Drought exposure and the risk of sexual, emotional, and physical violence against adolescents in Zimbabwe, Mozambique, and Lesotho: an observational study

Bothaina Eltigani, Roman Hoffmann, Lucie Cluver

Summary

Background Droughts are increasing in severity and frequency, severely impacting agriculture-dependent regions, such as southern Africa. Although direct health effects are increasingly well documented, associations with violence against adolescents remain largely unexplored. This multi-country, cross-sectional study examined associations between drought and risk of intimate partner and non-partner sexual, emotional, and physical violence.

Methods We combined violence victimisation and demographic data from 20 290 adolescents (aged 13–24 years) in the Violence Against Children Surveys from Zimbabwe, Mozambique, and Lesotho, between 2017 and 2019, with Standardised Precipitation and Evapotranspiration Index (SPEI) drought data for corresponding years. Multivariate logistic regression models, controlling for sociodemographic factors, assessed associations between past-year drought exposure and violence against adolescents. Interaction models explored potential moderating roles of adolescents' gender, age, and rural residence, and sensitivity analyses were used for robustness checks. Secondary analyses examined prolonged drought over the past 24 months.

Findings Drought was associated with increased risk of non-partner sexual violence (odds ratio 1·46 [95% CI 1·12–1·90]), emotional violence (1·73 [1·45–2·06]), and physical violence (1·41 [1·18–1·68]), as well as intimate partner emotional violence (1·51 [1·12–2·02]) and physical violence (1·39 [1·11–1·75]). Moderation analyses showed higher risk for adolescent girls and older adolescents (aged 18–24 years) for non-partner sexual violence and non-partner and partner emotional violence, whereas older adolescents had an increased risk for partner physical violence and adolescents in rural areas had higher risk for non-partner physical violence. Prolonged drought over 24 months had positive associations with larger effect sizes than 12-month drought.

Interpretation Drought exposure is associated with increased violence against adolescents in Zimbabwe, Mozambique, and Lesotho. Adolescent girls, older adolescents, and those living in rural areas are at heightened risk. Adolescent and youth-focused, gender-sensitive violence prevention strategies must be integrated into early warning systems with sustainable climate adaptation measures used in prolonged drought settings.

Funding The Reuben-AfOx scholarship, University of Oxford; The Natural Environment Research Council (NERC); the European Union's Horizon Europe Programme; and Oak Foundation, Wellspring Philanthropic Fund.

Lancet Planet Health 2026; 10: 101448

Published Online June 1, 2026
https://doi.org/10.1016/j.lanplh.2026.101448

Department of Social Policy and Intervention, University of Oxford, Oxfordshire, Oxford, UK (B Eltigani MBBS MSc, Prof L Cluver PhD); **International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria** (R Hoffmann PhD)

Correspondence to:
Dr Bothaina Eltigani, Department of Social Policy and Intervention, University of Oxford, Oxford OX1 2ER, UK
bothaina.eltigani@spi.ox.ac.uk

Introduction

Climate change, primarily driven by unsustainable human activities, is accelerating the frequency and severity of extreme weather events globally. Among these, drought has emerged as one of the most detrimental environmental hazards, particularly to agriculturally dependent regions.[1,2] Drought is often described as a prolonged period of below average rainfall, although its manifestations are varied and its definition remains debated.[3] Africa is the most affected continent, accounting for 44% of the global total of drought-related deaths.[4]

Southern Africa, in particular, is projected to have up to a 30% decrease in water availability by 2050,[5] largely linked to El Niño-Southern Oscillation-driven disruptions in rainfall patterns.[6] With nearly 70% of the region reliant on rain-fed agriculture, drought contributes to crop failure, livestock death, and loss of livelihoods. Zimbabwe, Mozambique, and Lesotho share similar climate vulnerabilities and exposure risk to El Niño-related drought, where maize—a primary staple food—is highly sensitive to droughts. After the 2016 southern African drought, Zimbabwe and Lesotho recorded a 56% and 67% reduction in maize production, respectively, while maize prices escalated by 177% in Mozambique.[7] These disruptions place economic and emotional strain on individuals and households, leading to increased poverty, food insecurity, and mental health distress. Droughts can also trigger cascading consequences of exacerbated existing social inequalities and harmful coping mechanisms, such as child marriage, child labour, and forced migration, all of which heighten risks of violence exposure.[8]

Violence against adolescents represents a public health crisis in sub-Saharan Africa, which is home to over

Research in context

Evidence before this study

We searched Google Scholar and Scopus databases for articles in English published between Jan 1, 2000, and Dec 31, 2024, using the keywords and Boolean operators: ("climate change" OR "drought*") AND ("child*" OR "adolescent*" OR "young adults") AND violen* AND "sub–Saharan Africa" OR "Southern Africa" OR "low-middle income"). After reviewing the abstracts, we reviewed relevant full texts and identified empirical studies and reviews that examined the impacts of drought on violence exposure in low-income and middle-income countries and sub-Saharan Africa. Given that there was almost no empirical evidence examining the association of drought with non-partner violence, we also consulted reference lists from systematic reviews, which included grey literature. Overall, the evidence base was scarce. Peer-reviewed, quantitative evidence focused exclusively on the effect of drought on gender-based violence and transactional sexual exploitation, demonstrating that living in drought significantly increased the risk of experiencing intimate partner violence (IPV) and transactional sex among girls and women aged 15–49 years. More recent global evidence showed that extreme drought is associated with increased risk of sexual violence by any perpetrator. For non-partner violence, grey literature included qualitative evidence that showed adolescent boys affected by drought were at risk of physical violence. No evidence was found on emotional violence in drought settings. This evidence showed clear and crucial evidence gaps in the literature.

Added value of this study

To our knowledge, this is the first known quantitative study to examine the association between drought exposure and the risk of experiencing sexual, emotional, and physical violence (both non-partner and IPV forms) among adolescents in sub-Saharan Africa. The study also provides a nuanced understanding of the roles of gender, age, and rural residence in shaping the vulnerability of adolescents to violence exposure during drought periods, while also examining risks associated with prolonged drought over 24 months. Our study combines the largest and most detailed surveys on violence exposure (Violence Against Children Surveys) across three southern African countries with drought data using the Standardised Precipitation and Evapotranspiration Index (SPEI), an indicator that accounts for both precipitation and temperature, making it highly suited for the context of southern African countries.

Implications of all the available evidence

Our findings support the sparse evidence linking drought to increased violence risk, disproportionately affecting highly vulnerable groups of adolescents. Given the vulnerability of southern African countries to climate change and the projected increase in frequency and intensity of droughts, our findings highlight the imperative to integrate violence prevention into climate resilience strategies. Furthermore, strengthening anticipatory action and early warning systems could help to mitigate violence risks before they escalate.

