Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Extreme weather events and child mental health: a global systematic review and meta-analysis of prevalence.

Friederike Suhr

friederike-suhr@gmx.de

University Medical Centre Mainz

Manzura Jumaniyazova

Technical University of Munich

Bhargavi Bajjuri

University Medical Centre Mainz

Caroline Reese

University Medical Centre Mainz

Pavel Dietz

University Medical Centre Mainz

Janina Isabel Steinert

Technical University of Munich

Research Article

Keywords: Mental health, extreme weather events, climate change, children, PTSD, depression

Posted Date: November 25th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11514948/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Extreme weather events and child mental health: a global systematic review and meta-analysis of prevalence.

Friederike Suhr*, Institute for Occupational, Social and Environmental Medicine, University Medical Centre of the Johannes Gutenberg University Mainz, Obere Zahlbacher Str. 67, 55131 Mainz, Germany

Manzura Jumaniyazova, Professorship of Global Health, School of Social Sciences and Technology, Technical University of Munich, Richard-Wagner-Straße 1, 80333 Munich, Germany

Bhargavi Bajjuri, Institute for Occupational, Social and Environmental Medicine, University Medical Centre of the Johannes Gutenberg University Mainz, Obere Zahlbacher Str. 67, 55131 Mainz, Germany

Caroline Reese, Institute for Occupational, Social and Environmental Medicine, University Medical Centre of the Johannes Gutenberg University Mainz, Obere Zahlbacher Str. 67, 55131 Mainz, Germany

Pavel Dietz, Institute for Occupational, Social and Environmental Medicine, University Medical Centre of the Johannes Gutenberg University Mainz, Obere Zahlbacher Str. 67, 55131 Mainz, Germany

Janina Isabel Steinert, Professorship of Global Health, School of Social Sciences and Technology, Technical University of Munich,Richard-Wagner-Straße 1, 80333 Munich, Germany

***Corresponding author**: Friederike Suhr, Institute for Occupational, Social and Environmental Medicine, University Medical Centre of the Johannes Gutenberg University Mainz, Obere Zahlbacher Str. 67, 55131 Mainz, Germany. Email: friederike-suhr@gmx.de

Abstract

Background: Climate change is increasing the frequency and severity of extreme weather events, yet the burden of mental disorders among exposed children has not been quantified globally. This systematic review and meta-analysis synthesised the global evidence, estimated the pooled prevalence of mental health outcomes in exposed children, and examined sources of heterogeneity.

Methods: PubMed, PsycINFO and Web of Science were searched for studies reporting clinically relevant mental health outcomes in children (≤18 years) exposed to extreme weather events. Prevalence was pooled using robust variance estimation in three-level random-effects models. Univariable meta-regressions with cluster-robust Wald tests examined event type, national income, age, sex and sampling frame.

Results: 42 studies (140,139 children, twelve countries) on storms, floods and wildfires were included; none examined heat or drought. Pooled prevalence was 17.6% (95% CI 11.2–24.9%, k=40) for post-traumatic stress disorder (PTSD) and 20.2% (95% CI 9.5–33.7%, k=20) for depression, with high heterogeneity (I^2>99%). Girls showed higher PTSD prevalence than boys (difference 2.22 percentage points, 95% CI 0.49–3.95, p=0.020). PTSD prevalence was lower in population-based than school-based samples (5.0% vs 23.6%, p=0.002) and in high-income than low- and middle-income countries (10.9% vs 25.5%, p=0.028).

Conclusions: Around one in six children exposed to extreme weather events met criteria for PTSD and one in five for depression. The evidence comes mainly from the United States and China: there are no studies from the Middle East and North Africa, only one from Sub-Saharan Africa, and none on heat or drought, even though children in these regions and exposed to these hazards face the greatest climate risk. Child mental health should be built into climate adaptation policy and post-disaster response, and research is urgently needed in under-studied settings.

Protocol registration: PROSPERO (CRD42024604257)

Keywords: Mental health, extreme weather events, climate change, children, PTSD, depression

Background

The Intergovernmental Panel on Climate Change (IPCC) reports that human-induced climate change has increased the frequency and intensity of extreme weather events, including heat extremes, heavy precipitation, droughts, and tropical cyclones, along with the likelihood of compound events such as concurrent heatwaves and floods [1]. These hazards are projected to become more frequent and severe even if global warming is limited to 1.5 °C [1]. As a result, large numbers of children are already exposed to climate extremes worldwide [2, 3]. According to the Children's Climate Risk Report 2026 of the United Nations Children's Fund, an estimated 1.2 billion children experience extreme heat, 662 million are exposed to tropical storms, and 370 million to coastal or riverine flooding [3]. Extreme weather events not only cause immediate physical harm, such as injuries and mortality, but also act as direct or indirect stressors influencing children's psychological well-being [4]. Compared to physical health, the psychological consequences of extreme weather event exposure for children remain poorly understood and inadequately quantified [4, 5].

This is especially alarming, since children compared to adults are particularly vulnerable to the psychological consequences of extreme weather events for several reasons. First, young children depend on caregivers as a primary buffer against threat and distress; when extreme weather events impair parental mental health or disrupt caregiving routines, this buffering capacity is compromised [6]. Consistent with this, a study by Li et al. demonstrates that the risk of PTSD is elevated among children whose parents also meet criteria for PTSD, providing support for a caregiver-mediated pathway of risk transmission [7]. Second, childhood constitutes a sensitive period of neurodevelopment, during which exposure to environmental stress can alter neurobiological and psychological developmental trajectories in ways that extend beyond the immediate post-exposure period [4]. For instance, a study of heat exposure and brain functioning in 2,229 children aged 9–12 found that heat exposure disrupts brain structure and function, with possible downstream effects on emotional regulation and cognitive development [8]. Third, extreme weather events frequently disrupt schools and community structures that children rely on for social support, with school closures and displacement compounding the direct psychological impact of the extreme weather event itself [9, 10]. Although evidence on school disruption following extreme weather events specifically is limited, a meta-analysis of pandemic-related school closures found that school closure was

associated with increased anxiety symptoms in children (standardised mean difference 0.44, 95% CI 0.23–0.65), suggesting that the loss of school-based structure and social support may similarly affect children following extreme weather events [11]. Together, these mechanisms suggest that evidence from adult populations cannot be directly extrapolated to children, underscoring the need for child-specific evidence.

Furthermore, mental health problems arising during childhood can have consequences that extend well beyond the immediate aftermath of an extreme weather event. A substantial body of research on adverse childhood experiences (ACEs) has established a relationship between childhood adversity and negative outcomes across the life course, including impaired educational attainment [12], poorer physical and mental health [13], and lower economic productivity in adulthood [14]. Yet, extreme weather events are rarely considered within traditional ACEs frameworks, which have historically emphasised interpersonal and household-level adversity such as abuse, neglect, and family dysfunction, the acute trauma, loss, and disruption associated with extreme weather events plausibly constitute a distinct, and increasingly studied, pathway into childhood adversity [4, 15, 16]. Understanding the mental health burden of extreme weather events in children is therefore important not only for reducing immediate suffering to children's mental health, but also for protecting long-term health, development, and human capital across an increasingly climate-exposed generation [3].

Several reviews have examined the association between extreme weather events and child mental health [17–22]. However, these existing reviews have generally been restricted to specific geographical or economic regions [17, 22], focused on individual hazards such as droughts [18] or examined single mental health outcomes, most commonly post-traumatic stress disorder [19, 20]. Furthermore, some reviews have not applied systematic methods [21] or have been limited to particular study designs [19]. To our knowledge, no previous review has comprehensively synthesised evidence across all extreme weather events, the full spectrum of child mental health outcomes, and all world regions, nor has any conducted a global meta-analysis of prevalence estimates.

This systematic review and meta-analysis were designed to address these gaps, with three specific objectives. First, to synthesise the global evidence on the association between extreme weather events and mental health among children and identify key knowledge gaps in the existing literature. Second, to estimate the pooled prevalence of clinically

relevant mental health outcomes among children exposed to extreme weather events. Third, to examine sources of heterogeneity across studies, including extreme weather event type, national income, age, sex, and study sampling frame.

Methods

Registration and reporting

This systematic review and meta-analysis was prospectively registered in PROSPERO (CRD42024604257) [23]. Following pilot screening of potentially eligible studies, the protocol was amended once to refine the eligibility criteria and improve consistency in study selection. The review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [24]. The completed PRISMA checklist is provided in Table S5 in the supplementary material.

Eligibility criteria

Studies were eligible if they (1) included participants aged 18 years or younger, consistent with Article 1 of the United Nations Convention on the Rights of the Child, which defines a child as any person below 18 years [25]; (2) examined exposure to an extreme weather event, defined by the glossary for the IPCC Fifth Assessment Report, an event that is rare at a particular place and time of year [26]; and (3) reported clinically relevant mental health outcomes, defined as outcomes corresponding to a disorder listed in the Diagnostic and Statistical Manual of Mental Disorders, ascertained either as a clinical diagnosis or as the proportion of participants meeting the diagnostic criteria or a cut-off score for that disorder [27].

We retained studies whose upper age limit extended to 19 years provided the sample was otherwise composed of children and adolescents, operationalised as mean age plus one standard deviation not exceeding 18 years. Such samples arise from school-grade-based sampling frames, which enrol intact classes and therefore capture the minority of final-year students who have turned 19 by the time of assessment; their presence reflects the sampling unit rather than the population targeted. Applying a strict 18-year ceiling would have excluded these studies completely rather than at random, removing school-based samples specifically and thereby introducing bias into the pooled estimate.

Studies reporting only continuous symptom scores or measures of psychological distress without estimates of clinically significant mental health conditions were excluded — for

example, studies reporting only a mean score on a depression or anxiety symptom scale without applying a diagnostic cut-off or reporting the proportion of participants meeting clinical criteria. Studies were included, by contrast, if continuous scores were dichotomised using a cut-off to estimate the proportion of participants with clinically significant symptoms. Studies focusing exclusively on personality traits or other non-clinical psychological characteristics — such as resilience, coping style, temperament, or general psychological distress indices not linked to a specific diagnostic category — were also excluded. We also excluded studies of man-made disasters (e.g., terrorism, industrial accidents, armed conflict) or tectonic events (e.g., earthquakes), studies examining psychiatric comorbidity only, intervention studies, validation studies of screening instruments, reviews, editorials, conference abstracts, and other non-peer-reviewed publications.

