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Social Desirability Bias Impacts Self-Reported Alcohol Use Among Persons With HIV in Uganda

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Background: Self-report is widely used to assess alcohol use in research and clinical practice, but may be subject to social desirability bias. We aimed to determine if social desirability impacts self-reported alcohol use.

Methods: Among 751 human immunodeficiency virus (HIV)-infected patients from a clinic in southwestern Uganda, we measured social desirability using the Marlowe–Crowne Social Desirability Scale (SDS) Short Form C, self-reported alcohol use (prior 3 months) Alcohol Use Disorders Identification Test—Consumption (AUDIT-C), and phosphatidylethanol (PEth), a biomarker of prior 3 weeks' drinking. We conducted multiple regression analyses to assess the relationship between SDS score (low, medium, and high levels) and (i) any self-reported recent alcohol use, among those who were PEth-positive (≥8 ng/ml), and (ii) continuous AUDIT-C score, among those reporting any recent alcohol use. We controlled for PEth level, age, gender, education, economic assets, marital status, religion, spirituality/religiosity, social support, and study cohort.

Results: Of 751 participants, 59% were women; the median age was 31 years (interquartile range [IQR]: 26 to 39). Median SDS score was 9 (IQR: 4 to 10). Two-thirds (62%) self-reported any recent alcohol use; median AUDIT-C was 1 (IQR: 0 to 4). Among those who were PEth-positive (57%), 13% reported no recent alcohol use. Those with the highest SDS tertile had decreased odds of reporting any recent alcohol use compared to the lowest tertile, but the association did not reach statistical significance in multivariable analyses (adjusted odds ratio 0.55 [95% confidence interval (CI): 0.25, 1.23]). Among participants self-reporting recent alcohol use, SDS level was negatively associated with AUDIT-C scores (adjusted β: −0.70 [95% CI: −1.19, −0.21] for medium vs. low SDS and −1.42 [95% CI: −2.05, −0.78] for high vs. low SDS).

Conclusions: While use of objective measures (e.g., alcohol biomarkers) is desirable for measuring alcohol use, SDS scores may be used to adjust self-reported drinking levels by participants' level of social desirability in HIV research studies.

Key Words: Phosphatidylethanol, Self-Report, Social Desirability, Alcohol Biomarker.

HIV/AIDS and alcohol use are significant causes of morbidity and mortality in sub-Saharan Africa (Williams et al., 2016). The deleterious relationship between alcohol use and HIV has been demonstrated in many studies (Fatch et al., 2013; Hendershot et al., 2009; Kalichman et al., 2013; Scott-Sheldon et al., 2016; Vagenas et al., 2015). Alcohol use not only affects human immunodeficiency virus (HIV) disease progression through poor antiretroviral therapy (ART) adherence (Kahler et al., 2017), but is also related to the transmission of HIV/AIDS (Williams et al., 2016; Woolf-King et al., 2013). However, alcohol use is a potentially modifiable behavior, and several interventions exist to reduce such use. The early detection of unhealthy alcohol use is important in order to be able to initiate alcohol use reduction interventions. Early detection and accurate quantification of alcohol use are also useful in order to mitigate some of the adverse outcomes of unhealthy alcohol use in HIV care (e.g., alcohol use combined with hepatotoxic drugs, or poor ART adherence).

HIV-positive persons in sub-Saharan Africa have been shown to underreport how much alcohol they consume (Bajunirwe et al., 2014; Muyindike et al., 2017). In Uganda, HIV treatment guidelines advise against concomitant alcohol use and ART (Ministry of Health UGANDA, 2016). Therefore, some HIV clinics in Uganda conduct group health

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education sessions that focus on the negative effects of alcohol use on HIV disease and its interaction with ART (Wandera et al., 2017); such sessions may lead to the perceived need to minimize reporting of alcohol use. However, despite this, HIV clinics, as well as a broad range of medical settings, and most health research studies, rely on self-report to determine whether patients consume alcohol, and if so, how much.

