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# Adverse Childhood Experiences, Alcohol Consumption, and the Modifying Role of Social Participation: Population-Based Study of Adults in Southwestern Uganda

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## Adverse childhood experiences, alcohol consumption, and the modifying role of social participation: population-based study of adults in southwestern Uganda



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### ABSTRACT

**Background:** Adverse childhood experiences (ACEs) include multiple forms of child maltreatment, including abuse and neglect, as well as other forms of household dysfunction. Studies from Uganda have revealed a high prevalence of child abuse, as well as one of the highest levels of alcohol consumption in Africa. Few population-based studies from Africa have estimated associations between ACEs and adult alcohol use, or assessed the potential buffering effects of social participation.

**Methods:** This cross-sectional, population-based study was conducted in a rural parish in southwestern Uganda between 2016 and 2018. We assessed self-reported ACEs using a modified version of the Adverse Childhood Experiences – International Questionnaire (ACE-IQ) scale. We measured heavy alcohol consumption using a 3-item scale previously validated in this population. We measured social participation using a 10-item scale eliciting participants' membership and participation in different community groups over the past two months. We fitted multivariable Poisson regression models to estimate the associations between ACEs and heavy alcohol consumption, and to assess for the potential buffering effects of social participation.

**Results:** We estimated statistically significant associations between the total ACE score and heavy alcohol consumption (adjusted relative risk [ARR] per ACE = 1.17; 95% CI, 1.09–1.25;  $P \leq 0.001$ ). Social participation had a statistically significant moderating effect on the association between total ACE score and heavy alcohol consumption ( $P = 0.047$  for interaction): the estimated association between total ACE score and heavy alcohol consumption among study participants who did not participate in a community group was larger, with a narrower confidence interval (ARR = 1.21 per ACE; 95% CI, 1.11–1.33;  $P < 0.001$ ), while the estimated association among study participants who did participate in a community group was smaller and less precisely estimated (ARR = 1.12 per ACE; 95% CI, 1.02–1.24;  $P = 0.02$ ).

**Conclusions:** Our findings demonstrate an association between ACEs and heavy alcohol consumption behavior among adults in rural Uganda. The adverse effects of ACEs were buffered in part by social participation. To prevent or reduce harmful alcohol use behaviors among adults, it is important to address the chronic stress caused by ACEs.

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## 1. Introduction

Adverse childhood experiences (ACEs) involve multiple forms of child maltreatment, including abuse and neglect, and other forms of household dysfunction (Felitti et al., 1998; Dube, Anda, Felitti, Edwards, & Croft, 2002). A survey of children aged 8-18-years-old in Uganda indicated that 98% of study participants had experienced physical and/or emotional abuse, while 76% reported sexual abuse (Naker, 2014). Another survey from Uganda, Kenya, and Ethiopia found that 94% of young women aged 18-24 years experienced physical violence during childhood, including being punched, kicked, or beaten with an object (Stavropoulos, 2006). Furthermore, there is a widely held belief, in many countries across sub-Saharan Africa, that physical punishment instills discipline, improves behavior, and regulates emotions (Tomasello, 2007); thus, corporal punishment, spanking, and other forms of harsh/coercive discipline are common (Boydell, Nalukenge, Siu, Seeley, & Wight, 2017; Clarke et al., 2016).

In addition to a high prevalence of ACEs, Uganda is also documented to have one of the highest levels of alcohol consumption in Africa. With an annual per capita rate of alcohol consumption of 23.7 L, 5.8% of the Ugandan population over age 15 are affected by alcohol use disorder (AUD) (Tumwesigye, Kasirye, & Nansubuga, 2009; World Health Organization, 2014). A community survey among 3956 adults in Uganda indicated that 27% of the population reported heavy alcohol consumption, with 10% meeting DSM-5 criteria for AUD (Kabwama et al., 2016). Heavy alcohol consumption has also been linked to domestic violence (Jouriles, McDonald, Slep, Heyman, & Garrido, 2008; Tumwesigye, Kyomuhendo, Greenfield, & Wanyenze, 2012) and separation or divorce, both of which are classified as ACEs for children exposed to these experiences (Devaney, 2004, 2009; McGavock & Spratt, 2017).

