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The Impact of Extreme Weather Events on Mental Health in Africa: A Mixed-Methods Systematic Review

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Declaration

I, Michaela Deglon, , hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university. I authorise the University to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

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Signature:…… Date: ……22 June 2022….

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Abstract

Introduction: The psychosocial impacts of extreme weather events are contributing to the burden of mental illness, exacerbated by pre-existing vulnerabilities. Despite an emerging global interest in this association, Africa remains poorly represented in the literature.

Methods: A mixed-methods systematic review of peer-reviewed studies was conducted to determine the adverse mental health outcomes associated with extreme weather events in Africa (2008-2021). The review was conducted in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

Results: A total of 12 204 peer-reviewed articles were identified of which 12 were retained for analysis. These studies were all conducted in 8 countries in Sub-Saharan Africa. Adverse mental health outcomes were identified resulting from flood (n=4), drought (n=4), extreme heat (n=1), bushfire (n=1), and multiple events (n=2). Findings included pathological outcomes with predictable symptomatology including mood disorders; trauma- and stressor-related disorders; and suicide. Additionally, conditions indicating psychological distress which were below the pathological threshold including emotion regulation difficulties, disturbed sleep, alcohol use, stress, and anxiety. The quantitative evidence for the association between extreme weather events and mental health was limited primarily by a lack of longitudinal data, exposure gradient, and comparison to an unaffected group, as well as a failure to provide an objective exposure measure. The qualitative evidence for this association was complimentary but without sufficient clinical measurement these outcomes cannot be verified as psychological morbidities. In addition, this review provided insight into the mental health of vulnerable communities affected by extreme weather events including those living in poverty, farmers, pastoralists, women, and children.

Conclusion: This review provided some preliminary evidence for the association between extreme weather events and adverse mental health outcomes for populations in Africa. The review also provides insight to vulnerable populations affected by extreme weather events. Future research with stronger designs and methodologies are recommended.

Keywords:

Extreme Weather Events; Climate Change; Mental Health; Africa; Depression; PTSD

Part A: Protocol

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Study Protocol

1. Introduction

1.1 Climate Change and Health

Anthropogenic activities are forcing climate change at unprecedented rates. Driven, primarily by the release of Green-House Gases into the atmosphere and large-scale land use changes for economic activity. The consequences of this change are global temperature rises, sporadic precipitation, rising sea levels, ocean acidification, desertification of arable land, and loss of biodiversity (Intergovernmental Panel on Climate Change [IPCC], 2019). However, climate change is not solely an environmental issue. It has serious consequences for human health and has been touted as the greatest global health challenge of the 21st century (Watts et al., 2021).

A changing climate will impact the cornerstones of public health, access to food and proper nutrition, clean drinking water, adequate housing and sanitation, and management of infectious disease, undoing decades of progress by the public healthcare system (Watts et al., 2018). Of particular threat to human well-being is the anticipated increase in the frequency and intensity of extreme weather events including floods, storms, and heat waves. As well as extreme climate events, patterns of extreme weather persisting over time or resulting from the accumulation of weather events such as drought or wildfires from protracted dry conditions (IPCC, 2019). Collectively referred to as climate extremes, these events describe incidents of severe weather or climate conditions that exceed the probability of occurrence or surpass a threshold of variables estimated from normal observation (IPCC, 2012). The Intergovernmental Panel on Climate Change reports that these climate extremes will alter ecosystems, damage infrastructure and human settlements, lead to increased morbidity and mortality, and negatively impact mental health (IPCC, 2019).

Extreme weather events have the potential to affect mental health in multiple ways. They may amplify the prevalence of adverse mental health outcomes through the introduction of stressful events, degrade the social and economic conditions conducive to good mental health, and exacerbate pre-existing conditions. Extreme weather events will also deplete the capacity of countries to treat and prevent mental disorders by disrupting health services, redirecting healthcare financing, and damaging built and institutional infrastructure, affecting both access and quality of care (Cianconi et al., 2020). The potentiality of extreme weather events to negatively impact on population mental health and well-being is heavily mediated by exposure and vulnerability factors (Morganstein & Ursano, 2020), both of which have an inequitable distribution across the globe. Africa has been identified as being particularly vulnerable to extreme weather events, due in combination to its high climate variability, low adaptive capacity, and extant burden of disease (Niang et al., 2014).

Climate change has a high degree of consensus among the scientific community and experts warn that previous failures to sufficiently abate carbon emissions means we are locked into a certain degree of warming. The subsequent increase in extreme weather events is set to have a devastating impact on the mental health of vulnerable populations. Proliferating service demands and damage to built and institutional infrastructures will overwhelm many already over-strained and under-resourced healthcare systems across the continent. It is therefore imperative that the risks to mental health posed by extreme weather events are identified in order to aid the preparation and strengthening of healthcare systems in Africa.

1.2 Extreme Weather Events in Africa

Increased temperatures over land regions in Africa have already been reported and are expected to increase more rapidly than global averages (Niang et al., 2014). This warming will intensify the hydrological cycle, altering the frequency, duration, and geographical distribution of extreme weather events on the continent (IPCC, 2019). Advancements in weather science have allowed the attribution of incidences of climate extremes to anthropogenic climate change both globally and with localised precision (Easterling et al., 2016). In Africa, studies conducted in Egypt (Mitchell, 2016) and Southern Africa (Herring et al., 2018) have confidently linked the increase of extreme heat events and incidences of flash drought to climate change, including Cape Town's infamous 'day zero' drought (Pascale et al., 2020). While an increased risk of wildfires was identified in Kenya and South Africa (Watts et al., 2021). Others have analysed drought and reduced precipitation in Tanzania, Ethiopia, Somalia, and Kenya (Funk et al., 2019). As well as heavy precipitation and flooding events in Mozambique, Zimbabwe, and Zambia (Fučkar et al., 2020).

Africa is set to face the full scope of extreme weather events based on climate models predicting general warming for inland subtropical regions, instances of extreme heat in West Africa, changes in precipitation patterns including increased aridity in Southern Africa and wetter conditions in Eastern Africa (Niang et al., 2014). Already we are seeing the occurrences of these climate extremes across the continent. Drought has affected several areas in Africa, particularly in Botswana, Namibia, and the western parts of South Africa where less than 50% average seasonal rainfall was recorded in 2019 (World Meteorological Organisation [WMO], 2020). Drought has significant consequences for people living in Africa, many of whom rely on agricultural activity for food and livelihood. Previous drought episodes have directly contributed to famine, especially in the arid and semi-arid regions of the Sahel (Simpkins, 2018) and horn of Africa (The International Federation of Red Cross and Red Crescent Societies [IFRC], 2011). Other areas with comparatively low rainfall

included southern Mozambique, Zambia, and Zimbabwe (WMO, 2020). This deficit is a continuation of a previous drought period in 2016, impacting many of the same areas. While recent seasonal cereal harvests in Somalia were the lowest in 25 years attributed to protracted dry conditions (WMO, 2020). Food insecurity has been positively correlated with poor mental health outcomes including depression, anxiety, psychological distress, caregiver burden and posttraumatic stress disorder (PTSD) in African populations (Trudell et al., 2021). Extreme heat events were recorded in South Africa, Zimbabwe, Mozambique, and Namibia, including an excess of 40° C during the winter months (WMO, 2020). Flooding has had the most extensive impact in Africa of late. According to the World Meteorological Organisation, an anticipated 2% of Niger's population has been affected by floods with 11 deaths recorded; repeated flooding episodes in Sudan resulted in the death of seventy-eight people and the destruction of some 69 000 homes. While the worst recorded floods in a decade caused the displacement of 28 000 people in the Central African Republic (WMO, 2020).

The regional variability of extreme weather events across the continent differs significantly, exposing people to both cumulative and contrasting events. For example, countries in the Greater horn of Africa recorded severe drought and successive dry spells between 2015 and 2017 (WMO, 2020). Failing crops and weakened or dead livestock impacted livelihoods and forced millions to rely on emergency food assistance (Jan van Oldenborgh et al., 2017). Yet in 2019 a dramatic shift in conditions across East Africa, including Somalia, Kenya, Ethiopia, Tanzania, and Uganda saw a two-fold increase in the average seasonal rainfall (WMO, 2020). Floods and associated landslides caused over 400 deaths in the region and have been linked to the subsequent locust plague which decimated crop production (WMO, 2020). While instances of tropical cyclones in the 2018-2019 season exceeded the long-term mean occurrence by 6 events including tropical cyclones Idai, Kenneth, and Desmond all making landfall within a 12-month period (WMO, 2020). Widespread wind and storm damage was caused along coastal areas of Mozambique. While associated flooding from the event affected those living inland and parts of Malawi and Zimbabwe. The impact of Idai was over 1200 deaths, the highest number of casualties attributed to a cyclone in the southern hemisphere (WMO, 2020).

1.3 Risk, Exposure and Vulnerability to Climate Extremes

The consequences of extreme weather events are a combination of the frequency and severity of the event as well as social development factors which modulate vulnerability and resilience. Even low magnitude events can have disastrous consequences if the population is particularly vulnerable.

The Global Climate Risk Index identifies regions particularly vulnerable to extreme weather events through consideration of relative fatalities and economic losses, as a percentage of GDP (Eckstein et al., 2021). In its most recent report, out of the 10 most affected countries identified, three were in Africa (Madagascar, Kenya, and Rwanda). Importantly, data included in this report accounts for direct impacts only such as immediate deaths and financial loss but does not account for indirect impacts resulting from slow-onset drought, food scarcity or resultant disease. The emphasis of the report is that extreme weather events will impact the poorest countries hardest and exacerbate existing vulnerabilities. Currently there are 490 million people living in extreme poverty in Africa (36% of the total population) (Human, 2021). Contributing factors to this poverty rate are the rapidly increasing population sizes and the relatively young age of persons in Africa. Those living in poverty are particularly vulnerable to climate shocks partly because they will lose a higher percentage of wealth following an extreme event and have less adaptive capacity due to low social capital. Poverty and exposure exhibit a bidirectional relationship, poor people are more likely to live in locations with high exposure such as flood plains. A study assessing the global exposure of poor people to flood, and drought demonstrated regional patterns of exposure and vulnerability in Africa (Winsemius et al., 2018). Those living in poverty had disproportionally high exposure to flood (southern and horn of Africa), drought (western Africa) and both flood and drought (sub-Saharan Africa), compared to the country average.

While physical exposure to risk is a key factor of vulnerability, the risk-hazard framework, which primarily considers biophysical factors and potential for loss, has been criticised for failing to account for the full spectrum of social factors that exacerbate vulnerability (Chaplin et al., 2019). An additional framework has been proposed in response, one that highlights the complex interplay of socio-cultural, historical, and political forces that underpin climate vulnerability (Argent, 2019). This social constructionist perspective on climate change, rejects broad concepts such as socio-economic status as homogenous and concrete determinants of vulnerability advocating instead for intersectionality and considerations of multiple social identities related to gender, race, class, disability, and community status. For example, a gendered perspective in vulnerability to extreme weather events suggests that in some instances women's mental health may be better preserved due to the enhanced benefit of social support (Harandi et al., 2017). While in high-income countries men and boys are more likely to commit suicide following social isolation and poor mental health in response to climate change (van Daalen et al., 2020). Men's safety and mental health is further impacted by notions of masculinity which encourage heroism and risk-taking during flooding events (Vinyeta et al., 2015).

1.4 Extreme Weather Events and Adverse Mental Health

Extreme weather events will adversely impact on mental health in a variety of ways and potentially contribute significantly to the burden of non-communicable disease in Africa. Natural disasters of this sort have anticipated patterns of behavioural and psychological outcomes. Some resulting in sustained poor mental health. However, the likelihood of development and the transmission of mental illness is amplified within some populations and communities based on a range of pre-existing vulnerabilities (Morganstein & Ursano, 2020). Adverse mental health outcomes may be a direct consequence of the extreme event including psychological responses that mirror trauma from experiencing a highly stressful and potentially life-threatening incident; as well as possibly acquiring a physical injury, witnessing injury or death, and the bereavement that follows loss of a loved one (Cianconi et al., 2020). Immediate manifestations of adverse mental health following extreme weather events can include sleep disturbances and insomnia (Morganstein & Ursano, 2020). Poor sleep quality increases the likelihood of a range of psychosocial difficulties such as poor emotion regulation, decreased mental function such as problem solving, attention and memory as well as disrupted social functions that diminish self-care, and affect personal relationships (Sabariego et al., 2015). In Korea, studies conducted following disasters including heavy rain and fire, found women, middle-aged persons, those with low educational attainment, and those who experienced the disaster within the previous two years had the lowest subjective sleep quality (Kim & Lee, 2021). Negative affect such as anger, fear, confusion, demoralisation, and reduced sense of safety within the first few weeks of experiencing a disaster have also been reported (Morganstein & Ursano, 2020). While these initial responses are not necessarily pathological, a failure to implement immediate and sustained psychosocial support for at-risk communities may result in the development of mental disorders which decrease quality of life, impede social development, and impact negatively on a country's economy by reducing the workforce capacity and increasing healthcare expenditure (Morganstein & Ursano, 2020). Further, maladaptive coping mechanisms for dealing with stress following disasters can include increased drug and alcohol use which has additional implications for health and safety (WHO, 2012) Commonly identified mental health concerns by primary care facilities and emergency personnel following periods of natural disaster included insomnia, anxiety and altered patterns of substance abuse (Morganstein & Ursano, 2020). Other causal pathways to adverse mental health are through degradation of healthcare facilities, infrastructure damage, prolonged disruption of social services, and the amplification of negative social determinants of health such as poverty, food insecurity, forced-migration, loss of employment

and reduced social support which increase the likelihood of mental illness acquisition over longer periods of time (Berry et al., 2010).

The link between extreme weather events and mental health is an emerging topic of interest. In the most recent report on climate change and health, the Lancet highlighted the need to develop indicators related to mental health (Watts et al., 2021). A number of systematic reviews have begun to consider these outcomes. Cianconi et al. (2020) undertook a descriptive global review that looked at the impact of climate change and psychiatric illness including studies on flooding, drought, heatwaves, hurricanes, wildfires, and those related to migration and vulnerability. Vulnerability, however, was broadly applied, and no-country specific analyses were conducted. The general conclusion was that climate change has both direct and indirect impacts on mental health, and that these outcomes are modulated by existing vulnerabilities of those exposed. There was no discussion of what these vulnerabilities may be in African populations and subsequently whether this would affect the manifestation of mental illness. In their analysis, exposure to acute events such as floods were comparable to well-established mechanisms of trauma resulting in a range of psychopathological sequelae. PTSD was a commonly cited outcome following acute stress experienced during and immediately after an extreme weather event, especially those resulting in the loss of life, resources, social support, and those requiring relocation (Kim, 2016). Other common outcomes included depression, general anxiety, suicidal ideation, and the misuse of drugs and alcohol. While exposure to a prolonged climate extreme such as drought resulted in reduced social functioning, demoralization, fatalism and feelings of distress and helplessness (Cunsolo Willox et al., 2013); as well as the development of mental illness including depression, anxiety, and eventual suicide (Carleton, 2017). The authors note that the lack of literature is due to a combination of novelty and the inherent complexity of attributing mental illness to climate change, especially for late-onset conditions. A second review focusing specifically on mental health disorders and exposure to extreme weather events in developing countries was conducted by Rataj et al. (2016). Prevalence rates of psychiatric disorders including PTSD, anxiety and depression were higher post-disaster compared to reference data in 16 of the 17 included studies. For PTSD post-disaster prevalence was between 0.7-52.6%, post-disaster anxiety prevalence was between 2.2-84%, and post-disaster depression prevalence was between 5.9-54% compared to a global pre-disaster prevalence of 2.5%. Notably this review did not identify any studies conducted in Africa nor any studies that considered drought or extreme heat events which are predominant in Africa. Authors argue that there is a gap in research conducted on the continent both in quantity and quality of data reported. Other review studies on extreme weather events and mental health have been conducted in the United

Kingdom (Cruz et al., 2020) and in Europe (Weilnhammer et al., 2021). Cruz et al. (2020) conducted a meta-analysis for 17 studies dealing with flood and heat wave impacts on common mental health problems. Point prevalence of each disorder within a 12-month period following an event was 19.8% for anxiety, 21.4% for depression, and 30.4% for PTSD. In Europe, various health outcomes were considered following extreme heat events, extreme cold events, wildfires, floods, droughts. The only retained studies with mental health outcomes were for flooding, particularly longer-term impacts. A household-level cross-sectional study conducted 6 years after the flooding event found that 60% of participants experienced anxiety, 40% experienced increased stress, 23% had frequent flashbacks, 18% reported sleeplessness and depression while 10% said they had frequent nightmares about the event (Lamond et al., 2015). While general mental illness prevalence three years after a flood was found to be higher compared to pre-flood levels (Mulchandani et al., 2020).

Other studies have considered the psychological consequences of extreme weather events individually. Studies on extreme heat events in India have found a link between mood disorders, anxiety and sleep disturbances following heat stress (Padhy et al., 2015). While exposure to high temperatures in Mississippi prisons caused psychological fatigue, discomfort and feelings of irritability and hostility (Mukherjee & Sanders, 2021). There is also evidence of heat-related violence with outbreaks of violent crimes, increased alcohol consumption, and rising suicide rates during peak summer months in both the United States and Mexico (Burke et al., 2018). Studies conducted on the experience of drought are typically done in high-income countries, with Australia being over-represented (Vins et al., 2015). Due to its slow onset the primary causal pathway that drought affects mental health is through disruption to economic activity, especially for those whose livelihoods depend on agriculture and water availability. The consequence of drought includes increased prevalence of depression, mental distress, anxiety, prolonged emotional stress, and feelings of shame and humiliation from an inability to provide, contributing to social isolation (Vins et al., 2015). There is also a strong association with suicide, especially among older populations (Sena et al., 2018) and farmers (Carleton, 2017) found in Brazil and India respectively. Mental health issues recorded one year following wildfire outbreak in Australia included PTSD, psychosomatic disorders, and substance abuse (McFarlane et al., 1997). Hurricanes and storms have been extensively studied after the occurrence of prominent events such as hurricane Katrina in the United States and Sandy in the Caribbean. Psychological stress experienced during these disasters exacerbated pre-existing health problems including cardiovascular disease (Becquart et al., 2018). Commonly reported psychological disorders included PTSD, stress, depression, and anxiety (Ruskin et al.,

2018). One in six people developed PTSD while 50% developed mood disorders. Prenatal maternal stress and depression increased, while anxiety, sadness and reduced response to pleasant stimuli was noted in children and infants (Nomura et al., 2019). Those living in close proximity to the disaster site reported suicidal ideation (Kessler, 2006). Finally, mental health evidence from studies related to flood events in Australia found a dose-response relationship between intensity of the flooding incident and severity of mental health outcome among senior citizens in rural settings (Bei et al., 2013). In Asia, floods introduced risk factors for the development of high burden diseases such as PTSD, depression and anxiety through displacement, injury, infrastructure damage and loss of loved ones (Bandla et al., 2019). Factors that rendered some people more susceptible to the development of mental disorders included being a woman, young or elderly age, low levels of education, living in a female-headed household, pre-existing disability, and belonging to ethnic or linguistic minority groups. Relief workers in low-middle income countries were more at risk of poor mental health than those in high income countries (Veenema et al., 2017).

1.5 Mental Health in Africa

In general, there is a lacuna in mental research in Africa. An analysis of the Lancet Global Health, a journal with a particular focus on disadvantaged populations, found a search for ‘mental health disorders’ in Africa resulted in just 16 articles (Sankoh et al., 2018). The scarcity of this research reflects a broader issue of mental health care on the continent. Evidence from the Mental Health Atlas (WHO, 2018) shows that only 3% of member states in Africa compiled both private and public sector mental health specific data in the previous two years. While 24% compiled no mental health data in that same period. Less than half of African member states (44%) report having stand-alone mental health legislation, of those, 55% admit to having an overseeing authority to assess compliance with that legislation. Africa also has the lowest availability of mental health workforce, including psychiatrists, medical doctors, nurses, psychologists, social workers, and other paid professionals in the field of mental health. Africa once again reports the lowest number of 0.9 workers per 100 000 population. Total adult inpatient care facilities available for mental health treatment average to 0.1 facilities per 100 000 population, amounting to 2.5 dedicated beds per 100 000 population.

These figures are concerning considering that Africa reports higher than global incidence of age-standardized suicide rate per 100 000 population (WHO, 2018). While a recent systematic review on mental illness amongst children and adolescents in sub-Saharan Africa (Jörns-Presentati et al., 2021) found the medium point prevalence rate of depression in general adolescent populations was 26.9%, 29.8% for anxiety disorders, 40.8% for

emotional and behavioural problems, 21.5% for PTSD and 20.8% for suicidal ideation. While vulnerable populations, including those living in poverty, high levels of deprivation, exposure to violence, being absent from school, and orphanhood, reported higher levels of depression (29%), emotional and behavioural issues (45%), and PTSD (24%). Frequently reported risk factors included being female, relative older age, and exposure to multiple traumatic events, as well as damage to vital infrastructure including healthcare services and schools.

A major challenge in understanding mental health in Africa is the diversity of cultural and social norms dictating the manifestation and perception of mental illness. Mental health is strongly contextually tied based on complex systems of values and beliefs, relying heavily on subjective reports of well-being. There has already been some debate about the difficulties of comparing mental health data across cultures, especially when translating and adapting western-standardised tests (Atilola, 2015; Quarshie et al., 2020). Many of the mental health studies undertaken in African populations have called for the development of locally validated tools and a greater focus on cultural contextualisation in order to enhance research capacity and promote successful policy change (Jörns-Presentati et al., 2021). Hence the need to conduct African-specific mental health vulnerability assessments.

Mental illness is considered taboo across much of Africa (Trudell et al., 2021). However, global initiatives such as the United Nations' Sustainable Development Goals (2015) have highlighted the burden of mental illness in developing countries with the inclusion of Goal 3 – to "ensure healthy lives and promote well-being for all at all ages" (United Nations, 2015, n.p). Specified targets within this goal include the promotion of mental health, particularly a reduction in suicide mortality rates. As well as the strengthening and prevention of substance abuse which is inherently linked with mental health. Additionally, the World Health Organisation's Mental Health Gap Action Plan (WHO, 2013) has pledged to promote mental well-being, prevent mental disorders, and reduce mortality and morbidity for persons with mental disorders through actions which include the identification of natural disasters as extreme stressors and the provisions of psychosocial support in emergency preparedness plans.

1.6 Mental Health Vulnerability

The concept of vulnerability has discipline-specific denotations. In mental health literature, vulnerability refers to the susceptibility of certain groups to develop mental health conditions. Groups identified as being particularly at risk include households living in poverty, those with chronic health conditions, and those who are exposed to or displaced by conflict (WHO, 2012). Each of these vulnerabilities is set to increase as a consequence of climate-driven extreme weather events. Additionally, people living with mental health disorders have their

own internal vulnerabilities, including disproportionately higher rates of disability and mortality resulting from diminished health seeking behaviours, typically lower socio-economic status, and increased incidences of stress and substance abuse (WHO, 2012). Emergency department data collected during periods of excessive heat in the Netherlands found that patients presenting with psychiatric symptoms were more likely to die during hot day periods than on other days (van der Linden et al., 2019).

Mental health vulnerability differs across the lifespan with age-specific risk factors. Children who experience adversity early in life, have poor nutrition, inadequate living conditions, and disrupted schooling as a consequence of stress, infrastructure damage and food shortages associated with extreme weather events are uniquely vulnerable to developing mental health conditions (Kousky, 2016), which may only manifest later in life; having long term consequences for their development and quality of life. Children who experienced climate shocks early in life have been shown to have delayed motor development, lower IQ scores, and increased incidence of behavioural problems (Kousky, 2016). Children also suffer a double burden as they are reliant on caregivers whose quality of care may be adversely impacted by poor mental health (Jörns-Presentati et al., 2021).

Vulnerability can also be viewed with a gendered lens. Women have heightened vulnerability both in general due to cultural and gender norms which dictate equality, and at specific periods such as during pregnancy. Studies which considered natural disasters and risk of violence for women and girls in high-income countries found an increased risk of physical, sexual, and psychological abuse following extreme weather events including floods in Canada (Sahni et al., 2016), hurricanes in the United States (Madkour et al., 2011), heatwaves in Spain (Sanz-Barbero et al., 2018), and bushfires in Australia (Molyneaux et al., 2020). While trauma and mental health issues resulting from an extreme weather event propagated further violence for women in Iran and Haiti (Epstein et al., 2020). For example, decreased sexual desire in grieving women post-disaster was noted as a trigger for abuse (Sohrabizadeh, 2016). As was increased substance use in men reporting poor mental health after experiencing a weather shock (Bermudez et al., 2019).

2. Aims and Objectives

2.1 Aims

This study aims to systematically review the scientific evidence on the association between extreme weather events and adverse mental health outcomes for persons living on the African continent.

2.2 Objectives

- To systematically search, identify and extract existing literature on the impact of climate-driven extreme weather events on mental health in Africa

- To describe all associated adverse mental health outcomes resulting from exposure to extreme weather events in Africa

- To identify populations deemed uniquely vulnerable to the transmission of mental illness by virtue of social and cultural identities related to sex, age, vocation, and socioeconomic status in Africa

2.3 Study Justification

The intensification of the hydrological cycle following anthropogenic climate change will significantly impact on the strength and geographical distribution of extreme weather events. These events are anticipated to occur more frequently, and with longer duration placing many more people at risk (IPCC, 2019). Africa has been identified as being particularly vulnerable to the impact of extreme weather events due in combination to its high climate variability, high burden of disease, and low adaptive capacity (Niang et al., 2014). Already, natural disasters including extreme heat events, fires, floods, storms, and droughts are impacting people living across the continent (Easterling et al., 2016). Resulting in death, injury, malnutrition, disease, and forced migration, each having serious psychosocial implications for mental health. Notably, these impacts will not be equitably distributed. The potential uptake of mental illness is inherently higher among some populations based on social, cultural, and political factors related to sex, age and socio-economic status which enhance their vulnerability (Chaplin et al., 2019). Identifying these vulnerabilities is essential to the strengthening and preparation of healthcare systems in Africa.

