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The Impact of Climate Change on Mental Health and Emotional Wellbeing: A Narrative Review of Current Evidence, and its Implications

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ABSTRACT

Converging global evidence highlights the dire consequences of climate change for human mental health and wellbeing. This paper summarises literature across relevant disciplines to provide a comprehensive narrative review of the multiple pathways through which climate change interacts with mental health and wellbeing. Climate change acts as a risk amplifier by disrupting the conditions known to support good mental health, including socioeconomic, cultural and environmental conditions, and living and working conditions. The disruptive influence of rising global temperatures and extreme weather events, such as experiencing a heatwave or water insecurity, compounds existing stressors experienced by individuals and communities. This has deleterious effects on people's mental health and is particularly acute for those groups already disadvantaged within and across countries. Awareness and experiences of escalating climate threats and climate inaction can generate understandable psychological distress; though strong emotional responses can also motivate climate action. We highlight opportunities to support individuals and communities to cope with and act on climate change. Consideration of the multiple and interconnected pathways of climate impacts and their influence on mental health determinants must inform evidence-based interventions. Appropriate action that centres climate justice can reduce the current and future mental health burden, while simultaneously improving the conditions that nurture wellbeing and equality. The presented evidence adds further weight to the need for decisive climate action by decision makers across all scales.

1 Introduction

Climate change and mental health are rightly regarded as two of the greatest challenges facing societies globally. However, insufficient attention has been given to the interaction between, and common causes for, these two crises. That "the climate crisis is a health crisis" is recognised by global health leaders, including the World Health Organization (1), and recent Intergovernmental Panel on Climate Change (IPCC) reports (2,3) have outlined that increased global heating will have catastrophic consequences for human health. While the ways climate change negatively affects physical health have been recognised for some time, the effects on mental health have been less well documented, with relevant reviews and policy briefing reports only increasing in the last couple of years (4–7). Mental health and wellbeing are interconnected with climate change via multiple and diverse pathways. Making the hidden costs of climate change on mental health and emotional wellbeing visible, and hidden benefits of climate action tangible therefore requires a synthesis and appreciation of contributions from multiple disciplines. Understanding the common causes of the dual challenges of climate change and mental health, and developing common solutions that nurture both people and the planet, will allow policy makers, health system leaders and mental health professionals to build systems and communities resilient to the global challenges of the Anthropocene.

The increasing unmet mental health needs of people across the world constitutes an urgent global

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health challenge even without the detrimental effects of the climate crisis. The global economic cost of mental disorders (from direct healthcare costs and indirect costs from lost productivity) was estimated in 2010 at $2.5 trillion USD (8) and is predicted to rise to $16 trillion by 2030 (9). Depression is a leading cause of disability worldwide (10) and rates of emotional disorders and self-harm are rising, particularly among females (11,12). 'All countries are developing countries' when it comes to mental health (9). No mental health system in the world is able to meet current need (9), with large 'treatment gaps' between need and provision of mental health support (13,14). Mental health systems are strained; 50% of people globally with mental health disorders receive no treatment, increasing to almost 90% in low-resource settings (15). Crucially, 75% of mental ill-health has been estimated to start before age 18 (16), and young people today have the added burden of growing up under the shadow of a climate crisis that is not of their making (17). Climate change threatens the ambitions of countries that are working to achieve universal healthcare by escalating mental and physical health needs while also disrupting service provision, with climate events threatening health infrastructure and supply chains (18).

When the impact of climate change on human health was recognised, mental health was a peripheral concern, with infectious disease and physical injuries from severe weather events being some of the first health impacts to be highlighted (19). Physical and mental health are closely intertwined, with strong co-morbidity between many physical and mental health disorders (20–22). As the COVID-19 pandemic has starkly illustrated, impacts on physical health have direct and indirect implications for mental health and wellbeing (23–25). Despite strong evidence, the indivisibility of mental and physical health is often under-appreciated. Over the past decade or so, the evidence base highlighting the multiple interconnections between climate change and mental health has strengthened considerably (26–30). This has taken place against a backdrop of increasing temperatures, increasing severity and intensity of extreme weather events and associated damage to human and natural systems, insufficient political action, and growing public awareness of the current and future impacts of the climate crisis. Levels of concern are high globally; in 2020, 69% of survey respondents across 40 countries felt climate change was either very or extremely serious, compared to 9% who did not perceive climate change as serious (31).

As our understanding of the interconnections between climate change and mental health and emotional wellbeing grows, a crucial need has been identified for sophisticated and cross-disciplinary 'systems' thinking (27), along with inclusion and synthesis of relevant literature from diverse disciplines in understanding the breadth and depth of this multifaceted topic. This narrative review adds to existing literature reviews on the topic of climate change and mental health (6,32–34), firstly by going beyond literature that explicitly focuses on climate change, for example by searching for relevant literature on experiences of fires and floods (which are not always explicitly linked to climate change), and secondly by including both academic and grey literature. This paper also accounts for the huge expansion of climate psychology literature in recent years, particularly mental health impacts arising from witnessing or being aware of climate change, and the relationships with coping, adapting, agency and action. Preparing communities for current and future climate threats requires a sufficient understanding of the psychological barriers and enablers of climate action, and what helps people to live with and through the crisis while strengthening local capacities to survive and thrive in a changing climate (psychological adaptation and emotional resilience).

We take a broad view of mental health, that acknowledges that mental health and emotional wellbeing is a continuum for which any individual can have better or worse mental health at any time, and that good mental health comprises a state of wellbeing in which an individual can cope and flourish across all aspects of their life and relationships (35). We therefore include not only outcomes related to deaths by suicide and clinically defined mental ill-health (i.e. new cases of mental disorders, worsened symptoms, increased mortality and morbidity for individuals with pre-existing mental disorders), but also consider impacts on population mental health and wellbeing metrics. We also acknowledge that health, including mental health, is not merely an individual experience, but has a range of social, environmental and economic causes and consequences (determinants of mental health) (9,36).

After outlining the methodological approach used for this paper, we present a framework for the multiple interacting layers of influence on an individual's mental health. This framework is then used to aid the reader in conceptualising the range of factors that mediate the impact of climate change on mental health and wellbeing. We explore the current evidence

base for how climate change is modifying these factors that affect mental health (different pathways of impact), before turning attention to the opportunities to support individuals and communities to both cope with and respond to the climate crisis. While the climate crisis is a risk multiplier, compounding existing vulnerabilities and disadvantages (37,38), climate action can also be an opportunity multiplier. The climate emergency demands that leaders drive an urgent societal switch from fossil fuels to low-carbon alternatives and invest in adaptation for communities dealing with the threats of an already warming world. Both design and implementation of such policies can best be achieved by understanding the psychology of climate change, and the possible win-wins for climate action to strengthen the determinants of good mental health and wellbeing. The paper concludes by providing examples of strategies that can incorporate support for mental health and wellbeing into climate mitigation and adaptation.

2 Methods

2.1 Search strategy

The search strategy to identify the literature on this topic commenced with a broad reading of the extant literature and consultation with experts to identify the key pathways through which climate change can affect mental health. On the basis of this reading and expert consultation, the following climate change and mental health-related terms were included to identify relevant literature on this topic: temperature, heat, heatwave, warming, season, hot, flooding, floods, hurricane, drought, forest fire, thunderstorm, cyclone, tornado, bushfire, snowstorm, natural disaster, forced displacement, forced migration, climate refugee, climate migration; mental health, mental illness, wellbeing, suicide, psychosis, anxiety, depression, PTSD/post-traumatic stress disorder, eco-anxiety, ecoanxiety, psychoterratic, solastalgia, ecoparalysis, ecological grief, ecopsychology.

The search engines WebofScience, PsychINFO, Embase, PubMed, and Google Scholar (first ten pages of results) were searched for terms relating to the effects of climate change on mental health and the full combination of search terms is provided in Supplementary Information. Three searches took place (initial search and data extraction/synthesis in 2019, updated in 2020 and then in January 2022 to include papers from 2021, all years/dates included). For each search, the titles in the first 10 pages of search results were scanned (for each search term on each search engine), unless the result list did not exceed 10 pages in which case all results were scanned. Abstracts and full papers were then screened for eligibility (that is, relevance to the question of how climate change is interconnected with mental health and wellbeing). Extra papers of interest were brought to the attention of the authors during the synthesis and writing process through examining paper reference lists, and from suggestions by global collaborators in the authors' networks.

2.2 Review process

For each thematic area (e.g. temperature, extreme weather events), the literature was catalogued and summarised by extracting the following fields from eligible papers: Author and year, Population, Exposure, Methods, Outcome, Conclusions. The full search strategy is provided in Supplementary Information and the information obtained was qualitatively synthesised by two reviewers (EL and RT) to inform the narrative review.

3 Results

3.1 Contextualising mental health and wellbeing

3.1.1 Relevant mental health definitions

While its use is increasingly widespread, the term 'mental health' is still difficult to succinctly define. Mental health is an all-encompassing term - just like physical health, everyone has mental health that can generally be better or worse at any one time. Hence, good mental health is not just the absence of illness or disorder, but positive wellbeing that leads to flourishing (39). Supporting mental health and wellbeing in the climate crisis requires an appreciation of the need to establish conditions that not only prevent illness but enable people to thrive.

Individuals may also experience symptoms that can be diagnosed as a mental illness or a mental disorder and examples of such are provided in Box 1. Mental disorders involve 'significant disturbances in thinking, emotional regulation, or behaviour' (40), and may be clinically diagnosed when constellations of abnormal psychological and behavioural symptoms become established and impair function. Many people do not (or cannot) access appropriate help for these symptoms and may not be in contact with support services, but community prevalence studies recognise the huge burden of disease that mental disorders confer across the world (41). Mental disorders, while generally diagnosed according to the symptoms outlined in the

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Box 1. Mental Health Definitions

Mental Health: Everyone has mental health and this can be better or worse over time, varying along a continuum. Mental health includes a band-width of cognitive and emotional experiences within an individual that are always in flux, and uncomfortable emotions, as long as well regulated, are part of good mental health and wellbeing. Good mental health was defined by the World Health Organisation as: "a state of well-being in which every individual realises his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community" (45). Alternative definitions of wellbeing include: "a subjective and dynamic state of feeling healthy and happy that ties into life satisfaction and influences a person's (or a collective's) psychological and social function" (46).

Mental Disorder: A mental disorder is a health condition generally involving some combination of abnormal changes in thoughts, emotions, percep-tions, behaviours or relationships with others (40, 41). They are associated with distress and/or problems functioning in activities such as work and social relationships. Mental illnesses and mental disorders include common disorders such as depression, anxiety, and substance abuse, and less com-mon disorders such as schizophrenia and bipolar disorder. Developmental disorders such as autism, and degenerative disorders such as dementia also fall under the umbrella of mental disorders (9, 47).

<u>Key Outcomes of Interest</u>
Worsened population mental health: An increase in the number of people with poorer mental health and emotional wellbeing, in either the short or long term.
Increased onset of mental disorders: An increase in the number of people experiencing symptoms that can be diagnosed as a mental illness or disorder, including anxiety, depression, post-traumatic stress disorder and substance abuse. More people with a diagnosed mental disorder.
Poorer outcomes for those with existing mental disorders: An increase in symptoms or more severe symptoms; poorer physical health; increased risk of death.
Increase in suicide attempts or completed suicides: An increase in the frequency or rate of completed or attempted suicides.

Diagnostic Statistics Manual, are also well known to be heterogeneous, overlapping, and dependent on biology, life experiences, interpersonal, and environ-mental factors. We use the term 'mental disorders' in this paper to refer to individuals who have symptoms consistent with what clinical mental health professio-nals would diagnose as a 'mental disorder', while rec-ognising that many people don't and can't access care and so can't receive such diagnoses, and that diagno-sis can be helpful for some individuals and not for others.

In this paper we cover healthy (psychological) responses to abnormal events as well as clinically diagnosable mental disorders. We note that distress can be a feature of both, often arising from experien-ces of trauma, though the latter is generally more associated with distress that becomes chronic and impairs the ability of a person to carry out daily activ-ities. Chronic and impairing distress, including in the context of the climate crisis, can be readily explain-able, but may require support to improve and protect quality of life. In line with Patel et al. (2018), we note that in practice mental health and mental disorders exist on a continuum, "from mild, time-limited dis-tress to chronic, progressive, and severely disabling conditions. The binary approach to diagnosing mental disorders, although useful for clinical practice, does not accurately reflect the diversity and complexity of mental health needs of individuals or populations" . In defining our terminology, it is noteworthy that the climate crisis tends not to cause new types of mental disorders, and distress related to the existential and lived threats of climate change will be covered in sec-tion 3.7. Rather, climate change is a risk multiplier. It increases the risk of experiencing symptoms diagnos-able as a mental disorder, or intensifies symptoms and distress, or both, particularly for groups already at increased risk, including due to structural inequal-ities. It can also reduce the resources available for individuals, communities and health systems to cope with and be resilient to stressors and distress.

Finally, mental health and physical health are tightly linked, with high rates of comorbidities (mul-tiple conditions that occur at the same time in the same person) (20,42) and a population-level correl-ation between good physical health and good mental health (43). Therefore, the well-established threats to physical health from the climate crisis (e.g. increased infectious disease spread), or policy changes that affect physical health, also typically have mental health implications. Because physical and mental health are two sides of the same coin, "initiatives which aim to promote physical wellbeing to the exclu-sion of mental and social wellbeing may be doomed to failure." (44)

3.1.2 A framework for the determinants of mental health and wellbeing

Mental health and wellbeing is influenced by a wide variety of interacting factors. As Patel et al. (2018) state, "the mental health of each individual is the unique product of social and environmental

influences, in particular during the early life course, interacting with genetic, neuro developmental, and psychological processes and affecting biological pathways in the brain." (9) These interactions also change over time, across an individual's life course and as global and local conditions change. Understanding these influences and interactions therefore requires a biopsychosocial approach. Research is ongoing to combine evidence across disciplines and establish the key "active ingredients" that can modulate an individual's mental wellness or illness (48). Several frameworks have been developed in efforts to usefully summarise and categorise the multiple influences affecting an individual's mental health and the levels at which they act (26,36). While the frameworks differ in their detail, there is a clear convergence of evidence that the health and wellbeing of an individual depends not only on factors residing in that person, but in the society and environment in which they live (49). This should not be surprising, considering that external conditions are widely acknowledged factors in whether a plant or animal thrives or dies. However, acknowledging the role of social and environmental determinants in an individual's mental health implies a need for mental health policies to invest in cultivating the right conditions for humans to thrive, rather than merely treating the symptoms of severe distress.

Climate change causes disruption to the determinants of mental health and wellbeing. Drawing inspiration from several existing models (9,50,51) that conceptualise the social determinants of health, we provide a framework to help the reader imagine the complex picture of interacting and dynamic influences on an individual's mental health and wellbeing, and how these interact with and are disrupted by climate change. Our review is structured accordingly. Our framework is an adaptation of Dahlgren and Whitehead's model (52), which categorises health determinants into layers. Socioeconomic, cultural and environmental conditions is the outermost layer, inside which sit: the material and social conditions a person lives and works in; their social and community networks; their individual psychology and lifestyle; and their biological factors. Our framework also brings in change over time as a key feature from Bronfenbrenner's Ecological Systems Theory (53), which sets out multiple systems that impact on child development. Our framework is not intended to be exhaustive but illustrative of the need to consider the variety and interconnection of mental health

determinants to "enable an environment that promotes mental health for all" (9).

Our framework sets out mental health and wellbeing determinants categorised into five nested layers, that interact with each other and with climate change. A person's biology, demographics and factors such as pre-existing mental ill-health and state of physical health interact with their individual psychology and lifestyle factors, including their own values, attitudes and behaviours. This is influenced by, and has influence on, their wider social and community networks; including personal relationships, the values and attitudes held by their social networks and communities, and the level of cohesion in their community. This all sits within their living and working conditions; whether a person has access to safe and secure housing, the state of water and food security, their access to healthcare, what green space and forms of transport are available to them, and their livelihood - including income, stability, and whether their livelihood is linked to the land they live on. Wider environmental (e.g. climate stability), socioeconomic (e.g. income inequalities), political (e.g. trust in government, opportunities for participation) and cultural conditions (e.g. whether centred on wellbeing, whether collectivist or individualist) interact with all these other layers of influence. In the context of climate change, all layers and determinants change over time, as the global environment and an individual's personal environment and life stage changes. They also interact with previous individual past experiences or wider historical events, such as prior exposure to extreme weather events, the time since that event occurred, and legacies of colonialism and conflict. The layers specified in the model and the constituent determinants are connected and interacting, so a disruption at one layer due to an adverse climate-relevant effect has implications for all other layers.

This complex picture of interacting and dynamic influences means that certain individuals and communities can experience multiple, compounding vulnerabilities. For example, poorer communities are more likely to be exposed to air pollution and poor quality housing and have less access to green space; while these factors each heighten the risk of poorer mental health, there are compounding and follow-on effects. Protecting and promoting mental health and wellbeing in the context of these interactions requires taking a rights-based approach; promoting an agenda that views mental health as a fundamental human right, that protects the welfare of those who are most vulnerable, and enables an environment that

promotes mental health for all (9,19). This is made even more vital in the context of climate change. For communities already facing complex disadvantage, climate change can act as a risk multiplier and exacerbate existing inequalities and vulnerabilities, including in mental health (38).

To reiterate, the categorisations of determinants in the framework are illustrative of the need to consider mental health as not only a product of an individual or their biology, or as factors within that individual's control, but as the product of many wider layers of influence around them. Effects in one layer will have influence across other layers, ultimately affecting the mental health and wellbeing of individuals. Interactions between layers can also be positive as well as negative - a point we will return to later in the context of the multiple positive impacts of action to reduce greenhouse gas emissions. Categories in the framework should not be taken as the only representation of such complex dynamics, and given their interacting nature it is impossible to draw distinct boundaries between them in practice. The framework is intended to encourage the reader to adopt a systems perspective and highlights the need for biopsychosocial and rights-based approaches in promoting and protecting mental health and wellbeing in the context of the climate crisis.

3.2 The multiple pathways through which climate change affects mental health

Rising global temperatures are expected to amplify existing climate-related risks and create new risks for natural and human systems (54). Some of these risks are regionally focused, others are more widespread. Figure 2 illustrates some of the key expected climate risks in different parts of the world (55). These risks are expected to become increasingly severe as global temperatures rise (56) and many of them are expected to impact human health.

These climate risks can affect mental health and emotional wellbeing through multiple pathways which
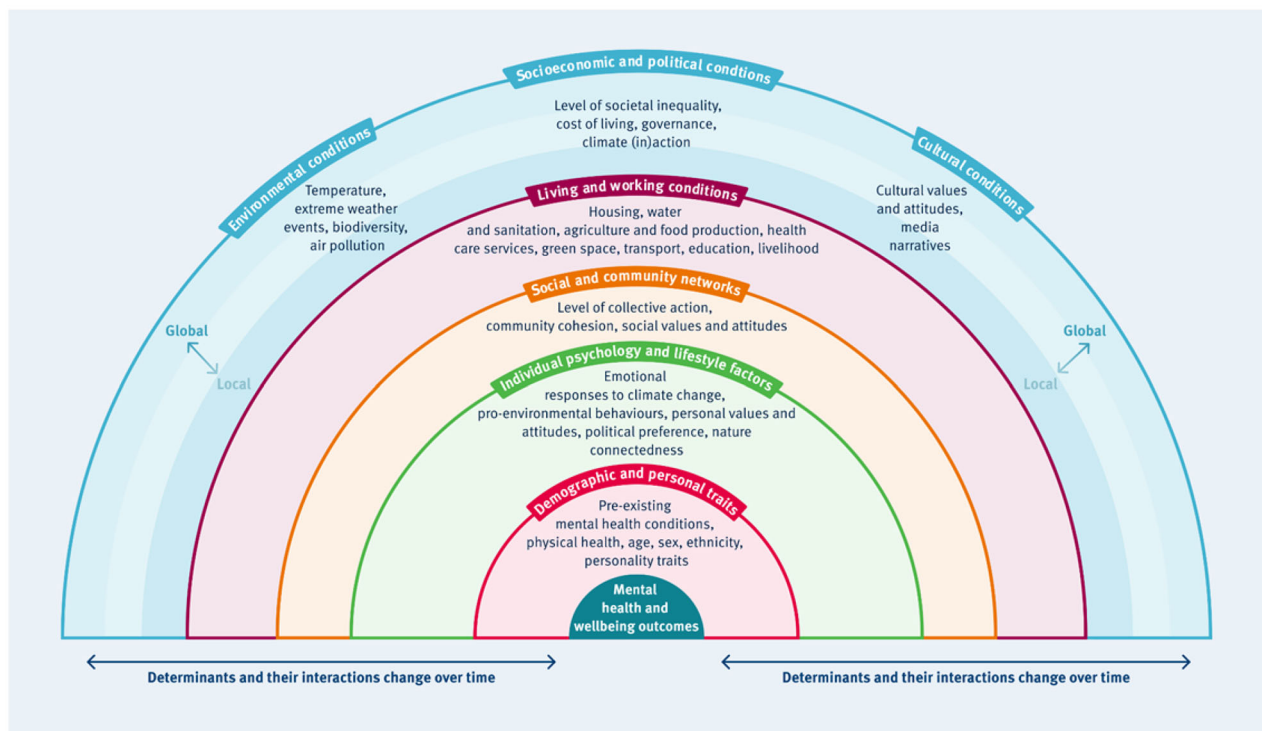
Figure 1. Framework for the determinants of mental health and wellbeing. The framework contains nested layers of determinant categories that all interactively influence each other and ultimately the mental health and wellbeing of an individual. The determinants, their interactions, and their influence on mental health and wellbeing changes over time. Changes over time include: changes across the lifecourse, increasing frequency and severity of extreme weather events, exposure to multiple climate impacts, and the time since the climate impact occurred. Adapted from Dahlgren and Whitehead's model, with influences from Bronfenbrenner's Ecological Systems Theory and the Lancet Commission for Global Mental Health and Sustainable Development (9,52,53). The framework is designed to be illustrative and encourage 'systems-thinking', but not to be exhaustive.

Figure 2. Key near term (to 2040) risks to physical, biological, human and managed systems resulting from climate change across different regions of the world. Risks include disruption to infrastructure, livelihoods and incomes due to increased extreme climate and weather events and impacts on health - including mental health - due to increased temperature. Adapted from content in Figure SPM.8 of the IPCC Fifth Assessment Report Summary for Policymakers (2014) (56) and Figure SPM.3 of the IPCC Sixth Assessment Working Group II Report on Impacts, Adaptation and Vulnerability (2022) (57). Risks presented here are illustrative and not exhaustive.

will be described in depth in the following sections. We conceive of these as a continuum (Figure 3a) from more 'direct' and explicit climate-related experiences (e.g. direct experience of a heatwave or flood), to longer-term direct impacts via disruption of social and economic determinants of mental health, to the more 'indirect' pathways related to climate awareness or bearing witness to climate-related damages and inaction of leaders. Figure 3b provides an illustrative example of the pathways through which one extreme weather event can both directly and indirectly impact mental health and emotional wellbeing in the immediate and longer term. It is worth acknowledging that many of the pathways of influence could be perceived as 'indirect'. This is because of the wide variety of pathways by which climate change has 'downstream' influences on mental health that are not the result of a single event (e.g. experiences of sexual violence or conflict during forced migration due to a drought, that itself is made more likely and more severe due to

climate change). This fact makes it challenging to quantify the true cost of climate change on mental health and emotional wellbeing, and we encourage the reader to consider these 'hidden costs', and possible 'flow on' effects that we can never exhaustively cover but attempt to meaningfully illustrate. Climate action by leaders at all levels can prevent the downstream consequences, as shown in figure 8.

Until recently, research has focussed predominantly on the direct impacts (6); a scoping review of the climate change and mental health literature up to 2020 found that only 11% of articles explored indirect effects (58). The last couple of years have seen a rapid rise in studies to address this clear evidence gap (59–65) as encouraged by scoping reviews (6,34,58,59,62,66) and 'calls to action' for the research community (59,66,67).

Despite the widely used terminology of direct and indirect impacts, we note that these are distinguished in different ways across the literature, and a clear
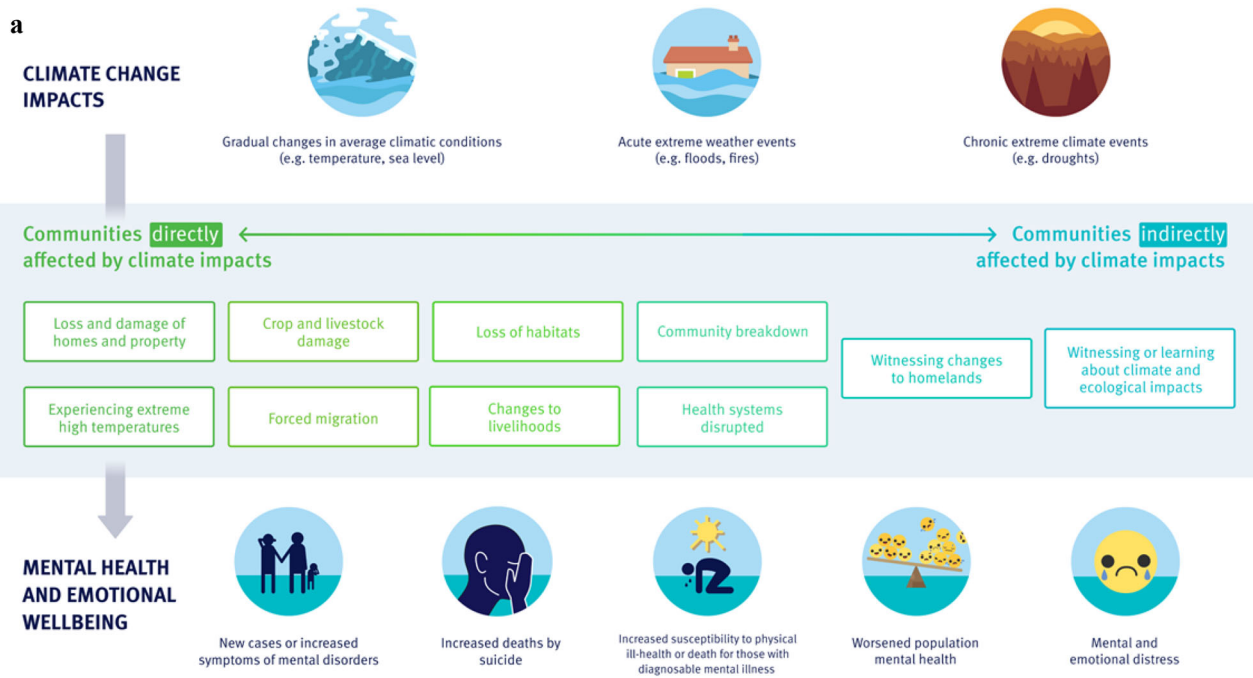
Figure 3a. Examples of the continuum of impacts that climate change has on mental health outcomes. Climate change impacts (top row of circles) including rising temperatures and sea level, and extreme weather events such as floods or droughts, effect mental health and emotional wellbeing (bottom row of circles) including: new cases or increased symptoms of mental disorders; increased deaths by suicide; increased susceptibility to physical illness or death for those who meet the criteria for mental disorders; worsened population mental health, and mental and emotional distress. This occurs directly and indirectly via a variety of pathways represented here as a continuum, from direct experiences (left hand side of shaded box), for example of extreme high temperatures or home loss in a wildfire, to indirect experiences of climate impacts (right hand side of shaded box), for example by reading about such events in the media and hearing about insufficient climate action from leaders.
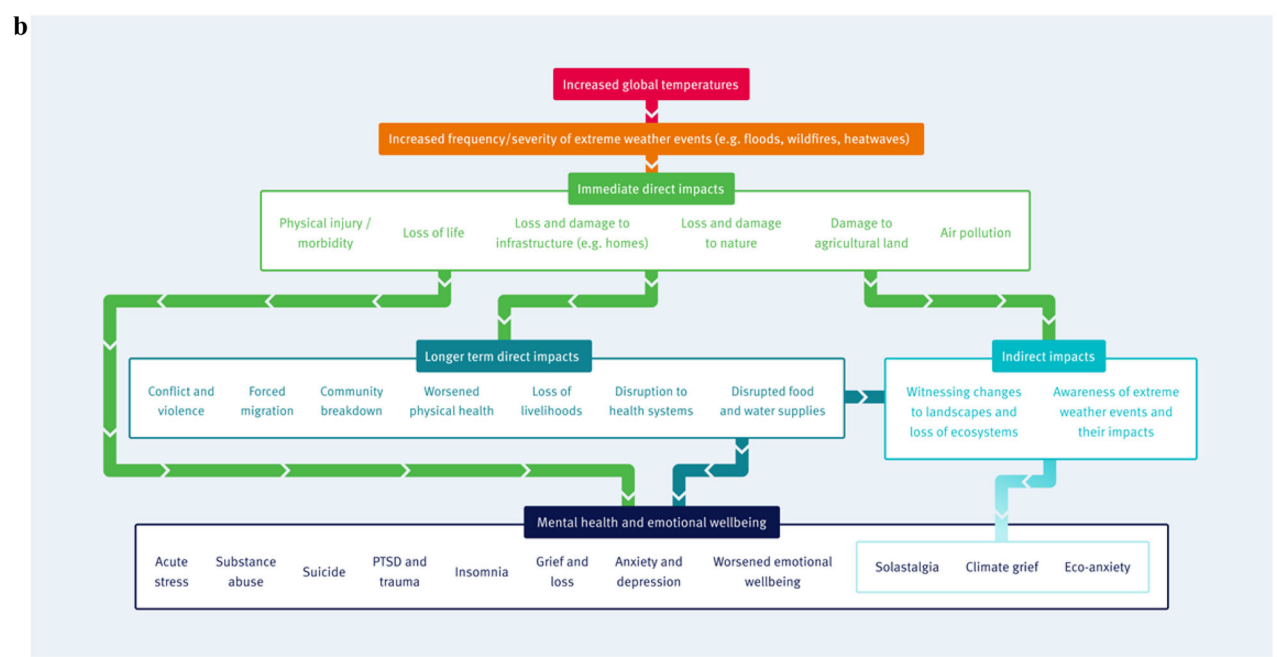
Figure 3b. An illustration of the multiple pathways (some more direct and some more indirect) by which a single example of a climate change-related event - e.g. a more severe wildfire - can ultimately worsen mental health and emotional wellbeing.

distinction between direct and indirect impacts often cannot be drawn in practice, not least because of the global nature of climate change where everyone is, to some extent, exposed to the impacts of a warming planet. Similarly, emerging data suggests it is direct experiences of climate change-related events, such as a wildfire, that heightens the 'indirect' psychological distress of recognising the threat posed by future and continued climate change. While recognising these limitations, we use the continuum here from direct to indirect to highlight the wide-ranging impact of climate change on mental health, and to usefully structure these impacts.