226 million adolescents (aged 15–24 years).[9] Adolescence is a crucial developmental stage characterised by rapid physical, cognitive, and psychosocial growth. Exposure to violence during this stage can disrupt neurodevelopment and stress regulation systems, increasing risks of poor mental health, cardiovascular diseases, risk-taking behaviours, and early adult mortality.[10] Further, adolescents in the region are disproportionately vulnerable to violence from both intimate partners and non-partners. Prevalences in several countries in southern African were reported to be among the highest in the world, with 17% of girls and women experiencing sexual violence and more than 60% of children subjected to violent discipline.[11] Consistent with the second *Lancet* Commission on adolescent health and wellbeing, and a scholarship recognising delayed social role transitions, this study adopts an inclusive definition of adolescents encompassing 10–24 years.[12,13]

Evidence linking drought to violence exposure remains scarce and inconsistent, with most studies focusing on intimate partner violence (IPV) among women. A multi-country study in Africa[14] found a significant association between drought and physical and sexual IPV among adult women, with stronger effects in severe drought, whereas a comparable study found no such associations.[15] Highly linked to drought, heat exposure was also found to be associated with increased IPV risks among female individuals (aged 15–49 years).[16] A study in Malawi found that moderate drought doubled the risk of transactional sex among adult women relying on agriculture for their livelihoods.[17] Evidence on other non-partner violence forms is underexplored, specifically within the adolescent age group, including males.

Climate change is rooted in structural inequality and existing vulnerability, with impacts unequally distributed across populations.[18] Gender, age, and rural residence are key social markers that can shape adolescents' violence differential vulnerability in drought settings. Drawing on feminist political ecology, heightened vulnerability among women and girls arises from gendered power structures that limit their access to climate resources, land tenure, and decision making while simultaneously assigning disproportionate unpaid domestic responsibilities and gendered roles (eg, water and fuelwood collection) that constrain adaptive capacity and heighten exposure to harm.[19] This differential vulnerability is supported by a systematic review showing that women and girls are disproportionately affected by extreme weather events.[20] For adolescent boys, economic stress during drought conditions can reinforce negative social norms and expectations of labour and financial contribution within households, increasing their exposure to exploitation and abuse.[21] Furthermore, age can also modify the risk: younger

adolescents (aged 13–17 years) might be more exposed to stress-induced caregiver violence, whereas older adolescents (aged 18–24 years), due to greater mobility and wider social networks can face increased violence risks by perpetrators, including intimate partners and non-partners.[22] Last, rural communities are disproportionately affected by drought due to their reliance on agriculture, reduced access to climate technologies, and weakened climate-adaptive infrastructure.[23] The role of these social markers in shaping adolescents' violence risk in drought settings is unknown. In this study, we aimed to examine the association between drought and violence risk, while considering possible moderating roles of gender, age, and rural residence.

Methods

Study design and survey data

In this observational study, we analysed data from three southern African countries with available Violence Against Children Surveys (VACS) containing spatial variables and drought variation during survey years: Zimbabwe (Jan 2–Aug 10, 2017), Mozambique (June 14–Sept 13, 2019), and Lesotho (June 1–Sept 17, 2018; appendix 1 p 21). The VACS are nationally representative, cross-sectional household surveys of adolescents aged 13–24 years designed to estimate past-year sexual, emotional, and physical violence by partners and non-partner perpetrators. The surveys use a three-stage cluster sampling design: enumeration areas are randomly selected, followed by random selection of households, and then one eligible adolescent per household is randomly invited to complete an interview. For each adolescent, detailed information on past-year violence exposure is collected drawing from standardised, validated, and cognitively tested measures, along with demographic, risk, and protective factors.[24] In most countries, adolescent girls had larger sample sizes (2129–7912) compared with adolescent boys (803–1467). Sofala region in Mozambique was excluded from the sampling design due to damages from cyclone Idai. A split-sample approach was used, whereby adolescent girls and boys were sampled from different enumeration areas to ensure confidentiality and eliminate the risk that both a perpetrator and a victim of violence would be interviewed. To be included in the survey, a participant had to reside in a selected household, be aged 13–24 years, and be able to communicate in one of the survey languages. Participants with physical or cognitive impairment that precluded participation, as well as those living in institutional settings (eg, hospitals, prisons, or orphanages), were excluded as the VACS is a household-based survey. Informed consent was obtained from all participants in accordance with WHO guidelines; for minors, permission and adolescent assent were obtained. The survey protocols were independently reviewed and approved by the Centre for Disease Control and Prevention as well as host countries' ethical review committees. For this current study, ethical approval was not required as it involves secondary analysis of anonymised, de-identified VACS data.

Procedures and outcomes

Our study outcomes were sexual, emotional, and physical violence, and were disaggregated by perpetrator type. IPV refers to violence perpetrated by a current or former romantic partner whereas non-partner violence includes all other perpetrators, such as caregivers, teachers, police, employers, co-workers, religious or community leaders, older neighbours, or schoolmates. This distinction follows those used by WHO, UNICEF, and national data collection agencies as a measurement of violence. Sexual violence included unwanted touching or attempted, pressured, or forced sex; emotional violence included any verbal abuse detrimental to an adolescent's mental health; and physical violence included intentional use of physical force likely to result in death, disability, injury, or harm (appendix 1 p 15). Sociodemographic measures were selected a priori based on published evidence and included age, gender, rural residence, informal housing defined as having no electricity or a roof, head of household gender, and adolescent completion or current education enrolment (pp 15–17).

See Online for appendix 1

To measure drought, we utilised the Standardised Precipitation Evapotranspiration Index (SPEI), an extension of the widely known Standardised Precipitation Index (SPI). The SPEI is increasingly recognised as an accurate measure to monitor drought onset, duration, and type. Unlike the SPI, which only considers precipitation, the SPEI also considers effect of temperature by calculating the difference between monthly precipitation and potential evapotranspiration. This approach represents a water climatic balance that is fitted into log-logistic distribution to produce standardised values. This standardisation facilitates the comparison of drought conditions across different regions and timescales equipping the index with unique multi-scalar features. The SPEI is calculated on a monthly level and can be obtained for timescales from 1 month to 48 months. Data were retrieved from the SPEI database at a spatial resolution of 0·5° with coverage from 1940 onwards.[25]

In this study, we define drought as the deviation of climatic water balance conditions from the country-specific long-run mean, using a 30-year reference period as recommended by the World Meteorological Association.[26] We used SPEI at a 12-month timescale (SPEI-12) to capture longer term water deficits that are likely to affect agricultural outputs and livelihoods. For each participant, we calculated drought exposure as the rolling mean SPEI-12 values over the 12 months before the interview, corresponding to the violence recall period. To examine cumulative effects of prolonged drought, we additionally constructed a 24-month exposure measure by calculating the rolling mean of SPEI-12 over the 24 months preceding the survey. Positive SPEI values indicate wet conditions whereas negative values indicate drier conditions, according to the SPI classification as described by McKee and colleagues.[27] For easier interpretation, SPEI values were reverse coded with positive values reflecting greater drought severity.