Search strategy and study selection

PubMed, PsycINFO and Web of Science were searched from database inception to 23.10.2024. Search strategies combined terms relating to (1) extreme weather events, (2) mental health outcomes and (3) paediatric populations using a validated search filter [28]. Full search strategies for each database are provided in Tables S2-S4 in the supplementary material. Reference lists of included studies and relevant reviews were screened manually to identify additional eligible studies.

Titles and abstracts were double-screened by rotating pairs of two investigators (TD, LB, CR, FS and MJ) against the inclusion criteria using Rayyan in blinded mode [29]. Full-text articles were assessed independently by three investigators (BB, CR, FS) against the inclusion criteria, with disagreements resolved through discussion with a third reviewer (JS and MJ).

Data extraction

Data were extracted by one investigator (BB) using a standardized extraction form, and all extracted data were independently checked against the source publications by a second investigator (FS). Discrepancies identified during validation were resolved through discussion between the two investigators. Extracted information included study characteristics (author, publication year, country, extreme weather event type, extreme weather event year, study design, sampling frame, participant age, sex distribution and sample size), outcome characteristics (mental health outcome, assessment instrument,

time since extreme weather event, number of cases and prevalence), and subgroup data by age, sex and longitudinal assessment where available. The data extraction form was piloted on 10% of included studies before full extraction. Discrepancies were resolved through discussion with a third investigator (MJ). Countries were classified according to World Bank region and World Bank income group at the time of the extreme weather event exposure. Studies were grouped by extreme weather event type.

Risk of bias assessment

Risk of bias was assessed using an adapted version of the Office of Health Assessment and Translation (OHAT) Risk of Bias Rating Tool [30]. OHAT was selected because, unlike risk-of-bias tools designed primarily for experimental designs such as randomised controlled trials, it does not penalise studies for lacking design features that are inapplicable to observational research (e.g., randomisation or blinding). This makes it better suited to the observational study designs in this literature and consistent with its use in other systematic reviews in this field [31]. Five domains were evaluated: outcome assessment, exposure assessment, comparator selection (if applicable), attrition before sampling and missing outcome data after sampling. Each domain was rated as definitely low (++), probably low (+), probably high/not reported (-) or definitely high risk (--) of bias. The assessment tool was piloted independently by two investigators (FS and MJ) on 10% of included studies before full assessment. Disagreements were resolved through discussion. Individual study risk of bias assessments are presented in Table S1 in the supplementary material.

Statistical analysis

All statistical analyses were conducted in R (Version 4.6.1) using the *metafor* package for pooling prevalence estimates, meta-analytic modelling, and the *clubSandwich* package for cluster-robust variance estimation [32, 33]. Data were imported directly from the extraction spreadsheet using the *readxl* package and analysed using the *dplyr* package [34].

Meta-analysis

Outcomes reported by more than three studies were quantitatively synthesised via meta-analysis; outcomes reported by fewer studies (e.g., separation anxiety disorder, attention-

deficit/hyperactivity disorder (ADHD), suicidal thinking) were not included in the meta-analysis, given the instability of pooled estimates based on very few studies.

Several sources of statistical dependence were present among the prevalence estimates. First, several studies reported prevalence estimates at multiple post-disaster assessment time points, meaning more than one estimate could originate from the same underlying sample. Second, four sets of studies examined the same extreme weather event and/or geographic area using different samples — for example, two studies by Kar and colleagues, and three studies examining the 1998 Hunan flood, each reported on distinct samples drawn from the same disaster and setting. Although these studies did not share individual participants, their prevalence estimates may still be correlated due to shared contextual factors, such as disaster severity and regional recovery conditions, and were therefore grouped into clusters and treated as correlated for the purposes of this analysis. Each cluster accordingly comprises either a single study, where no other study examined the same event or geography, or — in these four exceptions — two to three related studies. To account for dependence, pooled prevalence estimates were obtained using robust variance estimation (RVE), specified as a three-level random-effects model in which individual prevalence estimates are nested within studies, which are in turn nested within clusters [35, 36]. The model was specified as:

$$y_{ijk} = \theta + u_k + v_{jk} + e_{ijk} \quad (1),$$

where y_{ijk} denotes the Freeman-Tukey double-arcsine transformed prevalence estimate i in study j, within cluster k; θ is the pooled prevalence on the transformed scale, back-transformed to the original percentage scale as described above; u_k is the random effect of cluster k, representing variance between clusters; v_{jk} is the random effect of study j nested within cluster k, representing variance between studies within the same cluster; and e_{ijk} is the sampling error of prevalence estimates i in study j in cluster k.

Cluster-robust standard errors and confidence intervals were then obtained using the R2 small-sample correction, with degrees of freedom estimated via a Satterthwaite approximation, clustering at the level of k, to guard against possible misspecification of this variance structure. Studies reporting on the identical underlying sample rather than a distinct but related one were excluded entirely from the meta-analysis rather than clustered, as robust variance estimation is not appropriate for genuinely duplicated data [36]. Separate models were estimated for each outcome (PTSD, depression, and anxiety).

Between-study heterogeneity was quantified using an approximate I^2 statistic, representing the proportion of total variability attributable to true heterogeneity rather than sampling error [36].

Meta-regression

To explore sources of heterogeneity, univariable meta-regressions — testing one moderator at a time — were conducted for PTSD and depression, using five moderators: extreme weather event type (flood, storm, wildfire), national income (high vs. low- and middle-income countries (LMIC), using World Bank income group classification contemporaneous to each study's extreme weather event year), age band (<12 vs. 12–18 years), sex, and sample frame (population-based probability/convenience, school-based census/probability/convenience). Meta-regression was not conducted for anxiety outcomes due to insufficient studies. Each meta-regression was fitted as a three-level random-effects model with a single categorical moderator entered as a predictor, using the same cluster structure described above; differences between moderator categories were tested using a cluster-robust Wald test (CR2 correction, Satterthwaite-corrected degrees of freedom), rather than a conventional chi-square test, consistent with the robust variance estimation approach used for the primary pooled estimates.

For the subset of studies reporting prevalence separately by sex, a female-minus-male prevalence difference was calculated within each study and pooled across studies using the same three-level random-effects model with CR2 cluster-robust correction described above. This analysis was only feasible for PTSD, as it was the only outcome with a sufficient number of studies reporting sex-disaggregated prevalence; depression and anxiety, each had none or too few studies reporting sex-disaggregated prevalence data to support a meaningful pooled comparison.

Sensitivity analyses

Three sensitivity analyses were conducted for PTSD and two for depression: leave-one-cluster-out analyses, exclusion of studies at high risk of bias, and exclusion of studies with sample sizes $\leq$ 100 participants. Leave-one-cluster-out analyses were conducted by sequentially excluding each cluster of statistically dependent effect sizes and re-estimating the pooled prevalence to assess whether the overall estimate was disproportionately influenced by any single cluster. The sample size threshold of $\leq$ 100 participants was chosen arbitrarily, as only one included study had a sample size below

30 participants—the conventional minimum often cited in relation to the central limit theorem. Generalised anxiety disorder was not included in these analyses because the small number of available studies ($k = 4$) precluded reliable assessment of the sensitivity analyses.

Publication bias

Publication bias occurs when studies with statistically significant results are more likely to be published than those without. This mechanism does not apply to studies reporting prevalence or proportions of an outcome in a sample, since such estimates are not tied to a test of statistical significance [37]. Therefore, publication bias was not assessed.

Use of artificial intelligence

Artificial intelligence (ChatGPT (GPT-5.6 Sol) and Claude (Sonnet 5)) was used in the proofreading of the manuscript.

Results

Study selection

Figure 1 displays the PRISMA study selection flowchart. A total of 15,074 records were identified through database searches (PubMed: n=3,912; Web of Science: n=5,588; PsycINFO: n=5,574). After removal of 3,553 duplicate records, 11,521 records were screened by title and abstract, of which 11,083 were excluded. Full-text reports were sought for the remaining 438 records; seven could not be retrieved after authors were contacted. An additional nine records were identified through hand-searching. In total, 440 reports were assessed for eligibility, of which 398 were excluded for the following reasons: ineligible exposure (n=47), ineligible outcome (n=132), ineligible language (n=12), ineligible population (n=66), ineligible publication type (n=37), ineligible study design (n=39), and other reasons (n=65). 42 studies met eligibility criteria and were included in the systematic review, of which 36 studies and 64 effect sizes were included in the meta-analysis. The remaining six studies were excluded from the meta-analysis: three reported on the same samples with an already-included study, and three could not be attributed to a single extreme weather event due to multiple or dual extreme weather event exposures within the same study sample.

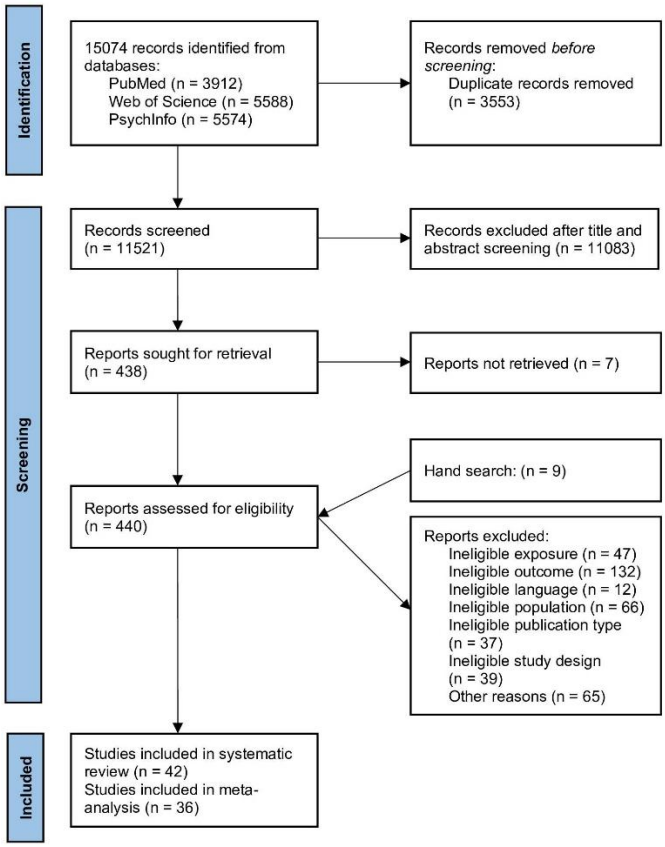


Figure 1 PRISMA Flowchart of study inclusion [24].

