






# Overestimation of alcohol consumption norms as a driver of alcohol consumption: a whole-population network study of men across eight villages in rural, southwestern Uganda

Jessica M. Perkins<sup>1,2</sup> , Bernard Kakuhihikire<sup>3</sup>, Charles Baguma<sup>3</sup>, Jordan Jurinsky<sup>1</sup> , Justin D. Rasmussen<sup>4</sup>, Emily N. Satinsky<sup>5</sup> , Elizabeth Namara<sup>3</sup>, Phionah Ahereza<sup>3</sup>, Viola Kyokunda<sup>3</sup>, H. Wesley Perkins<sup>6</sup>, Judith A. Hahn<sup>7</sup> , David R. Bangsberg<sup>3,8</sup> & Alexander C. Tsai<sup>3,5,9,10</sup> 

## ABSTRACT

**Background and aims** Little is known about how perceived norms about alcohol consumption may influence high alcohol consumption rates in Uganda. This study estimated the accuracy of perceived norms about men's alcohol consumption and estimated the association between perceived norms and personal alcohol consumption. **Design** Cross-sectional, whole-population, sociocentric social network study. **Setting** Eight rural villages in Rwampara District, southwestern Uganda in 2016–18. **Participants** A total of 719 men aged 18 years and older (representing 91% of permanent resident men). **Measurements** Self-reported frequent ( $\geq 4$  days per week) and heavy alcohol consumption (six or more drinks on one occasion, more than three occasions of intoxication, or spending an excessive amount on alcohol). Participants also reported whether they thought most other men in their village engaged in frequent and heavy alcohol consumption (perceived norms). Using the network study design, we calculated alcohol consumption behavior within villages and social networks. Perceived norms were compared with aggregated self-reports. Multivariable Poisson regression models were used to estimate the association between perceived norms and individual behavior. **Findings** Throughout villages, frequent and heavy alcohol consumption ranged from 7 to 37%. However, 527 (74%) participants perceived, contrary to fact, that most other men in their villages frequently consumed alcohol, and 576 (81%) perceived that most others heavily consumed alcohol. Overestimation of alcohol consumption by others was pervasive among socio-demographic subgroups and was present irrespective of the actual consumption behavior at the village level and within social networks. Men who misperceived these alcohol consumption behaviors as being common were more likely to engage in frequent [adjusted relative risk (aRR) = 3.98; 95% confidence interval (CI) = 1.69–9.34] and heavy (aRR = 4.75; 95% CI = 2.33–9.69) alcohol consumption themselves. **Conclusions** Most men in eight rural Ugandan villages incorrectly thought that frequent and heavy alcohol consumption were common among men in their villages. These misperceived norms had a strong positive association with individual drinking behavior.

**Keywords** Alcohol consumption, alcohol use, binge drinking, descriptive norms, misperception, perceived norms, social networks, social norms, sub-Saharan Africa, Uganda.

Correspondence to: Dr Jessica M. Perkins, Peabody College of Education and Human Development, Vanderbilt University, Nashville, TN, USA.

E-mail: jessica.m.perkins@vanderbilt.edu

Submitted 7 December 2020; initial review completed 20 January 2021; final version accepted 9 May 2021

## INTRODUCTION

During the last several decades, the commercial availability of alcohol has expanded across sub-Saharan Africa. Increases in alcohol marketing, alcohol industry influence, and alcohol consumption have accompanied this expansion [1–3]. Updates to national alcohol regulatory frameworks, however, have lagged [4]. Meanwhile, the

availability of treatment and support for people with alcohol use disorders remains limited [5]. Moreover, stigma attached to alcohol use and mental disorders is pervasive and undermines treatment-seeking [6–8].

Uganda has one of the highest per-capita rates of alcohol consumption among men in sub-Saharan Africa [9]. While fewer than 8% of women report heavy drinking in Uganda, one in three men report heavy episodic

drinking and one in 10 are classified as having alcohol use disorder [9,10]. Despite these high rates, Uganda has few alcohol use disorder treatment programs and most are particularly inaccessible in rural areas [11]. Identifying novel entry points to reduce harmful levels of alcohol consumption among men in this context is critical for reducing personal alcohol-related harms associated with consumption [12], as well as reducing negative consequences for others, such as HIV transmission [13] and intimate partner violence [14]. Perceived norms about alcohol consumption in this context may be an understudied key factor in determining alcohol consumption behaviors among men in Uganda.

### Conceptual framework

People often incorrectly perceive the extent to which health behaviors among peers are normative, i.e. which health behaviors or health risk behaviors are widely prevalent among their peers [15–18]. College students in the United States and Europe represent the canonical example of this phenomenon: studies have consistently found that college students believe that heavy alcohol consumption is more common among their peers than is actually true [17]. Moreover, individuals' perceptions concerning typical alcohol consumption behavior are strongly associated with their own alcohol consumption behavior [19–24]. This body of research has focused primarily upon studying alcohol consumption among young adults within educational or other institutional settings in high-income countries.

Emerging literature from sub-Saharan Africa has provided parallel evidence consistent with these findings. First, people overestimate the prevalence of high-risk or harmful behaviors and underestimate the prevalence of protective behaviors, in relation to HIV [25–29] and other health conditions of interest [30]. These studies also show evidence of associations between norm perceptions and individual behavior. Secondly, field experiments investigating expressions of dissent, conflict resolution, corruption, and violence against women find associations between changes in perceived norms and changes in individual attitudes and behaviors [31–34]. However, the extent to which alcohol consumption norms are misperceived—and the the role of this misperception in driving individual alcohol consumption—have not been studied within a general population sample in sub-Saharan Africa.

Additionally, no studies have assessed the extent to which exposure to alcohol consumption by others, either during childhood or adulthood, may confound estimates of the association between perceived norms about alcohol consumption and individual alcohol consumption. However, exposure to others' alcohol consumption is associated with both perceived norms [35, 36] and individual alcohol

consumption [37–39]. Failure to properly adjust for exposure to alcohol consumption by others may bias (away from the null) estimates of the association between perceived norms and individual consumption.

The relevance of this body of research for prevention of alcohol-related harms is clear: if men in Uganda overestimate alcohol consumption norms among their peers, and this misperception is a significant driver of their own heavy alcohol consumption, then the 'social norms approach' might be used to correct misperceived alcohol consumption norms and, ultimately, change behavior [40]. In contrast to interventions that aim to educate people about the harmful biological effects of alcohol consumption or to persuade people about the risks of heavy consumption, 'social norms' interventions provide information about how peers actually consume less alcohol than is commonly believed [40–43]. This intervention approach has primarily been used to reduce high-risk alcohol consumption among college students [17,18,44–46] but has also gained traction in other contexts [47–57].

For this study, we analysed data about perceived alcohol consumption norms and personal reports of alcohol consumption from individuals and peers in an ongoing whole-population, sociocentric social network study of adults in rural Uganda [58]. The study design uniquely allowed us to collect and compare measures of exposure with perceived norms and estimate their associations with personal consumption. This study focused only upon alcohol consumption behavior among men, because self-report of potentially harmful levels of alcohol use is rare among women in this setting in Uganda. We hypothesized that most men would not report frequent or heavy alcohol consumption, that men across the whole population perceive that most other men in their villages engage in frequent and heavy consumption of alcohol, and that individual alcohol consumption behavior would be associated with one's perception of alcohol consumption norms (after adjusting for exposure and other factors).

## METHODS

### Study population and procedure

We conducted a cross-sectional, whole-population study among all adult residents aged 18 years and older in eight villages in one administrative parish in Rwampara District, a rural region in southwestern Uganda. This parish, located approximately 20 km from the local commercial hub of Mbarara Town, was selected due to its tractable population and geographic size, the lack of non-profit and intervention presence in the parish, and its similarity to other rural areas in Uganda where most Ugandans reside [59]. Additionally, this region is similar to other low-resource rural contexts in sub-Saharan Africa in that most households engage in an agriculture-based economy

or small-scale trading/enterprise, household food and water insecurity are common, and access to electricity and piped water is rare [59–62].