Self-report is rapid and inexpensive; however, it may be subject to several biases, including social desirability bias (Davis et al., 2010; Vu et al., 2011). Social desirability bias is the tendency to respond to questions in a manner that is likely to be most socially sanctioned, especially when reporting socially or culturally "unacceptable" habits or behaviors. This may lead to underreporting of such behaviors, which in turn may ultimately translate into missed opportunities for intervention and missed contraindications for medications (Copeland et al., 1977; Richman et al., 1999).

To account for the existence of social desirability bias in research, the Marlowe–Crowne Social Desirability Scale (SDS) and its variations have been used to measure social desirability worldwide, including in sub-Saharan Africa (Vu et al., 2011). Using versions of this scale, prior studies have shown associations between the level of social desirability and self-reported alcohol use (Davis et al., 2010; Latkin et al., 2017). However, these studies did not include an objective measure of alcohol use, and thus, associations are difficult to interpret due to the possibility of inaccurate alcohol use measurement by self-report.

Phosphatidylethanol (PEth) is a highly sensitive and specific biomarker that is correlated with the amount of alcohol consumed during the previous 2 to 3 weeks (Wurst et al., 2015). PEth has highlighted differences between self-report and alcohol metabolites in several studies assessing alcohol use among HIV-positive persons in Africa (Hahn et al., 2015; Magidson et al., 2018; Muyindike et al., 2017; Papas et al., 2016) and has also been correlated with level of alcohol use (Hahn et al., 2016). Thus, it is a useful tool for objectively measuring any and level of alcohol use and can serve to help determine whether social desirability is a factor in alcohol use reporting.

This study sought to investigate the relationship between the SDS level and (i) any self-reported alcohol use (yes/no) and (ii) level of self-reported alcohol use, while controlling for PEth level, among persons with HIV in Uganda. We also explored whether age and gender modified the relationship between social desirability and self-reported alcohol use, because previous studies have shown that age (Muyindike et al., 2017) and gender (Bajunirwe et al., 2014) may affect self-reported alcohol use.

MATERIALS AND METHODS

For this analysis, we analyzed baseline data from 2 longitudinal cohorts of adults living with HIV recruited from the Mbarara Regional Referral Hospital's (MRRH) Immune Suppression Syndrome (ISS) clinic in southwestern Uganda. The studies are part of the Uganda–Russia–Boston Alcohol Network for Alcohol Research Collaboration on HIV/AIDS (URBAN ARCH) Consortium and are described in detail elsewhere (Hahn et al., 2015, 2018). ISS clinic patients were eligible for the Alcohol Drinking Effects Prior to Treatment (ADEPT) study from 2011 through 2014 if they were ≥18 years, fluent in English or Runyankole (the local language), lived within 60 km of the clinic, and were not yet eligible to initiate HAART. Recruitment was targeted to include approximately 50% unhealthy drinkers (defined after study enrollment as Alcohol Use Disorders Identification Test—Consumption (AUDIT-C) score of ≥3 for women and ≥4 for men, or PEth value ≥50 ng/ml; Hahn et al., 2018). The Biomarker Research on Ethanol Among Those with HIV (BREATH) study was a cohort study examining changes in alcohol use during the first year of HIV/AIDS care at the MRRH ISS Clinic, conducted from 2011 to 2014. BREATH enrollment criteria were similar to those in ADEPT, but additionally included the following: new to HIV care, self-reported alcohol use in the previous year at clinic enrollment, and no restrictions on HAART eligibility. BREATH participants were randomly assigned to participate in a main cohort study arm (followed for 1 year, with quarterly study visits) or a minimally assessed study arm. Those in the minimally assessed arm were interviewed only once at 6 months after enrollment; the purpose of this arm was to examine assessment reactivity (Emenyonu et al., 2017).