Non-communicable diseases including mental illness are predicted to be the leading cause of death and disability in Africa by 2030 (WHO, 2015). High prevalence of mental illness will severely impede public health initiatives and progress towards equitable social development, including the attainment of the United Nations' Sustainable Development Goals. Other global initiatives including the World Health Organisation have called for the strengthening of evidence and research for mental health (WHO, 2013). At the time of writing, there is no known systematic review that assesses the impacts of extreme weather events on mental health in Africa. Therefore, this study will contribute to a small body of literature with the intention of identifying knowledge gaps and highlighting the need to include mental health and psychosocial support needs in climate change adaptation and emergency planning.

3. Methods

3.1 Search strategy

The title of this review will be the Impact of Extreme Weather Events on Mental Health in Africa. Data collection will commence in October 2021 until December 2021. A search strategy for this systematic review was adapted from Rother et al. (2020), in consultation with a psychiatry & mental health specialist librarian. Both Text Word and Medical Subject Heading (MeSH) fields will be included for a comprehensive search. The PubMed search strategy is available in Appendix A, this will be adapted for other databases such as: EBSCOHost platform which includes Academic Search Premier, Africa-Wide Information, Cumulative Index of Nursing and Allied Health Literature [CINAHL], Health Source: Nursing/Academic Edition, APA PsycARTICLES and APA PsycINFO; Scopus which includes the contents of Embase; and Web of Science including Web of Science Core Collection and SciELO Citation Index databases. Further, a snowballing technique will be included whereby the reference indices of identified papers will be searched to find other relevant articles. Once identified, all studies will be populated into EndNote. All studies from 2008 until time of search will be included. The start date of 2008 was selected as it aligned with the World Health Organisation's call for enhanced research and evidence for mental health. Only articles written in English will be included in this review. Since Africa has both Francophone and Lusophone countries, this limitation is acknowledged. All databases will be searched on the same day for consistency.

3.2 Data Collection and Analysis

3.2.1 Study selection

This review will be conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Page et al., 2021) (Appendix B). Titles and abstracts of studies retrieved through the search strategy will be read and assessed for eligibility by the primary author. Studies will be excluded in-line with the exclusion criteria listed in this protocol. Studies that meet the inclusion criteria will be retained for full-text review. Any uncertainty regarding a study's relevance will be discussed with supervising academics for consensus. All duplicate articles will be excluded.

3.2.2 Inclusion Criteria

- Articles written in English
- Articles related to extreme weather events and their impacts on mental health

- Studies discussing adverse mental health outcomes including a range of mental and behavioural disorders with standard classifications and which cause a high burden of disease (e.g., PTSD, suicidal behaviour disorder, psychosomatic disorders, anxiety disorders, sleep-wake disorders etc). Operationalised with psychometric tests.
- Studies discussing adverse mental health outcomes including negative affect, reduced positive emotion, and culturally relevant descriptions of distress
- Articles published since 2008 (aligned with the launch of the WHO's mental health gap action plan aimed at strengthening evidence and research for mental health)
- Research conducted in any region of Africa and related territories including sovereign island nations
- Qualitative, quantitative, and mixed-methods study designs

3.2.3 Exclusion Criteria

- Articles written in any language other than English
- Articles discussing normal psychology or cognition/cognitive decline (e.g., dementia)
- Articles discussing mental health tangentially
- Articles discussing general climate change (no link to extreme weather events)
- Articles discussing events that are not attributable to abnormal climatic factors (e.g., flooding from burst dam walls, human-caused fires etc)
- Articles discussing non-weather-related natural disasters (e.g., Tsunamis, earthquakes)
- Systematic, review, and modelling type studies

3.2.4 Data extraction and management

Data extraction tables will be used to obtain relevant information from each eligible study. The table will include the following headings: title, authors names, year of publication, study design, methods, country/geographic location, study setting, sample size, extreme weather event(s) referred to, definition/measurement of extreme weather event, mental health conceptualization, main findings, and key limitations (Appendix C). Post-extraction, a narrative synthesis report will be written outlining the impacts of extreme weather events on mental health and associated vulnerabilities. These syntheses will also be presented in tables. A meta-analysis of the findings will not be conducted as there is anticipated heterogeneity in the study methods.

3.2.5 Assessment of risks and bias

Systematic reviews considering environmental hazard exposures rely predominantly on observational evidence. However, the accepted standards for assessing risk of bias in these types of studies are under debate (Bero et al., 2018). Tools that attempt to assess risk of bias in non-experimental studies including the Cochrane Risk of Bias Tool for Observational Studies of Interventions (ROBINS-I) and Bristol University's Risk of Bias in Observational Studies of Exposures (ROBINS-E) have been criticised for lack of clarity in instruction (Bero et al., 2018). Therefore, internal validity will be established using the National Heart, Lung, and Blood Institute (NHLBI) Quality Assessment tool for Observational Cohort and Cross-Sectional Studies (Appendix D). This tool categorises studies as 'poor', 'fair' and 'good' and has been used by health professionals when conducting systematic reviews to inform health guidelines (NHLBI, 2021). Internal validity assessments are not relevant to qualitative studies but there is an expectation of transparency and rigour. Therefore, these articles will be subject to a critical appraisal that categorises articles as 'poor', ''fair' and 'good' (previously described by Charlson et al., 2021) guided by the Joanna Briggs Institute (2020) critical appraisal checklist (Appendix E). Use of this critical appraisal checklist has been recently advocated for by Ma et al. (2020). Quality assessments will be made by the primary researcher, where there is uncertainty, the researcher will consult with supervising academics for consensus. Articles categorised as 'poor' will be included in the review but a general comment on the quality of studies will be made.

3.2.6 Dealing with missing data

In instances of missing data, original authors will be contacted where possible. Unavailable full-text reviews will be noted in the screening process.

4. Ethics

This is a systematic literature review and therefore a desktop activity. No ethical approval is required. This review will utilise secondary data containing no identifiable information linked to individual participants. All published literature is available through publicly accessible electronic databases. For good practice this protocol will be submitted to the Faculty of Health Science Human Research Ethics Review Committee at the University of Cape Town for review (Appendix F). The results of this study will be made available on-line in accordance with the university's open access policy.

5. Reference list

Argent, N. (2019). Rural geography II: Scalar and social constructionist perspectives on climate change adaptation and rural resilience. *Progress in Human Geography, 43*(1). https://doi.org/10.1177/0309132517743115

Bandla, S., Nappinnai, N., & Gopalasamy, S. (2019). Psychiatric morbidity in December 2015 flood-affected population in Tamil Nadu, India. *International Journal of Social Psychiatry, 65*(4). https://doi: 10.1177/0020764019846166

Becquart, N., Naumova, E., Singh, G., & Chui, K. (2018). Cardiovascular disease hospitalizations in Louisiana parishes' elderly before, during and after Hurricane Katrina. *International Journal of Environmental Research and Public Health, 16*(1). https://doi: 10.3390/ijerph16010074

Bei, B., Bryant, C., Gilson, K.-M., Koh, J., Gibson, P., Komiti, A., Jackson, H., & Judd, F. (2013). A prospective study of the impact of floods on the mental and physical health of older adults. *Aging & Mental Health, 17*(8). https://doi: 10.1080/13607863.2013.799119

Bermudez, L.G., Stark, L., Bennouna, C., Jensen, C., Potts, A., Kaloga, I.F., Tilus, R., Buteau, J.E., et al. (2019). Converging drivers of interpersonal violence: Findings from a qualitative study in post-hurricane Haiti. *Child Abuse & Neglect*, *89*. https://DOI: 10.1016/j.chiabu.2019.01.003

Bero, L., Chartres, N., Diong, J., Fabbri, A., Ghersi, D., Lam, J., Lau, A., McDonald, S., et al. (2018). The risk of bias in observational studies of exposures (ROBINS-E) tool: concerns arising from application to observational studies of exposures. *Systematic Reviews*, *7*(1). https://DOI: 10.1186/s13643-018-0915-2

Berry, H.L., Bowen, K., & Kjellstrom, T. (2010). Climate change and mental health: a causal pathways framework. *International Journal of Public Health*, *55*(2). https://DOI: 10.1007/s00038-009-0112-0

Burke, M., González, F., Baylis, P., Heft-Neal, S., Baysan, C., Basu, S., & Hsiang, S. (2018). Higher temperatures increase suicide rates in the United States and Mexico. *Nature Climate Change*, *8*(8). https://DOI: 10.1038/s41558-018-0222-x

Carleton, T.A. (2017). Crop-damaging temperatures increase suicide rates in India. *Proceedings of the National Academy of Sciences, 114*(33). https://doi: 10.1073/pnas.1701354114

Chaplin, D., Lovell, E., & Twigg, J. (2019). Intersectional approaches to vulnerability reduction and resilience-building. *Resilience Intel, 12*. https://DOI: 10.13140/RG.2.2.13404.03209

Cianconi, P., Betrò, S., & Janiri, L. (2020). The Impact of Climate Change on Mental Health: A Systematic Descriptive Review. *Frontiers in Psychiatry*, *11*. https://DOI: 10.3389/fpsyt.2020.00074

Cruz, J., White, P.C.L., Bell, A., & Coventry, P.A. (2020). Effect of extreme weather events on mental health: A narrative synthesis and meta-analysis for the UK. *International Journal of Environmental Research and Public Health*, *17*(22). https://DOI: 10.3390/ijerph17228581

Cunsolo Willox, A., Harper, S.L., Ford, J.D., Edge, V.L., Landman, K., Houle, K., Blake, S., & Wolfrey, C. (2013). Climate change and mental health: an exploratory case study from Rigolet, Nunatsiavut, Canada. *Climatic Change*, *121*(2). https://DOI: 10.1007/s10584-013-0875-4

van Daalen, K., Jung, L., Dhatt, R., & Phelan, A.L. (2020). Climate change and gender-based health disparities. *The Lancet Planetary Health*, *4*(2). https://DOI: 10.1016/S2542-5196(20)30001-2

Easterling, D.R., Kunkel, K.E., Wehner, M.F., & Sun, L. (2016). Detection and attribution of climate extremes in the observed record. *Weather and Climate Extremes*, *11*. https://DOI: 10.1016/j.wace.2016.01.001

Eckstein, D., Künzel, V., & Schäfer, L. (2021). *GLOBAL CLIMATE RISK INDEX 2021 Who Suffers Most from Extreme Weather Events? Weather-Related Loss Events in 2019 and 2000-2019*. Berlin. https://germanwatch.org/sites/default/files/Global%20Climate%20Risk%20Index%202021_2.pdf

Epstein, A., Bendavid, E., Nash, D., Charlebois, E.D., & Weiser, S.D. (2020). Drought and intimate partner violence towards women in 19 countries in sub-Saharan Africa during 2011-2018: A population-based study. *PLOS Medicine*, *17*(3). https://DOI: 10.1371/journal.pmed.1003064

Fučkar, N.S., Otto, F.E.L., Lehner, F., Pinto, I., Sparrow, S., Li, S., & Wallom, D. (2020). On high precipitation in Mozambique, Zimbabwe and Zambia in February 2018. *Bulletin of the American Meteorological Society*, *101*(1). https://DOI: 10.1175/BAMS-D-19-0162.1

Funk, C., Pedreros, D., Nicholson, S., Hoell, A., Korecha, D., Galu, G., Artan, G., Segele, Z., et al. (2019). Examining the potential contributions of extreme “Western V” sea surface temperatures to the 2017 March–June East African Drought. *Bulletin of the American Meteorological Society*, *100*(1). https://DOI: 10.1175/BAMS-D-18-0108.1

Harandi, F.T., Taghinasab, M., & Nayeri, D.T. (2017). The correlation of social support with mental health: A meta-analysis. *Electronic Physician*, *9*(9). https://DOI: 10.19082/5212

Herring, S.C., Christidis, N., Hoell, A., Kossin, J.P., Schreck, C.J., & Stott, P.A. (2018). Explaining extreme events of 2016 from a climate perspective. *Bulletin of the American Meteorological Society*, *99*(1). https://DOI: 10.1175/BAMS-ExplainingExtremeEvents2016.1

Human, J.H. (2021, February 25). *African countries continue to have the highest poverty rates in the world*. Development Aid. https://www.developmentaid.org/#!/news-stream/post/84943/highest-poverty-rates-in-africa

Intergovernmental Panel on Climate Change. (2012).*Summary for Policymakers. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]*. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 1-19.

Intergovernmental Panel on Climate Change. (2019). *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)].* In press

International Federation of Red Cross and Red Crescent Societies (2011). *Drought in the Horn of Africa: Preventing the next disaster*. Geneva. http://lib.riskreductionafrica.org/bitstream/handle/123456789/475/drought%20in%20the%20horn%20of%20Africa.pdf?sequence=1&isAllowed=y

Jan van Oldenborgh, G., van der Wiel, K., Philip, S., Kew, S., Cullen, H., Shah, K., Singh, R., van Aalst, M., et al. (2017). *Rapid analysis of drought in Somalia, 2016*. https://www.worldweatherattribution.org/somalia-drought-2016-2017/

Joanna Briggs Institute. (2020). *Checklist for Qualitative Research.* https://jbi.global/critical-appraisal-tools

Jörns-Presentati, A., Napp, A.-K., Dessauvagie, A.S., Stein, D.J., Jonker, D., Breet, E., Charles, W., Swart, R.L., et al. (2021). The prevalence of mental health problems in sub-Saharan adolescents: A systematic review. *PLOS ONE*, *16*(5). https://DOI: 10.1371/journal.pone.0251689

Kessler, R. (2006). Mental illness and suicidality after Hurricane Katrina. *Bulletin of the World Health Organization, 84*(12). https://doi: 10.2471/BLT.06.033019

Kim, E.J. (2016). U.S. Global Change Research Program: The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. *Journal of the American Planning Association, 82*(4). https://doi: 10.1080/01944363.2016.1218736

Kim, Y. and Lee, H. (2021). Sleep Problems among Disaster Victims: A Long-Term Survey on the Life Changes of Disaster Victims in Korea. *International Journal of Environmental Research and Public Health, 18*(6). https://doi: 10.3390/ijerph18063294

Kousky, C. (2016). Impacts of Natural Disasters on Children. *Future of Children, 26*(1), pp. 73–92.

Lachal, J., Revah-Levy, A., Orri, M., & Moro, M.R. (2017). Metasynthesis: An Original Method to Synthesize Qualitative Literature in Psychiatry. *Frontiers in Psychiatry*, *8*. https://doi: 10.3389/fpsyt.2017.00269

Lamond, J.E., Joseph, R.D., & Proverbs, D.G. (2015). An exploration of factors affecting the long term psychological impact and deterioration of mental health in flooded households. *Environmental Research*, *140*. https://DOI: 10.1016/j.envres.2015.04.008

van der Linden, N., Longden, T., Richards, J.R., Khursheed, M., Goddijn, W.M.T., van Veelen, M.J., Khan, U.R., & van der Linden, M.C. (2019). The use of an 'acclimatisation' heatwave measure to compare temperature-related demand for emergency services in Australia, Botswana, Netherlands, Pakistan, and USA. *PLOS ONE*, *14*(3). https://DOI: 10.1371/journal.pone.0214242

Ma, L.-L., Wang, Y.-Y., Yang, Z.-H., Huang, D., Weng, H., & Zeng, X.-T. (2020). Methodological quality (risk of bias) assessment tools for primary and secondary medical studies: what are they and which is better? *Military Medical Research*, *7*(1). https://DOI: 10.1186/s40779-020-00238-8

Madkour, A.S., Johnson, C.C., Clum, G.A., & Brown, L. (2011). Disaster and Youth Violence: The Experience of School-Attending Youth in New Orleans. *Journal of Adolescent Health*, *49*(2). https://DOI: 10.1016/j.jadohealth.2011.06.005

McFarlane, A.C., Clayer, J.R., & Bookless, C.L. (1997). Psychiatric morbidity following a natural disaster: An Australian bushfire. *Social Psychiatry and Psychiatric Epidemiology*, *32*(5). https://DOI: 10.1007/BF00789038

Mitchell, D. (2016). Human Influences on Heat-Related Health Indicators During the 2015 Egyptian Heat Wave. *Bulletin of the American Meteorological Society, 97*(12). https://doi: 10.1175/BAMS-D-16-0132.1

Molyneaux, R., Gibbs, L., Bryant, R.A., Humphreys, C., Hegarty, K., Kellett, C., Gallagher, H.C., Block, K., et al. (2020). Interpersonal violence and mental health outcomes following disaster. *BJPsych Open*, *6*(1). https://DOI: 10.1192/bjo.2019.82

Morganstein, J.C. and Ursano, R.J. (2020). Ecological Disasters and Mental Health: Causes, Consequences, and Interventions. *Frontiers in Psychiatry, 11*. https://doi: 10.3389/fpsyt.2020.00001

Mukherjee, A. and Sanders, N. (2021). *The Causal Effect of Heat on Violence: Social Implications of Unmitigated Heat Among the Incarcerated*. National Bureau of Economic Research. https://doi: 10.3386/w28987

Mulchandani, R., Armstrong, B., Beck, C.R., Waite, T.D., Amlôt, R., Kovats, S., Leonardi, G., Rubin, G.J., et al. (2020). The English National Cohort Study of Flooding & Health: psychological morbidity at three years of follow up. *BMC Public Health*, *20*(1). https://DOI: 10.1186/s12889-020-8424-3

National Heart, Lung, and Blood Institute. (2019). *Study Quality Assessment Tools*. https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools

Niang, I., Ruppel, O.C., Abdrabo, M.A., Dube, P., Leary, N., Schulte-Uebbing, L., Field, C., Dokken, D., et al. (2014). *Africa. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)].* Cambridge: Pieter Pauw. https://www.ipcc.ch/report/ar5/wg2/

Nomura, Y., Davey, K., Pehme, P.M., Finik, J., Glover, V., Zhang, W., Huang, Y., Buthmann, J., et al. (2019). Influence of in utero exposure to maternal depression and natural disaster-related stress on infant temperament at 6 months: The children of Superstorm Sandy. *Infant Mental Health Journal*. https://DOI: 10.1002/imhj.21766

Padhy, S., Sarkar, S., Panigrahi, M., & Paul, S. (2015). Mental health effects of climate change. *Indian Journal of Occupational and Environmental Medicine*, *19*(1). https://DOI: 10.4103/0019-5278.156997

Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff, J.M., et al. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. https://DOI: 10.1136/bmj.n71

Pascale, S., Kapnick, S.B., Delworth, T.L., & Cooke, W.F. (2020). Increasing risk of another Cape Town "Day Zero" drought in the 21st century. *Proceedings of the National Academy of Sciences*, *117*(47). https://DOI: 10.1073/pnas.2009144117

Quarshie, E.N.-B., Waterman, M.G., & House, A.O. (2020). Self-harm with suicidal and non-suicidal intent in young people in sub-Saharan Africa: a systematic review. *BMC Psychiatry*, *20*(1). https://DOI: 10.1186/s12888-020-02587-z

Rataj, E., Kunzweiler, K., & Garthus-Niegel, S. (2016). Extreme weather events in developing countries and related injuries and mental health disorders - a systematic review. *BMC Public Health*, *16*(1). https://DOI: 10.1186/s12889-016-3692-7

Rother, H.-A., Etzel, R.A., Shelton, M., Paulson, J.A., Hayward, R.A., & Theron, L.C. (2020). Impact of Extreme Weather Events on Sub-Saharan African Child and Adolescent Mental Health: A Protocol for a Systematic Review. *Atmosphere*, *11*(5). https://DOI: 10.3390/atmos11050493

Ruskin, J., Rasul, R., Schneider, S., Bevilacqua, K., Taioli, E., & Schwartz, R.M. (2018). Lack of access to medical care during Hurricane Sandy and mental health symptoms. *Preventive Medicine Reports*, *10*. https://DOI: 10.1016/j.pmedr.2018.04.014

Sabariego, C., Coenen, M., Ballert, C., Cabello, M., Leonardi, M., Anczewska, M., Pitkänen, T., Raggi, A., et al. (2015). Determinants of Psychosocial Difficulties Experienced by Persons with Brain

Disorders: Towards a 'Horizontal Epidemiology' Approach. *PLOS ONE*, *10*(12). https://DOI: 10.1371/journal.pone.0141322

Sahni, V., Scott, A.N., Beliveau, M., Varughese, M., Dover, D.C., & Talbot, J. (2016). Public health surveillance response following the southern Alberta floods, 2013. *Canadian Journal of Public Health*, *107*(2). https://DOI: 10.17269/cjph.107.5188

Sankoh, O., Sevalie, S., & Weston, M. (2018). Mental health in Africa. *The Lancet Global Health*, *6*(9). https://DOI: 10.1016/S2214-109X(18)30303-6

Sanz-Barbero, B., Linares, C., Vives-Cases, C., González, J.L., López-Ossorio, J.J., & Díaz, J. (2018). Heat wave and the risk of intimate partner violence. *Science of The Total Environment*, *644*. https://DOI: 10.1016/j.scitotenv.2018.06.368

Sena, A., Freitas, C., Feitosa Souza, P., Alpino, T., Pedroso, M., Corvalan, C., Barcellos, C., & Carneiro, F. (2018). Drought in the Semiarid Region of Brazil: Exposure, Vulnerabilities and Health Impacts from the Perspectives of Local Actors. *PLoS Currents*. https://DOI: 10.1371/currents.dis.c226851ebd64290e619a4d1ed79c8639

Simpkins, G. (2018). Unprecedented Sahel drought. *Nature Climate Change, 8*(8). https://doi: 10.1038/s41558-018-0252-4

Sohrabizadeh, S. (2016). A Qualitative Study of Violence Against Women after the Recent Disasters of Iran. *Prehospital and Disaster Medicine, 31*(4). https://doi: 10.1017/S1049023X16000431

Trudell, J.P., Burnet, M.L., Ziegler, B.R.. & Luginaah, I. (2021). The impact of food insecurity on mental health in Africa: A systematic review. *Social Science & Medicine*, *278*. https://DOI: 10.1016/j.socscimed.2021.113953

United Nations (2015). *Transforming our world: the 2030 agenda for sustainable development*. https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

Veenema, T.G., Thornton, C.P., Lavin, R.P., Bender, A.K., Seal, S., & Corley, A. (2017). Climate Change-Related Water Disasters' Impact on Population Health. *Journal of Nursing Scholarship*, *49*(6). https://DOI: 10.1111/jnu.12328

Vins, H., Bell, J., Saha, S. & Hess, J. (2015). The Mental Health Outcomes of Drought: A Systematic Review and Causal Process Diagram. *International Journal of Environmental Research and Public Health*, *12*(10). https://DOI: 10.3390/ijerph121013251

Vinyeta, K., Whyte, K., & Lynn, K. (2015). *Climate change through an intersectional lens: Gendered vulnerability and resilience in indigenous communities in the United States*. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Watts, N., Amann, M., Ayeb-Karlsson, S., Belesova, K., Bouley, T., Boykoff, M., Byass, P., Cai, W., et al. (2018). The Lancet Countdown on health and climate change: from 25 years of inaction to

a global transformation for public health. *The Lancet*, *391*(10120). https://DOI: 10.1016/S0140-6736(17)32464-9

Watts, N., Amann, M., Arnell, N., Ayeb-Karlsson, S., Beagley, J., Belesova, K., Boykoff, M., Byass, P., et al. (2021). The 2020 report of The Lancet Countdown on health and climate change: responding to converging crises. *The Lancet*, *397*(10269). https://DOI: 10.1016/S0140-6736(20)32290-X

Weilnhammer, V., Schmid, J., Mittermeier, I., Schreiber, F., Jiang, L., Pastuhovic, V., Herr, C., & Heinze, S. (2021). Extreme weather events in Europe and their health consequences – A systematic review. *International Journal of Hygiene and Environmental Health*, *233*. https://DOI: 10.1016/j.ijheh.2021.113688

Winsemius, H.C., Jongman, B., Veldkamp, T.I.E., Hallegatte, S., Bangalore, M., & Ward, P.J. (2018). Disaster risk, climate change, and poverty: assessing the global exposure of poor people to floods and droughts. *Environment and Development Economics*, *23*(3). https://DOI: 10.1017/S1355770X17000444

World Health Organization. (2012). *Risks to mental health: an overview of vulnerabilities and risk factors*. Geneva: https://www.who.int/mental_health/mhgap/risks_to_mental_health_EN_27_08_12.pdf

World Health Organization. (2013). *Comprehensive Mental Health Action Plan 2013-2020.* Geneva. https://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_R8-en.pdf?ua=1

World Health Organization. (2015). *Report on the status of major health risk factors for noncommunicable diseases: WHO Africa Region, 2015.* Geneva. https://www.afro.who.int/sites/default/files/2017-06/15264_who_afr-situation-ncds-15-12-2016-for-web_0.pdf

World Health Organization. (2018). *Mental Health Atlas 2017*. Geneva. https://www.who.int/publications/i/item/9789241514019

World Meteorological Organization. (2020). *State of the Climate in Africa 2019*. Geneva. https://library.wmo.int/doc_num.php?explnum_id=10421

Part B: Journal Article

Article to be submitted to the Science of The Total Environment journal and is written in accordance with the instructions for authors (Appendix G).

The Impact of Extreme Weather Events on Mental Health in Africa: A Mixed-Methods Systematic Review

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Highlights

- First mixed-methods review of studies on adverse mental health effects of extreme weather events in Africa
- Existing evidence on extreme weather events and mental health in Africa is limited
- Identification of vulnerability to adverse psychological outcomes
- Identification of research gaps requiring future investigation

Abstract

Introduction: The psychosocial impacts of extreme weather events are contributing to the burden of mental illness, exacerbated by pre-existing vulnerabilities. Despite an emerging global interest in this association, Africa remains poorly represented in the literature.

