

Natural hazards, disasters and violence against women and girls: a global mixed-methods systematic review

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ABSTRACT

Introduction Disasters triggered by climate and other natural hazards are increasing in frequency, severity and duration worldwide. Disasters disproportionately impact women and girls, with some evidence suggesting that violence against women and girls (VAWG) increases in disaster settings. Suggested risk factors for postdisaster VAWG include increased life stressors, failure of law enforcement, exposure to high-risk environments, exacerbation of existing gender inequalities and unequal social norms. We aim to systematically appraise the global literature on the association between disasters from natural hazards and VAWG.

Methods We conducted a systematic review using the following databases: Embase, Global Health, Medline, PubMed and Social Policy and Practice and searched grey literature. We included quantitative, qualitative or mixed-methods studies published in English language that examined the association between disasters from natural hazards and VAWG. We summarised the findings using a narrative synthesis approach.

Results Of 555 non-duplicate records, we included a total of 37 quantitative, qualitative and mixed-methods studies. Among the quantitative studies, eight studies found a positive association between disaster exposure and increased VAWG, and four additional studies found positive associations with some violence types but not others. Qualitative findings offered insights into three hypothesised pathways: disaster exposure associated with (1) an increase of stressors that trigger VAWG; (2) an increase of enabling environments for VAWG and (3) an exacerbation of underlying drivers of VAWG.

Conclusion As the first known global systematic review on the relationship between disasters from natural hazards and VAWG, this review contributes to the evidence base. We were limited by the quality of quantitative studies, specifically study designs, the measurement of variables and geographic scope. The severe health consequences of VAWG and increasing frequency of extreme events means that rigorously designed and better quality studies are needed to inform evidence-based policies and safeguard women and girls during and after disasters.

INTRODUCTION

Over the past two decades, 7348 disasters triggered by natural hazards were recorded—nearly double the number recorded between

Key questions

What is already known?

- Disasters triggered by climate and other natural hazards are increasing in frequency, severity and duration worldwide.
- Disasters disproportionately impact women and girls and emerging evidence suggesting that violence against women and girls (VAWG) increases in disaster settings through various pathways.

What are the new findings?

- The current quantitative and qualitative evidence suggests that exposure to disasters caused by climatological, geophysical, hydrological and meteorological hazards (collectively termed ‘natural’) can increase VAWG in various settings.
- Exposure to disasters can increase VAWG through an increase of stressors that trigger VAWG; an increase of enabling environments for VAWG to occur; and an exacerbation of underlying drivers of VAWG.

What do the new findings imply?

- Our findings imply that disaster-related VAWG is both a public health and disaster management concern and must be addressed across policy and practice.
- There is an urgent need for gender-sensitive disaster risk reduction policies, inclusion of women in disaster management, promotion of social protection programmes, and establishment of coordination systems between disaster management, law enforcement and health authorities to prevent VAWG and treat the health consequences.
- More high-quality research with greater geographical scope and use of standardised exposure and outcome measures is critical to generate further knowledge on the scale of the issue and mechanisms.

1980 and 1999.¹ Between 2008 and 2017, 84% of all recorded disasters were climate related,² and the number of people affected by floods and storms has significantly increased.^{2–4} There is strong evidence that climate change induced by unsustainable human activity is a driving force for the changing frequency, severity and duration of extreme events.^{1–4}

However, heightened exposure and vulnerability to natural hazards are rooted in structural challenges like poverty and inequalities, rapid population growth and urbanisation, migration and displacement, poor land use planning and management and the lack of resilient institutions.⁵⁻⁸

Against this backdrop, women and girls bear a disproportionate burden of disaster-related impacts.⁷⁻¹⁴ Mortality rates of women from disasters are often much higher than those of men; for example, 90% of the 140 000 deaths during the 1991 cyclone in Bangladesh were women.⁸⁻¹⁰ There are numerous explanations to the gendered impacts of disasters, including biological differences, gender discriminatory practices in relief efforts, lower access to information and resources, care responsibilities and gendered poverty.^{11 12} At the policy level, women's perspectives in disaster management are also not adequately considered and met,^{12 13} despite the affirmation of need by the Sendai Framework for Disaster Risk Reduction (DRR) 2015–2030 to integrate gender considerations for inclusive policy, strategies and practices in DRR.¹⁵

There is also growing evidence of the exacerbation of violence against women and girls (VAWG) during and after disasters,¹⁶⁻²⁰ including violence by a non-partner or intimate partner, rape/sexual assault, as well as female genital mutilation, honour killings and the trafficking of women.²¹ There were reports of widespread rape after the 2010 Haiti earthquake,¹⁶ while intimate partner violence (IPV) was estimated to have increased by 40% in rural areas after the 2011 Christchurch earthquake in New Zealand.¹⁷

Various pathways have been suggested to understand the association between disaster exposure and VAWG. As with other emergency settings, disasters can increase risk factors for VAWG, like trauma and mental health issues; substance abuse; breakdown of family structures and social isolation; collapse and failure of law enforcement and services; and stressors from loss of housing and livelihoods.^{19 22} Prolonged recovery and reconstruction can also leave displaced women and girls in camps and shelters where they are at heightened risk of experiencing violence.^{19 20 22} Disaster exposure may also exacerbate existing drivers of VAWG, like socioeconomic and gender inequalities, rigid social norms, and unbalanced power structures at various levels of the social ecology: household, community and macrolevels of society.^{19 20 22}

Increased VAWG after disasters may have dire health consequences for women across the life course. VAWG can lead to gynaecological complications from unintended pregnancies, unsafe abortions, miscarriages, sexually transmitted infections, poor overall health for mothers and babies, physical injuries, various mental health issues, and fatal outcomes from homicide or suicide.^{23 24} Within postdisaster settings, the reduced capacity and access to health and emergency services can delay provision of timely and quality treatment, potentially worsening health outcomes.²⁵

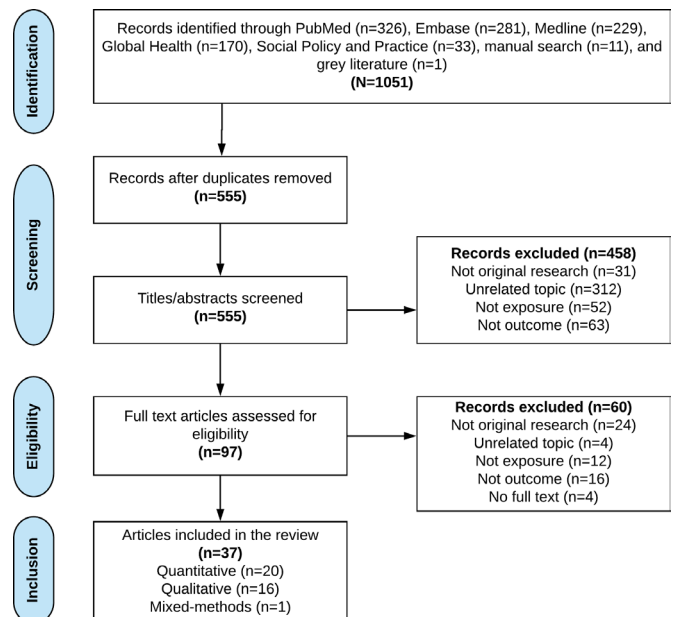


Figure 1 PRISMA flow diagram. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Understanding how disaster exposure impacts VAWG is more important than ever to inform gender-sensitive policy in disaster management.^{14 19} There is a dearth of critical and systematic appraisal of the current literature on the associations between disasters from natural hazards and VAWG. A review by Rezaeian²⁶ on the associations between disasters and violence found that disaster exposure increased VAWG, including sexual violence, IPV and child abuse. However, the limited methodological rigour of this review and the outcome not specific to VAWG means there remains a gap in the literature. Contrary to these findings, a systematic review by Cerna-Turoff *et al*²² on natural disasters and violence against children found no evidence for positive association, even when adjusted for gender. Other reviews on VAWG in emergency settings focus primarily on armed conflict,^{27 28} indicating a need for robust evidence on post-disaster VAWG within the development sector as well. The objective of this systematic review is to synthesise and assess the current quantitative and qualitative evidence on exposure to disasters due to natural hazards on the outcome of VAWG.