ACEs have been associated with a wide range of mental health problems in adulthood, including problematic substance and alcohol use (Anda et al., 2002; Dube et al., 2002, 2003, 2006; Strine et al., 2012), depression and suicidal behaviors (Brodsky & Stanley, 2008; Chapman et al., 2004; Molnar, Buka, & Kessler, 2001; Mwachofi, Imai, & Bell, 2020; Satinsky et al., 2021), health risk behaviors (Ramiro, Madrid, & Brown, 2010), and maladaptive coping behaviors (Schilling et al., 2007, 2008). Heavy alcohol consumption and AUD have been documented more frequently among adolescents and adults with a history of ACEs than among those in the general population (Chatterjee et al., 2016, 2018; Dube et al., 2006; Fang & McNeil, 2017; Jung et al., 2020; Kiburi, Molebatsi, Obondo, & Kuria, 2018; Rothman, Edwards, Heeren, & Hingson, 2008). Further, among people with substance use disorder, ACEs negatively affect treatment outcomes: people with a history of ACEs are less likely to fully recover from symptoms of substance use disorder compared with people who have not had these experiences (Douglas et al., 2010; Kabiru, Beguy, Crichton, & Ezeh, 2010; Pirard, Sharon, Kang, Angarita, & Gastfriend, 2005).

Previous research studies conducted among both adolescents and adults have suggested social support may buffer mental well-being against the negative effects of ACEs (Ashaba et al., 2021; Taylor & Aspinwall, 1996; Uchino, 2004). The putative mechanisms vary. Social support enhances people's motivation to remain abstinent (Stevens, Jason, Ram, & Light, 2015) by improving their ability to engage in adaptive coping behaviors under situations of stress (Humphreys, Mankowski, Moos, & Finney, 1999). Social participation (i.e., through involvement in social groups) is associated with an increased sense of belonging, security, and purpose; these, in turn, motivate individuals to focus on their health (Berkman & Glass, 2000). Furthermore, social groups provide acceptance and companionship, and have the potential to promote self-esteem and psychological wellbeing (Bathish et al., 2017; Berkman, 1985; Haslam, O'Brien, Jetten, Vormedal, & Penna, 2005; Jetten et al., 2015; Underwood and Rice, 2000). On the other hand, social groups can potentially also promote negative behaviors among adolescents, such as cigarette smoking, either through the enforcement of negative norms and demand for conformity (Boissevain, 1974; Simmel, 1964) or through downward leveling

norms (Bourgois, 1995; Suarez-Orozco, 1987). Thus in certain cases the harms imposed by negative social capital can potentially outweigh the benefits to health and well-being (Dingle, Stark, Cruwys, & Best, 2015).

Previous studies on the relationship between ACEs and heavy alcohol use have largely been conducted in high-income countries and among adolescents (Dube et al., 2006; Fang & McNeil, 2017; Jung et al., 2020; Kabiru et al., 2010; Kiburi et al., 2018). Although studies in Uganda have explored alcohol use behavior and treatment outcomes among people with AUD (Kabwama et al., 2016; Kalema et al., 2020), no studies have documented the impacts of ACEs on adult alcohol consumption, nor have any studies examined the potential buffering effects of social participation. To address this gap in the literature, we conducted a cross-sectional, population-based study of adults in rural Uganda to investigate ACEs, heavy alcohol use, and the potentially modifying role of social participation.

## 2. Methods

### 2.1. Study setting and population

This cross sectional, population-based study was conducted in Nyakabare Parish, Rwampara District, a rural region of southwestern Uganda (Takada et al., 2019). Nyakabare Parish is located approximately 20 km from Mbarara Town and is comprised of 8 villages, largely rural. The economy is driven by subsistence farming, animal husbandry, and small scale trading; food and water insecurity have been widely documented in this area (Mushavi et al., 2020; Tsai et al., 2011).

### 2.2. Sampling procedure and data collection

We first conducted an initial population census to enumerate all eligible adults across the 758 households in the parish. Study eligibility was limited to adults aged 18 years and older (and emancipated minors aged 16–18 years) who reported having a stable residence in the parish. There were 1795 people who were eligible for the survey wave, and 1630 people participated (90.8%). The eligible people who did not participate were either not found at home or refused. An additional 71 adults who had been identified in the parish census were found to be ineligible due to various reasons (e.g. they had died by the time of the survey; they had left the parish before they could participate; or they had cognitive impairment, behavioral problems, neurological damage, acute intoxication, and/or communication impairments that would affect their ability to provide informed consent and/or participate in the study).

Data were collected between December 13, 2016 and June 6, 2018 by trained research assistants. These research assistants visited all eligible adults in the parish and formally requested participation. Individuals who expressed a willingness to participate were asked to provide written informed consent. Following the consent process, interviews were conducted in a private location in the participant's home or in a nearby location, based on the participant's preference. Data were collected using the Computer Assisted Survey Information Collection (CASIC) Builder™ software program. All instruments were written in English, translated into Runyankore, and back translated into English in an iterative process to confirm translation fidelity. Interviews were conducted in Runyankore, the local language.