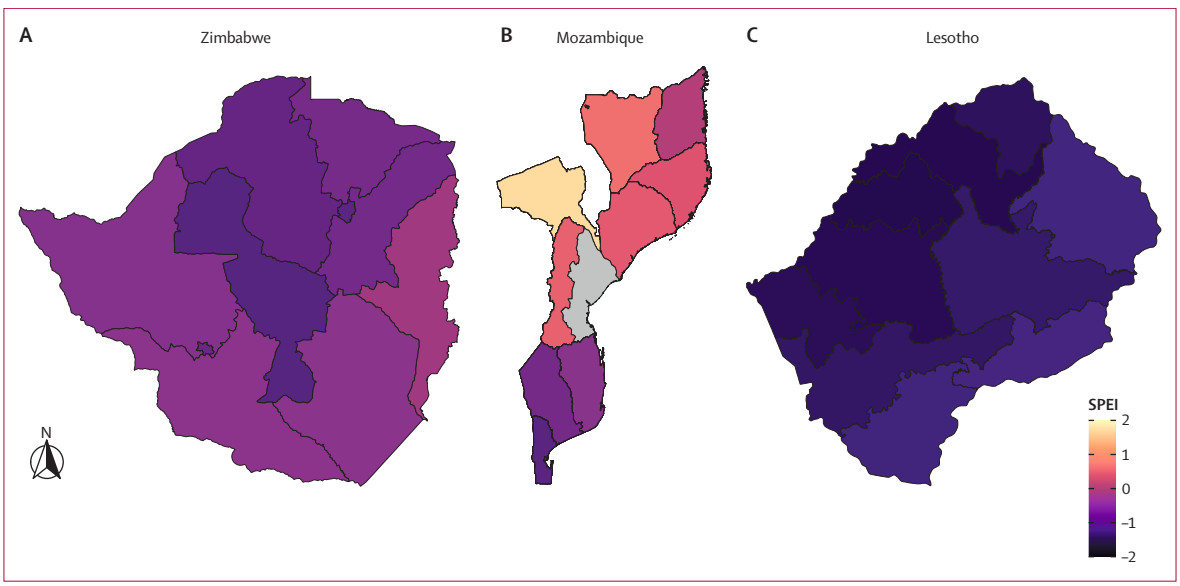

Figure 1: **Distribution of 12-month mean drought levels in Zimbabwe, Mozambique, and Lesotho using the SPEI database**
SPEI more than –0·49, normal conditions; –0·50 to –0·99, slightly dry; –0·10 to –1·49, moderate drought; and less than –1·50, severe or extreme drought, according to the drought classification published previously.[1] Positive values indicate wetter conditions, whereas negative values indicate drier conditions. However, SPEI values were reverse coded in the logistic models analyses for easier interpretation. The subnational region Sofala in Mozambique was excluded from Violence Against Children Surveys data collection and sampling design due to damages from cyclone Idai. SPEI=Standardised Precipitation and Evapotranspiration Index.

Due to unavailability of geocoordinates, our drought indicator was spatially linked to the subnational regions of VACS respondents' residence using the DHS shapefile repository. Hence, mean drought levels were measured on the administrative level one, for each country's administrative boundaries.

Statistical analysis

RStudio version 4.3.0 was used for the analysis of this study. The primary analyses used multivariate logistic regression models to examine associations between mean past-year drought exposure and violence risk in the past 12 months, adjusted for sociodemographic characteristics. Individual models were fitted for each violence form (ie, sexual, emotional, and physical) disaggregated by partner and non-partner perpetration, using logistic regression given the binary outcomes.

All models included country fixed effects, to account for unobserved, time-invariant heterogeneity, such as country demographics, economies, and cultural norms. Robust standard errors were clustered at the primary sampling unit to account for within-cluster correlation arising from the survey's nested sampling design (appendix 1 pp 21–22).

Interaction models were conducted to examine whether gender, age, and rural residence moderate associations between past-year drought and violence exposures. To minimise multiple testing risks, we limited moderation analyses to a small, prespecified set of social markers, based on established theoretical underpinnings of differential vulnerability in climate change. Marginal predicted probabilities from interaction models and corresponding interaction estimates were calculated. As secondary analyses, we examined whether prolonged, cumulative drought is associated with greater violence risk by re-estimating the primary multivariate logistic regression models using a 24-month mean drought exposure, instead of the 12-month measure.

Given that gender constitutes an important axis of inequality in both climate impacts and violence exposure, we stratified primary models by gender to examine within-gender vulnerability patterns that can be masked in pooled estimates (appendix 1 pp 4–5). Additionally, country-stratified analyses for Zimbabwe, Mozambique, and Lesotho are described in appendix 1 (p 6).

Primary models' diagnostics indicated good fit, with variance inflation factors below 1·86 indicating minimal collinearity and residual and calibration plots indicated adequate models' fit with no evidence of systematic correlation or miscalibration. Missing data ranged from 0·01% to 0·80% across all variables and were handled using listwise deletion due to low frequency (<5%) and bias risk.[28] Multiple imputations were conducted as a robustness check, which yielded highly consistent results with primary models. Minimum detectable effects were calculated indicating that our study was sufficiently powered to detect small effect sizes (odds ratio [OR] 1·06–1·12) per 1 SD increase in drought exposure (appendix 1 pp 17–20).

Several sensitivity analyses were conducted: first, given the hierarchal nature of the data, some of the variation seen in the primary models' estimates might be due to intra-cluster

correlations. Mixed-effects models were estimated with a random intercept on the cluster level using intracluster coefficients (appendix 1 p 7). Second, to strengthen temporal ordering between drought and violence, we used a 12-month lagged effects measure to capture drought conditions in the 12 months preceding the survey year (appendix 1 p 9). Third, we used the Palmer Drought Severity Index (PDSI) as an alternative drought exposure indicator to replicate the primary models and test for consistency of our findings (appendix 1 p 10-11). The PDSI estimates soil moisture based on a water balance model incorporating temperature and precipitation data. However, this indicator is often criticised for oversimplified hydrological calculation limiting its sensitivity to short-term variability.[29] Fourth, poverty was not included in the primary models because drought can negatively affect household wealth,[30] which is consequently a potential mediator and could thereby bias total-effect estimates. However, to assess potential confounding, we controlled for poverty (appendix 1 pp 12–13). Lastly, to assess robustness to drought operationalisation, we estimated models using a binary cutoff drought indicator defined by frequency of months during which SPEI values were one SD below the long-run mean. This estimation captures moderate-to-severe drought conditions consistent with McKee's SPI classifications (appendix 1 p 14).[27] Statistical significance was defined as a two-sided p value of less than 0·05, and 95% CIs were reported.

