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Maternal adverse childhood experiences, child mental health, and the mediating effect of maternal depression: A cross-sectional, population-based study in rural, southwestern Uganda

Andrew Wooyoung Kim[1,2] | Amber D. Rieder[3] | Christine E. Cooper-Vince[4] | Bernard Kakuhikire[5] | Charles Baguma[5] | Emily N. Satinsky[6,7] | Jessica M. Perkins[8,9] | Allen Kiconco[5] | Elizabeth B. Namara[5] | Justin D. Rasmussen[3] | Scholastic Ashaba[5] | David R. Bangsberg[5,10] | Alexander C. Tsai[5,6,11,12] | Eve S. Puffer[3]

[1]Department of Anthropology, University of California, Berkeley, California, USA

[2]SAMRC/Wits Developmental Pathways for Health Research Unit, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa

[3]Duke Global Health Institute, Durham, North Carolina, USA

[4]Département de Psychiatrie, Universitié de Genève, Geneva, Switzerland

[5]Mbarara University of Science and Technology, Mbarara, Uganda

[6]Center for Global Health, Massachusetts General Hospital, Boston, Massachusetts, USA

[7]Department of Psychology, University of Southern California, Los Angeles, California, USA

[8]Peabody College, Vanderbilt University, Nashville, Tennessee, USA

[9]Vanderbilt Institute of Global Health, Nashville, Tennessee, USA

[10]Oregon Health and Science University – Portland State University School of Public Health, Portland, Oregon, USA

[11]Mongan Institute, Massachusetts General Hospital, Boston, Massachusetts, USA

[12]Harvard Medical School, Boston, Massachusetts, USA

Correspondence
Andrew Wooyoung Kim, Department of Anthropology, University of California, Berkeley, California, USA.
Email: awkim@berkeley.edu

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Abstract

Objectives: This study aimed to examine the intergenerational effects of maternal adverse childhood experiences (ACEs) and child mental health outcomes in rural Uganda, as well as the potentially mediating role of maternal depression in this pathway. Additionally, we sought to test the extent to which maternal social group membership attenuated the mediating effect of maternal depression on child mental health.

Methods: Data come from a population-based cohort of families living in the Nyakabare Parish, a rural district in southwestern Uganda. Between 2016 and 2018, mothers completed surveys about childhood adversity, depressive symptoms, social

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group membership, and their children's mental health. Survey data were analyzed using causal mediation and moderated-mediation analysis.

Results: Among 218 mother–child pairs, 61 mothers (28%) and 47 children (22%) showed symptoms meeting cutoffs for clinically significant psychological distress. In multivariable linear regression models, maternal ACEs had a statistically significant association with severity of child conduct problems, peer problems, and total child difficulty scores. Maternal depression mediated the relationship between maternal ACEs and conduct problems, peer problems, and total difficulty, but this mediating effect was not moderated by maternal group membership.

Conclusions: Maternal depression may act as a potential mechanism linking maternal childhood adversity with poor child mental health in the next generation. Within a context of elevated rates of psychiatric morbidity, high prevalence of childhood adversity, and limited healthcare and economic infrastructures across Uganda, these results emphasize the prioritization of social services and mental health resources for rural Ugandan families.

KEYWORDS
adverse childhood experiences, child mental health, depression, mediation analysis, Uganda

1 | INTRODUCTION

A burgeoning literature in biological anthropology, epidemiology, and other disciplines has consistently documented the long-term effects of early life adversity on the development of future physical and mental illness across the life course (Barker, 1990; Kuzawa & Sweet, 2009; Lupien et al., 2009). These studies show that adverse childhood experiences (ACEs) (e.g., stressful life events, trauma/abuse, parental incarceration) are risk factors for a range of poor cardiovascular and psychiatric outcomes across the lifecourse (Felitti et al., 1998; Flores-Torres et al., 2020; Henry et al., 2021; Kim et al., 2020; Miller et al., 2018). In addition to these potentially durable effects on later-life physical health and mental health risk, growing evidence suggests that the long arm of maternal childhood adversity may extend across generations and shape offspring mental health outcomes, including hyperactivity, emotional disturbance, and depressive symptoms (Kumar et al., 2018; Madigan et al., 2019; Rieder et al., 2019; Roberts et al., 2015; Schickedanz et al., 2018). Research on the potentially modifiable psychosocial pathways affecting child mental health is particularly important for settings with high psychiatric morbidity and low availability of mental health resources, such as communities living within low- and middle-income countries (LMICs) (Vigo et al., 2016).

1.1 | Child mental health in Uganda

Mental illnesses are among the leading causes of disease burden among children and adolescents in sub-Saharan Africa (Gouda et al., 2019). Recent estimates report that in sub-Saharan Africa, one in seven adolescents face significant mental health difficulties, and one in ten can be diagnosed with a psychiatric disorder (Ashaba et al., 2019; Cortina et al., 2012). Despite the major role of mental illness in affecting children's health and well-being and the high prevalence of psychiatric morbidity, there are little epidemiological data on child mental illness and associated risk factors in sub-Saharan Africa.