### 2.3. Measures

ACEs were assessed using a modified version of the Adverse Childhood Experiences – International Questionnaire (ACE-IQ). The ACE-IQ was developed by the World Health Organization and Centers for Disease Control (CDC) for use across different cultures and was designed to assess different forms of abuse, neglect, and family dysfunction (World Health Organization, 2018). It has been validated for use among adolescents and adults in South Africa, Malawi, and Nigeria (Kazeem, 2015; Kidman, Smith, Piccolo, & Kohler, 2019; Quinn et al., 2018).

The ACE-IQ was modified for use in this setting and included 16 items to assess exposure to adverse experiences during the participant's first 18 years of life (Satinsky et al., 2021). The first set of questions asked participants about experiences of verbal, physical, and sexual abuse (threatened or enacted), perpetrated by a parent or other adult in the household. These were followed by questions exploring different aspects of household dysfunction including: witnessing violence or threats of violence towards their mother or grandmother; parental divorce or separation; exposure to a family member who had a mental illness or who used alcohol and/or other drugs on a regular basis; and/or exposure to a family member who was incarcerated. Participants were also asked about insecure access to food and water. These 16 items represented 9 unique domains of ACEs, with any experience in a given domain scored as 1 and no experience in a given domain scored as 0. We then calculated a cumulative ACE score, which had a range of 0–9.

Alcohol consumption behaviors were assessed with a series of questions. First, participants were asked to report how often they consumed alcohol in the past 12 months: never, once a month or less, 2–4 times per month, 2–3 times per week, or 4 or more times per week. Among participants who reported any alcohol use, three additional yes/no questions were used to elicit heavy alcohol consumption behaviors: 1) whether in the past 12 months they had taken 6 or more drinks in a single morning, afternoon, or night; 2) whether in the past 30 days they had experienced drunkenness or intoxication on 3 or more days; and 3) whether in the past 30 days they had spent more than 25,000 Ugandan shillings on any kind of alcohol for themselves. Following prior work (Fatch et al., 2013), participants who endorsed one or more of the three items were classified as having engaged in heavy alcohol consumption. Due to challenges in quantifying total alcohol consumption in a setting where nonstandard drink sizes are commonly consumed (Papas et al., 2010), we opted for the locally validated measure over the more widely used Alcohol Use Disorders Identification Test (AUDIT) (Saunders, Aasland, Babor, De la Fuente, & Grant, 1993).

Social participation was measured using a 10-item scale that elicited participants' membership and/or participation in different community groups during the past two months. These community groups were readily available and accessible to members of the community and included: HIV groups, gardening groups, vocation groups, the local council, the water committee, village health teams, National Agriculture Advisory Services groups, religious groups, women's groups, and savings and credit cooperative organizations (SACCOs). For this analysis, we created a binary variable equal to 1 for participation in any community group.

Loneliness was measured using the 3-item University of California Los Angeles (UCLA) Loneliness Scale (Hughes, Waite, Hawkey, & Cacioppo, 2004). Each question is scored on a 3-point Likert type scale, generating a total score with a range of 3–9. The Hopkins Symptom Checklist for Depression (HSCLD-15) was used to assess depression symptom severity. The HSCLD-15 has been modified and validated for use in Uganda (Ashaba et al., 2018; Bolton, 2001). Each symptom is scored on a 4-point Likert type scale, and the total scale score is computed by taking the average across the items. A threshold of >1.75 is commonly used as a screening threshold for probable depression (Hesbacher, Rickels, Morris, Newman, & Rosenfeld, 1980). Water insecurity was measured using the 8-item Household Water Access Insecurity Survey (HWIAS), a scale that was developed for use in the Ugandan context (Tsai et al., 2016a). Each item is scored on a 4-point Likert type, with a total score range of 0–24. Food insecurity was measured using the nine-item Household Food Insecurity Access Scale (HFIAS) (Swindale & Bilinsky, 2006; Tsai et al., 2012). Each item is scored on a 4-point Likert type-scale, with a scoring algorithm (Coates, Swindale, & Bilinsky, 2007) categorizing respondents as food secure, mildly food insecure, moderately food secure, and severely food insecure.

#### 2.4. Ethical considerations

This study received ethical approval from the Mbarara University of Science and Technology Research Ethics Committee and the Partners Human Research Committee. Clearance to conduct the study was obtained from the Uganda National Council for Science and Technology and the Research Secretariat in the President's Office.