METHODS

Search strategy and definitions

We conducted a systematic review of the databases Medline, PubMed, Global Health, Embase and Social Policy and Practice to identify studies published until 29 June 2020. Our review followed PRISMA guidelines (online supplemental appendix 1).²⁹ Our search strategy applied terms associated with three concepts: (1) violence; (2) women and girls; and (3) disasters caused by natural hazards (climatological, geophysical, hydrological and meteorological hazards) (online supplemental appendix 2).^{22 28} We also conducted a manual search using Google Scholar, as well as a grey literature search of the websites of organisations including

Table 1 Summary of study designs, quantitative measures, analysis type and associations between exposure and outcome in quantitative studies (N=20) and mixed-methods study (N=1)

Study design	No of studies	Reference
Quasi-experimental	21	37–43 46–59
Longitudinal	2	40 41
Cross-sectional	19	37–39 42 43 46–59
No comparison groups	3	53–55
Comparison groups	16	37–39 42 43 46–52 56 58 59
Measures of exposure and outcome variables	No of studies*	Reference
<i>Exposure variable</i>		
Ecological (eg, spatial data on residency and severity of disaster)	6	40–43 55 57
Self-reported disaster experience		
Binary variable of affectedness (eg, Were you affected by disaster?)	1	39
Ordered categorical variable of affectedness	2	37 38
Proxy measures (eg, living in displacement camp)	6	46 47 49 50 54 58
Not specified or unclear	6	48 51–53 56 59
<i>Outcome variable</i>		
Validated scale	4	37 49 58 59
Experience of a range of violent acts	8	39 42 43 46–48 56 58 59
Experience of violence (general)	9	38 40 47 50–55
Other	2	41 57
Analysis type	No of studies	Reference
Unadjusted or unclear	9	39 49 52–57 59
Adjusted or multivariate	12	37 38 40–43 46–48 50 51 58
Association between disaster exposure and VAWG	No of studies	Reference
Exposure associated with increased VAWG	8	37 38 41–43 46 57 59
Exposure associated with decreased VAWG	0	
Exposure associated with no effect on VAWG	5	39 49–52
Exposure associated with mixed effects on VAWG	4	40 47 48 58
Cannot determine relationship	4	53–56

*The number of studies does not equal 21 because some studies used multiple measures of exposure and/or outcome variables. VAWG, violence against women and girls.

the International Center for Research on Women, International Committee of the Red Cross, Human Rights Watch, Save the Children and UNICEF.

AMT and MR screened the titles and abstracts of articles, with full texts retrieved for articles that met the inclusion/exclusion criteria and both reviewed them against the same criteria.

Studies were included if they were constituted original research of any study design, published in peer-reviewed journals and in English language between the first logged records of databases and the date of the search (29 June 2020). No limits were set to geographical setting. We only included studies that assessed exposure to disasters (in line with the United Nations Office for DRR definition of disasters) caused by climatological, geophysical, hydrological and meteorological hazards (collectively termed

‘natural hazards’ in this review) (online supplemental appendix 3).^{30 31} Climate change itself was included as a hazard type, as some extreme events may be attributed to climate change and not to a specific natural hazard type. Biological and extraterrestrial hazards, as well as man-made disasters (eg, armed conflict, technological disasters) were excluded from this review. We included studies that assessed the outcome of VAWG of all types, including physical, psychological, sexual and/or financial (economic) abuse by an intimate or non-partner, as defined by the World Health Organization (WHO).³²

Quality assessment

We used adapted versions of the National Institutes of Health (NIH) Quality Assessment Tool for Observational Cohort and Cross-Sectional Design and the Critical

Appraisal Skills Programme (CASP) qualitative checklist to assess quantitative and qualitative studies respectively.^{33–34} Mixed-methods studies were assessed using both the NIH Quality Assessment Tool and CASP qualitative checklist, as well as the Mixed Methods Appraisal Tool.^{33–35} Based on the assessments, studies were scored between 0 and 10.

Data synthesis

We consolidated the quantitative size and direction of effect where available. Key themes and illustrative quotes were compiled from qualitative findings and structured into hypothesised pathways from disaster exposure to VAWG. We used a narrative synthesis approach to synthesise the findings from all studies.³⁶

The protocol was registered on the PROSPERO international prospective register of systematic reviews (CRD42020207911).

Patient and public involvement

There was no patient or public involvement in this review.

RESULTS

The search resulted in 1051 abstracts. After removing duplicates, the titles and abstracts of 555 records were screened against the inclusion/exclusion criteria, resulting in 97 full-text records assessed for eligibility using the same inclusion/exclusion criteria. Thirty-seven records were included in this review. For details, see [figure 1](#).

Study characteristics

Of the 37 studies included in this review, 20 were quantitative, 16 qualitative and 1 was mixed-methods design. The studies included were set in 15 low-income, middle-income and high-income countries and one region (sub-Saharan Africa) (online supplemental appendix 4). The studies assessed exposure to disasters caused by nine different natural hazard types, most frequently, exposure to earthquakes (40.0%), hurricanes (19.5%) and tsunamis (12.5%). A range of violence types were examined in relation to disaster exposure, primarily physical, psychological and sexual violence. Some studies also examined femicide, controlling or aggressive behaviour, forced early marriage and financial violence. Seventeen out of 37 studies examined VAWG caused by multiple perpetrator types versus one type. 37.0% of perpetrators were current or former intimate partners, 15.1% family members, 12.3% strangers, 11.0% authority figures, 8.2% friends/neighbours and 16.5% unspecified or other types of perpetrators.

Summary of quantitative studies

All 20 quantitative studies and one mixed-methods study had quasi-experimental designs: two were cohorts, and 16 had comparison groups, such as pre-disaster and post-disaster exposure, exposed or not exposed to the disaster, or different levels of disaster exposures. Three studies did not have comparison groups and reported post-disaster

prevalence of reported VAWG. There was wide variability in the confounders used in adjusted analyses, with the most common measures used across studies being, age, education status, marital status and characteristics of partners for studies with IPV as the outcome variable. Nine studies did not conduct an adjusted analysis or did not specify the variables they adjusted for in their analysis ([tables 1 and 2](#)).

Measures of exposure and outcome variables

The quantitative results were based on various measures of exposure and outcome variables ([table 1](#)). For disaster exposure, studies often used ecological measures such as spatial data on respondents' residency and the disaster-affected geographic area at a defined time point. Another common exposure measure was using proxy indicators like evacuation status during the disaster or post-disaster residence in displacement camps. Three studies used self-reported disaster experience.^{37–39} Only six out of 21 studies measured different levels of disaster exposure, with levels measured ecologically by mapping disaster intensity levels (eg, annual precipitation for drought severity)^{40–43} or by using scales to measure self-reported disaster experiences.^{37,38} Only two studies measured disaster exposure more than once over time.^{40,41}

Most studies measured VAWG as the outcome variable using general self-reported experiences of violence (eg, assault, harassment) or experiences of a range of violent acts (eg, being pushed, slapped), which included lifetime and/or pre-disaster/post-disaster prevalence ([table 1](#)). Only four studies used accepted and validated measurement tools like the Conflict Tactics Scale or the Women's Experience with Battering Scale,^{44,45} and only 12 out of 21 studies measured VAWG outcomes within 12 months of exposure to disaster(s). More than half (n=14) used surveys constructed for studies, while others used Demographic Health Surveys (n=2), other national surveys (n=4), hospital data (n=1) or police reports/help line calls (n=1).

Associations between disaster exposure and VAWG

Out of 20 quantitative studies and one mixed-methods study, eight studies found positive associations between disaster exposure and the measured violence outcome ([table 1](#)). Of these studies, IPV was most commonly associated with disaster exposure in four studies.^{37,41,42,46} In Spain, heat waves between 2008 and 2016 were associated with increased IPV risk (RR=1.02; p<0.001) and intimate partner femicide (RR=1.40; p=0.048), one to three days after the extreme heat event.⁴¹ In the USA, exposure to Hurricane Ike in 2008 was significantly associated with increasing the odds of boys physically (OR=3.19; p<0.01) or sexually assaulting (OR=3.73; p<0.01) dating partners,⁴⁶ while exposure to Hurricane Katrina increased the risk of women experiencing violent acts by intimate partners by 5–8 times.³⁷ In India, the odds of IPV was much higher among women living in states severely (OR=1.98; p<0.001) and moderately (OR=1.85; p<0.001) affected by tsunamis compared with those living in an unaffected state.⁴²

Table 2 Findings from quantitative studies (N=20) and mixed-methods study (N=1)