Approvals from the institutional review boards of the Mbarara University of Science and Technology (MUST), the University of California, San Francisco (UCSF), and Boston University were obtained, as well as the Uganda National Council for Science and Technology. Participants provided written informed consent prior to recruitment into both studies. Participants were informed at enrollment during the consenting process that their blood would be used to test for alcohol that was consumed in the last 2 to 3 weeks and also that a breathalyzer test would be performed as part of the study procedures.

Measurements

At the study visit, participants completed an interviewer-administered structured questionnaire in English or Runyankole, and breath alcohol tests and blood draws for the following laboratory tests were performed.

Laboratory Testing

Venous blood samples were collected; CD4 cell count was tested at the MUST Clinical Research Laboratory, and viral load was tested at the UCSF Virology Core Laboratory in San Francisco, CA. Dried blood spot (DBS) cards were also prepared from the venous blood draw. DBS testing for PEth, a biomarker of alcohol use, was conducted using liquid chromatography and tandem mass spectrometry (LC-MS/MS; Jones et al., 2011) at the United States Drug Testing Laboratory in Des Plaines, Illinois. A PEth result of ≥8 ng/ml was taken as positive.

Dependent/Outcome Variables

We examined 2 measures of self-reported alcohol use in the prior 3 months as the primary outcome variables. These measures were any self-reported alcohol use (yes/no) in the prior 3 months (outcome 1), and level of alcohol use, as a continuous measure, using the AUDIT-C (Bush et al., 1998; outcome 2). We modified the AUDIT-C to ask about a reference period of the prior 3 months.

Independent Variable

The primary explanatory variable of interest was social desirability, measured using the Marlowe–Crowne SDS Short Form C. The Marlowe–Crowne SDS Short Form C is a 13-item instrument used to assess a participant's need for social approval (Reynolds, 1982).

The higher the score, the more the participants' demonstrated need for social approval. Some of the items in the scale include the following: "I'm always willing to admit it when I make a mistake"; "I am always courteous, even to people who are disagreeable"; "I have never been annoyed when people expressed ideas very different from my own"; and "I have never deliberately said something that hurt someone's feelings." A 28-item version of the scale has been tested in the Ugandan setting with good reliability, $\alpha = 0.7$ (Vu et al., 2011). The Kuder–Richardson reliability coefficient (Kuder and Richardson, 1937) of the SDS Short Form C in our sample was 0.44. We graphically examined the relationship between SDS score and continuous AUDIT-C; the relationship did not appear linear. Therefore, SDS was analyzed as a 3-level variable based on tertiles for all analyses.

Covariates

Demographic characteristics collected during the baseline study interview included participant gender, age, education, marital status, and religion. We created a household asset index using principal components analysis to assess socioeconomic status (Filmer and Pritchett, 2001). The asset index was based on ownership of durable goods, household quality, and available energy sources; the bottom 40% was considered low, 41 to 80% middle, and the top 20% high. We measured social support using a modified 11-item version of the Duke University–University of North Carolina Social Support Scale (Broadhead et al., 1988), with a mean score of <3 indicating low perceived levels of social support (Antelman et al., 2001). We measured spirituality and religiosity using the short version of the Ironson–Woods Spirituality and Religiosity Index (SRI; Ironson et al., 2002) and included it as a continuous variable, with higher scores indicating higher levels of spirituality and religiousness.