Similar to other African nations with histories of European colonialism and war, Uganda faces deep economic insecurity, limited mental healthcare infrastructure, and a heightened prevalence of risk factors known to be associated with elevated mental health problems (Amone-P'Olak et al., 2014; Ashaba et al., 2018; Familiar et al., 2016). Communities in recently war-affected regions in northern Uganda report elevated levels of psychiatric morbidity. For example, one study of adolescent girls in southern Uganda found a 16% prevalence of severe depressive symptoms and a 30% prevalence of moderate symptoms (Nabunya et al., 2020). Another study of adolescents living with HIV in southwestern Uganda found 16% with major depressive disorder (Ashaba et al., 2018).

The long-term mental health effects of societal adversity due to colonialism, postcolonial reconstruction, and political violence in Ugandan communities raises the question: to what extent do past adversities, particularly those experienced during childhood, affect mental health outcomes among children in the next generation? The violent rule of the colonial British Empire in Uganda, which included forced taxation, the regulation of a cash crop industry, land seizures, militarized occupation, and ethnic fragmentation, has left local communities to grapple with a long history of political and economic

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marginalization and its ongoing societal impacts into the present (Lwanga-Lunyiigo, 1987). Past research suggests that these historical conditions of war, political violence, and economic insecurity in colonial and post-colonial Uganda exposed families to various forms of psychosocial stress, trauma, and household adversity (Decker, 2014; Tankink, 2004). While ACEs as risk factors are best documented in high-income countries, studies in LMICs in sub-Saharan Africa and elsewhere suggest they also affect mental health across the life course in these settings (Cluver et al., 2015; Kidman et al., 2020; Oladeji et al., 2010; Ramiro et al., 2010; Satinsky et al., 2021). Growing evidence suggests that the long-term mental health effects of maternal ACEs may also extend into the next generation and increase children's risk for internalizing and externalizing disorders (Madigan et al., 2019; Miranda et al., 2013a; Roberts et al., 2015).

1.2 | Maternal experiences of adversity during childhood and mental health among offspring: Possible pathways

Researchers have hypothesized that the intergenerational effects of maternal ACEs on child mental health may manifest through a variety of complex biological, psychological, and socioeconomic pathways. For instance, childhood adversity may alter the function of developing stress-sensitive mechanisms, such as neuroendocrine, inflammatory, and psychological pathways, and thereby shape both the reproductive biology of expectant mothers and intrauterine conditions of the fetus (Kuzawa & Sweet, 2009; Stephens et al., 2021). Additionally, the continuation of poor household and socioeconomic contexts, such as poverty, domestic violence, and substance use, across generations could place multiple household members at risk for mental illness (Jensen et al., 2017; Marsh et al., 2020).

The well-known depressive effects of childhood adversity and the close relationship between maternal and child mental health status highlight the role of maternal psychological well-being as a key pathway through which maternal ACEs can affect children's mental health. Maternal depression is associated with poorer cognitive and emotional development in children as well as with worse child mental health (Goodman et al., 2011; Herba et al., 2016; Kiernan & Huerta, 2008). Candidate mechanisms that may underlie the relationship between maternal psychological well-being and child mental health include attachment and parenting (Brown et al., 2021; Christodoulou et al., 2019; Pereira et al., 2018; Rijlaarsdam et al., 2014). Together, these studies suggest that maternal ACEs may increase the risk for future maternal mental health problems, which among caretaking women may correspond with poorer socioemotional development and mental health outcomes in their children (Tsai & Tomlinson, 2012). One recent study from rural Kenya found that the mothers' mental health symptoms mediated the relationship between the mothers' ACEs and their children's internalizing and externalizing symptoms (Rieder et al., 2019).

Finally, structural social capital, or the quantity of interpersonal relationships such as membership in groups or networks (Szreter & Woolcock, 2004), may buffer against the negative mental health effects of adversity (Cohen & Wills, 1985; Cruwys et al., 2013). Structural social capital can provide stronger social connections, shared identity, and instrumental support (De Silva et al., 2005; Szreter & Woolcock, 2004). Researchers have also found that certain forms of social support – such as maternal perceptions of support from relationships with friends, partners, and family – may buffer against the long-term psychological impacts of maternal ACEs on their children (Hatch et al., 2020; Uddin et al., 2020). Greater availability of emotional, peer, and instrumental support may translate to increased perceived social support, the amelioration of psychological distress and physiological arousal, a heightened sense of purpose and belonging, and access to resources (Berkman & Glass, 2000; Song & Lin, 2009), all of which may shield the individual against poorer mental health. However, the potentially buffering role of structural social capital against the poor mental health effects from maternal ACEs has not been widely studied.

Taken together, these strands of inquiry highlight the possibility that parents' experiences of adversity during childhood may influence both their own later-life mental health and their children's mental health, and that greater structural social capital may buffer their children against the potentially adverse effects of parents' poor mental health. While high-income countries comprise of only a fifth of the global population, few studies on the association between ACEs and mother–child mental health have been conducted in LMICs (Kumar et al., 2018; Rieder et al., 2019). This study examines the intergenerational effects of maternal ACEs on child mental health outcomes in a rural region of southwestern Uganda, the mediating role of maternal depression in the maternal ACEs-child mental health pathway, and the potentially moderating effect of maternal structural social capital – in the form of social group membership – on the mediating effect of maternal depression (Figure 1).