Study characteristics

The 42 included studies were conducted across twelve countries: the United States (n=18), China (n=9), Puerto Rico (n=3), India (n=3), Pakistan (n=2), Namibia (n=1), Nicaragua (n=1), the U.S. Virgin Islands (n=1), Haiti (n=1), Australia (n=1), Greece (n=1), and Canada (n=1), spanning six World Bank regions: North America (n=19), East Asia and the Pacific (n=10), Latin America and the Caribbean (n=6), South Asia (n=5), Sub-Saharan Africa (n=1) and Europe and Central Asia (n=1), see Figure 2. No study was conducted in the Middle East and North Africa. Together, the 42 included studies comprised 140,139 children between 3 and 19 years of age; the 36 studies retained for meta-analysis comprised 136,887 children. Studies examined extreme weather events occurring between 1982 and 2022 and three extreme weather event types: storms (n=28, comprising hurricanes/cyclones (n=22) and tornadoes (n=6)), floods (n=10), and wildfires (n=4). Most studies used a cross-sectional design (n=32), with the remainder based on longitudinal data (n=10). School-based samples, including school-based convenience samples (n=19), school-based census samples (n=6), and school-based

probability samples (n=2), were most common, with 27 studies using this sampling frame. Population-based samples, including population-based probability samples (n=8) and population-based convenience samples (n=5), were used in 13 studies. The single pre-school convenience sample and single purposive convenience sample were excluded from this comparison. Only one study by Felix and colleagues employed a design with an unexposed comparator group; a second study by Felton and colleagues assessed the same population before and after the extreme weather event [38, 39]. Across all 42 studies, including those not included in the meta-analysis, the most commonly assessed outcomes were PTSD (n=38), depression (n=18), and generalized anxiety (n=6). A range of other mental health outcomes were also examined, including separation anxiety disorder, ADHD, and suicidal thinking, none of which were included in the meta-analysis due to too few contributing studies. See Table 1 for the study characteristics of each included study.

Using each study's overall average risk of bias score, rounded to the nearest whole-number rating (1=++, 2=+, 3=−, 4=−−): 7.1% (n=3) were definitely low risk of bias (++), 66.7% (n=28) were probably low risk of bias (+), and 26.2% (n=11) were probably high risk of bias or not reported (−), see Table S1 in the supplementary materials.

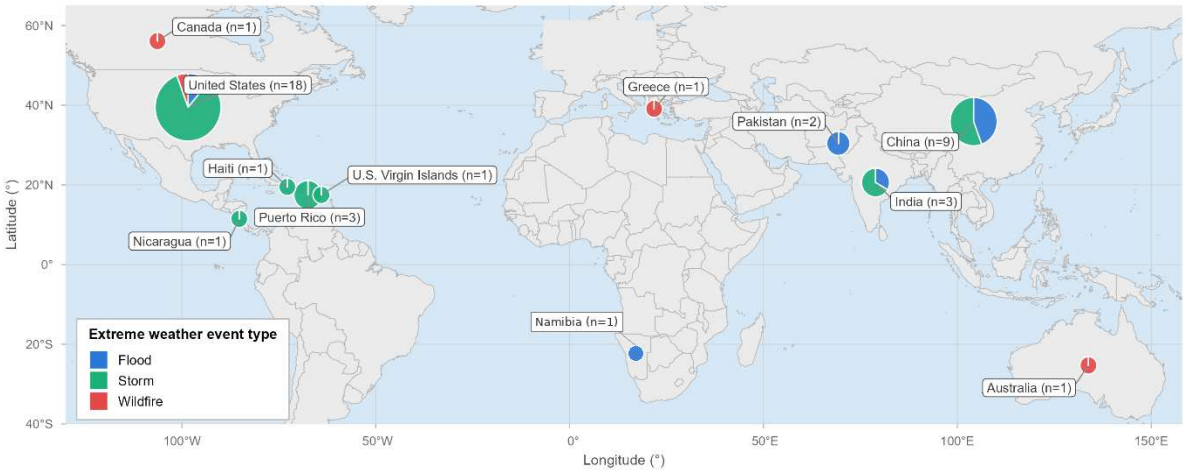


Figure 2 Number of included studies by country and extreme weather event type.

Meta-analysis and meta-regression

As shown in Figure 3, the pooled prevalence, obtained using robust variance estimation, was 17.6% (95% CI 11.2–24.9%, degrees of freedom (df)=23.1) for PTSD (n=32 studies, N=134,456, k=40 prevalence estimates), 20.2% (95% CI 9.5–33.7%, df=14.0) for depression (n=16 studies, N=10,431, k=20 prevalence estimates), and 8.0% (95% CI 0.0–33.6%, df=3.0) for generalized anxiety (n=4 studies, N=4,385, k=4 prevalence estimates). For generalized anxiety the denominator degrees of freedom were very low (df=3.0); therefore, this result should not be interpreted as a robust finding. Heterogeneity was substantial across all three outcomes (I^2=99.7% for PTSD, 99.3% for depression, 99.1% for generalized anxiety).

For PTSD, meta-regression by extreme weather event type did not reach statistical significance (flood 19.5%, storm 15.7%, wildfire 25.6%, F(2,4.7)=0.61, p=0.580). Age band showed a nominally significant association (<12 years 9.2% vs. 12–18 years 21.0%, F(1,1.7)=39.00, p=0.038), but like the anxiety prevalence result the denominator degrees of freedom were very low (df=1.7), driven by a single small cluster spanning both age categories with divergent prevalence estimates. Hence, this result should not be interpreted as a robust finding. National income was a significant moderator: high-income countries showed lower PTSD prevalence than LMICs (10.9% vs. 25.5%, F(1,22.0)=5.56, p=0.028). Sample frame was also a significant moderator: population-based samples showed markedly lower prevalence (5.0%) than school-based samples (23.6%, F(1,7.9)=22.30, p=0.002). Sex-disaggregated prevalence estimates, pooled separately using the same robust variance estimation as the primary analysis, were 13.2% (95% CI 6.4–21.8%) for females and 9.9% (95% CI 3.5–18.9%) for males. Within studies reporting sex specific prevalence, girls showed significantly higher PTSD prevalence than boys, with a pooled difference of 2.22 percentage points (95% CI 0.49–3.95, df=5.8, p=0.020).

For depression, age band (<12 years 10.6% vs. 12–18 years 30.4%, F(1,12.7)=4.18, p=0.062) and sampling frame (population-based 6.3% vs. school-based 22.1%, F(1,5.5)=4.97, p=0.071) were marginally significant at 10% significance level. Extreme weather event type (flood 5.8%, storm 24.6%, wildfire 18.3%, F(2,1.8)=0.83, p=0.558), and national income (high-income 12.8% vs. LMIC 38.6%, F(1,8.0)=2.82, p=0.132)

showed no indication of a statistically significant effect. The results of the meta-regression analyses are presented in Table 2.

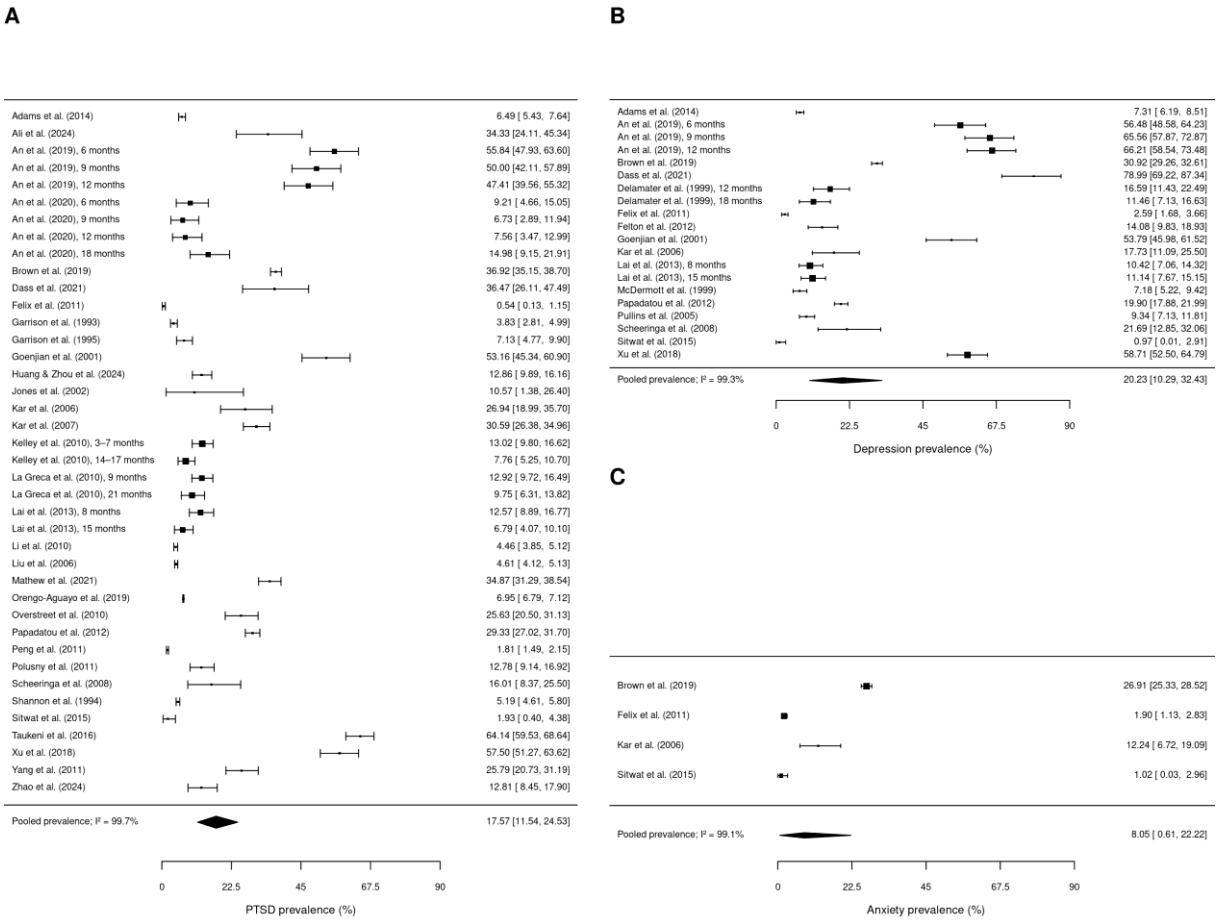


Figure 3 Forest plots of pooled child mental health prevalence following extreme weather events, by outcome. Panels show the prevalence of (A) PTSD, (B) depression, and (C) generalized anxiety among children exposed to extreme weather events. For each outcome, squares indicate the prevalence estimate reported by an individual study (or, for studies with multiple post-event assessments, a single time point within that study), with horizontal lines showing the 95% confidence interval and square size reflecting the study's relative weight in the pooled estimate. Studies contributing more than one timepoint are ordered earliest-to-latest and labelled with the corresponding follow-up interval; studies contributing a single timepoint are labelled with author and year only. The diamond at the bottom of each panel shows the pooled prevalence from a three-level random-effects model, with 95% confidence intervals obtained using cluster-robust variance estimation. All prevalence estimates were computed on the Freeman-Tukey double-arcsine transformed scale and back-transformed for presentation. The x-axis (prevalence, %) is held on the same 0–90% scale across all three panels.