Quantitative studies							
First author, publication year	Country	Objectives	Violence outcome	Perpetrator type	Confounders (if adjusted)	Key findings	Quality (0–10.0)*
Epstein, 2020 ⁴⁰	Various (Sub-Saharan Africa)	To assess the association between drought and IPV in 19 sub-Saharan African countries.	Physical, psychological, sexual; controlling behaviour (IPV)	Intimate partner	Age, literacy, marital status, number of births, household size, rural/urban residence, partner's age and education	Women living in severe drought vs no drought, marginal risk difference (RD) of reporting a controlling partner in percentage points from logistic regression models=3.0 (p<0.001; 95% CI 1.3 to 4.6); experiencing physical violence=0.8 (p=0.019; 95% CI 0.1 to 1.5); sexual violence=1.2 (p=0.001; 95% CI 0.4 to 2.0). Mild/moderate vs no drought, marginal RD of experiencing physical violence in percentage points=0.7 (p=0.003; 95% CI 0.2 to 1.1); sexual violence=0.7 (p=0.001; 95% CI 0.3 to 1.2).	10.0
Sanz-Barbero, 2018 ⁴¹	Spain	To assess the effect and impact of heat waves on IPV and IPF risk in Madrid.	IPV, femicide	Intimate partner	Variables related to seasonality and 1–5 day lag in effect of heat exposure	IPF risk increased 3 days after heat waves while IPV reports increased 1 day after. Attributable risk for femicide=1.40 (p=0.048; 95% CI 1.00 to 1.97); IPV reports=1.02 (p<0.001; 95% CI 1.00 to 1.03); Help line calls=1.02 (p=0.022; 95% CI 1.00 to 1.03).	9.0
Cerna-Turoff, 2020 ⁵⁰	Haiti	To examine the effect of internal displacement after the 2010 Haiti earthquake on violence against girls and boys.	Physical, psychological, sexual	Family member; caregiver; authority figure; other	Age, household characteristics, predisaster experience of range of violent acts, matched for girls and for boys	No association between earthquake-related internal displacement and past 12 month physical violence by family member (OR=0.90; p=0.795); physical violence by authority figure (OR=1.67; p=0.154); emotional violence by family member (OR=1.11; p=0.875); sexual violence by anyone (OR=1.29; p=0.597) against girls.	8.3
Temple, 2011 ⁴⁶	USA	To examine the effect of evacuation during Hurricane Ike on rates of physical and sexual dating violence exhibited by youth.	Physical, sexual (IPV)	Intimate partner	Race, ethnicity, age	Compared with evacuating boys, OR of non-evacuating boys physically assaulting their intimate partner=3.19 (p<0.01; 95% CI 1.50 to 6.80); sexually assaulting their intimate partners=3.73 (p<0.01; 95% CI 1.50 to 9.28).	7.5

Continued

Table 2 Continued

Quantitative studies

First author, publication year	Country	Objectives	Violence outcome	Perpetrator type	Confounders (if adjusted)	Key findings	Quality (0–10.0)*
Anastario, 2009 ⁴⁷	USA	To assess change in GBV rates one and 2 years after Hurricane Katrina among internally displaced women living in trailer parks in Mississippi.	IPV; physical, sexual	Any; intimate partner	Age, sex, income, ethnicity, marital status, number days lived in trailer park	Lifetime IPV prevalence increased in the year postdisaster (12.5% in 2006, 34.4% in 2007; p=0.001) and did not return to normal during displacement.	7.5
Harville, 2011 ³⁷	USA	To assess the relationship between exposure to Hurricane Katrina and reported IPV among post-partum women in Louisiana.	Physical, psychological, sexual; aggressive behaviour (IPV)	Intimate partner	Age, income, education, race, parity, marital status at delivery	Experiencing disaster-related damage increased likelihood of reported experience of IPV and aggressive behaviour in the past 6 months. RR between storm damage and verbal abuses=1.23 (95% CI 1.02 to 1.48); being pushed/shoved/slapped=5.28 (95% CI 1.93 to 14.45); punched/kicked/beat up=8.25 (95% CI 1.68 to 40.47).	7.5
Rao, 2020 ⁴²	India	To examine the prevalence and correlates of IPV in four Indian states before and after the 2004 Indian Ocean tsunami.	Physical, psychological, sexual (IPV)	Intimate partner	Socioeconomic factors, age, religion, alcohol use	Women living in Kerala, Tamil Nadu, and Andhra Pradesh (severely/moderately affected) had higher odds (1.41 (p<0.05); 1.98 (p<0.001); 1.85 (p<0.001)) of reporting IPV than women in Karnataka (unaffected) after the disaster. A decade after (2015–16), odds were two times higher in Tamil Nadu (2.42 (p<0.001)) and Andhra Pradesh (1.99 (p<0.001)) than Karnataka. Belonging to disadvantaged groups increased odds of IPV 1 year after disaster.	7.5
Weitzman, 2016 ⁴³	Haiti	To compare changes in IPV reported by women in the regions most affected and moderately affected by the 2010 earthquake.	Physical, sexual (IPV)	Intimate partner	Age, education, history of family violence, partner's alcohol consumption, marital status, number of surviving children	Women in most severely affected areas had higher probability of physical and sexual IPV one to 2 years after disaster.	7.5

Continued

Table 2 Continued

Quantitative studies

First author, publication year	Country	Objectives	Violence outcome	Perpetrator type	Confounders (if adjusted)	Key findings	Quality (0–10.0)*
Molyneaux, 2020 ³⁸	Australia	To examine experiences of violence victimisation among communities of differing levels of bushfire exposure.	Any	Not specified	Gender, age, education	Rates of violence against women increased with higher bushfire exposure (high affected area=7.4%; low affected=1.0%; p=0.003). Negative change in income significantly associated with increased violence against women in high bushfire affected areas (OR=4.68; p=0.004; 95% CI 1.62 to 3.54).	6.7
Sakurai, 2016 ⁴⁸	Japan	To examine the relationship between the 2011 Great East Japan Earthquake and IPV against pregnant women in Miyagi Prefecture.	Physical, psychological (IPV)	Intimate partner	Age, marital status, household income	Incidence of physical IPV in north coastal Miyagi=5.9%, significantly higher than inland (1.3%; p=0.0007) and nationwide incidence (1.5%; p<0.0001). No significant difference in incidence of psychological IPV between three areas of Miyagi or nationwide.	6.7
Madkour, 2011 ⁵¹	USA	To assess changes in dating violence victimisation among youth before and after exposure to Hurricane Katrina.	Any (IPV); sexual	Not specified	Age, ethnicity, gender	No significant difference in odds of experiencing dating violence pre-disaster (2005) and post-disaster (2007)=1.16 (p=0.155; 95% CI 0.92 to 1.39); and experiencing forced sex=0.92 (p=0.533; 95% CI 0.68 to 1.16).	5.8
Chan, 2011 ⁵⁹	China	To assess the impact of the 2008 earthquake in Sichuan on families already experiencing DV.	Physical, psychological	Intimate partner; known person; family member; stranger	None reported	Prevalence of physical violence pre-earthquake=5%; postearthquake=6.6%. Prevalence of psychological violence pre-earthquake=10.5%; postearthquake=19.3% (significance not reported).	5.0
Frasier, 2004 ³⁹	USA	To assess prevalence and incidence of IPV among female workers in North Carolina and perceived effect of Hurricane Floyd & floods on IPV.	Physical, psychological	Intimate partner	Multivariate analysis conducted but confounders unclear	No significant difference in pre-disaster and post-disaster prevalence of physical violence (pre=6%; post=4%); verbal abuse (12%; 8%); threats (8%; 4%). High rates of ever physically abused (28%) in sample compared with national rates.	5.0

Continued

Table 2 Continued

Quantitative studies

First author, publication year	Country	Objectives	Violence outcome	Perpetrator type	Confounders (if adjusted)	Key findings	Quality (0–10.0)*
Sloand, 2017 ⁵⁸	Haiti	To describe violence among internally displaced adolescent girls after the 2010 Haiti earthquake.	Physical, psychological, sexual	Family member; intimate partner	Age, education	No significant difference (p=0.510) in pre-disaster (59%) and post-disaster (64.1%) prevalence of physical, psychological, and sexual violence. After controlling for age and education, odds of being sexually abused post-earthquake=1.41 (95% CI 1.115 to 1.791).	5.0
Tanoue, 2019 ⁵⁶	Japan	To explore changes in IPV prevalence over time in three areas of Miyagi Prefecture after the Great East Japan Earthquake.	Physical, psychological (IPV)	Intimate partner	Multivariate analysis conducted but confounders unclear	Between 2011 and 2013, post-disaster prevalence of psychological IPV in north coastal area of Miyagi decreased from 2.7% in 2011, 1.5% in 2012, 1.3% in 2013 (Ptrend=0.04). Post-disaster physical IPV in south coastal area decreased from 2.7% in 2011, 1.5% in 2012, 1.3% in 2013 (Ptrend=0.03).	4.2
Kolbe, 2010 ⁵³	Haiti	To assess the consequences of the 2010 earthquake on the population living in Port-au-Prince.	Sexual	Stranger; intimate partner; friend/ neighbour	Unclear	29 individuals in sample sexually assaulted (rape n=16; forced oral sex n=7; unwanted sexual touching n=5; forced witness of sexual acts n=1). 10 813 (95% CI 6726 to 14 900) individuals estimated to have been sexually assaulted in Port-au-Prince 6 weeks after earthquake.	4.2
Lai, 2020 ⁵⁴	Haiti	To examine the prevalence of and relationships between violence among youth exposed to the 2010 earthquake.	Physical, psychological, sexual	Family member; caregiver; authority figure	None reported	Half of women reported experiencing at least one type of violence. Emotional=27.8% (95% CI 25.02 to 30.57); physical by parent/caregiver=22.03% (95% CI 18.11 to 25.94); physical by authority figure=10.20% (95% CI 7.54 to 12.87); sexual=23.01% (95% CI 19.19 to 26.84).	4.2
Sahni, 2016 ⁵⁷	Canada	To describe the public health surveillance response following southern Alberta floods in 2013.	Physical, sexual	Not specified	None reported	Threefold increase in rate of emergency department visit from reported sexual assault postflood compared with pre-flood=3.18 (95% CI 1.29 to 7.84). No change in rate from violent behaviour.	4.0