Research assistants who spoke the local language (Runyankore) collected data in 2016–18. Using a continuously updated parish census list of eligible adult residents, a research assistant approached a potential participant typically at their home and asked the person to participate in a study about health and wellbeing after undergoing an informed consent process. A signature or a thumbprint indicating consent to participate was obtained. Data were collected with a computer-assisted, survey-based interview tool. Survey questions had been written in English, translated into Runyankore and then back-translated to English to verify the translation's fidelity. Question piloting and translation followed an iterative process.

The network study design entailed using name generator questions to elicit the names of other adult parish residents with whom a participant directly interacted [63]. These questions focused upon social interactions related to social exchange, food exchange, financial discussions, health discussions, and emotional support [58,64]. Another question elicited the names of any spouses. Participants provided confirmation of responses via a photographic search function on the computer. All responses represented out-going personal network ties, and were collapsed across the six name generator questions [65]. Information was also available regarding incoming personal network ties because all the eligible nominations were also eligible study participants due to the sociocentric network design of the study, which targets everyone within a specific boundary [63,64]. Thus, the set of unique direct ties to a participant, regardless of tie direction, represented a participant's personal network [66]. Ties to people who did not participate in the study were excluded, as were ties to women, because this study focused upon men. Additionally, data self-reported by participants within a participant's personal network were linked to the index participant.

Ethical approval was granted by the Partners Human Research Committee at Massachusetts General Hospital, the Research Ethics Committee at Mbarara University of Science and Technology and the Vanderbilt Human Research Protections Program. We also received clearance from the Uganda National Council of Science and Technology and the Research Secretariat in the Office of the President of the Republic of Uganda. The analyses were not pre-registered; therefore, the results should be considered exploratory.

## Measures

### *Alcohol consumption behavior*

The primary outcomes for this analysis were frequent alcohol consumption and heavy alcohol consumption.

Participants reported their own frequency of alcohol consumption using the following categories as response options: within the past year (once a month or less, two to four times per month, two to three times per week and four or more times per week), 1–5 years prior to interview, more than 5 years prior and never. We defined frequent alcohol consumption as consuming alcohol four or more times per week (versus two to three times per week or less). This threshold was based on a prior study of alcohol consumption across 35 countries (including Uganda) classifying high-frequency drinking as five or more times per week [67].

Among participants who reported alcohol consumption within the past year, we administered a locally derived scale consisting of three items about alcohol consumption behavior [68]: consuming six or more drinks in a single sitting in the past 12 months; spending  $\geq 25\,000$  Ugandan shillings (approximately \$10 at the time of the survey) on alcohol in the past 30 days; or being intoxicated on three or more of the past 30 days. The first item was the only one to refer to 'drinks', and therefore also included these additional instructions: 'I understand that you may share drinks and that some drinks have different sizes. For the purposes of this question, "one drink" should be considered equal to 1 shot or 1 tot of a strong alcoholic drink like waragi or vodka, or 1 full glass of a light alcoholic drink like beer'. This instruction was pilot-tested. The definition gave participants a sense of the large quantity of alcohol that six or more drinks represented when thinking about their response to the first item. We defined heavy alcohol consumption as reporting at least one of these three behaviors [68]. This study did not collect the number of alcoholic drinks typically consumed, because alcoholic drinks of non-standardized quantities and types are commonly consumed in this context [69].

We used these individual-level data to calculate population-level norms of alcohol consumption behavior at the village level. Frequent alcohol consumption was considered normative in a village if  $> 50\%$  of men in the village reported frequent consumption of alcohol. The population-level norm for heavy alcohol consumption was defined similarly. This  $> 50\%$  threshold to identify population norms has been used in the social norms literature, both in Uganda [25,30] and in other settings [70–72].

We then combined the individual-level data with personal network data to calculate the number of male alters (i.e., men in the index participant's personal network) who reported frequent alcohol consumption and the number of male alters who reported heavy alcohol consumption. We also created two binary variables: exposure (versus no exposure) to at least one male alter who reported frequent alcohol consumption and exposure (versus no exposure) to at least one male alter who reported heavy alcohol consumption.

#### *Perceived norms about alcohol consumption behavior*

Four questions elicited participants' perceptions about norms of alcohol consumption among other men in their villages. They were asked to report their perceptions of the frequency with which most other adult men in their village consumed any alcohol, consumed six or more drinks in a single sitting, spent  $\geq 25\,000$  Ugandan shillings on alcohol in the past 30 days, or were intoxicated on three or more of the past 30 days. 'Other adult men in your village' was set as the social reference group [73,74]. Our pre-testing questionnaire suggested that this reference group was easily understood by participants as a group to which they they belonged [50]. Responses about perceived norms were re-coded in the same way as personal reports.

To identify misperceived norms, we compared participants' perceptions about most other men's alcohol consumption behavior against the actual population norms of alcohol consumption behavior at the village level. Take, for example, a participant who lived in a village where heavy alcohol consumption was not normative. If this participant mistakenly perceived that most other men in their village engaged in heavy alcohol consumption, then this participant would be considered as misperceiving the norm (in this case, overestimating the extent to which heavy alcohol consumption was normative). This approach to measuring misperceived norms draws upon methods from previous studies in this setting [8,25,75] and elsewhere [30,76–79].

#### *Additional covariates*

To adjust for other sources of potential exposure, we asked participants to report whether they had lived during childhood with an adult who consumed alcohol excessively or misused drugs. Married or cohabiting participants were also asked whether they believed their partner engaged in any past-year alcohol consumption.

To adjust for personal attitudes about alcohol consumption, we asked participants how they personally felt about intoxication among men, using a Likert scale. Due to skewness in responses, we grouped together the responses 'never okay to drink' and 'okay to drink but not to get drunk' into one category ('thought intoxication was not okay') and 'okay to get occasionally drunk as long as it does not interfere with responsibilities', 'okay to get drunk even if it interferes with responsibilities' and 'a frequent drink is okay if that is what the individual wants to do' into the other category ('thought intoxication was okay'). This question was adapted by locally piloting a version similar to one used in the United States [80].

Finally, participants reported their religion, education (completed primary school versus did not complete primary school), marital status, and HIV status (negative, positive, unknown). Household wealth quintile was created

using a household asset-based index [81]. A positive symptom screen for depression was measured using a locally adapted depression subscale of the Hopkins Symptom Checklist [82]. The total number of male alters in a participant's personal network and village of residence were also recorded.

#### **Statistical analysis**

We first examined the prevalence of alcohol consumption behavior and perceived norms of alcohol consumption behavior within socio-demographic, exposure, and attitude categories. To estimate the association between reported consumption and perceived norms, we fitted Poisson regression models with cluster-correlated robust estimates of variance to adjust for clustering at the village level. The primary outcomes for these analyses were the binary variables for frequent and heavy alcohol consumption. With a binary-dependent variable, the modified Poisson regression model has been shown to yield estimated incidence rate ratios that can be interpreted straightforwardly as relative risk ratios [83]. The primary explanatory variable of interest was misperceiving alcohol consumption norms (binary). Regression models adjusted for socio-demographic factors, exposure to alcohol consumption behavior of others and personal attitudes about intoxication. Analyses were conducted with Stata version 16 [84].

We conducted several sensitivity analyses to assess the robustness of our findings. First, we excluded 39 participants who reported belonging to a traditionally abstinent religion (Born-Again Pentecostal, Muslim, Seventh-Day Adventist) [85–89]. We then included religion (Catholic, Protestant, other) in the regression models. Secondly, we re-fitted the regression models to data for only married/cohabiting men. In these regression models we additionally adjusted for perception of their partner's alcohol consumption. Thirdly, we reclassified frequent alcohol consumption as two or more times per week for both the outcome and main explanatory variable and re-fitted the general model. Fourthly, we fitted linear probability models with identical outcomes and explanatory variables and village fixed effects, and accounted for network autocorrelation by specifying a weight based on an adjacency matrix (using the *lnam* package in R) [90]. Finally, based on results from the primary regression analyses, we used methods proposed by Vanderweele & Ding to calculate the e-value [91,92], which represents the minimum strength of association (on the risk ratio scale) that an unobserved confounder would need to have with both the exposure (norm misperception) and the outcomes (frequent or heavy alcohol consumption) to completely account for the estimated associations, conditional upon the included covariates.