[PLACEHOLDER: TABLE 1]

[PLACEHOLDER: TABLE 2]

Sensitivity analyses

Leave-one-cluster-out analyses indicated that no single cluster substantially influenced the pooled PTSD estimate (range across all 25 clusters: 16.1–19.3%, df=20.5–23.0), including when the largest cluster was removed. The same analysis for depression showed a similarly limited influence of any single cluster (range across all 15 clusters: 16.8–22.3%, df=13.0). Excluding high-risk-of-bias studies had minimal impact on the PTSD estimate (17.3% [95% CI 10.5–25.2%, df=21.2]; n=30 studies; k=39 prevalence estimates). High-risk-of-bias exclusion was not performed for depression, as only one included study for this outcome was rated at high risk of bias, making such an exclusion uninformative. Excluding studies with fewer than 100 participants produced a small reduction for PTSD (16.8% [95% CI 10.0–24.9%, df=20.3]; n=28 studies; k=37 prevalence estimates) and a larger but moderate reduction for depression (16.5% [95% CI 7.5–28.2%, df=12.0]; n=14 studies; k=18 prevalence estimates), the latter warranting some caution when interpreting the depression estimate's robustness to sample size. Due to the small number of contributing studies, no sensitivity analyses were performed for the generalized anxiety outcome. See Figures S1–S5 in the supplementary material for the results of the sensitivity analyses.

Discussion

This systematic review and meta-analysis provide the first global synthesis of mental health outcomes in children exposed to extreme weather events. The pooled prevalence was 17.6% (95% CI 11.2–24.9%, df=23.1) for PTSD and 20.2% (95% CI 9.5–33.7%, df=14.0) for depression, and the pooled within-study difference between girls and boys in PTSD prevalence was 2.22 percentage points (95% CI 0.49–3.95, df=5.8, p=0.020), indicating significantly higher prevalence among girls. Sampling frame and national income significantly explained PTSD heterogeneity: population-based and high-income countries showed markedly lower prevalence than school-based and LMICs. Heterogeneity was high throughout ($I^2 > 99\%$ for all three outcomes, see Figure 3), suggesting that pooled values summarise a widely dispersed literature rather than a stable underlying rate, which is common for prevalence meta-analyses of mental health outcomes [40, 41]. The PTSD and depression estimates were nonetheless robust to sensitivity analyses. The estimate for generalized anxiety (8.0%, 95% CI 0.0–33.6%) was derived from only four studies and is too imprecise to support any inference.

Our first research objective was to synthesise the global evidence and identify key knowledge gaps in the existing literature on extreme weather events and child mental health. Two absences in the evidence base are as informative as the estimates themselves. First, despite pre-specifying heat and drought as eligible exposures, we identified no study meeting our outcome criteria for either. This is a profound gap since an estimated 1.2 billion children worldwide are exposed to extreme heat [2, 3]. Second, no study was conducted in the Middle East and North Africa and only one study in Sub-Saharan Africa, regions with among the highest child climate risk globally [2, 3]. These striking mismatches between where children are most exposed to climate hazards and where evidence is generated highlight a critical imbalance in the current research landscape and limit our ability to inform equitable, evidence-based adaptation and mental health interventions in the settings where they are likely to be needed most.

Our second research objective was to estimate the pooled prevalence of clinically relevant mental health outcomes among children exposed to extreme weather events. Placed against general-population estimates, the pooled prevalence of 17.6% (95% CI 11.2–24.9%, df=23.1) for PTSD and of 20.2% (95% CI 9.5–33.7%, df=14.0) for depression appear elevated. A meta-analysis of the worldwide prevalence of mental disorders in children and adolescents reported 13.4% (95% CI 11.3–15.9) for any mental disorder, 2.6% (95% CI 1.7–3.9) for any depressive disorder and 6.5% (95% CI 4.7–9.1) for any anxiety disorder [41]. However, direct comparison with our pooled estimates is not straightforward because these general-population estimates from the referenced meta-analysis were derived from diagnostic interviews in population probability samples [41], whereas our estimates were predominantly based on screening instruments administered in school-based samples. A more comparable benchmark is therefore provided by the 13 population-based studies included in our meta-analysis. Within this subgroup, the pooled prevalence of depression was 6.3%, approximately 2.4 times the general-population estimate of 2.6%, rather than the nearly eightfold difference suggested by comparison with our overall pooled estimate [41]. The remaining difference may partly reflect an effect of exposure, but also the predominance of adolescent samples, in whom depression is more common than across the full childhood age range.

The comparison with trauma-exposed populations is similarly contingent. A recent three-level meta-analysis estimated PTSD prevalence in trauma-exposed children and adolescents at 20.3% (95% CI 14.9–26.2%) when PTSD was assessed according to the

Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV), criteria, compared with 12.0% (95% CI 3.7–24.2%) under the revised fifth edition (DSM-5) criteria [42]. Our pooled PTSD estimate of 17.6% falls between these two values, potentially reflecting differences in the diagnostic criteria applied across studies, including the use of DSM-IV- and DSM-5-based criteria. Taken together, these estimates suggest that PTSD prevalence following extreme weather events is broadly comparable to that reported among trauma-exposed children more generally. A key distinction, however, lies in the large and growing population exposed to extreme weather events [2, 3]. This convergence carries a further implication for how extreme weather exposure should be conceptualised. Extreme weather events are rarely considered within traditional ACEs frameworks, which have historically centred on interpersonal and household-level adversity such as violence, abuse, and family dysfunction; in this sense, extreme weather exposure constitutes a distinct pathway into childhood adversity [4, 15, 16]. However, the psychological harm we observed falls within the range reported for trauma-exposed children more broadly. This suggests extreme weather events differ from traditional ACEs in their source, not in how severely they affect children. Our finding argues for integrating extreme weather events into existing ACE-informed frameworks for screening, clinical response, and policy prioritisation - a case strengthened further by the growing scale of the child population exposed.

Lastly, we set out to examine sources of heterogeneity across studies, including extreme weather event type, national income, age, sex, and study sampling frame. No differences emerged by event type (flood 19.5%, storm 15.7%, wildfire 25.6%, $F(2,4.7)=0.61$, $p=0.580$), suggesting that prevalence is not strongly hazard-specific among the rapid-onset events represented in this study. This finding should not be extended to slow-onset or recurrent hazards such as drought and extreme heat, for which no eligible studies were identified. Unlike floods, storms and wildfires, which are typically discrete, time-limited exposures, drought and extreme heat may act as prolonged or repeated stressors. They often operate through indirect pathways such as livelihood loss or food insecurity and may therefore produce a different profile of mental health outcomes than the predominance of PTSD and depression observed in this review.

The dominant role of sampling frame as a source of heterogeneity warrants emphasis. Population-based samples yielded a PTSD prevalence of 5.0%, compared with 23.6% in school-based samples ($F(1,7.9)=22.20$, $p=0.002$); the same pattern, though not

statistically significant, was evident for depression (6.3% versus 22.1%, $F(1,5.5)=4.97$, $p=0.071$). School-based studies are frequently conducted in schools selected precisely because their communities were severely affected, whereas population-based probability samples capture a wider gradient of exposure intensity. Because 27 of the 42 included studies used a school-based sampling frame, our pooled estimates are weighted toward the higher end of this spectrum and are best interpreted as an upper bound.

Additionally, girls showed significantly higher PTSD prevalence than boys. Although 2.22 percentage points higher prevalence in girls is modest, the direction is consistent with the female preponderance reported in trauma-exposed paediatric samples more broadly [42]. Two considerations extend this finding. First, sex-disaggregated prevalence was reported by only twelve of the studies contributing PTSD estimates, so the pooled difference rests on a subset that may not be representative of the wider evidence base identified in this review; routine sex-disaggregated reporting would be a low-effort improvement to this literature. Second, the difference observed here is plausibly conservative. Post-disaster environments amplify gendered risks, for instance through displacement into insecure shelter, early marriage, and elevated exposure to violence [43–45]. These pathways operate most strongly where protective infrastructure is weakest, precisely the settings from which our evidence base is almost entirely absent [46].

The age pattern in PTSD and depression is developmentally coherent, though not robust given the very low degrees of freedom for both outcomes. Overall, the gradient was steeper for depression than for PTSD. The prevalence for depression in adolescents was roughly threefold that in children under 12, and approximately twofold for PTSD. This fits the sharp rise in depressive disorder incidence across adolescence in general populations [47]. Yet, this gradient should not be read as reduced susceptibility in younger children. A meta-analysis of 18 studies in trauma-exposed preschool children found a pooled PTSD prevalence of 21.5% (95% CI 13.8–30.4%) and argued that lower estimates in younger children may be partly artefactual because adult-oriented diagnostic criteria can underidentify PTSD in young children [48]. Specifically, in the subset of those studies applying both algorithms, adult DSM-IV criteria yielded a 4.9% (95% CI 2.5–8.0%) prevalence and developmentally appropriate criteria a 19.9% (95% CI 12.1–29.0%) prevalence in the same samples [48]. Hence, valid assessment of PTSD in preschool and early school-age children requires developmentally modified criteria and caregiver-report interviews [48].

The income difference ran in the same direction for both outcomes, reaching statistical significance for PTSD though not for depression, where prevalence was 12.8% in high-income countries compared to 38.6% in LMICs ($F(1,8.0)=2.82$, $p=0.132$). The pattern suggests differential vulnerability rather than differential exposure alone. Lower-income settings combine weaker protective infrastructure and the largest deficits in child mental health service provision [49]. A comparable event plausibly produces both greater material loss and less mitigation of its psychological consequences.