2 | METHODS

2.1 | Study site

This study was conducted between 2016 and 2018 through an ongoing population cohort in a rural region of southwestern Uganda (Takada et al., 2019). Subsistence agriculture, animal husbandry, petty trade, and migrant labor are prominent aspects of the local economy, and food and water insecurity are prevalent (Mushavi et al., 2020; Tsai et al., 2012). Inclusion criteria were as follows: women 18 years of age and older (and emancipated minors aged 16–17 years) who had a child between 4 and 12 years old, and who were either the biological mother of the child or married to the biological father; had primary residence in Nyakabare Parish; and had the ability to provide informed consent. Individuals who could not provide informed consent and communicate with research staff due to cognitive and perceptual impairments were excluded from the study.

All participants provided written informed consent before engaging in this study. Research assistants explained the study, probed for

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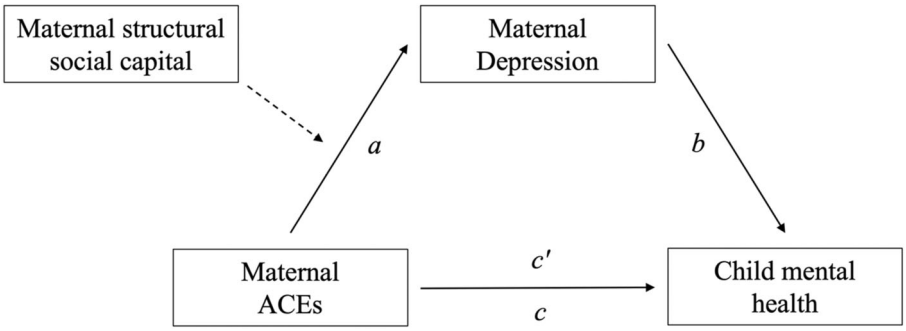


FIGURE 1 Conceptual model. Maternal depression as a proposed mediator of the association between maternal adverse childhood experiences and child mental health, and maternal structural social capital as a possible moderator of the mediating effect of maternal depression.

comprehension, and obtained written informed consent. Study participants who could not write provided their consent with a thumbprint. All study procedures were approved by the Mbarara University of Science and Technology Research Ethics Committee and the Partners Human Research Committee. Per national guidelines, the study received clearance from the Uganda National Council for Science and Technology and the Research Secretariat in the Office of the President of Uganda.

2.2 | Study measures

All participants completed a survey administered by research assistants that elicited individual sociodemographic characteristics, household conditions, and social environments. Socioeconomic status was measured through an asset inventory of the following household items: radio, lantern, bicycle, television, iron, motorbike, refrigerator, stove, car, and mobile phone; type of toilet facility; materials used to construct the household floors and walls; number of rooms in the home; number of plots of land owned; number of livestock; and size of the household's rainwater harvesting tank, if any. Using principal component analyses, we created asset index scores to categorize households into quintiles of asset wealth ("wealth quintiles") (Filmer & Pritchett, 2001; Smith et al., 2020). All instruments used in this study were translated to Runyankore and back-translated to English to confirm fidelity to the original text.

A modified version of the Adverse Childhood Experiences-International Questionnaire (ACE-IQ) was used to assess experiences of abuse, neglect, and household dysfunction during the mother's childhood (Satinsky et al., 2021). The ACE-IQ was modified by eliminating language that was unclear and also added items on material deprivation given the high prevalence of food and water insecurity in the region. The following 16 experiences were queried and each binary response was summed to create a total composite score: (1) verbal abuse, (2) fear of physical harm, (3) being pushed/grabbed/slapped/hit by an object, (4) scarring from physical abuse, (5) sexual abuse, (6) rape, (7) parental divorce, (8) observing one's mother or other guardian being pushed/grabbed/slapped or having an object thrown at them, (9) observing one's mother or other guardian being kicked/bit/punched, (10) observing one's mother or other guardian being threatened with a weapon, (11) living with an adult who had an alcohol or substance use disorder, (12) living with adult who had a mental illness, (13) having an incarcerated family member, (14) experiencing an entire day without food, (15) going to bed hungry, and (16) going to bed thirsty. The modified ACE-IQ shows strong evidence of construct validity in the population (Ashaba et al., 2022; Satinsky et al., 2021).

Child mental health was assessed using the Strengths and Difficulties Questionnaire (SDQ). The SDQ is a brief screening tool used to assess child behavioral and emotional problems (Goodman et al., 2011) and comprises 25 items equally divided across five subscales: emotional symptoms, conduct problems, hyperactivity-inattention, peer problems, and pro-sociality. The first four subscales can be summed together to create a total difficulties score (range, 0–40), and the pro-social behavior subscale represents a total strengths score (range, 0–10). Mothers were given the option to respond, "not true," "somewhat true," and "certainly true" to assess the relevance of their child's particular behavior in their lives. In this sample, the SDQ had an acceptable level of internal consistency ($\alpha = 0.71$). A "total difficulties" score of 15 or higher was used to determine "caseness" (Hinterding, 2011).

Maternal structural social capital was measured using a dichotomous variable assessing participants' membership in community-based social groups (e.g., vocational group, savings group, church group, etc.). Participants indicated whether they had in the past 2 months attended any meetings for a pre-selected list of social groups. A dichotomous variable was created, with 0 = individuals who did not attend any group meetings and 1 = individuals who attended one or more group meetings.