#### 2.5. Data analysis

After dropping participants with missing information on any of the variables, the data set consisted of 1586 participants for analysis. Variables missing information included age (24 participants), probable depression (4 participants), food insecurity (9 participants), water insecurity (3 participants), binge drinking and drunkenness (4 participants), and excessive spending on alcohol (5 participants). We summarized sociodemographic characteristics using proportions and means/standard deviations. To estimate the associations between ACEs and alcohol consumption behavior we fitted to the data multiple Poisson regression models with robust estimates of variance. As shown previously (Zou, 2004), the estimated incidence rate ratios can be interpreted as relative risk ratios. We fitted a single Poisson regression model to estimate an association between total ACE score (continuous variable, out of 9) and heavy alcohol consumption (Fatch et al., 2013) while adjusting for age, marital status, level of education, food insecurity (HFIAS), water insecurity (HWIAS), self-reported HIV status, probable depression (HSCLD-15), loneliness (UCLA Loneliness Scale), and social participation. These covariates were included in the regression model because of their potentially confounding effects as shown in previously published work (Chilton, Knowles, Rabinowich, & Arnold, 2015; Goodman, Grouls, Chen, Keiser, & Gitari, 2017; Hernandez, Marshall, & Mineo, 2014; Meinck, Orkin, & Cluver, 2019; Roy, Bouldin, Bennett, & Hege, 2019; Satinsky et al., 2021; Wong, Dirghangi, & Hart, 2019) or because they have been shown to correlate strongly with the outcome (Cambron, Kosterman, Catalano, Guttmanova, & Hawkins, 2018; Canham, Mauro, Kaufmann, & Sixsmith, 2016; Kim et al., 2008; McKay, Konowalczyk, Andretta, & Cole, 2017). Estimates were also stratified by sex. We estimated associations between the total ACE score and individual heavy alcohol consumption behaviors by fitting separate Poisson regression models for the 3 outcomes of binge drinking, drunkenness, and excessive spending on alcohol, adjusting for the same covariates listed above.

To determine the robustness of the estimated associations we performed an e-value analysis (VanderWeele & Ding, 2017). The e-value describes the minimum strength of association, on the risk ratio scale, between a putative confounder and the exposure, and between a putative confounder and the outcome, that would be needed to explain away the observed association. A large e-value suggests that potential confounding would need to be very strong in order to sufficiently explain away the observed association (Blum, Tan, & Ioannidis, 2020).

We also sought to determine whether social participation modified the relationship between ACEs and heavy alcohol consumption. This analysis was motivated by previous research findings that have demonstrated that social support enhances motivation to quit alcohol use (Stevens et al., 2015) and can serve as a buffer against psychosocial stressors (Ashaba et al., 2021; Tsai et al., 2012, 2016b). Effect modification was assessed by including a main effect for social participation, a main effect for exposure to ACEs, and a product term to test for the interaction between total ACE score and social participation. These multivariable regression models were also adjusted for the covariates listed above. Stratified estimates were examined to aid in exposition of the product terms. All analyses were conducted in Stata version 16 (StataCorp LP, College Station, Texas) and adjusted for clustering at the village level.

### 3. Results

More than half of the participants were women (56% [n = 882]) (Table 1). The mean age was 39.7 years (standard deviation [SD] = 15.9) for men and 40.2 years (SD = 17.3) for women. Overall, the prevalence of heavy alcohol consumption was 12% (n = 193) and was greater among men vs. women (25% vs. 2%;  $P < 0.001$ ). In terms of the individual alcohol consumption behaviors, the prevalence of drunkenness was 8% (n = 132), the prevalence of binge drinking was 6% (n = 94), and the prevalence of excessive spending on alcohol was 5% (n = 83). The mean ACE score was 3.44 (SD = 2.21) among men and 3.30 (SD = 2.18) among women. A comparable percentage of women and men reported participation in a community group (44% vs. 46%).

We estimated a statistically significant association between total ACE score and heavy alcohol consumption (adjusted risk ratio [ARR] per ACE = 1.17; 95% CI, 1.08–1.25;  $P < 0.001$ ) (Table 2). This estimated association was large in magnitude: at the 25th percentile of ACEs (2), the predicted probability of heavy alcohol consumption was 9.5%, while at the 75th percentile of ACEs (5), the predicted probability of heavy

alcohol consumption was 15.3%. Thus, an interquartile difference in the total ACEs score was associated with a 5.8 percentage point difference in the predicted probability of heavy alcohol consumption, or a 47.5% difference relative to the baseline prevalence. The Pearson goodness-of-fit chi-squared test statistic was 1382.2 ( $P = 0.99$ ).

We also estimated statistically significant associations between the total ACE score and individual heavy alcohol consumption behaviors among study participants. The estimated associations between the total ACE score and these individual variables were largely consistent with each other for binge drinking (ARR = 1.21 per ACE; 95% CI, 1.06–1.37;  $P = 0.003$ ), drunkenness (ARR = 1.20 per ACE; 95% CI, 1.12–1.29;  $P \leq 0.001$ ), and excessive spending on alcohol (ARR = 1.23 per ACE; 95% CI, 1.12–1.34;  $P \leq 0.001$ ) (Appendix A). The Pearson goodness-of-fit chi-squared test statistics ranged in value from 1389.1 to 1570.4 (P-values ranged from 0.55 to 0.99). When we stratified by sex, the association between total ACE score and heavy alcohol consumption was stronger among women (ARR = 1.19 per ACE; 95% CI, 1.06–1.34,  $P = 0.004$ ) than among men (ARR = 1.10 per ACE; 95% CI, 1.03–1.18;  $P = 0.004$ ) (Appendix B).