Methods: A mixed-methods systematic review of peer-reviewed studies was conducted to determine the adverse mental health outcomes associated with extreme weather events in Africa (2008-2021). The review was conducted in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

Results: A total of 12 204 peer-reviewed articles were identified of which 12 were retained for analysis. These studies were all conducted in 8 countries in Sub-Saharan Africa. Adverse mental health outcomes were identified resulting from flood (n=4), drought (n=4), extreme heat (n=1), bushfire (n=1), and multiple events (n=2). Findings included pathological outcomes with predictable symptomatology including mood disorders; trauma- and stressor-related disorders; and suicide. Additionally, conditions indicating psychological distress which were below the pathological threshold including emotion regulation difficulties, disturbed sleep, alcohol use, stress, and anxiety. The quantitative evidence for the association between extreme weather events and mental health was limited primarily by a lack of longitudinal data, exposure gradient, and comparison to an unaffected group, as well as a failure to provide an objective exposure measure. The qualitative evidence for this association was complimentary but without sufficient clinical measurement these outcomes cannot be verified as psychological morbidities. In addition, this review provided insight into

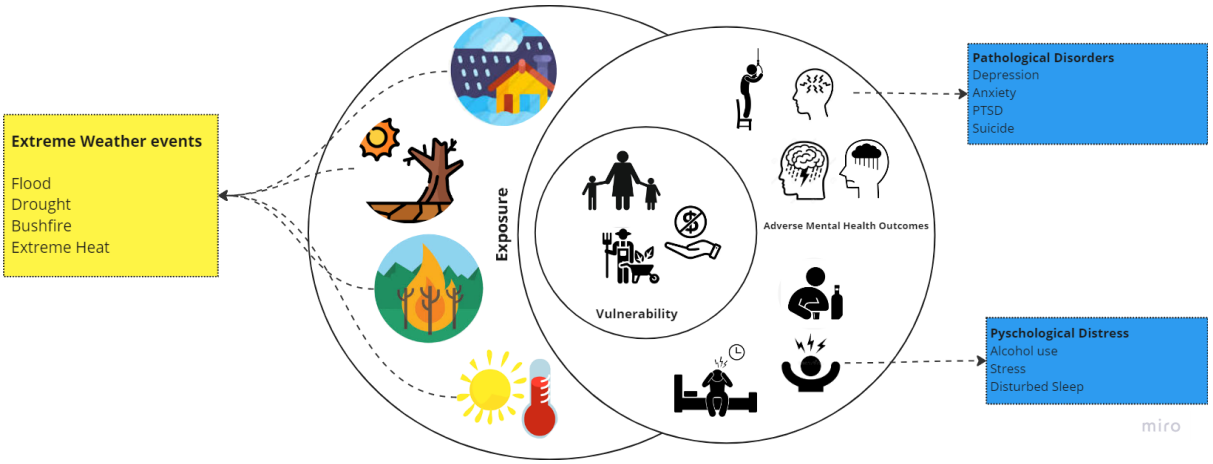
the mental health of vulnerable communities affected by extreme weather events including those living in poverty, farmers, pastoralists, women, and children.

Conclusion: This review provided some preliminary evidence for the association between extreme weather events and adverse mental health outcomes for populations in Africa. The review also provides insight to vulnerable populations affected by extreme weather events. Future research with stronger designs and methodologies are recommended.

Keywords:

Extreme Weather Events; Climate Change; Mental Health; Africa; Depression; PTSD

Graphical abstract



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1. Introduction

1.1 Background

Anthropogenic climate change is intensifying the hydrological cycle at unprecedented rates; significantly altering the strength and geographical distribution of extreme weather events (Intergovernmental Panel on Climate Change [IPCC], 2019). Increases in the frequency and duration of climate extremes resulting in floods, storms, drought, heatwaves, and bushfires pose a serious threat to the health and well-being of people (Watts et al., 2021). This is particularly true in Africa where high climate variability, low adaptive capacity and extant burden of disease contributes to the continent's vulnerability (Asmall et al., 2021). Africa is set to face the full scope of extreme weather events based on climate models predicting general warming for inland subtropical regions, instances of extreme heat in West Africa, changes in precipitation patterns including increased aridity in Southern Africa and wetter conditions in Eastern Africa (World Meteorological Organization [WMO], 2021). These

factors combined with high instances of poverty, resource-dependent livelihoods, political instability, and rising inequality presupposes that healthcare systems in Africa require strengthening and preparation to deal with the ramifications of climate-driven extreme weather events.

In addition to the myriad of physical health risks stemming from changes in the distribution of infectious disease, injury, and disrupted access to adequate food and drinking water, the impact of extreme weather events on mental health is of emerging interest. In the most recent report on climate change and health, the Lancet highlighted the need to develop indicators related to mental health when assessing climate change impacts (Watts et al., 2021). Further, several systematic reviews have recently been conducted exploring this association. Cianconi et al. (2020) undertook a descriptive global review that looked at the impact of climate change and psychiatric illness including studies on flooding, drought, heatwaves, hurricanes, and wildfires. In their analysis, exposure to acute events such as floods were comparable to well-established mechanisms of trauma, resulting in a range of psychopathological sequelae. Posttraumatic stress disorder (PTSD) was a commonly cited outcome following acute stress experienced during and immediately after an extreme weather event. Especially if there was resultant loss of life, injury, and poor social support (Kim, 2016). Other common outcomes following the experience of an acute event included depression, general anxiety, suicidal ideation, and the misuse of drugs and alcohol (Cianconi et al., 2020). While exposure to a prolonged climate extreme such as drought resulted in reduced social functioning, demoralisation, fatalism and feelings of distress and helplessness (Cunsolo Willox et al., 2013). A second review focusing specifically on mental health disorders and exposure to extreme weather events in developing countries was conducted by Rataj et al. (2016). Prevalence rates of psychiatric disorders including PTSD, anxiety and depression were higher post-disaster compared to reference data in 16 of the 17 included studies. Notably, Africa was underrepresented in Cianconi et al.'s (2020) review with just one study identified and no country-specific analysis undertaken, while Africa was wholly omitted from Rataj et al.'s (2016) due to a lack in both quality and quantity of data available on the continent. Recently, Rother et al. (2022) attempted to synthesise the literature on extreme weather events and child and adolescent mental health in sub-Saharan Africa, identifying only 2 studies. The scarcity of this research reflects a broader issue of mental health care on the continent. Africa reports both the lowest government mental health expenditure per region at $0.1 per capita and the lowest number of mental health workers at 0.9 per 100 000 population (World Health Organisation [WHO], 2018). These figures are concerning considering that Africa reports higher than global incidence of age-standardised

suicide rate (WHO, 2018) and higher than global average prevalence of depressive disorders (Lancet, 2022).

Extreme weather events have the potential to amplify the prevalence of adverse mental health outcomes. They may introduce stressful events, degrade the social and economic conditions conducive to good mental health, and exacerbate pre-existing conditions. Disruptions to healthcare services and damaged infrastructure may also deplete the capacity of countries to treat and prevent mental disorders (Cianconi et al., 2020). Notably, these impacts will not be equitably distributed. The potential uptake of mental illness is inherently higher among some populations based on social, cultural, and political factors related to sex, age and socio-economic status which magnify their vulnerability (Chaplin et al., 2019). Identifying these vulnerabilities and conducting region specific research is crucial to enhancing the adaptive capacity of African healthcare systems and highlighting the need to include mental health and psychosocial support needs in climate change adaptation and emergency planning.

This study aimed to systematically review the scientific evidence on the association between extreme weather events and adverse mental health outcomes for persons living on the African continent. This aim is aligned with global initiatives including those of the World Health Organisation who have called for the strengthening of evidence and research for mental health, particularly in developing countries (WHO, 2021). As well as those of the United Nations who have identified the promotion of mental health and reduction of suicide mortality as targets for Sustainable Development Goal 3, to “ensure healthy lives and promote well-being for all, at all ages” (United Nations, 2015, n.p).

2. Methods

2.1 Study Design

An integrated mixed-methods systematic review of published peer-reviewed studies was conducted to determine the adverse mental health outcomes associated with extreme weather events in Africa. The selection of a mixed-methods design was informed by the findings of a scoping review on climate change and mental health (Charlson et al., 2021) which reported that 28.3% and 15.8% of identified studies were qualitative and mixed-methods designs, respectively. As well as the growing prominence of synthesising diverse forms of evidence in contemporary health research. Especially when the intention is to inform policy and practice (e.g., Pearson et al., 2015). Due to the heterogeneity of findings, a narrative synthesis is presented in lieu of a meta-analysis.

2.2 Defining study variables

Disruptions to mental health are multi-layered and can present differently across age, sex, and cultural groups (Yeo & Suárez, 2022). While mental health is typically viewed as a state of well-being, distinct from mental illness the two are strongly related with mental health status shown to be predictive of mental illness (Keyes et al., 2012). However, the measurement of mental health outcomes has important implications for informing policy. Therefore, the following definitions have been used:

> Mental health is a dynamic state of internal equilibrium which enables individuals to use their abilities in harmony with universal values of society. Basic cognitive and social skills; ability to recognize, express and modulate one's own emotions, as well as empathise with others; flexibility and ability to cope with adverse life events and function in social roles; and harmonious relationship between body and mind represent important components of mental health which contribute, to varying degrees, to the state of internal equilibrium (Galderisi et al., 2015, p. 231).

Mental illness/disorder: “Any condition characterised by cognitive and emotional disturbances, abnormal behaviours, impaired functioning, or any combination of these (American Psychological Association, 2022, para 1). In this review, the definition of a disorder was dependent on the use of clinically accepted psychometric tests.

Psychological distress: “A set of painful mental and physical symptoms that are associated with normal fluctuations of mood in most people. In some cases, however, psychological distress may indicate the beginning of … a variety of other clinical conditions.” (American Psychological Association, 2022, para 1).

2.2 Literature Search Strategy and Selection Criteria

An extensive electronic search was conducted in November 2021. The search strategy included keywords related to Extreme Weather Events AND Mental Health AND Africa. An initial search strategy incorporating both Medical Subject Headings (MeSH) fields and additional search terms was developed for MEDLINE, via the PubMed search engine (See Appendix A for the detailed PubMed search strategy). This search strategy was then adapted for other databases including: Academic Search Premier, Africa-Wide Information, Cumulative Index of Nursing and Allied Health Literature [CINAHL], Health Source: Nursing/Academic Edition, APA PsycARTICLES and APA PsycINFO via EBSCOHost platform, Scopus (which includes records from Embase), and Web of Science Core Collection and SciELO Citation Index databases via Web of Science (See Appendix H for full search history). Articles written in English and published between January 2008 and

November 2021 were included. This start date coincided with the launch of the World Health Organisation's Mental Health Action Plan which called for enhanced research and evidence for mental health (WHO, 2021). Reference indices of identified papers were also hand-searched. Additional inclusion and exclusion criteria were established to guide article selection prior to engaging with the searches.

A study was considered eligible if it met the following conditions:

- Articles related to extreme weather events and their impacts on mental health
- Articles discussing adverse mental health outcomes including a range of mental and behavioural disorders with standardised classifications and operationalised using psychometric tests
- Articles discussing adverse mental health outcomes including negative affect, reduced positive emotion, and culturally relevant descriptions of distress
- Research conducted in any region of Africa and related territories including sovereign island nations
- Qualitative, quantitative, and mixed-methods study designs

A study was considered ineligible if it met the following conditions:

- Articles discussing normal psychology, cognition, or cognitive decline
- Articles discussing mental health tangentially
- Articles discussing general climate change
- Articles discussing events that are not attributable to abnormal climatic factors
- Articles discussing non-weather-related natural disasters
- Systematic, review, and modelling type studies

2.3 Data Analysis

This review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Page et al., 2021) (Appendix B). Studies identified in the search strategy were exported to the reference manager, Endnote. Titles and abstracts of studies were then imported to Rayyan and read and assessed for eligibility. Studies were excluded in-line with the exclusion criteria listed above. Studies that met the inclusion criteria were retained for full-text review. Studies retained for full-text review were subsequently imported to Covidence where data extraction and Quality Assessment was conducted using the National Heart, Lung, and Blood Institute (2021) Quality Assessment tool for Observational Cohort and Cross-Sectional Studies (Appendix D) and the Joanna Briggs Institute (2020) critical appraisal checklist (Appendix E). Screening

was done by the primary author [MD], and any uncertainty regarding a study's relevance was discussed with supervising academics for consensus. All duplicate articles were excluded.

3. Results

The screening and grouping steps followed in the literature search are summarised in Figure 1. A total of 12 204 peer-reviewed articles were identified through the database search. Hand-searching reference lists yielded no additional results that met the inclusion criteria. Following the removal of duplicates and an initial title and abstract screening, 167 articles were retained for full-text review. Studies that were excluded following full-text review did not report adverse mental health outcomes (58 articles), were not associated with an extreme weather event (50 articles), were not conducted in Africa (7 articles) or were dissertation, modelling, or review designs (39 articles). One article could not be located even with the assistance of a librarian (see Appendix I for articles excluded following full-text review). A final sample of 12 studies that met the criteria for review were included for analysis. Of those 12 studies, four used qualitative methodologies, four were cross-sectional designs, two were interventional, one was an ecological study, and one utilised a mixed-methods design that was partly cross-sectional.

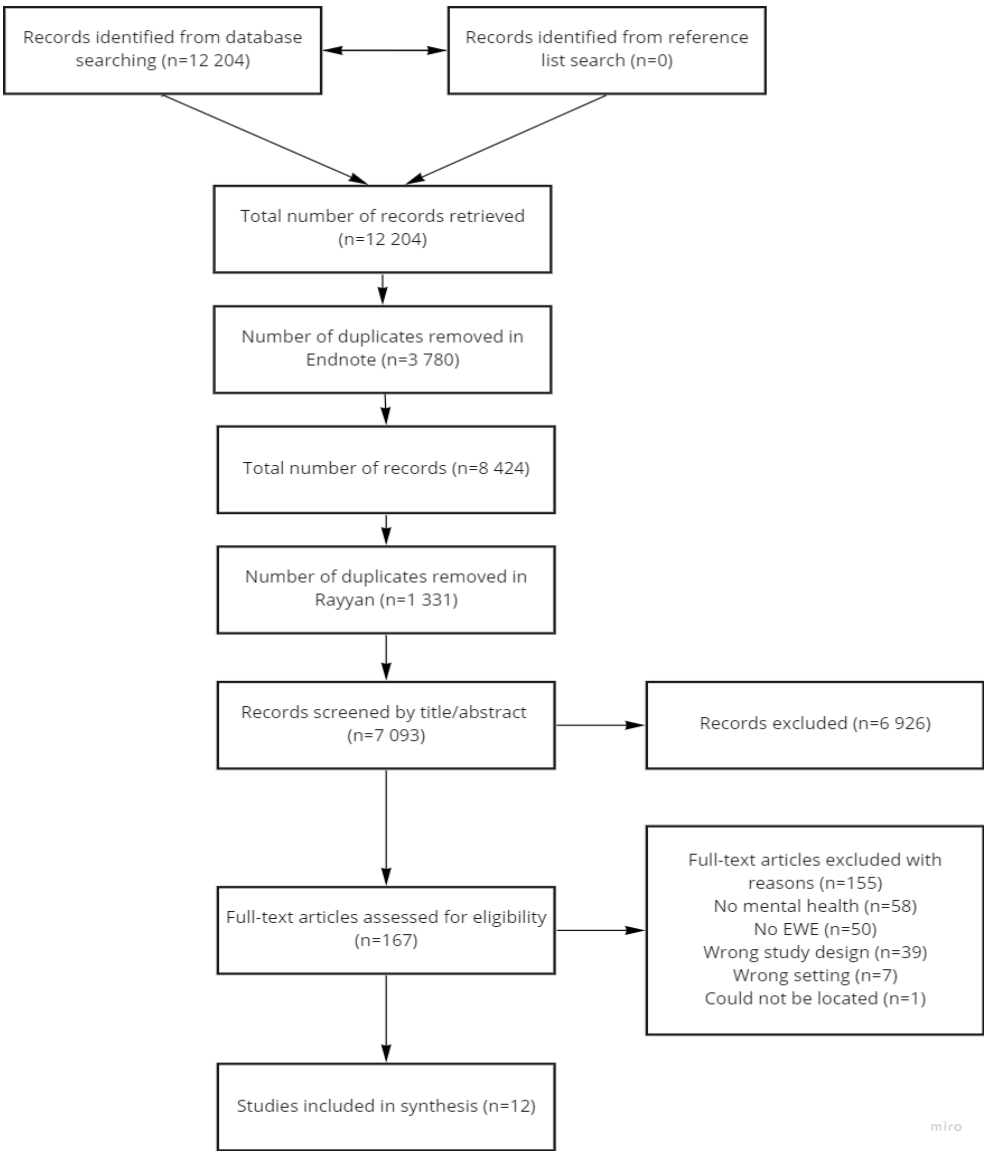

Figure 1. PRISMA flow diagram showing article selection process.

The articles were grouped according to the type of extreme weather event. Flood and drought were the most commonly studied phenomenon with four studies each, extreme heat, and bushfires had one study each and two studies considered overlapping extreme weather events. Eight studies identified pathological mental health outcomes, i.e., recognised disorders with predictable symptomatology as described in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association [APA], 2013). These outcomes were dependent on the use of clinically accepted psychometric tests. Pathological outcomes identified in the reviewed studies were Mood Disorders, including depression (n=3 studies); Trauma- and Stressor-Related Disorders, including trauma symptoms (n=3 studies) and PTSD (n=1); and suicide (n=1).

Other outcomes were those reported in qualitative and mixed-methods studies which did not use standardised psychometric tests. These outcomes were categorised as psychological distress and included participant descriptions of disturbed sleep suggestive of insomnia, emotion regulation difficulties, including intrusive thoughts, alcohol use, and culturally specific feelings of sadness or worry. Some of these symptoms may be indicative of a psychiatric condition but without sufficient clinical measurement the evidence for extreme weather events and psychiatric conditions emerging from qualitative studies is difficult to classify using diagnostic terminology.

3.1 Flood

The details of the four studies that considered flood and adverse mental health outcomes are described in Table 1. The majority of the studies (n=3) were quantitative in design (Taukeni et al., 2016; Crombach & Siehl, 2018; Ede et al., 2021). These were conducted in Namibia, Burundi, and Nigeria. All the outcomes measured in these studies were pathological including PTSD and depression (n=1), Posttraumatic depression (n=1), and trauma symptomatology corresponding to PTSD (n=1), and used standardised psychometric tests validated in similar populations. The qualitative study conducted in Ghana (Adams & Nyantakyi-Frimpong, 2021) reported on psychological distress outcomes, including acute anxiety and chronic stress, determined from thematic analysis of participant descriptions. The flooding incidents in all four studies resulted from heavy rains and were all described as extreme, resulting in the damage of property, disruptions to livelihood, and mortality. The qualitative study (Adams & Nyantakyi-Frimpong, 2021) investigated chronic and recurrent flooding while the three quantitative studies (Taukeni et al., 2016; Crombach & Siehl, 2018; Ede et al., 2021) focused on a discrete flooding incident that relied on emergency interventions including the establishment of camps for displaced persons, medical aid, food relief and the closure of schools and clinics.

Table 1. Studies exploring adverse mental health outcomes resulting from flood.

Author(s)	Study Design and Setting	Sampling and Measurement	Findings
FLOOD			
Adams & Nyantakyi-Frimpong (2021)	A qualitative study exploring the impact of flooding was conducted in Old Fadama, the largest informal settlement in Accra, Ghana's capital city. There is a history of extreme and recurrent flooding resulting in both destruction of property and mortality.	Between June 2018 and June 2020, a purposely selected sample of N= 20 Old Fadama residents were asked to capture five photographs exploring the impact of flooding. The SHOWED approach (Wang, 1999 as cited in Adams & Nyantakyi-Frimpong, 2021), and in-depth interviews were conducted to gain further detail. Data was grouped into themes. Verbatim quotations were included alongside the photographs to serve as low-inference descriptors.	Various negative psychological outcomes were reported by participants who experienced flooding, particularly elevated anxiety, and chronic stress in regard to the flooding event. Anxiety was often aroused in participants when the weather was cloudy, in anticipation of the consequences of flooding. Mental health effects were more prominent than physical effects including injury and infection as evidenced by the number of photographs.
Crombach & Siehl (2018)	An interventional, non-randomised-allocation study was used to test the efficacy of Narrative Exposure Therapy (NET) on PTSD and depression in victims of flood. In February 2014, heavy rainfall flooded several districts of Burundi's capital city. The study area was three emergency camps, established in response to the flooding disaster.	Between April 2014 and May 2015, N=40 participants were identified by Burundian Red Cross workers and determined to have met the minimum diagnostic criteria for PTSD. N=15 participants with the most severe symptoms received NET. A baseline assessment quantified lifetime trauma, suicidal tendencies, and PTSD and depression symptom severity. NET group participants received 6 sessions of therapy, one-per-week, that lasted between 1.5-2.5 hours. Sessions were conducted by trained counsellors. Repeated assessments were conducted at 3-months and 9-months	At baseline, both groups reported high PTSD and depression symptom severity and moderate-severe suicidal tendencies. Time emerged as a significant main effect with improved PTSD symptom severity for both groups from baseline to 9-month assessment (Hedges'g NET = 3.44; Hedges'g No-Treatment = 2.55). Both Time ($F (2, 32) = 9.35$, $p < .001$, $\eta 2 p = .23$) and Group ($F (1, 16) = 8.26$, $p = .011$, $\eta 2 p = .20$) emerged as significant main effects for depression symptom severity. Participants were prepared to forgo 1-months wages to receive post-trauma treatment.
Ede et al. (2021)	A Pre-test/Post-test experimental study was used to test the efficacy of Rational Emotive Behaviour Therapy (REBT) on posttraumatic depression in victims of flood. The study area was Kogi state, Nigeria. Nigeria has experienced increasingly frequent incidences of flooding from coastal, river and urban flooding.	Between September 2019 and November 2019, N=98 farmers met the minimum diagnostic criteria of depression. Participants were randomly allocated to groups. A Pre-test assessment quantified depression using two indicators. REBT participants received 20 therapy sessions of 50 minutes each over 12 weeks. Sessions were conducted by professional mental health counsellors. A Post-test assessment was conducted for both groups after the 12^{th} week. Two additional follow-up assessments were conducted after the Post-test.	At Pre-test there were no significant group differences for posttraumatic depression. Mean depression scores for both groups were above the conventional clinical cut-off score indicating severe depression using both scales. Significant group differences between REBT and control were indicated by Hamilton and Goldberg's Scales at Post-test ($F (1, 97) =378.484$, $p=0.001$; and $F (1, 97) =65.653$, $p=0.001$), respectively.
Taukeni et al. (2016)	A cross-sectional study assessing Post-Traumatic Stress Disorder following extreme flooding was conducted in Namibia.	In 2013, N=429 school children living in the Oshana region consented and completed a self-administered Child Trauma Screening Questionnaire (CTSQ). The test was administered by professional social workers and educational psychologists.	A number of children had a mean trauma score of >5 suggesting the existence of trauma and potential risk for PTSD. A total of 55.2% and 72.8% of the younger and older learners, respectively, reported experiencing symptoms of trauma, corresponding to PTSD, resulting from the floods.

According to the quality assessments, two of the studies were rated as ‘good’ (Adams & Nyantakyi-Frimpong, 2021; Taukeni et al., 2016) and two as ‘fair’ (Crombach & Siehl, 2018; Ede et al., 2021). There were several limitations in the studies reviewed. Despite the good quality assessment of the study by Adams and Nyantakyi-Frimpong (2021), women who are uniquely vulnerable during flooding due to differential domestic duties, were highly underrepresented in the study. Qualitative studies do not intend to be generalizable but susceptibility to mental disorders can exist along gendered lines thus limiting the evidence of this study. Taukeni et al. (2016) used a predictive trauma screening tool designed to be administered shortly after disaster exposure which may have introduced measurement bias. This study was conducted two-years post-flood and relied on children's retrospective memories for the event. Crombach and Siehl (2018) had a small sample size, high participant attrition rate, and a non-randomized study design. Ede et al. (2021) failed to give a clear sampling methodology, did not detail the timeline for the post-test assessments, and did not analyse symptom severity improvement between baseline and follow-up within groups. Both interventional studies demonstrated the efficacy of therapeutic intervention in alleviating adverse mental health symptoms for victims of flood who receive treatment compared to control. However, in Ede et al. (2021) no time analysis was conducted and both groups had high symptom severity at baseline therefore it is unclear whether Rational Emotive Behaviour Therapy (REBT) improved symptom severity overall. While the flooding events were described as ‘extreme’ by the authors, this assessment was subjective as no meteorological data was consulted nor a threshold applied. Ultimately none of the four studies provided an objective flood measure nor compared mental health outcomes to an unexposed group, which limits the findings.

3.2 Drought

The details of the four studies that considered drought and adverse mental health outcomes are described in Table 2. Two cross-sectional studies conducted in Botswana (Shannonhouse et al., 2019; Zeligman et al., 2020) measured trauma symptomatology using the Harvard Trauma Scale, a standardised psychometric test validated in populations in Southern Africa (e.g., Padmanabhanunni et al., 2017). While both studies measured trauma in a drought-impacted sample, the target outcome variable differed between them. Shannonhouse et al. (2019) showed that drought-related losses significantly positively predicted current trauma symptoms. There was also evidence of an exposure gradient with participants rating the degree to which they were impacted by drought on a Likert Scale. However, the clinical relevance of this finding is unclear as researchers used an averaged symptom severity score without indicating a threshold. In comparison, Zeligman et al. (2020) used a conventional clinical cut-off indicating a potential PTSD diagnosis in some

participants. Both studies indicated gender differences with female drought victims reporting higher symptom severity than their male counterparts.