3.3 Disruption to Environmental Conditions: higher temperatures, extreme weather and climate events, and air quality

Mental health and wellbeing of individuals and communities can be worsened by the direct impacts of increasing global temperatures, and the associated increasing frequency and severity of extreme weather and climate events. This section explores the pathways by which changes in climatic conditions can adversely affect mental health, and so relates to the environmental conditions layer of the framework shown in figure 1. We also illustrate how certain population groups (e.g. those with pre-existing mental health conditions) are at increased risk of severe and compounding negative experiences during extreme weather or climate events, which exacerbate existing inequalities and vulnerabilities. The section also highlights how the effects of exposure to weather and climate extremes can accumulate over time (e.g. via repeated exposure to flooding or wildfires) in a way that compounds negative mental health outcomes.

3.3.1 Temperature

Evidence from a range of countries suggests that high, extreme, and variable temperatures worsen a range of mental health and wellbeing outcomes, including increased suicide rates, hospital attendance and admission for mental disorders (68,69), and worsened population mental health and emotional wellbeing (70,71). However, the relationships between mental health and weather variables, including temperature, are complex and dependent on context and mediating factors (for example humidity, season, local baseline temperatures) (72,73). Negative mental health impacts of increased temperatures have primarily been reported in Europe (74–77), the USA (71,78–80), and East Asia (68,81–85), but have also been observed in Mexico (86), Brazil

(87), Australia (72), Kazakhstan (88), and Russia (89), with some studies reporting models using data from multiple countries (86,90,91).

Temperature may modulate symptoms of mental illness or worsen general mental health and wellbeing through a range of biological or cognitive and societal pathways. These include: physiological changes, such as 'heat stress' and alterations to blood flow and central nervous system function, which can lead to cognitive and emotional changes (92), and societal changes, such as reduced economic outputs (93) and increased conflict and violence (94). Higher or extreme temperatures can also disturb sleep (92,95) and reduce its quality, which is known to increase mental health risk.

Higher, extreme or more variable ambient temperatures also have physical health implications. For example, increasing temperatures are linked with direct physical health impacts such as worsening symptoms or death from diseases such as diabetes or cardiovascular disease, and indirect impacts such as increasing rates and geographical spread of infectious disease and waterborne diseases, such as dengue fever (96). These physical health impacts can interact with mental health outcomes, worsening individual and community mental health, and can also be worse for those with pre-existing mental illness.

3.3.1.1 Suicide.
Suicide rates depend on external events and conditions and have been found to positively correlate with local ambient temperature on daily, weekly and monthly scales (86,97,98). With insufficient adaptation, climate change could increase suicide risk by increasing ambient temperatures. A systematic review found strong evidence for a relationship between temperature and suicide frequency in 15/17 studies (69). Meta-analyses suggest that there is an approximate 1% increase in suicide incidence for each 1 °C temperature increase above a local ambient temperature threshold (99) and an associated 2.2% increase in overall mortality related to either suicide or mental disorders (100). A recent preprint reported similar results, where meta-analysis was supportive of associations between increased temperatures and suicide (70). In a scenario of unmitigated climate change, one study projected an extra 22,000 (confidence interval 9,000-40,000) deaths across the USA and Mexico alone by the year 2050 (86), a similar effect size to the impact of an economic recession.

The evidence on the relationship on deaths by suicide and heatwave events in particular (as opposed to the general relationship between suicide and ambient temperature described above) is currently
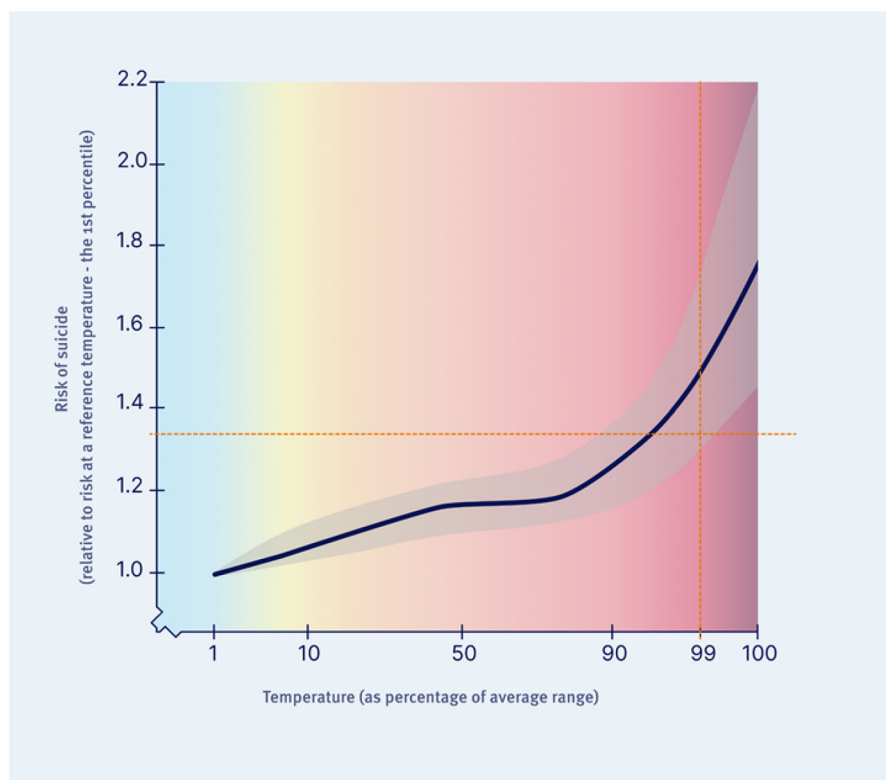
Figure 4. Modelled Relative Risk of suicide in the UK increases with increasing temperature, estimated using a conditional Poisson model that was adjusted for long-term time trend, season and day of the week. Relative Risk is the risk of suicide relative to the risk at the lowest suicide risk temperature. Adapted from Kim et al. 2019 (90).

inconclusive. There is some evidence that suicide risk rises with extreme temperatures such as sudden temperature spikes (101) or heatwaves, and with high temperature variability (79,86,98). A recent global modelling study however found mixed evidence on the relationship between suicide risk and number of heatwave events, and suggested that humidity was a stronger driver of this risk (91).

The exact mapping of temperature to suicide risk depends on local contexts and mediating factors, including local baseline temperatures, and other weather variables such as sunlight hours (102), humidity (72), or temporal variables (103) e.g. season (74,84,104). High relative humidity levels, the intensity and frequency of which is also affected by the climate crisis, appears to be particularly relevant to suicide risk (91), with woman and young people particularly vulnerable. There is also likely to be differential impacts of rising temperatures on suicide risk for different communities. Modelling of UK records from 1990-2011, for example, demonstrates a fairly linear increase in suicide rates with temperature, with higher temperatures associated with heightened risk (Figure 4). Other countries in the same study, however, showed non-linear patterns (90). Increasing suicide

rates at high temperatures have been reported globally, in both low- and high- income settings, though certain regions, including the whole of Africa, have not been studied. Studies of agricultural areas indicate that drought and heat can create conditions for higher suicide rates, for example among Australian and Indian farmers (101,105,106); these may operate over different timescales, for example effects of heat on crop yields is a distinct mechanism for increased suicide risk than physiological overheating when working outside at high temperatures. There are mixed results as to whether the effect of temperature on suicide vulnerability also depends on other demographic variables such as gender (103,107,108), and age (91).

3.3.1.2 Mental disorders. Higher temperatures have been linked to worsened physical and mental health outcomes for people living with symptoms of mental disorders. Evidence suggests higher heat-related mortality rates and increased hospital attendance and admission for symptoms of mental disorders during heatwaves (100). Evidence for such impacts comes mainly from hospital admissions data. Higher temperatures have been associated globally with increased

risks of mental health-related emergency department attendance, including for bipolar disorder, schizophrenia, dementia, self-harm, and alcohol and substance misuse (69,100,109–113). The evidence for the impact of heat on more common mental disorders such as anxiety and depression is more mixed (72,114), though studies have shown an increase in depressive language in the general population with heat (86), and there is some evidence for worsened symptoms of anxiety (69).

There is also a significant and unappreciated increase in mortality risk during heatwaves for individuals with symptoms that fit criteria for mental disorders (69,100,115,116), with this vulnerable group under-recognised by public health messaging around management of heat-related risks. The degree of increased risk requires further study, but indicatively, analysis of mortality and mental health data in Bologna, Italy between 2004 - 2017 found that for every 1 °C above 24 °C, mortality increased by 1.9% (95% CI 1.0–2.6, $p < 0.0001$) for people without mental disorders, while mortality increased by 5.5% (95% CI 2.4–8.6, $p < 0.0001$) for people with a psychiatric diagnosis using mental health services (117). A previous meta-analysis of factors associated with risk of death during heatwaves found that psychiatric illnesses tripled the likelihood of dying (OR, 3.61; 95% CI, 1.3-9.8), higher than the risk conferred by cardiovascular disease (116). This significantly increased risk of death from heat-related symptoms for those with mental disorders (118), particularly schizophrenia/schizotypal (119), psychosis, depression, dementia and substance abuse (69,118,120), may be due in part to side effects of psychotropic medication (medicines that treat a person's mental state). Prescription medications to treat mental illness can sometimes impair the body's ability to regulate temperature (thermoregulation), placing individuals taking such medications at increased risk of more severe heat-related symptoms or death at high temperatures, (92,118,121) particularly for the elderly (118,122). Such exacerbated heat stress may also worsen the symptoms of mental illness. There may be insufficient awareness of these risks among those on such medication or indeed among healthcare (123,124) and first aid practitioners. Psychotropic medications all act on the central nervous system, usually by altering neurotransmission through one or more neurochemical pathways. Their exact therapeutic mechanisms are not completely understood and nor are the mechanisms by which they can impair thermoregulation, other than to say this must be via central (i.e. cortical and sub-cortical brain) mechanisms (92,116).

3.3.1.3 General population mental health and wellbeing.
Psychological distress (feelings or thoughts that are troubling or upsetting) and negative emotions have been shown to rise across the general population with higher than average temperatures or extreme heat. Studies worldwide, primarily in the Global North, have reported that increased temperatures (sometimes above a locally-contingent threshold) are associated with: higher psychological distress (72), reduced positive emotion (125,126), increased negative emotion (102,125), increased fatigue (127), reduced wellbeing (125,127), 'depressive' language in social media posts (Figure 5) (45, 83, 86, 128), and higher self-reported mental health difficulties (129). This research has used correlational studies between weather data and either small scale or nation-wide survey data or analysis of social media posts, and the mental health metrics are heterogeneous. Humidity may compound effects of heat, while moderately or 'comfortably' warm weather or more sunshine hours may benefit wellbeing (103,126,130), and could mask the impacts of temperature if studies do not adequately control for these covariates.

The heat-induced societal, cognitive and biological changes that can worsen symptoms of mental disorders or increase suicide risks, such as sleep disruptions or changes in cognition, may also underlie the worsening mental wellbeing across the population more broadly.

3.3.1.4 Inequalities in temperature exposure and adaptation.
The ambient temperatures that an individual is exposed to depends on their local environment, including access to air conditioning and green space, with dense urban environments creating 'heat islands' (131,132). People of Colour, poorer communities, individuals who are housing insecure, and prisoners are less likely to have access to the cooling effects of tree cover, green space and quality housing (133–137), and hence are more likely to be exposed to mentally harmful levels of heat, particularly without investment in heat-adaptation under a changing climate. As those with mental disorders are over-represented in homeless and prison populations and those living in substandard housing, their greater susceptibility to heat represents a compounding of vulnerabilities likely to be exacerbated by climate change.

While individuals and communities may adapt to rising temperatures, particularly with investment in cooling cities (such as more tree cover), such efforts have not been sufficient to date; Burke et al. (2018) found no evidence for adaptation to rising temperatures in the USA thus far reducing the suicide risk
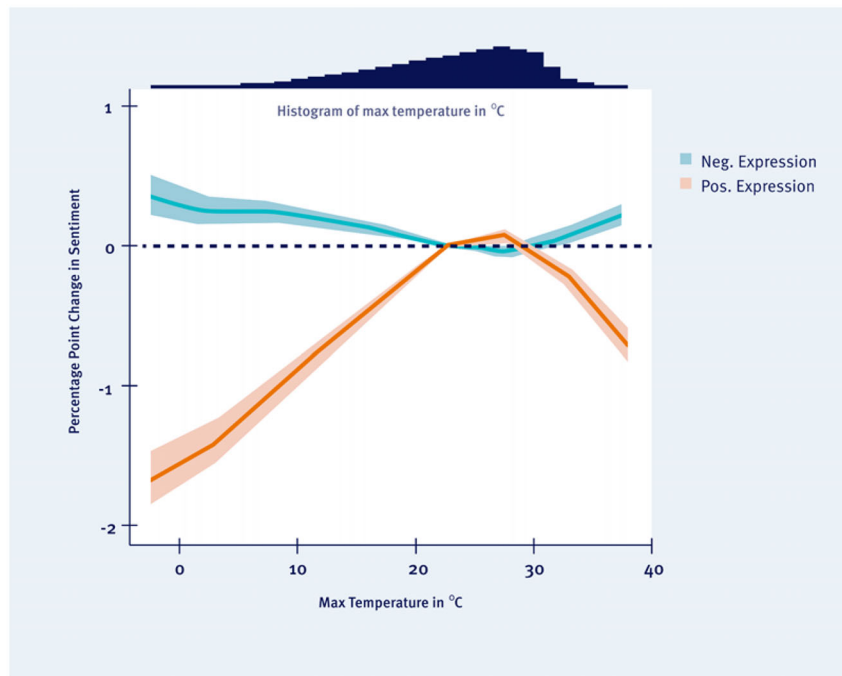
Figure 5. The relationship between daily maximum temperatures and the rates of expressed sentiment of approximately 2.4 billion Facebook status updates from 2009-2012. The relationship was produced by aggregating the facebook status updates to the city level of the 75 most populated metropolitan areas in the USA, and modelling the influence of maximum daily temperature on quantified sentiment (positive or negative) expressed in the status update. Other confounding variables were also considered. Sentiment is more negative at very low or very high temperatures. Adapted from Baylis et al., 2018 (128).

associated with the increased temperature, and hence the mental health costs and benefits of climate adaptation policies should be carefully monitored (86).

3.3.2 Extreme weather and climate events

The IPCC defines an extreme weather event as one "that is rare at a particular place and time of the year" while an extreme climate event is defined as "a pattern of extreme weather events that persists for some time, such as a season" (3). Living through an extreme weather or climate event, or weathering its aftermath, can be traumatic (Figure 6). While attribution of any one extreme weather or climate event to climate change has associated uncertainty, the frequency and severity of these will increase under a changing climate.

Extreme weather and climate events are associated with increased diagnoses of post-traumatic stress disorder (PTSD), depression, anxiety, extreme psychological stress and distress, substance use and suicidality (138–141). These effects have been observed in people of all ages (children, adolescents, adults, elderly), and healthcare professionals working in disaster relief (142–148). Such psychological impacts of climate extremes have received insufficient political attention considering their increasing frequency and high long-term costs to individuals and societies involved. While the costs of floods, fires or hurricanes are counted in bodies or building damage, the number of people psychologically impacted from any form of disaster can exceed those physically injured by 40–1 (149).

While most research has taken place in the USA and Australia (150–155), effects have also been observed in other countries including Thailand, China, Poland, South Korea, Chile, India, Bangladesh and the UK (142,143,156–162). Increased mental health needs have been observed following sudden extreme weather events including floods, tornados, hurricanes, wildfires (bushfires), earthquakes and tsunamis (138,152,157,162–164), but also in response to slower acting extreme climate events such as droughts (154,155,165,166) and rising sea-levels (167–169). It should be noted that heatwaves are also classified as extreme weather events but have been covered in the previous section as they are an extension of the effect of temperature on mental health outcomes. Single extreme weather events and slower-onset changes, such as rising sea levels, and indeed the threat of repeated extreme weather events, can all force people to choose between staying or migrating. Either decision can come with mental health challenges, as does the stress and uncertainty of grappling with such decisions.
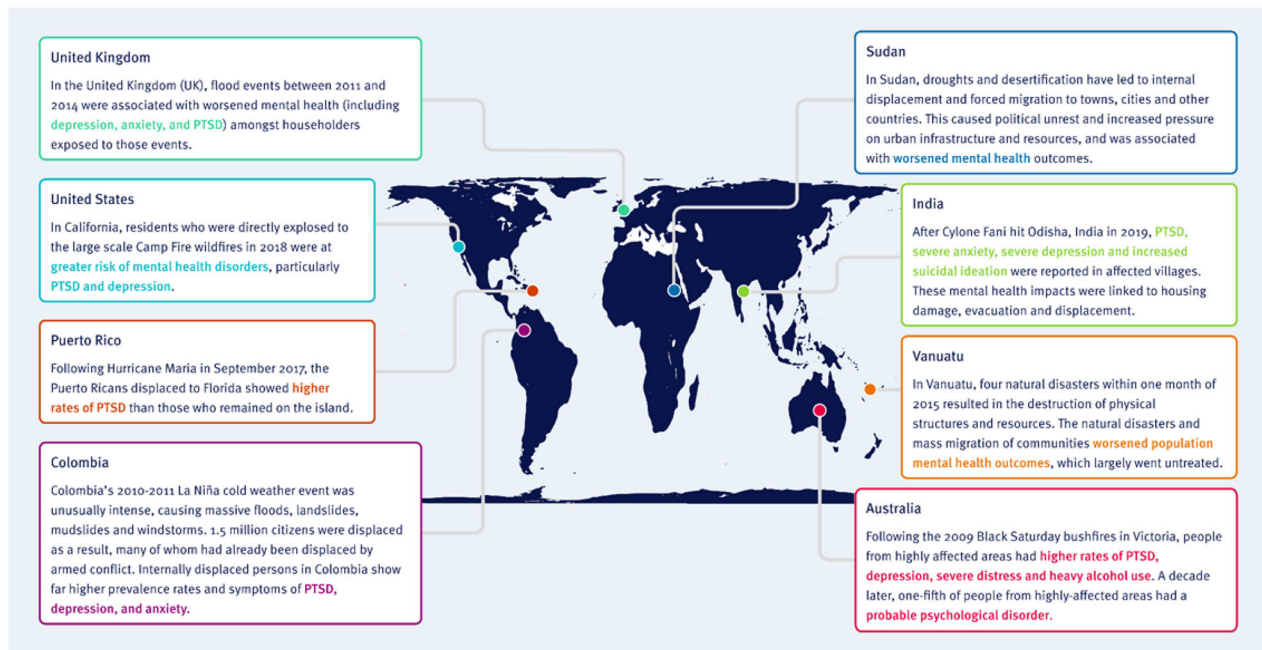
United Kingdom

In the United Kingdom (UK), flood events between 2011 and 2014 were associated with worsened mental health (including depression, anxiety, and PTSD) amongst householders exposed to those events.

United States

In California, residents who were directly exposed to the large scale Camp Fire wildfires in 2018 were at greater risk of mental health disorders, particularly PTSD and depression.

Puerto Rico

Following Hurricane Maria in September 2017, the Puerto Ricans displaced to Florida showed higher rates of PTSD than those who remained on the island.

Colombia

Colombia's 2010-2011 La Niña cold weather event was unusually intense, causing massive floods, landslides, mudslides and windstorms. 1.5 million citizens were displaced as a result, many of whom had already been displaced by armed conflict. Internally displaced persons in Colombia show far higher prevalence rates and symptoms of PTSD, depression, and anxiety.

Sudan

In Sudan, droughts and desertification have led to internal displacement and forced migration to towns, cities and other countries. This caused political unrest and increased pressure on urban infrastructure and resources, and was associated with worsened mental health outcomes.

India

After Cylone Fani hit Odisha, India in 2019, PTSD, severe anxiety, severe depression and increased suicidal ideation were reported in affected villages. These mental health impacts were linked to housing damage, evacuation and displacement.

Vanuatu

In Vanuatu, four natural disasters within one month of 2015 resulted in the destruction of physical structures and resources. The natural disasters and mass migration of communities worsened population mental health outcomes, which largely went untreated.

Australia

Following the 2009 Black Saturday bushfires in Victoria, people from highly affected areas had higher rates of PTSD, depression, severe distress and heavy alcohol use. A decade later, one-fifth of people from highly-affected areas had a probable psychological disorder.

Figure 6. Examples of the impact of extreme weather events on mental health across the world, including the United Kingdom (200–202), United States of America (203), Puerto Rico (204–207), Colombia (208), Sudan (208), India (209), Vanuatu (208), Australia (210).

Certain risk factors and secondary stressors may increase the likelihood of developing mental health problems after extreme weather events. These include demographic factors, such as being a woman (particularly if pregnant or postnatal) (170,171), a child (170,172,173), an ethnic minority (174–176), or having a pre-existing mental health disorder (140,177); and socioeconomic factors, including prior experiences of deprivation (178), and occupation (e.g. first responders are particularly vulnerable (179,180)). Secondary stressors predicting worse outcomes include experiences of evacuation (181,182), damage to property and possessions (183,184), financial loss (185,186), threat or harm to self or loved ones (187–189), lesser social support (146,150,185), inadequate medical care (190,191), and inadequate welfare support (such as unsafe or unclean accommodation, or inadequate food, water, or electricity) (192,193). Again, it is noted that climate change is a risk multiplier, with climate-related threats such as extreme weather and climate events exacerbating pre-existing vulnerabilities that occur for certain groups of people based on the current structure of our society. This includes inequalities that disadvantage certain groups such as women, ethnic minority groups, or poorer communities. These factors interact in complex ways, that climate change accelerates; for example, by creating traumatic experiences that further heighten the risk of mental disorders for already vulnerable groups.

While PTSD arising from extreme weather may bring to mind global-headline dominating events such as Hurricane Katrina, reoccurring extremes such as repeated flooding from unusually high and sustained rainfall can also lead to long-term mental health challenges and cumulative psychological tolls (156,187). Symptoms will tend to appear more quickly and more severely on the second and subsequent exposures, e.g. being exposed to multiple floods, cyclones, droughts or wildfires; or one then another) (194–196).

The psychological and social impacts of climate-related disasters can take some time to present themselves. While some evidence suggests the incidence and severity of psychological disorders peak within the first 6-12 months following an event such as a flood or hurricane (197,198), some have found an increase over time, with higher rates of PTSD in Hurricane Katrina survivors after 12 months than at 5-8 months (20.9% and 14.9% respectively) (199). Anxiety associated with flooding has been reported for individuals even at 2.5-5 years after a significant flooding event (200). Several years after the 2009 Australian 'Black Saturday' bushfires, a minority of individuals still experienced PTSD, depression or severe psychological distress, with the incidence rising for the worst affected communities and those who had feared for their life, lost a loved one, or experienced subsequent stressors (e.g. PTSD rates were 15.6% in high-, 7.2% in medium- and 1.0% in

low-affected communities) (138). A decade later, one-fifth of people from highly-affected areas had a probable psychological disorder.

3.3.3 Biodiversity

Biodiversity is innately linked with the requirements for life, including clean air, secure water and food (3). Exposure to biodiverse natural environments is an important environmental determinant of good mental health and wellbeing (211–213). Time spent in biodiverse natural environments has been shown to have a strong positive impact on wellbeing, including positive mood and happiness, improved cognitive function, increased vitality and reduced stress, anxiety and depression (214–218). People who feel more connected to nature have greater health and wellbeing, while also being more likely to take actions to protect nature (219–222). These benefits are greater if the spaces are more biodiverse (212).

Despite the many benefits provided by biodiverse ecosystems, on a global scale biodiversity is declining at an unprecedented rate and the drivers of this decline (e.g. land use change) are intensifying (223). Biodiversity loss and climate change are also inextricably linked (224). Climate change is a key driver of biodiversity loss (225) while ecosystems play an important role in absorbing and storing greenhouse gases as well as supporting climate adaptation, for example by providing societies with greater protection from extreme weather events. The interconnectedness of the biodiversity and climate crises is both a threat and an opportunity to mental health and emotional wellbeing. It means that climate change can threaten the biodiverse ecosystems on which people depend for their livelihoods and emotional wellbeing. Conversely, it also means that actions to reduce greenhouse gas emissions can often be synergistic with protecting and restoring biodiversity - a point we will elaborate on later.

3.3.4 Air quality

Burning fossil fuels is the largest contributor to climate change, and also results in air pollution, while climate change can further worsen air pollution through increased heat, humidity and wildfires (226,227). Air pollution, specifically particulate matter (PM), and nitrogen oxides (NOx), increase the risk of mental health problems, potentially via mechanisms of inflammation and neuronal injury (228–230). Exposure to different components of air pollution has been linked to higher rates of depression, anxiety, bipolar, psychosis, schizophrenia, neurodegenerative

disorders such as dementia, and increased suicide risk (short-term exposure) (229,231–233). Individuals exposed to more air pollution are more likely to use mental health services, even when controlling for covariates such as deprivation, age or ethnicity (234). Longitudinal research on mental health service users presenting with psychotic and mood disorders found a large increase after one year in both inpatient days and community mental health service use for those living at addresses with higher exposure to PM and NOx pollution (234). These increases persisted at the seven year study follow-up.

As with other mental health effects of climate change, the impacts of air pollution are spread unequally across populations. Socioeconomic disparities (235) in exposure to air pollution are seen globally (236,237), with low-income groups exposed to higher levels of outdoor and indoor air pollution (238,239). Air pollution exposure also increases physical health problems (240) which further increases the risk for mental health problems.

3.4 Disruption to socioeconomic and political conditions

Climate change can disrupt and destabilise social, economic and political determinants of good mental health and wellbeing, such as stable societies, governance and living costs. These determinants can be disrupted by climate change but also influence its trajectory, for example countries with trustworthy and transparent governance tend to have both higher mental wellbeing but also lower carbon emissions (241). Socioeconomic and political conditions interact with the other layers in our framework as we highlight below in the context of conflict and forced migration. Those examples attempt to show how climate change can affect socioeconomic and political conditions and how that can lead to cascading effects at every level of the system; disrupting living and working conditions, destabilising community networks, worsening physical health, and widening inequalities through disproportionately worse impacts for more vulnerable communities.