Continued

Table 2 Continued

Quantitative studies							
First author, publication year	Country	Objectives	Violence outcome	Perpetrator type	Confounders (if adjusted)	Key findings	Quality (0–10.0)*
Campbell, 2015 ⁴⁹	Haiti	To investigate GBV before and after the 2010 earthquake among displaced women in Port-au-Prince.	Physical, psychological, sexual	Intimate partner	None reported	High rate of physical, psychological, and sexual violence predisaster (71.2%) and postdisaster (75.0%). No significant difference between rates (p=0.266).	3.3
Fagen, 2011 ⁵²	USA	To examine the prevalence of violence experienced by female university students in New Orleans pre- and post-Hurricane Katrina.	Sexual	Not specified	Unclear	No significant difference in prevalence of sexual violence predisaster and postdisaster (size of effect and statistic unreported).	2.5
Mixed-methods study							
Azad, 2013 ⁵⁵	Bangladesh	To examine flood-induced vulnerabilities among women living in Sirajganj District.	Physical, psychological, sexual; IPV	Intimate partner; neighbour; stranger; family member	None reported	High prevalence of harassment=35%; psychological violence=33%; Verbal abuse=4%; Physical violence=34%; IPV=39% (significance not reported).	3.1

*Based on the adapted NIH Quality Assessment Tool for Observational Cohort and Cross-Sectional Design with 12 criteria for quantitative studies (online supplemental appendix 5); and adapted NIH tool, CASP checklist and Mixed Methods Appraisal Tool⁵⁶ for mixed-methods study (online supplemental appendix 7). Scores are calculated by dividing the sum of criteria met by the total number of criteria. Scores between 0 and 3.3 were classified as low, 3.3–6.6 as medium and 6.6–10.0 as high. CASP, Critical Appraisal Skills Programme; IPV, intimate partner violence; NIH, National Institutes of Health.

Three additional studies found associations between disaster exposure and IPV, but not other types of VAWG.^{40 47 48} Evidence from across sub-Saharan Africa showed significant increase in risk of physical and sexual IPV among women living in moderate and severe drought compared with women living in no drought, but no association was found for psychological violence.⁴⁰ Similarly in Japan, postearthquake prevalence of physical IPV against pregnant women was significantly higher in affected areas compared with the national prevalence ($p < 0.0001$) but there was no difference in psychological violence.⁴⁸ Meanwhile, hurricane exposure in the USA significantly increased ($p = 0.001$) reported lifetime IPV prevalence one year (12.5%) and two years (34.4%) postdisaster, but did not change prevalence of sexual violence.⁴⁷

Of the five studies that found no association between disaster exposure and VAWG, two studies commented on exceptionally high rates of predisaster VAWG.^{39 49} While there was no change in IPV prevalence among hurricane-exposed and flood-exposed women in the USA, nearly one-third of the women reported ever being physically abused—much higher than national rates.³⁹ Similarly, one study found no difference in pre-earthquake and postearthquake VAWG in Haiti, but prevalence of abuse in the sample was extremely high both before (71.2%) and after (75.0%) the disaster.⁴⁹ The other three studies that found no associations had the same subpopulation of adolescent girls. Earthquake-related displacement in Haiti was not associated with increased odds for any form of violence against girl (aged 13–17),⁵⁰ while exposure to Hurricane Katrina had no effect on risk of sexual violence among girls (aged 12–18) and female university students.^{51 52}

The direction of effect for four studies from Bangladesh, Haiti and Japan could not conclusively be determined, as postdisaster prevalence of VAWG was reported without comparison to predisaster prevalence or a comparison group with different exposure status. However, all of these studies showed high prevalence of postdisaster VAWG. Two studies from Haiti reported high prevalence of postearthquake VAWG in their respective samples.^{53 54} Weighting sampled household data to represent commune population, one study estimated that 10 813 individuals were sexually assaulted in Port-au-Prince after the 2010 earthquake.⁵³ In the second study set in Haiti, half of the women and girls reported experiencing at least one type of violence postearthquake, with 23% reporting sexual violence.⁵⁴ In Bangladesh, over 30% of sampled women had experienced a range of violence.⁵⁵ The prevalence of IPV in different areas of Miyagi Prefecture declined over two years after the 2011 Great East Japan Earthquake, suggesting that earthquake exposure may have impacted the higher prevalence reported immediately postdisaster.⁵⁶

There was limited consensus on findings from studies set within the same geographical setting. Evidence from North America on hurricane and flood exposure found contradictory effects, with four studies

finding associations with physical, sexual and psychological violence,^{37 46 47 57} and three studies finding no effect.^{39 51 52} All six studies set in Haiti examined earthquake exposure, with one study finding an increase in physical and sexual IPV following the disaster.⁴³ Another study found that the odds of adolescent girls reporting sexual abuse increased after adjusting for age and education, while it is important to note that 61% of girls in this study did not respond to questions about pre-earthquake and postearthquake abuse.⁵⁸ Two other studies found no effect,^{49 50} and the remaining two studies with no comparison groups described high rates of postearthquake VAWG.^{53 54}

Meanwhile, findings from across the Asia and Pacific region largely supported the positive association between disaster exposure and VAWG. Disaster exposures in Australia, China, India and Japan were all associated with increased risk or prevalence of VAWG.^{38 42 48 59} Interestingly, the odds of IPV increased with higher levels of tsunami exposure in India, with the odds remaining two times higher even 10 years after the event among those that were most severely exposed and belonged to disadvantaged groups.⁴² In Australia, the odds of VAWG was five times higher in communities most severely affected by bushfires and for households that had experienced postdisaster reductions in income.³⁸

Some authors of quantitative papers put forward ideas of hypothesised pathways from disaster exposure to increased VAWG but none were tested empirically. Many studies suggested poor mental health and related substance abuse as possible triggers of gendered violence.^{38 40–42 46 47 49 58} Poor mental health was linked to postdisaster stressors like poverty, food insecurity, unemployment and lack of social support that were themselves risk factors for VAWG.^{40 53} One study mentioned the failure of law enforcement and displacement camps as high risk environments in postdisaster settings.⁵³ Other hypothesised pathways were rooted in social norms, gender inequalities and financial dependence of women on men.^{40 42 49} Interestingly, one study that found no effect of hurricane exposure on violence against female students in the USA postulated that the sense of community on campus and available social support were protective factors.⁵²

Summary of qualitative studies

Qualitative findings from 16 studies and one mixed-methods study ($N = 17$) all described increased VAWG after disaster exposure (see [table 3](#)). A range of themes emerged from these studies on the mechanisms between disaster exposure to increased VAWG. These emergent themes from all studies are organised here into three overarching pathways: (1) disaster exposure associated with increase of stressors that trigger VAWG; (2) disaster exposure associated with increase of enabling environments for VAWG and (3) disaster exposure associated with exacerbating underlying drivers of VAWG.

Table 3 Findings from qualitative studies (N=16) and mixed-methods study (N=1)

Qualitative studies		Key findings and hypothesised pathways to risk				Quality (0–10.0)*
First author, publication year	Country	Objectives	Violence type	Perpetrator type		
Logie, 2017 ⁶⁰	Haiti	To explore experiences of violence among internally displaced girls and women in Leogane after the 2010 earthquake.	Physical, psychological, sexual	Stranger; intimate partner; family member	Housing insecurity=Internally Displaced Person camps common site of VAWG. Men enter tents with weapons and assault women. Economic insecurity=Men loot homes and commit sexual violence if women are present in the homes. Poverty reduces women's power in relationship—women do not leave husbands or report IPV because they are financially dependent. Self-initiated or pressures from family members to engage in survival sex. Male employers exploit women desperate for jobs. Failure of law enforcement=Most incidents unreported because fear of retaliation by perpetrator and perception that police will do nothing. Perpetrators pay off police.	10.0
Bermudez, 2019 ⁶¹	Haiti	To investigate the drivers of interpersonal violence in post-hurricane Coteaux.	Any (IPV and non-partner)	Intimate partner; non-partner (any)	Economic insecurity=Violence triggered by economic stress from loss of livelihood, food security, housing and community destruction. Violence unreported by women because financially dependent on partners. Rigid gender roles=As primary household providers, men feel inadequate when they are unable to fulfil role, assert dominance through physical violence, particularly when questioned by women on their ability to provide. Substance use=Men's increased substance use to cope with poor mental health. Wife's disapproval of husband's substance use and money spent can trigger violence.	9.0
Irshad, 2012 ⁷²	Pakistan	To explore impacts of the 2005 earthquake on women and men who suffered disaster-related paraplegia.	Physical, psychological; financial; controlling behaviour	Intimate partner	Low status of women=Women experience pressure from husband/family—in-law regarding husband's remarriage. Young girls (often orphans) married to older men as replacement wives and caretakes for paraplegic women. Child-bride strategic to ensure manipulation and control. Financial violence=Despite abandonment, husbands collected wives' disability stipends for new families/homes. Husbands believing that wives hide part of stipend triggers violence.	8.0