Statistical Analysis

We described the characteristics of the overall sample at baseline using proportions for categorical variables, and medians and interquartile ranges (IQR) for continuous variables. We limited our analyses of outcome 1 to those who were PEth-positive (≥8 ng/ml) because we were reasonably sure that they were consuming alcohol, given the high specificity of PEth (Hahn et al., 2016). We conducted logistic regression models controlling for potential confounders to assess the association between SDS level and any self-reported alcohol use. For the outcome, level of self-reported alcohol use (outcome 2), we limited the analyses to participants who were self-reported current drinkers (AUDIT-C > 0). We limited our analyses of outcome 2 to those who self-reported any alcohol use because we hypothesized that social desirability may be related to the level of reported alcohol use, among those who report engaging in any alcohol use. We conducted linear regression models controlling for potential confounders to assess the association between the SDS tertiles and AUDIT-C scores, among self-reported drinkers. Lastly, we conducted exploratory regression analyses assessing whether age (dichotomized as <35 and ≥35; we chose a cutoff of 35 as it was roughly the median age), gender, and PEth level (<50 ng/ml vs. ≥50 ng/ml) were possible effect modifiers. This was evaluated by testing separate 2-way interactions between SDS level and each potential effect modifier. We selected the following covariates a priori for inclusion in the above multivariable models: gender, age, education, household asset index, marital status, religion, social support, and spirituality/religiosity index score; these variables have been frequently associated with alcohol use (Adong et al., 2018; Crum et al., 1993; Ironson et al., 2002; Mavandadi et al., 2015). We included an indicator variable for whether the subject was a participant in ADEPT, BREATH main cohort arm, or BREATH minimally assessed arm. We also included PEth as a continuous covariate in the models, to allow us to examine the relationships between SDS tertile and self-reported alcohol use, controlling for the objective level of alcohol consumption. Approximately 10% of observations were missing data for at least one variable of interest. To account for missing data, we used multiple imputation via chained equations to impute missing data (Sterne et al., 2009). All analyses were conducted using Stata version 14.2.

RESULTS

The analysis included 751 participants; 59% were women with a median age of 31 years (IQR: 26 to 39). The median SDS score was 9 (out of a possible 13, IQR: 4 to 10). Forty-two percent of participants were in the low (scores 1 to 8) SDS group, 39% were in the medium (scores 9 to 10) group, and 20% were in the high (scores 11 to 13) group. Sixty-two percent ($n = 462$) self-reported any alcohol use in the past 3 months. The sample median AUDIT-C score was 1 (IQR:

Table 1. Participant Characteristics in 2 Studies of Alcohol Use by Persons With HIV in Southwestern Uganda ($n = 751$)

	N (%)	Median (IQR)
Gender		
Men	309 (41.2)	–
Women	442 (58.9)	–
Age (years)	–	31 (26 to 39)
Education		
Less than secondary	504 (67.1)	–
Secondary or more	247 (32.9)	–
Household asset index		
Low	295 (39.3)	–
Middle	303 (40.4)	–
High	152 (20.3)	–
Marital status		
Married	383 (51.0)	–
Not married	368 (49.0)	–
Religion		
Protestant	393 (52.3)	–
Catholic	276 (36.8)	–
Muslim	48 (6.4)	
Other	34 (4.5)	–
SDS	–	9 (4 to 10)
SDS		
Low (1 to 8)	309 (41.6)	–
Medium (9 to 10)	288 (38.8)	–
High (11 to 13)	146 (19.7)	–
Low social support		
Yes	173 (23.2)	–
No	573 (76.8)	–
Any alcohol use, prior 3 months (self-report)		
Yes	462 (61.8)	–
No	286 (38.2)	–
AUDIT-C score (prior 3 months)	–	1 (0 to 4)
PEth ≥ 8 ng/ml		
Yes	430 (57.4)	
No	319 (42.6)	
PEth result (ng/ml) among all	–	18.8 (1 to 141.8)
SRI score (overall)	–	97 (88 to 107)
Study		
BREATH cohort	205 (27.3)	–
BREATH comparison	141 (18.8)	–
ADEPT cohort	405 (53.9)	–

ADEPT, Alcohol Drinking Effects Prior to Treatment; BREATH, Biomarker Research on Ethanol Among Those with HIV; IQR, interquartile range; SDS, Social Desirability Scale; SRI, Spirituality and Religiosity Index.

0 to 4). Fifty-seven percent ($n = 430$) of the participants were PEth-positive (PEth ≥8 ng/ml; Table 1).