Several limitations apply to this study. First, heterogeneity was high across all outcomes ($I^2 > 99\%$), driven at least in part by the sampling-frame result: a small number of very large population-based surveys report prevalence of only a few percent, while numerous smaller school-based studies conducted in heavily affected communities report several-fold higher values. As a result, the pooled estimates should be read as summaries of a highly variable literature rather than as precise population parameters. Further, only one study included an unexposed comparator group and one assessed the same population before and after the event, so our estimates describe prevalence among exposed children and cannot isolate the fraction attributable to exposure itself [38, 39]. Thirdly, we restricted eligibility to English-language publications, which may have compounded the geographical gaps described above. A related concern applies to measurement: most of the applied screening instruments were originally developed and validated in high-income, English-language settings without reporting validation in the specific linguistic or cultural context of use. Where cross-cultural validation is not established, symptom endorsement may not carry the same clinical meaning as in the populations these instruments were originally developed for. Additionally, our requirement for clinically relevant outcomes, while necessary for prevalence estimation, excluded studies reporting only continuous symptom scores as well as qualitative work not reporting prevalence. Relatedly, and by design, this review quantifies the prevalence in exposed children without explaining it. We did not synthesise the individual-level factors — exposure severity, bereavement, displacement, property loss, prior adversity, caregiver mental health and social support — that the included studies frequently examined but rarely reported as stratified prevalence. Which exposed children are most affected, and through which pathways, therefore remains open, and cannot be answered based on prevalence data alone. Finally, the predominance of cross-sectional designs with widely varying time

intervals since extreme weather event exposure means the pooled figures blend acute and later phases.

Conclusions

Priorities for future research follow directly from this review. Studies are needed in Sub-Saharan Africa, the Middle East and North Africa, and other high-risk, under-represented settings, for all extreme weather events, but particularly heat and drought, for which no clinical-outcome evidence currently exists. Longitudinal designs with unexposed comparators or pre-exposure baselines are essential to move from prevalence toward attributable burden. Because extreme weather events can rarely be anticipated, pre-exposure data will most realistically come from cohort studies and routine child health or school surveys already in place when an event occurs, and from prospective cohorts established in hazard-prone regions where recurrent extreme weather events are likely. Greater coverage of varying set of mental health outcomes— extending beyond PTSD to anxiety and suicidality — together with routine reporting of prevalence stratified by sex and age and consistent reporting of time since event would reduce the methodological heterogeneity that currently dominates this literature and allow the determinants of risk to be examined directly. As compound and cascading events become more frequent, studies designed to isolate their effects from those of single-event exposure will become increasingly important [50].

These findings and suggestions for future research arrive at a moment when children are visible in climate adaptation policy but their mental health is not [51, 52]. A recent analysis of national adaptation policies from 198 countries found that 94% (n=185) identify children, adolescents or young people as groups disproportionately affected by climate change, yet only 6% set out any age-specific health strategy — nine policies for children under five and two for children under 18 years [51]. Mental health was among the most under-represented conditions overall, and least visible in sub-Saharan Africa, the region that also contributed only one eligible study to this review [51]. An analysis of child health prioritisation across 160 national adaptation policies reached the same conclusion in starker terms: no country addressed children's direct needs in the domain of mental health, although some policies included measures of indirect benefit [52]. Without a stronger and more geographically representative evidence base, climate adaptation efforts will continue to overlook one of the most consequential yet under-recognised

dimensions of climate change for children: their mental health. Ensuring that children's mental health is embedded within both research and adaptation policy should therefore be regarded as an urgent global public health priority.

List of abbreviations

ACEs: Adverse childhood experiences
ADHD: Attention-deficit/hyperactivity disorder
CI: Confidence interval
df: Degrees of freedom
DSM: Diagnostic and Statistical Manual of Mental Disorders
DSM-IV: Diagnostic and Statistical Manual of Mental Disorders, fourth edition
DSM-5: Diagnostic and Statistical Manual of Mental Disorders, fifth edition
IPCC: Intergovernmental Panel on Climate Change
LMICs: Low- and middle-income countries
OHAT: Office of Health Assessment and Translation
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PROSPERO: International Prospective Register of Systematic Reviews
PTSD: Post-traumatic stress disorder
RVE: Robust variance estimation

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

This article is based on findings in the published literature and did not involve analysis of newly generated data. The datasets and R code generated during the current study are available in the Open Science Framework repository, https://osf.io/t4vf8/overview?view_only=7e31ebfbeb674be0a5f3391368fe6afe

Competing interests

The authors declare that they have no competing interests.

Funding

This work was supported through internal funding from EXPOHEALTH (EXPOsure-related HEALTH effects), a research funding scheme of the University Medical Centre Mainz for early-career researchers, with FS and MJ as principal investigators. The funder had no role in the design of the study, data collection, analysis, interpretation, or writing of the manuscript.

Authors' contributions

FS conceptualised the study, conducted the systematic search, screening of title and abstracts, screening of full-text, data extraction, risk of bias assessment, statistical analysis, and drafted the manuscript. MJ contributed to conceptualisation, study screening, risk-of-bias assessment, and statistical analysis. BB contributed to data extraction and full-text screening. CR contributed to title and abstract screening and full-text screening. PD provided funding. JS contributed to conceptualisation, resolved screening and extraction discrepancies, and supervised the project. All authors critically reviewed and approved the final manuscript.

Acknowledgements

We thank Theresa Dicks and Leonhardt Berger (Institute for Occupational, Social and Environmental Medicine, University Medical Centre Mainz, Germany) for their assistance with the title and abstract screening in Rayyan.

We thank Lorena Cascant Ortolano (Johannes Gutenberg University Mainz) for a consultation on the development of a search strategy.

We thank EXPOHEALTH (EXPOsure-related HEALTH effects), a research funding scheme of the University Medical Centre Mainz for supporting this project.

Authors' information (optional)

Not applicable.

List of Figures

Figure 1: PRISMA flowchart.

Figure 2: Map of included studies by country and extreme weather event type.

Figure 3: Forest plots of pooled child mental health prevalence following extreme weather event exposure, by outcome.

List of Tables

Table 1: Study characteristics.

Table 2: Univariable meta-regression results for PTSD and depression.

List of Supplementary Material

Supplementary material 1

Format: .docx

Title: supplementary_material

Description: Table S1: Risk of bias assessments for each included study using the OHAT tool; Tables S2–S4: full search strategies for PubMed, PsycINFO and Web of Science; Table S5: completed PRISMA checklist; Figures S1–S5, results of the sensitivity analyses.

Tables

Table 1 Study characteristics.

No.	Author (year)	Country	Year of event	% female[1]	Age range in years (M, SD)	Study design[2]	Sample[3]	Sample size	Time since event	Instrument[4]	Mental disorder(s)[5]	Included in meta-analysis
Flood												
1	Earls et al. (1988) [53]	United States	1982, 1983	50%	6–17 years	C-S	Population	32	~ 1 year	DICA; DICA (parent-version)	ADD; ODD; CD; MAD; Adj. Reaction with Depressed Mood; SAD; Overanxious Disorder	No
2	Liu et al. (2006) [54]	China	1998–1999	53%	7 - 18 years	C-S	Population, random	6917	1–2 years	DSM-4 questionnaire	PTSD	Yes
3	Li et al. (2010) [7]	China	1998	47.7%	7–15 years	C-S	Population, random	4327	18 months	DSM-4 questionnaire	PTSD	Yes
4	Peng et al. (2011) [55]	China	1998	47%	7–15 years	C-S	Population, random	7038	~2 years	DSM-4 questionnaire	PTSD	Yes
5	Taukeni et al. (2016) [56]	Namibia	2011	63.2%	8–18 years	C-S	School	429	2 years	CTSQ	PTSD	Yes
6	Felton et al. (2012) [39]	United States	2010	56%	10–15 years (mean 11.27, SD 1.24)	L, with comparator	School	T1: 239, T2: 227	T1: 6 months before flood; T2: 6 months after flood	CDI	Depression	Yes
7	Sitwat et al. (2015) [57]	Pakistan	2010	100%	13–19 years (mean 15.8, SD 2.1)	C-S	Population	205	11 months	DSM-4-TR interview	PTSD; Depression; Anxiety	Yes

[1] *For longitudinal studies where percentages of females are given for each timepoint, the % female column lists them in increasing order (separated by /).*
[2] *Abbreviations: C-S=cross-sectional; L=longitudinal.*
[3] *Abbreviations: School=school-based sample; population=population-based sample.*
[4] *See notes.*
[5] *See notes.*

No.	Author (year)	Country	Year of event	% female[1]	Age range in years (M, SD)	Study design[2]	Sample[3]	Sample size	Time since event	Instrument[4]	Mental disorder(s)[5]	Included in meta-analysis
8	Mathew et al. (2021) [58]	India	2018	54%	Mean 16.03 years (SD 0.73)	C-S	School	670	8 months	TSQ	PTSD	Yes
9	Ali et al. (2024) [59]	Pakistan	2022	36.8%	8–16 years (mean 11.78, SD 1.94)	C-S	School	76	6 months	CRIES	PTSD	Yes
10	Zhao et al. (2024) [60]	China	2018	47.2%	14–17 years	C-S [6]	School	195	1 week	PCL-C	PTSD	Yes
Storm - Hurricane / Cyclone												
11	Garrison et al. (1993) [61]	United States	1989	52.5%	11–17 years	C-S	School	1264	1 year	DSM-3-R questionnaire	PTSD	Yes
12	Shannon et al. (1994) [62]	United States	1989	51%	9–19 years (mean 14.02, SD 2.41)	C-S	School	5687	3 months	FRI	PTSD	Yes
13	Garrison et al. (1995) [63]	United States	1992	52.8%	12–17 years (mean 14.5)	C-S	Population, random	400	6 months	Modified DIS (diagnosis based on DSM-3-R)	PTSD	Yes
14	Delamater et al. (1999) [64]	United States	1992	55%	3–5 years (mean: 3.45)	L	School	175	T1: 12 months; T2: 18 months	CPTSD-RI (diagnosis based on DSM-4)	PTSD	Yes
15	Goenjian et al. (2001) [65]	Nicaragua	1998	48.7%	12–17 years (mean 13.0, SD 0.31)	C-S	School	158	6 months	CPTSD-RI; DSRS	PTSD; Depression	Yes
16	Pullins et al. (2005) [66]	United States	1999	58%	5–19 years (mean 9.9, SD 3.0)	C-S	School	612	3-4 months	CDI-Short Form; CPTSD Interview	Depression	Yes
17	Kar et al. (2006) [67]	India	1999	55.6%	Mean 14.28 years, SD 0.73 years	C-S	School	108	14 months	MINI-KID (diagnosis based on DSM-4)	PTSD; Depression; Anxiety	Yes
18	Kar et al. (2007) [68]	India	1999	50.1%	7–17 years (mean 12.9, SD 1.83)	C-S	School	447	1 year	ICD-10 revision checklist	PTSD	Yes