	Adolescent boys (n=3148)	Adolescent girls (n=17 142)	p value*
12-month mean drought levels	0·59 (0·88)	0·56 (0·88)	0·60
Age group			0·02
13–17 years	1595 (46%)	7691 (42%)	
18–24 years	1553 (54%)	9449 (58%)	
Residence			0·90
Urban	970 (37%)	5074 (36%)	
Rural	2178 (63%)	12 068 (64%)	
Informal housing	2174 (66%)	10 907 (63%)	0·40
Head of household gender			<0·001
Man	1930 (63%)	8604 (49%)	
Woman	1200 (37%)	8413 (51%)	
Completed or currently in education	1876 (64%)	12 382 (67%)	0·081
Sexual violence			
Non-partner	65 (3%)	541 (4%)	0·004
Sexual IPV	44 (2%)	651 (4%)	<0·001
Emotional violence			
Non-partner	470 (13%)	2294 (13%)	0·60
Emotional IPV	99 (6%)	776 (10%)	<0·001
Physical violence			
Non-partner	555 (17%)	1714 (10%)	<0·001
Physical IPV	42 (1%)	726 (4%)	<0·001

Data are mean (SD) or weighted frequencies (%) using Violence Against Children Survey sampling weights. Details on missing values are presented in appendix 1 (p 20). IPV=intimate partner violence. *Wilcoxon rank sum test; Pearson's χ^2 test.

Table 1: **Weighted frequencies of sociodemographic characteristics of the study sample stratified by gender**

Role of the funding source

The funders of this study had no role in the study design, data collection, data analysis, data interpretation, or writing of the report.

Results

The analytic sample comprised 20 290 adolescents, including 17 142 adolescent girls and 3148 adolescent boys, aged 13–24 years. Mean past-year drought exposure varied across countries (figure 1). Subnational-level distribution demonstrates substantial within-country heterogeneity, with consistently drier conditions observed across Lesotho and Zimbabwe, whereas Mozambique exhibited greater variability including both drought-affected and relatively wetter regions (appendix 1 p 21). Approximately two-thirds lived in rural areas and informal housing. Households headed by women were more common among adolescent girls (8413 [51%]) than adolescent boys (1200 [37%]), and more adolescent girls (12 382 [67%]) had completed or were currently in education than adolescent boys (1876 [64%]). 12-month mean drought exposure was similar for adolescent girls (0·59 [SD 0·88]) and boys (0·59 [0·88]; table 1).

Non-partner physical violence was the most reported form, affecting more adolescent boys (555 [17%]) than girls (1714 [10%]; p<0·001). Sexual IPV was least prevalent, reported by 44 (2%) adolescent boys and 651 (4%) adolescent girls (p<0·001).

Pooled multivariate regression models found associations between 12-month mean drought exposure and several increased violence risks among adolescents, after adjusting for sociodemographic factors, country fixed effects, and incorporating robust standard errors at the cluster level (table 2). Adolescents exposed to higher past-year drought levels had increased risk of non-partner sexual violence (OR 1·46 [95% CI 1·12–1·90]), non-partner emotional violence (1·73 [1·45–2·06]), emotional IPV (1·51 [1·12–2·02]), non-partner physical violence (1·41 [1·18–1·68]), and physical IPV (1·39 [1·11–1·75]; table 2).

Moderation analyses (appendix 1 p 2) indicated that under drought conditions, adolescent girls, older adolescents, and rural residents were at heightened risks of violence exposure. Predicted probabilities from significant interaction terms (figure 2) showed that adolescent girls had steeper increases in violence risk in worsening drought conditions compared with adolescent boys, particularly for non-partner sexual violence, non-partner emotional violence, and emotional IPV, with differences widening at greater drought levels. Similar risk patterns were observed, including higher physical IPV risk, for older adolescents (aged 18–24 years) compared with younger adolescents (aged 13–17 years). Adolescents in rural settings had an increased risk of non-partner physical violence compared with those in urban settings, particularly under severe drought conditions (figure 2).

	Sexual violence		Emotional violence		Physical violence	
	Non-partner	IPV	Non-partner	IPV	Non-partner	IPV
12-month mean drought levels	1·46* (1·12–1·90)	0·88 (0·66–1·16)	1·73† (1·45–2·06)	1·51* (1·12–2·02)	1·41† (1·18–1·68)	1·39† (1·11–1·75)
Gender (woman)	1·71† (1·32–2·22)	2·83† (2·03–3·94)	0·96 (0·79–1·17)	2·11† (1·64–2·72)	0·54† (0·45–0·64)	3·60† (2·60–4·98)
Age group (18–24 years)	0·93 (0·78–1·11)	1·59† (1·34–1·88)	0·79† (0·72–0·87)	3·55† (3·02–4·18)	0·32† (0·29–0·36)	3·95† (3·29–4·74)
Residence (rural)	0·60† (0·48–0·75)	0·80‡ (0·64–1·00)	0·89 (0·74–1·06)	0·75§ (0·60–0·95)	0·89 (0·75–1·05)	0·79 (0·62–0·99)
Informal housing	0·81‡ (0·66–1·00)	0·73* (0·60–0·90)	0·88‡ (0·77–1·01)	0·92 (0·75–1·14)	0·93 (0·81–1·07)	1·34* (1·07–1·67)
Head of household gender (woman)	1·11 (0·94–1·32)	1·13 (0·96–1·32)	1·00 (0·91–1·10)	0·85§ (0·73–0·99)	1·05 (0·95–1·15)	0·80‡ (0·69–0·93)
Completed or currently in education	1·49† (1·18–1·89)	1·32* (1·09–1·60)	1·12§ (1·00–1·26)	1·09 (0·91–1·31)	1·02 (0·91–1·15)	0·77† (0·65–0·91)
Number of observations	20 066	20 067	20 055	11 393	19 926	20 083

Country fixed effects and robust standard errors at the cluster level are applied. Emotional IPV data were not collected for Zimbabwe. Each column represents a separate adjusted logistic regression model for a specific violence outcome. Drought exposure is measured on the subnational (administrative level one) level. IPV=intimate partner violence. *p<0·01. †p<0·001. ‡p<0·1. §p<0·05.