Among those who were PEth-positive ($n = 430$), 13% self-reported no alcohol use in the last 3 months; 9% (17/186) of those in the lowest SDS tertile reported no alcohol use in the last 3 months, 14% (21/149) of those in the middle SDS tertile reported no alcohol use in the last 3 months, and 19% (17/89) of those in the highest SDS tertile reported no alcohol use in the last 3 months. In bivariate analysis among participants who were PEth-positive, those with the highest SDS tertile had decreased odds of reporting any recent alcohol use, compared to the lowest tertile [odds ratio (OR): 0.43 (95% confidence interval [CI]: 0.21 to 0.88] (Table 2). However, the association was attenuated and not statistically significant in the adjusted analyses (adjusted OR [aOR] 0.72 [95% CI: 0.35 to 1.48] and 0.55 [95% CI: 0.25 to 1.23] for the medium and high SDS tertiles compared to the lowest, respectively).

Among participants self-reporting any recent alcohol use, higher SDS tertile was significantly associated with lower levels of self-reported alcohol use in both bivariate and multivariable analyses. The regression coefficients for the multivariable model of AUDIT-C score were as follows: adjusted β: −0.70 (95% CI: −1.19 to −0.21) and −1.42 (95% CI: −2.05 to −0.78) for those with medium and high versus low SDS tertiles, respectively (Table 3).

The overall effect modification by gender and age of the relationship between social desirability and either any alcohol use (p-values 0.16 and 0.26) or AUDIT-C (p-values 0.10 and 0.82) did not reach statistical significance (Tables 4 and 5). However, stratified analyses conducted for descriptive purposes suggested that high social desirability may be associated with lower odds of any self-reported alcohol use among women but not men. Also, both medium and high social desirability may be associated with lower odds of any self-reported alcohol use among those <35 but not those ≥35 (Table 4). The analyses of effect modification by PEth level did not reach statistical significance for either outcome (outcome 1, $p = 0.75$; outcome 2, $p = 0.76$, data not shown).

Table 2. Unadjusted and Adjusted Odds Ratios (ORs) and 95% Confidence Intervals (CIs) for Any Self-Reported Alcohol Use in the Prior 3 Months at Baseline (Outcome 1), Among Participants Who Are PEth-Positive (≥8 ng/ml—"PEth-Confirmed Drinkers"). ($n = 430$)

	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Social desirability score		0.07		0.34
Low (1 to 8)	1.00		1.00	
Medium (9 to 10)	0.60 (0.31, 1.19)		0.72 (0.35, 1.48)	
High (11 to 13)	0.43 (0.21, 0.88)		0.55 (0.25, 1.23)	
PEth (per 50 ng/ml)	1.03 (0.99, 1.08)	0.18	1.05 (1.00, 1.11)	0.06
Gender		0.43		0.96
Women	1.00		1.00	
Men	0.79 (0.45, 1.41)		0.98 (0.50, 1.94)	
Age (years)	0.98 (0.95, 1.01)	0.13	0.98 (0.94, 1.01)	0.18
Education		0.13		0.23
Less than secondary	1.00		1.00	
Secondary or more	1.68 (0.85, 3.30)		1.63 (0.73, 3.63)	
Household asset index		0.06		0.15
Low	1.00		1.00	
Middle	2.18 (1.12, 4.21)		2.02 (1.00, 4.11)	
High	1.65 (0.77, 3.55)		1.32 (0.52, 3.31)	
Marital status		0.05		0.06
Not married	1.00		1.00	
Married	0.57 (0.32, 1.01)		0.51 (0.25, 1.03)	
Religion		0.51		0.24
Protestant	1.00		1.00	
Catholic	0.81 (0.45, 1.47)		0.71 (0.38, 1.34)	
Muslim	0.42 (0.13, 1.37)		0.27 (0.07, 1.00)	
Other	0.61 (0.07, 5.53)		0.50 (0.05, 5.23)	
Low social support?		0.88		0.57
No	1.00		1.00	
Yes	0.95 (0.48, 1.88)		0.79 (0.35, 1.77)	
Overall SRI score	0.99 (0.96, 1.02)	0.46	1.00 (0.96, 1.03)	0.78
Study		<0.01		<0.01
BREATH cohort	1.00		1.00	
BREATH comparison	0.27 (0.12, 0.60)		0.27 (0.11, 0.62)	
ADEPT cohort	0.53 (0.24, 1.15)		0.56 (0.24, 1.31)	

ADEPT, Alcohol Drinking Effects Prior to Treatment; BREATH, Biomarker Research on Ethanol Among Those with HIV; SRI, Spirituality and Religiosity Index.