3.4.1 Social and global inequality

Social injustice and inequalities are key risk factors for poor mental health and developing mental disorders (242–244). Climate change directly exacerbates existing inequalities in health, including mental health, as the groups most likely to be negatively affected by climate change, and therefore have their

mental health and wellbeing compromised, are those that are already disadvantaged in society. This includes people with pre-existing mental health conditions. Further, climate change widens inequalities in social and economic opportunities, in a vicious cycle (245–247). Countries and contexts with higher income inequalities are associated with both higher levels of greenhouse gas emissions, and poorer mental health (242,248–250). Between 1990-2015, the richest 10% of the global population were responsible for 52% of carbon emissions, while the poorest 50% created only 7% (251) . More equal and democratic societies tend to have characteristics (including lower poverty, better education and healthcare) that are beneficial to climate resilience, willingness to adopt climate mitigation policies, and higher satisfaction of people's needs and better wellbeing outcomes with less energy use. Conversely, societies which "prioritize economic growth beyond moderate incomes and extractive sectors" have lower wellbeing outcomes with higher energy use (55,245,252). Climate injustice, whereby individuals, communities and countries who have contributed the least to greenhouse gas emissions are hit first and worst by the consequences, is a source of justifiable anger and distress that also increase mental health risk (253). Reducing inequalities in resource distribution will improve human mental health and wellbeing, and "the amount of energy needed for a high global level of human development is dropping", with options available to produce a great increase in wellbeing in low resource settings with only relatively slight increases in energy use (254). Improving equity in social and economic systems improves wellbeing for all, while also improving participation and trust in governance, and climate mitigation, in an "interactive and self-reinforcing process" (3).

3.4.2 Conflict, violence and destabilisation of societies

Climate change can escalate conflict and violence (255). This can happen through direct impacts, such as higher temperatures which heighten interpersonal violence (256). A meta-analysis reported a 4% increase in frequency of interpersonal violence and 14% increase in intergroup conflict for each standard deviation change in temperatures and rainfall from previous baseline conditions (257). Conflict is both a cause and consequence of disruption to the socioeconomic, cultural and environmental stability of societies, rupturing and resulting from ruptured community bonds and social cohesion, reduced

habitable and arable land, increased food and water insecurity, strains on health systems and forced migration. As climate change produces such myriad and compounding disruptions and the ability of governments to provide public services is reduced, increasingly desperate populations facing scarcity of resources can become more violence prone, increasing intergroup conflict, terrorism, sexual violence, domestic violence, and conflicts or wars within and across nations (255,258–261).

Conflict and violence have well documented mental health impacts, including post-traumatic stress disorder, depression, anxiety and substance abuse (262,263). Following the civil war in Guatemala, for example, 41% of survey respondents screened positive for depression, 50% for PTSD and 23% for alcohol dependence (264). Conflict-driven impacts on physical health, including increased sexual and gender-based violence (255,258,259), and increased spread of infectious diseases, also impact on mental health and wellbeing (258,263). Weakened social connections can impair the ability to process trauma and loss. Insecurity and disruption to normal patterns of work and social interactions are further risk factors for poor mental health outcomes (258,265).

Countries experiencing conflict are most at risk from climate change, in part due to geography, but primarily due to reduced ability to adapt (259,266). Insecurity limits the capacity of individuals, communities and governments to cope with climate shocks, such as from extreme weather events. The concerted and coordinated effort required to transform societies and support climate resilience of local communities can be limited during times of armed conflict. International support for adaptation efforts - by community organisations like the Red Cross or governments can also be reduced. These compounding crises and exacerbated vulnerabilities can take a heavy toll on mental health and wellbeing. Conflict can also damage the environment and escalate climate change, for example through contamination to air, water and soil from warfare or from deforestation and burning (255).

3.4.3 Forced migration

Climate change is likely to be an increasingly important factor in driving migration this century as extreme weather and climate events, rising sea levels, and related social changes force people from their homelands (267–270), producing 'climate migrants' or 'climate refugees'.

In 2021 23.7 million people were internally displaced from non-conflict disasters, the majority of which were weather-related (271). A widely cited figure estimates there could be as many as 200 million climate refugees by 2050 as a result of climate change and the associated flooding, sea level rises, droughts, food/arable land shortages and conflicts (272). Temporary evacuation or local displacement from climate-related disasters will also increasingly occur, such as forced relocation or home loss after wildfires. As people are forced to change their livelihoods and way of life - either preventatively as their situation worsens (e.g. drought), or to remain safe in the context of an extreme weather event - people from rural communities can find themselves in poor urban communities facing new complex risks (266,273). The precise experience of, and impacts on, migrating individuals is likely to be significantly affected by what kind of migration takes place, such as planned relocation versus emergency response, forced versus voluntary, or within-country versus cross-border migration. Planned versus emergency evacuation can be related to better mortality, physical and mental health outcomes for those affected (274,275).

Forced displacement or evacuation after climate-related disasters has been linked to depression, anxiety, and PTSD (181,182). Losing your home, community and culture, and navigating potentially perilous and difficult journeys to safety, comes with severe and on-going stress, loss of identity, and loss of supportive connections. First and second generation immigrants have double the risk of psychosis compared to non-immigrants (276). This risk is not equal across host countries and ethnicities, implying that social context is important (276,277). While there is less evidence reflecting the impact of climate migration relative to other causes of migration, the challenges faced by climate refugees are likely to emulate some of the challenges faced by refugees in general, who experience higher rates of mental disorders (278).

The mental health effects of *climate migration* in particular are currently understudied, though there is evidence for negative effects (208,279). For example, Indigenous Australians forced to migrate to towns as a result of droughts disrupting the pastoralism sector (280) have reduced mental wellbeing. People relocated by Hurricanes Katrina and Harvey in the USA showed increased psychological distress, stress, and posttraumatic stress compared to people who could stay in their original community (281,282). Again, outcomes substantially depend on stress exposure and support provided. After Hurricane Sandy in the USA,

for example, individuals who chose supported relocation (under a voluntary home buyout scheme) were less likely to report worsened stress than those who chose to rebuild in place with minimal support (283).

Displacement or migration triggered by climatic changes may involve a 'risk exchange', whereby migration improves certain determinants of physical and mental health but worsens others (284). Multiple factors will influence the decision to stay or go, and, if migration is appropriately planned and supported, some individuals and communities may benefit. How positive or traumatic the experience is - both before, during and after the relocation - depends on the circumstances of the situation being left and the nature of the receiving country/location, including how welcoming this is to migrants, both culturally and in the relevant support structures. The support available for people who stay versus who migrate will determine outcomes, either within or between countries. For example, the relative stress of staying versus moving will be influenced by escalating insurance costs for areas at increasing climate risk, or difficulty gaining aid to rebuild post-disaster in such locations (283).

Mental health and wellbeing outcomes are improved with access to appropriate resources. This includes support to process traumas associated with migration, and to relevant health, education, employment and social resources. Social factors seem to be especially important in other forced-migration scenarios, where 'cultural bereavement' can present mental health risks (285) (which could present alongside solastalgia, grief and bereavement of place in cases of climate migration). Social exclusion, economic disadvantage, stigma and discrimination all contribute to poor migrant mental health (286–288). In a UK study, refugees experienced higher stress, worry and depression with post-migration stressors such as unemployment or underemployment, victimisation, poor housing or homelessness (289). These factors reduced long-term health generally (289). Meta-analyses of disaster-driven refugee mental health have sought to identify what factors are linked with greater risk for worse mental health outcomes and with resilience. Particular risk factors for worse mental health outcomes have been found to include: living in institutional accommodation or rural locations, having limited economic opportunity, being of older age or female gender, and having had more education or higher pre-disaster socioeconomic status (278). In conflict-driven forced migration, factors such as family and community cohesion and support, collective identity and religion have been linked to resilience

(290). These studies highlight that appropriate structural, social and cultural resources for climate migrants are key mental health interventions.

Access to opportunities for important cultural and spiritual practices influences the mental health of climate migrants. Maintaining cultural traditions after climate migration may be difficult for communities with cultures strongly tied to the land, such as Indigenous Communities, greatly exacerbating the negative impacts of forced migration from homelands (291). Studies of conflict-displaced persons from Colombia, Ethiopia, and Bangladesh have observed the benefits of maintaining cultural traditions and community-based mental healthcare support (286,292–294).

3.4.4 Governance

Governance, at local, national and global scales, can create conditions that either support or detract from the wellbeing of people and the planet (2). Governance that is transparent, inclusive, trustworthy and provides opportunities for participation is linked to higher wellbeing of citizens (241,295). Climate action at all levels - from local to global - ultimately depends on good governance. Successful climate adaptation relies on using local knowledge and mobilising local communities, which ultimately depends on government investment. Likewise, support for climate mitigation policies is strongest when there are opportunities for meaningful participation in decision-making of all affected stakeholders (across sectors and levels of society), which can build societal trust, social cohesion and improve climate governance. This depends on and can also benefit the wellbeing of community members. Similarly, gender equity improves health and wellbeing for women, while greenhouse gas emissions are lower in countries where women have more political power. (296)

Conversely, climate change and its compounding risks can destablise governments, with flow on disruptions that ultimately worsen mental health. For example, 'the convergence of climate risks and conflict further worsens food and economic insecurity and health disparities, limits access to essential services, while weakening the capacity of governments, institutions and societies to provide support. The impact of this overlap is not only wide-ranging; it is also far-reaching. Ripple effects can shape mobility, patterns of transhumance or access to resources on a continental scale.' (266)

Mental health and wellbeing will ultimately only be protected by governments enacting policies that rapidly transition away from fossil fuels. These policies must be implemented with care to protect those who may be negatively affected, e.g. by the need to change livelihoods (see section 4.4 for more on a 'Just Transition'). Governance can also moderate the influence of climate change on mental health outcomes. For example, conflict can erupt when agricultural farmers and cattle herders are forced by a changing climate to compete for resources. This happens more when there is a lack of strong governance, while the conflicts can weaken governance further. By proactively strengthening the determinants of good mental health and wellbeing, including investment in trustworthy and participatory governance, the effects of climate change on the wellbeing of communities can be reduced.

3.5 Disruption to cultural conditions

The values, attitudes and narratives that are held within a particular culture, and globally, are both influenced by and have influence on climate change, and on mental health and wellbeing outcomes. We use cultural conditions here to include the values a society aims to uphold and that underpin economies and governance, the way people within a society view their relationships, connections and responsibilities to each other and to nature, their role and purpose in life and society, and the stories told by a people about themselves. Cultures influence mental health and wellbeing, but also how mental health and wellbeing are considered, understood and supported.

The widespread and multifarious effects of climate change causes disruptions to cultures and ways of life that can cause complex harm to identity, purpose, mental health and wellbeing. This particularly applies to individuals and communities that have strong cultural and spiritual connections to landscapes, including most Indigenous communities (see section 3.6 for further information). For example, melting sea ice in Canada is threatening Inuit communities that rely on the sea ice not only for their way of life, but for their fundamental identity as a people, intimately bound with wellbeing. An Inuit elder has been quoted as saying: "We are people of the sea ice. And if there's no more sea ice, how do we be people of the sea ice?" (297).

Conversely, climate change and poor mental health and wellbeing are both consequences of certain cultural conditions. Psychotherapist Sally Weintrobe has highlighted how 'cultures of uncare' and 'exceptionalism' (or the belief that standard

boundaries, including limits of natural systems, do not apply to that individual or culture) are dominating in many countries and contexts, and how these damage both mental health and wellbeing and drive climate change (298). Relevant cultural conditions include materialism, hyper-individualism, the legacy of colonialism, and disconnection between people and people and nature.

The rise of neoliberal economic policies and culture have been associated with multiple and widespread mental health harms (299). Materialism and overconsumption are also a key driver of the climate and ecological crises, with production, transport and disposal of unnecessary or throwaway items increasing use of fossil fuels and other non-renewable resources and creating waste. To stay within planetary boundaries richer nations must reduce their overconsumption. While this often plays into narratives of sacrifice, there is good evidence that materialistic values are negatively correlated with wellbeing (300), partly explainable by the individualistic nature of materialism being antithetic to collectivist values (301,302). Conversely, reducing materialistic values can improve wellbeing (303).

Fostering cultures that strengthen connections with people to themselves, other people and wider nature can reduce loneliness and increase wellbeing (221,304,305). Such cultures and opportunities for connection are also key to effective climate mitigation and adaptation actions (2). An over-focus on individual-level climate action has been criticised for distracting from the duty of care of government, business and other institutions while increasing the likelihood of individual citizens feeling overwhelmed and distressed. Similarly, a culture of mental health-care that focuses only on the individual-level causes of mental health problems can similarly distract from attention to wider societal contexts for distress and communal opportunities and conditions that better prevent and treat mental ill-health (306).

Many countries and communities particularly vulnerable to climate change are also dealing with the legacies of colonialism (307). Indigenous communities in Australia have highlighted how "the impacts of climate change resembles the experiences of colonisation. When the first settlers [Europeans] invaded Australia, falsely and disrespectfully calling it terra nullius, no one's land, they bought with them many strangers carrying many diseases. Today, the man-made impacts of climate change are bringing a new form of disease to our country" (308). Colonialist legacies also reduce the ability of, for example, small

island developing states to adapt to climate change, as livelihoods may depend on cash crops and vulnerable infrastructures. Colonisation turned many societies away from practices that were more protective of the environment, or traditional sources of food and agriculture more resilient to local conditions. Mental health and wellbeing impacts can therefore be exacerbated by how the 'structural violence of colonialism' increases economic hardship and inability to meet basic needs under a changing climate (309). 'Climate coloniality' plays out today in how many of the groups and countries most affected by climate change are those who have least contributed to the problem, while these same countries often have less power in international negotiations, as discussed at COP26 (307). The cultures of colonisation, that disconnect people from lands, eco-systems and traditional practices of sustainability living with the beyond human world, have both contributed to and perpetuate the climate crisis (307). Climate justice and decolonisation movements seek to redress the power and justice imbalances that were created during colonialism and still exist today.

Cultures that value connection to land and nature have benefits for both mental health and for addressing climate change. Nature connectedness, or the extent that humans identify with the rest of nature, is a core part of the identity of many Indigenous cultures worldwide, though has been reduced in highly urbanised and Westernised societies. People with a stronger connection to nature are more satisfied with their lives, have more positive emotions and higher vitality (221,310,311). "Feeling a part of nature has been shown to significantly correlate with life satisfaction, vitality, meaningfulness, happiness, mindfulness, and lower cognitive anxiety" (312). We are 'wired' to like and appreciate natural scenes, and to seek connections with the natural world and other life forms, known as the "biophilia hypothesis" (313). People who are more connected to nature are more likely to take action to protect it, and to support climate policies. Cultures more connected to the natural world, including Indigenous communities, are also best placed to guide local climate action. Participation in such programmes, including 'Caring for Country' initiatives in Australia (314), have benefits for mental health and wellbeing as will be discussed further in section 3.6.2.

Stories and narratives are a key part of culture. The media clearly plays an important role in communicating climate narratives. As frequency and severity of extreme weather events increases, how much news

coverage climate change receives and how it is reported also changes (315,316). Exposure to media coverage influences wellbeing and mental health; negative emotional responses to climate change are linked to higher exposure to information about climate impacts (64). Media narratives across different contexts also intersect with political, socioeconomic and environmental conditions. For example, one analysis of 37,000 news articles from 45 countries and territories found that media narratives in wealthier countries were more likely to emphasise domestic policies and scientific evidence of climate change, and in poorer countries were more focused on international relations and natural aspects of climate change (317). Another such analysis found climate change coverage to be generally more frequent in Global North countries, and more focused on the challenges and implications of climate change for society in the Global South (318). Global and local cultural narratives interact with local social values and attitudes, and influence psychological and emotional responses to climate change and individual and community behaviours (319,320). For example, as highlighted above, extreme heat has been linked with more 'depressive' language in social media posts (86). Media narratives can also exert pressure on the politicians which can both support or hinder meaningful action to mitigate and adapt to climate change, and the associated impacts that has on people's vulnerability to climate and anxiety about climate inaction.

3.6 Disruption to living and working conditions

Living and working conditions refer to the access, availability and opportunities that individuals have in terms of jobs, housing, education, food, water and welfare services, as shown in figure 1. In this section we provide examples of how climate change can disrupt some of these conditions and the associated risk of poorer mental health and wellbeing, including compounding existing disadvantages for some groups in society.

3.6.1 Food and water security

Climate change is affecting food and water security through changing precipitation patterns, increasing temperatures and extreme weather events. It will continue to negatively affect food security by reducing crop yields, disrupting food storage and distribution, and increasing prices or price volatility (3). This impacts mental health and wellbeing directly, through malnourishment and malnutrition impacts (which can

disrupt brain development in children), and indirectly, through the psychological distress and stress caused by uncertainty in the ability of people to acquire sufficient and appropriate food to feed themselves and their families (321–323). This stress response can increase symptoms of depression and anxiety. Reduced access to traditional foods with a changing climate has also been reported to worsen mental health in Indigenous communities (324).

Water insecurity directly and indirectly impacts mental health outcomes, with documented increases in psychological stress, despair, depression and anxiety amongst those who had insecure water supplies (325). Mechanisms can include: stress and insecurity due to water scarcity and material deprivation, displacement of families and loss of connection to people and places, social shame, experiences of injustice, loss of autonomy, conflict and violence, dehydration altering effectiveness of psychoactive medications, worry about health threats and physical ill-health including disease spread and effects of heat (326–328). Water-related hazards are unequally experienced, with communities who already experience systemic inequities and vulnerabilities being disproportionately affected. This includes people who are 'poor, women, children, Indigenous Peoples, and the elderly in all locations, especially in the Global South', (329) and mental health impacts have been documented across the world, including Indigenous communities in Peru, Australian farmers, and communities (particularly women) in USA, Bolivia, Nepal, India and Iran (101,328,330–334).

3.6.2. Livelihoods

Access to a secure and stable livelihood is a social and economic determinant of mental health, with the capacity to fully participate in society and fulfil one's potential part of the definition of good mental health. Climate change threatens livelihoods via its impact on sectors such as agriculture as outlined above or via the effect that high temperatures or highly polluted air have on reducing cognitive function and the ability to work (3,26). Such disruptions to livelihoods can increase stress and trauma, substance abuse and suicide ideation (105,335,336).

3.7 Disruption to individual psychology and interactions with social and community networks

Individual psychological responses to climate change are influenced by the social and community networks within which they are embedded - for example, by

the degree to which individuals are able to access support networks for collective action and the values of the groups to which an individual belongs. Conversely, social and community networks can change in response to the hopes and fears of individuals, as illustrated by the rise of social movements such as the 'Fridays for Future' youth climate movement. Because these layers are so closely intertwined, this section describes them and the interactions between them together, while also recognising how they themselves are affected by other layers such as the cultural conditions of a society and associated media narratives.

3.7.1 Psychological responses to climate awareness and the impact on mental health and wellbeing

As awareness of the severity of the climate crisis increases, through increased lived experiences of climate-related extreme events and associated media reporting, distress related to climate awareness is also increasing, with more frequent use of terms such as 'eco-anxiety' in academic and popular media discourse. Despite this, there remains a relative lack of data on the prevalence, nature and severity of emotional and psychological responses to the climate crisis and the mental health and wellbeing impacts. While this literature is rapidly widening and evolving, there are still gaps in standardisation of metrics and psychological constructs, how different groups are being affected globally, what strategies are most constructive for coping, and longitudinal changes. This section explores the range and prevalence of psychological and emotional responses that have been documented to date.

Strong psychological responses to the climate crisis are often part of a healthy and adaptive process to the threat posed, and thus should not be pathologised (17,337–339). However, these responses can become ongoing sources of stress and, without appropriate support, impact on mental health and wellbeing. To aid the avoidance of pathologisation, we have maintained a distinction in the following two subsections between psychological responses themselves, and how these can impact on mental health and wellbeing.

3.7.1.1 Psychological and emotional responses to climate change.

Being aware of, or bearing witness to, current and future climate-related threats and insufficient climate action can induce a range of psychological and emotional responses. These may include distress, worry, anxiety, anger, fear, grief, frustration, stress, denial, hopelessness, helplessness, guilt, cynicism, fatalism, and a paralysing inability to act (59,253,337,340). Lexicons have been established, such as 'eco-anxiety', 'climate anxiety', 'eco-distress', 'ecological grief' and 'solastalgia', to refer to experiences of strong emotions and distress arising from awareness of or witnessing the climate and ecological crises (Box 1).

While recent research has focused largely on experiences of distress, anxiety, fear, grief and anger in people aware of and concerned by the climate crisis, it is important to note that everyone exposed to information about climate change will have a psychological response to it, and this can include unconstructive (but understandable) psychological defence mechanisms to the threats, including disavowal, denial, delay, distancing, dissonance, doomism or numbness. How individual and community attributes including identities, values, psychology, narratives and political preferences contribute to these responses and the implications for generating climate action will be discussed in section 3.7.2.2.

Several survey instruments for climate anxiety, climate worry, climate distress, eco-anxiety and solastalgia have been developed (341–343). These vary in their definitions, measures and scales; some extend beyond capturing emotional experiences (affective symptoms) to also include: 1) cognitive aspects, such as propensity to ruminate, 2) functional (daily life) impairment, or 3) anxiety about personal impact on the planet (341,343). That varying definitions exist means these terms are imprecise and overlapping, with comparison across research studies challenging. The definitions provided in Box 1 are provided to guide the reader, but should be read with the acknowledgement of the inevitable overlaps and imprecision of the terminology as it stands. Some efforts are being made to provide a clearer conceptual framework for the range of psychological responses, for example via a recent eco-emotions taxonomy (340).

Importantly, although many emotional and psychological responses to the climate crisis appear to be globally-relevant, responses are also likely to be culturally dependent (340). To date, there have been a range of mostly quantitative (63,65,351–355), but also some qualitative (356–359), studies on emotional and psychological responses to climate awareness in different groups (Figure 7). Primarily these have been conducted in richer Western nations (UK, USA, Australia, Germany, Finland and Norway) (149,351,352,357,358) but a growing number of studies in low- and middle-income countries have taken place in recent years, including the Philippines (63),

Box 2. Psychological and emotional responses: Definitions

Eco-anxiety/ Climate Anxiety: defined by the American Psychological Association in 2017 as "the chronic fear of environmental doom" (115). May include a range of experiences including anxiety, worry, stress, hopelessness, despair, irritability, sleep disturbance, loss of appetite, panic attacks, bodily symptoms of anxiety (e.g. awareness of heartbeat, butterflies in stomach, sweaty palms, perceived shortness of breath) and other similar responses to the current and future impacts of the climate and ecological crises (253, 337). Notably, sometimes eco and climate anxiety are considered to include cognitive aspects such as rumination, while other researchers have classified climate worry as distinct from climate anxiety (59, 341).
Eco-distress/ climate distress: Defined by the Royal College of Psychiatrists, UK as: "a way of describing the wide range of thoughts and emotions people may experience when they hear bad news about our planet and the environment" (344, 345) and includes a range of emotions such as "feeling anxious, worried, upset, scared, sad, angry, distressed, vulnerable, or unsure about the future" (346). While eco-distress can be used interchangeably with eco-anxiety, the term is sometimes chosen to highlight that these experiences are not only about anxiety or fear.
Climate grief/ Ecological Grief/ Eco-grief: has been defined as "the grief felt in relation to experienced or anticipated ecological losses, including the loss of species, ecosystems and meaningful landscapes due to acute or chronic environmental change" (347). 'Ecological grief' has been found to particularly affect those with strong ties to place and those witnessing environmental destruction, including for example Indigenous and farming communities, and climate scientists (165, 336, 348).
Solastalgia: The distress experienced when your home environment is changing in ways perceived to be profoundly negative, either by events related to climate change but also scenarios such as establishment of a mine or a volcanic eruption. Changes that attack our sense of home, even without dislocation, can create a deep homesickness (349, 350).

South Africa (360), India (60), and Tuvalu (361). Places and individuals who have experienced more direct impacts of climate change also appear to have higher levels of eco-anxiety and climate distress, in contradiction to assumptions that such experiences are the domain of richer, whiter communities and nations (65,342,352,362).

The Yale Program on Climate Change Communication has a long-running survey study examining the responses of the American public to climate change. In 2021 they reported that 70% of Americans were at least somewhat worried about global warming, with 35% very worried (363). More than half felt disgusted (54%), and at least four in ten felt angry (47%), outraged (45%), or hopeful (42%). A 2021 study from this same centre also reported that the majority of Facebook users surveyed in 31 countries worldwide were very or somewhat worried about climate change (359). A 2020 UK survey found significantly higher levels of distress among 16-24 year olds for climate change than the COVID-19 pandemic, driven by relatively higher distress for climate change in people who don't otherwise experience anxiety in daily life (352). Grief is also a commonly reported response to witnessing breakdown in ecological systems and human societies, including from climate-related effects. Grief has been associated with ecological losses, loss of environmental and place-based knowledge and identities, and anticipated future losses (347).

The largest study to date (65) surveyed 10,000 English-speaking children and young people (aged 16-25) across 10 nations, including high-, middle- and low-income countries. The findings starkly highlighted the high levels of global climate worry in young people, with an average of 59% of respondents feeling "very" or "extremely" worried about climate change. Almost 40% reported that their climate concerns make them think twice about having children, with other studies also suggesting eco-anxiety is a significant factor in reluctance to become a parent (364). Over 60% of respondents reported feeling afraid, sad and/or anxious, and at least 50% reported feeling angry, powerless, helpless and/or guilty.

Further work is needed to clarify the various constructs of climate- and environment-related psychological responses, and reduce the uncertainty in understandings and definitions, and how these link with mental health and wellbeing, daily life impacts, future planning, agency, and action. This should be done with an appreciation for the evolving nature of these experiences as the climate crisis unfolds, and bearing in mind their complexity, while aiming for a consistency across the literature that can meaningfully inform climate, mental health and wellbeing policy and practice. Some individuals and communities report a sense of validation and empowerment from having terminology that describes their experiences (337,365). Others have warned of the need to ensure that labelling an individual as experiencing (for example) 'eco-anxiety' does not position the sole solution as individual mental health treatment, while disregarding the necessity of wider societal changes (339).

3.7.1.2 Relationship between psychological and emotional responses to climate change and mental health and wellbeing. Researchers and practitioners
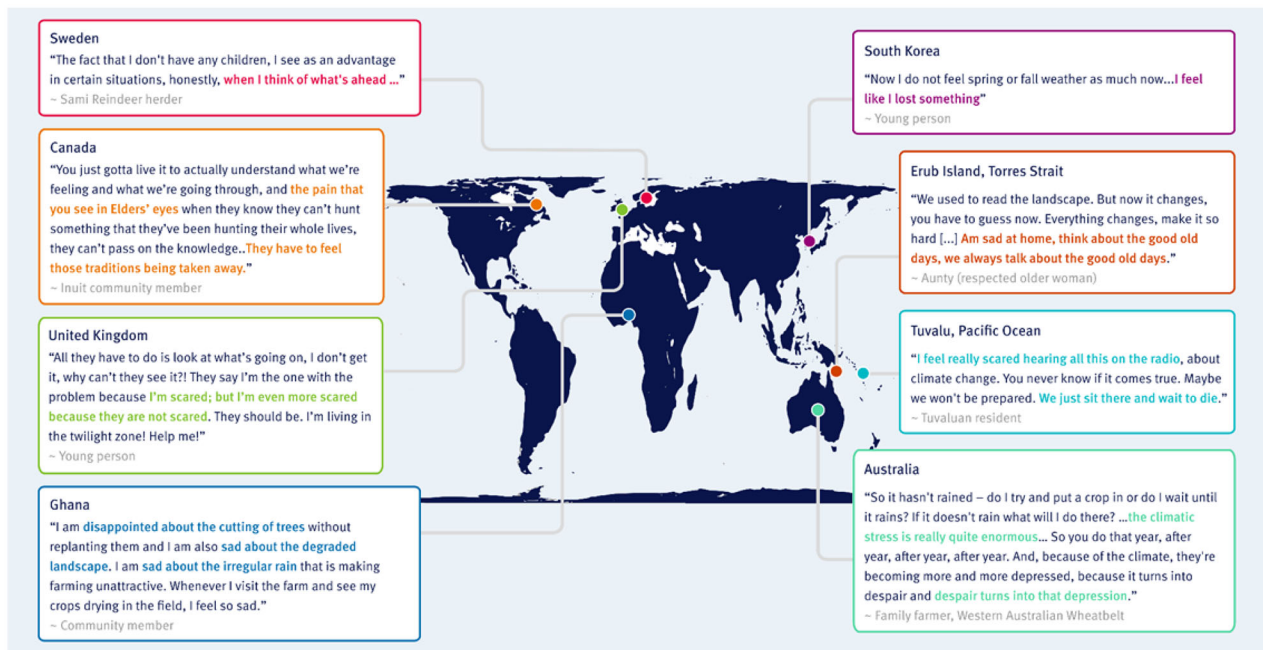
Figure 7. Example quotes from studies examining psychological and emotional impacts of climate crisis awareness or witnessing climate impacts, from Sweden (366), Canada (367), the United Kingdom (368), Ghana (369), South Korea (370), the Torres Strait (371), Tuvalu (361) and Australia (165).

agree that pathologising climate distress should be avoided; for most, strong emotional responses are part of a rational or appropriate response to the facts, and constitute a healthy and adaptive process (17,337,338). However, such worry, anxiety and/or strong emotions can be hard to cope with, provide a source of on-going stress, and deplete psychological resources. This can ultimately worsen mental health and wellbeing and impair functioning (253,351,372,373). It has been suggested that awareness of the climate crisis and insufficient action from leaders constitutes an adverse childhood event for children and young people, and a collective cultural trauma across society (374–376). Due to their rapid rate of mental development, children and adolescents are especially vulnerable to mental health and wellbeing stressors, and they are also especially vulnerable to the direct and indirect impacts of climate change (377,378). Therefore, there is growing concern that climate change may present a risk to their psychosocial development and risk of developing mental disorders (374), by not only additively increasing their distress, but interacting with developmental stage and other risk factors to adversely affect developmental trajectories (37).