Table 2: **Multivariate logistic regression on the association between 12-month mean drought levels and the risk of violence exposure in the past 12 months among adolescents pooled across Zimbabwe (n=8715), Mozambique (n=3007), and Lesotho (n=8568)**

The 24-month mean drought measure reported positive associations across violence forms. The effect estimates were larger than the 12-month mean drought measure (table 2), suggesting potential compounding effects of prolonged, cumulative drought on violence risk (table 3).

Gender-specific estimates (appendix 1 pp 4–5) showed that, among adolescent girls, associations were similar to those in the primary models using the full sample (table 3), although effect sizes were stronger, particularly for sexual and emotional violence. Among adolescent boys, drought was associated with increased odds of non-partner emotional and physical violence. Country-specific estimates varied by country and violence form for Zimbabwe and Mozambique, whereas those for Lesotho were highly unstable owing to minimal subnational-level drought variation over relatively small geographical size and were, therefore, removed (appendix 1 p 6).

Sensitivity analyses supported the robustness of main findings in table 3. Mixed-effects models yielded intraclass correlation coefficients ranging from 0·07 to 0·17, indicating minimal within-cluster correlation (appendix 1 pp 7–8). The 12-month lagged drought exposure had consistent results (appendix 1 p 9). Using an alternative SPEI measurement, the PDSI drought indicator showed highly consistent findings (appendix 1 p 10). Adjusting for household poverty slightly attenuated estimates but did not alter direction or significance. These findings also suggested potential overlap between the poverty variable and rural residence, likely reflecting the survey construction of poverty variable based on housing materials and assets that are more common in rural areas (appendix 1 p 12). Finally, using a binary drought indicator (SPEI ≤ -1 SD) produced similar results, although sexual IPV showed a positive association not observed in the primary models (appendix 1 p 14).

Discussion

This study provides novel evidence that past-year drought exposure is associated with increased risk of multiple forms of violence against adolescent girls and boys in Zimbabwe, Mozambique, and Lesotho. We found that each unit increase in drought was linked to a 39–73% higher odds of sexual, emotional, or physical violence. Adolescent girls, older adolescents, and those in rural areas were particularly vulnerable. Associations were generally stronger using a 24-month exposure measure, suggesting cumulative effects of prolonged drought on violence risk. As droughts intensify under climate change, the Sustainable Development Goal 16.2 of preventing violence against children and adolescents might be at great risk.

Findings of positive associations between drought exposure and several violence forms are consistent with growing qualitative evidence.[31,32] A systematic review proposed several pathways between natural hazards and violence against children, including economic stress, exacerbation of negative social norms, and maladaptive coping with stress.[32] A mixed methods study from Kenya showed that rates of physical, emotional, and sexual violence, as well as exploitation, and neglect increased during drought periods among children, driven by loss of livelihoods, caregiver psychological distress, school disruption, and child labour.[33]

Moderation analyses highlighted a strong gender modification effect, with adolescent girls facing heightened risks of non-partner sexual violence and both non-partner and partner emotional violence in drought settings. This pattern aligns with extensive literature documenting the disproportionate burden faced by women and girls in climate disasters.[20,31] Notably, although drought might not affect violence directly, it can exacerbate existing social and gender inequalities through increased socioeconomic vulnerabilities and aggravated harmful norms and gender roles that increase women and girls' exposure to violence. In some African contexts, adolescent girls are seen as responsible for fetching water and fuelwood from long distances.[34] Qualitative evidence from Uganda describes increased sexual violence risk among adolescent girls (aged 16–24 years) while collecting fuelwood during drought periods.[35] Furthermore, men might perpetrate violence against their partners due to feeling inadequate in fulfilling their roles as financial providers.[31] Financially dependent women and girls can be at heightened risk, as they are