## RESULTS

From 2016 to 2018, 719 men were interviewed (91% response rate), with 57 to 117 men interviewed per village. One person was deemed ineligible for the study because he was acutely intoxicated at each of multiple interview attempts. While everyone responded to the items about personal alcohol consumption, five did not report their perception about norms of frequent alcohol consumption and six did not report their perception about norms of heavy alcohol consumption. Fewer than 1% of observations for other variables were missing. The mean age was 40 years [standard deviation (SD) = 16], most participants [489 (68%)] had completed primary school or more and most [468 (65%)] were married/cohabiting. The median number of male alters was five [interquartile range (IQR) = 3–8]. While most men identified as Protestant [503 (70%)] or Catholic [174 (24%)], 39 (5%) identified as adherents of traditionally abstinent religions [Born-Again Pentecostal ( $n = 29$ ), Muslim ( $n = 9$ ) and Seventh-Day Adventist ( $n = 1$ )]. None of the participants from traditionally abstinent religions reported frequent alcohol consumption and only one reported heavy alcohol consumption. Most participants [455 (63%)] did not think intoxication was okay.

Overall, 377 men (52%) reported consuming alcohol within the past 12 months, 86 men (12%) reported frequent alcohol consumption, and 181 (25%) reported heavy alcohol consumption. Nineteen men (3%) reported frequent but not heavy alcohol consumption, 114 (16%) men reported heavy but not frequent alcohol consumption, and 67 men (9%) reported both frequent and heavy alcohol consumption. The median number of male alters who reported frequent alcohol consumption was 0 (IQR = 0–1), and the median number of male alters who reported heavy consumption was 1 (IQR = 0–2).

The prevalence of self-reported frequent and heavy alcohol consumption ranged from 0 to 44% across socio-demographic subgroups (Table 1). Across villages, 7–24% of men reported frequent alcohol consumption and 16–37% of men reported heavy alcohol consumption. Thus, by definition, neither frequent nor heavy alcohol consumption were normative (because each was reported by fewer than 50% of men within each village). Moreover, even when a less stringent threshold was used to define frequent consumption (two or more times per week), this behavior was not normative in any village (i.e. the prevalence of frequent alcohol consumption according to this lower threshold ranged from 22–43% across villages).

While the population data demonstrated that frequent and heavy alcohol consumption were not normative, 527 men (74%) incorrectly thought that most adult men in their own village engaged in frequent alcohol

consumption, and 576 men (81%) incorrectly thought that most adult men in their own village engaged in heavy alcohol consumption. Most men misperceived alcohol consumption norms by overestimating rates of potentially harmful consumption, irrespective of socio-demographic and other subgroups (Table 2).

In a multivariable Poisson regression model, misperceiving the norm was associated with a greater risk of frequent alcohol consumption after adjustment for socio-demographic factors [adjusted relative risk (aRR) = 3.82; 95% confidence interval (CI) = 1.61–9.09]. After additionally adjusting for personal attitudes about intoxication and exposure to others' consumption behavior, the estimated association remained statistically significant (aRR = 3.98; 95% CI = 1.69–9.34) (Table 3). Similarly, misperceiving the norm was associated with a greater risk of heavy alcohol consumption in the fully adjusted multivariable regression model (aRR = 4.75; 95% CI = 2.33–9.69) (Table 4).

Results from sensitivity analyses suggest that our findings remained qualitatively similar after excluding men belonging to traditionally abstinent religions (Supporting information, Table S1) and in the subgroup of married/cohabiting men (Supporting information, Table S2). Additionally, the pattern of results remained similar when we defined frequent consumption as two or more times per week for the whole population (Supporting information, Table S3), when we included the number of male alters who reported frequent consumption and heavy consumption (instead of the binary variables for exposure to at least one male alter who reported frequent consumption and heavy alcohol consumption) (Supporting information, Table S4), and when we accounted for network autocorrelation (Supporting information, Table S5). Finally, we calculated an e-value of 7.42 for the frequent alcohol consumption model and an e-value of 8.97 for the heavy alcohol consumption model. These e-values suggest that an unobserved confounder would need to have an estimated association with both one's own alcohol consumption behavior and perceived norm exceeding 7, on the risk ratio scale, to shift the associations estimated in our study to a null risk ratio of 1. Alternatively, an unobserved confounder would need to have an estimated association with both one's own alcohol consumption behavior and perceived norm exceeding 2.5 on the risk ratio scale to shift the associations estimated in our study to such a degree that the 95% CI could completely exclude a null risk ratio of 1.

## DISCUSSION

In this whole-population network study of men among eight villages in rural Uganda, 25% reported heavy alcohol consumption and 12% reported frequent alcohol

**Table 1** Prevalence of self-reported frequent and heavy alcohol consumption among men in eight villages in Rwampara District, southwest Uganda ( $n = 719$ ).

	<i>n (%)</i>		<i>n (%) Reporting personal</i>			
	<i>Participants</i>		<i>frequent alcohol consumption</i>		<i>heavy alcohol consumption</i>	
<i>Total</i>	719	(100%)	86	(12%)	181	(25%)
<b>Age (years)</b>						
18–25	160	(22%)	11	(7%)	36	(23%)
26–35	174	(24%)	21	(12%)	44	(25%)
36–45	139	(19%)	15	(11%)	39	(28%)
46–55	126	(18%)	21	(17%)	34	(27%)
≥ 56	115	(16%)	17	(15%)	26	(23%)
<b>Marital status</b>						
Not married/cohabiting	251	(35%)	30	(12%)	68	(27%)
Married/cohabiting as if married	468	(65%)	56	(12%)	113	(24%)
<b>Religion</b>						
Protestant	503	(70%)	58	(12%)	120	(24%)
Catholic	174	(24%)	28	(16%)	60	(34%)
Born-again Pentecostal	9	(1%)	0	(0%)	1	(11%)
Muslim	29	(4%)	0	(0%)	0	(0%)
Other (not religious; other; Seventh-Day Adventist)	4	(1%)	0	(0%)	0	(0%)
<b>Education</b>						
None/some primary education	230	(32%)	36	(16%)	64	(28%)
Completed primary education or more	489	(68%)	50	(10%)	117	(24%)
<b>Household asset wealth</b>						
1st quintile (poorest)	123	(17%)	26	(21%)	44	(36%)
2nd quintile	145	(20%)	18	(12%)	43	(30%)
3rd quintile	136	(19%)	12	(9%)	27	(20%)
4th quintile	156	(22%)	20	(13%)	40	(26%)
5th quintile (least poor)	159	(22%)	10	(6%)	27	(17%)
<b>Personal attitudes about intoxication</b>						
Did not think intoxication was okay	455	(63%)	27	(6%)	74	(16%)
Thought intoxication was okay	264	(37%)	59	(22%)	107	(41%)
<b>Had childhood exposure to adult who consumed alcohol excessively or who misused drugs</b>						
No	297	(41%)	30	(10%)	57	(19%)
Yes	421	(59%)	56	(13%)	123	(29%)
<b>Participant reported spouse/partner to have consumed alcohol in past 12 months (among married or cohabiting men only, <math>n = 468</math>)</b>						
No	266	(58%)	24	(9%)	53	(20%)
Yes	194	(42%)	30	(15%)	58	(30%)
<b>Personal network size</b>						
0–2 male alters	107	(15%)	7	(7%)	16	(15%)
3–8 male alters	433	(60%)	56	(13%)	125	(29%)
≥ 9 male alters	179	(25%)	23	(13%)	40	(22%)
<b>Exposure to frequent alcohol consumption by men in personal network</b>						
No male alters reported frequent alcohol consumption	370	(51%)	23	(6%)	–	–
At least one male alter reported frequent consumption	349	(49%)	63	(18%)	–	–
<b>Exposure to heavy alcohol consumption by men in personal network</b>						
No male alters reported heavy alcohol consumption	192	(27%)	–	–	29	(15%)
At least one male alter reported heavy alcohol consumption	527	(73%)	–	–	152	(29%)

Frequent alcohol consumption was defined as alcohol consumption four or more times per week. Heavy alcohol consumption was defined as reporting consumption of six or more drinks on one occasion at least once in the past 12 months, spending excessive money on alcohol in the past 30 days, or being intoxicated three or more times in the past 30 days.

consumption. However, most men overestimated local population rates of potentially harmful alcohol consumption behavior and mistakenly thought that heavy and frequent

alcohol consumption were normative among men in their village. These norm misperceptions were pervasive across social strata and strongly correlated with individual

**Table 2** Misperceptions of normative alcohol consumption behavior among men in eight villages in Rwampara District, southwest Uganda ( $n = 719$ ).