Maternal depression symptoms were assessed using the depression subscale of the Hopkins Symptom Checklist (HSCLD-15). The 15-item self-report survey elicited symptoms of depression over the past week. The HSCL was modified for the local context (Ashaba et al., 2018) following the procedures described in Bolton and Ngodoni (2001), with strong evidence shown for internal consistency, coherent factor structure, and construct validity in the local population (Mushavi et al., 2020; Tsai et al., 2012; Tsai et al., 2016). The average value across all responses served as the final score for the HSCLD-15. Probable depression was defined as a score above 1.75 (Hesbacher et al., 1980). In this sample, the HSCLD-15 had an excellent level of internal consistency ($\alpha = 0.88$).

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2.3 | Statistical analysis

All analyses were conducted using Stata version 15.1 (Stata Corporation, College Station, TX, USA). We examined bivariate associations to estimate the relationships between maternal ACEs, maternal depression, child mental health, and the other covariates. We then fitted multivariable linear regression models to the data, specifying child mental health as the primary outcome of interest and maternal ACEs and maternal depression as the primary explanatory variables of interest. Psychological, household, and social factors that were thought to potentially confound the relationship between maternal ACEs and child mental health were included as covariates: maternal age, child sex, child age, household asset wealth, maternal educational attainment, and maternal marital status.

Next, to explore the potentially mediating effect of maternal depression on the association between maternal ACEs and child mental health, as well as any potential moderated-mediation effects of maternal social group members, we used structural equation modeling to examine a simple (unadjusted) mediation model and a simple moderated-mediation model. Because we found no evidence of moderated mediation (i.e., maternal social group membership was not found to be a moderator of the mediating effect of maternal depression), we then focused our analysis on assessing the robustness of the mediating effect of maternal depression following the causal framework outlined by Imai et al. (2010a). We used linear regression to estimate the average causal mediation effect (or the average change in child mental health in relation to a change in maternal depression under conditions of less versus more exposure to maternal ACEs) and the average direct effect (or the average of all other causal mechanisms linking maternal ACEs and child mental health). These regression models adjusted for the same demographic and socioeconomic covariates listed above. Cluster-correlated robust standard errors were used to account for clustering of observations within villages.

To estimate the average causal mediation effect and the average direct effect, we assumed that maternal ACEs (the primary explanatory variable of interest) is independent of all potential values of outcomes and mediators, and that maternal depression (the primary mediator variable of interest) is independent of the outcome (child mental health) after adjusting for the exposure variable and baseline characteristics. Imai et al. (2010b) proposed a sensitivity analysis to examine the robustness of putative mediation findings to the violation of sequential ignorability. Sequential ignorability assumes that there is no unmeasured confounding between the exposure, mediator, and outcome variables, conditional on pretreatment covariates. This sensitivity analysis estimates how large the magnitude of the correlation there would need to be between the mediator model error term and the outcome model error term (and therefore the extent to which sequential ignorability is violated) to render the average causal mediation effect null.

Additionally, to determine the robustness of the estimated association between maternal ACEs and child mental health outcomes, we used the sensitivity analysis described by Oster (2019), which determines how much greater selection on unobservable variables would need to be, relative to selection on observed variables, in order to account for the estimated associations. This method calculates relative differences in coefficient and R^2 values to identify the degree to which the model is sensitive to unobserved confounding. A "delta" value is estimated, which is the relative degree of selection on unobserved versus observed variables needed to eliminate an estimated association (i.e., to generate a regression coefficient of zero).

3 | RESULTS

3.1 | Descriptive statistics

Data were available from 218 mother–child dyads. The average age of mothers was 35.1 years (standard deviation [SD], 7.7) (Table 1). The average age of children was 8.9 years (SD, 2.5). ACEs were common among study participants: the average number of ACEs was 5.1 (SD, 3.4, range: 0–15) out of a possible 16. Living with an adult who used alcohol/drugs was the most commonly reported experience ($n = 133$, [61%]), followed by experiencing physical abuse ($n = 128$, [58%]), experiencing verbal abuse or humiliation ($n = 126$ [58%]), and having a family member incarcerated ($n = 124$, [44%]) (Table S1). Sixty-one mothers (28%) reported symptoms consistent with probable depression based on the HSCLD-15. Forty-seven children (22%) met the cutoff for caseness, or significant psychological distress, based on their SDQ total difficulties scores.

3.2 | Mediation analyses

In fully-adjusted, multivariable regression models (Table 2), we found that the estimated association between maternal ACEs and the total difficulties score was statistically significant ($b = 0.36$; 95% confidence interval [CI] [0.17, 0.55]). For the average study participant, a one-standard deviation shift in maternal ACEs (3.4) would be associated with a $3.4 \times 0.36 = 1.224$ point increase in the SDQ total difficulties score, or a $1.224/10.5 = 12\%$ difference relative to the baseline mean or $1.224/5.2 = 0.24$ standard deviation units. There were statistically significant associations between maternal ACEs and both the conduct problems subscale ($b = 0.19$; 95% CI [0.12, 0.27]) and the peer problems subscale ($b = 0.093$; 95% CI [0.024, 0.16]). Maternal ACEs did not have statistically significant associations with the child hyperactivity-inattention, emotional symptoms, and prosociality subscales.