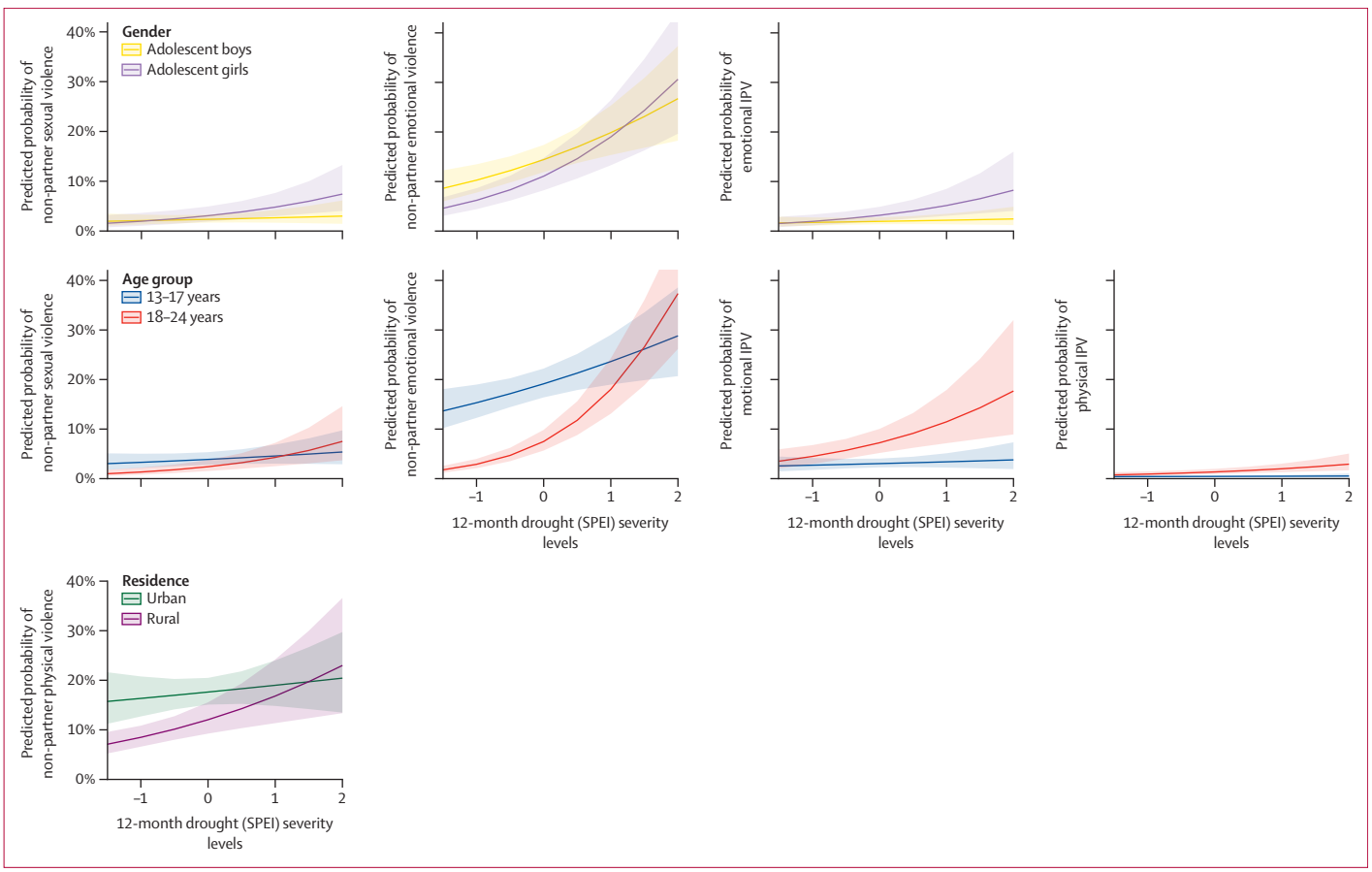

Figure 2: **Predicted probabilities of violence forms by 12-month drought severity from interaction effects for gender, age, and rural residence among adolescents aged 13–24 years**
Predicted probabilities from significant interaction effects between drought and gender, age group, and rural residence (further details are in appendix 1 [p 2]). All models used logistic regression, controlled for sociodemographic characteristics and country fixed effects, and included robust standard errors at the primary sampling unit level. Shaded areas represent 95% CIs. Positive values indicate higher drought levels for easier interpretation. IPV=intimate partner violence. SPEI=Standardised Precipitation and Evapotranspiration Index.

unable to report or leave abusive relationships. Additional drought-related consequences—including child marriage[36] and forced migration[37]—are known violence risk factors that disproportionately affect the female population.[31] Crucially, it is important to note that the vulnerability of women and girls in climate disasters is differential and not uniform, as this vulnerability might be mediated by intersecting factors such as level of poverty, ethnicity, occupation, and marital status, which can shape their victimisation experiences.[19]

Older adolescents were also at increased risk of violence. Although evidence shows a positive association between age and IPV, in particular,[38] our findings suggest that, in drought conditions, older adolescents are at increased risk of sexual and emotional violence perpetrated by non-partners. This expanded risk profile could reflect greater physical mobility, economic responsibilities, and changing social roles. In the absence of adequate protective mechanisms, these factors might place older adolescents at heightened risk by exposing them to a wider range of perpetrators.

Although in general adolescents living in rural areas were at lower risk of all violence forms compared with those in urban areas, drought reversed this pattern for non-partner physical violence, underscoring the disproportionate impacts of drought on rural communities potentially due to greater reliance on agriculture and weakened infrastructure. A multi-country observational study in sub-Saharan Africa found a positive association between drought and poverty for women and men in rural, but not in urban, settings.[30] This link between drought and poverty might compel families in rural areas to send away their children for work to contribute financially. Qualitative evidence from Somalia revealed that male adolescents who migrated seeking work opportunities faced heightened risk of physical violence from employers and other adults. Additionally, caregivers reported considering inflicting physical violence on their sons who failed to provide, despite restricted work opportunities during the drought.[39]

Further, livestock deaths and failed crops can exacerbate psychological distress, especially among rural and pastoralist communities. For example, a qualitative study among

	Sexual violence		Emotional violence		Physical violence	
	Non-partner	IPV	Non-partner	IPV	Non-partner	IPV
24-month mean drought levels	2·53* (1·51–4·22)	1·05 (0·68–1·64)	2·75*(1·87–4·04)	2·10*[1.36–3.25]	1·99* (1·41–2·81)	1·87† (1·20–2·91)
Gender (female)	1·67*(1·29–2·16)	2·80* (2·02–3·88)	0·96 (0·78–1·16)	2·06* (1·60–2·66)	0·53* (0·45–0·64)	3·53*(2·55–4·88)
Age group (18–24 years)	0·93 (0·78–1·11)	1·59* (1·35–1·88)	0·80* (0·73–0·87)	3·56* (3·02–4·19)	0·33* (0·29–0·36)	3·96* (3·30–4·75)
Residence (rural)	0·60* (0·48–0·75)	0·81‡ (0·65–1·02)	0·89 (0·75–1·06)	0·75§ (0·60–0·95)	0·89 (0·75–1·05)	0·78 (0·62–0·98)
Informal housing	0·82‡ (0·67–1·01)	0·75† (0·61–0·92)	0·88‡ (0·77–1·00)	0·92 (0·75–1·14)	0·94 (0·81–1·08)	1·34† (1·07–1·67)
Head of household gender	1·11 (0·93–1·31)	1·12 (0·96–1·32)	1·00 (0·91–1·10)	0·85§ (0·73–0·99)	1·04 (0·95–1·15)	0·80‡ (0·69–0·93)
Completed or currently in education	1·47† (1·17–1·86)	1·30† (1·07–1·58)	1·13§ (1·00–1·28)	1·09 (0·91–1·30)	1·01 (0·90–1·14)	0·77* (0·65–0·91)
Number of observations	20 066	20 067	20 055	11 393	19 926	20 083

Country fixed effects and robust standard errors at the cluster level are applied. Emotional IPV data were not collected for Zimbabwe. Each column represents a separate adjusted logistic regression model for a specific violence outcome. Drought exposure is measured on the subnational (administrative level one) level. IPV=intimate partner violence. *p<0·001. †p<0·01. ‡p<0·1. §p<0·05.

Table 3: **Multivariate logistic regression on the association between 24-month mean drought levels and the risk of violence exposure in the past 12 months among adolescents pooled across Zimbabwe (n=8715), Mozambique (n=3007), and Lesotho (n=8568)**

Kenyan Maasai parents found that drought-related stress increased their use of physical violence against their children.[40] Our male gender disaggregated model showed an increased risk of non-partner physical and emotional violence, highlighting that adolescent males affected by drought also experience violence risks.

This study has several limitations. First, the cross-sectional design limits establishing causality between drought and violence. However, risk of reverse causality is minimised due to exogenous drought unlikely to be affected by violence. Furthermore, long-term drought over 24 months, and lagged drought in the 13–24 months before the survey date, strengthened our temporal ordering and reinforced the robustness of our observed associations. Second, drought was measured at the subnational level. This approach could have masked localised, within-region effects. However, drought has a slow-occurring and widespread nature, resulting in economic and social effects that transcend administrative boundaries, such as increased price of commodities and disrupted food supply chains.[7] Hence, our broader subnational-level drought indicator might be able to better capture such indirect spatial effects. Third, complex survey weights were not applied; hence, findings are not generalisable. However, the large sample size of the study and accounting for clustering improves the robustness of our estimates. Fourth, our drought measurement relies on satellite data combined with meteorological station data, which might be affected by sparsity of stations in some regions, potentially introducing measurement bias. However, use of the standardised, country-referenced SPEI metric enhances comparability and minimises systemic bias. Additionally, SPEI is a widely validated drought indicator, often adopted in southern African contexts.[41] Fifth, our study design, limited number of subnational units, and aggregated drought measurement constrained the application of formal spatial modelling, potentially introducing spill-over effects from spatial autocorrelation. Future research with finer spatial resolution could apply such approaches. Lastly, our analyses might not include all confounding factors potentially relevant to the drought–violence link. Further, our study does not conduct formal mediation analysis, and future studies should examine potential mechanisms explaining this link.