DISCUSSION

We evaluated the associations of social desirability with self-reported alcohol use among HIV-positive participants in Uganda. The results of the analysis that were limited to those who were PEth-positive (i.e., those we were reasonably sure were consuming alcohol) showed that those with the highest SDS scores had decreased odds of reporting any alcohol use compared to those with the lowest SDS scores, but this association was not statistically significant in analyses adjusting for several variables, including the PEth biomarker. The results revealed a more robust association for social desirability with levels of drinking. Among participants who reported any alcohol use in the last 3 months, higher SDS scores were significantly associated with lower levels of self-reported alcohol using the AUDIT-C, by an average of 0.7 AUDIT-C points for the middle tertile of SDS scores, and 1.4 AUDIT-C points for the highest tertile of SDS scores (adjusted analysis). These findings together suggest that social desirability may be associated with how much alcohol use is reported among those who admit to drinking alcohol, but in our study where participants were aware of biomarker measurement, social desirability was not associated with whether any alcohol use was reported. Thus, for future studies measuring level of alcohol use by self-report, additionally adjusting for social desirability analytically may improve the validity of research conclusions. Also, measures that reduce social desirability during self-report may be useful in order to improve alcohol use quantification. However, measuring and/or reducing social desirability may not have an impact on determining whether any recent alcohol use has occurred.

Table 3. Unadjusted and Adjusted Linear Regression Coefficients (β) and 95% Confidence Intervals (CIs) for AUDIT-C Score for the Prior 3 Months (Outcome 2), Among Participants Who Self-Reported Any Alcohol Use in the Prior 3 Months (n = 462)

	Unadjusted β (95% CI)	p-value	Adjusted β (95% CI)	p-value
Social desirability score		<0.01		<0.01
Low (1 to 8)	Ref		Ref	
Medium (9 to 10)	−0.78 (−1.30, −0.25)		−0.70 (−1.19, −0.21)	
High (11 to 13)	−1.23 (−1.88, −0.57)		−1.42 (−2.05, −0.78)	
PEth (per 50 ng/ml)	0.10 (0.08, 0.13)	<0.01	0.09 (0.06, 0.11)	<0.01
Gender		<0.01		<0.01
Women	Ref		Ref	
Men	1.16 (0.70, 1.62)		1.40 (0.89, 1.90)	
Age (years)	0.03 (0.01, 0.06)	0.01	0.01 (−0.02, 0.03)	0.67
Education		0.83		0.54
Less than secondary	Ref		Ref	
Secondary or more	−0.05 (−0.55, 0.44)		−0.16 (−0.66, 0.35)	
Household asset index		0.50		0.30
Low	Ref		Ref	
Middle	0.24 (−0.30, 0.78)		0.35 (−0.15, 0.85)	
High	0.36 (−0.29, 1.01)		0.43 (−0.24, 1.09)	
Marital status		0.27		<0.01
Not married	Ref		Ref	
Married	−0.27 (−0.74, 0.21)		−0.82 (−1.30, −0.34)	
Religion		0.34		0.30
Protestant	Ref		Ref	
Catholic	−0.39 (−0.88, 0.10)		−0.41 (−0.85, 0.04)	
Muslim	0.43 (−1.02, 1.89)		0.06 (−1.26, 1.37)	
Other	0.37 (−1.74, 2.48)		0.36 (−1.55, 2.27)	
Low social support?		0.77		0.95
No	Ref		Ref	
Yes	0.09 (−0.49, 0.66)		−0.02 (−0.58, 0.54)	
Overall SRI score	−0.00 (−0.03, 0.02)	0.77	−0.01 (−0.03, 0.02)	0.61
Study		0.01		0.05
BREATH cohort	Ref		Ref	
BREATH comparison	−0.70 (−1.38, −0.03)		−0.50 (−1.12, 0.12)	
ADEPT	0.27 (−0.26, 0.80)		0.33 (−0.21, 0.87)	

ADEPT, Alcohol Drinking Effects Prior to Treatment; BREATH, Biomarker Research on Ethanol Among Those with HIV; SRI, Spirituality and Religiosity Index.