	<i>Participants who misperceived frequent alcohol consumption as the norm</i>		<i>Participants who misperceived heavy alcohol consumption as the norm</i>	
	<i>n</i>	<i>(%)</i>	<i>n</i>	<i>(%)</i>
Total	527	(74%)	576	(81%)
Age (years)				
18–25	119	(75%)	136	(85%)
26–35	131	(76%)	144	(85%)
36–45	96	(70%)	108	(78%)
46–55	92	(73%)	99	(79%)
≥ 56	85	(75%)	84	(74%)
Marital status				
Not married/cohabiting	183	(73%)	206	(83%)
Married/cohabiting as if married	344	(74%)	370	(80%)
Religion				
Protestant	353	(71%)	392	(79%)
Catholic	142	(82%)	151	(87%)
Born-again Pentecostal	8	(89%)	9	(100%)
Muslim	22	(76%)	22	(79%)
Other (not religious; other; Seventh-Day Adventist)	2	(50%)	2	(50%)
Education				
None/some primary education	186	(81%)	197	(86%)
Completed primary education or more	341	(70%)	379	(78%)
Household asset wealth				
1st quintile (poorest)	97	(80%)	104	(85%)
2nd quintile	110	(76%)	118	(82%)
3rd quintile	94	(70%)	108	(80%)
4th quintile	107	(69%)	120	(77%)
5th quintile (least poor)	119	(75%)	126	(80%)
Personal attitudes about intoxication				
Did not think intoxication was okay	333	(74%)	357	(79%)
Thought intoxication was okay	194	(74%)	219	(84%)
Had childhood exposure to adult who consumed alcohol excessively or who misused drugs				
No	212	(72%)	230	(78%)
Yes	314	(75%)	345	(83%)
Participant reported spouse/partner to have consumed alcohol in past 12 months (among married or cohabiting men only, $n = 467$ )				
No	189	(72%)	209	(79%)
Yes	151	(78%)	157	(81%)
Personal network size				
0–2 male alters	80	(76%)	85	(82%)
3–8 male alters	325	(75%)	347	(81%)
≥ 9 male alters	122	(69%)	144	(81%)
Exposure to frequent alcohol consumption by men in personal network				
No male alters reported frequent alcohol consumption	263	(72%)	–	–
At least one male alter reported frequent consumption	264	(76%)	–	–
Exposure to heavy alcohol consumption by men in personal network				
No male alters reported heavy alcohol consumption	–	–	150	(80%)
At least one male alter reported heavy alcohol consumption	–	–	426	(81%)

Frequent alcohol consumption was defined as alcohol consumption four or more times per week. Heavy alcohol consumption was defined as reporting consumption of six or more drinks on one occasion at least once in the past 12 months, spending excessive money on alcohol in the past 30 days, or being intoxicated three or more times in the past 30 days.

alcohol consumption behavior. The estimated associations were statistically significant, large in magnitude, and robust to potential confounding by unobserved variables.

Our study extends the literature on perceived norms and alcohol consumption in two key ways. First, we provide strong evidence of these phenomena in a general adult

**Table 3** Modified Poisson regression models estimating associations between perceived norms and frequent alcohol consumption among men in eight villages in Rwampara District, southwestern Uganda.

	<i>Frequent alcohol consumption</i>		
	<i>(n = 708)</i>		
	<i>aRR</i>	<i>95% CI</i>	<i>P-value</i>
Perceived norm			
Incorrectly thought that most men in own village consume alcohol frequently	3.98	1.69, 9.34	0.002
Correctly thought that frequent alcohol consumption was not the norm	Ref		
Exposure to frequent alcohol consumption by men in personal network			
At least one male alter reported frequent alcohol consumption	2.43	1.56, 3.79	< 0.001
No male alters reported frequent alcohol consumption	Ref		
Personal attitude about intoxication			
Thought intoxication was okay	3.58	2.50, 5.12	< 0.001
Did not think intoxication was okay	Ref		
Number of male alters in personal social network	1.01	1.00, 1.03	0.121
Childhood exposure to adult who consumed alcohol excessively or who misused drugs			
Had exposure	1.22	0.85, 1.76	0.278
Did not have exposure	Ref		
Self-reported HIV serostatus			
HIV serostatus unknown	1.95	1.50, 2.52	< 0.001
HIV-positive	1.60	1.02, 2.50	0.039
HIV-negative	Ref		
Depression status			
Symptoms indicate probable depression	0.96	0.48, 1.92	0.918
Symptoms did not indicate probable depression	Ref		
Age (years)	1.01	1.00, 1.02	0.036
Marital status			
Married/cohabiting	0.85	0.69, 1.05	0.133
Divorced/separated/single	Ref		
Education level			
Completed primary education	0.96	0.64, 1.43	0.828
Did not complete primary education	Ref		
Household asset wealth			
1st quintile (poorest)	2.23	1.34, 3.71	0.002
2nd quintile	1.46	0.97, 2.21	0.072
3rd quintile	1.35	0.94, 1.93	0.104
4th quintile	1.87	1.04, 3.38	0.037
5th quintile (least poor)	Ref		

Each column represents one multivariable Poisson regression model fitted to the data. aRR = adjusted relative risk ratio; CI = confidence interval. Ref = reference category for dichotomous and categorical variables. Frequent alcohol consumption was defined as alcohol consumption four or more times per week.

population of men in a low-resource setting in sub-Saharan Africa. Our findings are consistent with research on alcohol consumption among college students in other contexts [17,93] and with perceived social pressure to consume alcohol in Uganda [94]. Secondly, we provide initial evidence that perceptions concerning consumption within a population-based social reference group substantially matter for individual behavior regardless of consumption behavior by family members or network ties.

Taken together, these novel findings offer considerable support for a population-wide social norms approach to

reduce frequent and heavy alcohol consumption among men in rural Uganda. Communicating true alcohol consumption norms that represent moderate (or less) consumption behavior across the population could be especially effective, given that most men already think intoxication is not acceptable, especially when it interferes with responsibilities. Additionally, reducing alcohol consumption by focusing upon positive community norms may be more palatable in this context than discussing alcohol use disorder directly, given the high stigma associated with mental and behavioral health issues [6–8]. Exemplar messages might take the form of:



**Table 4** Modified Poisson regression models estimating associations between perceived norms and heavy alcohol consumption among men in eight villages in Rwampara District, southwestern Uganda.