Despite these limitations, there are several notable strengths. First, our study is the first to assess associations between drought and multiple violence forms, among a large sample of 20 290 adolescents in three countries, using validated and internationally comparable violence data. Second, we conducted a rigorous analysis strengthened by exploiting plausibly exogenous variation in past-year drought exposure and accounting for hierarchal study design and spatial dependence through country fixed effects, clustered robust standard errors, and mixed-effects models. Third, although the drought and violence literature is primarily limited to gender-based violence and adult female populations, our findings advance the evidence base by providing rigorous quantitative evidence on the increased risk of multiple violence forms among the adolescent age group including both girls and boys. Importantly, our analyses further highlight how structural social markers of gender, age, and rural residence interact with drought conditions, offering insights for targeted prevention. Lastly, we extend existing literature by showing that prolonged exposure to drought over a 2-year period might place adolescents at greater risk of violence exposure.

By 2055, there will be a billion children and adolescents in Africa. Considering projected increases in droughts in the African continent under all climate scenarios, our findings carry important policy implications.[42,43] There is an urgent need for integration of violence prevention into drought disaster responses and climate adaptation programmes. Evidence-based approaches—including economic strengthening, parenting programmes, and school-based programmes[44]—should be linked to early warning systems to enable targeted anticipatory action support, particularly for girls, older adolescents, and those in rural areas. For regions experiencing prolonged and cumulative drought, these services should be scaled up and embedded within long-term, sustainable climate adaption measures. Lastly, national coordination mechanisms between disaster

management, law enforcement, health systems, and social services are essential to provide effective and timely support to adolescents in escalating global risk.

Contributors

BE conceived the study idea, cleaned the data, conducted the analysis, and wrote the original manuscript draft. RH assisted in conceptualisation, led drought data cleaning, oversaw the analysis plan, and edited the manuscript. LC assisted in conceptualisation, provided supervision, and edited the manuscript. BE, RH, and LC have accessed and verified the data. BE, RH, and LC were responsible for the decision to submit the manuscript.

Equitable Partnership Declaration

The authors of this paper have submitted an Equitable Partnership Declaration (appendix 2). This statement allows researchers to describe how their work engages with researchers, communities, and environments in the countries of study. This statement is part of The Lancet Group's broader goal to decolonise global health.

Declaration of interests

We declare no competing interests.

Data sharing

This study is based on publicly available survey data from the VACS by Together for Girls in partnership with the Centre for Disease Control and Prevention and Standardised Precipitation and Evapotranspiration Index (SPEI) drought data from the Global SPEI database.

Acknowledgments

We are grateful for the broader support from the Accelerate Hub, specifically researchers based at the University of Oxford and University of Cape Town who attended our analysis presentations and provided us with feedback, including William Rudgard, Amiya Bhatia, Hernando Grueso, Seth Flaxman, Madison Little, and Denis Okova, who provided advice on analysing the VACS surveys. We also appreciate valuable feedback from participants at conferences, especially Alessandra Guedes. Finally, we thank Chrissy Hart and Francis Annor for providing access to the VACS data and invaluable advice. BE was supported by the Reuben-AfOx scholarship, University of Oxford (Oxford, UK). BE and LC were supported by the Natural Environment Research Council (grant number NE/W004976/1) as part of the Agile Initiative at the Oxford Martin School (Oxford, UK). RH was supported by the European Union's Horizon Europe Programme under grant agreement number 101094551 (SPES) and 101162653 (2C-RISK), supported by the European Research Council (Brussels, Belgium). LC was supported by the Oak Foundation (grant number OFIL-20–057), (Geneva, Switzerland), Wellspring Philanthropic Fund (grant number 16204) (New York, USA), and a private family trust which wishes to remain anonymous.

References

1 Arias PA, Bellouin N, Coppola E, et al. Technical Summary. In: Masson-Delmotte V, Zhai P, Pirani A, et al, eds. Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, 2023: 35–144.

2 Leng G, Hall J. Crop yield sensitivity of global major agricultural countries to droughts and the projected changes in the future. *Sci Total Environ* 2019; **654:** 811–21.

3 AghaKouchak A, Mirchi A, Madani K, et al. Anthropogenic drought: definition, challenges, and opportunities. Wiley Online Library, 2021.

4 Tsegai D, Medel M, Augenstein P, Huang Z. Drought in numbers 2022: restoration for readiness and resilience. United Nations, 2022.

5 Intergovernmental Panel on Climate Change. *Global warming of 1·5o C. An IPCC Special Report on the impacts of global warming of 1·5o C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. Intergovernmental Panel on Climate Change, 2018.

6 Ibebuchi CC. Revisiting the 1992 severe drought episode in South Africa: the role of El Niño in the anomalies of atmospheric circulation types in Africa south of the equator. *Theor Appl Climatol* 2021; **146:** 723–40.

7 Ainembabazi JH, Rusike J, Keizire B. The 2015–16 El Niño-induced drought crisis in Southern Africa: lessons from historical data and policy implications. 2018. https://agra.org/wp-content/uploads/2020/08/AGRA-drought-crisis-in-Southern-Africa_v2-.pdf (accessed March 25, 2026).

8 Boender C. The relationship between child labour and child marriage: a discourse analysis. Kathmandu: UNICEF, 2021.

9 Population Reference Bureau. Africa's future: youth and the data defining their lives. 2019. https://www.prb.org/resource/africas-future-youth-and-the-data-defining-their-lives/ (accessed March 2, 2025).

10 Rivara F, Adhia A, Lyons V, et al. The effects of violence on health. *Health Aff (Millwood)* 2019; **38:** 1622–29.

11 UNICEF. Violence against girls, boys and women in southern Africa: a statistical profile. New York, NY: UNICEF, 2023.

12 Sawyer SM, Azzopardi PS, Wickremarathne D, Patton GC. The age of adolescence. *Lancet Child Adolesc Health* 2018; **2:** 223–28.