There is mixed evidence on the specific relationships between climate-related psychological responses and mental health and wellbeing metrics. Some studies find correlations between climate anxiety/eco-anxiety and generalised anxiety or depression scores, while others do not (343,352,379,380). It has been suggested that the mixed findings may be explained by a combination of (a) different conceptualisations of what constitutes climate anxiety, (b) inconsistent measurement of climate anxiety and related constructs, including a lack of cross-cultural validation of tools and techniques, and (c) the influence of moderating factors which differ among groups of people (59). By way of example, whether the measure of climate anxiety includes rumination or not, or whether the study focuses on particular climate-related emotions (e.g. hopelessness (59)) may differentially reveal mediating factors that explain the relationship between psychological responses and mental health.

Feelings associated with ecological grief and solastalgia, such as an altered sense of place and identity and perceived lack of control, can be predictive of mental health difficulties such as depression, psychological distress and clinical anxiety (59,165,347,381–383). Experiencing solastalgia heightened clinically-significant psychological distress for community members following the 2011 Arizona Wallow Fire (384). The distress seemed to stem from environmental destruction and the removal of the

natural environment as a source of solace. Negative emotional responses to climate change were also associated with poorer mental health and wellbeing in a survey of over 10,000 people and in all 28 countries studied (64).

The mental health professions have typically conceived that an issue becomes clinically relevant (potentially requiring professional support) when it is impacting on daily life and functioning. By this metric, the self-reported daily life impacts of climate worry in 45% of children and young people surveyed globally (65) is indicative of challenges relevant for mental health support services. Likewise the reported impacts of climate anxiety on sleep (351). Surveys of UK mental health professionals indicate increasing levels of climate-related distress in mental health service users, albeit in unpublished small-scale studies (385). Most studies suggest that climate concern is widespread but more severe anxiety occurs in a smaller sub-group (352,379), and notably levels of distress/concern/anxiety will depend on what scale is used. That there is a sub-group of individuals who are experiencing on-going extreme distress and daily life impacts from climate awareness is still highly relevant for support provision, especially when there are anecdotal reports of this understandable distress leading to suicidal ideation (59,65,351,368).

Clayton et al. have argued that differentiating between healthy or unhealthy worry may involve understanding and accounting for 'psychological adaptation' (386), or the way people process and adapt their worldview on the basis of experiences with and awareness of climate change (342). Confronting and processing what is happening, with the right support, may allow people to make space for and constructively hold the grief, fear and anger about climate impacts alongside an 'active hope' to work towards the world they want to see with like-minded individuals (387). Of course, some individuals and communities will be better placed to do this than others, and those already experiencing significant climate impacts, with less resources, or individuals more susceptible to mental ill-health, may not have the resources to help them cope with compounding crises. On-going climate stress and distress, particularly without wide-scale support in place, threatens to escalate the global mental health crisis.

3.7.1.3 Inequalities influence psychological and emotional responses to climate change. While there is limited data on demographic influences on the psychological and emotional responses to climate change,

individuals and groups already experiencing climate change-related events and those at most risk, often due to complex disadvantage, appear to be most distressed. This includes intergenerational effects, with younger people more affected while having contributed the least to the crisis. Groups who may particularly experience climate distress and related mental health impacts may include: children and young people, elderly people, women, activists, parents or potential parents, those directly affected by climate change, those with climate-related careers, those with pre-existing mental or physical health conditions, or those with less privileged socioeconomic status, and those who seek to contribute to society and care for people and nature (335,344,348,357,365,380,388–393).

Climate and environmental change is particularly distressing for Indigenous communities and others whose lives, livelihood and culture depend strongly on the lands and natural environments of which they are a part. Being separated from cultural lands and traditional ways of life by climate-related migration can create strong feelings of dispossession and grief (165,366,371,394,395) . Ecological grief and solastalgia have been reported particularly for rural or Indigenous communities (169,347), including: youth in Indonesia (396); Inuit communities in northern Canada (73,336,347,367); farmers in the Australian wheatbelt (165); residents and tourists of communities around the Great Barrier Reef (397); elders in the Torres Strait (371) between Australia and New Guinea; communities in Ghana (369,398); coastal communities in Ireland (169) and the USA (168); and rural communities in India (60) and South Africa (360) (Figure 7). It may also be particularly common in scientists working in climate and ecological related fields (399).

Communities who are already most affected by climate change impacts, and most susceptible to future threats, are understandably among those most distressed (253,400). For example, in the global survey of climate anxiety in children and young people, higher levels of worry, negative emotions, daily life impacts and future concerns were reported in countries already experiencing the impacts of climate change, with levels highest in the Philippines (65). Personal experiences of extreme weather events an individual attributes to climate change can shape "feelings about climate change through an experiential process, whereby negative emotions triggered by the harmful consequences of extreme weather events become intuitively associated with climate change, and memories of these harmful consequences simultaneously

increase the psychological salience of climate risks" (59).

While climate worry may be higher in people who are more aware of the facts of climate change (401), it is also worth noting that experiencing climate change-related events can still potentially impact the mental health and wellbeing even of people who haven't been taught the facts of climate change, and so don't necessarily make the link between their experiences and a changing climate. While an understudied area, private communications with practitioners in diverse global settings indicate that communities where climate change is increasing the frequency and severity of extreme weather events, reducing certainty of crop yields or fishing etc (e.g. in the Philippines), are struggling to cope with and make decisions on the future for them and their families in light of the loss, grief, fear, and upheaval in the face of a more precarious, uncertain and dangerous seeming future.

Many of the communities least responsible for historic and current greenhouse gas emissions are those facing the greatest climate impacts, and are also those who are more vulnerable to and least resourced to access support for the mental health effects of climate change (253,402,403). Understandable feelings of injustice may exacerbate distress (253). These differences in vulnerability means that climate change risks exacerbating mental health inequalities. In Canada, for example, Inuit populations already face pre-existing mental health disparities compared with the non-indigenous Canadian population and are now also experiencing some of the fastest climate changes globally, potentially exacerbating this mental health inequality (253,382,404).

3.8 Coping with and acting on climate change and its mental health and wellbeing impacts

Psychological associations have collectively acknowledged eco-anxiety as an understandable response to the climate and ecological crises, while also highlighting the clear need to provide appropriate support to ensure individuals and communities can reflect, process and cope with the psychological burden of the climate crisis in a healthy and constructive manner (61,338,347,405,406). Vitally, not only is climate action at all levels - individually, in communities and at a systemic level - paramount for minimising severe climate threats, but climate action influences and is influenced by the way people think and feel about climate change, and the narratives we hold and are told. Increasing climate agency and action has the potential to reduce the impact of climate distress on mental health and wellbeing, while also creating co-beneficial improvements for the climate. Interventions are being developed that draw on this evidence-base of psychological responses, coping mechanisms, climate narratives, and the links between action and wellbeing.

3.8.1 Coping mechanisms

The way individuals and communities cope and adapt psychologically to the changing climate is increasingly important as "humanity's ability to adapt physically will depend in part on how well people adapt psychologically" (407). A variety of coping mechanisms have been documented in those experiencing climate distress, and these mechanisms may modulate the effects on both mental health and wellbeing and pro-environmental behaviours and climate action (391).

Research reveals sub-groups with high climate distress/climate emotions but also high wellbeing (408). Poor mental health and wellbeing are associated with feelings of hopelessness, despair and powerlessness, while hope, anger and meaningfulness appear protective; allowing psychological and emotional responses to the climate crisis to be translated into action while protecting wellbeing (408).

Observed coping mechanisms (353,408–410) in children and young people have been mapped by Ojala, including: 1) 'problem-focussed coping', which involves responding to the threat by planning or taking action; 2) 'emotion-focussed coping' which can include trying to distance from the threat by de-emphasising its severity; and 3) 'meaning-focussed coping', which includes putting trust in 'powerful societal actors' such as governments, aligning action with values, and looking at positive as well as negative trends. Meaning-focussed is the most constructive of the coping styles in studies of children, related to both pro-environmental behaviour and wellbeing. This coping style is related to 'active hope', whereby the focus is on generating hope through action, and helping to bring about the future one desires. This comes in contrast with the hope associated with distancing strategies, that attempts to reappraise the situation as less threatening (387,411). Interventions and resources to help individuals and communities to cope with and respond to climate change can build on the value of generating hopeful perspectives alongside creating space to process more challenging emotions.

3.8.2 Climate action: barriers, enablers, and interactions with mental wellbeing

Climate action at all levels can improve mental health and wellbeing. This includes individual-level wellbeing improvements through lifestyle changes and the positive emotional response of acting in line with values; strengthening of social and community networks through collective action; and building of positive socioeconomic, cultural and environmental conditions through policy/systems-level action. Climate action has a huge potential for achieving co-beneficial outcomes for both better mental health and wellbeing, and a safer climate. Individual, collective and systems factors can also facilitate or hinder climate action, including psychological and emotional responses to climate change, personal beliefs and values, accessibility of climate actions, and climate narratives in media and politics.

3.8.2.1 Individual psychology and climate action.

Individual climate actions or pro-environmental behaviours (e.g. choosing sustainable options when making purchases, cycling rather than driving) may reduce eco-anxiety (354,412–418) and benefit mental wellbeing, while simultaneously benefiting the environment. A meta-analysis of 78 studies found a 'robust, positive relation' between people's pro-environmental behaviours and their subjective levels of wellbeing. The relationship was particularly strong for behaviours and wellbeing indicators that reflected a sense of meaning (412). Climate actions can provide individuals with a greater sense of agency and control and increase feelings of meaning and empowerment.

Whether people take or support climate action interacts with their psychological and emotional responses to climate change (347,419). The way we feel and our values affect the way we act; climate worry may be higher in those who are more engaged with wider society and who believe life has meaning, and is predictive of higher personal responsibility to take, and of taking, climate action (420,421), though causality has not been established (59). Climate worry is also predictive of support for climate policies (421–423). Personal responsibility for pro-environmental or climate actions may also relate to feelings of guilt, with UK 16-24 year olds reporting in 2020 significantly higher levels of guilt over climate change than the COVID-19 pandemic, despite reporting a lower belief in the efficacy of their personal actions in response to climate than COVID-19 (352). Certain emotional responses to climate change, including anger and hope, may also drive pro-environmental

behaviours, including climate action or activism (67,353,420). Cultural context influences how climate-related feelings translate into action. A survey study of 28 countries found that respondents experiencing the strongest 'negative' climate emotions (e.g. fear, anger) were also the most likely to behave in pro-environmental ways (46% of countries) or engage in environmental activism (25% of countries) (64).

These relationships may also be causal - a lab study found that the intention to protect the environment was heightened in participants when they were primed to be more fearful of the negative consequences of climate change or to believe that group environmental action is effective, however other studies have reported that fear can prevent people from acting (356,424–426). A UK study of national survey data reported individuals with direct experience of floods were more concerned by climate change, more likely to believe their actions could make a difference, and were more willing to reduce their energy consumption (427). However these relationships may depend on the individual's psychological response to the flood event and their coping abilities; a study of UK flood victims found that individuals who were less negatively affected emotionally by the flood event and felt more able to cope were also less motivated to mitigate future climate change, which the authors termed the "resilience paradox" (428). A study across 23 European countries found that the more worried people were about climate change, and particularly the higher their feelings of personal responsibility to reduce climate change, the more likely they were to take and support climate action - indicating a potential mechanism for coping with their worries (421). These relationships are complex though, as other work has found individuals reporting eco-anxiety were less likely to be involved in collective climate action, while the converse was true for those reporting eco-depression (420). A recent review on eco-emotions surmised that while climate emotions do significantly influence behaviour, the dynamics are complex and context dependent (340).

The same study of 23 European countries reported that climate worry was also rooted in values of care for nature and the environment ('biospheric values'); these values were also directly and positively predictive of personal climate action. As Albrecht, who coined the term 'solastalgia' has noted, the grief that many feel when witnessing the destruction of the natural environment and their homelands also points to a place of hope: this grief is felt due to the strong connection that people can have with place and the

natural world. (349) Higher place attachment is associated with greater pro-environmental behaviour but worse solastalgia (169,429). This connection to nature could be harnessed to improve mental health and as an impetus for action on climate.

Beliefs, attitudes and responses to the climate crisis are linked with individual and political preferences. The Yale Centre for Climate Communication (YCCC), for example, has found six distinct groupings of climate change responses across the US population: from alarmed through concerned to dismissive. These groups are distinguishable based on beliefs, attitudes, risk perceptions, motivations, values, policy preferences, behaviours and underlying barriers to action (422,430,431).

It is vital to note that even when individuals are concerned or anxious about climate change, they may not take action. The YCCC segmented the 'Alarmed' group of their 'Six Americas' research as described above, into three categories based on their climate-related behaviour including "past political behaviour, willingness to engage in climate activism, consumer behaviours, and social behaviours". The three segments, the 'Active Alarmed', the 'Willing Alarmed' and the 'Inactive Alarmed' differ in their levels of current engagement in climate activism and political engagement on the issue, and their willingness to do so. Notably, the Active Alarmed, with the highest levels of engagement also had the highest levels of anger, disgust and outrage in response to global warming, and the strongest belief in the efficacy of collective action to affect political climate action.

At the other end of the spectrum to those feeling overwhelmed and distressed from insufficient climate progress, the psychological responses of fatalism, disavowal and denial produce barriers to engagement and opposition to climate policies (432–434). Opposition to climate mitigation actions like installing wind farms can also arise from conflict between local and global desires or attachments. For some, climate change can still feel too removed in time or space to warrant mitigation actions that require perceived sacrifices (429,435). Climate change denial can also serve a palliative function, perhaps especially for people in more vulnerable countries (436).

There are a range of barriers, including psychological, social, cultural and structural in individuals and societies that may explain the widespread lack of engagement with climate change and climate action, in light of the existential threats (437). Some work has classified the 'dragons of inaction', barriers to acting on climate change such as social comparison,

sunk costs, temporal discounting, tokenism or perceived risks that can undermine even the best intentioned individuals (426). It is also important to examine climate action through a justice lens, and acknowledge that the individuals and communities most directly impacted by climate change may also be less well resourced to take action to prevent it (253). As described, an individual's social identity interacts with their values, their feelings, and ultimately their behaviours. But social identities, including for example, being more engaged with wider society, can differ for groups that are more advantaged and disadvantaged in society. Being more engaged in society is more common and accessible for those with psychosocial advantages, including higher educational attainment and wealth, and is itself associated with better mental health and wellbeing (438,439). So factors associated with advantages in society will affect opportunities to engage with climate action, available coping mechanisms and ultimately mental health and wellbeing.

In summary, while the relationships are complex, strong emotional and psychological responses to climate change can be adaptive. As Cunsolo et al state: "recognising that emotions are often what leads people to act, it is possible that feelings of ecological anxiety and grief, although uncomfortable, are in fact the crucible through which humanity must pass to harness the energy and conviction that are needed for the lifesaving changes now required." (419)

3.8.2.2 Community action. Collective action, where people can connect with like-minded communities and get social support, may be particularly helpful for both affecting change and protecting mental health and wellbeing, especially for those living in places more climate vulnerable (308,357,440–442). A study of US students found collective action was a more potent protector of mental health than individual action, weakening the association between certain aspects of climate anxiety and symptoms of major depression (442). The higher value of collective action for mental health was attributed to the perception that individual action is insufficient compared to the severity of climate threats (442). Collective action may also engender more hope and community connection, both independently predictive of good mental health (30,357). Coupled with the evidence previously described about the importance of hope for action, this suggests that a virtuous circle may exist, whereby climate hope engenders climate action that further promotes climate hope. Importantly, collective action

can also help ensure individuals don't feel the burden to solve climate change is theirs to carry alone, which can lead to burnout, particularly for those highly engaged in climate activism or climate-related careers (390,443).

Collective action interacts with other layers of the framework in figure 1, including personal beliefs and the media narratives portrayed in the wider cultural context. For example, polls suggest the majority of people are concerned about climate change and care for nature and other people, but believe others around them don't care; this can be a considerable barrier to collective action (444,445).

3.8.2.3 Systems level political and cultural action.

'Meaning-focussed coping', the most constructive reported coping strategy (410), relies in part on trust in societal actors (including government and business leaders) to help solve the crisis. This trust is currently threatened by insufficient climate action by leaders; the survey of 10,000 young people globally revealed 65% felt their governments were failing young people, and 58% said their government was betraying them and future generations (65). Hence youth climate distress is heightened by the continued inaction of leaders.

Fundamentally, it is urgent action by government and industry leaders that is required to protect populations from the dire threats of the climate crisis. As there are sufficient global resources and technologies to enact the necessary transformations away from fossil fuels, the main barrier to climate action is the unwillingness of leaders to enact the required policies. Barriers to action include the influence of companies in political spheres, but it is also worth noting that the same range of individual psychological barriers to action, such as distancing, denial, delay, and dissonance that were previously noted also apply to political leaders.

Good leadership on the climate crisis improves mental health and wellbeing. The IPCC Sixth Assessment report on mitigation highlights how social trust, effective and participatory governance, wellbeing and emissions reductions form a self-reinforcing process (2). For example, participatory governance, where local communities have opportunities to be involved in political processes, can foster understanding of and engagement with climate policies, promoting wider participation in climate action and thus greater emissions reductions. Effective governance also fosters improved wellbeing, social trust (trust in other people and in governments) and equity across and within societies (54). These links are bidirectional; equity, for example, strengthens governance (institutions work more fairly), builds public trust and promotes efficient energy and resource use.

As the climate emergency affects everyone, climate change must be appropriately addressed in education and the media (446). However, access to climate change facts do not necessarily translate into concern and action (122,437). Beliefs about climate change and climate action are also interconnected with 'climate narratives'; the stories we hold and are told. Examples of such narratives include: 'I am too small to make a difference'; 'humanity is doomed no matter what we do'; or 'there are always steps to take towards a better future, and I can actively generate hope through my actions'. National and global media clearly plays an important role in communicating climate narratives, and it is important to ensure climate communication effectively raises awareness and generates action at all levels of society, while protecting mental health and wellbeing. Higher climate distress and negative emotional response to climate change are linked to higher exposure to information about climate impacts (64). As previously described, this has implications for mental health (352). Research with UK young people has revealed a distrust of the media, with climate coverage being seen as "stressful, negative and catastrophising", and more distressing than stories about the COVID-19 pandemic in 2020 (352,357). Distress can motivate action, provided it does not become overwhelming. Optimistic messaging alone may be less effective for driving change (447) (or see 'constructive pessimism' (448)), and if done well, effective communication about climate risks "promotes adaptive and preventive individual or collective action" (122,437). Whether narratives that heighten alarm either activate or undermine the ability to act may depend on differences in individual starting points - too much or too little pressure is asserted in psychology to diminish performance in an 'inverted-U' relationship (449). Effective climate change communication and education requires an understanding of how people will respond differently. The facts of the climate emergency should be shared alongside information on how to best cope and act, including the opportunities for climate action to create win-win changes in society.

3.8.3 Interventions and support for climate distress and related mental health impacts

There are a growing number of interventions, resources, tools and community programmes to support those experiencing climate distress or climate-related

poor mental health. These interventions vary in their nature, timing and targeting. For example, existing interventions encompass formally delivered mental health and psychosocial support programmes adapted to the context of climate change, and individual and community tools that have been informally developed. The latter often draw on evidence-based theories of change and climate psychology to help individuals and communities to process climate-related emotions and develop coping strategies and climate agency (450–453). Table 1 outlines examples of existing interventions.

The climate change-induced mental health impacts of extreme weather events, community breakdown, food and water shortages, conflict and other such events can be partly mitigated by early warning systems and timely provision of basic financial and physical needs (454). Supporting communities to support each other before, during and after such events can also reduce negative effects on mental health. Mental health and psychosocial support developed for humanitarian crises and trauma may also be appropriate for climate-related emergencies (455).

Communities experiencing worsened mental health and wellbeing from changes to their landscapes, culture and livelihoods can benefit from community-led programs that facilitate social connection, emotional processing and collective-efficacy (59). While Indigenous communities are some of the most vulnerable to climate impacts, they also offer invaluable knowledge to mitigate and adapt to its effects (291).

The range of psychological responses people have to the climate crisis, and the interactions with climate narratives, climate action and mental health, necessitate better climate communication. It is vital to create spaces for people to better understand one another, and not only to help people process their distress, but also to feel safe enough to reduce defence mechanisms such as denial and engage with the uncomfortable truths. Doing so could encourage psychological adaptation and constructive coping that could potentially even enable psychological growth and improved wellbeing in the longer term. There are many resources available to guide climate communication (for example climate outreach (456)) and climate psychologists are starting to understand how relevant therapies, such as those created to process existential threats or grief, could be adapted and scaled for constructively processing the threats of the climate crisis (457).

Interventions have largely not been aggregated, mapped, costed (including costs saved), evaluated or scaled-up, and hence this constitutes an area for urgent research and innovation (for review see Baudon et al. (450)). The lack of evaluated interventions specifically tailored to climate change was highlighted in a scoping review of climate change and mental health articles, finding only 8 out of 120 relevant studies focused on interventions (6).

4 Implications for policy and practice

Poor health of people and the wider natural world share many common causes and therefore common solutions which will be drawn out in this section. The evidence presented in this review illustrates the need to account for currently hidden climate-related costs to mental health and conversely the benefits of climate action. Climate action, both policies and behaviours designed to mitigate or to adapt to climate change, can improve mental health outcomes by reducing the severity of climate change and/or its impacts, and hence preventing some of the mental health effects previously outlined (466,467). Moreover, climate action has the potential to further improve mental health through changes for individuals, communities and systems that improve the determinants known to reduce mental illness or improve mental health and wellbeing (Figure 1). Central to achieving these co-benefits or win-wins is collaboration across sectors and siloes, and participatory approaches with affected communities (466,468). This includes creating opportunities for co-design of policies and interventions, shared decision-making, and knowledge exchange with local and Indigenous communities and those already experiencing and responding to climate impacts (469).

Cross-disciplinary research can make the currently hidden costs of climate inaction and benefits of action tangible and win-win policies possible. The current gaps and future priorities for research on climate change and mental health have been extensively captured elsewhere (58). Acting on these priorities is essential to build understanding of the nature and prevalence of climate-related mental health impacts to guide action. Effective action requires a clear understanding of the interconnected pathways of impact, to ensure policies are designed and implemented with evidence-based targets, prevention is used more often than cure, and unintended negative consequences are avoided.

Education and training for key stakeholder groups, including health leaders, policymakers, educators, mental health professionals and emergency

Table 1. Some examples of interventions and support for mental health and wellbeing impacts of climate change

Targeting	Purpose	Examples
Ongoing support to process psychological responses to climate change, encourage constructive psychological adaptation, and build emotional resilience	Supporting individuals to understand and process their emotional and psychological responses to climate change	Climate-aware therapists are trained to recognise and support climate-related emotions and psychological responses. Climate-aware therapeutic support is becoming increasingly available, e.g. from psychological associations such as the Climate Psychology Alliance and the UK Royal College of Psychiatrists. A growing number of articles, books and podcasts suggest appropriate coping mechanisms for individuals experiencing eco-anxiety, ecological grief and other related distress (65, 458).
	Supporting individuals and communities to build resilience, coping strategies, mindset shifts, and agency	Facilitated group workshops, events and community building: Force of Nature, Good Grief Network, Carbon Conversations, Climate Cafes, the Resilience Project, Sustyvibes (451–453, 459–461). These programmes have been largely started by community members and activists, using evidence-based theories of change and climate psychology.
	Building social connection and efficacy through community-led programmes, and centring indigenous knowledge in climate solutions	Indigenous Australian communities lead 'Caring for Country' programmes, which mitigate climate change and protect biodiversity while improving social and emotional well-being (314). Inuit communities in Canada are creating spaces to "discuss and have a sense of self-efficacy in changes happening around them" and taking action to understand and respond to the changing environment and health needs through environmental health monitoring and programmes to preserve land-based cultural traditions (462, 463).
Mental health support following climate events	Building community capacity and resilience to provide support for mental health in the context of extreme weather and climate events	Following Cyclone Idai in Zimbabwe, a capacity-building project among nurses and key community stakeholders to deliver mental health and psychosocial support led to improved awareness and meaningful mental health dialogues within communities, tackling issues of discrimination (464). Following Hurricane Katrina, training local health service providers in New Orleans to provide mental health support led to increased mental health support capacity and improved mental health outcomes (465).

responders, must increase awareness of the evidence presented in this review and ensure it is translated into climate-mental health aligned policy and practice. Such education and awareness building initiatives must also upskill relevant institutions (e.g. mental health systems, schools, universities) and community leaders to support individuals and communities to cope in the climate crisis while fostering participatory and collective climate action. Finally, mapping, development, evaluation and scale-up of relevant interventions will support co-beneficial climate and mental health and wellbeing advances for individuals, communities and systems.

Interventions that act earlier in the pathways by which climate change affects mental health can mitigate against downstream effects; action is needed at all stages as illustrated in Figure 8. This review has emphasised that climate change compounds disadvantage and worsens mental health and wellbeing through multiple impact pathways. These result partly due to the interconnections between the determinants of good mental health and wellbeing, from individual to community and global levels. The following sections provide examples of interventions and co-beneficial policies and practices that can achieve win-wins for climate and mental health.