A qualitative study conducted in Botswana (Babugura, 2008) found that drought negatively impacted children's mental health, particularly through the exacerbation of poverty. There was a common belief among guardians in the study that children's mental health was not an issue as all their physical needs were being met. There were also gender differences with girls being more vulnerable to adverse mental health due to increased domestic responsibilities and engagement in sex work. Notably, this study presented conflicting results as some participants reported less psychological distress during periods of drought due to the financial compensation they received from the Government. Another qualitative study conducted in Ethiopia (Cooper et al., 2019) occurred during the dry season following a La Nina event which intensified drought in the region. Participants gave culturally relevant descriptions of negative affect, indicating depression and anxiety, arising from water insecurity.

In terms of quality ratings, one of the studies associated with drought was ‘good’ (Cooper et al. 2019), and three were ‘fair’ (Babugura, 2008; Shannonhouse et al., 2019; Zeligman et al., 2020). The study sample in the Shannonhouse et al. (2019) and Zeligman et al. (2020) studies is non-representative as university students are likely to have access to additional resources compared to the general population. Both studies have cross-sectional designs which limits the evidence due to a lack of temporality. A limitation in the study by Shannonhouse and others (2019) was the use of an adapted disaster-related resource loss questionnaire typically used following acute, not chronic disasters. Another limitation in the latter study was the exclusion of items related to basic services such as food and water that did not have a correlation greater than 0.5 in the factor analysis using least squares. For particularly vulnerable populations, such as subsistence farmers or pastoralists, drought is likely to impede access to these items and contribute significantly to trauma. No objective measure of drought was detailed, and exposure varied across the studies including data collection during a drought period, water insecurity as a proxy indicator, and drought-related resource losses. Other than Cooper et al. (2019), who had participants describe the emotions associated with water security, in contrast to water insecurity, no study had a strong comparison to a non-drought period thereby limiting the findings.

Table 2. Studies exploring adverse mental health outcomes resulting from drought.

Author(s)	Study Design and Setting	Sampling and Measurement	Findings
DROUGHT			
Babugura (2008)	A qualitative study assessing children's vulnerability during drought was conducted in Botswana. The study was conducted in Matsheng village, located about 500km from the capital city Gaborone. The area is highly rural, underdeveloped and surrounded by wildlife management areas.	In 2005, N=30 children (10-18 years) and N= 25 guardians consented to participate. Data collection occurred through 3 avenues, picture drawing, open-ended questions, and narration of stories. Face-to-face interview techniques were used for guardians and with children who were considered the heads of their households. The interviews focused on the ways in which children communicated their experiences of drought.	Children indicated that seeing dead livestock and having less free time due to increased domestic workloads negatively impacted their mental health. Children also suffered the dual burden of poor mental health in their guardians. Arguments and family tension resulting from the drought contributed to stress, frustration, and feelings of guilt. A fear of separation from siblings and subsequent abuse and maltreatment was a source of worry. Children turned to alcohol and smoking as a way to cope.
Cooper et al. (2019)	A qualitative study using focus group and interview data explored the relationship between water security and emotional well-being in the Afar Region, Ethiopia. The area is semi-arid and characterised by low rainfall and extreme heat. Three villages with varying access to improved (free from contamination) water were selected.	In December 2017, two-focus group discussions were held in each village with N=16 participants. Participants were asked about their daily lives and stresses. In March 2018 this process was repeated with different participants matched for characteristics. Participants were asked specifically about water security. Interviews were recorded, transcribed, and thematically coded. Emotions described by participants were ranked from positive to negative and as active or passive, with the assistance of a translator.	Afar pastoralists described 6 emotions related to anxiety (negative-active) and 3 words related to depression (negative-passive), due to water insecurity. Participants felt extreme grief, worry, helplessness, and feelings of isolation, and abandonment, resulting in suicidal ideation. No positive emotions were reported by participants in relation to water insecurity. In contrast, participants described feelings of happiness, relief, peace, and security during the rainy season when water was readily available.
Shannonhouse et al. (2019)	A cross-sectional study exploring the association between disaster-related resource loss (DRL), religious coping, and trauma symptoms was conducted in Botswana. This arid region is covered in large part by the Kalahari Desert. The study was conducted at a major university in Botswana.	In 2016, a convenience sample of N=300 university students were contacted by a local research team over a 1-month period. Paper versions of consent forms and test instruments were provided to students who completed them during class. Students completed culturally adapted measures of disaster-related losses, positive and negative religious coping, meaning-focused coping, lifetime trauma exposure and current trauma symptoms.	Majority of participants reported experiencing disaster-related losses to a considerable degree. Total DRL's ($r = .22$, $p < .01$), personal characteristics ($r = .12$, $p < .01$), conditions ($r = .20$, $p < .01$), and energies ($r = .23$, $p < .01$) were significantly associated with trauma symptoms. Only DRL objects were not. Hierarchical regression analysis indicated that female gender ($\beta = .16, p < .05$), trauma exposure ($\beta = .35, p < .05$),and DRL energies (sleep, free-time, money)($\beta = .72, p < .05$) all predicted trauma symptoms. Other DRL's (objects, personal characteristics, conditions) did not significantly predict symptoms.
Zeligman et al. (2020)	A cross-sectional study assessing the relationship between social and religious variables, trauma symptoms, and post-traumatic growth was conducted during a chronic drought period in Botswana.	In 2016, N=300 students were recruited from counselling courses at a major university. Students were approached by local researchers and signed consent forms. Hard copies of the surveys were given to students to complete in class. The survey assessed symptoms of trauma occurring in the week prior to testing.	44% of participants had a mean trauma symptom severity score of > 2.5 indicating a potential PTSD diagnosis. Females (M=2.39) reported more trauma symptoms than males (M=2.16,$t(297) = -3.03$, $p = .003$) but also greater levels of social support. Bivariate correlations indicated that trauma symptoms ($r = .17$, $p < .01$, social support ($r = .35$, $p < .01$), and religious coping ($r = .26$, $p < .01$) were all positively associated with posttraumatic growth.

3.3 Extreme heat

The details of a single ecological study (Kim et al., 2019) conducted in multiple countries, including South Africa are described in Table 3. This large-scale study investigated the association between ambient temperature and suicide. Suicide is considered a psychiatric complication which may be predicted by mental illness but can also correlate with poor quality of life (Fehling & Selby, 2021). Climate and suicide data were obtained from reliable databases. Higher ambient temperatures were associated with increased risk of suicide and there was some evidence for seasonality.

The quality of this study was rated as 'good'. However, it is important to note that the suicide data set provided for South Africa was likely underreported or misclassified according to authors (Kim et al., 2019). South African data for suicide rates in younger and elder people, which may skew distribution, were not available and therefore not analysed. Further there is a risk of ecological fallacy present in this study due to the inference of individual health outcomes from climatic exposures.

3.4 Bushfire

The details of a single qualitative study (Becker et al., 2015) assessing the association between bushfire and psychological distress are described in Table 3. The fire supposedly resulted from a damaged cable which ignited a nearby bush. Increasingly dry conditions due to climate change were identified as contributing factors. This qualitative study was conducted in South Africa and relied on participant recollections of emotional experiences in the months following the event. Differential patterns of emotions and coping strategies emerged over time. There was evidence of PTSD symptomatology including intrusive thoughts, disturbed sleep, anger, and anxiety as well as adverse coping strategies such as deliberate avoidance and emotional dismissal resulting from the experience of bushfire.

The quality of this study was rated as 'fair' due to the reliance on retrospective self-reported data that included reconstructed memories for an event that occurred several months before the interview period. This is a major limitation in studies of traumatic events as poor memory for the event can be a symptom of PTSD.

3.5 Multiple Extreme Weather Events

The details of two studies which explored the association between multiple extreme weather events and adverse mental health outcomes are described in Table 3. One cross-sectional study conducted in Tanzania (Prencipe et al., 2021) reported a pathological mental outcome, namely symptoms associated with depression using the Centre for Epidemiological Studies

Depression Scale, a standardised test previously used in similar populations. One mixed-methods study conducted in Ghana (Acharibasam & Anuga, 2018) reported emotional regulation practises using an Affective Style Questionnaire measuring concealing, adjusting, and tolerating.

Acharibasam and Anuga (2018) reported that participants were experiencing multiple extreme weather events which differentially predicted engagement in emotion regulation tendencies. The experience of extreme weather events, and the degree of perceived psychological closeness, increased engagement in maladaptive strategies, predisposing participants to mental disorders. There is also evidence for differences in emotion regulation tendencies for acute and chronic events. Prencipe et al. (2021) reported that rates of depression were higher among participants who experienced recent drought or flood compared to those who did not. There were also gender differences with higher rates of depression and increased symptom severity among boys who experienced extreme weather events compared to girls.

Quality ratings of these studies were both ‘fair’. Acharibasam and Anuga (2018) used a mixed-methods design but did not describe the qualitative data collection methods or qualitative data analysis. There was also no comparison with a sample unaffected by extreme weather events. Prencipe et al. (2021) did not provide an objective measure for drought or flooding but rather combined data from various household surveys reporting negative shocks from drought, irregular rainfall, flood, or landslide, into one indicator. Further, Prencipe et al. (2021) used a cut-off value of 10 or higher to indicate depression, while this is standard according to the scale, validation metrics in other African populations suggest a cut-off value of >13 (Baron et al., 2017). Therefore, it is possible that depression was overestimated in this sample.

Table 3. Studies exploring adverse mental health outcomes resulting from extreme heat, bushfire, and multiple events.

Author(s)	Study Design and Setting	Sampling and Measurement	Findings
Extreme Heat			
Kim et al. (2019)	An ecological study was conducted across multiple locations in 12 countries, including South Africa. Data was collected from 52 districts in South Africa, of those 13 districts were excluded from analysis due to missing values of either extreme temperature or suicide counts. A list of the districts is provided for in the study's supplementary materials.	Data for South Africa was collected between 1 January 2000 and 31 December 2013. Daily mean temperature and daily total sunshine duration was provided by the Agricultural Research Council of South Africa and the National Oceanographic and Atmospheric Association (NOAA) of the United States. Daily suicide counts were obtained from Statistics South Africa.	Higher ambient temperatures were associated with increased risk of suicide. This observation was non-linear with the highest risk occurring at 27 °C (the 93rd percentile). The relative risk was RR= 1.33 (95% CI:1.30, 1.36) for the highest risk compared to that occurring in the first percentile. The temperature for the highest risk of suicide in South Africa was in the 99th percentile where the association was almost linear. Minimum mean surface temperature in South Africa was 7.6°C corresponding to 1st percentile and Maximum mean surface temperature was 26.4°C corresponding to the 99th percentile. The risk ratio was RR=1.79 (95%CI: 1.30, 2.46). Seasonal patterns for suicide were less clear for South Africa but suicide counts tended to be lower in the cool season, between May and July, with a peak in December.
Bushfire			
Becker et al. (2015)	A qualitative study exploring the long-term psychological effects of bushfire disaster was conducted in the North-West province of South Africa. This highly arid region is predominantly rural. Most of the economic activity is centred around agriculture which accounts for the majority of formal employment in the region. Bushfires occur regularly, resulting in the loss of life and affecting livelihoods, cattle, and equipment.	A purposively selected sample of N=8 farmers who had been affected by the fire were invited to participate in the study. Farmers were interviewed 9 months after the fire and asked to retrospectively describe their emotional experiences. Interviews were semi-structured, lasted between 60-80 minutes and were conducted on each respective farm. The interviews were recorded, transcribed, and analysed. Textual data was analysed using thematic content analysis. Themes were identified. Verbatim extracts were then selected as evidence to each theme.	Emotional experiences and emotion-focused coping emerged distinctly across 3 time periods. In the first three days after the fire participants described feelings of helplessness, shock, sadness, fear, anxiety, and anger. Many reported intense anxiety from the magnitude of the destruction which resulted in disturbed sleep. Farmers employed psychic numbing, distraction and assigning blame as a way to cope with their emotional responses. In the following three months farmers reported experiencing intrusive thoughts and insomnia. Others say they began to feel better during this period of psychological recovery. Some farmers were able to regulate their emotions while others deliberately minimised or dismissed them. Nine months after the fire, farmers reported anxiety in anticipation of future fires. They were also concerned that another fire would undo the psychological recovery they had made.
Multiple Extreme Weather Events			

Acharibasam & Anuga (2018)	A mixed-methods study assessing emotional regulation practices given psychological distance to climate change was conducted in Northern Ghana. The sample was drawn from three regions thought to be vulnerable to climate change. These were the Talensi-Nabdam District in the Upper East Region, Sawla-Tuna Kalba in the Northern Region, and Lawra District in the Upper West Region.	A convenience sample of N=180 smallholder farmers were recruited by trained field assistants. A semi-structured questionnaire was employed to assess three variables. 1) Mental health risks using a psychological affective style modelling scale. 2) psychological distance of climate change including geographical and social. 3) Adaptation measures. This was completed by all participants. Additional interviews were conducted with female farmers to assess their unique vulnerabilities to extreme weather events.	Excessive heat (β=17.85) erratic rainfalls (β=7.95) and floods (β=4.92) emerged as statistically significant direct correlates of emotional regulation. While heat and drought emerged as statistically significant when moderated by perceived psychological closeness. Concealing emotions was inversely correlated with floods and heat and positively so with drought and erratic rainfall. Floods, heat, and drought were all significantly moderated by psychological closeness. Adjusting was negatively associated with floods, heat, and drought but positively with erratic rainfall. Adjusting to drought was significantly moderated by closeness. Tolerating was positively associated with each event except heat. When moderation of psychological closeness was checked, flood, heat and drought were significant but erratic rainfall became negatively correlated.
Prencipe et al. (2021)	A cross-sectional study exploring the social determinants of depression was conducted in Tanzania. Data was collected in 130 villages from four districts within the Iringa and Mbeya regions of mainland Tanzania.	Cross-sectional data from N= 2458 youths (14-19 years) was collected from April to June 2017 and May to June 2018. All youths lived in households that were participating in a governmental social intervention programme. Data came from village, household, and youth surveys which were translated into Swahili. Mental health was assessed using the 10-item Centre for Epidemiological Studies Depression Scale. Questions assessed symptoms and behaviours for the week prior to assessment. A cut-off score of 10 or greater indicates depression. Married youths and those over 18 gave their permission to participate. Caregiver permission was obtained for the other participants.	Nearly one-third of the sample, n=796 (32%) had been affected by droughts or floods in the year prior to the survey. Higher rates of depression were found for youth affected by droughts/floods (35%) than not (26%). Depressive symptomatology was higher among boys who experienced droughts or floods (40%) than boys who did not (26%) at the level of significance. The percentage of depressed females who experienced drought/flood was higher than those who did not (29% versus 26%) but this was not at the level of significance. The association between extreme precipitation and depressive symptoms was strongest among boys, as evidenced by a mean CES-D10 score more than 1 point higher than the reference score which was significant (β=1.03; 95% CI 0.51 to 1.90). Factors associated with depressive symptoms in the fully adjusted models included experiencing droughts/floods (β=0.76; 95% CI 0.36 to 1.17) as well as experiencing five or more household economic shocks (β=2.40; 95% CI 1.48 to 3.32), being in a relationship (β=1.82; 95% CI 1.30 to 2.33) and having moderate (β=1.26; 95% CI 0.80 to 1.71) or low (β=2.27; 95% CI 1.81 to 2.74) social support.

4. Discussion

4.1 Summary of findings

The purpose of this review was to provide a systematic analysis of the relationship between extreme weather events and adverse mental health outcomes for people living on the African continent. A total of 12 identified studies including quantitative (n=7), qualitative (n=4) and mixed-methods (n=1) studies, investigated adverse mental health outcomes resulting from flood, drought, extreme heat, bushfires and multiple events. This review found some evidence that experiencing an extreme weather event was associated with mental disorders including depression, trauma symptomology, PTSD, and suicide, as well as adverse emotional symptoms below the pathological threshold including disturbed sleep, emotion regulation difficulties, and stress.

The extreme weather events identified in this study mirror the hazards of greatest concern for the African region in which flood was identified as the highest risk followed by drought and then temperature increase, based on an analysis of the Nationally Determined Contributions of 53 African countries (WMO, 2021). Despite accounting for 17% of reported disasters and 37% of economic losses in Africa (WMO, 2021) no studies exploring the impacts of storms were identified. Cyclones, dust storms and cold snaps are also underrepresented in the literature.

Four studies (Adams & Nyantakyi-Frimpong, 2021; Crombach & Siehl, 2018; Ede et al., 2021; Taukeni et al., 2016) reported stress, anxiety and trauma-related mental health disorders including depression and PTSD in victims of extreme flooding, with these conditions persisting several months after the event. Two studies (Crombach & Siehl, 2018; Ede et al., 2021) demonstrated that therapeutic intervention was effective in alleviating the symptoms of these disorders in participants who received treatment compared to controls. Interestingly, there was a downward trend in symptom severity in the control groups of both studies which Crombach and Siehl (2018) attributed to spontaneous recovery among less psychologically affected individuals. However, this was not compared to an unaffected group and the duration of each intervention fails to provide insight into the nature of longer-term psychiatric morbidities. For example, longitudinal data from 819 participants on depression, anxiety and PTSD following a flooding event in England found that after three years crude mental disorder prevalence amongst flood victims stabilised at higher rates compared to an unaffected population (Mulchandani et al., 2020). This was despite a reduction in psychological morbidity within the flooded group during that time period (Mulchandani et al., 2020). Given the potentially delayed onset and persistent nature of these conditions longitudinal epidemiological evidence is necessary to fully comprehend the mental health trajectories following flooding.

Four studies were conducted on drought (Babugura, 2008; Cooper et al., 2019; Shannonhouse et al., 2019; Zeligman et al., 2020). Drought-related resource losses, particularly money, free-time, and sleep, significantly predicted trauma symptoms (Shannonhouse et al., 2019), while trauma symptom severity indicating a PTSD diagnosis was reported by 44% of participants experiencing a chronic drought (Zeligman et al., 2020). However, identifying trauma and PTSD in relation to drought is potentially challenging as its definition in the DSM-5 (APA, 2013) stipulates that it must arise from actual or threatened death, injury, or sexual violence, as such, drought, which is a psychosocial stressor, does not meet this definition. Droughts, unlike acute events such as floods, are considered creeping processes with indistinctive onsets and are not immediately life-threatening. It is therefore difficult to identify the traumatic incident within a chronic drought period. Yet, vulnerability to drought in developing countries may be dramatically increased to the extent that severe drought could threaten life, particularly for populations where primary food source and livelihood are dependent on natural resources.

Additionally, drought has been linked to increases in transactional sex and sexual violence which does meet the definition of trauma, especially among women and girls (Women Deliver, 2021). In this review, the adverse economic impact of drought resulted in some participants engaging in sexual activities in exchange for money (Babugura, 2008) making them vulnerable to sexual violence. The impact of drought on trauma and PTSD is clearly complex, with multiple causal pathways that require integration when guiding Public Mental Health interventions. Further thinking about chronic, slow-onset climate extremes is necessary when correlating plausible psychopathologies; consideration of chronic exposure, as well as creeping (increasingly severe) exposures warrants further research.

There was evidence that drought increased several indicators of psychological distress, as reported by victims during qualitative interviews, including grief, isolation, worry, and a range of negative emotions that were conceptualised as depression and anxiety (Cooper et al., 2019). Additionally, adverse coping strategies in response to drought-related stressors were found to drive alcohol use (Babugura, 2008). The link between drought and substance abuse has been well-established and is presumed to arise from unemployment, income loss, migration, and drought-related disease stressors (Orievulu et al., 2022). However, there was conflicting evidence from one study that suggested drought improved mental health due to increased work opportunities and government-supplied food parcels during drought periods (Babugura, 2008). This highlights the complexities of decoupling economic vulnerabilities and health vulnerabilities in research on climate extremes in Africa.

One study indicated that extreme heat increased the risk of suicide (Kim et al., 2019). Suicide rate is particularly responsive to changes in atmospheric conditions with increases linked to air pollution (Aguglia et al., 2021), relative humidity (Florido Ngu et al., 2021) and solar radiation (Jee et al., 2017). A range of plausible biological mechanisms have been proposed to account for the relationship between high temperatures and mental health (for a detailed discussion see Lõhmus, 2018). However, these associations have been criticised by researchers in developing countries for failing to account for underlying economic impacts. For example, temperature increases of 1 °C caused an excess of suicide deaths in India, but only during the agricultural growing season when heat impacted crop production (Carleton, 2017).

Interestingly, a projection in estimated suicide rate under unmitigated climate change conditions, in the USA and Mexico, predicted an increase of 1.4% (95% CI: 0.6%–2.6%) and 2.3% (95% CI: −0.3%–5.6%), respectively, surpassing the impacts of an economic recession (Burke et al., 2018). These findings add depth to the thinking around suicide as a mental health indicator in climate change. In addition to atmospheric environmental factors, suicide risk is associated with a range of individual characteristics, socio-economic, demographic and biological factors, combined with stressful life events (Fehling & Selby, 2021). The use of population-level suicide data without meaningful disaggregation, such as in the included study, limits our understanding of the interplay between these elements.

Another study demonstrated that experiencing a bushfire resulted in a myriad of adverse psychological outcomes for farmers including insomnia, anger, helplessness and anxiety (Becker et al., 2015). There is also some evidence emerging from this review that highlights the effects specific to experiencing multiple, and/or overlapping extreme weather events. Experiencing either drought or flood in the previous year predicted higher depression symptom severity in youths compared to an unaffected group (Prencipe et al., 2021). The regional climatic variability across Africa anticipates that people will be exposed to concurrent and contrasting events significantly increasing their vulnerability and increasing the complexities of adaptation and public health intervention (IPCC, 2019). Acharibasam and Anuga (2018) for example, confirmed that farmers were actively experiencing multiple extreme weather events which predicted maladaptive emotion regulation strategies. This is concerning as several clinical studies have indicated that inappropriate emotion regulation contributes to the development and maintenance of psychopathologies, particularly anxiety and depression (Compare et al., 2014).

4.2 Vulnerability

This review has provided insight into vulnerable communities affected by extreme weather events. The factors found to be contributing to the vulnerability of participants in African settings were most commonly poverty and low-socio-economic status, resource-dependent livelihoods, age, gender, socio-political conflict, and government intervention capacity. Economic vulnerability is a major issue throughout Africa with 34% of people living below the poverty threshold (Human, 2021). In the event of an extreme weather event, those living in poverty are likely to lose a higher percentage of wealth due to damage to material possessions, repair costs, time away from work, and increased food prices. Additionally, poverty predicts exposure to climate extremes as poor people are more likely to live in locations with high exposure - such as flood plains, have limited or no infrastructure/service delivery, and limited adaptation options such as air conditioning. One study assessing the global exposure of poor people to extreme weather events found that, in Africa, those living in poverty had disproportionately high exposure to both flood and drought compared to the country average (Winsemius et al., 2018).

For some climate extremes the primary causal pathway impacting on mental health is via the degradation of economic activity especially when these activities are reliant on agriculture or water (Vin et al., 2015). In the current review farmers and pastoralists were regularly identified as the population of interest based on their vulnerability to bushfire (Becker et al., 2015), drought (Cooper et al., 2019), flood (Ede et al., 2021) and multiple extreme weather events (Acharibasam & Anuga, 2018). Farmers and pastoralists reported both direct and indirect climate-driven stressors such as, sustaining property damage, witnessing death, crop failure, livestock death, and increased labour, sometimes resulting in social isolation and suicidal ideation. This mirrors the findings of other studies on extreme weather events and mental health in farmers conducted in both developed and developing countries (Austin et al., 2018; Carleton 2017, respectively).

Children are considered vulnerable to poor mental health following exposure to an extreme weather event for various physiological and social reasons including developing cognitive functions, immature emotion regulation capacity, reliance on their caregivers, and limited social protection, all of which puts them at risk of exploitation or abuse (Rother et al., 2022). Among the studies in this review, children reported schooling interruptions, decreased playtime, nightmares, irritability, trouble sleeping, and noticing mental distress in their guardians, all contributing to their own poor mental health (Babugura, 2008; Taukeni et al. 2016). Relative age of the children was an important factor and influenced mental health outcomes, for example older children (>13 years) were more likely to report psychological symptoms of trauma following flood exposure while younger children more often reported

physical symptoms of trauma (Taukeni et al., 2016). This has implications for age-relevant trauma identification and intervention, especially in Africa where mental health literacy is limited and so psychosomatic conditions could be misdiagnosed.

Other factors such as orphanhood and living in single-parent or child-headed households increased vulnerability during drought periods with children reporting economic hardship, increased domestic and care duties as well as fear of separation from their siblings (Babugura, 2008). The paucity of research on extreme weather events and children's mental health in Africa has already been identified by Rother et al. (2022) who highlighted the need to facilitate children's resilience by implementing mental health interventions at the family, school, and community levels.

Gender differences in the health effects from extreme weather events were also identified but the findings were conflicting, especially the evidence for internalising mental health disorders. For example, women and girls were found to have higher trauma and PTSD symptom severity (Taukeni et al., 2016; Shannonhouse et al. 2019; Zeligman et al., 2020), while boys had higher depression symptom severity (Prencipe et al., 2021). Women also reported increased domestic responsibilities, and lower social capital which prevented them from accessing the same resources as men during disaster periods (Babugura, 2008; Acharibasam & Anuga, 2018). However, women and girls also reported higher levels of social support (Babugura, 2008; Zeligman et al., 2020) which has been shown to preserve women's mental health during extreme weather events (Harandi et al., 2017).

Certain vulnerable groups such as physically-disabled persons, ethnic minorities, and climate-driven migrants were either not identified or beyond the scope of this review. According to a report by the World Bank (2018), 86 million people in sub-Saharan Africa are anticipated to be displaced by climate change by 2050. Climate refugees have unique vulnerabilities driven by disrupted healthcare access, cramped living conditions, marginalisation, and a lack of resilience-enabling factors such as social support (DiGiorgi et al., 2020). Other displacement related vocabulary has begun to emerge in the climate change and mental health literature, for example, solastalgia was introduced to describe the distress associated with displacement following environmental degradation or loss of one's home and belongings (Askland & Bunn, 2018). Displacement and its consequences may act as important secondary stressors following an extreme weather event.