Table 4. Adjusted Odds Ratios (aORs) and 95% Confidence Intervals (CIs) for Any Self-Reported Alcohol Use in the Prior 3 Months at Baseline (Outcome 1), Among Participants Who Are PEth-Positive (≥8 ng/ml, "PEth-Confirmed Drinkers"). Models Stratified by Gender and Age

	Stratified by gender[a] p-value for interaction = 0.16				Stratified by age[b] p-value for interaction = 0.26			
	Women		Men		Age <35		Age ≥35	
	aOR (95% CI)	p-value	aOR (95% CI)	p-value	aOR (95% CI)	p-value	aOR (95% CI)	p-value
Social desirability score		0.09		0.76		0.09		0.98
Low (1 to 8)	1.00		1.00		1.00		1.00	
Medium (9 to 10)	0.69 (0.21, 2.30)		0.72 (0.28, 1.85)		0.33 (0.10, 1.06)		1.10 (0.39, 3.12)	
High (11 to 13)	0.23 (0.06, 0.87)		0.95 (0.32, 2.81)		0.27 (0.07, 0.95)		1.04 (0.32, 3.32)	

[a]Stratified models adjusted for PEth, age, education, economic assets, marital status, religion, spirituality/religiosity, social support, and study.
[b]Stratified models adjusted for PEth, gender, education, economic assets, marital status, religion, spirituality/religiosity, social support, and study.

Thus, objective measures and/or alcohol biomarkers or other interventions that encourage reporting, such as a bogus pipeline, in which the threat of biologically validating a reported behavior encourages truthful reporting (Adams et al., 2008), may be needed.

We conducted exploratory analyses of effect modification by gender and by age-group. While we found no statistically significant effect modification overall, stratified analyses suggested that women and those <35 years old who had the highest tertile SDS scores had lower odds of self-reporting any alcohol use compared to those in the lower tertile of SDS scores. The direction of this association was similar (although attenuated and not significant) among men. Among those ≥35 years, no associations between SDS tertiles and self-reporting any alcohol use were detected. These findings among women and younger participants are consistent with the higher level of stigma associated with alcohol use for women compared to men in Uganda (Kabwama et al., 2016), and possible increased impression management among younger persons (Davis et al., 2010). The study

Table 5. Adjusted Linear Regression Coefficients (β) and 95% Confidence Intervals (CIs) for Self-Reported Recent Alcohol Use (AUDIT-C, Outcome 2), Among Participants Who Self-Reported Any Alcohol Use in the Prior 3 Months. Models Stratified by Gender and Age

	Stratified by gender[a] *p*-value for interaction = 0.10				Stratified by age[b] *p*-value for interaction = 0.82			
	Women		Men		Age < 35		Age >=35	
	Adjusted β (95% CI)	*p*-value	Adjusted β (95% CI)	*p*-value	Adjusted β (95% CI)	*p*-value	Adjusted β (95% CI)	*p*-value
Social desirability score		<0.01		<0.01		<0.01		<0.01
Low (1 to 8)	Ref		Ref		Ref		Ref	
Medium (9 to 10)	−1.11 (−1.70, −0.52)		−0.23 (−1.04, 0.58)		−0.61 (−1.22, 0.00)		−0.93 (−1.77, −0.10)	
High (11 to 13)	−1.15 (−2.06, −0.24)		−1.44 (−2.39, −0.49)		−1.38 (−2.18, −0.58)		−1.65 (−2.72, −0.58)	

[a]Stratified models adjusted for PEth, age, education, economic assets, marital status, religion, spirituality/religiosity, social support, and study.
[b]Stratified models adjusted for PEth, gender, education, economic assets, marital status, religion, spirituality/religiosity, social support, and study.

findings suggest that the effects of social desirability on alcohol use reporting may vary by subgroup; however, further research is needed to explore gender and age differences in how alcohol use is reported.