	<i>Heavy alcohol consumption</i>		
	<i>(n = 707)</i>		
	<i>aRR</i>	<i>95% CI</i>	<i>P-value</i>
Perceived norm			
Incorrectly thought that most men in own village consume alcohol heavily	4.75	2.33, 9.69	< 0.001
Correctly thought that heavy alcohol consumption was not the norm	Ref		
Exposure to heavy alcohol consumption by men in personal network			
At least one male alter reported heavy alcohol consumption	1.59	0.95, 2.64	0.075
No male alters reported heavy alcohol consumption	Ref		
Personal attitude about intoxication			
Thought intoxication was okay	2.21	1.98, 2.48	< 0.001
Did not think intoxication was okay	Ref		
Number of male alters in personal social network	0.99	0.98, 1.01	0.483
Childhood exposure to adult who consumed alcohol excessively or who misused drugs			
Had exposure	1.34	0.94, 1.91	0.106
Did not have exposure	Ref		
Self-reported HIV serostatus			
HIV serostatus unknown	1.73	1.53, 1.97	< 0.001
HIV positive	0.92	0.57, 1.49	0.743
HIV negative	Ref		
Depression status			
Symptoms indicate probable depression	1.19	0.80, 1.78	0.389
Symptoms did not indicate probable depression	Ref		
Age (in years)	1.00	1.00, 1.01	0.182
Marital status			
Married/cohabiting	0.95	0.75, 1.20	0.658
Divorced/separated/single	Ref		
Education level			
Completed primary education	1.10	0.74, 1.64	0.640
Did not complete primary education	Ref		
Household asset wealth			
1st quintile (poorest)	1.47	1.15, 1.89	0.003
2nd quintile	1.41	1.00, 2.00	0.051
3rd quintile	1.05	0.78, 1.43	0.740
4th quintile	1.36	1.04, 1.77	0.024
5th quintile (least poor)			

Each column represents one multivariable Poisson regression model fitted to the data. aRR = adjusted relative risk ratio; CI = confidence interval; Ref = reference category for dichotomous and categorical variables. Heavy alcohol consumption was defined as reporting consumption of six or more drinks on one occasion at least once in the past 12 months, spending excessive money on alcohol in the past 30 days, or being intoxicated three or more times in the past 30 days.

'Most men in your village choose to drink alcohol three or fewer times per week or not at all', 'Most single (or young or married, etc.) men in your village never have six or more drinks when consuming alcohol' and 'Most men do not think it is okay to get drunk'. Such messages could be shared via various platforms such as billboards, radio shows, community meetings, social media and text messages. This information could also be embedded in peer-based counseling interventions, financial incentive programs or couples-based support programs [95–97]. Creation of such messages in

collaboration with community members may maximize their credibility and reach [17,43,98].

This kind of messaging could influence behavior across the population in multiple ways. First, it would encourage reductions in alcohol consumption among people who consume alcohol frequently or heavily. Secondly, men who had consumed alcohol in moderate amounts, and who had previously misperceived most other men to engage in frequent or heavy alcohol consumption, would be supported to continue consuming alcohol moderately or even less often because they would learn that most men

typically consume alcohol less than they had thought. Similarly, this kind of messaging would also support men who do not consume alcohol and who had overestimated the norms so that they could continue to remain abstinent. Both the moderate consumption group and the abstinent group who had misperceived norms would learn that they are part of a larger moderately consuming or abstinent population. Additionally, male alters who had overestimated the norms might become less supportive of their contacts who do engage in heavy or frequent alcohol consumption. Finally, applying a social norms approach to reduce harmful levels of alcohol consumption in this context would not ignore the long cultural tradition of alcohol consumption during ceremonies and social events in Uganda [99], nor would it preclude or stigmatize the informal production and selling of alcohol as an income-generating activity for some households [100].

### Limitations

First, although the population prevalence of alcohol consumption in this parish is similar to that reported elsewhere in Uganda [9,10], personal alcohol consumption may be under-reported [101–103]. Research using objective biomarkers to assess consumption levels would be helpful to determine actual population norms for comparison with perceived norms. However, population norms based on objective measurements would be unlikely to differ substantively. Moreover, some evidence suggests that, although there may be errors at the individual level, norms based on aggregated measures from survey data closely reflect norms based on aggregate measures of objective markers [104]. Secondly, our estimates could be subject to confounding by a variable unmeasured in our surveys. However, the estimated *e*-value suggests that any such confounding would need to be extremely strong in order to explain away the observed estimates. Thirdly, this study was conducted among a small set of villages, so we cannot claim generalizability of findings to the national population or other countries. However, findings provide a foundation for conducting research on misperceived alcohol use norms in similar sub-Saharan contexts (e.g. in South Africa, which has similar national rates of heavy episodic drinking and alcohol use disorder among men) [105].

### CONCLUSION

In this whole-population study of alcohol consumption behavior among men in eight villages in rural Uganda, we found that most men incorrectly thought that frequent and heavy alcohol consumption were common among men in their villages when, in fact, such behaviors were not typical at the village level nor within personal networks. These misperceived norms were strongly associated

with individual consumption behavior. Interventions to correct these misperceptions may hold promise for reducing problematic or hazardous alcohol use among men in this setting.

### Declaration of interests

None.

### Acknowledgements

This study was funded by Friends of a Healthy Uganda and U.S. National Institutes of Health (NIH) R01MH113494 and R01MH125667. J.M.P. acknowledges salary support from NIH K01MH115811. We thank the HopeNet cohort study participants, without whom this research would not be possible. We also thank members of the HopeNet study team for research assistance; in addition to the named study authors, HopeNet and other collaborative team members who contributed to data collection and/or study administration during all or any part of the study were as follows: Owen Alleluya, Patience Ayebare, Dickson Beinomugisha, Bridget Burns, Patrick Gumisiriza, Clare Kamagara, Justus Kananura, Allen Kiconco, Juliet Mercy, Patrick Lukwago Muleke, Rhina Mushagara, Rumbidzai Mushavi, Elijah Musinguzi, Moran Owembabazi, Immaculate Ninsiima, Mellon Tayebwa and Dagmar Vořechovská. We also thank Roger Hofmann of West Portal Software Corporation (San Francisco, CA, USA), for developing and customizing the CASIC Builder software program used for survey administration. We also thank Claire Evans who contributed research assistance in finalizing the manuscript.

### Author contributions

**Jessica Perkins:** Conceptualization; formal analysis; writing – original draft; writing – review & editing. **Bernard Kakuhikire:** Project administration; supervision; writing – review & editing. **Charles Baguma:** Project administration; writing – review & editing. **Jordan Jurinsky:** Formal analysis; writing – review & editing. **Justin D. Rasmussen:** Project administration; writing – review & editing. **Emily N. Satinsky:** Data curation; project administration; writing – review & editing. **Elizabeth Namara:** Investigation; writing – review & editing. **Phionah Ahereza:** Investigation; writing – review & editing. **Viola Kyokunda:** Investigation; writing – review & editing. **H Wesley Perkins:** Conceptualization; writing – review & editing. **Judith A. Hahn:** Writing – review & editing; supervision. **David R. Bangsberg:** Funding acquisition; writing – review & editing. **Alexander C. Tsai:** Funding acquisition; writing – review & editing; supervision.

## Author's affiliations

Peabody College of Education and Human Development, Vanderbilt University, Nashville, TN, USA,<sup>1</sup> Vanderbilt Institute of Global Health, Vanderbilt University Medical Center, Nashville, TN, USA,<sup>2</sup> Mbarara University of Science and Technology, Mbarara, Uganda,<sup>3</sup> Duke University, Durham, NC, USA,<sup>4</sup> Center for Global Health, Massachusetts General Hospital, Boston, MA, USA,<sup>5</sup> Hobart and William Smith Colleges, Geneva, NY, USA,<sup>6</sup> University of California at San Francisco, San Francisco, CA, USA,<sup>7</sup> Oregon Health and Science University-Portland State University School of Public Health, Portland, OR, USA,<sup>8</sup> Harvard Medical School, Boston, MA, USA<sup>9</sup> and Mongan Institute, Massachusetts General Hospital, Boston, MA, USA<sup>10</sup>