Additional vulnerabilities worth exploring would be mental comorbidities, as people living with serious mental illness are, in general, less prepared for disasters, and have greater difficulties coping, evidenced by increased incidences of forced hospitalisation for mental illness in disaster-affected communities (Substance Abuse and Mental Health Services

Administration [SAMHSA], 2019). Further, several studies in the United States have confirmed that pre-existing mood, anxiety, and alcohol-use disorders are risk factors for post-disaster psychopathology (North et al., 2018; Stough & North, 2018). Finally, these vulnerabilities rarely exist in isolation, the combination of socio-demographic, economic, cultural, and political factors that forge disaster risk profiles must be identified and considered synchronously so that healthcare systems with limited resources can target those most at risk.

4.3 Comparisons with other reviews

A small number of systematic reviews synthesising the literature on extreme weather events and mental health exist. Those most closely aligned to the aims of this review were conducted by Rataj et al. (2016), Cianconi et al. (2020), and Rother et al. (2022). The strength of evidence in all reviews was limited by the quantity of available literature and a lack of meta-analysis due to the heterogeneity of included studies.

Rataj et al. (2016) reviewed observational evidence [case-control, cohort and cross-sectional studies] until 2014 in developing countries. A total of n=17 studies were retained for analysis. All the studies were conducted in either Asia (n=11) or South America (n=6) and only two included studies were from countries in the lowest HDI category. No studies conducted in Africa were identified. Exposure to a storm (tropical cyclone, hurricane, tornado, snowstorm) or flood resulted in increased prevalence of mental disorders compared to the global rate. No studies on heat waves or droughts were identified. Mental health outcomes of interest were much narrower including PTSD, anxiety disorders and depressive disorders exclusively. Predictive and risk factors for mental illness acquisition were identified, including death of a family member, poor health status, damage to house or valuables, and seeing dead bodies. No evidence for anxiety disorders or predictive factors were found in the current review. Similar methodological limitations were reported by Rataj et al. (2016) as were identified in the current review, including lack of comparison to an unexposed or control group.

Cianconi et al. (2020) conducted a global review of literature on the association between climate change and psychiatric illness (1996-2019). Both the global review and the current review included qualitative studies and found evidence of adverse mental health outcomes resulting from extreme heat, flooding, drought, and wildfires. Cianconi additionally reported hurricanes, and general climate change as exposures. Due to the magnitude of their review which included 163 papers, several mental health outcomes were identified that are not represented here. Some of which include mood and anxiety disorders resulting from heat waves, psychosomatic illness following bushfire, and a host of outcomes associated with

storms, cyclones and hurricanes. Authors also included papers that explored vulnerable groups including indigenous communities and migrants. However, Cianconi et al. (2020) did not contextualise the evidence with reference to geographical parameters, development and health indices or local factors. It is therefore unclear whether differences in climatic exposures, disease profiles and mental health stigma will alter the manifestation of mental illness, limiting the transferability of evidence into practice.

Rother et al. (2022) conducted a review on the impact of extreme weather events on child and adolescent mental health in Sub-Saharan African. Despite a comprehensive search of both published and grey literature since 1989 only two studies met the inclusion criteria. The two studies provided evidence on the impact of flood and psychological distress. One study (Taukeni et al., 2016) identified by Rother et al. (2022) is also included in the current review. The other, was excluded following full-text review due to a focus on resilience rather than adverse mental health outcomes. The scope of the current review is similar to that of Rother et al. (2022) but includes qualitative methodologies and investigates these outcomes for persons of all ages.

4.4 Limitations in the studies reviewed and, in this study

Evidence on the strength of the association between extreme weather events and mental health in Africa is limited, in part, due to the heterogeneity of the study designs, which prevented meta-analysis. The small sample of studies which met the inclusion criteria for review . As well as inherent weaknesses in the study designs available to investigate climatic exposures and mental health outcomes including difficulties establishing cause-effect relationships and inconsistent or non-standard thresholds for weather events (see Asmall et al., 2021). In this review, the majority of the quantitative study designs were cross-sectional (62.5%) and one was ecological, therefore temporality could not be demonstrated and there was potential loss of data resolution or misclassification. No longitudinal study designs were identified which is a major limitation in mental health research as disorders may have late onset or non-linear trajectories.

The most common limitations noted include a lack of an exposure gradient and comparison with an unexposed or control group, as well as a failure to provide an objective exposure measure. Only half of the quantitative studies (50%) included an exposure gradient in their analysis (Acharibasam & Anuga, 2018; Kim et al., 2019; Shannonhouse et al., 2019; Prencipe et al., 2021). Comparison of health outcomes in groups with different levels of exposure including an unexposed or control group is considered the gold-standard in epidemiological designs for generating scientific evidence. The lack of control groups in the studies reviewed may be due to several factors including the fact that the exposure

assessment typically relied on self-reported or subjective ratings and not decentralised objective indicators. Underdeveloped healthcare systems, stigmatisation, and a general scarcity of mental health care on the continent means that pre-disaster population-level mental health data is virtually non-existent. Further, mental health data collection following disaster periods is typically collected in the field, under difficult conditions and with participants who may be traumatised and not willing to undergo extensive testing. In these circumstances, there are sampling limitations and little control over exposure variation.

Additionally, verification of psychological morbidities in non-westernised populations has faced criticism for its lack of accuracy and relevance (Quarshie et al., 2020). Mental health assessment tools are typically developed in western populations, even those that have been validated in what are subjectively considered 'similar populations' have indicated key differences including cut-off scores for clinical diagnoses depending on factors such as language and education which significantly alter the representation of patterns of mental illness in Africa. Unfortunately, psychometric tools are subject to measurement variance whereby measurement of a construct is not equivalent across groups and therefore not meaningful or valid. Measurement bias in disaster-related outcomes such as trauma have been found across gender, age, and HIV status (Rodriguez et al., 2018) which is particularly prevalent in sub-Saharan Africa. Therefore, the use of psychometric tests with limited cultural validation should be interpreted with caution.

Alternatively, research into culturally-specific individual risk factors to mental disorders may be more useful. The argument has been made that even well-described disorders such as PTSD are culturally-bound and unlikely to accurately represent the well-being of participants within particular contexts (Gilmoor et al., 2019). An extrapolation of this argument is that diagnosing mental disorders will diminish the prominence of economic and social stressors in the prediction and maintenance of poor mental health (Fernando et al., 2010). A remedy to this paradox would be to adopt a more holistic approach to mental health that is not focused on pathologisation. For example, the World Health Organisation considers mental health to be "a state of mental well-being that enables people to cope with the stresses of life, realize their abilities, learn well and work well, and contribute to their community." (WHO, 2022, para 1). While this conceptualisation was beyond the scope of the current study, redirecting research away from mental disorders and towards barriers to the attainment of good mental health may produce data that is more inclusive and culturally-fluid.

Importantly no study attempted to explore the critical features of an extreme weather event that may increase mental health risk. Factors such as type, severity, proximity, duration, or presence of an early warning system are important as individual predictors of risk but also

due to evidence of a dose-response relationship between high exposure to an extreme weather event and mental illness severity (Bei et al., 2013). Future research should focus on mapping psychological outcomes from specific geographical parameters of extreme weather events.

Generalisability is limited by the number of countries represented. Despite purposefully including literature from Northern African states in the search parameters, all studies were conducted in sub-Saharan Africa. A total of eight countries were represented - Botswana, Burundi, Ethiopia, Ghana, Namibia, Nigeria, South Africa, and Tanzania. The country representation could be due in part to the economic and scientific wealth correlate. It is well-established that both the quality and quantity of scientific literature is predicted by economic affluence and investment into research and development activities (Rodríguez-Navarro & Brito, 2022). Of the 11 African countries with a per Capita GDP higher than the continent average, 5 of them are represented in the current review (Nigeria, South Africa, Ethiopia, Ghana, Tanzania) (Statista, 2022).

Stronger epidemiological evidence for the association between extreme weather events and mental morbidities may be available in languages other than English, considering the large numbers of Francophone and Lusophone countries in Africa. The reliance on peer-reviewed studies is also acknowledged as a limitation given the economic investment required to publish, especially for developing countries. Future reviews should include grey literature sources to account for this. Finally, this review included both quantitative and qualitative literature in an effort to strike a balance between scientific rigour and cultural sensitivity. While there is evidence for poor mental health following extreme weather events in qualitative studies these cannot be verified as psychological morbidities. To do so would be to risk the pathologisation of normal psychological responses to adverse conditions. Therefore, while qualitative analysis is useful and adds to a deeper understanding of the relationship between climate extremes and well-being, the weight of this evidence should be interpreted with a consideration of the severity and duration of mental distress exhibited by the participant.

5. Conclusion

This review provided some preliminary evidence for the association between extreme weather events and adverse mental health outcomes for populations in Africa. There was however a concerning lack of literature available focusing on the relationship between these variables. The psychosocial impacts of flood, drought, extreme heat, bushfire and multiple extreme weather events resulted in a range of mental morbidities including PTSD, depression, trauma, suicide and conditions below the pathological threshold including

disturbed sleep, emotion regulation difficulties, stress and anxiety. While the strength of the evidence is weak owing to a number of methodological weaknesses in the identified studies, there is potential for climate extremes to seriously degrade mental health and promote the uptake of psychopathologies. As identified in this review a number of intrinsic vulnerabilities exist that compound that risk. More research is necessary to identify all associated stressors and key climatic variables that modulate this association. Additionally, increased mental health surveillance systems should be introduced to provide comparative reference data. As extreme weather events begin to occur with more frequency and intensity, failure to accurately comprehend the mental health effects will only increase the burden of disease and prevent attainment of Africa's development goals.

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8. Reference list

Acharibasam, J. W., & Anuga, S. W. (2018). Psychological distance of climate change and mental health risks assessment of smallholder farmers in Northern Ghana: Is habituation a threat to climate change? *Climate Risk Management*, *21*. https://doi.org/10.1016/j.crm.2018.04.002

Adams, E. A., & Nyantakyi-Frimpong, H. (2021). Stressed, anxious, and sick from the floods: A photovoice study of climate extremes, differentiated vulnerabilities, and health in Old Fadama, Accra, Ghana. *Health & Place*, *67*. https://doi.org/10.1016/j.healthplace.2020.102500

Aguglia, A., Giacomini, G., Montagna, E., Amerio, A., Escelsior, A., Capello, M., Cutroneo, L., Ferretti, G., Scafidi, D., Costanza, A., Serafini, G., & Amore, M. (2021). Meteorological Variables and Suicidal Behavior: Air Pollution and Apparent Temperature Are Associated With High-Lethality Suicide Attempts and Male Gender. *Frontiers in Psychiatry*, *12*. https://doi.org/10.3389/fpsyt.2021.653390

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

American Psychological Association. (2022). Dictionary of Psychology. Washington DC. https://dictionary.apa.org/.

Askland, H. H., & Bunn, M. (2018). Lived experiences of environmental change: Solastalgia, power and place. *Emotion, Space and Society*, *27*, 16–22. https://doi.org/10.1016/j.emospa.2018.02.003

Asmall, T., Abrams, A., Röösli, M., Cissé, G., Carden, K., & Dalvie, M. A. (2021). The adverse health effects associated with drought in Africa. *Science of The Total Environment*, *793*, 148500. https://doi.org/10.1016/j.scitotenv.2021.148500

Austin, E. K., Handley, T., Kiem, A. S., Rich, J. L., Lewin, T. J., Askland, H. H., Askarimarnani, S. S., Perkins, D. A., & Kelly, B. J. (2018). Drought-related stress among farmers: findings from the Australian Rural Mental Health Study. *Medical Journal of Australia*, *209*(4), 159–165. https://doi.org/10.5694/mja17.01200

Babugura, A. (2008). Vulnerability of children and youth in drought disasters: A case study of Botswana. *Children, Youth and Environments*, *18*, 126–157.

Baron, E. C., Davies, T., & Lund, C. (2017). Validation of the 10-item Centre for Epidemiological Studies Depression Scale (CES-D-10) in Zulu, Xhosa and Afrikaans populations in South Africa. *BMC Psychiatry*, *17*(1), 6. https://doi.org/10.1186/s12888-016-1178-x

Becker, C., Roos, V., & Coetzee, H. (2015). Disaster recovery experiences of a South African rural farming community. *Journal of Psychology in Africa*, *25*(3). https://doi.org/10.1080/14330237.2015.1065051

Bei, B., Bryant, C., Gilson, K.-M., Koh, J., Gibson, P., Komiti, A., Jackson, H., & Judd, F. (2013). A prospective study of the impact of floods on the mental and physical health of older adults. *Aging & Mental Health*, *17*(8). https://doi.org/10.1080/13607863.2013.799119

Burke, M., González, F., Baylis, P., Heft-Neal, S., Baysan, C., Basu, S., & Hsiang, S. (2018). Higher temperatures increase suicide rates in the United States and Mexico. *Nature Climate Change*, *8*(8), 723–729. https://doi.org/10.1038/s41558-018-0222-x

Carleton, T. A. (2017). Crop-damaging temperatures increase suicide rates in India. *Proceedings of the National Academy of Sciences*, *114*(33). https://doi.org/10.1073/pnas.1701354114

Chaplin, D., Lovell, E., & Twigg, J. (2019). *Intersectional approaches to vulnerability reduction and resilience-building*. https://doi.org/10.13140/RG.2.2.13404.03209

Charlson, F., Ali, S., Benmarhnia, T., Pearl, M., Massazza, A., Augustinavicius, J., & Scott, J. G. (2021). Climate Change and Mental Health: A Scoping Review. *International Journal of Environmental Research and Public Health*, *18*(9). https://doi.org/10.3390/ijerph18094486

Cianconi, P., Betrò, S., & Janiri, L. (2020). The Impact of Climate Change on Mental Health: A Systematic Descriptive Review. *Frontiers in Psychiatry*, *11*. https://doi.org/10.3389/fpsyt.2020.00074

Compare, A., Zarbo, C., Shonin, E., van Gordon, W., & Marconi, C. (2014). Emotional Regulation and Depression: A Potential Mediator between Heart and Mind. *Cardiovascular Psychiatry and Neurology*, *2014*, 1–10. https://doi.org/10.1155/2014/324374

Cooper, S., Hutchings, P., Butterworth, J., Joseph, S., Kebede, A., Parker, A., Terefe, B., & van Koppen, B. (2019). Environmental associated emotional distress and the dangers of climate change for pastoralist mental health. *Global Environmental Change*, *59*. https://doi.org/10.1016/j.gloenvcha.2019.101994

Crombach, A., & Siehl, S. (2018). Impact and cultural acceptance of the Narrative Exposure Therapy in the aftermath of a natural disaster in Burundi. *BMC Psychiatry*, *18*(1). https://doi.org/10.1186/s12888-018-1799-3

Cunsolo Willox, A., Harper, S. L., Ford, J. D., Edge, V. L., Landman, K., Houle, K., Blake, S., & Wolfrey, C. (2013). Climate change and mental health: an exploratory case study from Rigolet, Nunatsiavut, Canada. *Climatic Change*, *121*(2). https://doi.org/10.1007/s10584-013-0875-4

DiGiorgi, E., Michielin, P., & Michielin, D. (2020). Perception of climate change, loss of social capital and mental health in two groups of migrants from African countries. *Annali Dell'Istituto Superiore Di Sanita*, *56*(2), 150–156. https://doi.org/10.4415/ANN_20_02_04

Ede, M. O., Adene, F. M., Okeke, C. I., Mezieobi, D. I., Isiwu, E. N., & Abdullahi, Y. (2022). The Effect of Rational Emotive Behaviour Therapy on Post-Traumatic Depression in Flood Victims. *Journal of Rational-Emotive & Cognitive-Behavior Therapy*, *40*(1). https://doi.org/10.1007/s10942-021-00401-7

Fehling, K. B., & Selby, E. A. (2021). Suicide in DSM-5: Current Evidence for the Proposed Suicide Behavior Disorder and Other Possible Improvements. *Frontiers in Psychiatry*, *11*. https://doi.org/10.3389/fpsyt.2020.499980

Fernando, G.A., Miller, K.E., & Berger, D.E. (2010). Growing pains: the impact of disaster-related and daily stressors on the psychological and psychosocial functioning of youth in Sri Lanka. *Child Dev, 81*(4). https://doi: 10.1111/j.1467-8624.2010.01462.x

Florido Ngu, F., Kelman, I., Chambers, J., & Ayeb-Karlsson, S. (2021). Correlating heatwaves and relative humidity with suicide (fatal intentional self-harm). *Scientific Reports*, *11*(1), 22175. https://doi.org/10.1038/s41598-021-01448-3

Galderisi, S., Heinz, A., Kastrup, M., Beezhold, J., & Sartorius, N. (2015). Toward a new definition of mental health. *World Psychiatry*, 14(2), 231–233. https://doi.org/10.1002/wps.20231

Gilmoor, A. R., Adithy, A., & Regeer, B. (2019). The Cross-Cultural Validity of Post-Traumatic Stress Disorder and Post-Traumatic Stress Symptoms in the Indian Context: A Systematic Search and Review. *Frontiers in Psychiatry*, *10*. https://doi.org/10.3389/fpsyt.2019.00439

Harandi, T.F., Taghinasab, M., & Nayeri, D.T. (2017). The correlation of social support with mental health: A meta-analysis. *Electronic Physician*, *9*(9). https://doi.org/10.19082/5212

Human, J.H. (2021, February 25). African countries continue to have the highest poverty rates in the world. Development Aid. https://www.developmentaid.org/#!/news-stream/post/84943/highest-poverty-rates-in-africa

Intergovernmental Panel on Climate Change. (2019). Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In press

Jee, H.-J., Cho, C.-H., Lee, Y. J., Choi, N., An, H., & Lee, H.-J. (2017). Solar radiation increases suicide rate after adjusting for other climate factors in South Korea. *Acta Psychiatrica Scandinavica*, *135*(3), 219–227. https://doi.org/10.1111/acps.12676

Joanna Briggs Institute. (2020). Checklist for Qualitative Research. https://jbi.global/critical-appraisal-tools

Keyes, C. L. M., Eisenberg, D., Perry, G. S., Dube, S. R., Kroenke, K., & Dhingra, S. S. (2012). The Relationship of Level of Positive Mental Health With Current Mental Disorders in Predicting Suicidal Behavior and Academic Impairment in College Students. Journal of American College Health, 60(2), 126–133. https://doi.org/10.1080/07448481.2011.608393

Kim, E. J. (2016). U.S. Global Change Research Program: The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. *Journal of the American Planning Association*, *82*(4). https://doi.org/10.1080/01944363.2016.1218736

Kim, Y., Kim, H., Gasparrini, A., Armstrong, B., Honda, Y., Chung, Y., Ng, C. F. S., Tobias, A., Íñiguez, C., Lavigne, E., Sera, F., Vicedo-Cabrera, A. M., Ragettli, M. S., Scovronick, N., Acquaotta, F., Chen, B.-Y., Guo, Y.-L. L., Seposo, X., Dang, T. N., … Hashizume, M. (2019). Suicide and Ambient Temperature: A Multi-Country Multi-City Study. *Environmental Health Perspectives*, *127*(11). https://doi.org/10.1289/EHP4898

Lancet. (2022). Global, regional, and national burden of 12 mental disorders in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *The Lancet Psychiatry*, *9*(2), 137–150. https://doi.org/10.1016/S2215-0366(21)00395-3

Lõhmus, M. (2018). Possible Biological Mechanisms Linking Mental Health and Heat—A Contemplative Review. *International Journal of Environmental Research and Public Health*, *15*(7), 1515. https://doi.org/10.3390/ijerph15071515

Mulchandani, R., Armstrong, B., Beck, C. R., Waite, T. D., Amlôt, R., Kovats, S., Leonardi, G., Rubin, G. J., & Oliver, I. (2020). The English National Cohort Study of Flooding & Health: psychological morbidity at three years of follow up. *BMC Public Health*, *20*(1). https://doi.org/10.1186/s12889-020-8424-3

National Heart, Lung, and Blood Institute. (2019). Study Quality Assessment Tools. https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools

North, C. S., Baron, D., & Chen, A. F. (2018). Prevalence and predictors of postdisaster major depression: Convergence of evidence from 11 disaster studies using consistent methods. Journal of Psychiatric Research, 102, 96–101. https://doi.org/10.1016/j.jpsychires.2017.12.013

Orievulu, K. S., Ayeb-Karlsson, S., Ngema, S., Baisley, K., Tanser, F., Ngwenya, N., Seeley, J., Hanekom, W., Herbst, K., Kniveton, D., & Iwuji, C. C. (2022). Exploring linkages between drought and HIV treatment adherence in Africa: a systematic review. *The Lancet Planetary Health*, *6*(4), e359–e370. https://doi.org/10.1016/S2542-5196(22)00016-X

Padmanabhanunni, A., Campbell, J., & Pretorius, T. B. (2017). Gendered role of appraisals of safety in psychological outcome in relation to trauma. *Psychological Trauma: Theory, Research, Practice, and Policy*, *9*(5), 518–525. https://doi.org/10.1037/tra0000167

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. https://doi.org/10.1136/bmj.n71

Pearson, A., White, H.,Bath-Hextall, F., Salmond, S., Apostolo, J., & Kirkpatrick, P. (2015). A mixed-methods approach to systematic reviews. *JBI Evidence Implementation, 13*(3). https://doi: 10.1097/XEB.0000000000000052

Prencipe, L., Houweling, T. A., van Lenthe, F. J., Palermo, T. M., & Kajula, L. (2021). Exploring multilevel social determinants of depressive symptoms for Tanzanian adolescents: evidence from a cross-sectional study. *Journal of Epidemiology and Community Health*, *75*(10). https://doi.org/10.1136/jech-2020-216200

Quarshie, E. N.-B., Waterman, M. G., & House, A. O. (2020). Self-harm with suicidal and non-suicidal intent in young people in sub-Saharan Africa: a systematic review. *BMC Psychiatry*, *20*(1). https://doi.org/10.1186/s12888-020-02587-z

Rataj, E., Kunzweiler, K., & Garthus-Niegel, S. (2016). Extreme weather events in developing countries and related injuries and mental health disorders - a systematic review. *BMC Public Health*, *16*(1). https://doi.org/10.1186/s12889-016-3692-7

Rodriguez, V. J., Radusky, P. D., Kumar, M., Nemeroff, C. B., & Jones, D. (2018). Measurement invariance of the Childhood Trauma Questionnaire by gender, poverty level, and HIV status. *Personalized Medicine in Psychiatry*, *11–12*, 16–22. https://doi.org/10.1016/j.pmip.2018.10.002

Rodríguez-Navarro, A., & Brito, R. (2022). The link between countries' economic and scientific wealth has a complex dependence on technological activity and research policy. *Scientometrics*. https://doi.org/10.1007/s11192-022-04313-w

Rother, H.-A., Hayward, R. A., Paulson, J. A., Etzel, R. A., Shelton, M., & Theron, L. C. (2022). 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*, *5*, 100087. https://doi.org/10.1016/j.joclim.2021.100087

Shannonhouse, L. R., Bialo, J. A., Majuta, A. R., Zeligman, M. R., Davis, D. E., McElroy-Heltzel, S. E., Aten, J. D., Davis, E. B., van Tongeren, D. R., & Hook, J. N. (2019). Conserving resources during chronic disaster: Impacts of religious and meaning-focused coping on Botswana drought survivors. *Psychological Trauma: Theory, Research, Practice, and Policy*, *11*(2). https://doi.org/10.1037/tra0000420

Statista. (2022). *African countries with the highest Gross Domestic Product (GDP) in 2021*. https://www.statista.com/statistics/1120999/gdp-of-african-countries-by-country/

Stough, L. M., & North, C. S. (2018). The association of adverse mental health effects with repeated exposure to disasters. *Annals of Clinical Psychiatry : Official Journal of the American Academy of Clinical Psychiatrists*, *30*(1), 17–24.