Continued

Table 3 Continued

Qualitative studies

First author, publication year	Country	Objectives	Violence type	Perpetrator type	Key findings and hypothesised pathways to risk	Quality (0–10.0)*
Parkinson, 2019 ⁷¹	Australia	To investigate increases in IPV following the 2009 bushfires in Victoria.	Physical, psychological, (IPV)	Intimate partner	Increase in new and existing IPV=Most women discussed new or increased violence in their own relationships or relationships they knew after the fires. Abusive ex-partners return to “help” after fires which creates opportunities to resume violence Reasons for not reporting= (1) Reduced access to services and law enforcement due to reduced capacity; (2) fear of repercussions from partners, (3) desire to protect/compassion for violent partners; (4) family/community pressure to not report at a time of community tragedy; (5) women perceived as being disloyal if report partners.	8.0
Rezwana, 2020 ⁶²	Bangladesh	To investigate the relationship between GBV and cyclone exposure in Barguna.	Physical, psychological, sexual; forced early marriage	Intimate partner; family member; stranger; authority figure; friend/ neighbour	Predisaster=IPV prevalent and triggered by dowry, poverty, adultery, extra marriages, tradition. Forced early marriage common. During disaster=Men pretend to be relief workers to abuse women. Women refuse evacuation/shelters because high rates of molestation, verbal abuse, rape at shelters. Postdisaster=Sexual violence while receiving relief but also beaten by husband/family if refuse to collect relief. Increased poverty from high cost of recovery and reconstruction—women become more financially dependent. Poverty increases forced early marriage and labour of girls, increasing risk of GBV and trafficking.	8.0
Sohrabzadeh, 2016 ⁶³	Iran	To examine VAW after earthquake and flood exposure in East Azerbaijan, Bushehr, and Mazandaran.	Physical, psychological, sexual	Family member; friend/ neighbour; authority figure	IPV existed predisaster but physical/psychological violence increased postdisaster, attributed to men’s reaction to stress. Decreased spousal sexual contact due to grief/stress triggers sexual violence. Mixed perceptions on increased forced early marriage due to postdisaster poverty. Verbal abuse common: family-in-laws spread rumours about widows to ruin reputation for remarriage. Participants denied that sexual violence can happen in the community because ‘all inhabitants know each other’.	8.0

Continued

Table 3 Continued

Qualitative studies

First author, publication year	Country	Objectives	Violence type	Perpetrator type	Key findings and hypothesised pathways to risk	Quality (0–10.0)*
Fisher, 2010 ⁶⁴	Sri Lanka	To examine the types of violence throughout phases of the 2005 tsunami disaster and assess whether levels of violence increased.	Physical, sexual; forced early marriage	Intimate partner; stranger; authority figure	Housing insecurity=Rape and other physical/sexual abuse rampant in low security camps. Reports of extreme IPV (eg, severing legs, setting wife on fire) in shelters. Authorities and humanitarian workers commit sexual and physical violence in shelters. Increased vulnerability from poorly lit toilets; journeys to damaged homes or to fulfil chores. Economic insecurity=Women vulnerable because financially dependent on partners. Increased forced marriage of girls. Over double the no of DV support referrals postdisaster compared with pre-disaster. Stress/trauma=Violence triggered by trauma and stresses related to loss of home/livelihoods, lack of privacy, substance use. Husbands blame partners for failing to save children common context of abuse.	7.0
Human Rights Watch, 2011 ²⁵	Haiti	To explore women and girls' access to reproductive and maternal health services; food and economic security; experience of GBV after earthquake exposure.	Sexual	Stranger; intimate partner; employer	Housing insecurity=Limited security in camps and rape is rampant. Lack of lighting in camps enables rape and violence. Sexual violence existed before the earthquake but some evidence suggests increase. Failure of law enforcement=Few women seek help from police. Women are ashamed to report rape. Mixed views on camp patrols deterring GBV, some women concerned that hours of patrols are too predictable. Economic insecurity=Orphans live with families while doing domestic chores, vulnerable to rape by employer.	7.0
Parkinson, 2013 ⁶⁵	Australia	To examine the link between bushfires and increased VAW and describe women's experiences.	Physical, sexual	Intimate partner	Increased IPV=17 women personally affected by IPV, with nine never having experienced violence before the bushfires. Contact with abusive ex-partner may be unavoidable in shelters. Women may have to rely on abusive partners to stay relatively safe and housed. Stressors=homelessness, unemployment, increased substance use. Rigid gender roles=Men feel inadequate from not being able to protect livelihoods/homes. Women do not report because of community attitudes that justify men's violent behaviour and pressures to stay silent. Reporting violent men perceived as woman causing the community more harm during a tragedy.	7.0

Continued

Table 3 Continued
Qualitative studies

First author, publication year	Country	Objectives	Violence type	Perpetrator type	Key findings and hypothesised pathways to risk	Quality (0–10.0)*
Rahill, 2015 ⁶⁶	Haiti	To describe the symptoms reported by victims of postearthquake and hurricane violence in Cite Soleil.	Physical, psychological, sexual	Non partner (Any)	Majority experienced sexual violence immediately postearthquake. Extreme and purposeful injury with men using broken marbles and rubber bands during rape to severely injure victims. Sexual violence linked to vulnerability of women in homes and tents destroyed by disasters. Victims pregnant from rapes subjected to verbal and emotional abuse from community.	7.0
Sohrabzadeh, 2017 ⁷³	Iran	To assess women's vulnerabilities after two earthquakes in eastern Azerbaijan in 2013.	Forced early marriage, controlling behaviour	Family member	Forced early marriage existed predisaster but exacerbated due to postdisaster poverty. Controlling behaviour of women by men to go to school, work, or to receive relief.	7.0
Yoshihama, 2018 ⁶⁷	Japan	To investigate VAWG in the aftermath of the Great East Japan earthquake and tsunami.	Physical, psychological, sexual; financial	Intimate partner; family member; neighbour; authority figure; coworkers	IPV=Majority described postdisaster increase in severity of IPV that had already existed predisaster; few cases of IPV began postdisaster. Husbands abandoned financially dependent family or squandered compensation payments. Exposure to abusive ex-partners with men returning to "help" or women having no option but to return to ex-partners due to loss of residency. Non-partner violence=Sexual violence in shelters, family/friend's residence, or temporary housing. Sexual molestation and voyeurism of girls at shelters. Abuse by shelter leaders unreported because fear of being killed; abusing family; being removed from shelter.	7.0
Nguyen, 2018 ⁶⁸	Philippines	To understand VAWG after Typhoon Haiyan and characterise the drivers of violence.	Physical, sexual	Intimate partner; neighbour; authority figure	Housing insecurity=Evacuation shelters heighten women's vulnerability to violence. Failure of law enforcement=Women believe their reports of abuse will not be believed. High incidence of rape by police and military. Gender norms=Women are financially dependent on men and cannot leave abusive husbands. Expectations to remain submissive and accept violence as part of marriage.	6.0
Standing, 2016 ⁶⁹	Nepal	To examine postearthquake VAWG and the role of grassroots activities for disaster response.	Physical, sexual	Stranger; authority figure; family member	High levels of existing VAWG augmented postdisaster. Lack of security in shelters and tents increase vulnerability. Menstrual taboo means women may sleep outside of the tent until menstruation is over, increasing their vulnerability to violence.	5.0

Continued

Table 3 Continued

Qualitative studies						
First author, publication year	Country	Objectives	Violence type	Perpetrator type	Key findings and hypothesised pathways to risk	Quality (0–10.0)*
Nguyen, 2018 ⁷⁴	Philippines and Viet Nam	To explore domestic VAWG pre and post-typhoon in 2013.	Physical, sexual	Intimate partner	While VAWG increased after disaster in the Philippines, it amplified existing violence and male dominance. In both countries, violence unreported to authorities because victims often blamed (eg, they are not good wives or have bad attitudes) and violence justified/normalised.	4.0
Rees, 2005 ⁷⁰	Sri Lanka	To describe a programme to support women and reduce post-tsunami GBV.	Sexual	Stranger; intimate partner	Economic insecurity=Post-tsunami poverty made women vulnerable to traffickers and forced sexual relations to feed themselves/family. Housing insecurity=Lack of privacy while changing clothes and receiving menstrual hygiene products leads to harassment. Insufficient lighting increases risk of rape. Women fear men because of high incidence of sexual abuse and unable to voice opinions/make decisions to address GBV risk.	3.0
Mixed-methods study						
Azad, 2013 ⁵⁵	Bangladesh	To examine flood-induced vulnerabilities among women living in Sirajganj District.	Physical, psychological, sexual; IPV	Intimate partner; neighbour; stranger; family member	During and after floods sexual violence against women increased. Sexual harassment particularly observed at shelters.	3.1

*Based on the adapted CASP qualitative checklist with 10 criteria for qualitative studies (online supplemental appendix 6). Scores are calculated by dividing the sum of criteria met by the total number of criteria, where 0–3.3 was of low quality, 3.3–6.6 medium and 6.6–10.0 of high quality. CASP, Critical Appraisal Skills Programme; DV, domestic violence; GBV, gender based violence; IPV, intimate partner violence; VAWG, violence against women and girls.