## References

- Bakke Ø., Endal D. Vested interests in addiction research and policy alcohol policies out of context: drinks industry supplanting government role in alcohol policies in sub-Saharan Africa. *Addiction* 2010; **105**: 22–8.
- Babor T. F., Robaina K., Jernigan D. The influence of industry actions on the availability of alcoholic beverages in the African region. *Addiction* 2015; **110**: 561–71.
- Shield K., Manthey J., Rylett M., Probst C., Wettlaufer A., Parry C. D. H., et al. National, regional, and global burdens of disease from 2000 to 2016 attributable to alcohol use: a comparative risk assessment study. *Lancet Public Health* 2020; **5**: e51–e61.
- Ferreira-Borges C., Esser M. B., Dias S., Babor T., Parry C. D. H. Alcohol control policies in 46 African countries: opportunities for improvement. *Alcohol Alcohol* 2015; **50**: 470–6.
- Francis J. M., Cook S., Morojele N. K., Swahn M. H. Rarity and limited geographical coverage of individual level alcohol interventions in sub Saharan Africa: findings from a scoping review. *J Subst Use* 2020; **25**: 11–9.
- McCann T. V., Renzaho A., Mugavin J., Lubman D. I. Stigma of mental illness and substance misuse in sub-Saharan African migrants: a qualitative study. *Int J Ment Health Nurs* 2018; **27**: 956–65.
- Kalichman S. C., Banas E., Kalichman M., Mathews C. Stigmatisation of alcohol use among people receiving antiretroviral therapy for HIV infection, Cape Town, South Africa. *Glob Public Health* 2020; **15**: 1040–9.
- Rasmussen J. D., Kakuhikire B., Baguma C., et al. Portrayals of mental illness, treatment, and relapse and their effects on the stigma of mental illness: population-based, randomized survey experiment in rural Uganda. *PLOS Med* 2019; **16**: 1–19.
- World Health Organization (WHO) *Uganda Alcohol Consumption: Levels and Patterns. Global Status Report on Alcohol and Health 2018*. Geneva: WHO; 2018.
- Kabwama S. N., Ndyabangi S., Mutungi G., Wesonga R., Bahendeka S. K., Guwatudde D. Alcohol use among adults in Uganda: findings from the countrywide non-communicable diseases risk factor cross-sectional survey. *Glob Health Action* 2016; **9**: 31302.
- Kuule Y., Dobson A. E., Harries A. D., Mutahunga B., Stewart A. G., Wilkinson E., et al. Screening, diagnosis, and management of patients with alcohol use disorders at Bwindi community hospital, Uganda. *Front Public Health* 2018; **6**: 1–8.
- Graham K., Bernards S., Knibbe R., Kairouz S., Kuntsche S., Wilsnack S. C., et al. Alcohol-related negative consequences among drinkers around the world. *Addiction* 2011; **106**: 1391–405.
- Hahn J. A., Woolf-King S. E., Muyindike W. Adding fuel to the fire: alcohol's effect on the HIV epidemic in sub-Saharan Africa. *Curr HIV/AIDS Rep* 2011; **8**: 172–80.
- Greene M. C., Kane J. C., Tol W. A. Alcohol use and intimate partner violence among women and their partners in sub-Saharan Africa. *Global Mental Health* 2017; **4**: e13.
- Perkins H. W. Misperceptions of peer substance use among youth are real. *Addiction* 2012; **107**: 885–6.
- Perkins H. W. Misperception is reality: the 'Reign of Error' about peer risk behaviour norms among youth and young adults. In: Xenitidou M., Edmonds B., editors. *The Complexity of Social Norms*. New York, NY: Springer International Publishing; 2014, pp. 11–36.
- Perkins H. W., Perkins J. M. Using the social norms approach to promote health and reduce risk among college students. In: Cimini M. D., Rivero E. M., editors. *Promoting Behavioral Health and Reducing Risk among College Students*. New York, NY: Routledge; 2018, pp. 127–44.
- Dempsey R. C., McAlaney J., Bewick B. M. A critical appraisal of the social norms approach as an interventional strategy for health-related behavior and attitude change. *Front Psychol* 2018; **9**: 1–16.
- Borsari B., Carey K. B. Descriptive and injunctive norms in college drinking: a meta-analytic integration. *J Stud Alcohol* 2003; **64**: 331–41.
- Perkins H. W. Misperceptions of peer drinking norms in Canada: another look at the 'reign of error' and its consequences among college students. *Addict Behav* 2007; **32**: 2645–56.
- Lewis M. A., Neighbors C., Geisner I. M., Lee C. M., Kilmer J. R., Atkins D. C. Examining the associations among severity of injunctive drinking norms, alcohol consumption, and alcohol-related negative consequences: the moderating roles of alcohol consumption and identity. *Psychol Addict Behav* 2010; **24**: 177–89.
- Neighbors C., Dillard A. J., Lewis M. A., Bergstrom R. L., Neil T. A. Normative misperceptions and temporal precedence of perceived norms and drinking. *J Stud Alcohol* 2006; **67**: 290–9.
- Perkins H. W., Haines M. P., Rice R. Misperceiving the college drinking norm and related problems: a nationwide study of exposure to prevention information, perceived norms and student alcohol misuse. *J Stud Alcohol Drugs* 2005; **66**: 470–8.
- Prentice D. A., Miller D. T. Pluralistic ignorance and alcohol use on campus: some consequences of misperceiving the social norm. *J Pers Soc Psychol* 1993; **64**: 243–56.
- Perkins J. M., Nyakato V. N., Kakuhikire B., Mbabazi P. K., Perkins H. W., Tsai A. C., et al. Actual versus perceived HIV testing norms, and personal HIV testing uptake: a cross-sectional, population-based study in rural Uganda. *AIDS Behav* 2018; **22**: 616–28.
- Carey K. B., Scott-Sheldon L. A. J., Carey M. P., Cain D., Mlobeli R., Vermaak R., et al. Community norms for HIV risk behaviors among men in a South African township. *J Behav Med* 2011; **34**: 32–40.
- Mulawa M., Yamanis T. J., Balvanz P., Kajula L. J., Maman S. Comparing perceptions with actual reports of close friend's HIV testing behavior among urban Tanzanian men. *AIDS Behav* 2016; **20**: 2014–22.
- Eggers S. M., Mathews C., Aarø L. E., McClinton-Appollis T., Bos A. E. R., de Vries H. Predicting primary and secondary