4.1 Incorporate mental health into emergency responses and interventions

By incorporating mental health as a key pillar of emergency responses, disaster relief organisations can
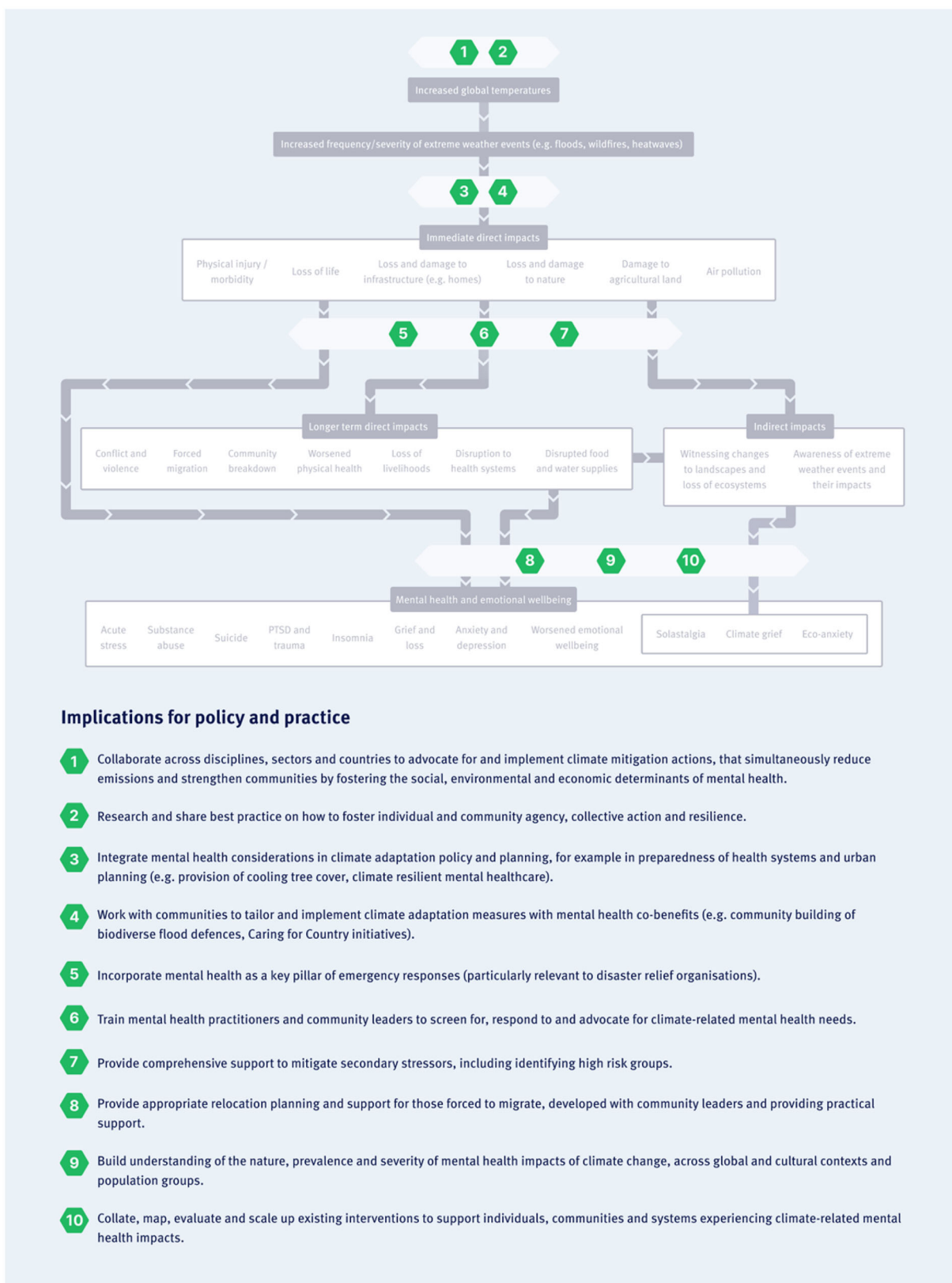
Implications for policy and practice

1. Collaborate across disciplines, sectors and countries to advocate for and implement climate mitigation actions, that simultaneously reduce emissions and strengthen communities by fostering the social, environmental and economic determinants of mental health.

2. Research and share best practice on how to foster individual and community agency, collective action and resilience.

3. Integrate mental health considerations in climate adaptation policy and planning, for example in preparedness of health systems and urban planning (e.g. provision of cooling tree cover, climate resilient mental healthcare).

4. Work with communities to tailor and implement climate adaptation measures with mental health co-benefits (e.g. community building of biodiverse flood defences, Caring for Country initiatives).

5. Incorporate mental health as a key pillar of emergency responses (particularly relevant to disaster relief organisations).

6. Train mental health practitioners and community leaders to screen for, respond to and advocate for climate-related mental health needs.

7. Provide comprehensive support to mitigate secondary stressors, including identifying high risk groups.

8. Provide appropriate relocation planning and support for those forced to migrate, developed with community leaders and providing practical support.

9. Build understanding of the nature, prevalence and severity of mental health impacts of climate change, across global and cultural contexts and population groups.

10. Collate, map, evaluate and scale up existing interventions to support individuals, communities and systems experiencing climate-related mental health impacts.

Figure 8. Illustrative intervening actions taken at each point of the pathways by which an extreme climate event impacts mental health, as originally considered in Figure 1. Action at 'upstream' or earlier points can mitigate against 'downstream' impacts, though action and support is needed at all levels.

provide appropriate and timely support following extreme weather events to reduce the risk of negative mental health outcomes in both the short and long term (470). This could include identifying and actively supporting groups at high risk (such as those with pre-existing mental health conditions or from ethnic minorities), and providing comprehensive support to mitigate secondary stressors (such as quality accommodation, financial support, high quality and accessible medical care) (471). Evaluations of previous responses to weather or environmental disasters have emphasised the importance of creating multi-sector collaborations and plans that link government, private sector, and local organisations before events happen, so that the response is organised, efficient and comprehensive (173–175), and local leadership is pro-actively strengthened, including working with teachers and religious leaders (470,472–476). Mental health and psychosocial interventions must be developed or repurposed to reduce climate disasters' mental health burden. These will need to account for mental health impacts not only from the particular climate-related event, but distress associated with awareness of increased future risks of a changing climate, including repeated emergency events. Proactive investment in resilient communities may also create circumstances more likely to result in post-traumatic *growth*; psychologists have noted that, even with investment in disaster management, many affected individuals will remain unable to access mental health support and a significant emphasis should be on tools that equip people preventatively (122,170,477–480).

Proactive climate mitigation and adaptation actions can strengthen the resilience of individuals, communities, and systems to climate disasters by fostering the determinants of good mental health and wellbeing. However, investment in mental health support that is responsive to the mental health needs arising from climate-related disruptions and compounding stressors is also required. Response to forced climate migration provides a relevant example. With such a large number of people who will experience forced displacement over the coming decades, either within or between countries, and either temporarily or permanently, relocation planning and support must consider mental health needs. The World Meteorological Organisation (WMO) and Red Cross are investing in research on early warning systems and planned relocation infrastructure, to better facilitate smoother transitions for those affected by climate change migration (481,482). Fostering social inclusion is of particular importance, and support for climate migrants should be developed in collaboration with community leaders from their country or culture and those with relevant lived experiences. Investment in practical support for finances, housing, employment, and healthcare will be required to help mitigate the mental health impact of forced climate migration; long-term negative outcomes for mental health and emotional wellbeing are by no means inevitable.

4.2 Sustainably redesign health systems and provide climate-informed mental health support

Health systems and their supply chains are a significant contributor to greenhouse gas emissions, and mental health professionals and health system leaders should advocate for the sustainable redesign of mental health systems (483). This includes both rapidly evolving to a net zero health system, but also considering how best to provide mental healthcare to meet population needs in the climate crisis. This may include healthcare that is more embedded within local communities and improves community connectedness and social resilience, including to a changing climate. Such changes to provision of mental healthcare offer co-benefits; for example, green social prescribing initiatives (such as community rewilding programmes) are a formal mental health treatment option with the potential to provide multiple benefits for social- and nature-connectedness and climate action (484).

Climate mitigation and adaptation efforts within health systems must consider how such policies could affect mental health and/or alleviate the negative mental health consequences of climate change. As an example, in planning for higher temperatures and more frequent and severe heatwaves, health services must: 1) ensure that indoor air temperatures do not further exacerbate symptoms of mental disorders or physical co-morbidities during extreme heat periods; 2) public health campaigns to reduce heatwave risks must account for increased vulnerabilities of individuals with pre-existing mental disorders; and 3) first aiders and other healthcare professionals must be made aware of these vulnerabilities, including for individuals on psychoactive medications. More generally, mental health practitioners and community leaders must be trained to screen for, respond to and advocate for climate-related mental health needs (344,485,486).

4.3 Support individuals and communities to cope and act

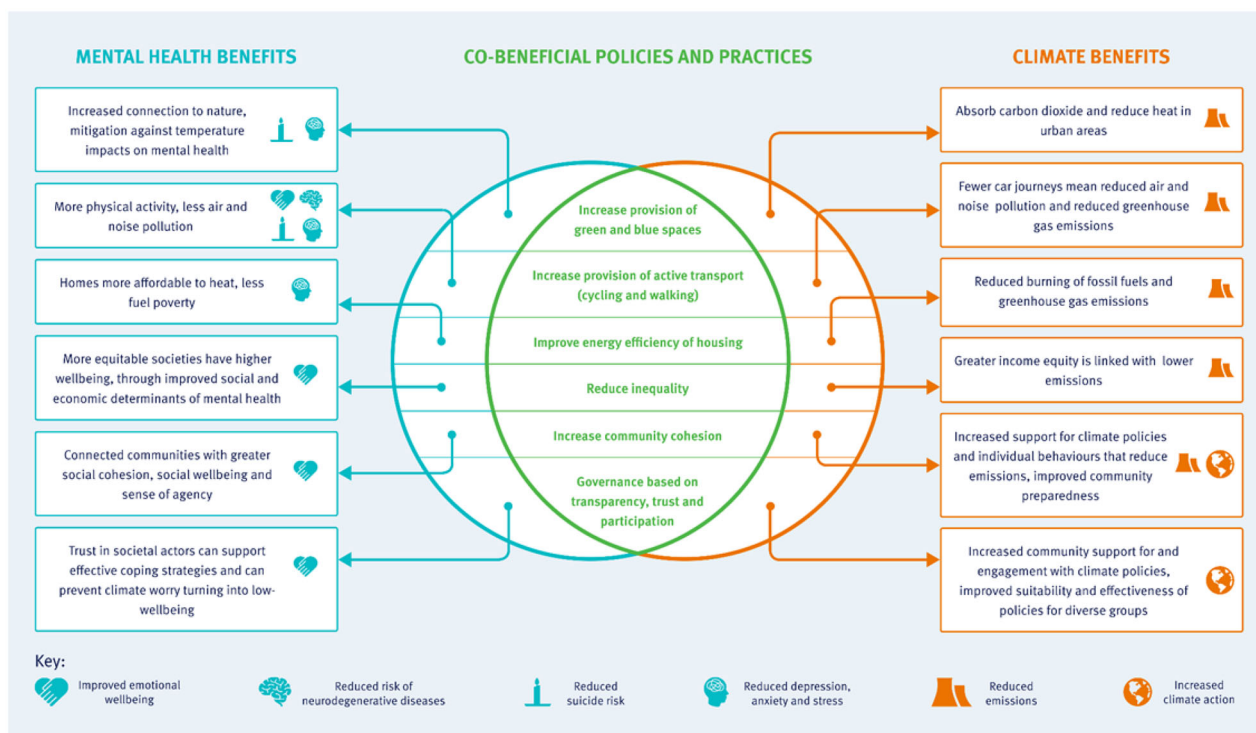Individuals and communities must be appropriately equipped and supported to cope with the range of

Figure 9. Illustrative examples of co-beneficial policies and practices that can deliver benefits for both mental health and the climate. This includes provision of green and blue spaces and active transport, improving energy efficiency of housing, reducing inequity across and within societies, increasing community cohesion and governance based on transparency, trust and participation (2,308,462,466,497,498,508).

mental health and wellbeing effects of the climate crisis, and to contribute to the changes they want to see. Relevant interventions include those that can: 1) encourage healthy processing of psychological and emotional responses including grief, loss and fears; 2) value hopeful perspectives; 3) enable individuals and communities to imagine the future they want to build; 4) ensure psychological distress is not compounded; 5) facilitate creation of community; 6) develop constructive coping strategies; and 7) develop agency to respond to the climate crisis. Individual and collective climate action also has potential to further strengthen community cohesion, social wellbeing and agency (308,462).

Interventions for individuals, communities and systems to cope with and respond to the mental health impacts of climate change do exist, but have not been sufficiently collated, mapped, or evaluated (6,450). Appropriate interventions, once identified or developed, need support for widespread scale-up, with appropriate co-designed amendments to be relevant for different groups, cultures and contexts (381,487).

There are roles for climate scientists, social scientists, the media and mental health professionals in supporting communities to take action. This can include sharing hopeful narratives of relevant climate action initiatives, including the imaginative ways system transformation can occur and the role different individuals and communities can play. Mental health professional expertise can inform development of new interventions, including advising on helpful information and skills that equip people to process climate-related grief, loss, fears and secondary trauma, adapt to uncertainty and change, and build agency, coping skills and resilience. Training toolkits to upskill community leaders and institutions can help them create informal spaces and support for individuals and communities to process and respond to climate distress. Climate change must feature in all levels of education (though this must be done with awareness of the distress that it can engender), while equipping students with opportunities to process their climate-related feelings, learn coping strategies and participate in relevant climate action.

4.4 Prioritise co-beneficial climate policies and practices

To maximise the chance of realising sufficient action on climate change and mental health, identifying

policies that deliver benefits for both areas should be a priority for policymakers across multiple sectors. This can help societies to move from a situation where climate change is a risk amplifier to one where climate action is seen as an opportunity multiplier. This section provides illustrative examples of policies that can achieve such win-win outcomes (see also Figure 9).

Reducing emissions from burning fossil fuels in industry and transport leads to reductions in air pollution in surrounding areas with associated benefits to mental health (229,230,232,233) as outlined in section 3.5.1. Reducing personal car use and promoting active transport options in urban areas are likely to form key components of climate change mitigation policies in the years ahead. Active travel, such as walking or cycling, can improve physical activity levels, and enable social activities and employment opportunities that may otherwise be impossible (488,489). This is particularly true for those on low incomes (488,489). Beyond the physical health benefits of greater physical activity, there is evidence of positive impacts on mental health and wellbeing from, for example, active commuting on foot or by bike (490–496).

Maximising green space, particularly in urban areas, and restoring wild spaces or 'rewilding', increases atmospheric carbon dioxide absorption and mitigates climate change while providing greater access to nature. Nature-based solutions, such as urban tree-planting or green roofs, also provide benefits for climate adaptation by reducing the urban heat island effect and the risk of flooding from extreme weather events (497,498). Access to green spaces is decreasing in quality and quantity for many people across the world and huge disparities in access exist, with poorer communities and minority ethnic groups less likely to have access to green space in urban environments (133–137,499). Exposure to green space and spending time in nature can reduce psychological distress and symptoms of anxiety and depression, increase happiness and wellbeing and increase physical activity (with its own mental health co-benefits) (214–216,500–504). Use of green spaces can also increase the sense of connectedness with nature, which itself predicts both climate action and better mental health (221,222,311).

Safe and secure housing is an important environmental determinant of good mental health (505,506). Poorly insulated housing contributes to the risk of adverse mental health outcomes during periods of extreme heat or cold. Improvements to housing such as better insulation can improve mental as well as physical health by making homes easier to heat and reducing rates of fuel poverty (466,507,508).

Food security is a key requirement for good mental health and wellbeing (322,509,510). Physical and mental health is known to be strongly influenced by the type and quality of food consumed (509,510). The agriculture sector is a large contributor to carbon emissions and environmental degradation in many parts of the world (511,512). Adapting agricultural practices to increase the health of local ecosystems and reduce carbon emissions can also increase the nutrition density of the food produced (including anti-inflammatory compounds and healthy microbes), and therefore its benefits for human wellbeing (513).

As highlighted by Working Group III (Mitigation of Climate Change) of the IPCC Sixth Assessment report (57), effective and participatory governance, social trust and trust in government institutions, equity across society, wellbeing and climate mitigation are all linked and can positively reinforce each other (2). More equitable and democratic societies are associated with both lower energy use and higher wellbeing outcomes than societies which are not. Improving social and economic equity also builds trust and effective participatory governance, which also increases support for and engagement with climate policies.

If not managed carefully, there are risks that the transition to a lower carbon society could leave particular regions or sectors behind. This would exacerbate social inequality (514) that can amplify the threat of mental disorders and poor mental health for already marginalised and vulnerable populations. In response to such concerns, the concept of a 'Just Transition' has emerged as a key strand that should underpin the shift towards lower carbon economies (515).

Proportionate, inclusive and just systemic climate action is a mental health intervention, not only by helping to mitigate the mental health impacts of the climate crisis, but also as it addresses the cause of climate distress - not only climate change itself but inaction and betrayal from leaders (65). Trust in societal actors appears to help prevent climate worry and anxiety impacting on wellbeing, but this relies on proportionate and visible climate leadership (59,440,441).

5 Limitations

While we believe the wide-ranging search strategy and multi-disciplinary synthesis used in this review strengthens the value of its contribution to the

developing climate change and mental health field, we acknowledge some limitations. First, the subtopics and disciplines relevant to climate change and mental health are so vast that some relevant subtopics may have been missed, precluding inclusion of relevant literature. Second, and similarly, variation in terminology used to describe the same event (e.g. a fire), in different global regions may have limited the completeness of our search terms. We mitigated these risks by consulting with experts in our global networks on relevant subtopics and key papers, and including papers known to the authors and their networks. Third, our search was also focussed on papers, articles or reports in English, and hence likely misses relevant insights from global contexts where English is not the language used for publication. A related fourth challenge is the limitations of the existing literature as a whole; we have only been able to summarise insights published in formats accessible online, and this very likely misses local and Indigenous knowledge relevant to this topic that isn't found in the academic and grey literature. There are many gaps in the evidence base available, especially from large geographical regions such as South America and Africa, and many low- and middle-income settings. However, a lack of evidence should not be taken as a lack of effect. Finally, while we structured our synthesis of the mental health impacts of climate change around a framework of mental health and wellbeing determinants adapted from Dahlgren and Whitehead (52) and inspired by others (9,53), we acknowledge this is inherently limited in mapping the true extent of complex, interconnected factors that influence mental health, and that there are other equally valid ways to categorise the complex impacts of climate change on individuals and communities. The framework and paper structure aims to highlight the need for a 'systems-level' understanding of the topic that views an individual's mental health as dependent on their wider environment. With this understanding, the compounding and interconnected risks of climate change for mental health become clear, as do the compounding and interconnected benefits of climate action.

6. Conclusion

While mental health has often been the neglected 'poorer cousin' of physical health in research, awareness and support, there has been a rising global awareness of the central importance of mental health and wellbeing to quality of life, its indivisibility from physical health, and its dependence on a range of interconnecting factors in individual, social, economic, cultural, political and environmental conditions (mental health determinants). This led the Lancet Commission on Global Mental Health and Sustainable Development to advocate for creation of "environments that promote mental health for all" (9). The climate emergency is a mental health emergency and threatens progress to improve mental health and wellbeing in all contexts. This is through direct experiences of higher temperatures and extreme weather and climate effects, through on-going disruption to the determinants of good mental health, and through the psychological trauma of living with and through an existential threat that is insufficiently addressed by leaders. As a risk multiplier, it compounds existing vulnerabilities to poor mental health and wellbeing for groups and countries already disadvantaged. Many of the conditions that create these disadvantages and worsen mental health, for example, poor governance, high social and income inequalities, cultures of extractivism and polluting air and ecosystems with fossil fuels, are the same societal issues that perpetuate the climate crisis.

The solutions to the climate crisis and its damaging effects on mental health and wellbeing exist, and delay from leaders in acting on them only adds to the psychological and moral injury. As Hurley et. al. note: "It is completely unfair to ask a generation of young people to develop enhanced psychological stamina to face climate change. But because of decades of inaction on the part of previous generations, they are being asked to do so. We owe it to children and young people to prioritise mitigation of climate change at its source, while at the same time investing in evidence-based tools to support their mental wellbeing in the face of this ongoing crisis" (17). Climate action at all levels depends on and interconnects with psychological responses to climate change, mental health and wellbeing, and the sense of agency to address the challenge. Both good mental health and the actions required for a safe climate are dependent on our connections with nature and with each other, and the changes that address society's need for a safe climate can also bring big mental health and wellbeing benefits.

The interconnections between climate change and mental health outlined in this paper are vast and frequently bidirectional; to understand the myriad of ways the health of our minds are interwoven with the health of the planet requires 'big picture' or systems thinking, and a synthesis of evidence across numerous

disciplines (27). This narrative review represents what we believe to be the most comprehensive overview to date of the evidence relevant for understanding the nascent but growing field of climate change and mental health. By going beyond literature explicitly referring to climate change to include insights from literature now relevant to this topic, for example evidence on the mental health impacts of hurricanes or forced migration, and by including grey literature, we have synthesised a diverse knowledge base to paint a more complete picture of the collective understanding of how climate change interacts with mental health and wellbeing. This review also goes beyond the synthesised evidence base of previous reviews (6,32–34) by summarising the climate psychology literature that has seen an enormous expansion in the last couple of years, with much evidence emerging since previous reviews were published. Future research should aim to clarify: 1) the emerging picture of what factors confer vulnerability or resilience to the vast impacts of the climate crisis; 2) what, if any, sub-groupings of individuals are meaningful for targeting interventions; and 3) what interventions work best for different contexts and climate-related stressors.

This review has illustrated how the psychological, emotional and social burden of climate change will increase as more people directly experience climate change, and as awareness rises of the crisis, especially in the context of inadequate ameliorative action. All this emphasises the urgency with which world leaders in particular must accelerate action to reduce greenhouse gas emissions to avoid these inequitable burdens on society, while supporting communities to adapt to a heating world. Actions must be grounded in the needs of citizens to ensure the fairness and acceptability of the low carbon transition and so that resources are directed where they are most needed and most impactful. We have highlighted the range of pathways by which climate change can impact mental health and wellbeing; understanding these and how they vary in different cultural settings is key to developing appropriate interventions and ameliorative actions. Finally, while the threats posed by climate change to mental health and wellbeing are significant, so too are the benefits of climate action. The burden of climate change provides an urgent opportunity to build a better, more sustainable, and healthy future for all.

Author Contributions

ELL conceptualised the paper; RT conducted the literature search, with support from ELL and JNLV. All authors contributed to drafting and editing the paper.

Disclosure statement

The authors report there are no competing interests to declare.

Supplementary Information

Search Strategy

Locations

1. WebofScience (TS/Topic)
2. PsychINFO via Ovid (Title)
3. Ovid Embase (Title and abstract)
4. PubMed (Title)
5. Google scholar (searchbar, first ten pages of results)

Terms

1. (temperature or heat or heatwave or warming or season or hot) AND (mental health or mental illness or wellbeing or suicide or psychosis or anxiety or depression)
2. (flooding or floods or hurricane or drought or forest fire or thunderstorm or cyclone or tornado or bushfire or snowstorm or natural disaster) AND (mental health or mental illness or PTSD or post-traumatic stress disorder or wellbeing or suicide or psychosis or anxiety or depression)
3. (forced displacement or forced migration or climate refugee or climate migration) AND (mental health or mental illness or wellbeing or PTSD or post-traumatic stress disorder or suicide or psychosis or anxiety or depression)
4. (eco-anxiety or ecoanxiety or psychoterratic or solastalgia or ecoparalysis or ecological grief or ecopsychology)
5. (Greenspace and mental health) or (treecover and mental health) or (physical health and mental health) or (respiratory disease and mental health) or (asthma and mental health) or (cycling and mental health) or (walking and mental health) or (minimalism and mental health)

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References

1. World Health Day: Take climate action, take care of each other [Internet]. UN News. 2022 [cited 2022 Apr 28]. Available from: https://news.un.org/en/story/2022/04/1115722

2. Climate Change 2022: Mitigation of Climate Change [Internet]. [cited 2022 Apr 28]. Available from: https://www.ipcc.ch/report/ar6/wg3/

3. Climate Change 2022: Impacts, Adaptation and Vulnerability [Internet]. [cited 2022 Apr 28]. Available from: https://www.ipcc.ch/report/ar6/wg2/

4. Liu J, Potter T, Zahner S. Policy brief on climate change and mental health/well-being. *Nurs Outlook*. 2020;68 (4):517–22. https://doi.org/10.1016/j.outlook.2020.06.003

5. Mental health and Climate Change: Policy Brief [Internet]. [cited 2022 Sep 19]. Available from: https://www.who.int/publications-detail-redirect/9789240045125

6. Charlson F, Ali S, Benmarhnia T, Pearl M, Massazza A, Augustinavicius J, et al. Climate Change and Mental Health: A Scoping Review. *Int J Environ Res Public Health*. 2021;18 (9):4486. https://doi.org/10.3390/ijerph18094486

7. Lawrance DE, Thompson R, Fontana G, Jennings DN. The impact of climate change on mental health and emotional wellbeing: current evidence and implications for policy and practice [Internet]. Grantham Institute, Imperial College London; 2021 [cited 2022 Mar 3]. Available from: https://www.imperial.ac.uk/grantham/publications/briefing-papers/the-impact-of-climate-change-on-mental-health-and-emotional-wellbeing-current-evidence-and-implications-for-policy-and-practice.php

8. Trautmann S, Rehm J, Wittchen HU. The economic costs of mental disorders: Do our societies react appropriately to the burden of mental disorders? *EMBO Rep*. 2016;17 (9):1245–9. https://doi.org/10.15252/embr.201642951

9. Patel V, Saxena S, Lund C, Thornicroft G, Baingana F, Bolton P, et al. The Lancet Commission on global mental health and sustainable development. *The Lancet*. 2018;392 (10157):1553–98. https://doi.org/10.1016/S0140-6736(18)31612-X

10. James SL, Abate D, Abate KH, Abay SM, Abbafati C, Abbasi N, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet*. 2018;392 (10159):1789–858.

11. NHS Digital: the Mental Health and Young People Survey (MHCYP). Mental Health of Children and Young People in England, 2017 [Internet]. NHS Digital. [cited 2021 Feb 22]. Available from: https://digital.nhs.uk/data-and-information/publications/statistical/mental-health-of-children-and-young-people-in-england/2017/2017

12. McManus S, Gunnell D, Cooper C, Bebbington PE, Howard LM, Brugha T, et al. Prevalence of non-suicidal self-harm and service contact in England, 2000–14: repeated cross-sectional surveys of the general population. *Lancet Psychiatry*. 2019;6 (7):573–81. https://doi.org/10.1016/S2215-0366(19)30188-9

13. Frankish H, Boyce N, Horton R. Mental health for all: a global goal. *The Lancet*. 2018;392 (10157):1493–4. https://doi.org/10.1016/S0140-6736(18)32271-2

14. Souraya SCT, Farmer P. Addressing Anxiety and Depression: A whole system approach. *Doha Qatar World Innov Summit Health*. 2018;2018.

15. Roland J, Lawrance E, Insel T, Christensen H. The digital mental health revolution: Transforming care through innovation and scale-up [Internet]. 2020 p. 45. Available from: https://www.nweurope.eu/media/12272/wish-forum_report-on-mental-health-and-digital-technologies_11-2020.pdf

16. Wilkinson R. What age do mental health conditions develop at? [Internet]. Full Fact. [cited 2020 May 5]. Available from: https://fullfact.org/health/what-age-do-mental-health-conditions-develop/

17. Hurley EA, Dalglish SL, Sacks E. Supporting young people with climate anxiety: mitigation, adaptation, and resilience. *Lancet Planet Health*. 2022;6 (3):e190. https://doi.org/10.1016/S2542-5196(22)00015-8

18. Roland J, Kurek N, Nabarro D. HEALTH IN THE CLIMATE CRISIS. A GUIDE FOR HEALTH LEADERS [Internet]. 2020 p. 6. (Doha, Qatar: World Innovation Summit for Health, 2020). Available from: https://www.wish.org.qa/reports/health-in-the-climate-crisis-a-guide-for-health-leaders/

19. Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, et al. Managing the health effects of climate change: lancet and University College London Institute for Global Health Commission. *The lancet*. 2009;373 (9676):1693–733. https://doi.org/10.1016/S0140-6736(09)60935-1

20. De Hert M, Correll CU, Bobes J, Cetkovich-Bakmas M, Cohen D, Asai I, et al. Physical illness in patients with severe mental disorders. I. Prevalence, impact of medications and disparities in health care. *World Psychiatry*. 2011;10 (1):52–77. https://doi.org/10.1002/j.2051-5545.2011.tb00014.x

21. Jiang CQ, Loerbroks A, Lam KB, Bosch JA, Thomas GN, Zhang WS, et al. Mental health and asthma in China: the Guangzhou Biobank Cohort Study. *Int J Behav Med*. 2013;20 (2):259–64. https://doi.org/10.1007/s12529-012-9222-9

22. Bolton JM, Walld R, Chateau D, Finlayson G, Sareen J. Risk of suicide and suicide attempts associated with physical disorders: a population-based, balancing score-matched analysis. *Psychol Med.* 2015;45 (3):495–504. https://doi.org/10.1017/S0033291714001639

23. Pfefferbaum B, North CS. Mental Health and the Covid-19 Pandemic. *N Engl J Med.* 2020;383 (6): 510–2. https://doi.org/10.1056/NEJMp2008017

24. Jia R, Ayling K, Chalder T, Massey A, Broadbent E, Coupland C, et al. Mental health in the UK during the COVID-19 pandemic: cross-sectional analyses from a community cohort study. *BMJ Open.* 2020;10 (9):e040620. https://doi.org/10.1136/bmjopen-2020-040620

25. Marazziti D, Cianconi P, Mucci F, Foresi L, Chiarantini C, Vecchia AD. Climate change, Environment Pollution, Covid-19 Pandemic and Mental Health. *Sci Total Environ.* 2021;145182. https://doi.org/10.1016/j.scitotenv.2021.145182

26. Berry HL, Bowen K, Kjellstrom T. Climate change and mental health: a causal pathways framework. *Int J Public Health.* 2010;55 (2):123–32. https://doi.org/10.1007/s00038-009-0112-0

27. Berry HL, Waite TD, Dear KBG, Capon AG, Murray V. The case for systems thinking about climate change and mental health. *Nat Clim Change.* 2018;8 (4):282–90. https://doi.org/10.1038/s41558-018-0102-4

28. Hayes K, Poland B. Addressing Mental Health in a Changing Climate: Incorporating Mental Health Indicators into Climate Change and Health Vulnerability and Adaptation Assessments. *Int J Env Res Public Health.* 2018;15 (9):1806. https://doi.org/10.3390/ijerph15091806

29. Page LA, Howard LM. The impact of climate change on mental health (but will mental health be discussed at Copenhagen?). *Psychol Med.* 2010;40 (2): 177–80. https://doi.org/10.1017/s0033291709992169

30. Fritze JG, Blashki GA, Burke S, Wiseman J. Hope, despair and transformation: Climate change and the promotion of mental health and wellbeing. *Int J Ment Health Syst.* 2008;2 (1):13. https://doi.org/10.1186/1752-4458-2-13

31. Stokes B, Wike R, Carle J. 1. Concern about Climate Change and Its Consequences [Internet]. Pew Research Center's Global Attitudes Project. 2015 [cited 2022 Sep 19]. Available from: https://www.pewresearch.org/global/2015/11/05/1-concern-about-climate-change-and-its-consequences/

32. Cianconi P, Betrò S, Janiri L. The impact of climate change on mental health: a systematic descriptive review. *Front Psychiatry.* 2020;11.