Pathway 1: disaster exposure associated with increase of stressors that trigger VAWG

Across many of the studies, VAWG was often triggered by three stressors that emerged in postdisaster settings: (1) housing insecurity; (2) economic insecurity and (3) trauma and mental health issues.

Housing insecurity

Almost all studies discussed women's heightened risk of violence caused by housing insecurity.^{25 60–70} The lack of privacy and security at temporary housing like evacuation shelters and displacement camps led to high rates of primarily sexual violence including rape, harassment, molestation and unwanted sexual contact. Violence was perpetrated by intimate partners, family members, strangers, community members and authority figures like police or leaders of evacuation shelters. In Bangladesh, perpetrators were also men who pretended to be relief workers to gain access to and abuse women.⁶²

Extreme forms of postdisaster VAWG in displacement camps were reported. Women in Sri Lanka described partners setting wives on fire or severing their legs.⁶⁴ In Haiti, perpetrators used broken marbles or rubber bands to rape and severely injure women.⁶⁶ A key respondent from Haiti described the realities of rampant VAWG in displacement camps and the intersections with other stressors⁶⁰:

When the earthquake just happened, all the time they are raping somebody or commit a violent act. Because there is no security in the tents. You may be in a tent and they set it on fire. There are no jobs. (Key respondent; Logie *et al.*⁶⁰, Haiti)

Loss of housing also allowed for abusive ex-partners to re-enter survivors' lives in different ways. In Australia, there were risks for victims coming into contact with abusive ex-partners in community evacuation shelters.⁶⁵ For some women, IPV resumed when abusive ex-partners returned under the pretext of helping out or when women had no options but to reside with violent partners to stay relatively safe from disasters.^{65 67 71}

Economic insecurity

Economic insecurity in the aftermath of disasters was a major trigger of VAWG. In Haiti, postdisaster poverty and lack of policing resulted in men looting homes and assaulting women found in the homes.⁶⁰ In Iran and Japan, economic violence was also perpetrated by husbands abandoning their financially dependent families or squandering compensation payments.^{67 72} Economic insecurity also served to increase women's vulnerability to VAWG. A recurring theme across studies was that financial dependence of women on their partners was augmented postdisaster. This increased their vulnerability to VAWG as they would not report or leave abusive partners.^{60–62 64 65 68} For some survivors, enduring violence may be preferable to losing the household's breadwinner, as this quote suggests⁶¹:

I think this is the reason why women think twice before [reporting]. They see that they sentence the man for 10 years. Who is going to feed the house? Therefore, they don't make any complaints. (Male respondent; Bermudez *et al.*⁶¹, Haiti)

Poverty also drove some women to engage in transactional sex, while some employers took advantage of desperate, job-seeking women with sexual coercion in Bangladesh, Haiti and Sri Lanka.^{60 61 70} Across South Asia and Iran, studies confirmed that forced early marriage or labour of young girls increased due to postdisaster poverty.^{62 64 72 73}

Trauma and mental health issues

Trauma and mental health issues often led to VAWG through various pathways. Decreased sexual contact between spouses due to wives and/or husbands coping with grief and stress triggered IPV in postdisaster Iran.⁶³ Increased substance abuse by men struggling with poor mental health was a risk factor for VAWG across many postdisaster settings.^{61 64 65 67 74} Wives expressing disapproval of their husbands' use and money spent on alcohol and drugs was a scenario that triggered IPV in postdisaster Haiti and Viet Nam.^{61 74} In Australian communities that suffered extreme tragedy and loss from bushfires, community-level empathy for traumatised men pressured women to not report abusive partners, while some survivors themselves felt compassion towards their partners and did not want to report IPV.⁷¹

Pathway 2: Disaster exposure associated with increase of enabling environments for VAWG

The studies described how postdisaster environments often heightened risks that enabled VAWG. For example, failures of law enforcement after disasters created environments that allowed for rampant VAWG in both high and low-income and middle-income settings, particularly in displacement camps and shelters.^{60 64 65 68 69 71} Limited police presence was an issue in itself, but improper conduct of police fostered mistrust among women and those experiencing VAWG. Perceptions and realities of officers not taking reports seriously, not doing anything, shaming victims, taking bribes from perpetrators or sometimes committing VAWG themselves meant that women would not report abuse or seek help from law enforcement.^{60 64 68 69 74} In the aftermath of bushfires in Australia, police officers discouraged and trivialised reports of IPV⁶⁵:

So much has been justified as a result of the fires... so much has been fobbed off. So many women have gone to police and been told by police, 'Things will settle down again'. The responsibility is back on the women. (Health professional; Parkinson and Zara⁶⁵, Australia)

The postdisaster displacement camp and shelter environments were also enablers of VAWG. The lack of privacy from open-planned evacuation shelters and insecurity from the lack of doors, walls and locks in displacement camps heightened VAWG in Haiti, Japan

and Nepal.^{25 60 67 69} Limited consideration of women's needs in camps created opportunities for violence and abuse. In Sri Lanka, women receiving menstrual products in view of men led to harassment in camps,⁷⁰ while severe menstrual taboo in Nepal meant that some women slept outside of tents until menstruation was over, increasing their risk of experiencing violence.⁷⁴ Poor lighting in these settings and lack of gender-segregated water, sanitation and hygiene facilities were also risky for women.^{25 64 67 69 70}

Pathway 3: disaster exposure associated with exacerbating underlying drivers of VAWG

Many qualitative studies described existing high rates of VAWG before disaster exposure,^{25 62 63 67 69 71 74} indicating that underlying drivers of VAWG were already present in many settings that experienced a postdisaster increase. For example, the low status and agency of women and girls, combined with the effects of postdisaster poverty, facilitated an increase in forced early marriage of girls and women engaging in transactional sex to support themselves and those in their care.^{60 62 64 73}

Rigid gender roles were also key underlying drivers of VAWG, particularly IPV. Studies from Australia, Haiti and Viet Nam described how VAWG triggered by stressors related to housing, income and employment was often rooted in men feeling inadequate in providing for financially dependent wives and children.^{60 61 65 74} The intersections of gender roles, financial dependence of women on men, as well as substance use are exemplified in this quote by a male perpetrator in Viet Nam⁷⁴:

When we men came home after a night of drinking alcohol, we often lost our temper. Imagine a wife is complaining about financial issues and blaming one for being lazy. This made us men very frustrated and we often responded with violence. (Male respondent; Nguyen and Rydstrom⁷⁴, Viet Nam)

Women in Australia and Viet Nam that experienced postdisaster IPV were sometimes blamed by their families or police as not fulfilling their role in caring for their husbands.^{65 74} In Iran, the double standards of gender roles were particularly evident among those disabled from disaster exposure.⁷² Wives were expected to become caretakers of their disabled husbands who were no longer able to provide for the family. Meanwhile, remarriage for husbands with disabled wives was perceived as normal, as wives could no longer fulfil their duties.⁷²

DISCUSSION

Our systematic review of 37 studies clearly suggests that disasters caused by climate related or other natural hazards can increase VAWG across various settings. Eight out of 20 quantitative studies found an association between disaster exposure and increased VAWG, and an additional four studies found positive associations between exposure and some types of violence. Nearly half of all quantitative studies found that disaster exposures

were associated with increased IPV across high-income, middle-income and low-income settings. While study designs and lack of comparison groups for four studies set in Bangladesh, Haiti and Japan limits the ability to draw firm conclusions, all these studies found high rates of postdisaster VAWG, speculated to have increased from disaster exposure. Importantly, no study found that disaster exposure was associated with decreased VAWG.

Three potential pathways emerged from the qualitative and quantitative studies with positive associations between disaster exposure and increased VAWG: (1) disaster exposure increased stressors that trigger VAWG, such as poor mental health, loss of housing and livelihoods; (2) disaster exposure increased enabling environments for VAWG, including poor law enforcement and risky postdisaster housing environments and (3) disaster exposure exacerbated underlying drivers of VAWG, for example, gender inequalities and worsened social norms. Together, these pathways informed our conceptual framework outlined in [figure 2](#).