- abstinence among adolescent boys and girls in the Western cape. *South Africa AIDS Behav* 2017; **21**: 1417–28.
29. Hill L. M., Moody J., Gottfredson N. C., Kajula L. J., Pence B. W., Go V. F., et al. Peer norms moderate the association between mental health and sexual risk behaviors among young men living in Dar Es Salaam. *Tanzania Soc Sci Med* 2018; **196**: 77–85.
  30. Perkins J. M., Krezanoski P., Takada S., Kakuhikire B., Batwala V., Tsai A. C., et al. Social norms, misperceptions, and mosquito net use: a population-based, cross-sectional study in rural Uganda. *Malar J* 2019; **18**: 1–13.
  31. Blair G., Littman R., Paluck E. L. Motivating the adoption of new community-minded behaviors: an empirical test in Nigeria. *Sci Adv* 2019; **5**: 1–9.
  32. Paluck E. L., Green D. P. Deference, dissent, and dispute resolution: an experimental intervention using mass media to change norms and behavior in Rwanda. *Am Polit Sci Rev* 2009; **103**: 622–44.
  33. Paluck E. L. Reducing intergroup prejudice and conflict using the media: a field experiment in Rwanda. *J Pers Soc Psychol* 2009; **96**: 574–87.
  34. Green D. P., Wilke A., Cooper J. Countering violence against women at scale: a mass media experiment in rural Uganda. *Comp Polit Stud* 2019; **53**: 2283–320.
  35. Lerman K., Yan X., Wu X.-Z. The ‘majority illusion’ in social networks. *PLoS One* 2016; **11**: e0147617.
  36. Alipourfard N., Nettasinghe B., Abeliuk A., Krishnamurthy V., Lerman K. Friendship paradox biases perceptions in directed networks. *Nat Commun* 2020; **11**: 707.
  37. Anda R. E., Whitfield C. L., Felitti V. J., Chapman D., Edwards V. J., Dube S. R., et al. Adverse childhood experiences, alcoholic parents, and later risk of alcoholism and depression. *Psychiatr Serv* 2002; **53**: 1001–9.
  38. Polenick C. A., Birditt K. S., Blow F. C. Couples’ alcohol use in middle and later life: stability and mutual influence. *J Stud Alcohol Drugs* 2018; **79**: 111–8.
  39. Rosenquist J. N., Murabito J., Fowler J. H., Christakis N. A. The spread of alcohol consumption in a large social network. *Ann Intern Med* 2010; **152**: 426–33 W141.
  40. Perkins H. W., editor. *The Social Norms Approach to Preventing School and College Age Substance Abuse: A Handbook for Educators, Counselors, and Clinicians*. San Francisco, CA: Jossey-Bass; 2003.
  41. Perkins H. W. *College student misperceptions of alcohol and other drug norms among peers: exploring causes, consequences, and implications for prevention programs. Designing alcohol and other drug prevention programs in higher education: bringing theory into practice*. Newton, MA: Higher Education Center for Alcohol and Other Drug Prevention; 1997, pp. 177–206.
  42. Perkins H., Craig D. W. *A Multifaceted Social Norms Approach to Reduce High-Risk Drinking: Lessons from Hobart and William Smith Colleges*. Newton, MA: The Higher Education Center for Alcohol and Other Drug Prevention and the US Department of Education; 2002.
  43. Haines M. P., Perkins H. W., Rice R. M., Barker G. A guide to marketing social norms for health promotion in schools and communities: National Social Norms Resource Center East Lansing, MI; 2005.
  44. Miller D. T., Prentice D. A. Changing norms to change behavior. *Annu Rev Psychol* 2016; **67**: 339–61.
  45. Bewick B. M., Bell D., Crosby S., Edlin B., Keenan S., Marshall K., et al. Promoting improvements in public health: using a social norms approach to reduce use of alcohol, tobacco and other drugs. *Drugs Educ Prev Med* 2013; **20**: 322–30.
  46. DeJong W., Schneider S. K., Towvim L. G., Murphy M. J., Doerr E. E., Simonsen N. R., et al. A multisite randomized trial of social norms marketing campaigns to reduce college student drinking. *J Stud Alcohol* 2006; **67**: 868–79.
  47. Pedersen E. R., Parast L., Marshall G. N., Schell T. L., Neighbors C., et al. A randomized controlled trial of a web-based, personalized normative feedback alcohol intervention for young-adult veterans. *J Consult Clin Psychol* 2017; **85**: 459–70.
  48. Prentice D., Paluck E. L. Engineering social change using social norms: lessons from the study of collective action. *Curr Opin Psychol* 2020; **35**: 138–42.
  49. Bursztyjn L., González A. L., Yanagizawa-Drott D. Misperceived social norms: women working outside the home in Saudi Arabia. *Am Econ Rev* 2020; **110**: 2997–3029.
  50. Tankard M. E., Paluck E. L. Norm perception as a vehicle for social change. *Soc Issues Policy Rev* 2016; **10**: 181–211.
  51. Linnemayr S., Rice T. Insights from behavioral economics to design more effective incentives for improving chronic health behaviors, with an application to adherence to antiretrovirals. *J Acquir Immune Defic Syndr* 2016; **72**: e50–e52.
  52. Zapp D., Buelow R., Soutiea L., Berkowitz A., DeJong W., et al. Exploring the potential campus-level impact of online universal sexual assault prevention education. *J Interpers Violence* 2021; **36**(5-6): NP2324–NP2345.
  53. Perkins H. W., Linkenbach J. W., Lewis M. A., Neighbors C. Effectiveness of social norms media marketing in reducing drinking and driving: a statewide campaign. *Addict Behav* 2010; **35**: 866–74.
  54. Neighbors C., Rodriguez L. M., Rinker D. V., Gonzales R. G., Agana M., Tackett J. L., et al. Efficacy of personalized normative feedback as a brief intervention for college student gambling: a randomized controlled trial. *J Consult Clin Psychol* 2015; **83**: 500–11.
  55. Reid A. E., Aiken L. S. Correcting injunctive norm misperceptions motivates behavior change: a randomized controlled sun protection intervention. *Health Psychol* 2013; **32**: 551–60.
  56. Testa M., Livingston J. A., Wang W., Lewis M. A. Preventing college sexual victimization by reducing hookups: a randomized controlled trial of a personalized normative feedback intervention. *Prev Sci* 2020; **21**: 388–97.
  57. Orchowski L. M. ‘Trouble in paradigm’ and the social norms approach to violence prevention. *Violence Against Women* 2019; **25**: 1672–81.
  58. Takada S., Nyakato V., Nishi A., O’Malley A. J., Kakuhikire B., Perkins J. M., et al. The social network context of HIV stigma: population-based, sociocentric network study in rural Uganda. *Soc Sci Med* 2019; **233**: 229–36.
  59. Uganda Bureau of Statistics—UBOS and ICF *Uganda Demographic and Health Survey 2016*. Kampala, Uganda: UBOS and ICF; 2018.
  60. Perkins J. M., Nyakato V. N., Kakuhikire B., Tsai A. C., Subramanian S. V., Bangsberg D. R., et al. Food insecurity, social networks, and symptoms of depression among men and women in rural Uganda: a cross-sectional, population-based study. *Public Health Nutr* 2018; **21**: 838–48.
  61. Mushavi R. C., Burns B. F. O., Kakuhikire B., Owembabazi M., Vořechovská D., McDonough A. Q., et al. ‘When you have no water, it means you have no peace’: a mixed-