**Table 1**  
Characteristics of the sample, stratified by sex (n = 1586).

	Men (n = 704)			Women (n = 882)			Total (n = 1586)	
	n	Mean/%	SD	n	Mean/%	SD	n	%
Age (years)		39.7	15.9		40.2	17.3		
Marital status								
Married/cohabitating	461	65%		522	59%		983	62%
Separated, divorced, widow	56	8%		215	24%		271	17%
Single, never married	188	27%		147	17%		335	21%
HIV status								
Positive	58	8.2%		106	12%		164	10%
Negative or Unknown	646	91.8%		776	88%		1422	90%
Education level								
No formal education	40	6%		150	17%		190	12%
Some primary (P1–P6)	180	26%		252	29%		432	27%
Completed primary (P7–P8)	204	29%		188	21%		392	25%
Secondary, vocational, or university	280	39%		292	33%		572	36%
Food insecurity								
Food secure	253	36%		263	30%		516	33%
Mildly food insecure	105	15%		100	11%		205	13%
Moderately food insecure	245	35%		364	41%		609	38%
Severely food insecure	101	14%		155	18%		256	16%
Water insecurity								
Water secure	367	52%		415	47%		782	49%
Mildly water insecure	73	10%		114	13%		187	12%
Moderately water insecure	146	21%		199	23%		345	22%
Severely water insecure	118	17%		154	17%		272	17%
Total ACEs (out of 9)		3.44	2.21		3.30	2.18		
Ever experienced ACE								
Yes	631	90%		794	90%		1425	90%
No	73	10%		88	10%		161	10%
Probable depression (HSCLD > 1.75)								
Yes	89	13%		232	26%		321	20%
No	615	87%		650	74%		1265	80%
Social participation								
Yes	323	46%		387	44%		710	45%
No	381	54%		495	56%		876	55%
Loneliness (UCLA Loneliness Scale ≥ 6)								
Yes	70	10%		133	15%		203	13%
No	634	90%		749	85%		1383	87%
Binge drinking								
Yes	88	13%		6	0.7%		94	6%
No	616	88%		876	99.3%		1492	94%
Drunkenness								
Yes	117	17%		15	1.7%		132	8%
No	587	83%		867	98.3%		1454	92%
Excessive spending on alcohol								
Yes	78	11%		5	0.6%		83	5%
No	626	89%		877	99.4%		1503	95%
Heavy alcohol consumption								
Yes	176	25%		17	2%		193	12%
No	528	75%		865	98%		1393	88%

\* ACE, adverse childhood experience; HSCLD, Hopkins Symptom Checklist for Depression; SD, standard deviation; UCLA, University of California at Los Angeles.



**Table 2**  
Association between total ACE score and heavy alcohol consumption (n = 1586).

	Unadjusted RR (95% CI) P-value		Adjusted RR (95% CI) P-value	
Total ACE score (per ACE)	1.13 (1.07–1.190)	<0.001	1.17 (1.08–1.25)	<0.001
Age (per year)	1.00 (0.99–1.00)	0.66	1.01 (1.00–1.02)	0.005
Married	1.08 (0.84–1.38)	0.54	0.96 (0.75–1.22)	0.75
HIV-positive	0.73 (0.41–1.31)	0.29	0.67 (0.39–1.15)	0.15
<i>Education level</i>				
No formal education	Ref		Ref	
Some primary	2.72 (1.74–4.25)	<0.001	3.03 (1.76–5.20)	<0.001
Completed primary	2.71 (1.43–5.15)	0.002	3.13 (1.46–6.69)	0.003
Secondary, vocational, or university	2.15 (1.44–3.22)	<0.001	2.56 (1.52–4.32)	<0.001
<i>Food insecurity</i>				
Food secure	Ref		Ref	
Mildly food insecure	0.76 (0.57–1.03)	0.08	0.79 (0.56–1.13)	0.19
Moderately food insecure	0.79 (0.55–1.16)	0.24	0.77 (0.54–1.10)	0.15
Severely food insecure	1.11 (0.82–1.51)	0.50	1.12 (0.75–1.67)	0.57
<i>Water insecurity</i>				
Water secure	Ref		Ref	
Mildly water insecure	0.61 (0.34–1.07)	0.08	0.60 (0.35–1.03)	0.06
Moderately water insecure	0.97 (0.76–1.22)	0.79	0.94 (0.78–1.14)	0.54
Severely water insecure	0.86 (0.48–1.55)	0.63	0.78 (0.39–1.57)	0.49
Probable depression	0.97 (0.60–1.41)	0.85	0.71 (0.48–1.05)	0.08
Social participation	0.95 (0.71–1.30)	0.74	0.90 (0.68–1.20)	0.48
Loneliness	0.88 (0.54–1.40)	0.58	0.87 (0.53–1.45)	0.60