These hypothesised pathways are supported by non-empirical studies and grey literature,^{11 20 75} including some that compare the postdisaster environments caused by natural hazards and armed conflict.^{76 77} Some argue that in both, an accumulation of stressors from displacement, poverty, poor mental health and increased substance use, and collapse of policing and social order can trigger VAWG.^{76 77} Yet unlike armed conflict that begins and ends with the destruction to social structures,⁷⁸ some studies argue that disasters caused by natural hazards can increase altruism, social cohesion or women's economic participation in previously male-dominated spaces and may have protective effects on postdisaster VAWG.^{79–82} This premise, however, is not well supported by this present review and no study suggested any protective effects of disaster exposure.

Of the five quantitative studies that found no association between disaster exposure and VAWG, two studies had samples with exceptionally high existing baseline levels of VAWG, which may have reduced participants' ability to recall nuanced differences in violence before and after disaster exposure. The other three studies that found no effect assessed disaster exposure on violence against young girls only and had poor measurement quality. Furthermore, it is well documented that there remains significant under-reporting of VAWG either due to measurement issues or participant reluctance to disclose violence.^{21 83} Many qualitative studies included in this review described under-reporting of VAWG in postdisaster settings due to failures of law enforcement, silencing by communities, fear of repercussions from perpetrators, financial dependence on violent partners or survivors' empathy for abusive partners. Thus, the data and accounts of postdisaster VAWG presented in the current literature likely underestimates the true scope of the issue. On the contrary, it may be possible that VAWG reported in postdisaster settings may not reflect a true increase in VAWG after the exposure, but an increase

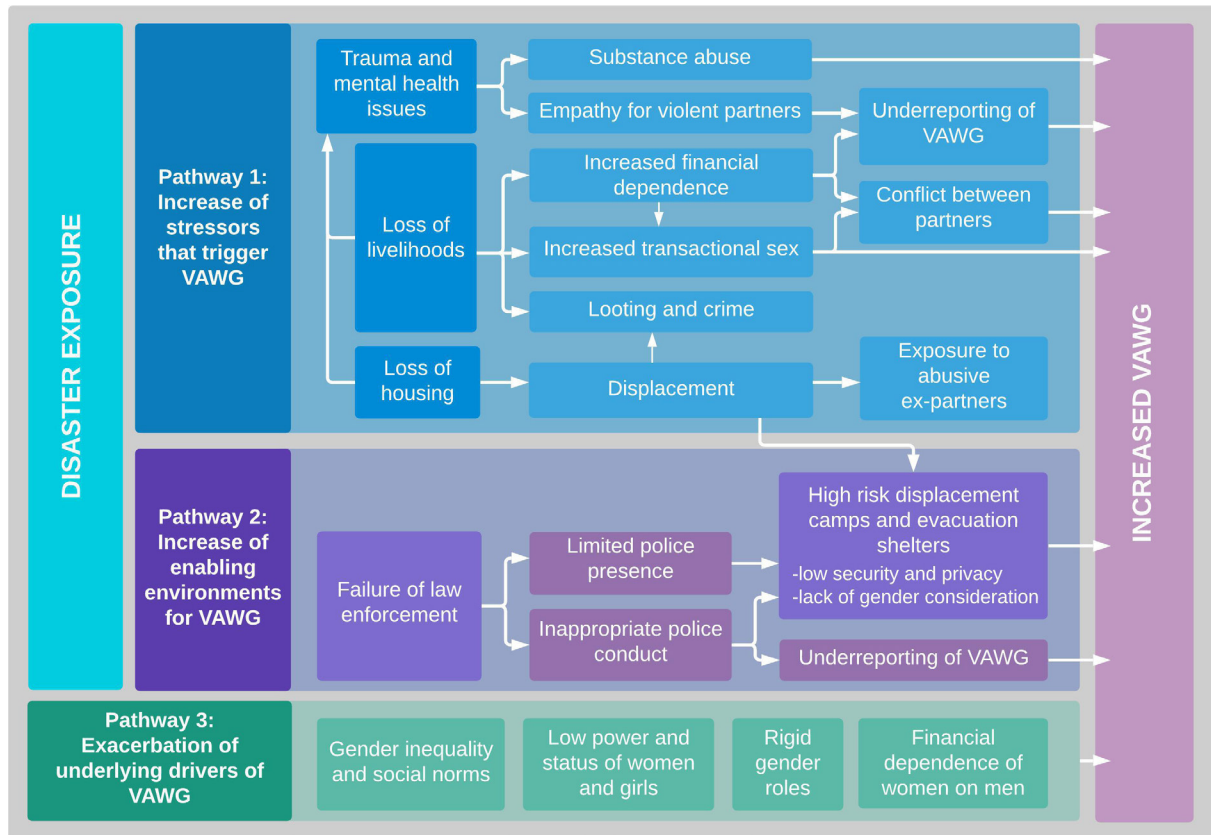


Figure 2 Conceptual framework of hypothesised pathways from disaster exposure to increased VAWG from all included studies. The exposure includes disasters caused by climatological, geophysical, hydrological and meteorological hazards and associated with climate change. Increased VAWG includes outcomes of physical, psychological (including emotional and verbal), sexual and financial violence. VAWG, violence against women and girls.

in reporting mechanisms (eg, those offered by humanitarian actors) that capture existing high levels of VAWG.

Beyond disasters caused by the natural hazardsexplored in this review, VAWG in the context of other threats like biological hazards also merits attention. The COVID-19 pandemic has increased global rates of VAWG,^{84–86} with some overlaps in the theorised pathways between pandemics and VAWG and this present study, including declining mental health; economic insecurity-related stressors; and pressures related to men’s roles as income earners.⁸⁵ During the 2013–2015, West Africa Ebola outbreak, school closures and quarantine measures to contain the virus increased exposure of women to abusers in the home,⁸⁷ similar to current global lockdown measures to reduce COVID-19 transmission.^{84–86}

Strengths and limitations

As the first known global systematic review examining the associations between disasters caused by natural hazards and VAWG, this review adds to the much-needed evidence base. The review was limited by the lack of high quality, rigorously designed studies and the shortcomings of exposure and outcome measures used in the included studies. Disaster exposure was often measured ecologically or by proxy measures and few measured different individual levels of exposure or disaster affectedness. The

measurement of VAWG was similarly problematic with few studies using a scale of violent acts experienced and even fewer using validated scales. Notably, no study used the WHO Violence Against Women measures that are validated and standardised measures in VAWG research.³² Some studies also measured VAWG several years after the exposure event which introduces recall bias, while variations in time scales between studies also limits comparison. The inclusion of English only articles and the overrepresentation of evidence from events in the USA (eg, Hurricane Katrina) and Haiti may have resulted in publication bias and limits the generalisability of the review.

Our findings have implications for future research. First, to address measurement issues, studies should carefully consider the IPV and other VAWG metrics to be included to ensure that they capture internationally validated measures that are sensitive to disaster effects. In addition, advancing the measurement of disaster exposure for related research merits further attention, such as the use of ecological approaches like spatial data on residency and disaster severity. Relatedly, as highlighted earlier, the complexities of reporting VAWG highlights the need for more robust longitudinal and/or comparative studies. Second, the scope can be expanded by including non-English studies and including additional

search terms for VAWG, such as forced early marriage, trafficking and sexual exploitation that were found to be relevant in this context. Finally, apart from strengthening study designs to better estimate linkages between disasters and VAWG, we need studies that also start to unpack the association between climate-related change and environmental degradation and impacts on VAWG.

CONCLUSION

To our knowledge, this is the first systematic evidence on the effects of exposure to disasters from natural hazards on VAWG. We present quantitative and qualitative evidence on increased VAWG after disaster exposure and have developed a conceptual framework with three hypothesised pathways to explain this association. More high-quality research with greater geographical scope and use of standardised exposure and outcome measures is critical to generate further knowledge on the magnitude of the issue and mechanisms. As populations are increasingly affected by climate-related disasters and VAWG can have severe and lasting health impacts, existing knowledge must inform rapid action across policy and practice. At the policy level, greater awareness on disaster related VAWG, gender-sensitive DRR policies and inclusion of women in disaster management is critical. Social protection programmes that address the underlying drivers of VAWG, such as poverty and economic insecurity, could be designed to be gender-sensitive. Further, systems for rapid and effective coordination between disaster management, law enforcement and health authorities must be defined clearly to prevent VAWG and address its health consequences.