- methods, whole-population study of water insecurity and depression in rural Uganda. *Soc Sci Med* 2020; **245**: 112561.
62. Tsai A. C., Kakuhikire B., Mushavi R., Vořechovská D., Perkins J. M., McDonough A. Q., *et al.* Population-based study of intra-household gender differences in water insecurity: reliability and validity of a survey instrument for use in rural Uganda. *J Water Health* 2016; **14**: 280–92.
  63. Marsden P. V. Network data and measurement. *Annu Rev Sociol* 1990; **16**: 435–63.
  64. Perkins J. M., Subramanian S. V., Christakis N. A. Social networks and health: a systematic review of sociocentric network studies in low- and middle-income countries. *Soc Sci Med* 2015; **125**: 60–78.
  65. Marin A., Hampton K. N. Simplifying the personal network name generator: alternatives to traditional multiple and single name generators. *Field Methods* 2007; **19**: 163–93.
  66. Marsden P. V. Egocentric and sociocentric measures of network centrality. *Social Networks* 2002; **24**: 407–22.
  67. Wilsnack R. W., Wilsnack S. C., Kristjanson A. F., Vogeltanz-Holm N. D., Gmel G. Gender and alcohol consumption: patterns from the multinational GENACIS project. *Addiction* 2009; **104**: 1487–500.
  68. Fatch R., Bellows B., Bagenda F., Mulogo E., Weiser S., Hahn J. A. Alcohol consumption as a barrier to prior HIV testing in a population-based study in rural Uganda. *AIDS Behav* 2013; **17**: 1713–23.
  69. Papas R. K., Sidle J. E., Wamalwa E. S., Okumu T. O., Bryant K. L., Goulet J. L., *et al.* Estimating alcohol content of traditional brew in Western Kenya using culturally relevant methods: the case for cost over volume. *AIDS Behav* 2010; **14**: 836–44.
  70. Perkins H. W., Craig D. W. Student-athletes' misperceptions of male and female peer drinking norms: a multi-site investigation of the 'reign of error'. *J Coll Stud Dev* 2012; **53**: 367–82.
  71. Perkins H. W., Craig D. W., Perkins J. M. Using social norms to reduce bullying: a research intervention among adolescents in five middle schools. *Group Process Intergroup Relat* 2011; **14**: 703–22.
  72. Perkins H. W., Meilman P. W., Leichter J. S., Cashin J. R., Presley C. A. Misperceptions of the norms for the frequency of alcohol and other drug use on college campuses. *J Am Coll Health Assoc* 1999; **47**: 253–8.
  73. Shibutani T. Reference groups as perspectives. *Am J Sociol* 1955; **60**: 562–9.
  74. Sherif M. *The Concept of Reference Groups in Human Relations. Group Relations at the Crossroads*. Oxford, UK: Harper; 1953, pp. 203–31.
  75. Tsai A. C., Kakuhikire B., Perkins J. M., Vorechovská D., McDonough A. Q., Ogburn E. L., *et al.* Measuring personal beliefs and perceived norms about intimate partner violence: population-based survey experiment in rural Uganda. *PLoS Med* 2017; **14**(5): 1–20.
  76. Perkins J. M., Perkins H. W., Craig D. W. Misperceived norms and personal sugar-sweetened beverage consumption and fruit and vegetable intake among students in the United States. *Appetite* 2018; **129**: 82–93.
  77. Dempsey R. C., McAlaney J., Helmer S. M., Pischke C. R., Akvardar Y., Bewick B. M., *et al.* Normative perceptions of cannabis use among European university students: associations of perceived peer use and peer attitudes with personal use and attitudes. *J Stud Alcohol Drugs* 2016; **77**: 740–8.
  78. McAlaney J., Helmer S. M., Stock C., Vriesacker B., van Hal G., Dempsey R. C., *et al.* Personal and perceived peer use of and attitudes toward alcohol among university and college students in seven EU countries: project SNIPE. *J Stud Alcohol Drugs* 2015; **76**: 430–7.
  79. Perkins J. M., Perkins H. W., Craig D. W. Misperceiving a code of silence: peer support for telling authorities about weapons at school among middle school and high school students in the United States. *Youth Soc* 2019; **51**: 814–39.
  80. Perkins H. W., Berkowitz A. D. Perceiving the community norms of alcohol use among students: some research implications for campus alcohol education programming. *Subst Use Misuse* 1986; **21**: 961–76.
  81. Smith M. L., Kakuhikire B., Baguma C., Rasmussen J. D., Bangsberg D. R., Tsai A. C., *et al.* Do household asset wealth measurements depend on who is surveyed? Asset reporting concordance within multi-adult households in rural Uganda. *J Glob Health* 2020; **10**: 010412.
  82. Ashaba S., Kakuhikire B., Vořechovská D., Perkins J. M., Cooper-Vince C. E., Maling S., *et al.* Reliability, validity, and factor structure of the Hopkins symptom Checklist-25: population-based study of persons living with HIV in rural Uganda. *AIDS Behav* 2018; **22**: 1467–74.
  83. Zou G. A modified Poisson regression approach to prospective studies with binary data. *Am J Epidemiol* 2004; **159**: 702–6.
  84. StataCorp *Stata Statistical Software: Release 16*. College Station, TX: StataCorp LLC; 2019.
  85. Seventh-day Adventist Church. *Drugs: General Conference of Seventh-day Adventists*; 2021. Available at: <https://www.adventist.org/articles/drugs/> (Accessed 13 April 2021).
  86. Dudley R. L., Mutch P. B., Cruise R. J. Religious factors and drug usage among seventh-day Adventist youth in North America. *J Sci Study Relig* 1987; **26**: 218–33.
  87. Pew Forum on Religion and Public Life *Tolerance and Tension: Islam and Christianity in sub-Saharan Africa*. Washington, DC: Pew Research Center; 2010, p. 147.
  88. al-Ansari B., Thow A.-M., Day C. A., Conigrave K. M. Extent of alcohol prohibition in civil policy in Muslim majority countries: the impact of globalization. *Addiction* 2016; **111**: 1703–13.
  89. Assemblies of God. *Abstinence from Alcohol: General Council of the Assemblies of God*; 2016. Available at: <https://ag.org/Beliefs/Position-Papers/Abstinence-from-Alcohol>. Accessed 14 April 2021.
  90. Butts CT. Package 'sna': Tools for Social Network Analysis. R package version 2.6 (5 Oct 2020). Available at: <https://cran.r-project.org/web/packages/sna/sna.pdf>. Accessed 14 April 2021.
  91. VanderWeele T. J., Ding P. Sensitivity analysis in observational research: introducing the e-value. *Ann Intern Med* 2017; **167**: 268–74.
  92. Haneuse S., VanderWeele T. J., Arterburn D. Using the e-value to assess the potential effect of unmeasured confounding in observational studies. *JAMA* 2019; **321**: 602–3.
  93. Steyl T., Phillips J. Actual and perceived substance use of health science students at a university in the Western cape. *South Africa Afr Health Sci* 2011; **11**: 329–33.
  94. Breuer C., Bloom B., Miller A. P., Kigozi G., Nakyanjo N., Ddaaki W., *et al.* 'The bottle is my wife': exploring reasons

- why men drink alcohol in Ugandan fishing communities. *Soc Work Public Health* 2019; **34**: 657–72.
95. Haberer J. E., Sabin L., Amico K. R., *et al.* Improving antiretroviral therapy adherence in resource-limited settings at scale: a discussion of interventions and recommendations. *J Int AIDS Soc* 2017; **20**: 1–15.
  96. Bassett I. V., Wilson D., Taaffe J., Freedberg K. A. Financial incentives to improve progression through the HIV treatment cascade. *Curr Opin HIV AIDS* 2015; **10**: 451–63.
  97. Remien R. H., Stirratt M. J., Dolezal C., Dognin J. S., Wagner G. J., Carballo-Diequez A., *et al.* Couple-focused support to improve HIV medication adherence: a randomized controlled trial. *AIDS* 2005; **19**: 807–14.
  98. Hummer J. E., Davison G. C. Examining the role of source credibility and reference group proximity on personalized normative feedback interventions for college student alcohol use: a randomized laboratory experiment. *Subst Use Misuse* 2016; **51**(13): 1701–15.
  99. Willis J. *Potent Brews: a Social History of Alcohol in East Africa 1850–1999*. Oxford, UK: James Currey; 2002.
  100. Holmila M., Mäkelä P., Österberg E. A window to alcohol problems and politics in Africa. Kettil Bruun society meeting in Uganda. *Nord Stud Alcohol Drugs* 2011; **28**(1): 97–100.
  101. Adong J., Fatch R., Emenyonu N. I., Cheng D. M., Muyindike W. R., Ngabirano C., *et al.* Social desirability bias impacts self-reported alcohol use among persons with HIV in Uganda. *Alcohol Clin Exp Res* 2019; **43**: 2591–8.
  102. Bajunirwe F., Haberer J. E., Boum Y. I. I., Hunt P., Mocello R., Martin J. N., *et al.* Comparison of self-reported alcohol consumption to phosphatidylethanol measurement among HIV-infected patients initiating antiretroviral treatment in southwestern Uganda. *PLoS One* 2014; **9**: 1–12.
  103. Muyindike W. R., Lloyd-Travaglini C., Fatch R., Emenyonu N. I., Adong J., Ngabirano C., *et al.* Phosphatidylethanol confirmed alcohol use among ART-naïve HIV-infected persons who denied consumption in rural Uganda. *AIDS Care* 2017; **29**: 1442–7.
  104. Craig D. W., Perkins H. W. Accuracy of estimated blood alcohol concentration norms from college student drinking survey data: verification using matched late-night breath measurements. *J Stud Alcohol Drugs* 2018; **79**: 455–64.
  105. World Health Organization (WHO) *South Africa Alcohol Consumption: Levels and Patterns*. Geneva: WHO; 2018.

### Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

**Table S1** Modified Poisson regression models estimating associations between perceived norms and frequent and heavy alcohol consumption among men in eight villages in rural Uganda -- excluding 39 men who identified as Muslim, Born-again Pentecostal, and Seventh Day Adventist.

**Table S2** Modified Poisson regression models estimating associations between perceived norms and frequent and heavy alcohol consumption among men in eight villages in rural Uganda -- excluding men who were not married or cohabiting.

**Table S3** Modified Poisson regression models estimating associations between perceived norms and frequent alcohol consumption among men in eight villages in rural Uganda -- using an alternative threshold for defining frequent alcohol consumption (2 days per week).

**Table S4** Modified Poisson regression models estimating associations between perceived norms and frequent and heavy alcohol consumption among men in eight villages in rural Uganda -- using an alternative measure of exposure to alcohol consumption by men in one's personal network.

**Table S5** Linear probability model estimating associations between perceived norms and frequent and heavy alcohol consumption among men in rural Uganda -- adjusting for social network autocorrelation.