\* ACE, adverse childhood experience; CI, confidence interval; RR, relative risk. Estimates in column 1 (“unadjusted”) are derived from 10 Poisson regression models in which the row variable is the only covariate in the model. Estimates in column 2 (“adjusted”) are derived from a single multivariable Poisson regression model in which all of the row variables are included simultaneously.

When we included a main effect for social participation in the regression model for heavy alcohol consumption, along with product terms to test for an interaction between social participation and total ACE score, social participation was found to moderate the effect of total ACE score on heavy alcohol consumption. The coefficient on the product term was statistically significant ( $P = 0.047$  for interaction). The estimated association between total ACE score and heavy alcohol consumption among people who did not participate in a community group was larger in magnitude, and with a narrower confidence interval (ARR = 1.21 per ACE; 95% CI 1.11–1.33;  $P < 0.001$ ), compared with the estimated association among people who did participate in a community group (ARR = 1.12 per ACE; CI 1.02–1.24;  $P = 0.02$ ) (Appendix C). As is depicted in Fig. 1, the effect appears to be driven largely by a differential association at the upper end of the distribution of ACEs, i.e. the predicted probability of heavy alcohol consumption is largely similar for people with a low number of ACEs whereas the predicted probability of heavy alcohol consumption among people reporting 9 ACEs is approximately twice as large among people who report no social participation compared with people who participate in one or more groups.

We also examined effect modification for each of the individual alcohol consumption behaviors. The differences in the estimated association between total ACE score and the individual alcohol consumption behaviors, stratified by social participation, varied according to the specific behavior, but generally followed the same pattern: the estimated

association with the total ACE score was larger among study participants who did not participate in a community group (ARRs ranged from 1.22 to 1.31;  $P$ -values ranged from  $<0.001$  to 0.004) than the estimated association with the total ACE score among study participants who did participate in a community group (ARRs ranged from 1.13 to 1.20;  $P$ -values ranged from  $<0.001$  to 0.15).

The e-value analysis yielded e-values ranging from 1.62 to 1.76, depending on the outcome. This represents the strength of association, on the risk ratio scale, that an unmeasured confounder would need to have with both heavy alcohol consumption and total ACEs in order to explain away the reported estimates.

#### 4. Discussion

In this population-based study of adult men and women, we estimated statistically significant associations between ACEs and heavy alcohol consumption. Participation in community groups moderated the effect of ACEs on heavy alcohol consumption, suggesting that social participation exerted a buffering effect against this long-term stressor. While other studies from sub-Saharan Africa have estimated associations between ACEs and alcohol use among women and adolescents (Bhengu, Tomita, Mashaphu, & Paruk, 2019; Goodman et al., 2017; Kabiru et al., 2010), none have yet estimated associations between ACEs and alcohol use in a population-based sample of both men and women or assessed the modifying role of social participation.

The high prevalence of ACEs is consistent with other research from Uganda (Koenig et al., 2004; Naker, 2014; Stavropoulos, 2006), where reports indicate that most children are subjected to physical abuse as a form of discipline (Boydell et al., 2017; Clarke et al., 2016; Tomasello, 2007). In addition, domestic violence is common in Uganda (Tsai et al., 2017), and many children are exposed through either observation or experience (Koenig et al., 2003; Ogland, Xu, Bartkowski, & Ogland, 2014). For example, studies have estimated a prevalence of intimate partner violence against women between 54% and 56% (Karamagi, Tumwine, Tyleskar, & Heggenhougen, 2006; Uganda Bureau of Statistics, 2016). Furthermore, exposure to domestic violence increases the risk of exposure to other childhood adversities (McGavock & Spratt, 2017), with most children who are exposed to domestic violence also being victims of maltreatment themselves (Hamby et al., 2010, 2011; Jouriles et al., 2008).