Substance Abuse and Mental Health Services Administration. (2019). *Disasters and People With Serious Mental Illness: Disaster Technical Assistance Centre Supplemental Research Bulletin.* https://www.samhsa.gov/sites/default/files/disasters-people-with-serious-mental-illness.pdf

Taukeni, S., Chitiyo, G., Chitiyo, M., Asino, I., & Shipena, G. (2016). Post-traumatic stress disorder amongst children aged 8–18 affected by the 2011 northern-Namibia floods. *Jàmbá: Journal of Disaster Risk Studies*, *8*(2). https://doi.org/10.4102/jamba.v8i2.169

United Nations (2015). *Transforming our world: the 2030 agenda for sustainable development*. Geneva. https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

Vins, H., Bell, J., Saha, S., & Hess, J. (2015). The Mental Health Outcomes of Drought: A Systematic Review and Causal Process Diagram. *International Journal of Environmental Research and Public Health*, *12*(10). https://doi.org/10.3390/ijerph121013251

Watts, N., Amann, M., Arnell, N., Ayeb-Karlsson, S., Beagley, J., Belesova, K., Boykoff, M., Byass, P., Cai, W., Campbell-Lendrum, D., Capstick, S., Chambers, J., Coleman, S., Dalin, C., Daly, M., Dasandi, N., Dasgupta, S., Davies, M., di Napoli, C., … Costello, A. (2021). The 2020 report of The Lancet Countdown on health and climate change: responding to converging crises. *The Lancet*, *397*(10269). https://doi.org/10.1016/S0140-6736(20)32290-X

Winsemius, H. C., Jongman, B., Veldkamp, T. I. E., Hallegatte, S., Bangalore, M., & Ward, P. J. (2018). Disaster risk, climate change, and poverty: assessing the global exposure of poor people to floods and droughts. *Environment and Development Economics*, *23*(3). https://doi.org/10.1017/S1355770X17000444

Women Deliver. (2021). *The link between climate change and sexual and reproductive health and rights*. https://womendeliver.org/wp-content/uploads/2021/02/Climate-Change-Report.pdf

World Bank. (2018). *Groundswell - Preparing for Internal Climate Migration*. https://www.worldbank.org/en/news/infographic/2018/03/19/groundswell---preparing-for-internal-climate-migration

World Health Organization. (2018). *Mental Health Atlas 2017*. Geneva. https://www.who.int/publications/i/item/9789241514019

World Health Organization. (2021). *Comprehensive mental health action plan 2013–2030*. Geneva. https://www.who.int/publications/i/item/9789240031029

World Health Organization. (2022). Mental health: strengthening our response. Geneva. https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response

World Meteorological Organization. (2021). *State of the Climate in Africa 2020*. https://library.wmo.int/index.php?lvl=notice_display&id=21973#.YrBhXHZByUk

Yeo, Z. Z., & Suárez, L. (2022). Validation of the mental health continuum-short form: The bifactor model of emotional, social, and psychological well-being. PLOS ONE, 17(5), e0268232. https://doi.org/10.1371/journal.pone.0268232

Zeligman, M., Majuta, A. R., & Shannonhouse, L. R. (2020). Posttraumatic growth in prolonged drought survivors in Botswana: The role of social support and religious coping. *Traumatology*, *26*(3). https://doi.org/10.1037/trm0000237

Part C: Appendices

Appendix A: PubMed Search Strategy

Exposure:		
#1	**MeSH terms:**	Weather OR Extreme Weather OR Climatic Processes OR Disasters
#2	**Text Word:**	avalanche OR avalanches OR climate change OR cyclone OR cyclones OR cyclonic OR drought OR droughts OR El Nina OR La Nina OR El Nino OR La Nino OR El Nino-southern oscillation OR extreme cold OR extreme heat OR extreme precipitation OR extreme temperature OR flood OR floods OR flooding OR global warming OR heat wave OR heatwave OR heavy precipitation OR heavy rain OR heavy rainfall OR global warming OR hurricane OR hurricanes OR landslide OR landslides OR mudslide OR mudslides OR natural disasters OR storm OR storms OR tidal wave OR tidal waves OR tornado OR tornadoes OR tsunami OR tsunamis OR wildfires OR weather OR weather-driven
#3	**#1 OR #2**	
Outcome:		
#4	**MeSH terms:**	Mental Health OR Mental Disorders OR Adaptation, Psychological OR Violence

#5	**Text Word:**	anxiety OR stress OR attachment disorders OR cognition OR cognitive OR coping OR depression OR depressive OR drug use OR drug abuse OR substance abuse OR substance use OR alcoholism OR alcohol abuse OR emotion OR emotions OR emotional OR mental OR mood OR phobias OR post-traumatic OR posttraumatic OR PTSD OR psychological OR psychology OR psychosocial OR resilience OR resiliency OR sleep disorders OR temperament OR traumatic OR vulnerability OR vulnerable populations OR mental illness OR mental orders OR suicide OR suicidal OR violence OR assault OR robbery
#6	**#4 OR #5**	
Filter:		
#7	**MeSH term:**	Africa
#8	**Text Word:**	Africa OR African OR Algeria OR Angola OR Benin OR Botswana OR Burkina Faso OR Burundi OR Cameroon OR “Canary Islands” OR “Cape Verde” OR “Central African Republic” OR Chad OR Comoros OR Congo OR “Democratic Republic of Congo” OR Djibouti OR Egypt OR Eritrea OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR “Ivory Coast” OR “Cote d'Ivoire” OR Jamahiriya OR Kenya OR Lesotho OR Liberia OR Libya OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mayotte OR Morocco OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Reunion OR Rwanda OR “Sao Tome” OR Senegal OR Seychelles OR “Sierra Leone” OR Somalia OR “St Helena” OR Sudan OR Swaziland OR Tanzania OR Togo OR Tunisia OR Uganda OR “Western Sahara” OR Zaire OR Zambia OR Zimbabwe
#9	**#7 OR #8**	
#10	**#3 AND #6 AND #9**	

#11	**Date**	2008-2021
#12	**#10 AND #11**	

Appendix B: PRISMA (2020) Guidelines

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	

Section and Topic	Item #	Checklist item	Location where item is reported
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	
Study characteristics	17	Cite each included study and present its characteristics.	
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	
	23b	Discuss any limitations of the evidence included in the review.	
	23c	Discuss any limitations of the review processes used.	
	23d	Discuss implications of the results for practice, policy, and future research.	
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	
Competing interests	26	Declare any competing interests of review authors.	
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	

From: 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

For more information, visit: http://www.prisma-statement.org/

Appendix C: Data Extraction Table

Data	Explanation	
Authors Details	Author team Affiliation Lead Authors contact information Study funding sources Conflicts of interest	
Study Context	Country in which study was conducted Study area location (geographical, socio-economic, climate) Any background information detailing mental health care infrastructure or baseline mental disorder prevalence.	
Study Details	Aims of the study Outcomes of interest Unique contribution of study to the field Study design Data collection start date Data collection end date	
Study Sample	Population description Sample size Inclusion criteria Exclusion Criteria Method of recruitment	

Extreme Weather Event	EWE conceptualisation Method of determining EWE	
Other	Other interesting observations Authors suggestions for future research Discussion of limitations	

Appendix D: NHLBI Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies

Criteria	Yes	No	Other (CD, NR, NA)*
1. Was the research question or objective in this paper clearly stated?			
2. Was the study population clearly specified and defined?			
3. Was the participation rate of eligible persons at least 50%?			
4. Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?			
5. Was a sample size justification, power description, or variance and effect estimates provided?			
6. For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?			
7. Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?			
8. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?			
9. Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?			
10. Was the exposure(s) assessed more than once over time?			
11. Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?			
12. Were the outcome assessors blinded to the exposure status of participants?			
13. Was loss to follow-up after baseline 20% or less?			
14. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?			

Appendix E: JBI Critical Appraisal Checklist for Qualitative Research

JBI CRITICAL APPRAISAL CHECKLIST FOR QUALITATIVE RESEARCH

Reviewer_____ Date_____

Author_____ Year_____ Record Number_____

		Yes	No	Unclear	Not applicable
1.	Is there congruity between the stated philosophical perspective and the research methodology?	☐	☐	☐	☐
2.	Is there congruity between the research methodology and the research question or objectives?	☐	☐	☐	☐
3.	Is there congruity between the research methodology and the methods used to collect data?	☐	☐	☐	☐
4.	Is there congruity between the research methodology and the representation and analysis of data?	☐	☐	☐	☐
5.	Is there congruity between the research methodology and the interpretation of results?	☐	☐	☐	☐
6.	Is there a statement locating the researcher culturally or theoretically?	☐	☐	☐	☐
7.	Is the influence of the researcher on the research, and vice- versa, addressed?	☐	☐	☐	☐
8.	Are participants, and their voices, adequately represented?	☐	☐	☐	☐
9.	Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?	☐	☐	☐	☐
10.	Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

Appendix F: Ethics Approval Letter

School of Public Health and Family Medicine
Isikolo Sempilo Yoluntu kunye Namayeza Osapho
Departement Openbare Gesondheid en Huisartskunde

UNIVERSITY OF CAPE TOWN

Departmental Research Committee
Chairperson: Associate Professor Jill Olivier

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15 October 2021

Student Number: dglmic003

Dear Michaela Deglon

Please be advised that this protocol has been reviewed by the Public Health and Family Medicine Departmental Research Committee (DRC), agreeing that the study does not require Human Research Ethics Committee (HREC) approval, and has been submitted to Vuyi Mgoqi at the Postgraduate Office, for the Dean's Circular.

Title: The Impact of Extreme Weather Events on Mental Health in Africa: A Mixed-Methods Systematic Review

Please upload this letter to Peoplesoft in the 'Copy of Ethics Approval Letter' section when you do your Intent to Submit.

Kind regards

A/Prof Jill Olivier
Chairperson: PHFM Departmental Research Committee

Appendix G: Science of the Total Environment: Guide for Authors

Available at: https://www.elsevier.com/journals/science-of-the-total-environment/0048-9697/guide-for-authors (Accessed March 2022)

Article structure

Manuscript page limit
There is no restriction on the number of pages but brevity of papers is greatly encouraged. The length of a paper should be commensurate with the scientific information being reported. In particular, the introductory material should be limited to a few paragraphs and results presented in figures should not be repeated in tables.

Subdivision - numbered sections
Divide your article into clearly defined and numbered sections. Subsections should be numbered 1.1 (then 1.1.1, 1.1.2, ...), 1.2, etc. (the abstract is not included in section numbering). Use this numbering also for internal cross-referencing: do not just refer to 'the text'. Any subsection may be given a brief heading. Each heading should appear on its own separate line.

Introduction
State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Material and methods
Provide sufficient details to allow the work to be reproduced by an independent researcher. Methods that are already published should be summarized, and indicated by a reference. If quoting directly from a previously published method, use quotation marks and also cite the source. Any modifications to existing methods should also be described.

Theory/calculation
A Theory section should extend, not repeat, the background to the article already dealt with in the Introduction and lay the foundation for further work. In contrast, a Calculation section represents a practical development from a theoretical basis.

Results
Results should be clear and concise.

Discussion
This should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature.

Conclusions
The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section.

Appendices
If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

Essential title page information

• ***Title.*** Be concise and informative. Titles are often used in information-retrieval systems. Acronyms and brand names of products should not appear in the title of a paper. Instead they may be listed in the key words, and spelled out the first time they appear in the body of the paper.
• ***Author names and affiliations.*** Please clearly indicate the given name(s) and family name(s) of each author and check that all names are accurately spelled. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lower-case superscript letter immediately after the author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name and, if available, the e-mail address of each author.
• ***Corresponding author.*** Clearly indicate who will handle correspondence at all stages of refereeing and publication, also post-publication. **The inclusion of multiple corresponding authors is strongly discouraged. Ensure that the e-mail address is given and that contact details are kept up to date by the corresponding author.**
• ***Present/permanent address.*** If an author has moved since the work described in the article was done, or was visiting at the time, a 'Present address' (or 'Permanent address') may be indicated as a footnote to that author's name. The address at which the author actually did the work must be retained as the main, affiliation address. Superscript Arabic numerals are used for such footnotes.

Highlights

Highlights are mandatory for this journal as they help increase the discoverability of your article via search engines. They

consist of a short collection of bullet points that capture the novel results of your research as well as new methods that were used during the study (if any). Please have a look at the examples here: example Highlights.

Highlights should be submitted in a separate editable file in the online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points (maximum 85 characters, including spaces, per bullet point).

Abstract
A concise and factual abstract is required. The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. For this reason, References should be avoided, but if essential, then cite the author(s) and year(s). Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.Please limit your abstract to **300 words**.

Mandatory graphical abstract
A graphical abstract is mandatory for all Research Papers, Review Articles and Short Communications submitted to this journal. It does not need to be uploaded with the initial submission but must be supplied with any subsequent revisions. It should summarize the contents of the article in a concise, pictorial form designed to capture the attention of a wide readership online. Authors must provide images that clearly represent the work described in the article. Graphical abstracts should be submitted as a separate file in the online submission system. Image size: please provide an image with a minimum of 531 × 1328 pixels (h × w) or proportionally more. The image should be readable at a size of 5 × 13 cm using a regular screen resolution of 96 dpi. Preferred file types: TIFF, EPS, PDF or MS Office files. You can view Example Graphical Abstracts on our information site. Authors can make use of Elsevier's Illustration Services to ensure the best presentation of their images also in accordance with all technical requirements.

The mandatory highlights are important because they appear online in the Table of Contents of the journal. Highlights that list bullet points about the results are therefore not very informative for readers scanning the contents. Here is an outline of what the highlights should contain:

1. What is the overall scientific problem and why did you study it?
2. How did you address the problem, and which spheres are included?
3. What was the major method used?
4. Major finding(s)
5. Take home message

Keywords
Immediately after the abstract, provide a maximum of 6 keywords, using American spelling and avoiding general and plural terms and multiple concepts (avoid, for example, 'and', 'of'). Be sparing with abbreviations: only abbreviations firmly established in the field may be eligible. These keywords will be used for indexing purposes.

Abbreviations
Define abbreviations that are not standard in this field in a footnote to be placed on the first page of the article. Such abbreviations that are unavoidable in the abstract must be defined at their first mention there, as well as in the footnote. Ensure consistency of abbreviations throughout the article.

Acknowledgements
Collate acknowledgements in a separate section at the end of the article before the references and do not, therefore, include them on the title page, as a footnote to the title or otherwise. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proof reading the article, etc.).

Formatting of funding sources
List funding sources in this standard way to facilitate compliance to funder's requirements:.

Footnotes
Footnotes should be used sparingly. Number them consecutively throughout the article. Many word processors build footnotes into the text, and this feature may be used. Should this not be the case, indicate the position of footnotes in the text and present the footnotes themselves separately at the end of the article.

Electronic artwork
General points
• Make sure you use uniform lettering and sizing of your original artwork.
• Preferred fonts: Arial (or Helvetica), Times New Roman (or Times), Symbol, Courier.
• Number the illustrations according to their sequence in the text.
• Use a logical naming convention for your artwork files.
• Indicate per figure if it is a single, 1.5 or 2-column fitting image.
• For Word submissions only, you may still provide figures and their captions, and tables within a single file at the revision stage.
• Please note that individual figure files larger than 10 MB must be provided in separate source files.

Color artwork
Please make sure that artwork files are in an acceptable format (TIFF (or JPEG), EPS (or PDF), or MS Office files) and with the correct resolution. If, together with your accepted article, you submit usable color figures then Elsevier will ensure, at no

additional charge, that these figures will appear in color online (e.g., ScienceDirect and other sites) regardless of whether or not these illustrations are reproduced in color in the printed version. **For color reproduction in print, you will receive information regarding the costs from Elsevier after receipt of your accepted article**. Please indicate your preference for color: in print or online only. Further information on the preparation of electronic artwork.

Figure captions
Ensure that each illustration has a caption. A caption should comprise a brief title (**not** on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used.

Tables
Number tables consecutively with Arabic numerals in accordance with their appearance in the text. Type each table double-spaced on a separate page with a short descriptive title typed directly above and place footnotes to tables below the table body and indicate them with superscript lowercase letters. Avoid vertical rules. Be sparing in the use of tables and ensure that the data presented in tables do not duplicate results described elsewhere in the article. Tables should never be included within the text, because file(s) containing tables are attached separately in the electronic submission system.

Please submit Figures and Tables in separate files in an approved format (TIFF or EPS with the correct resolution for figures and MS Office files for tables).

References

Citation in text
Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include a substitution of the publication date with either 'Unpublished results' or 'Personal communication'. Citation of a reference as 'in press' implies that the item has been accepted for publication.

Reference links
Increased discoverability of research and high quality peer review are ensured by online links to the sources cited. In order to allow us to create links to abstracting and indexing services, such as Scopus, CrossRef and PubMed, please ensure that data provided in the references are correct. Please note that incorrect surnames, journal/book titles, publication year and pagination may prevent link creation. When copying references, please be careful as they may already contain errors. Use of the DOI is highly encouraged.

Web references
As a minimum, the full URL should be given and the date when the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately (e.g., after the reference list) under a different heading if desired, or can be included in the reference list.

Data references
This journal encourages you to cite underlying or relevant datasets in your manuscript by citing them in your text and including a data reference in your Reference List. Data references should include the following elements: author name(s), dataset title, data repository, version (where available), year, and global persistent identifier. Add [dataset] immediately before the reference so we can properly identify it as a data reference. The [dataset] identifier will not appear in your published article.

References in a special issue
Please ensure that the words 'this issue' are added to any references in the list (and any citations in the text) to other articles in the same Special Issue.

Reference management software
Most Elsevier journals have their reference template available in many of the most popular reference management software products. These include all products that support Citation Style Language styles, such as Mendeley. Using citation plug-ins from these products, authors only need to select the appropriate journal template when preparing their article, after which citations and bibliographies will be automatically formatted in the journal's style. If no template is yet available for this journal, please follow the format of the sample references and citations as shown in this Guide. If you use reference management software, please ensure that you remove all field codes before submitting the electronic manuscript. More information on how to remove field codes from different reference management software.

Reference formatting
There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent. Where applicable, author(s) name(s), journal title/book title, chapter title/article title, year of publication, volume number/book chapter and the article number or pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct. If you do wish to format the references yourself they should be arranged according to the following examples:

Reference style
Text: All citations in the text should refer to:

1. *Single author:* the author's name (without initials, unless there is ambiguity) and the year of publication;
2. *Two authors:* both authors' names and the year of publication;
3. *Three or more authors:* first author's name followed by 'et al.' and the year of publication.

Citations may be made directly (or parenthetically). Groups of references can be listed either first alphabetically, then chronologically, or vice versa.

Examples: 'as demonstrated (Allan, 2000a, 2000b, 1999; Allan and Jones, 1999)…. Or, as demonstrated (Jones, 1999; Allan, 2000)… Kramer et al. (2010) have recently shown …'

List: References should be arranged first alphabetically and then further sorted chronologically if necessary. More than one reference from the same author(s) in the same year must be identified by the letters 'a', 'b', 'c', etc., placed after the year of publication.

Appendix H: Electronic Search History

(Conducted 3rd November 2021)

PubMed

1."Weather"[Mesh]
2."Extreme Weather"[Mesh]
3."Climatic Processes"[Mesh]
4. "Disasters"[Mesh]
5. Text Word Field: avalanche OR avalanches OR climate change OR cyclone OR cyclones OR cyclonic OR drought OR droughts OR El Nina OR La Nina OR El Nino OR El Nino-southern oscillation OR extreme cold OR extreme heat OR extreme precipitation OR extreme temperature OR flood OR floods OR flooding OR global warming OR heat wave OR heatwave OR heavy precipitation OR heavy rain OR heavy rainfall OR hurricane OR hurricanes OR landslide OR landslides OR mudslide OR mudslides OR natural disasters OR storm OR storms OR tornado OR tornadoes OR wildfires OR weather OR weather-driven
6. 1 OR 2 OR 3 OR 4 OR 5
7."Mental Health"[Mesh]
8."Mental Disorders"[Mesh]
9."Adaptation, Psychological"[Mesh]
10."Violence"[Mesh]
11. Text Word Field: alcoholism OR alcohol abuse OR anxiety OR assault OR attachment disorders OR cognition OR cognitive OR coping OR depression OR depressive OR drug abuse OR drug use OR emotion OR emotions OR emotional OR mental OR mental illness OR mood OR pathological OR phobias OR post-traumatic OR posttraumatic OR PTSD OR psychological OR psychology OR psychosocial OR sleep disorders OR stress OR substance abuse OR substance use OR suicide OR suicidal OR temperament OR traumatic OR violence
12. 7 OR 8 OR 9 OR 10 OR 11
13. “Africa”[Mesh]
14. Text Word Field: Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR “Cabo Verde” OR Cameroon OR Cameroun OR "Canary Islands" OR "Cape Verde" OR “Central Africa” OR "Central African Republic" OR Chad OR Comoros OR Congo OR "Cote d'Ivoire" OR "Democratic Republic of Congo" OR Djibouti OR “Eastern Africa” OR Eritrea OR eSwatini OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR "Ivory Coast" OR Jamahiriya OR Kenya OR Lesotho OR Liberia OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mayotte OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Reunion OR Rwanda OR “Sao Tome” OR Senegal OR Seychelles OR “Sierra Leone” OR “Saint Helena” OR Somalia OR “St Helena” OR “South Africa” OR “Southern Africa” OR "Sub-Saharan Africa" OR Sudan OR Swaziland OR Tanzania OR Togo OR Uganda OR “ Western Africa” OR “Western Sahara” OR Zaire OR Zambia OR Zimbabwe
15. 13 OR 14
16. 6 AND 12 AND 15 **(1,491 results)**
17. Filter by date, 2008 - 2021 **(975 results)**
18. Filter by language, English **(953 results)**

Search: ((((((("Weather"[Mesh]) OR ("Extreme Weather"[Mesh])) OR ("Climatic Processes"[Mesh])) OR ("Disasters"[Mesh])) OR (avalanche[Text Word] OR avalanches[Text Word] OR climate change[Text Word] OR cyclone[Text Word] OR cyclones[Text Word] OR cyclonic[Text Word] OR drought[Text Word] OR droughts[Text Word] OR El Nina[Text Word] OR La Nina[Text Word] OR El Nino[Text Word] OR El Nino-southern oscillation[Text Word] OR extreme cold[Text Word] OR extreme heat[Text Word] OR extreme precipitation[Text Word] OR extreme temperature[Text Word] OR flood[Text Word] OR floods[Text Word] OR flooding[Text Word] OR global warming[Text Word] OR heat wave[Text Word] OR heatwave[Text Word] OR heavy precipitation[Text Word] OR heavy rain[Text Word] OR heavy rainfall[Text Word] OR hurricane[Text Word] OR hurricanes[Text Word] OR landslide[Text Word] OR landslides[Text Word] OR mudslide[Text Word] OR mudslides[Text Word] OR natural disasters[Text Word] OR storm[Text Word] OR storms[Text Word] OR tornado[Text Word] OR tornadoes[Text Word] OR wildfires[Text Word] OR weather[Text Word] OR weather-driven[Text Word])) AND (((((("Mental Health"[Mesh]) OR ("Mental Disorders"[Mesh])) OR ("Adaptation, Psychological"[Mesh])) OR ("Violence"[Mesh]))

OR (alcoholism[Text Word] OR alcohol abuse[Text Word] OR anxiety[Text Word] OR assault[Text Word] OR attachment disorders[Text Word] OR cognition[Text Word] OR cognitive[Text Word] OR coping[Text Word] OR depression[Text Word] OR depressive[Text Word] OR drug abuse[Text Word] OR drug use[Text Word] OR emotion[Text Word] OR emotions[Text Word] OR emotional[Text Word] OR mental[Text Word] OR mental illness[Text Word] OR mood[Text Word] OR pathological[Text Word] OR phobias[Text Word] OR post-traumatic[Text Word] OR posttraumatic[Text Word] OR PTSD[Text Word] OR psychological[Text Word] OR psychology[Text Word] OR psychosocial[Text Word] OR sleep disorders[Text Word] OR stress[Text Word] OR substance abuse[Text Word] OR substance use[Text Word] OR suicide[Text Word] OR suicidal[Text Word] OR temperament[Text Word] OR traumatic[Text Word] OR violence[Text Word])))) AND (("Africa"[Mesh]) OR (Angola[Text Word] OR Benin[Text Word] OR Botswana[Text Word] OR "Burkina Faso"[Text Word] OR Burundi[Text Word] OR "Cabo Verde"[Text Word] OR Cameroon[Text Word] OR Cameroun[Text Word] OR "Canary Islands"[Text Word] OR "Cape Verde"[Text Word] OR "Central Africa"[Text Word] OR "Central African Republic"[Text Word] OR Chad[Text Word] OR Comoros[Text Word] OR Congo[Text Word] OR "Cote d'Ivoire"[Text Word] OR "Democratic Republic of Congo"[Text Word] OR Djibouti[Text Word] OR "Eastern Africa"[Text Word] OR Eritrea[Text Word] OR eSwatini[Text Word] OR Ethiopia[Text Word] OR Gabon[Text Word] OR Gambia[Text Word] OR Ghana[Text Word] OR Guinea[Text Word] OR Guinea-Bissau[Text Word] OR "Ivory Coast"[Text Word] OR Jamahiriya[Text Word] OR Kenya[Text Word] OR Lesotho[Text Word] OR Liberia[Text Word] OR Madagascar[Text Word] OR Malawi[Text Word] OR Mali[Text Word] OR Mauritania[Text Word] OR Mauritius[Text Word] OR Mayotte[Text Word] OR Mozambique[Text Word] OR Namibia[Text Word] OR Niger[Text Word] OR Nigeria[Text Word] OR Principe[Text Word] OR Reunion[Text Word] OR Rwanda[Text Word] OR "Sao Tome"[Text Word] OR Senegal[Text Word] OR Seychelles[Text Word] OR "Sierra Leone"[Text Word] OR "Saint Helena"[Text Word] OR Somalia[Text Word] OR "St Helena"[Text Word] OR "South Africa"[Text Word] OR "Southern Africa"[Text Word] OR "Sub-Saharan Africa"[Text Word] OR Sudan[Text Word] OR Swaziland[Text Word] OR Tanzania[Text Word] OR Togo[Text Word] OR Uganda[Text Word] OR " Western Africa"[Text Word] OR "Western Sahara"[Text Word] OR Zaire[Text Word] OR Zambia[Text Word] OR Zimbabwe[Text Word])) Filters: English, from 2008 - 2021

Academic Search premier (EBSCO)

1. avalanche* OR “climate change” OR cyclon* OR drought* OR “La Nina” OR “El Nino” OR “El Nino-southern oscillation” OR “extreme cold” OR “extreme heat” OR “extreme precipitation” OR “extreme temperature” OR flood* OR “global warming” OR “heat wave” OR heatwave* OR “heavy precipitation” OR “heavy rain*” OR hurricane* OR landslide* OR mudslide* OR “natural disaster*” OR storm* OR tornado* OR wildfires OR weather
2. “alcohol use” OR “alcohol abuse” OR anxiety OR assault OR “attachment disorder*” OR cognit* OR coping OR depression OR depressive OR “drug abuse” OR “drug use” OR emotion* OR mental OR “mental illness” OR mood OR “pathological psychology” OR phobias OR post-traumatic OR posttraumatic OR PTSD OR psycholog* OR psychosocial OR “sleep disorder*” OR stress OR “substance abuse” OR “substance use” OR suicid* OR temperament OR traumatic OR violen*
3. Africa OR Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR “Cabo Verde” OR Cameroon OR Cameroun OR "Canary Islands" OR "Cape Verde" OR “Central Africa” OR "Central African Republic" OR Chad OR Comoros OR Congo OR "Cote d'Ivoire" OR "Democratic Republic of Congo" OR Djibouti OR “Eastern Africa” OR Eritrea OR eSwatini OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR "Ivory Coast" OR Jamahiriya OR Kenya OR Lesotho OR Liberia OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mayotte OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Reunion OR Rwanda OR “Sao Tome” OR Senegal OR Seychelles OR “Sierra Leone” OR “Saint Helena” OR Somalia OR “St Helena” OR “South Africa” OR “Southern Africa” OR "Sub-Saharan Africa" OR Sudan OR Swaziland OR Tanzania OR Togo OR Uganda OR “ Western Africa” OR “Western Sahara” OR Zaire OR Zambia OR Zimbabwe
4. 1 AND 2 AND 3 **(3,515 results)**
5. Filter by date, 2008-2021 **(3057 results)**
6. Filter by language, English **(2995 results)**
7. Filter by type, peer-reviewed journal articles **(2828 results)**