[6] *Although originally a longitudinal study, prevalence data were reported only for the first assessment timepoint; this study is therefore classified as cross-sectional.*

No.	Author (year)	Country	Year of event	% female[1]	Age range in years (M, SD)	Study design[2]	Sample[3]	Sample size	Time since event	Instrument[4]	Mental disorder(s)[5]	Included in meta-analysis
19	La Greca et al. (2010) [9]	United States	2004	54%/53 %	7–11 years (T1: mean 8.74, SD 0.93; T2: Not reported)	L	School	T1: 384; T2: 245	T1: 9 months; T2: 21 months	LA PTSD-RI, child version (DSM-4)	PTSD	Yes
20	Rubens et al. (2013) [69]	Puerto Rico	1998	47.4%	11–18 years (mean 14.17, SD 1.97)	C-S	Population, random	905	12-27 months	DISC	PTSD; Depression; Anxiety	No
21	Felix et al. (2011) [38]	Puerto Rico	1998	48.9%/49.2%	4–17 years (T1: 4-10= 50.2 %, 11-17=49.8%; T2: 4-10= 42.9%, 11-17=57.1%)	L, with comparator	Population, random	T1: 1886; T2: 1788	T1: 18 months; T2: 30 months	DISC	PTSD; Depression; Anxiety, Dysthymia; Social phobia; SAD; Panic	Yes
22	Scheeringa et al. (2008) [70]	United States	2005	42.9%	3.1–6.8 years (mean 5.1)	C-S	Population	70	~ 6 months	PAPA	PTSD; Depression; ADHD; ODD; SAD	Yes
23	Scheeringa et al. (2015) [71]	United States	2005	43%	3-6 years (mean 5.1, SD 1.0)	C-S	Population	85	Not reported	PAPA	PTSD; Depression; Anxiety; ADHD; ODD	No
24	Kelley et al. (2010) [72]	United States	2005	Not reported	8–16 years (mean 12.0, SD 2.0)	L	School	381	T1: 3–7 months; T2: 14–17 months	UCLA PTSD-RI-Revised	PTSD	Yes
25	Overstreet et al. (2010) [73]	United States	2005	55%	Grades 8–11	C-S	School	261	18 months	LASC-Adolescents	PTSD	Yes
26	Salloum et al. (2011) [74]	United States	2008	42.6%	7–12 years (mean 9.48, SD 1.51)	C-S	School	122	10-19 days after Hurricane Gustav, 3 years after Hurricane Katrina	UCLA PTSD Index; MFQ-C	PTSD; Depression	No
27	Yang et al. (2011) [75]	China	2010	54.2%	12–15 years (mean 13.4, SD 1.0)	C-S	School	271	3 months	MINI-KID	PTSD	Yes
28	Lai et al. (2013) [76]	United States	2008	52%	7–11 years (mean 8.7, SD 1.0)	L	School	277	T1: 8 months; T2: 15 months	CDI; PTSD-RI-Revision1	PTSD; Depression	Yes

No.	Author (year)	Country	Year of event	% female[1]	Age range in years (M, SD)	Study design[2]	Sample[3]	Sample size	Time since event	Instrument[4]	Mental disorder(s)[5]	Included in meta-analysis
29	Orengo-Aguayo et al. (2019) [77]	Puerto Rico	2017	50.3%	Grades 3–12	C-S	School	96108	5-9 months	NCTSN Hurricane Tool	PTSD	Yes
30	Pittman et al. (2020) [78]	U.S. Virgin Islands	2017	56.5%	8–18 years (mean 11.59, SD 2.43)	C-S	School	108	3 months	UCLA PTSD-RI (DSM-5)	PTSD	No
31	Dass et al. (2021) [79]	Haiti	2016	63.6%	14–17 years (mean 14.99)	C-S	Other	77	Not reported	UCLA PTSD-RI (DSM-5); CES-DC	PTSD; Depression	Yes
32	Huang & Zhou et al. (2024) [80]	China	2019	55.9%	Grades 7–11 (mean 13.4, SD 1.2)	L	School	447	T1: 3 months; T2: 15 months	Weathers' PTSD Checklist	PTSD	Yes
Storm - Tornado												
33	Polusny et al. (2011) [81]	United States	1998	62%	12–19 years (mean 15.32, SD 1.78)	C-S	School	288	6-9 months	IES-R	PTSD	Yes
34	Adams et al. (2014) [82]	United States	2011	50.9%	12–17 years (mean 14.5, SD 1.7)	C-S	Population, random	2000	8.8 months (SD=2.6, range = 4.0–13.5)	NSA-PTSD; NSA-Dep	PTSD; Depression	Yes
35	Paul et al. (2015) [83]	United States	2011	50.9%	Mean 14.56 years (SD 1.75)	C-S	Population, random	2000	8.8 months (SD=2.59, range = 4.98–13.5)	NSA-PTSD; NSA-Dep	PTSD; Depression	No
36	Xu et al. (2018) [84]	China	2016	59.5%	Grades 7–9 (mean 14.0, SD 0.9)	C-S	School	247	3 months	CPSS; CES-DC	PTSD; Depression	Yes
37	An et al. (2019) [85]	China	2016	59.5%	mean 14.04 years, SD 0.93	L	School	154	T1: 6 months; T2: 9 months; T3: 12 months	CPSS; CES-DC	PTSD; Depression	Yes
38	An et al. (2020) [86]	China	2016	Not reported	12-19 years (mean 14.04, SD 0.93)	L	School	121	T1: 6 months; T2: 9 months; T3: 12 months; T4: 18 months	CPSS	PTSD	Yes
Wildfire												

No.	Author (year)	Country	Year of event	% female[1]	Age range in years (M, SD)	Study design[2]	Sample[3]	Sample size	Time since event	Instrument[4]	Mental disorder(s)[5]	Included in meta-analysis
39	McDermott et al. (1999) [87]	Australia	1994	54.6%	8–12 years (mean 10.1, SD 0.9)	C-S	School	601	6 months	Birleson Depression Scale	Depression	Yes
40	Jones et al. (2002) [88]	United States	1990	40.9%	7-12 years (mean 9.37, SD 1.62)	C-S	Population	22	6 weeks	DICA-R (PTSD module)	PTSD	Yes
41	Papadatou et al. (2012) [89]	Greece	2007	48.6%	12–17 years (mean 14.6, SD 1.6)	C-S	School	1468	6 months	CRIES; DSRS	PTSD; Depression	Yes
42	Brown et al. (2019) [90]	Canada	2016	48%	11–19 years (mean 14.32, SD 1.82)	C-S	School	2877	18 months	CPSS, HADS	PTSD; Depression; Anxiety; Suicidal thinking	Yes

***Notes**: **Abbreviations for instruments:** CDI=Children's Depression Inventory; CES-DC=Center for Epidemiologic Studies Depression Scale for Children; CPSS=Child PTSD Symptom Scale; CRIES=Child(ren's) Revised Impact of Events Scale; DICA=Diagnostic Interview for Children and Adolescents; DIS(C)=Diagnostic Interview Schedule (for Children); DSM=Diagnostic and Statistical Manual of Mental Disorders; DSRS=Depression Self-Rating Scale; HADS=Hospital Anxiety and Depression Scale; ICD=International Classification of Diseases; IES-R=Impact of Event Scale–Revised; MFQ-C=Mood and Feelings Questionnaire–Child; MINI-KID=Mini International Neuropsychiatric Interview for Children and Adolescents; NCTSN=National Child Traumatic Stress Network; NSA=National Survey of Adolescents; PAPA=Preschool Age Psychiatric Assessment; PCL(-C)=PTSD Checklist (for Civilians); PHQ=Patient Health Questionnaire; RCMAS=Revised Children's Manifest Anxiety Scale; RCMPS=Revised Civilian Mississippi PTSD Scale; TSQ=Trauma Screening Questionnaire; UCLA PTSD-RI=UCLA PTSD Reaction Index; CTSQ=Child Trauma Screening Questionnaire.; **Abbreviations for mental disorders:** ADD=attention-deficit disorder; CD=conduct disorder; MAD=major affective disorder; ODD=oppositional defiant disorder; PTSD=posttraumatic stress disorder; SAD=separation anxiety disorder.*

Table 2 Univariable meta-regression results for PTSD and depression.

	PTSD Prevalence [95% CI]	**Depression Prevalence [95% CI]**
Extreme weather event type	*F(2, 4.7) = 0.61, p = 0.580*	*F(2, 1.8) = 0.83, p = 0.558*
Flood	19.5% [1.5, 50.2]	5.8% [0.0, 100.0]
Storm	15.7% [8.8, 24.0]	24.6% [8.6, 45.3]
Wildfire	25.6% [1.8, 63.2]	18.3% [0.1, 55.2]
National income	*F(1, 22.0) = 5.56, p = 0.028**	*F(1, 8.0) = 2.82, p = 0.132*
High income country	10.9% [5.8, 17.2]	12.8% [7.5, 19.2]
Low- and middle-income country	25.5% [13.3, 40.0]	38.6% [3.0, 84.2]
Age band	*F(1, 1.7) = 39.00, p = 0.038**	*F(1, 12.7) = 4.18, p = 0.062*
<12 years	9.2% [4.6, 15.0]	10.6% [5.6, 16.9]
12–18 years	21.0% [13.9, 29.2]	30.4% [9.1, 57.4]
Sample frame	*F(1, 7.9) = 22.30, p = 0.002***	*F(1, 5.5) = 4.97, p = 0.071*
Population-based	5.0% [1.6, 9.8]	6.3% [0.0, 23.9]
School-based	23.6% [15.9, 32.2]	22.1% [10.8, 36.0]