Next, we estimated a simple mediation model without covariates using structural equation modeling (Figure 1). A mediating effect of maternal depression was confirmed for the associations between maternal ACEs and the total difficulties score ($b = 3.49$; 95% CI [2.00, 4.98]), the conduct problems subscale ($b = 0.89$, 95% CI [0.31, 1.47]), and the peer problems subscale ($b = 0.63$, 95% CI [0.24, 1.02]). We then explored the extent to which the mediating role of maternal depression on these associations was moderated by maternal structural social capital, using a moderated-mediation analysis. We found that, among women with no structural social capital (e.g., no

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TABLE 1 Sample characteristics.

Variables	*n*	Mean/%	SD
Mothers			
Age (years)		35.1	7.7
Educational status			
None	18	8.2	
Some primary school	75	34.4	
Completed primary school	68	31.2	
Some secondary or more	57	26.2	
Assets			
Poorest	51	23.4	
Poorer	51	46.8	
Middle	43	66.5	
Richer	46	87.6	
Richest	27	12.4	
Partnered	194	89.0	0.31
ACEs		5.1	3.4
HSCL-D		1.6	0.49
Probable depression[a]	61	28.0	0.31
Children			
Age (years)		8.9	2.5
Female	115	52.8	0.5
SDQ (score)			
Emotional symptoms		1.8	1.7
Conduct problems		2.6	2.1
Hyperactivity/inattention		3.6	2.2
Peer problems		2.4	1.7
Prosociality		7.6	2.0
Total difficulties		10.5	5.2

Abbreviations: ACEs, adverse childhood experiences; HSCL-D, 15-item Hopkins Symptom Checklist for Depression; SD, standard deviation; SDQ, strengths and difficulties questionnaire.
[a]HSCL-D-15 > 1.75.

membership in any community-based social group), maternal ACEs had a statistically significant association with maternal depression ($b = 0.047$; 95% CI [0.22, 0.72]), and maternal depression had a statistically significant association with the total difficulties score ($b = 3.91$; 95% CI [2.06, 5.76]). Among women with maternal structural social capital (e.g., membership in one or more community-based social groups), the estimated associations were qualitatively similar: maternal ACEs were positively associated with maternal depression ($b = 0.025$; 95% CI [−0.0016, 0.052]), and although the estimate was not statistically significant, maternal depression had a statistically significant association with child total difficulties score ($b = 2.99$; 95% CI [1.05, 4.92]). Thus, there was little evidence of moderated mediation. A Wald test between the coefficients of the maternal structural social capital categories (none vs. any) also found no statistically significant evidence for moderated mediation ($p = 0.19$). Similar findings were obtained in the analyzes of the conduct problems subscale and the peer problems subscale, which also showed no evidence for moderated mediation. Thus, we found no evidence for the moderating role of maternal structural social capital on the mediating effect of maternal depression.

We then focused our analysis to evaluate the mediating effect of maternal depression in the pathway from maternal ACEs to child mental health. Following the framework proposed by Imai et al. (2010a) as described above, we found that maternal depression mediated the association between maternal ACEs and the total difficulties score among children (Table 3). Maternal ACEs had a statistically significant association with maternal depression ($b = 0.034$, 95% CI [0.016, 0.052]), and maternal depression had a statistically significant association with child total difficulties score ($b = 3.4$, 95% CI [1.96, 4.90]). The mediating effect of maternal depression accounted for 32.4% of the total effect on the child's total difficulties score. Similar findings were obtained in the mediation analyses for the child conduct problems subscale and the peer problems subscale. For the conduct problems analysis, maternal ACEs had a statistically significant association with maternal depression ($b = 0.034$, 95% CI [0.016, 0.052]), and maternal depression had a statistically significant association with the conduct problem subscale score ($b = 0.87$, 95% CI [0.30, 1.43]) (Table S2). For the peer problems analysis, maternal ACEs had a statistically significant association with maternal depression ($b = 0.034$, 95% CI, [0.016, 0.052]), and maternal depression had a statistically significant association with the peer problem subscale score ($b = 0.71$, 95% CI [0.30, 1.11]) (Table S3). The mediating role of maternal depression accounted for 15.1% of the total effect on child conduct problems, and 25.4% of the total effect on child peer problems.

3.3 | Sensitivity analyses

The results of our sensitivity analysis showed that a correlation of $\rho = 0.33$ between the error terms of the mediator model and the outcome model for total difficulties scores would be necessary for the average causal mediation effect to equal zero. Thus, the product of the R^2 values for the mediator model and the outcome model would have to be 0.11 in order for the average causal mediation effect to be zero. Such a pattern of correlations could be consistent with, for example, an omitted confounder explaining 32% of the remaining variance in maternal depression and 35% of the remaining variance in child mental health ($0.32 \times 0.35 = 0.11$). To determine the robustness of the relationship between maternal ACEs and the child total difficulties score, we first identified the R^2 value of the fully-adjusted model specifying the child total difficulties score as the outcome (0.134). Based on the methods outlined by Oster (2019), we calculated a maximum R^2 value (i.e., consistent with findings from randomized trials) of $0.134 \times 1.3 = 0.174$. The delta value was 6.9, which indicates that selection on unobserved variables would need to be nearly 7 times as important as selection on observed variables to eliminate the observed effect of maternal ACEs on total difficulties scores and generate a regression coefficient equal to zero.

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TABLE 2 Multiple regression models of the association between adverse childhood experiences and strengths and difficulties subscales.