Africa-Wide Information (EBSCO)

1. avalanche* OR “climate change” OR cyclon* OR drought* OR “La Nina” OR “El Nino” OR “El Nino-southern oscillation” OR “extreme cold” OR “extreme heat” OR “extreme precipitation” OR “extreme temperature” OR flood* OR “global warming” OR “heat wave” OR heatwave* OR “heavy precipitation” OR “heavy rain*” OR hurricane* OR landslide* OR mudslide* OR “natural disaster*” OR storm* OR tornado* OR wildfires OR weather
2. “alcohol use” OR “alcohol abuse” OR anxiety OR assault OR “attachment disorder*” OR cognit* OR coping OR depression OR depressive OR “drug abuse” OR “drug use” OR emotion* OR mental OR “mental illness” OR mood OR “pathological psychology” OR phobias OR post-traumatic OR posttraumatic OR PTSD OR psycholog* OR psychosocial OR “sleep disorder*” OR stress OR “substance abuse” OR “substance use” OR suicid* OR temperament OR traumatic OR violen*
3. Africa OR Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR “Cabo Verde” OR Cameroon OR Cameroun OR "Canary Islands" OR "Cape Verde" OR “Central Africa” OR "Central African Republic" OR Chad OR Comoros OR Congo OR "Cote d'Ivoire" OR "Democratic Republic of Congo" OR Djibouti OR “Eastern Africa” OR Eritrea OR eSwatini OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR "Ivory Coast" OR Jamahiriya OR Kenya OR Lesotho OR Liberia OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mayotte OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Reunion OR Rwanda OR “Sao Tome” OR Senegal OR Seychelles OR “Sierra Leone” OR “Saint Helena” OR Somalia OR “St Helena” OR “South Africa” OR “Southern Africa” OR "Sub-Saharan Africa" OR Sudan OR Swaziland OR Tanzania OR Togo OR Uganda OR “ Western Africa” OR “Western Sahara” OR Zaire OR Zambia OR Zimbabwe
4. 1 AND 2 AND 3 **(5,182 results)**
5. Filter by date, 2008-2021 **(1,904 results)**
6. Filter by language, English (**1,766 results)**
7. Filter by type, peer-reviewed journal articles (**0 results**) - ***Step 7 excluded**

CINAHL (EBSCO)

1. avalanche* OR “climate change” OR cyclon* OR drought* OR “La Nina” OR “El Nino” OR “El Nino-southern oscillation” OR “extreme cold” OR “extreme heat” OR “extreme precipitation” OR “extreme temperature” OR flood* OR “global warming” OR “heat wave” OR heatwave* OR “heavy precipitation” OR “heavy rain*” OR hurricane* OR landslide* OR mudslide* OR “natural disaster*” OR storm* OR tornado* OR wildfires OR weather
2. “alcohol use” OR “alcohol abuse” OR anxiety OR assault OR “attachment disorder*” OR cognit* OR coping OR depression OR depressive OR “drug abuse” OR “drug use” OR emotion* OR mental OR “mental illness” OR mood OR “pathological psychology” OR phobias OR post-traumatic OR posttraumatic OR PTSD OR psycholog* OR psychosocial OR “sleep disorder*” OR stress OR “substance abuse” OR “substance use” OR suicid* OR temperament OR traumatic OR violen*
3. Africa OR Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR “Cabo Verde” OR Cameroon OR Cameroun OR "Canary Islands" OR "Cape Verde" OR “Central Africa” OR "Central African Republic" OR Chad OR Comoros OR Congo OR "Cote d'Ivoire" OR "Democratic Republic of Congo" OR Djibouti OR “Eastern Africa” OR Eritrea OR eSwatini OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR "Ivory Coast" OR Jamahiriya OR Kenya OR Lesotho OR Liberia OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mayotte OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Reunion OR Rwanda OR “Sao Tome” OR Senegal OR Seychelles OR “Sierra Leone” OR “Saint Helena” OR Somalia OR “St Helena” OR “South Africa” OR “Southern Africa” OR "Sub-Saharan Africa" OR Sudan OR Swaziland OR Tanzania OR Togo OR Uganda OR “ Western Africa” OR “Western Sahara” OR Zaire OR Zambia OR Zimbabwe

4. 1 AND 2 AND 3 **(180 results)**
5. Filter by date, 2008-2021 (**153 results)**
6. Filter by language, English **(153 results)**
7. Filter by type, peer-reviewed journal articles (*Filter not shown in search history) **(143 results)**

Health Sources: Nursing/Academic Edition (EBSCO)

1. avalanche* OR “climate change” OR cyclon* OR drought* OR “La Nina” OR “El Nino” OR “El Nino-southern oscillation” OR “extreme cold” OR “extreme heat” OR “extreme precipitation” OR “extreme temperature” OR flood* OR “global warming” OR “heat wave” OR heatwave* OR “heavy precipitation” OR “heavy rain*” OR hurricane* OR landslide* OR mudslide* OR “natural disaster*” OR storm* OR tornado* OR wildfires OR weather
2. “alcohol use” OR “alcohol abuse” OR anxiety OR assault OR “attachment disorder*” OR cognit* OR coping OR depression OR depressive OR “drug abuse” OR “drug use” OR emotion* OR mental OR “mental illness” OR mood OR “pathological psychology” OR phobias OR post-traumatic OR posttraumatic OR PTSD OR psycholog* OR psychosocial OR “sleep disorder*” OR stress OR “substance abuse” OR “substance use” OR suicid* OR temperament OR traumatic OR violen*
3. Africa OR Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR “Cabo Verde” OR Cameroon OR Cameroun OR "Canary Islands" OR "Cape Verde" OR “Central Africa” OR "Central African Republic" OR Chad OR Comoros OR Congo OR "Cote d'Ivoire" OR "Democratic Republic of Congo" OR Djibouti OR “Eastern Africa” OR Eritrea OR eSwatini OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR "Ivory Coast" OR Jamahiriya OR Kenya OR Lesotho OR Liberia OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mayotte OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Reunion OR Rwanda OR “Sao Tome” OR Senegal OR Seychelles OR “Sierra Leone” OR “Saint Helena” OR Somalia OR “St Helena” OR “South Africa” OR “Southern Africa” OR "Sub-Saharan Africa" OR Sudan OR Swaziland OR Tanzania OR Togo OR Uganda OR “ Western Africa” OR “Western Sahara” OR Zaire OR Zambia OR Zimbabwe
4. 1 AND 2 AND 3 **(149 results)**
5. Filter by date, 2008-2021 **(121 results)**
6. Filter by language, English **(121 results)**

PsychArticles (EBSCO)

1. avalanche* OR “climate change” OR cyclon* OR drought* OR “La Nina” OR “El Nino” OR “El Nino-southern oscillation” OR “extreme cold” OR “extreme heat” OR “extreme precipitation” OR “extreme temperature” OR flood* OR “global warming” OR “heat wave” OR heatwave* OR “heavy precipitation” OR “heavy rain*” OR hurricane* OR landslide* OR mudslide* OR “natural disaster*” OR storm* OR tornado* OR wildfires OR weather
2. “alcohol use” OR “alcohol abuse” OR anxiety OR assault OR “attachment disorder*” OR cognit* OR coping OR depression OR depressive OR “drug abuse” OR “drug use” OR emotion* OR mental OR “mental illness” OR mood OR “pathological psychology” OR phobias OR post-traumatic OR posttraumatic OR PTSD OR psycholog* OR psychosocial OR “sleep disorder*” OR stress OR “substance abuse” OR “substance use” OR suicid* OR temperament OR traumatic OR violen*
3. Africa OR Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR “Cabo Verde” OR Cameroon OR Cameroun OR "Canary Islands" OR "Cape Verde" OR “Central Africa” OR "Central African Republic" OR Chad OR Comoros OR Congo OR "Cote d'Ivoire" OR "Democratic Republic of Congo" OR Djibouti OR “Eastern Africa” OR Eritrea OR eSwatini OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR "Ivory Coast" OR Jamahiriya OR Kenya OR Lesotho OR Liberia OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mayotte OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Reunion OR Rwanda OR “Sao

Tome” OR Senegal OR Seychelles OR “Sierra Leone” OR “Saint Helena” OR Somalia OR “St Helena” OR “South Africa” OR “Southern Africa” OR "Sub-Saharan Africa" OR Sudan OR Swaziland OR Tanzania OR Togo OR Uganda OR “ Western Africa” OR “Western Sahara” OR Zaire OR Zambia OR Zimbabwe
4. 1 AND 2 AND 3 **(19 results)**
5. Filter by date, 2008-2021 **(14 results)**
6. Filter by language, English **(14 results)**
7. Filter by type, peer-reviewed journal articles **(14 results)**

PsychInfo (EBSCO)

1. avalanche* OR “climate change” OR cyclon* OR drought* OR “La Nina” OR “El Nino” OR “El Nino-southern oscillation” OR “extreme cold” OR “extreme heat” OR “extreme precipitation” OR “extreme temperature” OR flood* OR “global warming” OR “heat wave” OR heatwave* OR “heavy precipitation” OR “heavy rain*” OR hurricane* OR landslide* OR mudslide* OR “natural disaster*” OR storm* OR tornado* OR wildfires OR weather
2. “alcohol use” OR “alcohol abuse” OR anxiety OR assault OR “attachment disorder*” OR cognit* OR coping OR depression OR depressive OR “drug abuse” OR “drug use” OR emotion* OR mental OR “mental illness” OR mood OR “pathological psychology” OR phobias OR post-traumatic OR posttraumatic OR PTSD OR psycholog* OR psychosocial OR “sleep disorder*” OR stress OR “substance abuse” OR “substance use” OR suicid* OR temperament OR traumatic OR violen*
3. Africa OR Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR “Cabo Verde” OR Cameroon OR Cameroun OR "Canary Islands" OR "Cape Verde" OR “Central Africa” OR "Central African Republic" OR Chad OR Comoros OR Congo OR "Cote d'Ivoire" OR "Democratic Republic of Congo" OR Djibouti OR “Eastern Africa” OR Eritrea OR eSwatini OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR "Ivory Coast" OR Jamahiriya OR Kenya OR Lesotho OR Liberia OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mayotte OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Reunion OR Rwanda OR “Sao Tome” OR Senegal OR Seychelles OR “Sierra Leone” OR “Saint Helena” OR Somalia OR “St Helena” OR “South Africa” OR “Southern Africa” OR "Sub-Saharan Africa" OR Sudan OR Swaziland OR Tanzania OR Togo OR Uganda OR “ Western Africa” OR “Western Sahara” OR Zaire OR Zambia OR Zimbabwe
4. 1 AND 2 AND 3 (121 results) (actual search 453)
5. Filter by date, 2008-2021 (16 results) (actual search 348)
6. Filter by language, English (16) (actual 342)
7. Filter by type, peer-reviewed journal articles (16) ***** Excluded books (actual search 287)

Scopus

(TITLE-ABS-KEY (avalanche* OR "climate change" OR cyclon* OR drought* OR "La Nina" OR "El Nino" OR "El Nino-southern oscillation" OR "extreme cold" OR "extreme heat" OR "extreme precipitation" OR "extreme temperature" OR flood* OR "global warming" OR "heat wave" OR heatwave* OR "heavy precipitation" OR "heavy rain*" OR "global warming" OR hurricane* OR landslide* OR mudslide* OR "natural disaster*" OR storm* OR tornado* OR wildfire* OR weather)) AND (TITLE-ABS-KEY ("alcohol use*" OR "alcohol abuse" OR anxiety OR assault OR "attachment disorder*" OR cognit* OR coping OR depression OR depressive OR "drug use" OR "drug abuse" OR emotion* OR mental OR "mental illness" OR mood OR "pathological psychology" OR phobias OR post-traumatic OR posttraumatic OR ptsd OR psycholog* OR psychosocial OR "sleep disorder*" OR stress OR "substance abuse" OR "substance use" OR suicid* OR temperament OR traumatic OR violen*)) AND (TITLE-ABS-KEY (africa OR angola OR benin OR botswana OR "Burkina Faso" OR burundi OR "Cabo Verde" OR cameroon OR cameroun OR "Canary Islands" OR "Cape Verde" OR "Central Africa" OR "Central African Republic" OR chad OR comoros OR congo OR "Cote d'Ivoire" OR "Democratic Republic of Congo" OR djibouti OR "Eastern

Africa" OR eritrea OR eswatini OR ethiopia OR gabon OR gambia OR ghana OR guinea OR guinea-bissau OR "Ivory Coast" OR jamahiriya OR kenya OR lesotho OR liberia OR madagascar OR malawi OR mali OR mauritania OR mauritius OR mayotte OR mozambique OR namibia OR niger OR nigeria OR principe OR reunion OR rwanda OR "Sao Tome" OR senegal OR seychelles OR "Sierra Leone" OR "Saint Helena" OR somalia OR "St Helena" OR "South Africa" OR "Southern Africa" OR "Sub-Saharan Africa" OR sudan OR swaziland OR tanzania OR togo OR uganda OR " Western Africa" OR "Western Sahara" OR zaire OR zambia OR zimbabwe)) AND (LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011) OR LIMIT-TO (PUBYEAR , 2010) OR LIMIT-TO (PUBYEAR , 2009) OR LIMIT-TO (PUBYEAR , 2008)) AND (LIMIT-TO (LANGUAGE , "English")) AND (EXCLUDE (DOCTYPE , "ch") OR EXCLUDE (DOCTYPE , "bk"))

Web of Science Core Collection (WEB OF SCIENCE)

1. Title: avalanche* OR “climate change” OR cyclon* OR drought* OR “La Nina” OR “El Nino” OR “El Nino-southern oscillation” OR “extreme cold” OR “extreme heat” OR “extreme precipitation” OR “extreme temperature” OR flood* OR “global warming” OR “heat wave” OR heatwave* OR “heavy precipitation” OR “heavy rain*” OR “global warming” OR hurricane* OR landslide* OR mudslide* OR “natural disaster*” OR storm* OR tornado* OR wildfire* OR weather
2. Abstract: avalanche* OR “climate change” OR cyclon* OR drought* OR “La Nina” OR “El Nino” OR “El Nino-southern oscillation” OR “extreme cold” OR “extreme heat” OR “extreme precipitation” OR “extreme temperature” OR flood* OR “global warming” OR “heat wave” OR heatwave* OR “heavy precipitation” OR “heavy rain*” OR “global warming” OR hurricane* OR landslide* OR mudslide* OR “natural disaster*” OR storm* OR tornado* OR wildfire* OR weather
3. **#**1 OR **#**2
4. Title: “alcohol use*” OR “alcohol abuse” OR anxiety OR assault OR “attachment disorder*” OR cognit* OR coping OR depression OR depressive OR “drug use” OR “drug abuse” OR emotion* OR mental OR “mental illness” OR mood OR “pathological psychology” OR phobias OR post-traumatic OR posttraumatic OR PTSD OR psycholog* OR psychosocial OR “sleep disorder*” OR stress OR “substance abuse” OR “substance use” OR suicid* OR temperament OR traumatic OR violen*
5. Abstract: “alcohol use*” OR “alcohol abuse” OR anxiety OR assault OR “attachment disorder*” OR cognit* OR coping OR depression OR depressive OR “drug use” OR “drug abuse” OR emotion* OR mental OR “mental illness” OR mood OR “pathological psychology” OR phobias OR post-traumatic OR posttraumatic OR PTSD OR psycholog* OR psychosocial OR “sleep disorder*” OR stress OR “substance abuse” OR “substance use” OR suicid* OR temperament OR traumatic OR violen*
6. **#**4 OR **#**5
7. Title: Africa OR Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR “Cabo Verde” OR Cameroon OR Cameroun OR "Canary Islands" OR "Cape Verde" OR “Central Africa” OR "Central African Republic" OR Chad OR Comoros OR Congo OR "Cote d'Ivoire" OR "Democratic Republic of Congo" OR Djibouti OR “Eastern Africa” OR Eritrea OR eSwatini OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR "Ivory Coast" OR Jamahiriya OR Kenya OR Lesotho OR Liberia OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mayotte OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Reunion OR Rwanda OR “Sao Tome” OR Senegal OR Seychelles OR “Sierra Leone” OR “Saint Helena” OR Somalia OR “St Helena” OR “South Africa” OR “Southern Africa” OR "Sub-Saharan Africa" OR Sudan OR Swaziland OR Tanzania OR Togo OR Uganda OR “ Western Africa” OR “Western Sahara” OR Zaire OR Zambia OR Zimbabwe

8. Abstract: Africa OR Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR “Cabo Verde” OR Cameroon OR Cameroun OR "Canary Islands" OR "Cape Verde" OR “Central Africa” OR "Central African Republic" OR Chad OR Comoros OR Congo OR "Cote d'Ivoire" OR "Democratic Republic of Congo" OR Djibouti OR “Eastern Africa” OR Eritrea OR eSwatini OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR "Ivory Coast" OR Jamahiriya OR Kenya OR Lesotho OR Liberia OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mayotte OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Reunion OR Rwanda OR “Sao Tome” OR Senegal OR Seychelles OR “Sierra Leone” OR “Saint Helena” OR Somalia OR “St Helena” OR “South Africa” OR “Southern Africa” OR "Sub-Saharan Africa" OR Sudan OR Swaziland OR Tanzania OR Togo OR Uganda OR “ Western Africa” OR “Western Sahara” OR Zaire OR Zambia OR Zimbabwe
9. **#**7 OR **#8**
10. **#3 AND #6 AND #9 (3,144 results)**
11. **Filter by year 2008-2021 (2,585 results)**
12. **Filter by language (2,566)**

Scielo (WEB OF SCIENCE)

1. Topic: avalanche* OR “climate change” OR cyclon* OR drought* OR “La Nina” OR “El Nino” OR “El Nino-southern oscillation” OR “extreme cold” OR “extreme heat” OR “extreme precipitation” OR “extreme temperature” OR flood* OR “global warming” OR “heat wave” OR heatwave* OR “heavy precipitation” OR “heavy rain*” OR “global warming” OR hurricane* OR landslide* OR mudslide* OR “natural disaster*” OR storm* OR tornado* OR wildfire* OR weather
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3. Topic: Africa OR Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR “Cabo Verde” OR Cameroon OR Cameroun OR "Canary Islands" OR "Cape Verde" OR “Central Africa” OR "Central African Republic" OR Chad OR Comoros OR Congo OR "Cote d'Ivoire" OR "Democratic Republic of Congo" OR Djibouti OR “Eastern Africa” OR Eritrea OR eSwatini OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR "Ivory Coast" OR Jamahiriya OR Kenya OR Lesotho OR Liberia OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mayotte OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Reunion OR Rwanda OR “Sao Tome” OR Senegal OR Seychelles OR “Sierra Leone” OR “Saint Helena” OR Somalia OR “St Helena” OR “South Africa” OR “Southern Africa” OR "Sub-Saharan Africa" OR Sudan OR Swaziland OR Tanzania OR Togo OR Uganda OR “ Western Africa” OR “Western Sahara” OR Zaire OR Zambia OR Zimbabwe
4. **#**1 AND **#**2 AND **#**3 (71 results)
5. Filter by date 2008-2021 (69 results)
6. Filter by language (58 results)

Appendix I: Articles Removed Following Full-Text Review

Author(s) name	Article Title	Reason for Exclusion
Coleman	24-hour support line for Northern Cape drought victims	Wrong study design
Nazeer, Ahsan	CLIMATE CHANGE AND CHILD AND ADOLESCENT MENTAL HEALTH IN ASIA, MIDDLE EAST, AND NORTH AFRICA REGION: POINTS TO PONDER	Wrong study design
Filho, W. L.; Al-Amin, A. Q.; Nagy, G. J.; Azeiteiro, U. M.; Wiesböck, L.; Ayal, D. Y.; Morgan, E. A.; Mugabe, P.; Aparicio-Effen, M.; Fudjumdjum, H.; Jabbour, C. J. C.	A comparative analysis of climate-risk and extreme event-related impacts on well-being and health: Policy implications	No mental health outcome
Malla, Ashok; Margoob, Mushtaq; Iyer, Srividya; Joober, Ridha; Lal, Shalini; Thara, Rangawsamy; Mushtaq, Huda; Mansouri, Bilal Issaoui	A model of mental health care involving trained lay health workers for treatment of major mental disorders among youth in a conflict-ridden, low-middle income environment: Part I adaptation and implementation	Wrong setting
Baker, Ria Echteld	A phenomenological study of the resettlement experiences and mental health needs of Somali Bantu refugee women	No EWE exposure
Gray, B.; Eaton, J.; Christy, J.; Duncan, J.; Hanna, F.; Kasi, S.	A proactive approach: Examples for integrating disaster risk reduction and mental health and psychosocial support programming	No EWE exposure
Owoaje me, T.; Uchendu, Obioma C.; Ajayi, Tumininu O.; Cadmus, Eniola O.	A review of the health problems of the internally displaced persons in Africa	Wrong study design
Tlou, Emmanuel R	A South African Perspective on Culturally Congruent Mental Health Services	No EWE exposure
Bidassey, Manila Shalin; Wright, Caradee Yael; Kapwata, Th; Shirinde, Joyce	A Study Protocol to Determine Heat-Related Health Impacts among Primary Schoolchildren in South Africa	Wrong study design
Sleigh, Tom	A Violent Prone, Poor People Zone: The Dadaab Refugee Camp and the Eastleigh neighbourhood of Nairobi have seen an influx of hundreds of thousands of Somalis seeking a better life—but, as often as not, Kenya can offer them little	Wrong study design
O'Grady, Kari A.; Orton, James Douglas; White, Kenneth; Snyder, Nicole	A way forward for spirituality, resilience, and international social science	No mental health outcome
Torubeli, Victor Ayebami	Adjustment and Psychological Well-Being of School- Going Adolescent Flood Victims in Bayelsa State, Nigeria	No mental health outcome
Anastario, Michael Philip	An analysis of violence victimisation and women's mental and reproductive health in two internally displaced populations	No EWE exposure
Chigeza, S.	An exploration of older persons' experiences of drought as revealed in indigenous knowledge practices	No mental health outcome
Pyszczynski, T.; Kesebir, P.	Anxiety buffer disruption theory: a terror management account of posttraumatic stress disorder	No EWE exposure
Chilo, D.	ASSESSMENT OF SUBSTANCE ABUSE AND ITS ASSOCIATED FACTORS IN COLLEGES OF AFAR REGIONAL STATE OF ETHIOPIA, 2016	No EWE exposure
Sorsdahl, K.; Stein, D. J.; Williams, D. R.; Nock, M. K.	Associations between traumatic events and suicidal behavior in South Africa	No EWE exposure

Dozio, Elisabetta; Le Roch, Karine; Bizouerne, Cécile	Baby friendly spaces: an intervention for pregnant and lactating women and their infants in Cameroon	No EWE exposure
Epping-Jordan, JoAnne E.; van Ommeren, Mark; Ashour, Hazem Nayef; Maramis, Albert; Marini, Anita; Mohanraj, Andrew; Noori, Aqila; Rizwan, Humayun; Saeed, Khalid; Silove, Derrick; Suveendran, T.; Urbina, Liliana; Ventevogel, Peter; Saxena, Shekhar	Beyond the crisis: building back better mental health care in 10 emergency-affected areas using a longer-term perspective	No EWE exposure
Epping-Jordan, JoAnne E.; van Ommeren, Mark; Ashour, Hazem Nayef; Maramis, Albert; Marini, Anita; Mohanraj, Andrew; Noori, Aqila; Rizwan, Humayun; Saeed, Khalid; Silove, Derrick; Suveendran, T.; Urbina, Liliana; Ventevogel, Peter; Saxena, Shekhar	Beyond the crisis: building back better mental health care in 10 emergency-affected areas using a longer-term perspective	No EWE exposure
Dube, E.; Wedawatta, G.; Ginige, K.	Building-Back-Better in Post-Disaster Recovery: Lessons Learnt from Cyclone Idai-Induced Floods in Zimbabwe	No mental health outcome
Moore, M.; Ch; ra, A.; Feeney, K. C.	Building community resilience: what can the United States learn from experiences in other countries?	No mental health outcome
Nieuwenhuys, Olga	Can the teddy bear speak?	No mental health outcome
Betancourt, T. S.; Yudron, M.; Wheaton, W.; Smith-Fawzi, M. C.	Caregiver and adolescent mental health in Ethiopian Kunama refugees participating in an emergency education program	No EWE exposure
Yigzaw, G. S.; Abitew, E. B.	Causes and impacts of internal displacement in Ethiopia	No mental health outcome
Mensah, H.; Ahadzie, D. K.	Causes, impacts and coping strategies of floods in Ghana: a systematic review	Wrong study design
Boyd, Andrew T.; Cookson, Susan T.; Anderson, Mark; Bilukha, Oleg O.; Brennan, Muireann; zel, Thomas; Hardy, Colleen; Husain, Farah; Cardozo, Barbara Lopes; Colorado, Carlos Navarro; Shahpar, Cyrus; Talley, Leisel; Toole, Michael; Gerber, Michael	Centres for Disease Control and Prevention Public Health Response to Humanitarian Emergencies, 2007-2016	No mental health outcome
van de Vijver, Steven; Oti, Samuel; Oduor, Clement; Ezeh, Alex; Lange, Joep; Agyemang, Charles; Kyobutungi, Catherine	Challenges of health programmes in slums	No EWE exposure
Iversen, S. A.; Nalugya, J.; Babirye, J. N.; Engebretsen, I. M. S.; Skokauskas, N.	Child and adolescent mental health services in Uganda	Wrong study design
Zuurmond, M.; Nyapera, V.; Mwenda, V.; Kisia, J.; Rono, H.; Palmer, J.	Childhood disability in Turkana, Kenya: Understanding how carers cope in a complex humanitarian setting	No mental health outcome
Owusu Twum, K.; Abubakari, M.	Cities and floods: A pragmatic insight into the determinants of households' coping strategies to floods in informal Accra, Ghana	No mental health outcome
Pule, V.; Mathee, A.; Melariri, P.; Kapwata, T.; Abdelatif, N.; Balakrishna, Y.; Kunene, Z.; Mogotsi, M.; Wernecke, B.;	Classroom temperature and learner absenteeism in public primary schools in the eastern cape, south africa	No mental health outcome