** p < .05; ** p < .01*

References

1. Seneviratne, S.I., X. Zhang, M. Adnan, W. Badi, C. Dereczynski, A. Di Luca, S. Ghosh, I. Iskandar, J. Kossin, S. Lewis. Weather and Climate Extreme Events in a Changing Climate. In: 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, United Kingdom, and New York, NY, USA; 2021. p. 1513–1766. doi:10.1017/9781009157896.013.
2. United Nations Children's Fund. The Climate Crisis is a Child Rights Crisis: Introducing the Children's Climate Risk Index. New York; 2021.
3. United Nations Children's Fund. Children's Climate Risk Report 2026. Florence; 2026.
4. Thapa S, Giri S, Ross AG. Extreme weather and climate-related adverse childhood experiences are a humanitarian crisis during the 21st century. Commun Med (Lond). 2025;5:357. doi:10.1038/s43856-025-01089-x.
5. Suhr F, Steinert JI. Epidemiology of floods in sub-Saharan Africa: a systematic review of health outcomes. BMC Public Health. 2022;22:268. doi:10.1186/s12889-022-12584-4.
6. Cobham VE, McDermott B, Haslam D, Sanders MR. The Role of Parents, Parenting and the Family Environment in Children's Post-Disaster Mental Health. Curr Psychiatry Rep. 2016;18:53. doi:10.1007/s11920-016-0691-4.
7. Li X, Huang X, Tan H, Liu A, Zhou J, Yang T. A study on the relationship between posttraumatic stress disorder in flood victim parents and children in Hunan, China. Australian and New Zealand Journal of Psychiatry. 2010:543–50.
8. Granés L, Kusters MS, Ballester J, Essers E, Petricola S, López-Vicente M, et al. Exposure to Ambient Temperature and Functional Connectivity of Brain Resting-State Networks in Preadolescents. J Am Acad Child Adolesc Psychiatry. 2025;64:1317–28. doi:10.1016/j.jaac.2024.11.023.
9. La Greca AM, Silverman WK, Lai B, Jaccard J. Hurricane-related exposure experiences and stressors, other life events, and social support: concurrent and prospective impact on children's persistent posttraumatic stress symptoms. J Consult Clin Psychol. 2010;78:794–805. doi:10.1037/a0020775.
10. Lai BS, Osborne MC, Piscitello J, Self-Brown S, Kelley ML. The relationship between social support and posttraumatic stress symptoms among youth exposed to a natural disaster. Eur J Psychotraumatol. 2018;9:1450042. doi:10.1080/20008198.2018.1450042.
11. Ludwig-Walz H, Dannheim I, Pfadenhauer LM, Fegert JM, Bujard M. Anxiety increased among children and adolescents during pandemic-related school closures in Europe: a systematic review and meta-analysis. Child Adolesc Psychiatry Ment Health. 2023;17:74. doi:10.1186/s13034-023-00612-z.
12. Qu G, Shu L, Liu H, Ma S, Han T, Zhang H, et al. Association Between Adverse Childhood Experiences and Academic Performance Among Children and

Adolescents: A Global Meta-Analysis. Trauma Violence Abuse. 2024;25:3332–45. doi:10.1177/15248380241246758.
13. Hughes K, Bellis MA, Hardcastle KA, Sethi D, Butchart A, Mikton C, et al. The effect of multiple adverse childhood experiences on health: a systematic review and meta-analysis. Lancet Public Health. 2017;2:e356-e366. doi:10.1016/S2468-2667(17)30118-4.
14. Jang H, Kim J. Adverse childhood experiences and adult employment outcomes: Unpacking mechanisms across the life course. Soc Sci Med. 2025;384:118514. doi:10.1016/j.socscimed.2025.118514.
15. Karatekin C, Mason SM, Riegelman A, Bakker C, Hunt S, Gresham B, et al. Adverse childhood experiences: A scoping review of measures and methods. Children and Youth Services Review. 2022;136:106425. doi:10.1016/j.childyouth.2022.106425.
16. Sasaki N, Watanabe K, Kanamori Y, Tabuchi T, Fujiwara T, Nishi D. Effects of expanded adverse childhood experiences including school bullying, childhood poverty, and natural disasters on mental health in adulthood. Sci Rep. 2024;14:12015. doi:10.1038/s41598-024-62634-7.
17. Rother H-A, Hayward RA, Paulson JA, Etzel RA, Shelton M, Theron LC. Impact of extreme weather events on Sub-Saharan African child and adolescent mental health: The implications of a systematic review of sparse research findings☆. The Journal of Climate Change and Health. 2022;5:100087. doi:10.1016/j.joclim.2021.100087.
18. Algur KD, Patel SK, Chauhan S. The impact of drought on the health and livelihoods of women and children in India: A systematic review. Children and Youth Services Review. 2021;122:105909. doi:10.1016/j.childyouth.2020.105909.
19. Terasaka A, Tachibana Y, Okuyama M, Igarashi T. POST-TRAUMATIC STRESS DISORDER IN CHILDREN FOLLOWING NATURAL DISASTERS: A SYSTEMATIC REVIEW OF THE LONG-TERM FOLLOW-UP STUDIES. ijcyfs. 2015;6:111–33. doi:10.18357/ijcyfs.61201513481.
20. Lai BS, Auslander BA, Fitzpatrick SL, Podkowirow V. Disasters and Depressive Symptoms in Children: A Review. Child Youth Care Forum. 2014;43:489–504. doi:10.1007/s10566-014-9249-y.
21. Garcia DM, Sheehan MC. Extreme Weather-driven Disasters and Children's Health. Int J Health Serv. 2016;46:79–105. doi:10.1177/0020731415625254.
22. Sharpe I, Davison CM. A Scoping Review of Climate Change, Climate-Related Disasters, and Mental Disorders among Children in Low- and Middle-Income Countries. Int J Environ Res Public Health 2022. doi:10.3390/ijerph19052896.
23. Suhr F, Jumaniyazova M, Dietz P, Steinert J, Reese C, Bajjuri B. Extreme weather events and child mental health: a global systematic review and meta-analysis. PROSPERO. 2024.

24. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71. doi:10.1136/bmj.n71.
25. UN General Assembly. Convention on the Rights of the Child; 1989.
26. Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley, editor. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom, New York, NY, USA: Cambridge University Press; 2013.
27. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders: American Psychiatric Association; 2013.
28. Leclercq E, Leeflang MMG, van Dalen EC, Kremer LCM. Validation of search filters for identifying pediatric studies in PubMed. J Pediatr. 2013;162:629-634.e2. doi:10.1016/j.jpeds.2012.09.012.
29. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan-a web and mobile app for systematic reviews. Syst Rev. 2016;5:210. doi:10.1186/s13643-016-0384-4.
30. National Institute of Environmental Health Sciences. Handbook for Conducting a Literature-Based Health Assessment Using OHAT Approach for Systematic Review and Evidence Integration; 2019.
31. Thompson R, Lawrance E, Roberts L et al. Ambient temperature and mental health: a systematic review and meta-analysis. The Lancet Planetary Health;2023.
32. Viechtbauer W. Conducting Meta-Analyses in R with the metafor Package. J. Stat. Soft. 2010. doi:10.18637/jss.v036.i03.
33. James E. Pustejovsky. clubSandwich: Cluster-Robust (Sandwich) Variance Estimators with Small-Sample; 2026.
34. Hadley Wickham and Jennifer Bryan. readxl: Read Excel Files; 2022.
35. Harrer, M., Cuijpers, P., Furukawa, T.A., & Ebert, D.D. Doing Meta-Analysis with R: A Hands-On Guide. London: Chapman & Hall/CRC Press; 2021.
36. Borenstein M, Hedges LV, Higgins JPT, Rothstein HR. Introduction to Meta-Analysis 2009. doi:10.1002/9780470743386.
37. Borenstein M. Common mistakes in meta-analysis and how to avoid them. Englewood, NJ: Biostat Inc; 2019.
38. Felix E, Hernández LA, Bravo M, Ramirez R, Cabiya J, Canino G. Natural disaster and risk of psychiatric disorders in Puerto Rican children. J Abnorm Child Psychol. 2011;39:589–600. doi:10.1007/s10802-010-9483-1.
39. Felton JW, Cole DA, Martin NC. Effects of rumination on child and adolescent depressive reactions to a natural disaster: the 2010 Nashville flood. J Abnorm Psychol. 2013;122:64–73. doi:10.1037/a0029303.
40. Luo L, Li K, Zhou X, Bao Y, Lu L, Chang S. A systematic review and meta-analysis of mental disorders in homeless children, adolescents and youths. Nat. Mental Health. 2026;4:675–85. doi:10.1038/s44220-026-00616-6.

41. Polanczyk GV, Salum GA, Sugaya LS, Caye A, Rohde LA. Annual research review: A meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. J Child Psychol Psychiatry. 2015;56:345–65. doi:10.1111/jcpp.12381.
42. Visser I, van der Mheen M, Dorsman H, Knipschild R, Staaks J, Hein I, et al. Post-traumatic stress disorder rates in trauma-exposed children and adolescents: updated three-level meta-analysis. Br J Psychiatry. 2026;228:465–73. doi:10.1192/bjp.2025.30.
43. 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. doi:10.1136/bmjgh-2020-004377.
44. Pope DH, McMullen H, Baschieri A, Philipose A, Udeh C, Diallo J, McCoy D. 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. doi:10.1080/17441692.2022.2095655.
45. Eltigani B, Hoffmann R, Cluver L. Drought exposure and the risk of sexual, emotional, and physical violence against adolescents in Zimbabwe, Mozambique, and Lesotho: an observational study. Lancet Planet Health. 2026;10:101448. doi:10.1016/j.lanplh.2026.101448.
46. Abdullah-Al-Baki C, Ahmed A. Natural Disasters and Child Marriage: Evidence from the 2007 Cyclone in Bangladesh. The Journal of Development Studies. 2026:1–26. doi:10.1080/00220388.2026.2671787.
47. Hua Z, Wang S, Yuan X. Trends in age-standardized incidence rates of depression in adolescents aged 10-24 in 204 countries and regions from 1990 to 2019. J Affect Disord. 2024;350:831–7. doi:10.1016/j.jad.2024.01.009.
48. Woolgar F, Garfield H, Dalgleish T, Meiser-Stedman R. Systematic Review and Meta-analysis: Prevalence of Posttraumatic Stress Disorder in Trauma-Exposed Preschool-Aged Children. J Am Acad Child Adolesc Psychiatry. 2022;61:366–77. doi:10.1016/j.jaac.2021.05.026.
49. Dutsadee Juengsiragulwit. Opportunities and obstacles in child and adolescent mental health services in low- and middle-income countries: a review of the literature. WHO South-East Asia Journal of Public Health. 2015:110 - 122.
50. Masson-Delmotte, V., P. Zhai. 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, United Kingdom, and New York, NY, USA; 2021.
51. Morneau CC, Philippon-Dulac D, Hu X, Jain A, Liu M, Gruber M, et al. Health integration in national climate adaptation policies from 198 countries: a global policy analysis. Lancet Planet Health. 2026;10:101466. doi:10.1016/j.lanplh.2026.101466.
52. Zangerl KE, Hoernke K, Andreas M, Dalglish SL, Kelman I, Nilsson M, et al. Child health prioritisation in national adaptation policies on climate change: a policy