The finding of heavy alcohol consumption among our study participants is also reflective of previous studies from low and middle-income countries (Emslie, Lewars, Batty, & Hunt, 2009; Hao et al., 2004; Helzer & Canino, 1992; Kabwama et al., 2016). This finding is also in keeping with cultural expectations and gender roles in Uganda, whereby alcohol use among men is associated with masculinity and social independence, and no expectations for domestic responsibilities (Wolff, Busza, Bufumbo, & Whitworth, 2006). However, alcohol use among women is associated with defiant behavior, contrary to local feminine ideals (Wolff et al., 2006). In some African societies, women who engage in alcohol use may be subject to punishment and social opprobrium (Bryceson, 2002).

The robust associations between ACEs and heavy alcohol consumption in our study have been demonstrated in a wide range of settings (Fang & McNeil, 2017; Jung et al., 2020). Previous studies have shown that ACEs are associated with unhealthy alcohol use behaviors during adulthood, including binge drinking and drunkenness, as well as clinically diagnosed AUDs (Crouch, Radcliff, Strompolis, & Wilson, 2018; Fang & McNeil, 2017; Kiburi et al., 2018; Loudermilk, Loudermilk, Obenauer, & Quinn, 2018). Higher cumulative ACE scores are associated with higher risk for these problems (Anda et al., 2002; Loudermilk et al., 2018; Pilowsky, Keyes, & Hasin, 2009; Strine et al., 2012). Moreover, the cycle of alcohol consumption exposes more children to trauma due to the fact that many children in Uganda grow up in families where at least one family member uses alcohol regularly (Tumwesigye & Kasirye, 2005). Our findings also support research showing that people who have

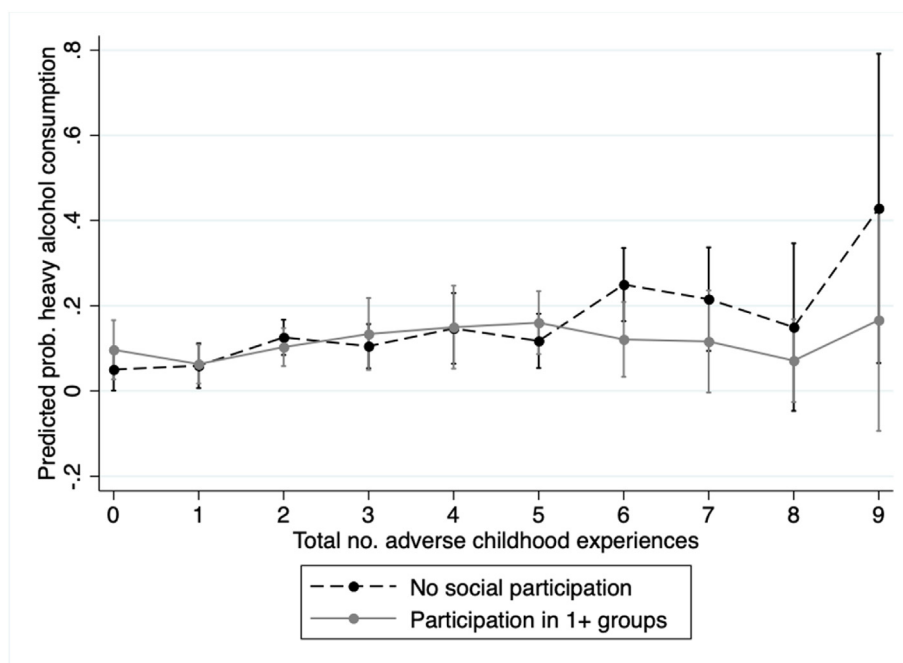


Fig. 1. The modifying effect of social participation on the association between total ACE score and alcohol consumption.

experienced traumatic events may adopt maladaptive coping mechanisms, including substance misuse, particularly when other support systems are lacking (Larkin, Felitti, & Anda, 2014).

It has been reported that adult women with a history of ACEs are at a higher risk of AUD and other mental health problems compared with men (Briere, Hodges, & Godbout, 2010; Kendler, Kuhn, & Prescott, 2004; McLaughlin, Conron, Koenen, & Gilman, 2010). Our findings showed a statistically significant association between total ACEs and heavy alcohol consumption among both men and women, although the estimated association was slightly stronger among women (Currie, Sanders, Swanepoel, & Davies, 2020; Frankenberger, Clements-Nolle, & Yang, 2015). It is possible that ACEs among women more strongly amplify emotional reactivity and emotion regulation, and more greatly impair responses to reward mechanisms that drive binge drinking behavior to alleviate negative emotions (Brenhouse, Lukkes, & Andersen, 2013; Dennison et al., 2019; McLaughlin, DeCross, Jovanovic, & Tottenham, 2019). However some previous research has also documented a higher risk of binge drinking among men with a history of ACEs (Kappel, Livingston, Patel, Villaveces, & Massetti, 2021; Loudermilk et al., 2018).