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Appendix 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist²⁹

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4-5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5-6
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5-6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5-6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Appendix 2
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	5-6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	5-6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	5-6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	NA
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	6
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	NA
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	NA
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	7
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	11-13; 17-19
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Appendices 5-7
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	7-21
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	NA
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	NA
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	NA

DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	21-23
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	23
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	24
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	24

Appendix 2. Complete search strategy for Medline

Set	Concept	Search string
1	Women	(wom?n or girl* or gender or female*).ti,ab
2	Violence	Violence/ or Domestic Violence/ or Gender-Based Violence/ or Intimate Partner Violence/ [MeSH]
3	Violence	(abus* or "physical violen*" or "emotional* violen*" or "mental* violen*" or "psychological* violen*" or "sexual* violen*" or "physical* abus*" or "emotion* abus*" or "mental* abus*" or "psychological* abus*" or "sexual* abuse*" or "verbal abus*" or "physical assault*" or "sexual assault*" or "physical attack*" or "sexual attack*" or punish* or maltreat* or mistreat* or molest* or defile* or intimidat* or aggression* or bully* or incest* or violat* or "sexual violation*" or "domestic abuse" or harass* or rape or "forced sex" or "coerced sex" or "intimate partner abuse" or "dating violen*" or "spous* abuse").ti,ab.
4	Natural disaster	Disasters/ [MeSH]
5	Natural disaster	("climate change" or "climate-related" or "climate related" or climatic or "global warming" or humanitarian or "natural disaster*" or "natural hazard*" or "geophysical hazard*" or "meteorological hazard*" or "hydrological hazard*" or "climatological hazard*" or glaci* or "glacial lake outburst" or volcan* or earthquake* or avalanche* or tsunami* or "tidal wave*" or "extreme temperature" or storm* or "cyclonic storm*" or cyclone* or "tropical storm*" or thunderstorm* or rainstorm* or "winter storm*" or snowstorm* or blizzard* or tornado* or fog* or flood* or landslide* typhoon* or hurricane* or whirlwind* or "heat wave*" or heatwave* or "cold wave*" or sinkhole* or mudslide* or wildfire* or bushfire* or "forest fire*" or drought*).ti,ab.
6	Combine sets	2 or 3
7	Combine sets	4 or 5
8	Combine sets	1 and 6 and 7
9	Limits	Limit 8 to English language
10	Limits	Limit 9 to journal article

Appendix 3. EM-DAT Classification and definitions of disasters caused by natural hazards³²

Natural hazard*	Definition	Main disaster types
Geophysical	A hazard originating from solid earth. This term is used interchangeably with the term geological hazard.	Earthquake Mass movement (dry) Volcanic activity
Meteorological	A hazard caused by short-lived, micro- to meso-scale extreme weather and atmospheric conditions that last from minutes to days.	Extreme temperature Fog Storm
Hydrological	A hazard caused by the occurrence, movement, and distribution of surface and subsurface freshwater and saltwater.	Flood Landslide Wave action
Climatological	A hazard caused by long-lived, meso- to macro-scale atmospheric processes ranging from intra-seasonal to multi-decadal climate variability.	Drought Glacial Lake Outburst Wildfire

*Excluding biological and extra-terrestrial hazards

Appendix 4. Geographic settings of included studies. $N > 37$ because one study examined disaster exposure and VAWG in two countries.



Appendix 5. Quality assessment for quantitative studies

Author/ Year	Clear research question / objective	Clear study population	Participation rate < or 50%	Recruited from similar population, time period, same inclusion/ exclusion criteria	Sample size justification/ power description/ variance/ effect estimate provided	Comparison group to assess directionality	Outcome measured <one year of exposure	Different levels of exposure measured	Clear exposure measures	Exposure assessed more than once over time	Clear outcome measures	Confounders measured and adjusted	Overall score (0- 10)*
Epstein, 2020	Y	Y	NA	Y	Y	Y	Y	Y	Y	Y	Y	Y	10.0.0
Sanz- Barbero, 2018	Y	Y	NA	NA	N	Y	Y	Y	Y	Y	Y	Y	9.00.9
Cerna- Turoff, 2020	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	8.8.3
Temple, 2011	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	8.8.3
Anastario, 2009	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	7.5
Harville, 2011	Y	Y	N	Y	N	Y	Y	Y	Y	N	Y	Y	7.5
Rao, 2020	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	7.5
Weitzman, 2016	Y	Y	Y	Y	N	Y	N	Y	Y	N	Y	Y	7.5
Molyneaux , 2019	Y	Y	N	Y	N	Y	N	Y	Y	N	Y	Y	6.6.7
Sakurai, 2016	Y	Y	Y	Y	N	Y	Y	N	N	N	Y	Y	6.7
Madkour, 2011	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	5.8
Chan, 2011	Y	Y	NR	Y	N	Y	Y	N	N	N	Y	N	5.0
Frasier, 2004	Y	Y	Y	Y	N	Y	NR	N	N	N	Y	N	5.0
Sloand, 2017	Y	Y	NR	Y	N	Y	N	N	N	N	Y	Y	5.0
Tanoue, 2019	Y	Y	NR	Y	N	N	Y	N	N	N	Y	NY	4.250
Kolbe, 2010	Y	Y	Y	Y	N	N	Y	N	N	N	N	N	4.2
Lai, 2020	Y	Y	NR	Y	N	N	Y	N	N	N	Y	N	4.2
Sahni, 2016	Y	Y	NA	NA	N	Y	Y	N	N	N	N	N	4.0
Campbell,	Y	N	NR	Y	N	Y	N	N	N	N	Y	N	3.3

Appendix 6. Quality assessment for qualitative studies

Author/Year	Clear aim	Appropriate methodology	Appropriate research design	Appropriate recruitment strategy	Appropriate data collection	Consideration of researcher-participant relationship	Consideration of ethical issues	Rigorous data analysis	Clear statement of findings	Discussion on value of research*	Overall score (0-10.0)**
Logie, 2017	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10.0
Bermudez, 2019	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	9.0
Irshad, 2012	Y	Y	Y	N	Y	N	Y	Y	Y	Y	8.0
Parkinson, 2019	Y	Y	Y	Y	Y	N	Y	Y	Y	N	8.0
Rezwana, 2020	Y	Y	Y	Y	Y	N	Y	N	Y	Y	8.0
Sohrabizadeh, 2016	Y	Y	Y	N	Y	N	Y	Y	Y	Y	8.0
Fisher, 2010	Y	Y	Y	N	Y	N	Y	N	Y	Y	7.0
Human Rights Watch, 2011	Y	Y	Y	N	Y	N	Y	N	Y	Y	7.0
Parkinson & Zara, 2013	Y	Y	Y	Y	Y	N	N	N	Y	Y	7.0
Rahill, 2015	Y	Y	Y	N	Y	N	N	Y	Y	Y	7.0
Sohrabizadeh, 2017	Y	Y	Y	Y	Y	N	Y	N	N	Y	7.0
Yoshihama, 2018	Y	Y	Y	N	Y	N	Y	N	Y	Y	7.0
Nguyen, 2018	Y	Y	Y	N	Y	Y	Y	N	N	N	6.0
Standing, 2016	Y	Y	Y	N	N	N	N	N	Y	Y	5.0
Nguyen & Rydstrom, 2018	Y	Y	Y	N	N	N	N	N	N	Y	4.0
Rees, 2005	Y	Y	N	N	N	N	N	N	N	Y	3.0

*Value of research: (1) Contribution of evidence to policy/practice; (2) Identification of new areas of research needed; (3) Discussion of applicability to other contexts.

**Scores calculated by dividing the sum of criteria met by the total number of criteria, where 0-3.3 was of low quality, 3.3-6.6 medium, and 6.6-10.0 of high quality.

Appendix 7. Quality assessment for mixed-methods study

Author/Year	Criteria	
Azad et al., 2013	Quantitative	
	Clear research question/objective	Y
	Clear study population	N
	Participation rate at least 50%	NR
	Recruited from similar population, time period, same inclusion/exclusion criteria	NR
	Sample size justification/power description/variance/effect estimate provided	N
	Comparison group to assess directionality	N
	Outcome measured within one year of exposure	N
	Different levels of exposure measured	N
	Clear exposure measures	N
	Exposure assessed more than once over time	N
	Clear outcome measures	N
	Confounders measured and adjusted	N
	Qualitative	
	Clear aim	Y
	Appropriate methodology	Y
	Appropriate research design	Y
	Appropriate recruitment strategy	N
	Appropriate data collection	N
	Consideration of researcher-participant relationship	N
	Consideration of ethical issues	N
	Rigorous data analysis	N
	Clear statement of findings	Y
	Discussion on value of research	Y
	Mixed methods	
	Is there adequate rationale for using a mixed methods design to address the research question?	N
	Are the different components of the study effectively integrated to answer the research question?	Y
	Are the outputs of the integration of qualitative and quantitative components adequately interpreted?	N
	Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?	Y
Overall score (0-10.0)*	3.1	

*Score calculated by dividing the sum of criteria met by the total number of criteria, where 0-3.3 was of low quality, 3.3-6.6 medium, and 6.6-10.0 of high quality.