33. Vecchio EA, Dickson M, Zhang Y. Indigenous mental health and climate change: A systematic literature review. *J Clim Change Health.* 2022;100121. https://doi.org/10.1016/j.joclim.2022.100121

34. Ma T, Moore J, Cleary A. Climate change impacts on the mental health and wellbeing of young people: A scoping review of risk and protective factors. *Soc Sci Med.* 2022;301:114888. https://doi.org/10.1016/j.socscimed.2022.114888

35. World Health Organization W. Promoting mental health: concepts, emerging evidence, practice: a report of the World Health Organization, Department of Mental Health and Substance Abuse in collaboration with the Victorian Health Promotion Foundation and the University of Melbourne. World Health Organization; 2005.

36. Dykxhoorn J, Fischer L, Bayliss B, Brayne C, Crosby L, Galvin B, et al. Conceptualising public mental health: development of a conceptual framework for public mental health. *BMC Public Health.* 2022;22 (1):1–15. https://doi.org/10.1186/s12889-022-13775-9

37. Vergunst F, Berry HL. Climate Change and Children's Mental Health: A Developmental Perspective. *Clin Psychol Sci.* 2021; 21677026211040788.

38. Network TOF. Scores to Settle: What does climate change have to do with mental health and young people? [Internet]. The OECD Forum Network. 2021 [cited 2022 Sep 19]. Available from: http://www.oecd-forum.org/posts/scores-to-settle-what-does-climate-change-ave-to-do-with-mental-health-andh-young-people

39. WHO (World Health Organisation). Mental health: strengthening our response [Internet]. [cited 2021 Mar 31]. Available from: https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response

40. WHO (World Health Organisation). Mental disorders [Internet]. [cited 2021 Feb 22]. Available from: https://www.who.int/news-room/fact-sheets/detail/mental-disorders

41. GBD 2019 Mental Disorders Collaborators. 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. *Lancet Psychiatry.* 2022;9 (2):137–50.

42. Aarons GA, Monn AR, Leslie LK, Garland AF, Lugo L, Hough RL, et al. Association between mental and physical health problems in high-risk adolescents: A longitudinal study. *J Adolesc Health.* 2008;43 (3): 260–7. https://doi.org/10.1016/j.jadohealth.2008.01.013

43. Ohrnberger J, Fichera E, Sutton M. The relationship between physical and mental health: A mediation analysis. *Soc Sci Med.* 2017;195:42–9. https://doi.org/10.1016/j.socscimed.2017.11.008

44. Stewart-Brown S. Emotional wellbeing and its relation to health. *BMJ.* 1998;317 (7173):1608–9. https://doi.org/10.1136/bmj.317.7173.1608

45. WHO (World Health Organisation). Health and Well-Being [Internet]. [cited 2022 Sep 19]. Available from: https://www.who.int/data/gho/data/major-themes/health-and-well-being

46. Ayeb-Karlsson S. No power without knowledge: a discursive subjectivities approach to investigate climate-induced (im) mobility and wellbeing. *Soc Sci.* 2020;9 (6):103. https://doi.org/10.3390/socsci9060103

47. Ganguli M, Blacker D, Blazer DG, Grant I, Jeste DV, Paulsen JS, et al. Classification of Neurocognitive Disorders in DSM-5: A Work in Progress. *Am J Geriatr Psychiatry.* 2011;19 (3):

205–10. https://doi.org/10.1097/jgp.0b013e3182051ab4

48. Pote I. What Science Has Shown Can Help Young People with Anxiety and Depression [Internet]. wellcome; 2021. Available from: https://wellcome.org/reports/what-science-has-shown-can-help-young-people-anxiety-and-depression

49. Gislason M, Kennedy A, Witham S. The Interplay between Social and Ecological Determinants of Mental Health for Children and Youth in the Climate Crisis. *Int J Environ Res Public Health.* 2021;18 (9).

50. World Health Organization. A conceptual framework for action on the social determinants of health [Internet]. World Health Organization; 2010 [cited 2022 Sep 19]. Available from: https://apps.who.int/iris/handle/10665/44489

51. Compton MT, Shim RS. The Social Determinants of Mental Health. *FOCUS.* 2015;13 (4):419–25. https://doi.org/10.1176/appi.focus.20150017

52. Dahlgren G, Whitehead M. *Policies and strategies to promote social equity in health. Background document to WHO - Strategy paper for Europe.* Institute for Future Studies.; 1991.

53. Bronfenbrenner U. Ecological systems theory. In: *Making human beings human: Bioecological perspectives on human development.* Sage Publications Ltd; 1992. p. 106–73.

54. Shukla, P.R., Skea, J, Calvo Buendia, E., Masson-Delmotte, V., Portner, H.-O., Roberts, D.C., et al. Summary for Policymakers. In: 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 [Internet]. IPCC; 2019 [cited 2020 Jul 14]. Available from: https://www.ipcc.ch/site/assets/uploads/2019/11/02_Summary-for-Policymakers_SPM.pdf

55. IPCC. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. [Internet]. 2014 p. 151. Available from: https://www.ipcc.ch/report/ar5/syr/

56. IPCC. Climate Change 2014: Summary for Policymakers [Internet]. [cited 2020 Jul 4]. Available from: https://www.ipcc.ch/report/sr15/summary-for-policymakers/

57. Working Group III contribution to the Sixth Assessment Report of the International Panel on Climate Change [Internet]. [cited 2022 May 9]. Available from: https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_FullReport.pdf

58. Hwong AR, Wang M, Khan H, Chagwedera DN, Grzenda A, Doty B, et al. Climate change and mental health research methods, gaps, and priorities: a scoping review. *Lancet Planet Health.* 2022;6 (3): e281–91. https://doi.org/10.1016/S2542-5196(22)00012-2

59. Ojala M, Cunsolo A, Ogunbode CA, Middleton J. Anxiety, Worry, and Grief in a Time of Environmental and Climate Crisis: A Narrative Review. *Annu Rev Environ Resour.* 2021;46 (1): 35–58. https://doi.org/10.1146/annurev-environ-012220-022716

60. Kumar P, Kumar N, Sarthi PP. Feeling solastalgia: A study of the effects of changing climate in rural india. *Asian J Soc Psychol.* 2021;No-Specified. https://doi.org/10.1111/ajsp.12473

61. Comtesse H, Ertl V, Hengst SMC, Rosner R, Smid GE. Ecological Grief as a Response to Environmental Change: A Mental Health Risk or Functional Response? *Int J Environ Res Public Health.* 2021;18 (2).

62. Thoma M, Rohleder N, Rohner S. Clinical Ecopsychology: The Mental Health Impacts and Underlying Pathways of the Climate and Environmental Crisis. *Front Psychiatry.* 2021;12.

63. Reyes MES, Carmen BPB, Luminarias MEP, Mangulabnan SANB, Ogunbode CA. An investigation into the relationship between climate change anxiety and mental health among Gen Z Filipinos. *Curr Psychol.* 2021; https://doi.org/10.1007/s12144-021-02099-3

64. Ogunbode C. Climate anxiety, pro-environmental action and wellbeing: antecedents and outcomes of negative emotional responses to climate change in 28 countries. *OSF Prepr.* 2022.

65. Hickman C, Marks E, Pihkala P, Clayton S, Lewandowski RE, Mayall EE, et al. Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. *Lancet Planet Health.* 2021;5 (12):e863–73. https://doi.org/10.1016/S2542-5196(21)00278-3

66. Martin G, Reilly K, Everitt H, Gilliland JA. Review: The impact of climate change awareness on children's mental well-being and negative emotions – a scoping review. *Child Adolesc Ment Health.* 2022;27 (1):59–72. https://doi.org/10.1111/camh.12525

67. Pihkala P. Commentary: Three tasks for eco-anxiety research–a commentary on Thompson et al. (2021). *Child Adolesc Ment Health.* 2022;27 (1):92–3. https://doi.org/10.1111/camh.12529

68. Liu XN, Liu H, Fan H, Liu YZ, Ding GY. Influence of Heat Waves on Daily Hospital Visits for Mental Illness in Jinan, ChinaA Case-Crossover Study. *Int J Environ Res Public Health.* 2019;16 (1):11.

69. Thompson R, Hornigold R, Page L, Waite T. Associations between high ambient temperatures and heat waves with mental health outcomes: a systematic review. *Public Health.* 2018;161:171–91. https://doi.org/10.1016/j.puhe.2018.06.008

70. Thompson R, Lawrance E, Roberts LF, Ashrafian H, Maheswaran H, Toledano MB, et al. Temperature and Mental Health: A Systematic Review and Meta-Analysis [Internet]. Rochester, NY: Social Science Research Network; 2021 Sep [cited 2022 Mar 3]. Report No.: ID 3915433. Available from: https://papers.ssrn.com/abstract=3915433

71. Mullins JT, White C. Temperature and mental health: Evidence from the spectrum of mental health outcomes. *J Health Econ.* 2019;68:102240. https://doi.org/10.1016/j.jhealeco.2019.102240

72. Ding N, Berry HL, Bennett CM. The importance of humidity in the relationship between heat and population mental health: Evidence from Australia. *PLOS ONE*. 2016;11 (10):e0164190. https://doi.org/10.1371/journal.pone.0164190

73. Middleton J, Cunsolo A, Pollock N, Jones-Bitton A, Wood M, Shiwak I, et al. Temperature and place associations with Inuit mental health in the context of climate change. *Environ Res*. 2021;198.

74. Preti A, Miotto P, De Coppi M. Season and suicide: Recent findings from Italy. Apter, editor. *Crisis J Crisis Interv Suicide Prev*. 2000;21 (2):59–70. https://doi.org/10.1027//0227-5910.21.2.59

75. Ruuhela R, Hiltunen L, Venäläinen A, Pirinen P, Partonen T. Climate impact on suicide rates in Finland from 1971 to 2003. *Int J Biometeorol*. 2009; 53 (2):167–75. https://doi.org/10.1007/s00484-008-0200-5

76. Helama S, Holopainen J, Partonen T. Temperature-associated suicide mortality: contrasting roles of climatic warming and the suicide prevention program in Finland. *Environ Health Prev Med*. 2013;18 (5): 349–55. https://doi.org/10.1007/s12199-013-0329-7

77. Santurtún M, Sanchez-Lorenzo A, Del Real Á, Zarrabeitia MT, Santurtún A. Association Between Suicide and Environmental Variables in the North of Spain: A 14-Year Analysis. *Cult Med Psychiatry*. 2018;42 (3):647–53. https://doi.org/10.1007/s11013-018-9578-7

78. Tietjen GH, Kripke DF. Suicides in California (1968–1977): Absence of seasonality in Los Angeles and Sacramento counties. *Psychiatry Res*. 1994;53 (2):161–72. https://doi.org/10.1016/0165-1781(94)90107-4

79. Parks RM, Bennett JE, Tamura-Wicks H, Kontis V, Toumi R, Danaei G, et al. Anomalously warm temperatures are associated with increased injury deaths. *Nat Med*. 2020;26 (1):65–70. https://doi.org/10.1038/s41591-019-0721-y

80. Dixon PG, Kalkstein AJ. Where are weather-suicide associations valid? An examination of nine US counties with varying seasonality. *Int J Biometeorol*. 2018; 62 (5):685–97. https://doi.org/10.1007/s00484-016-1265-1

81. Tsai JF, Cho W. Temperature change dominates the suicidal seasonality in Taiwan: A time-series analysis. *J Affect Disord*. 2012;136 (3):412–8. https://doi.org/10.1016/j.jad.2011.11.010

82. Hu J, Wen Y, Duan Y, Yan S, Liao Y, Pan H, et al. The impact of extreme heat and heat waves on emergency ambulance dispatches due to external cause in Shenzhen, China. *Environ Pollut*. 2020;261: 114156. https://doi.org/10.1016/j.envpol.2020.114156

83. Chung Y, Kim Y, Sim K, Gasparrini A, Armstrong B, Sera F, et al. Suicide risk associated with season and temperature in Japan, 1972-2015; the role of climate, demographic, and socioeconomic factors. *Environ Epidemiol*. 2019;3:74.

84. Kalkstein AJ, Belorid M, Dixon PG, Kim KR, Bremer KA. Seasonal Variations in Temperature-Suicide Associations across South Korea. *Weather Clim Soc*. 2019;11 (4):731–9. https://doi.org/10.1175/WCAS-D-19-0019.1

85. Kim Y, Kim H, Honda Y, Guo YL, Chen BY, Woo JM, et al. Suicide and Ambient Temperature in East Asian Countries: A Time-Stratified Case-Crossover Analysis. *Environ Health Perspect*. 2016;124 (1): 75–80. https://doi.org/10.1289/ehp.1409392

86. Burke M, González González F, Baylis P, Heft-Neal S, Baysan C, Basu S, et al. Higher temperatures increase suicide rates in the United States and Mexico. *Nat Clim Change*. 2018;8.

87. Bando DH, Teng CT, Volpe FM, Masi E de, Pereira LA, Braga AL. Suicide and meteorological factors in São Paulo, Brazil, 1996-2011: a time series analysis. *Braz J Psychiatry*. 2017;39:220–7. https://doi.org/10.1590/1516-4446-2016-2057

88. Grjibovski AM, Kozhakhmetova G, Kosbayeva A, Menne B. Associations between air temperature and daily suicide counts in Astana, *Kazakhstan. Med Kaunas*. 2013;49 (8):379–85.

89. Gupta S, Murray RM. The Relationship of Environmental Temperature to the Incidence and Outcome of Schizophrenia. *Br J Psychiatry*. 1992;160 (6):788–92. https://doi.org/10.1192/bjp.160.6.788

90. Kim Y, Kim H, Gasparrini A, Armstrong B, Honda Y, Chung Y, et al. Suicide and Ambient Temperature: A Multi-Country Multi-City Study. *Environ Health Perspect*. 2019;127 (11):117007. https://doi.org/10.1289/EHP4898

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

92. Lõhmus M. Possible Biological Mechanisms Linking Mental Health and Heat-A Contemplative Review. *Int J Env Res Public Health*. 2018;15 (7):1515. https://doi.org/10.3390/ijerph15071515

93. Burke M, Hsiang SM, Miguel E. Global non-linear effect of temperature on economic production. *Nature*. 2015;527 (7577):235–9. https://doi.org/10.1038/nature15725

94. Tiihonen J, Halonen P, Tiihonen L, Kautiainen H, Storvik M, Callaway J. The Association of Ambient Temperature and Violent Crime. *Sci Rep*. 2017;7. https://doi.org/10.1038/s41598-017-06720-z

95. Buguet A. Sleep under extreme environments: effects of heat and cold exposure, altitude, hyperbaric pressure and microgravity in space. *J Neurol Sci*. 2007; 262 (1–2):145–52. https://doi.org/10.1016/j.jns.2007.06.040

96. Patz JA, Githeko AK, McCarty JP, Hussein S, Confalonieri U, de Wet N. Climate change and infectious diseases. *Infect Dis*. :30.

97. Deisenhammer EA, Kemmler G, Parson P. Association of meteorological factors with suicide. *Acta Psychiatr Scand*. 2003;108 (6):455–9. https://doi.org/10.1046/j.0001-690x.2003.00219.x

98. Dixon PG, Sinyor M, Schaffer A, Levitt A, Haney CR, Ellis KN, et al. Association of weekly suicide rates with temperature anomalies in two different climate types. *Int J Env Res Public Health*. 2014;11

(11):11627–44. https://doi.org/10.3390/ijerph111111627

99. Gao J, Cheng Q, Duan J, Xu Z, Bai L, Zhang Y, et al. Ambient temperature, sunlight duration, and suicide: A systematic review and meta-analysis. *Sci Total Environ.* 2019;646:1021–9. https://doi.org/10.1016/j.scitotenv.2018.07.098

100. Liu J, Varghese B, Hansen A, Xiang J, Zhang Y, Dear K, et al. Is there an association between hot weather and poor mental health outcomes? A systematic review and meta-analysis. *Environ Int.* 2021; 153.

101. Carleton TA. Crop-damaging temperatures increase suicide rates in India. *Proc Natl Acad Sci.* 2017;114 (33):8746–51. https://doi.org/10.1073/pnas.1701354114

102. Denissen JJA, Butalid L, Penke L, van Aken MAG. The effects of weather on daily mood: a multilevel approach. *Emot Wash DC.* 2008;8 (5):662–7. https://doi.org/10.1037/a0013497

103. Linkowski P, Martin F, De Maertelaer V. Effect of some climatic factors on violent and non-violent suicides in Belgium. *J Affect Disord.* 1992;25 (3): 161–6. https://doi.org/10.1016/0165-0327(92)90001-m

104. Moore FR, Bell M, Macleod M, Smith E, Beaumont J, Graham L, et al. Season, weather, and suicide-Further evidence for ecological complexity. Ajdacic-Gross, editor. *Neurol Psychiatry Brain Res.* 2018;30: 110–6. https://doi.org/10.1016/j.npbr.2018.08.002

105. Perceval M, Kolves K, Ross V, Reddy P, De Leo D. Environmental factors and suicide in Australian farmers: A qualitative study. *Arch Environ Occup Health.* 2019;74 (5):279–86. https://doi.org/10.1080/19338244.2018.1453774

106. Austin EK, Rich JL, Kiem AS, Handley T, Perkins D, Kelly BJ. Concerns about climate change among rural residents in Australia. *J Rural Stud.* 2020;75: 98–109. https://doi.org/10.1016/j.jrurstud.2020.01.010

107. Inoue K, Nishimura Y, Fujita Y, Ono Y, Fukunaga T. The relationship between suicide and five climate issues in a large-scale and long term study in Japan. *West Indian Med J.* 2012;61 (5):532–7. https://doi.org/10.7727/wimj.2010.141

108. Preti A, Lentini G, Maugeri M. Global warming possibly linked to an enhanced risk of suicide: Data from Italy, 1974-2003. *J Affect Disord.* 2007;102 (1–3):19–25. https://doi.org/10.1016/j.jad.2006.12.003

109. Nori-Sarma A, Sun S, Sun Y, Spangler KR, Oblath R, Galea S, et al. Association Between Ambient Heat and Risk of Emergency Department Visits for Mental Health Among US Adults, 2010 to 2019. *JAMA Psychiatry.* 2022;79 (4):341–9. https://doi.org/10.1001/jamapsychiatry.2021.4369

110. Williams MN, Hill SR, Spicer J. Do hotter temperatures increase the incidence of self-harm hospitalisations? *Psychol Health Med.* 2016;21 (2):226–35. https://doi.org/10.1080/13548506.2015.1028945

111. Basu R, Gavin L, Pearson D, Ebisu K, Malig B. Examining the Association Between Apparent Temperature and Mental Health-Related Emergency Room Visits in California. *Am J Epidemiol.* 2017;187 (4):726–35. https://doi.org/10.1093/aje/kwx295

112. Lee S, Lee H, Myung W, Kim EJ, Kim H. Mental disease-related emergency admissions attributable to hot temperatures. *Sci Total Environ.* 2018;616: 688–94. https://doi.org/10.1016/j.scitotenv.2017.10.260

113. Trang PM, Rocklöv J, Giang KB, Kullgren G, Nilsson M. Heatwaves and hospital admissions for mental disorders in Northern Vietnam. *PLOS ONE.* 2016;11 (5):e0155609. https://doi.org/10.1371/journal.pone.0155609

114. Xue T, Zhu T, Zheng YX, Zhang Q. Declines in mental health associated with air pollution and temperature variability in China. *Nat Commun.* 2019;10: 8. https://doi.org/10.1038/s41467-019-10196-y

115. Clayton S. Mental Health and Our Changing Climate: Impacts, Implications, and Guidance. *Wash DC Am Psychol Assoc EcoAmerica.* 2017;

116. Bouchama A, Dehbi M, Mohamed G, Matthies F, Shoukri M, Menne B. Prognostic Factors in Heat Wave–Related Deaths: A Meta-analysis. *Arch Intern Med.* 2007;167 (20):2170–6. https://doi.org/10.1001/archinte.167.20.ira70009

117. Berardi D, Pavarin RM, Chierzi F, Terzi L, Manzo V, Piazza A, et al. Mortality Rates and Trends among Bologna Community Mental Health Service Users: A 13-Year Cohort Study. *J Nerv Ment Dis.* 2018;206 (12):944–9. https://doi.org/10.1097/NMD.0000000000000906

118. Martin-Latry K, Goumy MP, Latry P, Gabinski C, Bégaud B, Faure I, et al. Psychotropic drugs use and risk of heat-related hospitalisation. *Eur Psychiatry.* 2007;22 (6):335–8. https://doi.org/10.1016/j.eurpsy.2007.03.007

119. Hansen A, Bi P, Nitschke M, Ryan P, Pisaniello D, Tucker G. The effect of heat waves on mental health in a temperate Australian city. *Environ Health Perspect.* 2008;116 (10):1369–75. https://doi.org/10.1289/ehp.11339

120. Page LA, Hajat S, Kovats RS, Howard LM. Temperature-related deaths in people with psychosis, dementia and substance misuse. *Br J Psychiatry J Ment Sci.* 2012;200 (6):485–90. https://doi.org/10.1192/bjp.bp.111.100404

121. Stöllberger C, Lutz W, Finsterer J. Heat-related side-effects of neurological and non-neurological medication may increase heatwave fatalities. *Eur J Neurol.* 2009;16 (7):879–82. https://doi.org/10.1111/j.1468-1331.2009.02581.x

122. Dodgen D, Donato D, Kelly N, La Greca A, Morganstein J, Reser J, et al. Ch. 8: Mental health and well-being [Internet]. US Global Change Research Program, Washington, DC; 2016. (Climate and Health Assessment). Available from: https://health2016.globalchange.gov/mental-health-and-well-being

123. Hoffmann MS, Oliveira LM, Lobato MIR, Belmonte-de-Abreu P, Hoffmann MS, Oliveira LM, et al. Heat stroke during long-term clozapine treatment: should we be concerned about hot weather? *Trends*

Psychiatry Psychother. 2016;38 (1):56–9. https://doi.org/10.1590/2237-6089-2015-0066

124. Psychotropic drugs, summer heat and humidity, and hyperpyrexia: a danger restated. *Am J Psychiatry.* 1978;135 (9):1097–100.

125. Keller MC, Fredrickson BL, Ybarra O, Cote S, Johnson K, Mikels J, et al. A warm heart and a clear head. The contingent effects of weather on mood and cognition. *Psychol Sci.* 2005;16 (9):724–31. https://doi.org/10.1111/j.1467-9280.2005.01602.x

126. Knapp PA, Maxwell JT, Ortegren JT, Soulé PT. Spatiotemporal changes in comfortable weather duration in the continental United States and implications for human wellness. *Ann Am Assoc Geogr.* 2016;106 (1):1–18. https://doi.org/10.1080/00045608.2015.1095058

127. Noelke C, McGovern M, Corsi DJ, Jimenez MP, Stern A, Wing IS, et al. Increasing ambient temperature reduces emotional well-being. *Environ Res.* 2016;151:124–9. https://doi.org/10.1016/j.envres.2016.06.045

128. Baylis P, Obradovich N, Kryvasheyeu Y, Chen H, Coviello L, Moro E, et al. Weather impacts expressed sentiment. *PLOS ONE.* 2018;13 (4):e0195750. https://doi.org/10.1371/journal.pone.0195750

129. Obradovich N, Migliorini R, Paulus MP, Rahwan I. Empirical evidence of mental health risks posed by climate change. *Proc Natl Acad Sci.* 2018;115 (43):10953. https://doi.org/10.1073/pnas.1801528115

130. Beecher ME, Eggett D, Erekson D, Rees LB, Bingham J, Klundt J, et al. Sunshine on my shoulders: Weather, pollution, and emotional distress. *J Affect Disord.* 2016;205:234–8. https://doi.org/10.1016/j.jad.2016.07.021

131. Stivanello E, Chierzi F, Marzaroli P, Zanella S, Miglio R, Biavati P, et al. Mental Health Disorders and Summer Temperature-Related Mortality: A Case Crossover Study. *Int J Environ Res Public Health.* 2020;17 (23):9122. https://doi.org/10.3390/ijerph17239122

132. Önder S, Akay A. The roles of plants on mitigating the urban heat islands' negative Effects. *Int J Agric Econ Dev.* 2014;2 (2):18.