Wright, C. Y.		
McMichael, Anthony J.	Climate Change and Children: Health Risks of Abatement Inaction, Health Gains from Action	Wrong study design
Bernstein, Aaron S.; Myers, Samuel S.	Climate change and children's health	No mental health outcome
Borg, F. H.; Greibe Andersen, J.; Karekezi, C.; Yonga, G.; Furu, P.; Kallestrup, P.; Kraef, C.	Climate change and health in urban informal settlements in low- and middle-income countries - a scoping review of health impacts and adaptation strategies	Wrong study design
Emilia, E.; Ngowo, E.	Climate change as a determinant of lifestyle changes and strange living conditions in Cameroon: Which coping strategies?	No mental health outcome
Akresh, Richard	Climate Change, Conflict, and Children	No mental health outcome
Bowles, D. C.; Butler, C. D.; Morisetti, N.	Climate change, conflict and health	Wrong study design
Sorgho, R.; Jungmann, M.; Souares, A.; Danquah, I.; Sauerborn, R.	Climate Change, Health Risks, and Vulnerabilities in Burkina Faso: A Qualitative Study on the Perceptions of National Policymakers	Wrong study design
Wright, C. Y.; Norval, M.	Climate change: one of the greatest threats to public health in the 21st century: CME - guest editorial	Wrong study design
Heaney, Alex; ra; Winter, S; ra; Heaney, Alex; ra K.; Winter, S; ra J.	Climate-driven migration: an exploratory case study of Maasai health perceptions and help-seeking behaviours	No EWE exposure
Diwakar, V.; Lacroix, A.	Climate shocks and poverty persistence: Investigating consequences and coping strategies in Niger, Tanzania, and Uganda	No mental health outcome
Asare-Nuamah, P.	Climate variability, subsistence agriculture and household food security in rural Ghana	No mental health outcome
Anyanwu, I. N.; Nwajiuba, C. A.	Climatic impacts on socio-cultural behaviour, health and psychology of rural communities in South East Nigeria	No EWE exposure
MacFarlane, M.; Rubenstein, B. L.; Saw, T.; Mekonnen, D.; Spencer, C.; Stark, L.	Community-based surveillance of unaccompanied and separated children in drought-affected northern Ethiopia	No mental health outcome
Gebrekidan, AbbayAradom; Tibebe Mulatu, Alemayehu; Azadi, Hossein	Community Knowledge, Perceived Beliefs and Associated Factors of Mental Distress: A Case Study from Northern Ethiopia	No EWE exposure
Willett, Jennifer; Sears, Jeanelle	Complicating our understanding of environmental migration and displacement: The case of drought-related human movement in Kenya	No mental health outcome
Beogo, I.; Darboe, A.; Oluwafunmilade Adesanya, A.; Mendez Rojas, B.	Critical assessment of refugees' needs in post-emergency context: the case of Malian war refugees settled in Northern Burkina Faso	No EWE exposure
Chancy, M. J. A.	Desecrated bodies/phantom limbs: Post-traumatic reconstructions of corporeality in Haiti/Rwanda	No EWE exposure
Mathee, Angela; Barnes, Brendon; Naidoo, Shan; Swart, Andre; Rother, Hanna-Andrea	Development for children's environmental health in South Africa: Past gains and future opportunities	Wrong study design
Koka, P. M.; Sawe, H. R.; Mbaya, K. R.; Kilindimo, S. S.; Mfinanga, J. A.; Mwafongo, V. G.; Wallis, L. A.; Reynolds, T. A.	Disaster preparedness and response capacity of regional hospitals in Tanzania: a descriptive cross-sectional study	No mental health outcome
de Waal, J.; Vogel, C.	Disaster risk profiling in southern Africa: inventories, impacts and implications	No mental health outcome

Muzenda-Mudavanhu, C.; Manyena, B.; Collins, A. E.	Disaster risk reduction knowledge among children in Muzarabani District, Zimbabwe	No mental health outcome
Moayedoddin, Babak; Nangho Makaya, Christelle; Canuto, Aless; ra	Do humanitarian crises offer opportunities for change? A critical review of the mental health and psychosocial support post emergency in the Republic of the Congo	No EWE exposure
Schneider, Anna; Pfeiffer, Anett; Conrad, Daniela; Elbert, Thomas; Kolassa, Iris-Tatjana; Wilker, Sarah	Does cumulative exposure to traumatic stressors predict treatment outcome of community-implemented exposure-based therapy for PTSD?	No EWE exposure
Mughairbi, F. A.; Abdulaziz Alnajjar, A.; Hamid, A.	Effects of Psychoeducation and Stress Coping Techniques on Posttraumatic Stress Disorder Symptoms	No EWE exposure
Ejeta, L. T.; Ardalan, A.; Paton, D.; Yaseri, M.	Emotional and cognitive factors influencing flood preparedness in Dire Dawa town, Ethiopia	No mental health outcome
Feinstein, David	Energy psychology in disaster relief	No EWE exposure
Opondo, D. O.	Erosive coping after the 2011 floods in Kenya	No mental health outcome
Beshir, Habtamu Ali	Essays on early life shocks and human capital production	No EWE exposure
Ferreira, Regardt J.; Buttell, Fred; Cannon, Clare	Ethical Issues in Conducting Research With Children and Families Affected by Disasters	Wrong study design
Mundt, Adrian P.; Wünsche, Petra; Heinz, Andreas; Pross, Christian	Evaluating interventions for posttraumatic stress disorder in low and middle income countries: Narrative Exposure Therapy	Wrong study design
Frimpong, K.; Odonkor, S. T.; Kuranchie, F. A.; Nunfam, V. F.	Evaluation of heat stress impacts and adaptations: perspectives from smallholder rural farmers in Bawku East of Northern Ghana	No mental health outcome
Bunker, A.; Sewe, M. O.; Sié, A.; Rocklöv, J.; Sauerborn, R.	Excess burden of non-communicable disease years of life lost from heat in rural Burkina Faso: A time series analysis of the years 2000-2010	No mental health outcome
Ziervogel, Gina; Taylor, Anna	Feeling Stressed: Integrating Climate Adaptation with Other Priorities in South Africa	No EWE exposure
Caruso, German Daniel	First and second generation impacts of shocks in early childhood: Evidence from Latin America and Africa	No mental health outcome
Wakuma Abaya, S.; ere, N.; Ewald, G.	Floods and health in Gambella region, Ethiopia: a qualitative assessment of the strengths and weaknesses of coping mechanisms	No mental health outcome
Lozano, R.; et al.	Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: A systematic analysis for the Global Burden of Disease Study 2010	Wrong study design
Rosenthal, Joshua P.; Jessup, Christine M.	Global climate change and health: developing a research agenda for the NIH	Wrong study design
Naghavi, M. et al.	Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: A systematic analysis for the Global Burden of Disease Study 2013	No mental health outcome
Zhao, Q et al.	Global, regional, and national burden of mortality associated with non-optimal ambient temperatures from 2000 to 2019: a three-stage modelling study	No mental health outcome
Kassebaum, N. J et al.	Global, regional, and national disability-adjusted life-years (DALYs) for 315 diseases and injuries and healthy life expectancy (HALE), 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015	No EWE exposure
Kirabira, P.; Orach, C. G.; Mukanga, D.	HEALTH EFFECTS AND COPING STRATEGIES TO FLOODS IN KUMI DISTRICT, EASTERN UGANDA	Could not be located

Talukder, B.; van Loon, G. W.; Hipel, K. W.; Chiotha, S.; Orbinski, J.	Health impacts of climate change on smallholder farmers	Wrong study design
Verner, Glenn; Schütte, Stefanie; Knop, Juliane; Sankoh, Osman; Sauerborn, Rainer	Health in climate change research from 1990 to 2014: positive trend, but still underperforming	Wrong study design
Lindvall, K.; Kinsman, J.; Abraha, A.; Dalmar, A.; Abdullahi, M. F.; Godefay, H.; Lerenten Thomas, L.; Mohamoud, M. O.; Mohamud, B. K.; Musumba, J.; Schumann, B	Health Status and Health Care Needs of Drought-Related Migrants in the Horn of Africa-A Qualitative Investigation	No mental health outcome
Okaka, F. O.; Odhiambo, B. D. O.	Households' perception of flood risk and health impact of exposure to flooding in flood-prone informal settlements in the coastal city of Mombasa	No mental health outcome
Kohrt, B. A.; Mutamba, B. B.; Luitel, N. P.; Gwaikolo, W.; Mangen, P. O.; Nakku, J.; Rose, K.; Cooper, J.; Jordans, M. J. D.; Baingana, F.	How competent are non-specialists trained to integrate mental health services in primary care? Global health perspectives from Uganda, Liberia, and Nepal	No mental health outcome
	Impact of disasters on seniors	Wrong setting
ChersichMatthew, F.; Wright, Caradee Y.; Venter, Francois; Rees, Helen; Scorgie, Fiona; Erasmus, Barend	Impacts of Climate Change on Health and Wellbeing in South Africa	Wrong study design
Ngutor, Karshima S.	Implications of the recurrent flood episodes in Nigeria on public health: a review	Wrong study design
Nemeroff, Charles B.; Goldschmidt-Clermont, Pascal J.	In the aftermath of tragedy: Medical and psychiatric consequences	Wrong setting
Tumwine, J. K.	Infections, NCDS, and the scourge of cyclones and Ebola in sub-Saharan Africa	No mental health outcome
Findlater, K. M.; Donner, S. D.; Satterfield, T.; Iikar, M.	Integration anxiety: The cognitive isolation of climate change	No mental health outcome
Quarshie, Emmanuel Nii-Boye; Peprah, Jennifer; Asante, Paapa Yaw; Verstraaten-Bortier, Mabel; Abbey, Elizabeth Anorkor; Agyei, Francis	"It was touching": Experiences and views of students in the June 3 flood and fire disaster relief response volunteerism in Accra, Ghana	No mental health outcome
Kelly, Frances	Keeping PAEDIATRICS in paediatric disaster management: Before, during, and in the aftermath of complex emergencies	No mental health outcome
Dinkelman, T.	Long-run Health Repercussions of Drought Shocks: Evidence from South African Homelands	No mental health outcome
Wright, C. Y.; Kapwata, T.; du Preez, D. J.; Wernecke, B.; Garl; , R. M.; Nkosi, V.; man, W. A.; Dyson, L.; Norval, M.	Major climate change-induced risks to human health in South Africa	Wrong study design
Rao, Nitya; Singh, Ch; ni; Solomon, Divya; Camfield, Laura; Sidiki, Rahina; Angula, Margaret; Poonacha, Prathigna; Sidibé, Amadou; Lawson, Elaine T.	Managing risk, changing aspirations and household dynamics: Implications for wellbeing and adaptation in semi-arid Africa and India	No mental health outcome
Heyns, C. F.; Bornman, M. S.	Men's Health in Africa Part 2: Non-communicable diseases, malignancies and socio-economic determinants of health	Wrong study design
Garoff, F.; Skogberg, N.; Klemettilä, A.; Lilja, E.; Ahmed	Mental health and traumatization of newly arrived asylum seeker adults in finland: A population-based study	No EWE exposure

Haji Omar, A.; Snellman, O.; Castaneda, A. E.		
Harris, D.; Endale, T.; Lind, U. H.; Sevalie, S.; Bah, A. J.; Jalloh, A.; Baingana, F.	Mental health in Sierra Leone	Wrong study design
Syed Sheriff, R. J.; Reggi, M.; Mohamed, A.; Haibe, F.; Whitwell, S.; Jenkins, R.	Mental health in Somalia	No EWE exposure
Harris, D.; Wurie, A.; Baingana, F.; Sevalie, S.; Beynon, F.	Mental health nurses and disaster response in Sierra Leone	Wrong study design
Eaton, J.; Maiga, D. D.; Pate, S.	Mental health services in the Republic of Niger	Wrong study design
Willett, Jennifer	Micro disasters: Expanding the social work conceptualization of disasters	No mental health outcome
Mugabe, V. A.; Gudo, E. S.; Inlamea, O. F.; Kitron, U.; Ribeiro, G. S.	Natural disasters, population displacement and health emergencies: Multiple public health threats in Mozambique	No mental health outcome
Balgah, R. A.; Buchenrieder, G.	Natural shocks and risk behaviour: Experimental evidence from Cameroon	No mental health outcome
Ogunbode, Charles Adedayo et al.	Negative emotions about climate change are related to insomnia symptoms and mental health: Cross-sectional evidence from 25 countries	No EWE exposure
Barnwell, Garret Christopher; Stroud, Louise; Watson, Mark	'Nothing green can grow without being on the land': Mine-affected communities' psychological experiences of ecological degradation and resistance in Rustenburg, South Africa	No EWE exposure
Ayazi, T.; Swartz, L.; Eide, A. H.; Lien, L.; Hauff, E.	Perceived current needs, psychological distress and functional impairment in a war-affected setting: a cross-sectional study in South Sudan	No EWE exposure
DiGiorgi, E.; Michielin, P.; Michielin, D.	Perception of climate change, loss of social capital and mental health in two groups of migrants from African countries	No EWE exposure
Hall, B. J.; Garabiles, M. R.; de Hoop, J.; Pereira, A.; Prencipe, L.; Palermo, T. M.	Perspectives of adolescent and young adults on poverty-related stressors: a qualitative study in Ghana, Malawi and Tanzania	No mental health outcome
Craig, J. M.; Prescott, S. L.	Planning ahead: the mental health value of natural environments	No EWE exposure
Nuvey, F. S.; Kreppel, K.; Nortey, P. A.; Addo-Lartey, A. A.; Sarfo, B.; Fokou, G.; Ameme, D.; Kenu, E.; Sackey, S. O.; Addo, K. K.; Afari, E.; Chib; a, D.; Bonfoh, B.	Poor mental health of livestock farmers in Africa: a mixed methods case study from Ghana	No EWE exposure
Gwarisa, M.	Post Cyclone Idai Depression Stalks Chimanimani	Wrong study design
Hiller, R. M.; Halligan, S. L.; Tomlinson, M.; Stewart, J.; Skeen, S.; Christie, H.	Post-trauma coping in the context of significant adversity: A qualitative study of young people living in an urban township in South Africa	No EWE exposure
Bromet, E. J.; Atwoli, L.; Kawakami, N.; Navarro-Mateu, F.; Piotrowski, P.; King, A. J.; Aguilar-Gaxiola, S.; Alonso, J.; Bunting, B.; Demyttenaere, K.; Florescu, S.; de Girolamo, G.; Gluzman, S.; Haro, J. M.; de Jonge, P.; Karam, E. G.; Lee, S.; Kovess-Masfety, V.; Medina-Mora, M. E.; Mneimneh,	Post-traumatic stress disorder associated with natural and human-made disasters in the World Mental Health Survey	Wrong Setting

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Stupar, Dusko; Stevanovic, Dejan; Vostanis, Panos; Atilola, Olayinka; Moreira, Paulo; Dodig-Curkovic, Katarina; Franic, Tomislav; Doric, Ana; Davidovic, Nikolina; Avicenna, Mohamad; Multazam, Isa Noor; Nussbaum, Laura; Thabet, Abdul Aziz; Ubalde, Dino; Petrov, Petar; Deljkovic, Azra; Monteiro, Antonio Luis; Ribas, Adriana; Jovanovic, Mirjana; Joana, Oliveira	Posttraumatic stress disorder symptoms among trauma-exposed adolescents from low- and middle-income countries	No EWE exposure
Wright, Caradee Yael; Norval, Mary	Present and Future Impacts of Climate Change on Human Health in Sub-Saharan Africa	Wrong study design
Asnakew, S.; Shumet, S.; Ginbare, W.; Legas, G.; Haile, K.	Prevalence of post-traumatic stress disorder and associated factors among Koshe landslide survivors, Addis Ababa, Ethiopia: a community-based, cross-sectional study	No EWE exposure
Crosby, Sondra S.	Primary care management of non–English-speaking refugees who have experienced trauma: A clinical review	Wrong study design
Lamberg, L.	Psychiatrists strive to help children heal mental wounds from war and disasters	No EWE exposure
Chipfupa, U.; Tagwi, A.; Wale, E.	Psychological capital and climate change adaptation: Empirical evidence from smallholder farmers in South Africa	No mental health outcome
Ayal, D. Y.; Tilahun, K.; Ture, K.; Zeleke, T. T.	Psychological dimensions of climate change: perceptions, collective efficacy, and responses in Berehat District, north Shoa, Ethiopia	No mental health outcome
Purgato, M.; Gastaldon, C.; Papola, D.; van Ommeren, M.; Barbui, C.; Tol, W. A.	Psychological therapies for the treatment of mental disorders in low- and middle-income countries affected by humanitarian crises	Wrong study design
Napper, Lucy E.; Fisher, Dennis G.; Jaffe, Adi; Jones, Russell T.; Lamphear, Vivian S.; Joseph, Lisa; Grimaldi, Elizabeth M.	Psychometric properties of the Child's Reaction to Traumatic Events Scale-Revised in English and Luganda	No EWE exposure
Kuriansky, J.; Daisey, R.; Zinsou, J. C.; Jean-Charles, W.; Harada, S.; Shibata, T.	Psychosocial Recovery from Natural Disaster, Epidemics and Terrorism: Ebola in West Africa; SARS in China; Japan TsunamiEarthquake; Earthquakes in Haiti and China; 911, Superstorm Sandy and Hurricane Katrina in USA	Wrong study design
Nübler, L.; Austrian, K.; Maluccio, J. A.; Pinchoff, J.	Rainfall shocks, cognitive development and educational attainment among adolescents in a drought-prone region in Kenya	No mental health outcome
Yoder-van den Brink, H. N. C.	Reflections on "Building Back Better" Child and Adolescent Mental Health Care in a Low-Resource Post Emergency Setting: The Case of Sierra Leone	No mental health outcome
Tol, W. A.; Patel, V.; Tomlinson, M.; Baingana, F.; Galappatti, A.; Silove, D.; Sondorp, E.; van Ommeren, M.; Wessells, M. G.; Panter-Brick, C.	Relevance or excellence? Setting research priorities for mental health and psychosocial support in humanitarian settings	No EWE exposure
NgudiDelphin, Diasolua; Kuo, Yu-Haey; Van Montagu, Marc; Lambein, Fern	Research on motor neuron diseases konzo and neurolathyrism: trends from 1990 to 2010	No mental health outcome
Kamaru Joseph, K.; Akombi, Blessing J.; Agho, Kingsley; Renzaho, Andre M. N.	Resilience to Climate-Induced Disasters and Its Overall Relationship to Well-Being in Southern Africa: A Mixed-Methods Systematic Review	Wrong study design
Jemtrud, S. M.; Rhoades, R. D.; Gabbai, N.	Reunification of the Child and Caregiver in the Aftermath of Disaster	Wrong setting
Gwarisa, M.	Save The Children Offers Psychosocial Support To Cyclone Idai Affected Children	Wrong study

		design
Bauer, M. et al.	Solar insolation in springtime influences age of onset of bipolar I disorder	No EWE exposure
Ager, A.; Pasha, E.; Yu, G.; Duke, T.; Eriksson, C.; Cardozo, B. L.	Stress, mental health, and burnout in national humanitarian aid workers in Gulu, northern Uganda	No EWE exposure
Fredricks, Karla	The Early Childhood Experience of Trauma	Wrong setting
Nicholas, Patrice K.	The Economics of Climate Change and the Intersection with Conflict, Violence, and Migration: Implications for the Nursing Profession	Wrong study design
Ebhuoma, O. O.; Gebreslasie, M.; Ebhuoma, E. E.; Leonard, L.	The future looks empty': embodied experiences of distress triggered by environmental and climatic changes in rural KwaZulu-Natal, South Africa	No EWE exposure
Schnyder, Ulrich; Schäfer, Ingo; Aakvaag, Helene F.; Ajdukovic, Dean; Bakker, Anne; Bisson, Jonathan I.; Brewer, Douglas; Cloitre, Marylène; Dyb, Grete A.; Frewen, Paul; Lanza, Juliana; Le Brocque, Robyne; Lueger-Schuster, Brigitte; Mwiti, Gladys K.; Oe, Misari; Rosner, Rita; Schellong, Julia; Shigemura, Jun; Wu, Kitty; Olff, Mir	The global collaboration on traumatic stress	No EWE exposure
Schwerdtle, P.; Bowen, K.; McMichael, C.	The health impacts of climate-related migration	No mental health outcome
Nguyen, C. V.; Pham, N. M	The impact of natural disasters on children's education: Comparative evidence from Ethiopia, India, Peru, and Vietnam	No mental health outcome
Majbauddin, A.; Otani, S.; Tsunekawa, A.; Haregeweyn, N.; Abeje, M. T.; Nigussie, Z.; Alam, I.; Qing, Q.; Masumoto, T.; Kurozawa, Y.	The Influence of Income and Livelihood Diversification on Health-Related Quality of Life in Rural Ethiopia	No EWE exposure
Slekiene, Jurgita; Mosler, Hans-Joachim	The link between mental health and safe drinking water behaviours in a vulnerable population in rural Malawi	No EWE exposure
Roos, Vera	The Mmogo-Method™: An Exploration of Experiences through Visual Projections	No mental health outcome
Stewart, Jackie; Swartz, Leslie; Ward, Catherine	THE PERSONAL POLITICS OF DISASTER: NARRATIVES OF SURVIVORS OF A SOUTH AFRICAN SHANTY TOWN FIRE	No EWE exposure
Harry, Tinashe Timothy; Dodd, Nicole	The practice of humanitarian work psychology	Wrong study design
Wang, Zhipeng; Wu, Xin; Dai, Wenjie; Kaminga, Atipatsa C.; Wu, Xiaoli; Pan, Xiongfeng; Liu, Ziyan; Wen, Shiwu; Hu, Shixiong; Liu, Aizhong	The Prevalence of Posttraumatic Stress Disorder Among Survivors After a Typhoon or Hurricane: A Systematic Review and Meta-Analysis	Wrong setting
Nell, Werner; de Crom, Engela; Coetzee, Hendri; van Eeden, Elize	The psychosocial well-being of a “forgotten” South African community: the case of Ndumo, KwaZulu-Natal	No EWE exposure
Hugelius, K.; ain, C.; Semrau, M.; Holmefur, M.	The Reliability and Feasibility of the HESPER Web to Assess Perceived Needs in a Population Affected by a Humanitarian Emergency	No EWE exposure
Augusterfer, E. F.; O'Neal, C. R.; Martin, S. W.; Sheikh, T. L.; Mollica, R. F.	The Role of Telemental Health, Tele-consultation, and Tele-supervision in Post-disaster and Low-resource Settings	No EWE exposure
Rasmussen, Susan J.	THE SLIPPERY SIGN: Cultural Constructions of Youth and Youthful Constructions of	Wrong study

	Culture in Tuareg Men's Face-Veiling	design
Myers, Jonny	The South African burden of disease and climate change	Wrong study design
van der Linden, N.; Longden, T.; Richards, J. R.; Khursheed, M.; Goddijn, W. M. T.; van Veelen, M. J.; Khan, U. R.; van der Linden, M. C.	The use of an 'acclimatisation' heatwave measure to compare temperature-related demand for emergency services in Australia, Botswana, Netherlands, Pakistan, and USA	No mental health outcome
	Top ten threats to global health	Wrong study design
Schaafsma, M.; Gross-Camp, N.	Towards capturing human well-being-nature relationships in poverty assessments in rural Malawi and Rwanda	No mental health outcome
Patel, P. P.; Russell, J.; Allden, K.; Betancourt, T. S.; Bolton, P.; Galappatti, A.; Hijazi, Z.; Johnson, K.; Jones, L.; Kadis, L.; Leary, K.; Weissbecker, I.; Nakku, J.	Transitioning mental health & psychosocial support: from short-term emergency to sustainable post-disaster development. Humanitarian Action Summit 2011	No EWE exposure
NöthlingJani; Simmons, C; ice; Suliman, Sharain; Seedat, Soraya	Trauma type as a conditional risk factor for posttraumatic stress disorder in a referred clinic sample of adolescents	No EWE exposure
Toussaint, Loren L.; Kalayjian, Ani; Herman, Kaley; Hein, Alex; ra; Maseko, Njabulo; Diakonova-Curtis, Daria	Traumatic stress symptoms, forgiveness, and meaning in life in four traumatised regions of the world	No EWE exposure
Mk; awire, P.	Vulnerability of HIV/AIDS orphans to floods in Malawi	No mental health outcome
Marcantonio, R. A	Water, anxiety, and the human niche: a study in Southern Province, Zambia	Wrong study design
Sorgho, R.; Mank, I.; Kagoné, M.; Souares, A.; Danquah, I.; Sauerborn, R.	"We Will Always Ask Ourselves the Question of How to Feed the Family": Subsistence Farmers' Perceptions on Adaptation to Climate Change in Burkina Faso	No mental health outcome
Simpson, N. P.; Shearing, C. D.; Dupont, B.	When Anthropocene shocks contest conventional mentalities: a case study from Cape Town	No mental health outcome
Hove, M.	When Flood Victims Became State Victims: Tokwe-Mukosi, Zimbabwe	No mental health outcome
Theron, L.; Ruth Mampane, M.; Ebersöhn, L.; Hart, A.	Youth Resilience to Drought: Learning from a Group of South African Adolescents	No mental health outcome