	Emotional problems		Conduct disorders		Hyperactivity-inattention	
Variable	***b***	**(95% CI)**	***b***	**(95% CI)**	***b***	**(95% CI)**
Total no. ACEs	0.046	−0.0256–0.118	0.194***	0.121–0.267	0.026	−0.051–0.102
Maternal age (years)	−0.022	−0.533–0.009	0.008	−0.029–0.045	−0.015	−0.059–0.030
Education	−0.114	−0.301–0.073	0.052	−0.127–0.231	−0.099	−0.307–0.110
Partnered	−0.917*	−1.769–0.064	−0.533	−1.530–0.465	0.079	−0.0818–0.976
Asset index	0.047	−0.101–0.195	−0.253***	−0.396–0.110	−0.191*	−0.0366–0.016
Female	0.103	−0.358–0.564	−0.416	−0.927–0.095	−0.021	−0.602–0.561
Child age (months)	0.003	−0.005–0.012	−0.011*	−0.020–0.001	−0.018**	−0.029–0.007
Constant	3.119***	1.29–4.95	2.966**	1.012–4.919	6.117***	3.929–8.305
	Peer problems		**Prosociality (reversed)**		**Total difficulties**	
Variable	***b***	**(95% CI)**	***b***	**(95% CI)**	***b***	**(95% CI)**
Total no. ACEs	0.093**	0.024–0.162	−0.031	−0.124–0.061	0.360***	0.172–0.547
Maternal age (years)	0.007	−0.026–0.041	−0.012	−0.051–0.026	−0.021	−0.122–0.079
Education	−0.025	−0.192–0.014	−0.064	−0.246–0.118	−0.186	−0.0682–0.310
Partnered	0.551	−0.157–1.258	−0.631	−1.688–0.427	−0.82	−3.209–1.569
Asset index	−0.086	−0.224–0.052	0.142	−0.031–0.316	−0.483*	−0.870–0.096
Female	−0.202	−0.651–0.247	0.27	−0.294–0.834	−0.535	−1.852–0.782
Child age (months)	−0.002	−0.011–0.006	0.013*	0.002–0.024	−0.028*	−0.052–0.004
Constant	1.594	−0.028–3.217	7.379***	5.574–9.182	13.796***	8.552–19.041

Abbreviations: ACEs, adverse childhood experiences; *b*, unstandardized regression weights; CI, confidence interval.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

TABLE 3 Regression coefficients for mediation analysis (child total difficulties).

Path	*b*	95% CI	*P*
a	0.034	0.016–0.052	<0.0001
b	3.427	1.957–4.897	<0.0001
c	0.360	0.171–0.557	<0.0001
c′	0.244	0.055–0.428	0.010

Note: See Figure 1 for conceptual diagram of paths.
Abbreviations: *a*, association between maternal ACEs and maternal depression; *b*, association between maternal depression and child mental health; *c*, association between maternal ACEs and child mental health without inclusion of maternal depression in the model (total effect); *c′*, the remaining effect of maternal ACEs and child mental health (direct effect).

We found similar results for our models specifying conduct scores as the outcomes. Sensitivity analysis for our conduct problems model estimated that there would need to be a correlation of $\rho = 0.21$ between the mediator model error term and the outcome model error term for the average causal mediation effect to equal zero. The R^2 value of the fully-adjusted model was 0.195, resulting in a maximum R^2 value of 0.253, and a delta of 6.6. Similarly, we estimated that there would need to be a correlation between the mediator and peer problems outcome model error terms of $\rho = 0.20$ for the average causal mediation effect to equal zero. The R^2 value of the fully-adjusted model was 0.053, resulting in a maximum R^2 value of 0.068, and a delta of 11.5.

4 | DISCUSSION

In this analysis of the intergenerational effects of maternal childhood adversity on child mental health in rural Uganda, we found that mothers who reported a history of ACEs also reported an increasing severity of mental health problems among their children. This association was mediated by the mothers' depressive symptoms. However, we did not find evidence that mothers' membership in social groups moderated the mediating effect of maternal depression. These results contribute to a limited literature on the pathways of intergenerational stress transmission in sub-Saharan Africa and LMICs as well as on potential buffers against the long-term mental health effects of maternal ACEs.

While the frequency of adults who reported having grown up with a parent who used alcohol and/or drugs (61%) seems to be elevated, the lack of consistency in how researchers assessed childhood exposure to parental alcohol and drug use in past studies limits our ability to compare results. Past data suggest that retrospective reporting of parental alcohol and drug use is high in Uganda (Babihuga, 2015; Okello et al., 2014; Swahn et al., 2012; Swahn et al., 2018). One study, which utilized the 10-item ACEs

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Questionnaire in Kampala, found that only 41% of youth lived with parents that used alcohol and drugs, but that study limited their sample to children ages 13 and under (Babihuga, 2015). Another study of Ugandan youth between ages 12 and 18 living in lower-income urban communities in Kampala found that 69% of children reported living with a parent who used alcohol (Swahn et al., 2018). Nonetheless, research shows that children whose parents have substance use disorders face elevated risk for developing both internalizing and externalizing disorders later in life (Muniz et al., 2019; Wasserman et al., 2021).

