cohort Study database at Rakai Health Sciences Program (www.rhsp.org).

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