13 Patton GC, Sawyer SM, Santelli JS, et al. Our future: a *Lancet* Commission on adolescent health and wellbeing. *Lancet* 2016; **387:** 2423–78.

14 Epstein A, Bendavid E, Nash D, Charlebois ED, Weiser SD. Drought and intimate partner violence towards women in 19 countries in sub-Saharan Africa during 2011–2018: a population-based study. *PLoS Med* 2020; **17:** e1003064.

15 Cools S, Flatø M, Kotsadam A. Rainfall shocks and intimate partner violence in sub-Saharan Africa. *J Peace Res* 2020; **57:** 377–90.

16 Wang P, Chu L, Ban J, Sullivan TP, et al. Drought, extreme heat, and intimate partner violence in low- and middle-income countries. *JAMA Netw Open* 2025; **8:** e2527818.

17 Treibich C, Bell E, Lépine A, Blanc E. From a drought to HIV: an analysis of the effect of droughts on transactional sex and sexually transmitted infections in Malawi. *SSM Popul Health* 2022; **19:** 101221.

18 Parsons ES, Jowell A, Veidis E, Barry M, Israni ST. Climate change and inequality. *Pediatr Res* 2024; **98:** 1238–45.

19 Rocheleau D, Thomas-Slayter B, Wangari E. Gender and environment: a feminist political ecology perspective. Routledge, 2013: 3–23.

20 van Daalen KR, Kallesøe SS, Davey F, et al. Extreme events and gender-based violence: a mixed-methods systematic review. *Lancet Planet Health* 2022; **6:** e504–23.

21 UNICEF. When numbers demand action: confronting the global scale of sexual violence against children. United Nations Children's Fund, 2024.

22 Sardinha L, Maheu-Giroux M, Stöckl H, Meyer SR, García-Moreno C. Global, regional, and national prevalence estimates of physical or sexual, or both, intimate partner violence against women in 2018. *Lancet* 2022; **399:** 803–13.

23 Mekonen AA, Berlie AB. Rural households' livelihood vulnerability to climate variability and extremes: a livelihood zone-based approach in the Northeastern Highlands of Ethiopia. *Ecol Process* 2021; **10:** 1–23.

24 Chiang LF, Kress H, Sumner SA, Gleckel J, Kawemama P, Gordon RN. Violence Against Children Surveys (VACS): towards a global surveillance system. *Inj Prev* 2016; **22** (suppl 1): i17–22.

25 Beguería S, Vicente-Serrano SM, Reig F, Latorre B. Standardised precipitation evapotranspiration index (SPEI) revisited: parameter fitting, evapotranspiration models, tools, datasets and drought monitoring. *Int J Climatol* 2014; **34:** 3001–23.

26 Svoboda M, Hayes M, Wood D. Standardised precipitation index: user guide. 2012. https://digitalcommons.unl.edu/droughtfacpub/209/ (accessed March 25, 2026).

27 McKee TB, Doesken NJ, Kleist J. The relationship of drought frequency and duration to time scales. In: Proceedings of the 8th Conference on Applied Climatology. Boston, MA: American Meteorological Society, 1993: 179–83.

See Online for appendix 2

28 Little RJ, Rubin DB. Statistical analysis with missing data. John Wiley & Sons, 2019.

29 Wang Z, Yang Y, Zhang C, Guo H, Hou Y. Historical and future Palmer Drought Severity Index with improved hydrological modeling. *J Hydrol (Amst)* 2022; **610:** 127941.

30 Trickey A, Johnson LF, Bonifacio R, et al. Investigating the associations between drought, poverty, high-risk sexual behaviours, and HIV incidence in sub-Saharan Africa: a cross-sectional study. *AIDS Behav* 2024; **28:** 1752–65.

31 Thurston AM, Stöckl H, Ranganathan M. Natural hazards, disasters and violence against women and girls: a global mixed-methods systematic review. *BMJ Glob Health* 2021; **6:** e004377.

32 Cerna-Turoff I, Fischer H-T, Mansourian H, Mayhew S. The pathways between natural disasters and violence against children: a systematic review. *BMC Public Health* 2021; **21:** 1249.

33 Mburu S, Wali I, Mukisa S, Sironga N, Adan H. Effects of drought on child protection in hard-to-reach communities in Kenya. *Soc Sci (Basel)* 2024; **13:** 375.

34 Tallman PS, Collins S, Salmon-Mulanovich G, Rusyidi B, Kothadia A, Cole S. Water insecurity and gender-based violence: a global review of the evidence. *WIREs Water* 2023; **10:** e1619.

35 Logie CH, Loutet M, MacKenzie F, et al. Experiences of drought, heavy rains, and flooding and linkages with refugee youth sexual and reproductive health in a humanitarian setting in Uganda: qualitative insights. *Glob Public Health* 2025; **20:** 2503863.

36 Pope DH, McMullen H, Baschieri A, et al. What is the current evidence for the relationship between the climate and environmental crises and child marriage? A scoping review. *Glob Public Health* 2023; **18:** 2095655.

37 Hoffmann R, Abel G, Malpede M, Muttarak R, Percoco M. Drought and aridity influence internal migration worldwide. *Nat Clim Chang* 2024; **14:** 1–9.

38 Stark L, Seff I, Hoover A, Gordon R, Ligiero D, Massetti G. Sex and age effects in past-year experiences of violence amongst adolescents in five countries. *PLoS One* 2019; **14:** e0219073.

39 Save the Children, Rapid needs assessment: drought situation in Bari, Nugal and Sanaag regions of Somalia. 2016. https://resourcecentre.savethechildren.net/document/rapid-needs-assessment-drought-situation-bari-nugal-and-sanaag-regions-somalia (accessed March 26, 2026).

40 UNICEF. Children's care in the context of climate change: change in Kajiado County Kenya. 2024. https://www.unicef.org/esa/media/14441/file/Care-in-the-Context-of-Climate-Change-in-Kenya-2024.pdf (accessed March 26, 2026).

41 Marumbwa FM, Cho MA, Chirwa PW. Geospatial analysis of meteorological drought impact on Southern Africa biomes. *Int J Remote Sens* 2021; **42:** 2155–73.

42 UNICEF. Generation 2030 Africa 2.0: prioritizing investments in children to reap the demographic dividend. United Nations Children's Fund, 2017.

43 Serdeczny O, Adams S, Baarsch F, et al. Climate change impacts in sub-Saharan Africa: from physical changes to their social repercussions. *Reg Environ Change* 2017; **17:** 1585–600.

44 Little MT, Butchart A, Massetti GM, et al. Interventions to prevent, reduce, and respond to violence against children and adolescents: a systematic review of systematic reviews to update the INSPIRE Framework. *Lancet Child Adolesc Health* 2026; **10:** 49–61.