document analysis across 160 countries. Lancet Child Adolesc Health. 2024;8:532–44. doi:10.1016/S2352-4642(24)00084-1.
53. Earls F, Smith E, Reich W, Jung KG. Investigating psychopathological consequences of a disaster in children: a pilot study incorporating a structured diagnostic interview. J Am Acad Child Adolesc Psychiatry. 1988;27:90–5. doi:10.1097/00004583-198801000-00014.
54. Liu A, Tan H, Zhou J, Li S, Yang T, Wang J, et al. An epidemiologic study of posttraumatic stress disorder in flood victims in Hunan China. Can J Psychiatry. 2006;51:350–4. doi:10.1177/070674370605100603.
55. Peng M, Liu A, Zhou J, Wen S, Li S, Yang T, et al. Association between posttraumatic stress disorder and preflood behavioral characteristics among children aged 7-15 years in Hunan, China. Med Princ Pract. 2011;20:336–40. doi:10.1159/000323757.
56. Taukeni S, Chitiyo G, Chitiyo M, Asino I, Shipena G. Post-traumatic stress disorder amongst children aged 8-18 affected by the 2011 northern-Namibia floods. Jamba. 2016;8:169. doi:10.4102/jamba.v8i2.169.
57. Sitwat A, Asad S, Yousaf A. Psychopathology, Psychiatric Symptoms and their Demographic Correlates in Female Adolescents Flood Victims. Journal of the College of Physicians and Surgeons Pakistan. 2015:886–90.
58. Mathew G, Varghese AD, Sabu AM, Joseph A. Screening for post-traumatic stress disorder among adolescents following floods- a comparative study from private and public schools in Kerala, India. BMC Pediatr. 2021;21:462. doi:10.1186/s12887-021-02933-4.
59. Ali A, Rahman F, Sarwar Z, Abbas S. Behavior Problem and Mental Health of Children Affected by Floods-2022 in Pakistan. Journal of Loss and Trauma. 2025;30:540–65. doi:10.1080/15325024.2024.2390445.
60. Zhao L, Wang H, Wang K, Shen C, Tao M. Study on the relationship between PTSD and academic control and academic emotion in primary and middle school students after flood disaster. Front Psychol. 2024;15:1429238. doi:10.3389/fpsyg.2024.1429238.
61. Garrison CZ, Weinrich MW, Hardin SB, Weinrich S, Wang L. Post-traumatic stress disorder in adolescents after a hurricane. Am J Epidemiol. 1993;138:522–30. doi:10.1093/oxfordjournals.aje.a116886.
62. Shannon MP, Lonigan CJ, Finch AJ, Taylor CM. Children exposed to disaster: I. Epidemiology of post-traumatic symptoms and symptom profiles. J Am Acad Child Adolesc Psychiatry. 1994;33:80–93. doi:10.1097/00004583-199401000-00012.
63. Garrison CZ, Bryant ES, Addy CL, Spurrier PG, Freedy JR, Kilpatrick DG. Posttraumatic stress disorder in adolescents after Hurricane Andrew. J Am Acad Child Adolesc Psychiatry. 1995;34:1193–201. doi:10.1097/00004583-199509000-00017.
64. Delamater AM, Applegate EB. Child development and post-traumatic stress disorder after hurricane exposure. Traumatology 1999. doi:10.1177/153476569900500303.

65. Goenjian AK, Molina L, Steinberg AM, Fairbanks LA, Alvarez ML, Goenjian HA, Pynoos RS. Posttraumatic stress and depressive reactions among Nicaraguan adolescents after hurricane Mitch. Am J Psychiatry. 2001;158:788–94. doi:10.1176/appi.ajp.158.5.788.
66. Pullins LG, McCammon SL, Lamson AS, Wuensch KL, Mega L. School-Based Post-Flood Screening and Evaluation: Findings and Challenges in One Community. Stress, Trauma, and Crisis. 2005;8:229–49. doi:10.1080/15434610500406343.
67. Kar N, Bastia BK. Post-traumatic stress disorder, depression and generalised anxiety disorder in adolescents after a natural disaster: a study of comorbidity. Clin Pract Epidemiol Ment Health. 2006;2:17. doi:10.1186/1745-0179-2-17.
68. Kar N, Mohapatra PK, Nayak KC, Pattanaik P, Swain SP, Kar HC. Post-traumatic stress disorder in children and adolescents one year after a super-cyclone in Orissa, India: exploring cross-cultural validity and vulnerability factors. BMC Psychiatry. 2007;7:8. doi:10.1186/1471-244X-7-8.
69. Rubens SL, Vernberg EM, Felix ED, Canino G. Peer deviance, social support, and symptoms of internalizing disorders among youth exposed to Hurricane Georges. Psychiatry. 2013;76:169–81. doi:10.1521/psyc.2013.76.2.169.
70. Scheeringa MS, Zeanah CH. Reconsideration of harm's way: onsets and comorbidity patterns of disorders in preschool children and their caregivers following Hurricane Katrina. J Clin Child Adolesc Psychol. 2008;37:508–18. doi:10.1080/15374410802148178.
71. Scheeringa MS. Untangling Psychiatric Comorbidity in Young Children Who Experienced Single, Repeated, or Hurricane Katrina Traumatic Events. Child Youth Care Forum. 2015;44:475–92. doi:10.1007/s10566-014-9293-7.
72. Kelley ML, Self-Brown S, Le B, Bosson JV, Hernandez BC, Gordon AT. Predicting posttraumatic stress symptoms in children following Hurricane Katrina: a prospective analysis of the effect of parental distress and parenting practices. J Trauma Stress. 2010;23:582–90. doi:10.1002/jts.20573.
73. Overstreet S, Salloum A, Badour C. A school-based assessment of secondary stressors and adolescent mental health 18 months post-Katrina. J Sch Psychol. 2010;48:413–31. doi:10.1016/j.jsp.2010.06.002.
74. Salloum A, Carter P, Burch B, Garfinkel A, Overstreet S. Impact of exposure to community violence, Hurricane Katrina, and Hurricane Gustav on posttraumatic stress and depressive symptoms among school age children. Anxiety Stress Coping. 2011;24:27–42. doi:10.1080/10615801003703193.
75. Yang P, Yen C-F, Tang T-C, Chen C-S, Yang R-C, Huang M-S, et al. Posttraumatic stress disorder in adolescents after Typhoon Morakot-associated mudslides. J Anxiety Disord. 2011;25:362–8. doi:10.1016/j.janxdis.2010.10.010.
76. Lai BS, La Greca AM, Auslander BA, Short MB. Children's symptoms of posttraumatic stress and depression after a natural disaster: comorbidity and risk factors. J Affect Disord. 2013;146:71–8. doi:10.1016/j.jad.2012.08.041.

77. Orengo-Aguayo R, Stewart RW, Arellano MA de, Suárez-Kindy JL, Young J. Disaster Exposure and Mental Health Among Puerto Rican Youths After Hurricane Maria. JAMA Netw Open. 2019;2:e192619. doi:10.1001/jamanetworkopen.2019.2619.
78. Pittman LD, Cutright NL, McNeela L, Awada S, Pabis JM, Kochanova K, Shelleby E. Coping Strategies and Psychological Symptoms Among Children on St. Thomas in the Aftermath of Hurricanes Irma and Maria. J Trauma Stress. 2020;33:151–60. doi:10.1002/jts.22471.
79. Dass-Brailsford P, Thomley RSH, Jain D, Jarrett ES. The Mental Health Consequences of Hurricane Matthew on Haitian Children and Youth: An Exploratory Study. J Child Adolesc Trauma. 2022;15:899–909. doi:10.1007/s40653-021-00413-6.
80. Huang J-L, Zhou X. Posttraumatic stress disorder symptoms among parents and adolescents following Typhoon Lekima: Examination of the mother-daughter sex matching effect. Dev Psychopathol. 2024;36:709–18. doi:10.1017/S0954579422001511.
81. Polusny MA, Ries BJ, Meis LA, DeGarmo D, McCormick-Deaton CM, Thuras P, Erbes CR. Effects of parents' experiential avoidance and PTSD on adolescent disaster-related posttraumatic stress symptomatology. J Fam Psychol. 2011;25:220–9. doi:10.1037/a0022945.
82. Adams ZW, Sumner JA, Danielson CK, McCauley JL, Resnick HS, Grös K, et al. Prevalence and predictors of PTSD and depression among adolescent victims of the Spring 2011 tornado outbreak. J Child Psychol Psychiatry. 2014;55:1047–55. doi:10.1111/jcpp.12220.
83. Paul LA, Felton JW, Adams ZW, Welsh K, Miller S, Ruggiero KJ. Mental Health Among Adolescents Exposed to a Tornado: The Influence of Social Support and Its Interactions With Sociodemographic Characteristics and Disaster Exposure. J Trauma Stress. 2015;28:232–9. doi:10.1002/jts.22012.
84. Xu W, Yuan G, Liu Z, Zhou Y, An Y. Prevalence and predictors of PTSD and depression among adolescent victims of the Summer 2016 tornado in Yancheng City. Arch Psychiatr Nurs. 2018;32:777–81. doi:10.1016/j.apnu.2018.04.010.
85. An Y, Huang J, Chen Y, Deng Z. Longitudinal cross-lagged relationships between posttraumatic stress disorder and depression in adolescents following the Yancheng tornado in China. Psychol Trauma. 2019;11:760–6. doi:10.1037/tra0000455.
86. An Y, Sun X, Le Y, Zhou X. Trajectory and relation between posttraumatic stress disorder on resilience in adolescents following the Yancheng tornado. Personality and Individual Differences. 2020;164:110097. doi:10.1016/j.paid.2020.110097.
87. McDermott BM, Palmer LJ. Post-disaster service provision following proactive identification of children with emotional distress and depression. Aust N Z J Psychiatry. 1999;33:855–63. doi:10.1046/j.1440-1614.1999.00611.x.
88. Jones RT, Ribbe DP, Cunningham PB, Weddle JD, Langley AK. Psychological impact of fire disaster on children and their parents. Behav Modif. 2002;26:163–86. doi:10.1177/0145445502026002003.

89. Papadatou D, Giannopoulou I, Bitsakou P, Bellali T, Talias MA, Tselepi K. Adolescents' reactions after a wildfire disaster in Greece. J Trauma Stress. 2012;25:57–63. doi:10.1002/jts.21656.
90. Brown MRG, Agyapong V, Greenshaw AJ, Cribben I, Brett-MacLean P, Drolet J, et al. Significant PTSD and Other Mental Health Effects Present 18 Months After the Fort Mcmurray Wildfire: Findings From 3,070 Grades 7-12 Students. Front Psychiatry. 2019;10:623. doi:10.3389/fpsyt.2019.00623.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- supplementarymaterial.docx