The observed associations between maternal ACEs and poor child mental health outcomes, as well as the association between maternal depression and child mental health, were largely consistent with the larger literature. Past research has consistently shown that maternal childhood adversity is consistently associated with poorer child mental health in the next generation (Min et al., 2013; Rijlaarsdam et al., 2014). Additionally, these findings are consistent with findings reported from other LMICs, sub-Saharan contexts, and communities across Uganda (Familiar et al., 2016; Kumar et al., 2018; Rieder et al., 2019). One study in eastern Uganda found that caregiver depressive symptoms were associated with child executive function (Familiar et al., 2016). Additionally, past research in this sample shows that maternal ACEs are strongly associated with maternal depression in fully adjusted models (Satinsky et al., 2021).

4.1 | Mediating role of maternal depression

The mediating effect of maternal depression on the relationship between maternal ACEs and child mental health outcomes is consistent with past studies on this topic, yet comparatively fewer studies have been done in this area in LMICs. Similar to our findings, these studies report that maternal depression mediates the association between maternal childhood trauma exposure and poor child mental health status (Cooke et al., 2019; Min et al., 2013; Pereira et al., 2018; Rijlaarsdam et al., 2014). Two studies in sub-Saharan Africa have assessed the mediating role of maternal depression in the association between maternal ACEs and child mental health (Kumar et al., 2018; Rieder et al., 2019). Both studies identified a significant mediating effect of maternal depression, and Rieder and colleagues found that the conditional indirect effects on child mental health accounted for 23%–26% of the overall variance in child mental health.

We also found that the mediating effect of maternal depression was only significant for externalizing symptoms (e.g., conduct disorder symptoms), but not internalizing symptoms (e.g., emotional symptoms). Our results contrast with the current literature, which tend to show that maternal ACEs and maternal depression are associated with externalizing as well as internalizing symptoms among samples in high-income countries (Hatch et al., 2020; Schickedanz et al., 2018). Additionally, while the literatures on the child mental health impacts of maternal ACEs and maternal depression in sub-Saharan Africa are quite nascent, findings have found that maternal ACEs are significantly associated with both internalizing and externalizing symptoms (Goodman et al., 2011; Kumar et al., 2018; Rieder et al., 2019). Different types of ACEs may have emotionally and psychologically distinct impacts on child mental health. For instance, recent research has shown that early life socioeconomic deprivation is associated with greater child externalizing symptoms but not internalizing symptoms (Busso et al., 2017; Kiernan & Huerta, 2008).

Our results found that structural social capital did not moderate the mediating effect of maternal depression in the association between maternal ACEs and child mental health. While studies have found that greater levels of structural social capital buffer against the negative mental health impacts of past adversity (Cruwys et al., 2013; Haslam et al., 2019), there is a dearth of evidence that has specifically assessed the buffering role of structural social capital on the intergenerational mental health effects of maternal ACEs, which limits our ability to compare our findings. However, there are multiple possible reasons for why structural social capital did not moderate the mediating effect of maternal depression.

First, structural social capital may not have stress buffering effects against maternal depression due to high levels of mental health stigma. In this region of Uganda, stigma against individuals exhibiting depression and other symptoms of mental illness is common (Rasmussen et al., 2019), meaning that group membership may not exert as protective an effect as expected, or could even act as a psychological stressor for some individuals. Furthermore, participants in this study expressed beliefs that an individual with a mental illness can bring shame to their own family, which may further contribute to feelings of loneliness (Takada et al., 2014), discourage group membership (Kawachi & Berkman, 2001), or compromise the stress buffering effects of group membership itself (Hall et al., 2019). Second, depressed individuals may have been more likely to socially isolate themselves as a consequence of their depression and not participate in social groups (Elmer & Stadtfeld, 2020). Third, other dimensions of social capital may be more effective in buffering the mediating effect of maternal depression in this context, such as instrumental support or the quality of relationships (Szreter & Woolcock, 2004).

Uganda's recent history of colonialism and war and its deep socioeconomic consequences may have contributed to the high prevalence of maternal ACEs in our sample and its long-term effects on maternal depression and child mental health. Socioeconomic adversity, which was common during the period that our participants were children during the mid- to late-1900s (Harris, 2005), may have exacerbated household problems, including parent psychological distress, disrupted parent–child relationships, and economic well-being, and contributed to future mental health concerns in children and into their adult years as mothers (Masarik & Conger, 2017). Several related mediating pathways, mostly operating through maternal behavior, have also been explored and implicated. Alterations in maternal behavior or psychological status – in some studies assessed cross-sectionally with measures of child mental health (Kumar et al., 2018; Rieder et al., 2019), but in other studies prospectively assessed in relation to child health (Cooke et al., 2019; Min et al., 2013; Pereira et al., 2018; Rijlaarsdam et al., 2014) – have exhibited significant mediating effects. These negative changes in maternal behavior or psychological status include

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maternal attachment (Cooke et al., 2019) and overwhelmingly, maternal mental health (Cooke et al., 2019; Kumar et al., 2018; Min et al., 2013; Miranda et al., 2013a; Miranda et al., 2013b; Pereira et al., 2018; Rieder et al., 2019).