One of the primary findings to emerge from this study was that, consistent with conceptual models of buffering and social support, social participation moderated the relationship between total ACE score and heavy alcohol consumption. This is in line with previous research showing that social support modifies harmful behavior and helps people focus on their health by supporting the adoption of positive behaviors (Taylor & Aspinwall, 1996; Uchino, 2004). Social support has a protective effect against traumatic experiences (Ashaba et al., 2021; Jonzon & Lindblad, 2006; Stevens et al., 2015), and social support networks have been reported to influence or prevent alcohol consumption behaviors (Perreira & Sloan, 2001). A higher number of supportive relationships has been associated with reduced levels of alcohol consumption (Booth, Russell, Soucek, & Laughlin, 1992; Perreira & Sloan, 2001; Zywiak, Longabaugh, & Wirtz, 2002). The protective nature of social support networks on reduced alcohol consumption relates to how much an individual is invested in the social network (Longabaugh, Wirtz, Zywiak, & O'malley, 2010; Zywiak et al., 2002), especially if the group promotes self-esteem and psychological wellbeing (Bathish et al., 2017; Jetten et al., 2015). This is further reinforced by the quality of group memberships and social connectedness that contribute towards improved

quality of life (Sani, 2012).

Our study has limitations which must be considered when interpreting these results. First, self-reported ACEs elicited during adulthood may be limited by recall bias. Inconsistencies in reporting ACEs among adults have been described in previous research (Baldwin, Reuben, Newbury, & Danese, 2019). Second, the study was conducted in a single rural parish in southwestern Uganda. Since Uganda has multiple tribes with differing cultural practices, the findings may not generalize to other adults in the country, or other countries in sub-Saharan Africa. Third, this was a cross-sectional study, limiting our ability to establish the causal pathway between ACEs and adult alcohol consumption behavior. Fourth, we did not use a standard instrument, like the AUDIT, to measure alcohol consumption behavior, because consumption of alcohol beverages of nonstandard volumes and varying concentrations is common in this rural area of Uganda, which limits the application of standard instruments. While our measure of heavy alcohol consumption was validated in the local setting (Fatch et al., 2013), measurement error is nonetheless possible. The direction of bias is unpredictable; we have no basis for speculating whether overestimation or underestimation is more likely. If the measurement error is non-differential, then this would tend to bias our estimates of the association between ACEs and alcohol consumption toward the null. Moreover, the findings are in agreement with findings of other studies among adults indicating an association between ACEs and alcohol use behaviors (Kiburi et al., 2018; Strine et al., 2012). Lastly, although the ACE-IQ was modified for the local context, the wording of some of the items could have resulted in underreporting. For example, the questions on physical abuse only elicited experiences that took place within the household, potentially excluding experiences of corporal punishment that may have taken place in schools (Boydell et al., 2017; Clarke et al., 2016; Devries et al., 2014). On this note, due to cultural norms, some participants may not have viewed spanking or corporal punishment as forms of physical abuse.

## 5. Conclusion

Our findings reinforce prior studies on the pervasiveness of ACEs in this context, and demonstrate an association between ACEs and heavy alcohol consumption behavior. These findings are relevant given that Uganda has a high prevalence of both ACEs and alcohol consumption



(Ferreira-Borges, Rehm, Dias, Babor, & Parry, 2016; Kabwama et al., 2016; World Health Organization, 2019). In addition to allocating resources to address problematic alcohol use among adults, there is also a need to address the chronic stress resulting from ACEs to prevent or reduce harmful alcohol consumption behaviors. The finding that social integration partly moderated the relationship between ACEs and heavy alcohol consumption suggests a role for social support programs to be disseminated within the community. Such programs would aim to foster social connectedness and improve self-esteem in order to prevent harmful alcohol use in rural settings in Uganda.

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### CRedit author statement

**Scholastic Ashaba:** Writing original draft, Data curation, visualization, Revising, Editing. **Bernard Kakuhikire:** Reviewing, Editing. **Charles Baguma:** Project administration, Reviewing, Editing. **Emily N. Satinsky:** Project administration, Data curation, Reviewing and Editing. **Jessica M. Perkins:** Reviewing and Editing. **Justin D. Rasmussen:** Reviewing and Editing. **Christine E. Cooper-Vince:** Reviewing, Editing. **Phionah Ahereza:** Data collection, Reviewing, Editing. **Patrick Gumisiriza:** Data collection, Reviewing, Editing. **Justus Kananaura:** Data collection, Reviewing, Editing. **David R. Bangsberg:** Reviewing and Editing. **Alexander C. Tsai:** Conceptualization, Methodology, Funding acquisition, Supervision, Visualization, Data curation, Reviewing, Editing.

### Declaration of competing interest

The authors have no conflict of Interest to declare.

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### Appendix A. Supplementary data

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