133. Wüstemann H, Kalisch D, Kolbe J. Access to urban green space and environmental inequalities in Germany. *Landsc Urban Plan.* 2017;164:124–31. https://doi.org/10.1016/j.landurbplan.2017.04.002

134. You H. Characterizing the inequalities in urban public green space provision in Shenzhen, China. *Habitat Int.* 2016;56:176–80. https://doi.org/10.1016/j.habitatint.2016.05.006

135. Mushangwe S, Astell-Burt T, Steel D, Feng X. Ethnic inequalities in green space availability: Evidence from Australia. *Urban For Urban Green.* 2021;64:127235. https://doi.org/10.1016/j.ufug.2021.127235

136. Rigolon A, Browning MH, Lee K, Shin S. Access to urban green space in cities of the Global South: A systematic literature review. *Urban Sci.* 2018;2 (3):67. https://doi.org/10.3390/urbansci2030067

137. Henderson SB, McLean KE, Lee MJ, Kosatsky T. Analysis of community deaths during the catastrophic 2021 heat dome. *Environ Epidemiol.* 2022;6 (1):e189. https://doi.org/10.1097/EE9.0000000000000189

138. Bryant RA, Waters E, Gibbs L, Gallagher HC, Pattison P, Lusher D, et al. Psychological outcomes following the Victorian Black Saturday bushfires. *Aust N Z J Psychiatry.* 2014;48 (7):634–43. https://doi.org/10.1177/0004867414534476

139. Wagner KD, Brief DJ, Vielhauer MJ, Sussman S, Keane TM, Malow R. The potential for PTSD, substance use, and HIV risk behavior among adolescents exposed to Hurricane Katrina. *Subst Use Misuse.* 2009;44 (12):1749–67. https://doi.org/10.3109/10826080902963472

140. Brown LA, Fernandez CA, Kohn R, Saldivia S, Vicente B. Pre-disaster PTSD as a moderator of the relationship between natural disaster and suicidal ideation over time. Akaike, editor. *J Affect Disord.* 2018;230:7–14. https://doi.org/10.1016/j.jad.2017.12.096

141. Wasserstein SB, La Greca AM. Hurricane Andrew: Parent conflict as a moderator of children's adjustment. *Hisp J Behav Sci.* 1998;20 (2):212–24. https://doi.org/10.1177/07399863980202005

142. Bokszczanin A. Parental support, family conflict, and overprotectiveness: Predicting PTSD symptom levels of adolescents 28 months after a natural disaster. *Anxiety Stress Coping.* 2008;21 (4):325–35. https://doi.org/10.1080/10615800801950584

143. Mamun MA, Huq N, Papia ZF, Tasfina S, Gozal D. Prevalence of depression among Bangladeshi village women subsequent to a natural disaster: A pilot study. Abate, editor. *Psychiatry Res.* 2019;276:124–8. https://doi.org/10.1016/j.psychres.2019.05.007

144. Kar N. Depression in Youth Exposed to Disasters, Terrorism and Political Violence. *Curr Psychiatry Rep.* 2019;21 (8). https://doi.org/10.1007/s11920-019-1061-9

145. McDermott B, Cobham V, Berry H, Kim B. Correlates of persisting posttraumatic symptoms in children and adolescents 18 months after a cyclone disaster. *Aust N Z J Psychiatry.* 2014;48 (1):80–6. https://doi.org/10.1177/0004867413500349

146. Weems CF, Watts SE, Marsee MA, Taylor LK, Costa NM, Cannon MF, et al. The psychosocial impact of Hurricane Katrina: Contextual differences in psychological symptoms, social support, and discrimination. *Behav Res Ther.* 2007;45 (10):2295–306. https://doi.org/10.1016/j.brat.2007.04.013

147. Battles ED. An exploration of post-traumatic stress disorder in emergency nurses following Hurricane Katrina. *J Emerg Nurs.* 2007;33 (4):314–8. https://doi.org/10.1016/j.jen.2007.01.008

148. Sirey JA, Berman J, Halkett A, Giunta N, Kerrigan J, Raeifar E, et al. Storm Impact and Depression Among Older Adults Living in Hurricane Sandy-Affected Areas. *Disaster Med Public Health Prep.* 2017;11 (1):97–109. https://doi.org/10.1017/dmp.2016.189

149. Hayes K, Blashki G, Wiseman J, Burke S, Reifels L. Climate change and mental health: risks, impacts and priority actions. *Int J Ment Health Syst*. 2018;12 (1):28. https://doi.org/10.1186/s13033-018-0210-6

150. McGuire AP, Gauthier JM, Anderson LM, Hollingsworth DW, Tracy M, Galea S, et al. Social support moderates effects of natural disaster exposure on depression and posttraumatic stress disorder symptoms: Effects for displaced and nondisplaced residents. *J Trauma Stress*. 2018;31 (2):223–33. https://doi.org/10.1002/jts.22270

151. Picou SJ, Hudson K. Hurricane Katrina and mental health: A research note on Mississippi Gulf Coast residents. *Sociol Inq*. 2010;80 (3):513–24. https://doi.org/10.1111/j.1475-682x.2010.00345.x

152. Rhodes J, Chan C, Paxson C, Rouse CE, Waters M, Fussell E. The impact of Hurricane Katrina on the mental and physical health of low-income parents in New Orleans. *Am J Orthopsychiatry*. 2010;80 (2):237. https://doi.org/10.1111/j.1939-0025.2010.01027.x

153. Reifels L, Bassilios B, Spittal MJ, King K, Fletcher J, Pirkis J. Patterns and Predictors of Primary Mental Health Service Use Following Bushfire and Flood Disasters. *Disaster Med Public Health Prep*. 2015;9 (3):275–82. https://doi.org/10.1017/dmp.2015.23

154. Vins H, Bell J, Saha S, Hess JJ. The Mental Health Outcomes of Drought: A Systematic Review and Causal Process Diagram. *Int J Environ Res Public Health*. 2015;12 (10):13251–75. https://doi.org/10.3390/ijerph121013251

155. Obrien LV, Berry HL, Coleman C, Hanigan IC. Drought as a mental health exposure. *Environ Res*. 2014;131:181–7. https://doi.org/10.1016/j.envres.2014.03.014

156. Yoda T, Yokoyama K, Suzuki H, Hirao T. Relationship Between Long-term Flooding and Serious Mental Illness After the 2011 Flood in Thailand. *Disaster Med Public Health Prep*. 2017;11 (3):300–4. https://doi.org/10.1017/dmp.2016.148

157. An YY, Huang JL, Chen YR, Deng Z. Longitudinal Cross-Lagged Relationships Between Posttraumatic Stress Disorder and Depression in Adolescents Following the Yancheng Tornado in China. *Psychol Trauma-Theory Res Pract Policy*. 2019;11 (7):760–6. https://doi.org/10.1037/tra0000455

158. Cho S, Cho Y. Depressive symptoms following natural disaster in Korea: Psychometric properties of the Center for Epidemiologic Studies Depression Scale. *Health Qual Life Outcomes*. 2017;15 (230). https://doi.org/10.1186/s12955-017-0811-9

159. Chae EH, Kim TW, Rhee SJ, Henderson TD. The impact of flooding on the mental health of affected people in South Korea. *Community Ment Health J*. 2005;41 (6):633–45. https://doi.org/10.1007/s10597-005-8845-6

160. Fernandez CA, Vicente B, Marshall BDL, Koenen KC, Arheart KL, Kohn R, et al. Longitudinal course of disaster-related PTSD among a prospective sample of adult Chilean natural disaster survivors. *Int J Epidemiol*. 2017;46 (2):440–52.

161. Kar N, Bastia BK. Post-traumatic stress disorder, depression and generalised anxiety disorder in adolescents after a natural disaster: a study of comorbidity. *Clin Pr Epidemiol Ment Health*. 2006;2: 17.

162. Mason V, Andrews H, Upton D. The psychological impact of exposure to floods. *Psychol Health Med*. 2010;15 (1):61–73. https://doi.org/10.1080/13548500903483478

163. Kalayjian AS. Mental health outreach program following the earthquake in Armenia: utilizing the nursing process in developing and managing the post-natural disaster plan. *Issues Ment Health Nurs*. 1994;15 (6):533–50. https://doi.org/10.3109/01612849409040532

164. Arnberg FK, Johannesson KB, Michel PO. Prevalence and duration of PTSD in survivors 6 years after a natural disaster. *J Anxiety Disord*. 2013; 27 (3):347–52. https://doi.org/10.1016/j.janxdis.2013.03.011

165. Ellis NR, Albrecht GA. Climate change threats to family farmers' sense of place and mental wellbeing: A case study from the Western Australian Wheatbelt. *Soc Sci Med*. 2017;175:161–8. https://doi.org/10.1016/j.socscimed.2017.01.009

166. Edwards B, Gray M, Hunter B. The impact of drought on mental health in rural and regional Australia. *Soc Indic Res*. 2015;121 (1):177–94. https://doi.org/10.1007/s11205-014-0638-2

167. Asugeni J, MacLaren D, Massey PD, Speare R. Mental health issues from rising sea level in a remote coastal region of the Solomon Islands: current and future. *Australas Psychiatry*. 2015;23 (6_suppl):22–5. https://doi.org/10.1177/1039856215609767

168. Simms J. Solastalgic Landscapes: Prospects of Relocation in Coastal Louisiana. *Front Environ Sci*. 2021 May 24;9.

169. Phillips C, Murphy C. Solastalgia, place attachment and disruption: insights from a coastal community on the front line. *Reg Environ Change*. 2021;21 (2): 46. https://doi.org/10.1007/s10113-021-01778-y

170. APA (American Psychological Association). Climate change is threatening mental health [Internet]. https://www.apa.org. [cited 2020 May 5]. Available from: https://www.apa.org/monitor/2016/07-08/climate-change

171. Akerkar S, Fordham M. Gender, place and mental health recovery in disasters: Addressing issues of equality and difference. *Int J Disaster Risk Reduct*. 2017;23:218–30. https://doi.org/10.1016/j.ijdrr.2017.03.014

172. Dyregrov A, Yule W, Olff M. Children and natural disasters. Vol. 9, *European Journal of Psychotraumatology*. Taylor & Francis; 2018. https://doi.org/10.1080/20008198.2018.1500823

173. Uddin R, Philipsborn R, Smith D, Mutic A, Thompson LM. A global child health perspective on climate change, migration and human rights. *Curr Probl Pediatr Adolesc Health Care*. 2021;51 (6): 101029. https://doi.org/10.1016/j.cppeds.2021.101029

174. Perilla JL, Norris FH, Lavizzo EA. Ethnicity, culture, and disaster response: Identifying and explaining ethnic differences in PTSD six months after

Hurricane Andrew. *J Soc Clin Psychol.* 2002;21 (1): 20–45. https://doi.org/10.1521/jscp.21.1.20.22404

175. Joseph NT. Stress, trauma, and resilience in African-American Hurricane Katrina survivors: Stress exposures and perceived stress endurance as associated with long-term depression, post-traumatic stress, and cortisol levels. *Diss Abstr Int Sect B Sci Eng.* 2012;73 (6-B):3953.

176. Fothergill A, Maestas EG, Darlington JD. Race, ethnicity and disasters in the United States: A review of the literature. *Disasters.* 1999;23 (2):156–73. https://doi.org/10.1111/1467-7717.00111

177. Sullivan G, Vasterling JJ, Han X, Tharp AT, Davis T, Deitch EA, et al. Preexisting mental illness and risk for developing a new disorder after Hurricane Katrina. Altevogt BBBBCCDGHJKKMNNNNNNNNOPQRSSS, editor. *J Nerv Ment Dis.* 2013;201 (2):161–6. https://doi.org/10.1097/NMD.0b013e31827f636d

178. Goldmann E, Galea S. Mental Health Consequences of Disasters. In: Fielding JE, editor. *Annual Review of Public Health*, Vol 35. Palo Alto: Annual Reviews; 2014. p. 169–83. (Annual Review of Public Health; vol. 35).

179. Benedek DM, Fullerton C, Ursano RJ. First responders: mental health consequences of natural and human-made disasters for public health and public safety workers. *Annu Rev Public Health.* 2007;28: 55–68. https://doi.org/10.1146/annurev.publhealth.28.021406.144037

180. Doherty T. Hurricane Katrina and Superstorm Sandy: Mental health providers as victims and first responders. *Ecopsychology.* 2013;5 (Suppl 1):S1. https://doi.org/10.1089/eco.2013.5501

181. Munro A, Kovats RS, Rubin GJ, Waite TD, Bone A, Armstrong B, et al. Effect of evacuation and displacement on the association between flooding and mental health outcomes: a cross-sectional analysis of UK survey data. *Lancet Planet Health.* 2017;1 (4): e134–41. https://doi.org/10.1016/S2542-5196(17)30047-5

182. Schwartz RM, Rasul R, Kerath SM, Watson AR, Lieberman-Cribbin W, Liu B, et al. Displacement during Hurricane Sandy: The impact on mental health. *J Emerg Manag West Mass.* 2018;16 (1): 17–27.

183. Galea S, Brewin CR, Gruber M, Jones RT, King DW, King LA, et al. Exposure to hurricane-related stressors and mental illness after Hurricane Katrina. *Arch Gen Psychiatry.* 2007;64 (12):1427–34. https://doi.org/10.1001/archpsyc.64.12.1427

184. Graham H, White P, Cotton J, McManus S. Flood- and Weather-Damaged Homes and Mental Health: An Analysis Using England's Mental Health Survey. *Int J Environ Res Public Health.* 2019;16 (18).

185. Galea S, Tracy M, Norris F, Coffey SF. Financial and social circumstances and the incidence and course of PTSD in Mississippi during the first two years after Hurricane Katrina. *J Trauma Stress.* 2008; 21 (4):357–68. https://doi.org/10.1002/jts.20355

186. Coleman KR. *Helping behavior, resource loss, and PTSD in survivors of Hurricane Katrina*. Wheaton College ProQuest Dissertations Publishing; 2013.

187. Fernandez A, Black J, Jones M, Wilson L, Salvador-Carulla L, Astell-Burt T, et al. Flooding and Mental Health: A Systematic Mapping Review. *PLOS ONE.* 2015;10 (4):e0119929. https://doi.org/10.1371/journal.pone.0119929

188. Ruzek JI, Young BH, Cordova MJ, Flynn BW. Integration of disaster mental health services with emergency medicine. *Prehospital Disaster Med.* 2004; 19 (1):46–53. https://doi.org/10.1017/s1049023x00001473

189. Norris FH, Friedman MJ, Watson PJ, Byrne CM, Diaz E, Kaniasty K. 60,000 Disaster Victims Speak: Part I. An Empirical Review of the Empirical Literature, 1981–2001. *Psychiatry Interpers Biol Process.* 2002 Sep 1;65 (3):207–39. https://doi.org/10.1521/psyc.65.3.207.20173

190. Ruskin J, Rasul R, Schneider S, Bevilacqua K, Taioli E, Schwartz RM. Lack of access to medical care during Hurricane Sandy and mental health symptoms. *Prev Med Rep.* 2018;10:363–9. https://doi.org/10.1016/j.pmedr.2018.04.014

191. Storch EA, Shah A, Salloum A, Valles N, Banu S, Schneider SC, et al. Psychiatric Diagnoses and Medications for Hurricane Harvey Sheltered Evacuees. *Community Ment Health J.* 2019;55 (7): 1099–102. https://doi.org/10.1007/s10597-019-00378-9

192. Butler C, Walker-Springett K, Adger WN. Narratives of recovery after floods: Mental health, institutions, and intervention. *Soc Sci Med.* 2018;216:67–73. https://doi.org/10.1016/j.socscimed.2018.09.024

193. Sharma D, McIntyre R, Cuffy M, Masicot A. Post-traumatic stress disorder prevention for medical students evacuated from Dominica following Hurricane Maria. *West Indian Med J.* 2018;67 (Supplement 2): 64.

194. Van den Berg B, Wong A, van der Velden PG, Boshuizen HC, Grievink L. Disaster exposure as a risk factor for mental health problems, eighteen months, four and ten years post-disaster–a longitudinal study. *BMC Psychiatry.* 2012;12 (1):1–13. https://doi.org/10.1186/1471-244X-12-147

195. Leppold C, Gibbs L, Block K, Reifels L, Quinn P. *Public health implications of multiple disaster exposures*. Lancet Public Health. 2022;

196. Sansom GT, Thompson C, Sansom L, Fawkes L, Boerlin E. Compounding impacts of hazard exposures on mental health in Houston, TX. *Nat Hazards.* 2022;111 (3):2809–18. https://doi.org/10.1007/s11069-021-05158-x

197. CDC (Centers for Disease Control and Prevention). Climate and Health Intervention Assessment: Evidence on Public Health Interventions to Prevent the Negative Health Effects of Climate Change [Internet]. [cited 2020 Jul 15]. Available from: https://www.cdc.gov/climateandhealth/docs/ClimateAndHealthInterventionAssessment_508.pdf

198. Azuma K, Ikeda K, Kagi N, Yanagi U, Hasegawa K, Osawa H. Effects of water-damaged homes after

flooding: health status of the residents and the environmental risk factors. *Int J Environ Health Res.* 2014;24 (2):158–75. https://doi.org/10.1080/09603123.2013.800964

199. Kessler RC, Galea S, Gruber MJ, Sampson NA, Ursano RJ, Wessely S. Trends in mental illness and suicidality after Hurricane Katrina. *Mol Psychiatry.* 2008;13 (4):374. https://doi.org/10.1038/sj.mp.4002119

200. Tunstall S, Tapsell S, Green C, Floyd P, George C. The health effects of flooding: Social research results from England and Wales. *J Water Health.* 2006;4 (3):365–80. https://doi.org/10.2166/wh.2006.031

201. Cruz J, White PCL, Bell A, Coventry PA. Effect of Extreme Weather Events on Mental Health: A Narrative Synthesis and Meta-Analysis for the UK. *Int J Environ Res Public Health.* 2020;17 (22):8581. https://doi.org/10.3390/ijerph17228581

202. French CE, Waite TD, Armstrong B, Rubin GJ, Beck CR, Oliver I. Impact of repeat flooding on mental health and health-related quality of life: A cross-sectional analysis of the English National Study of Flooding and Health. *BMJ Open.* 2019;9 (11):e031562. https://doi.org/10.1136/bmjopen-2019-031562

203. Silveira S, Kornbluh M, Withers MC, Grennan G, Ramanathan V, Mishra J. Chronic Mental Health Sequelae of Climate Change Extremes: A Case Study of the Deadliest Californian Wildfire. *Int J Environ Res Public Health.* 2021;18 (4):1487. https://doi.org/10.3390/ijerph18041487

204. Scaramutti C, Salas-Wright CP, Vos SR, Schwartz SJ. The Mental Health Impact of Hurricane Maria on Puerto Ricans in Puerto Rico and Florida. *Disaster Med Public Health Prep.* 2019;13 (1):24–7. https://doi.org/10.1017/dmp.2018.151

205. Orengo-Aguayo R, Stewart RW, de Arellano MA, Suárez-Kindy JL, Young J. Disaster Exposure and Mental Health Among Puerto Rican Youths After Hurricane Maria. *JAMA Netw Open.* 2019;2 (4): e192619. https://doi.org/10.1001/jamanetworkopen.2019.2619

206. Ferré IM, Negrón S, Shultz JM, Schwartz SJ, Kossin JP, Pantin H. Hurricane Maria's Impact on Punta Santiago, Puerto Rico: Community Needs and Mental Health Assessment Six Months Postimpact. *Disaster Med Public Health Prep.* 2019;13 (1):18–23. https://doi.org/10.1017/dmp.2018.103

207. Chavez JCJ, Sanchez EV, Maldonado FJR, Lucca AJR, Cartagena BB. Promoting Integrated Mental Health Care Services in Disaster Response Programs: Lessons Learned After the Impact of Hurricane Maria in Puerto Rico. *Disaster Med Public Health Prep.* 2020 Feb;14 (1):130–8.

208. Shultz JM, Rechkemmer A, Rai A, McManus KT. Public health and mental health implications of environmentally induced forced migration. *Disaster Med Public Health Prep.* 2019;13 (2):116–22. https://doi.org/10.1017/dmp.2018.27

209. Kar N, Samantaray NN, Kar S, Kar B. Anxiety, Depression, and Post-traumatic Stress a month after

210. Bryant RA, Gibbs L, Colin Gallagher H, Pattison P, Lusher D, MacDougall C, et al. The dynamic course of psychological outcomes following the Victorian Black Saturday bushfires. *Aust N Z J Psychiatry.* 2021;55 (7):666–77. https://doi.org/10.1177/0004867420969815

211. Dean J, van Dooren K, Weinstein P. Does biodiversity improve mental health in urban settings? *Med Hypotheses.* 2011;76 (6):877–80. https://doi.org/10.1016/j.mehy.2011.02.040

212. Fuller RA, Irvine KN, Devine-Wright P, Warren PH, Gaston KJ. Psychological benefits of greenspace increase with biodiversity. *Biol Lett.* 2007;3 (4):390–4. https://doi.org/10.1098/rsbl.2007.0149

213. Duarte-Tagles H, Salinas-Rodriguez A, Idrovo AJ, Burquez A, Corral-Verdugo V. Biodiversity and depressive symptoms in Mexican adults: Exploration of beneficial environmental effects. *Biomedica.* 2015;35:46–57.

214. MacKerron G, Mourato S. Happiness is greater in natural environments. *Glob Environ Change-Hum Policy Dimens.* 2013;23 (5):992–1000. https://doi.org/10.1016/j.gloenvcha.2013.03.010

215. Wang RY, Helbich M, Yao Y, Zhang JB, Liu PH, Yuan Y, et al. Urban greenery and mental wellbeing in adults: Cross-sectional mediation analyses on multiple pathways across different greenery measures. *Environ Res.* 2019 Sep;176.

216. Dzhambov A, Hartig T, Markevych I, Tilov B, Dimitrova D. Urban residential greenspace and mental health in youth: Different approaches to testing multiple pathways yield different conclusions. *Env Res.* 2018;160:47–59. https://doi.org/10.1016/j.envres.2017.09.015

217. Barton J, Rogerson M. The importance of greenspace for mental health. *BJPsych Int.* 2017;14 (4):79–81. https://doi.org/10.1192/s2056474000002051

218. Vanaken GJ, Danckaerts M. Impact of green space exposure on children's and adolescents' mental health: A systematic review. *Int J Environ Res Public Health.* 2018;15 (12):2668. https://doi.org/10.3390/ijerph15122668

219. Gianfredi V, Buffoli M, Rebecchi A, Croci R, Oradini-Alacreu A, Stirparo G, et al. Association between urban greenspace and health: a systematic review of literature. *Int J Environ Res Public Health.* 2021;18 (10):5137. https://doi.org/10.3390/ijerph18105137

220. Klaniecki K, Leventon J, Abson DJ. Human–nature connectedness as a 'treatment' for pro-environmental behavior: making the case for spatial considerations. *Sustain Sci.* 2018;13 (5):1375–88. https://doi.org/10.1007/s11625-018-0578-x

221. Martin L, White MP, Hunt A, Richardson M, Pahl S, Burt J. Nature contact, nature connectedness and associations with health, wellbeing and pro-environmental behaviours. *J Environ Psychol.* 2020;68: 101389. https://doi.org/10.1016/j.jenvp.2020.101389

222. Barbaro N, Pickett SM. Mindfully green: Examining the effect of connectedness to nature on the

relationship between mindfulness and engagement in pro-environmental behavior. *Personal Individ Differ*. 2016;93:137–42. https://doi.org/10.1016/j.paid.2015.05.026

223. Outlook GB. 5–Summary for Policy Makers. In: *Secretariat of the Convention on Biological Diversity: Montreal, QB, Canada*. 2020.

224. Pörtner, Hans-Otto, Scholes, Robert J., Agard, John, Archer, Emma, Bai, Xuemei, Barnes, David, et al. IPBES-IPCC co-sponsored workshop report synopsis on biodiversity and climate change [Internet]. Zenodo; 2021 Jun [cited 2022 Sep 20]. Available from: https://zenodo.org/record/4920414

225. Climate change and biodiversity loss should be tackled together | Research and Innovation [Internet]. [cited 2022 Sep 20]. Available from: https://ec.europa.eu/research-and-innovation/en/horizon-magazine/climate-change-and-biodiversity-loss-should-be-tackled-together

226. Air Pollution | CDC [Internet]. [cited 2022 Apr 28]. Available from: https://www.cdc.gov/climateand-health/effects/air_pollution.htm

227. Hong C, Zhang Q, Zhang Y, Davis SJ, Tong D, Zheng Y, et al. Impacts of climate change on future air quality and human health in China. *Proc Natl Acad Sci*. 2019;116 (35):17193–200. https://doi.org/10.1073/pnas.1812881116

228. Attademo L, Bernardini F, Garinella R, Compton MT. Environmental pollution and risk of psychotic disorders: A review of the science to date. *Schizophr Res*. 2017;181:55–9. https://doi.org/10.1016/j.schres.2016.10.003

229. Braithwaite I, Zhang S, Kirkbride JB, Osborn DPJ, Hayes JF. Air Pollution (Particulate Matter) Exposure and Associations with Depression, Anxiety, Bipolar, Psychosis and Suicide Risk: A Systematic Review and Meta-Analysis. *Environ Health Perspect*. 127 (12):126002. https://doi.org/10.1289/EHP4595

230. de Prado Bert P, Mercader EMH, Pujol J, Sunyer J, Mortamais M. The effects of air pollution on the brain: a review of studies interfacing environmental epidemiology and neuroimaging. *Curr Environ Health Rep*. 2018;5 (3):351–64. https://doi.org/10.1007/s40572-018-0209-9

231. Ali NA, Khoja A. Growing Evidence for the Impact of Air Pollution on Depression. *Ochsner J*. 2019;19 (1):4. https://doi.org/10.31486/toj.19.0011

232. Chen S, Oliva P, Zhang P. Air Pollution and Mental Health: Evidence from China [Internet]. National Bureau of Economic Research; 2018 Jun [cited 2022 Apr 28] p. w24686. (NBER Working Papers). Report No.: w24686. Available from: http://www.nber.org/papers/w24686.pdf

233. Carey IM, Anderson HR, Atkinson RW, Beevers SD, Cook DG, Strachan DP, et al. Are noise and air pollution related to the incidence of dementia? A cohort study in London, England. *BMJ Open*. 2018;8 (9):e022404. https://doi.org/10.1136/bmjopen-2018-022404

234. Newbury JB, Stewart R, Fisher HL, Beevers S, Dajnak D, Broadbent M, et al. Association between air pollution exposure and mental health service use among individuals with first presentations of psychotic and mood disorders: retrospective cohort study. *Br J Psychiatry*. 2021;219 (6):678–85. https://doi.org/10.1192/bjp.2021.119

235. Olvera Alvarez HA, Kubzansky LD, Campen MJ, Slavich GM. Early life stress, air pollution, inflammation, and disease: An integrative review and immunologic model of social-environmental adversity and lifespan health. *Neurosci Biobehav Rev*. 2018;92:226–42. https://doi.org/10.1016/j.neubiorev.2018.06.002

236. Hajat A, Hsia C, O'Neill MS. Socioeconomic Disparities and Air Pollution Exposure: a Global Review. *Curr Environ Health Rep*. 2015;2 (4):440–50. https://doi.org/10.1007/s40572-015-0069-5

237. Tonne C, Milà C, Fecht D, Alvarez M, Gulliver J, Smith J, et al. Socioeconomic and ethnic inequalities in exposure to air and noise pollution in London. *Environ Int*. 2018;115:170–9. https://doi.org/10.1016/j.envint.2018.03.023

238. Fairburn J, Schüle SA, Dreger S, Karla Hilz L, Bolte G. Social Inequalities in Exposure to Ambient Air Pollution: A Systematic Review in the WHO European Region. *Int J Environ Res Public Health*. 2019;16 (17):3127. https://doi.org/10.3390/ijerph16173127

239. Ferguson L, Taylor J, Zhou K, Shrubsole C, Symonds P, Davies M, et al. Systemic inequalities in indoor air pollution exposure in London, UK. *Build Cities*. 2021;2 (1):425–48. https://doi.org/10.5334/bc.100

240. Manisalidis I, Stavropoulou E, Stavropoulos A, Bezirtzoglou E. Environmental and Health Impacts of Air Pollution: A Review. *Front Public Health*. 2020;8:14.

241. Omri A, Omri H, Slimani S, Belaid F. Environmental degradation and life satisfaction: Do governance and renewable energy matter? *Technol Forecast Soc Change*. 2022;175:121375. https://doi.org/10.1016/j.techfore.2021.121375

242. Murali V, Oyebode F. Poverty, social inequality and mental health. *Adv Psychiatr Treat*. 2004;10 (3):216–24. https://doi.org/10.1192/apt.10.3.216

243. Yu S. Uncovering the hidden impacts of inequality on mental health: a global study. *Transl Psychiatry*. 2018;8 (1):1–10. https://doi.org/10.1038/s41398-018-0148-0

244. Patel V. Addressing social injustice: a key public mental health strategy. *World Psychiatry*. 2015;14 (1):43–4. https://doi.org/10.1002/wps.20179

245. Islam N, Winkel J. Climate Change and Social Inequality (Department of Economic & Social Affairs). United Nations. 2017.