Several study limitations merit discussion. First, these findings may be specific to the setting of HIV care and/or the setting of semirural Uganda. Social desirability may be more salient in this setting. Alcohol use among persons living with HIV in Uganda is advised against (Ministry of Health UGANDA, 2016), and clinic-based group health education includes focus on the negative effects of alcohol use on HIV disease and its interaction with ART, which may lead to the perceived need to minimize reporting of alcohol use. Previous studies using PEth have shown that many persons with HIV in Uganda and elsewhere underreport alcohol consumption (Asiimwe et al., 2015; Bajunirwe et al., 2014; Magidson et al., 2018; Papas et al., 2016), particularly to clinic healthcare providers (Muyindike et al., 2017). These data were collected prior to 2016, when ART initiation became universal upon clinic entry in Uganda, after the implementation of the World Health Organization HIV treatment guidelines (Ministry of Health UGANDA, 2016). Thus, individuals presenting to the clinic could have perceived that self-reported alcohol use might impact the clinical recommendation for ART prescription.

Participants were informed during the consent process that a breathalyzer test would be performed and also that blood samples collected would be used to test for prior 2 to 3 weeks of alcohol use. This may have resulted in higher levels of reporting of alcohol use than would have been found in settings without breathalyzers or biomarker specimen collection (Hahn et al., 2012). This may explain the relatively low levels of denial of any alcohol use (outcome 1) among those testing PEth-positive (13%), and the lack of significant association of social desirability with reporting any alcohol use.

A further limitation was the poor internal consistency of the 13-item SDS we used in our study (Cronbach's $\alpha = 0.44$). Although we conducted cognitive interviewing (Gordon, 2005) for the scale prior to launching the study, which confirmed good understanding of the scale items, internal consistency analysis could only be conducted after data collection. The low reliability coefficient suggests we may not have been adequately measuring the general construct of social desirability. A longer 28-item version of the scale has been used in this setting with better reliability ($\alpha = 0.70$; Vu et al., 2011), suggesting that a scale with more items may be needed in future studies. Psychometric validation of self-report scales is an ongoing research need in this setting, and a more extensive evaluation of the SDS may be required to confirm the findings we report here.

A strength of the study was its use of a sensitive and specific biomarker of alcohol use to include an objective measure of alcohol consumption, PEth. This enabled us to compare self-reported alcohol use among participants with likely similar alcohol consumption levels.

In conclusion, social desirability was not significantly associated with any recent self-reported alcohol use overall, although stratified analyses suggested that it might be a predictor of denying alcohol use among women and younger patients, with the magnitude of these associations appearing strongest among these groups in descriptive, exploratory analyses. Among those who self-reported any recent alcohol use, higher social desirability was associated with lower levels of self-reported alcohol use. Thus, social desirability may have a role in minimizing reporting the amount of alcohol consumed. This suggests some possible pathways for improving measurement of alcohol use. When possible, objective measures of alcohol use should be used. In situations where biomarkers or other objective measures are not feasible, methods are needed to improve the accuracy of alcohol self-report. The design of alcohol assessment tools or interview methods that minimize social desirability may be helpful. These may include the use of self-administered surveys, which have been shown to increase the rate of reporting of stigmatized behaviors (Anton, 1985); these surveys may possibly be embedded within larger health surveys to reduce socially desirable reporting. Bogus pipelines such as the use of breathalyzers may also be considered. In the HIV research setting, implementing SDSs may enable examination of their

use in analyses, serving to adjust drinking levels among those who do report any recent drinking by their level of social desirability.

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CONFLICT OF INTEREST

None declared.

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