4.2 | Limitations

Interpretation of our findings is subject to several limitations. First, retrospective recall measures of childhood adversity can be subject to both recall and emotional bias; prospective versus retrospective assessments of childhood trauma have been shown to differ (Naicker et al., 2017). Furthermore, both maternal and child mental health assessments were based on maternal-report. If mothers' reporting of ACEs, depressive symptoms, and/or of their children's mental health, are systematically influenced by fixed personality traits, their own psychological status, or by variable situational factors, these correlated errors could bias our estimates of association away from the null (Podsakoff et al., 2003). However, our sensitivity analysis of the association between maternal ACEs and child mental health showed that selection on the basis of unobserved variables would need to be nearly seven times as strong as selection on the basis of observed variables in order to generate a regression coefficient equal to zero. A second limitation is that our measure of maternal social membership – recent attendance at community group meetings – does not fully capture the complexity of social life and social integration in this sample. Being unable to meet the cultural expectations for social support may have stress-inducing and negative impacts on the individual. Third, because this analysis was limited to a cross-sectional design, the relationship between maternal depression and child mental health may be subject to reverse causality, limiting our ability to determine the true temporal ordering of events.

4.3 | Future directions

While we also found maternal depression to be a significant mediating mechanism between maternal ACEs and child mental health, the mechanistic pathways remain unknown. This intergenerational pathway may operate through multiple, and likely interacting, mechanisms: the alteration of stress-sensitive biological functions (e.g., epigenetics, neurotransmission, neuroendocrinology, inflammation, etc.), psychopathology, and bidirectional mother–child interactions (Brand et al., 2010; Grasso et al., 2020; Miranda et al., 2013b); other childhood experiences; parenting behavior; the roles of fathers and other caretakers; larger environmental and structural factors, such as socioeconomic conditions and discrimination; and also potential buffering and protective effects, such as social support, psychoeducation, or anti-poverty initiatives (Karimli et al., 2019). Additionally, the nature of specific ACEs, including the frequency, timing, and chronicity, are not well known in the rural Ugandan context, which are known to have variable impacts on future mental health (Lacey & Minnis, 2020). Finally, greater understandings of specific ACEs relative to their local meanings and various consequences can allow us to identify which forms of childhood adversity are more deleterious for mothers and children and more crucial for future intervention.

4.4 | Implications for interventions

Finally, our results raise important implications for interventions and social programs aimed at improving mental health and family outcomes. Our findings highlight the close relationship between maternal mental health and children's outcomes in our sample in Mbarara, Uganda, which could provide context-specific evidence of how mental health treatment could have cascading benefits in the population. Our results emphasize the importance of interventions aimed at improving mother–child outcomes, including psychological, educational, and socioeconomic programs for mitigating and preventing the effects of substance abuse, harsh parenting practices, and maternal depression, improving child mental health, and bolstering family well-being (Atukunda et al., 2019; Sherr et al., 2017; Singla et al., 2014; Singla et al., 2015; Ssewamala et al., 2012). Our study also found that household socioeconomic status was a major predictor of child mental health and emphasizes the importance of structural interventions for more holistic impacts on family well-being. Pairing interventions to improve household socioeconomic well-being (e.g., cash transfers) with psychosocial programs (e.g., trauma counseling) may have greater impacts together than either of the interventions alone (Van Reisen et al., 2018).

5 | CONCLUSION

To summarize, in this population-based sample of Ugandan mothers and children, we found that maternal ACEs have long-term associations with child mental health—externalizing and peer difficulties—and that maternal depression significantly mediated these associations. We did not find evidence that maternal social group membership moderated the mediating effect of maternal depression. Set within a context of elevated rates of psychiatric morbidity, high prevalence of childhood adversity, and limited healthcare and economic infrastructures across the country, these data emphasize the prioritization of social services and mental health resources for rural Ugandan families. In the most recent World Health Organization Mental Health Atlas (WHO, 2018), of the 47 WHO member states, 16 countries still lacked standalone mental health policies. Furthermore, the proportion of admissions, beds, mental healthcare workers, and facilities to the total population continue to be low. Generating further research on the pathways underlying poor child and adult mental health as well as identifying potential protective factors and effective, ameliorative resources may assist with informing the development and implementation of important interventions. These programs may ultimately lessen the burden of psychological morbidity and improve public mental health in Uganda and elsewhere.

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AUTHOR CONTRIBUTIONS

Andrew Wooyoung Kim: Conceptualization (lead); formal analysis (lead); investigation (equal); writing – original draft (lead); writing – review and editing (lead). **Amber Rieder:** Investigation (equal); writing – review and editing (equal). **Christine Cooper-Vince:** Writing – review and editing (equal). **Bernard Kakuhikire:** Investigation (equal); project administration (equal); writing – review and editing (equal). **Charles Baguma:** Investigation (equal); project administration (equal). **Emily Satinsky:** Data curation (equal); project administration (equal); writing – review and editing (equal). **Jessica Perkins:** Project administration (equal); writing – review and editing (equal). **Allen Kiconco:** Investigation (equal); writing – review and editing (equal). **Elizabeth Namara:** Investigation (equal); writing – review and editing (equal). **Justin Rasmussen:** Investigation (equal); writing – review and editing (equal). **Scholastic Ashaba:** Investigation (equal); writing – review and editing (equal). **David Bangsberg:** Investigation (equal); writing – review and editing (equal). **Alexander C. Tsai:** Funding acquisition (lead); investigation (lead); methodology (equal); resources (lead); supervision (equal); writing – review and editing (lead). **Eve Puffer:** Investigation (equal); writing – review and editing (equal).

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interests to report.

DATA AVAILABILITY STATEMENT

Data are available in the following GitHub repository: https://github.com/awkkim/Maternal-depression-mediation-analysis-HopeNet.

ORCID

Andrew Wooyoung Kim https://orcid.org/0000-0002-0148-7565

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