246. Diffenbaugh NS, Burke M. Global warming has increased global economic inequality. *Proc Natl Acad Sci*. 2019;116 (20):9808–13. https://doi.org/10.1073/pnas.1816020116

247. Rao ND, Min J. Less global inequality can improve climate outcomes. *WIREs Clim Change*. 2018;9 (2):e513. https://doi.org/10.1002/wcc.513

248. McGee JA, Greiner PT, Christensen M, Ergas C, Clement MT. Gender inequality, reproductive justice, and decoupling economic growth and emissions: a panel analysis of the moderating association of gender equality on the relationship between economic growth and CO2 emissions. *Environ Sociol.* 2020;6 (3):254–67. https://doi.org/10.1080/23251042.2020.1736364

249. Kelly O, Thombs RP, Jorgenson A. The Unsustainable State: Greenhouse Gas Emissions, Inequality, and Human Well-Being in the United States, 1913 to 2017. *Socius Sociol Res Dyn World.* 2021;7:237802312110205. https://doi.org/10.1177/23780231211020536

250. Jorgenson AK, Schor JB, Knight KW, Huang X. Domestic Inequality and Carbon Emissions in Comparative Perspective. *Sociol Forum.* 2016;31: 770–86. https://doi.org/10.1111/socf.12272

251. Confronting Carbon Inequality: Putting climate justice at the heart of the COVID-19 recovery [Internet]. Oxfam Policy & Practice. [cited 2022 Sep 20]. Available from: https://policy-practice.oxfam.org/resources/confronting-carbon-inequality-putting-climate-justice-at-the-heart-of-the-covid-621052/

252. Vogel J, Steinberger JK, O'Neill DW, Lamb WF, Krishnakumar J. Socio-economic conditions for satisfying human needs at low energy use: An international analysis of social provisioning. *Glob Environ Change.* 2021;69:102287. https://doi.org/10.1016/j.gloenvcha.2021.102287

253. Ingle HE, Mikulewicz M. Mental health and climate change: tackling invisible injustice. *Lancet Planet Health.* 2020;4 (4):e128–30. https://doi.org/10.1016/S2542-5196(20)30081-4

254. Steinberger JK, Roberts JT. From constraint to sufficiency: The decoupling of energy and carbon from human needs, 1975–2005. *Spec Sect Ecol Distrib Confl.* 2010;70 (2):425–33. https://doi.org/10.1016/j.ecolecon.2010.09.014

255. Climate change and conflict [Internet]. International Committee of the Red Cross. 2020 [cited 2022 Apr 29]. Available from: https://www.icrc.org/en/what-we-do/climate-change-conflict

256. Mahendran R, Xu R, Li S, Guo Y. Interpersonal violence associated with hot weather. *Lancet Planet Health.* 2021;5 (9):e571–2. https://doi.org/10.1016/S2542-5196(21)00210-2

257. Hsiang SM, Burke M, Miguel E. Quantifying the Influence of Climate on Human Conflict. *Science.* 2013;341 (6151):1235367. https://doi.org/10.1126/science.1235367

258. Bowles DC, Butler CD, Morisetti N. Climate change, conflict and health. *J R Soc Med.* 2015;108 (10): 390–5. https://doi.org/10.1177/0141076815603234

259. Burke M, Hsiang SM, Miguel E. Climate and Conflict. *Annu Rev Econ.* 2015;7 (1):577–617. https://doi.org/10.1146/annurev-economics-080614-115430

260. Akresh R. Climate Change, Conflict, and Children. *Future Child.* 2016;26 (1):51–71. https://doi.org/10.1353/foc.2016.0003

261. Mazo J. *Climate Conflict: How Global Warming Threatens Security and What to Do about It.* Routledge; 2010. 139 p.

262. Charlson F, van Ommeren M, Flaxman A, Cornett J, Whiteford H, Saxena S. New WHO prevalence estimates of mental disorders in conflict settings: a systematic review and meta-analysis. *The Lancet.* 2019;394 (10194):240–8. https://doi.org/10.1016/S0140-6736(19)30934-1

263. Jewkes R, Jama-Shai N, Sikweyiya Y. Enduring impact of conflict on mental health and gender-based violence perpetration in Bougainville, Papua New Guinea: A cross-sectional study. *PLOS ONE.* 2017;12 (10):e0186062. https://doi.org/10.1371/journal.pone.0186062

264. Branas CC, Dinardo AR, Polanco VDP, Harvey MJ, Vassy JL, Bream K. An exploration of violence, mental health and substance abuse in post-conflict Guatemala. *Health (N Y).* 2013;05 (05):825–33. https://doi.org/10.4236/health.2013.55109

265. Hsiang SM, Burke M. Climate, conflict, and social stability: what does the evidence say? *Clim Change.* 2014;123 (1):39–55. https://doi.org/10.1007/s10584-013-0868-3

266. When rain turns to dust: Understanding and responding to the combined impact of armed conflicts and the climate and environment crisis on people's lives | Knowledge Hub [Internet]. [cited 2022 Sep 20]. Available from: https://knowledge.unccd.int/publications/when-rain-turns-dust-understanding-and-responding-combined-impact-armed-conflicts-and

267. Times TNY, Lustgarten A. *The great climate migration.* New York Times Magazine; 2020.

268. Semenza JC, Ebi KL. Climate change impact on migration, travel, travel destinations and the tourism industry. *J Travel Med.* 2019;26 (5):taz026.

269. Black R, Bennett SRG, Thomas SM, Beddington JR. Migration as adaptation. *Nature.* 2011;478 (7370): 447–9. https://doi.org/10.1038/478477a

270. Internal displacement monitoring centre (IDC). Global Report on Internal Displacement. 2019 [cited 2022 Sep 23]; Available from: https://www.internal-displacement.org/publications/2019-global-report-on-internal-displacement

271. IDMC. 2022 GLOBAL REPORT ON INTERNAL DISPLACEMENT: Children and Youth in Internal Displacement [Internet]. Norwegian Refugee Council; 2022. (IDMC's Global Report on Internal Displacement (GRID)). Available from: https://www.internal-displacement.org/sites/default/files/publications/documents/IDMC_GRID_2022_LR.pdf

272. Myers N. Environmental Refugees: A Growing Phenomenon of the 21st Century. *Philos Trans Biol Sci.* 2002;357 (1420):609–13. https://doi.org/10.1098/rstb.2001.0953

273. Negev M, Teschner N, Rosenthal A, Levine H, Lew-Levy C, Davidovitch N. Adaptation of health systems to climate-related migration in Sub-Saharan Africa: Closing the gap. *Int J Hyg Env Health.* 2019; 222 (2):311–4. https://doi.org/10.1016/j.ijheh.2018.10.004

274. Pearson L, Pelling M. The UN Sendai framework for disaster risk reduction 2015–2030: Negotiation process and prospects for science and practice. *J Extreme Events.* 2015;2 (01):1571001. https://doi.org/10.1142/S2345737615710013

275. Reifels L. *Reducing Mental Health Risks in Emergencies: MHPSS through a Disaster Risk Reduction Lens.* MHPSS Network Webinar: MHPSS & DRR; 2018 Feb 21.

276. Bourque F, van der Ven E, Malla A. A meta-analysis of the risk for psychotic disorders among first- and second-generation immigrants. *Psychol Med.* 2011;41 (5):897–910. https://doi.org/10.1017/S0033291710001406

277. Gleeson C, Frost R, Sherwood L, Shevlin M, Hyland P, Halpin R, et al. Post-migration factors and mental health outcomes in asylum-seeking and refugee populations: a systematic review. *Eur J Psychotraumatology.* 2020;11 (1):1793567. https://doi.org/10.1080/20008198.2020.1793567

278. Porter M, Haslam N. Predisplacement and postdisplacement factors associated with mental health of refugees and internally displaced persons: a meta-analysis. *JAMA.* 2005;294 (5):602–12. https://doi.org/10.1001/jama.294.5.602. https://jamanetwork.com/journals/jama/article-abstract/201335?casa_token=bNSxWMQgA_EAAAAA:H6DO8XY_vHUmZmqMwPRoAaNT-fHxkgEz-n8RIxl3xsyoRkx_NWTaJgGWYrT1fAf9xmsbtG1x

279. Torres JM, Casey JA. The centrality of social ties to climate migration and mental health. *BMC Public Health.* 2017;17 (1):600. https://doi.org/10.1186/s12889-017-4508-0

280. Pearce M, Eagle L, Low D, Schurmann A. Cut from 'country': the impact of climate change on the mental health of Aboriginal pastoralists. *Australas J Reg Stud.* 2015;21 (1):50–79.

281. Fussell E, Lowe SR. The impact of housing displacement on the mental health of low-income parents after Hurricane Katrina. Abramson, editor. *Soc Sci Med.* 2014;113:137–44. https://doi.org/10.1016/j.socscimed.2014.05.025

282. Fitzpatrick K. Post-traumatic stress symptomatology and displacement among Hurricane Harvey survivors. *Soc Sci Med.* 2021 Feb;270.

283. Koslov L, Merdjanoff A, Sulakshana E, Klinenberg E. When rebuilding no longer means recovery: the stress of staying put after Hurricane Sandy. *Clim CHANGE.* 2021;165 (3–4).

284. Nayna Schwerdtle P, Baernighausen K, Karim S, Raihan TS, Selim S, Baernighausen T, et al. A Risk Exchange: Health and Mobility in the Context of Climate and Environmental Change in Bangladesh—A Qualitative Study. *Int J Environ Res Public Health.* 2021;18 (5):2629. https://doi.org/10.3390/ijerph18052629

285. Eisenbruch M. The Cultural Bereavement Interview: A New Clinical Research Approach for Refugees. *Psychiatr Clin North Am.* 1990;13 (4):715–35. https://doi.org/10.1016/S0193-953X(18)30345-9

286. Campo-Arias A, Herazo E. Stigma and mental health in victims of Colombia's internal armed conflict in situation of forced displacement. *Allman, editor. Estigma Salud Ment En Pers Vict Confl Armado Interno Colomb En Situacion Desplazamiento Forzado.* 2014;43 (4):212–7.

287. James P, Iyer A, Webb TL. The impact of post-migration stressors on refugees' emotional distress and health: A longitudinal analysis. *Eur J Soc Psychol.* 2019;49 (7):1359–67. https://doi.org/10.1002/ejsp.2589

288. Siriwardhana C, Stewart R. Forced migration and mental health: Prolonged internal displacement, return migration and resilience. *Int Health.* 2013;5 (1):19–23. https://doi.org/10.1093/inthealth/ihs014

289. Palmer D, Ward K. 'Lost': listening to the voices and mental health needs of forced migrants in London. *Med Confl Surviv.* 2007;23 (3):198–212. https://doi.org/10.1080/13623690701417345

290. Siriwardhana C, Ali SS, Roberts B, Stewart R. A systematic review of resilience and mental health outcomes of conflict-driven adult forced migrants. *Confl Health.* 2014;8:13. https://doi.org/10.1186/1752-1505-8-13

291. Barnett J, Tschakert P, Head L, Adger WN. A science of loss. *Nat Clim Change.* 2016;6 (11):976. https://doi.org/10.1038/nclimate3140

292. Bonilla-Escobar F, Osorio-Cuellar G, Pacichana-Quinayaz SG, Sanchez-Renteria G, Fandino-Losada A. Do not forget culture when implementing mental health interventions for violence survivors. *Cienc Saude Coletiva.* 2017;22 (9):3053–9. https://doi.org/10.1590/1413-81232017229.12982016

293. Spruyt O. Community-based palliative care for Bangladeshi patients in east London. Accounts of bereaved carers. *Palliat Med.* 1999;13 (2):119–29. https://doi.org/10.1191/026921699667569476

294. Schreiber S. Migration, traumatic bereavement and transcultural aspects of psychological healing: Loss and grief of a refugee woman from Begameder County in Ethiopia. *Br J Med Psychol.* 1995;68 (2):135–42. https://doi.org/10.1111/j.2044-8341.1995.tb01820.x

295. Kickbusch I. Governance for health, wellbeing and sustainability – what is at stake. *Glob Health Promot.* 2014;21 (1_suppl):83–83. https://doi.org/10.1177/1757975914521352

296. Ergas C, York R. Women's status and carbon dioxide emissions: A quantitative cross-national analysis. *Soc Sci Res.* 2012;41 (4):965–76. https://doi.org/10.1016/j.ssresearch.2012.03.008

297. Vince G. How scientists are coping with 'ecological grief'. The Observer [Internet]. 2020 Jan 12 [cited 2022 Sep 20]; Available from: https://www.theguardian.com/science/2020/jan/12/how-scientists-are-coping-with-environmental-grief

298. Weintrobe S. *Psychological roots of the climate crisis: neoliberal exceptionalism and the culture of uncare.* Bloomsbury Publishing USA; 2021.

299. Zeira A. Mental Health Challenges Related to Neoliberal Capitalism in the United States. *Community Ment Health J.* 2022;58 (2):205–12. https://doi.org/10.1007/s10597-021-00840-7

300. Burroughs JE, Rindfleisch A. Materialism and Well-Being: A Conflicting Values Perspective. *J Consum Res.* 2002;29 (3):348–70. https://doi.org/10.1086/344429

301. Moldes O, Ku L. Materialistic cues make us miserable: A meta-analysis of the experimental evidence for the effects of materialism on individual and societal well-being. *Psychol Mark.* 2020;37 (10):1396–419. https://doi.org/10.1002/mar.21387

302. Dittmar H, Bond R, Hurst M, Kasser T. The relationship between materialism and personal well-being: A meta-analysis. - PsycNET. *J Pers Soc Psychol.* 2014;107 (5):879–924. https://doi.org/10.1037/a0037409

303. Kasser T, Rosenblum KL, Sameroff AJ, Deci EL, Niemiec CP, Ryan RM, et al. Changes in materialism, changes in psychological well-being: Evidence from three longitudinal studies and an intervention experiment. *Motiv Emot.* 2014;38 (1):1–22. https://doi.org/10.1007/s11031-013-9371-4

304. Heu LC, van Zomeren M, Hansen N. Lonely Alone or Lonely Together? A Cultural-Psychological Examination of Individualism–Collectivism and Loneliness in Five European Countries. *Pers Soc Psychol Bull.* 2019 May;45 (5):780–93. https://doi.org/10.1177/0146167218796793

305. Klussman K, Nichols AL, Langer J, Curtin N. Connection and disconnection as predictors of mental health and wellbeing. *Int J Wellbeing.* 2020;10 (2).

306. Ahsan S. I'm a psychologist – and I believe we've been told devastating lies about mental health. The Guardian [Internet]. 2022 Sep 6 [cited 2022 Sep 20]; Available from: https://www.theguardian.com/commentisfree/2022/sep/06/psychologist-devastating-lies-mental-health-problems-politics

307. Sultana F. The unbearable heaviness of climate coloniality. *Polit Geogr.* 2022;102638. https://doi.org/10.1016/j.polgeo.2022.102638

308. Godden NJ, Farrant BM, Yallup Farrant J, Heyink E, Carot Collins E, Burgemeister B, et al. Climate change, activism, and supporting the mental health of children and young people: Perspectives from Western Australia. *J Paediatr Child Health.* 2021;57 (11):1759–64. https://doi.org/10.1111/jpc.15649

309. Kelman I, Ayeb-Karlsson S, Rose-Clarke K, Prost A, Ronneberg E, Wheeler N, et al. A review of mental health and wellbeing under climate change in small island developing states (SIDS). *Environ Res Lett ERL Web Site.* 2021;16 (3):033007. https://doi.org/10.1088/1748-9326/abe57d

310. Pritchard A, Richardson M, Sheffield D, McEwan K. The relationship between nature connectedness and eudaimonic well-being: A meta-analysis. *J Happiness Stud.* 2020;21 (3):1145–67. https://doi.org/10.1007/s10902-019-00118-6

311. Capaldi CA, Dopko RL, Zelenski JM. The relationship between nature connectedness and happiness: A meta-analysis. *Front Psychol.* 2014;976.

312. Mukherjee PK. Being One with Nature has Tremendous Benefits. *NISCAIR-CSIR India.* 2019; 28–30.

313. Grinde B, Patil G. Biophilia: Does Visual Contact with Nature Impact on Health and Well-Being? *Int J Environ Res Public Health.* 2009;6 (9):2332–43. https://doi.org/10.3390/ijerph6092332

314. Berry HL, Butler JR, Burgess CP, King UG, Tsey K, Cadet-James YL, et al. Mind, body, spirit: co-benefits for mental health from climate change adaptation and caring for country in remote Aboriginal Australian communities. *New South Wales Public Health Bull.* 2010;21 (6):139–45. https://doi.org/10.1071/NB10030

315. Boykoff MT, Boykoff JM. Climate change and journalistic norms: A case-study of US mass-media coverage. *Geoforum.* 2007;38 (6):1190–204. https://doi.org/10.1016/j.geoforum.2007.01.008

316. Ford JD, King D. Coverage and framing of climate change adaptation in the media: A review of influential North American newspapers during 1993–2013. *Environ Sci Policy.* 2015;48:137–46. https://doi.org/10.1016/j.envsci.2014.12.003

317. Vu HT, Liu Y, Tran DV. Nationalizing a global phenomenon: A study of how the press in 45 countries and territories portrays climate change. *Glob Environ Change.* 2019;58:101942. https://doi.org/10.1016/j.gloenvcha.2019.101942

318. Hase V, Mahl D, Schäfer MS, Keller TR. Climate change in news media across the globe: An automated analysis of issue attention and themes in climate change coverage in 10 countries (2006–2018). *Glob Environ Change.* 2021;70:102353. https://doi.org/10.1016/j.gloenvcha.2021.102353

319. Maran DA, Begotti T. Media Exposure to Climate Change, Anxiety, and Efficacy Beliefs in a Sample of Italian University Students. *Int J Environ Res Public Health.* 2021;18 (17):9358. https://doi.org/10.3390/ijerph18179358

320. Parry S, McCarthy SR, Clark J. Young people's engagement with climate change issues through digital media–a content analysis. *Child Adolesc Ment Health.* 2022;27 (1):30–8. https://doi.org/10.1111/camh.12532

321. Cole SM, Tembo G. The effect of food insecurity on mental health: Panel evidence from rural Zambia. *Soc Sci Med.* 2011;73 (7):1071–9. https://doi.org/10.1016/j.socscimed.2011.07.012

322. Elgar FJ, Pickett W, Pförtner TK, Gariépy G, Gordon D, Georgiades K, et al. Relative food insecurity, mental health and wellbeing in 160 countries. *Soc Sci Med.* 2021;268:113556. https://doi.org/10.1016/j.socscimed.2020.113556

323. Chertoff M. Protein malnutrition and brain development. *Brain Disord Ther.* 2015;4 (168). https://doi.org/10.4172/2168-975X.1000171

324. Lebel L, Paquin V, Kenny TA, Fletcher C, Nadeau L, Chachamovich E, et al. Climate change and Indigenous mental health in the Circumpolar North: A systematic review to inform clinical practice. *Transcult Psychiatry.* 2022;13634615211066698. https://doi.org/10.1177/13634615211066698

325. Wutich A, Brewis A, Tsai A. Water and mental health. *Wiley Interdiscip Rev-Water.* 2020;7 (5):e1461.

326. Brewis A, Roba KT, Wutich A, Manning M, Yousuf J. Household water insecurity and psychological distress in Eastern Ethiopia: Unfairness and water sharing as undertheorized factors. *SSM-Ment Health*. 2021;1:100008. https://doi.org/10.1016/j.ssmmh.2021.100008

327. Mushavi RC, Burns BF, Kakuhikire B, Owembabazi M, Vořechovská D, McDonough AQ, et al. "When you have no water, it means you have no peace": a mixed-methods, whole-population study of water insecurity and depression in rural Uganda. *Soc Sci Med*. 2020;245:112561. https://doi.org/10.1016/j.socscimed.2019.112561

328. Tallman PS. Water insecurity and mental health in the Amazon: economic and ecological drivers of distress. *Econ Anthropol*. 2019;6 (2):304–16. https://doi.org/10.1002/sea2.12144

329. MetLink - Royal Meteorological Society IPCC 2022 - Women and Climate Change - [Internet]. MetLink - Royal Meteorological Society. [cited 2022 Sep 20]. Available from: https://www.metlink.org/resource/ipcc-2022-women-and-climate-change/

330. Trumble BC, Stieglitz J, Jaeggi A, Beheim B, Schwartz M, Kaplan H, et al. The impact of a natural disaster on physical and mental health: Offspring morbidity and crop loss as mediators of paternal testosterone, cortisol, and depression among Bolivian forager-farmers. *Am J Phys Anthropol*. 2016;159 (SUPPL. 62):318.

331. Austin EK, Handley T, Kiem AS, Rich JL, Lewin TJ, Askland HH, et al. Drought-related stress among farmers: Findings from the Australian rural mental health study. *Med J Aust*. 2018;209 (4):159–65. https://doi.org/10.5694/mja17.01200

332. Aihara Y, Shrestha S, Sharma J. Household water insecurity, depression and quality of life among postnatal women living in urban Nepal. *J Water Health*. 2016;14 (2):317–24. https://doi.org/10.2166/wh.2015.166

333. Gaber N, Silva A, Lewis-Patrick M, Kutil E, Taylor D, Bouier R. Water insecurity and psychosocial distress: case study of the Detroit water shutoffs. *J Public Health*. 2021;43 (4):839–45. https://doi.org/10.1093/pubmed/fdaa157

334. Ženko M, Menga F. Linking water scarcity to mental health: Hydro–social interruptions in the Lake Urmia Basin, *Iran. Water*. 2019;11 (5):1092. https://doi.org/10.3390/w11051092

335. Berry HL, Hogan A, Owen J, Rickwood D, Fragar L. Climate change and farmers' mental health: risks and responses. *Asia Pac J Public Health*. 2011;23 (2_suppl):119S–132S. https://doi.org/10.1177/1010539510392556

336. Cunsolo Willox A, Stephenson E, Allen J, Bourque F, Drossos A, Elgarøy S, et al. Examining relationships between climate change and mental health in the Circumpolar North. *Reg Environ Change*. 2015;15 (1):169–82. https://doi.org/10.1007/s10113-014-0630-z

337. Clayton S. Climate anxiety: Psychological responses to climate change. *J Anxiety Disord*. 2020;74:102263. https://doi.org/10.1016/j.janxdis.2020.102263

338. Verplanken B, Roy D. "My Worries Are Rational, Climate Change Is Not": Habitual Ecological Worrying Is an Adaptive Response. *PLOS ONE*. 2013;8 (9):e74708. https://doi.org/10.1371/journal.pone.0074708

339. Bhullar N, Davis M, Kumar R, Nunn P, Rickwood D. Climate anxiety does not need a diagnosis of a mental health disorder. *Lancet Planet Health*. 2022;6 (5):e383. https://doi.org/10.1016/S2542-5196(22)00072-9

340. Pihkala P. Toward a Taxonomy of Climate Emotions. *Front Clim*. 2022;3 (3:738154).

341. Hogg TL, Stanley SK, O'Brien LV, Wilson MS, Watsford CR. The Hogg Eco-Anxiety Scale: Development and validation of a multidimensional scale. *Glob Environ Change*. 2021;71:102391. https://doi.org/10.1016/j.gloenvcha.2021.102391

342. Reser JP, Bradley GL, Glendon AI, Ellul MC, Callaghan R. Public Risk Perceptions, Understandings, and Responses to Climate Change and Natural Disasters in Australia and Great Britain. Gold Coast, Australia: National Climate Change Adaptation Research Facility.; 2012.

343. Clayton S, Karazsia BT. Development and validation of a measure of climate change anxiety. *J Environ Psychol*. 2020 Jun 1;69:101434. https://doi.org/10.1016/j.jenvp.2020.101434

344. The climate crisis is taking a toll on the mental health of children and young people [Internet]. www.rcpsych.ac.uk. [cited 2021 Apr 26]. Available from: https://www.rcpsych.ac.uk/news-and-features/latest-news/detail/2020/11/20/the-climate-crisis-is-taking-a-toll-on-the-mental-health-of-children-and-young-people

345. Usher K, Durkin J, Bhullar N. Eco-anxiety: How thinking about climate change-related environmental decline is affecting our mental health. *Int J Ment Health Nurs*. 2019;28 (6):1233–4. https://doi.org/10.1111/inm.12673

346. Burke SEL, Sanson AV, Van Hoorn J. The Psychological Effects of Climate Change on Children. *Curr Psychiatry Rep*. 2018;20 (5):35. https://doi.org/10.1007/s11920-018-0896-9

347. Cunsolo A, Ellis NR. Ecological grief as a mental health response to climate change-related loss. *Nat Clim Change*. 2018;8 (4):275–81. https://doi.org/10.1038/s41558-018-0092-2

348. Conroy G. 'Ecological grief' grips scientists witnessing Great Barrier Reef's decline. *Nature*. 2019;573 (7774):318–9. https://doi.org/10.1038/d41586-019-02656-8

349. Albrecht G, Sartore GM, Connor L, Higginbotham N, Freeman S, Kelly B, et al. Solastalgia: the distress caused by environmental change. *Australas Psychiatry*. 2007;15 (Suppl 1):S95–S8. https://doi.org/10.1080/10398560701701288

350. Galway LP, Beery T, Jones-Casey K, Tasala K. Mapping the Solastalgia Literature: A Scoping Review Study. *Int J Environ Res Public Health*. 2019;16 (15):2662. https://doi.org/10.3390/ijerph16152662

351. Ogunbode CA, Pallesen S, Böhm G, Doran R, Bhullar N, Aquino S, et al. Negative emotions about

climate change are related to insomnia symptoms and mental health: Cross-sectional evidence from 25 countries. *Curr Psychol*. 2021 Feb 16; https://doi.org/10.1007/s12144-021-01385-4

352. Lawrance EL, Jennings N, Kioupi V, Thompson R, Diffey J, Vercammen A. Psychological responses, mental health, and sense of agency for the dual challenges of climate change and the COVID-19 pandemic in young people in the UK: an online survey study. *Lancet Planet Health*. 2022;6 (9):e726–38. https://doi.org/10.1016/S2542-5196(22)00172-3

353. Ojala M. Regulating Worry, Promoting Hope: How Do Children, Adolescents, and Young Adults Cope with Climate Change? *Int J Environ Sci Educ*. 2012;7 (4):537–61.

354. Chukwuorji JC, Iorfa SK, Nzeadibe TC, Ifeagwazi CM. Role of Climate Change Awareness and Pro-Environmental Behaviour in Subjective Wellbeing. *Niger J Soc Sci*. 2017;13 (1).

355. Sciberras E, Fernando JW. Climate change-related worry among Australian adolescents: an eight-year longitudinal study. *Child Adolesc Ment Health*. 2022; 27 (1):22–9. https://doi.org/10.1111/camh.12521

356. Kelly A. Eco-Anxiety at University: Student Experiences and Academic Perspectives on Cultivating Healthy Emotional Responses to the Climate Crisis [Internet]. [Independent Study Project (ISP) Collection]: University of Colorado at Boulder; 2017 [cited 2020 Jan 22]. Available from: https://digitalcollections.sit.edu/isp_collection/2642

357. Thompson R, Fisher HL, Dewa LH, Hussain T, Kabba Z, Toledano MB. Adolescents' thoughts and feelings about the local and global environment: a qualitative interview study. *Child Adolesc Ment Health*. 2021;

358. Connell S, Fien J, Lee J, Sykes H, Yencken D. If It Doesn't Directly Affect You, You Don't Think About It': a qualitative study of young people's environmental attitudes in two Australian cities. *Environ Educ Res*. 1999;5 (1):95–113. https://doi.org/10.1080/1350462990050106

359. Strife SJ. Children's Environmental Concerns: Expressing Ecophobia. *J Environ Educ*. 2012;43 (1):37–54. https://doi.org/10.1080/00958964.2011.602131

360. Ebhuoma O, Gebreslasie M, Ebhuoma E, Leonard L. 'The future looks empty': embodied experiences of distress triggered by environmental and climatic changes in rural KwaZulu-Natal, South Africa. *GeoJournal*. 2022;87:3169–85. https://doi.org/10.1007/s10708-021-10426-1

361. Gibson KE, Barnett J, Haslam N, Kaplan I. The mental health impacts of climate change: Findings from a Pacific Island atoll nation. *J Anxiety Disord*. 2020;73:102237. https://doi.org/10.1016/j.janxdis.2020.102237

362. Ogunbode CA, Doran R, Böhm G. Individual and local flooding experiences are differentially associated with subjective attribution and climate change concern. *Clim Change*. 2020;162 (4):2243–55. https://doi.org/10.1007/s10584-020-02793-4

363. Climate Change in the American Mind, September 2021 - Yale Program on Climate Change Communication [Internet]. [cited 2022 Apr 30]. Available from: https://climatecommunication.yale.edu/publications/climate-change-in-the-american-mind-september-2021/

364. Pihkala P. Anxiety and the Ecological Crisis: An Analysis of Eco-Anxiety and Climate Anxiety. *Sustainability*. 2020;12 (19).

365. Verlie B, Clark E, Jarrett T, Supriyono E. Educators' experiences and strategies for responding to ecological distress. *Aust J Environ Educ*. 2021;37 (2):132–46. https://doi.org/10.1017/aee.2020.34

366. Furberg M, Evengård B, Nilsson M. Facing the limit of resilience: perceptions of climate change among reindeer herding Sami in Sweden. *Glob Health Action*. 2011;4 (1):8417. https://doi.org/10.3402/gha.v4i0.8417

367. Cunsolo A, Borish D, Harper SL, Snook J, Shiwak I, Wood M. 'You can never replace the caribou': Inuit Experiences of Ecological Grief from Caribou Declines. *Am Imago*. 2020 SPR;77 (1):31–59. https://doi.org/10.1353/aim.2020.0002

368. Hickman C. We need to (find a way to) talk about horizontal ellipsis Eco-anxiety. *J Soc Work Pract*. 2020;34 (4):411–24. https://doi.org/10.1080/02650533.2020.1844166

369. Tschakert P, Tutu R, Alcaro A. Embodied experiences of environmental and climatic changes in landscapes of everyday life in Ghana. *Emot Space Soc*. 2013;7:13–25. https://doi.org/10.1016/j.emospa.2011.11.001

370. Anghelcev G, Chung MY, Sar S, Duff BRL. A ZMET-based analysis of perceptions of climate change among young South Koreans: Implications for *social marketing communication*. *J Soc Mark*. 2015;5 (1):56–82. https://doi.org/10.1108/JSOCM-12-2012-0048

371. McNamara KE, Westoby R. Solastalgia and the Gendered Nature of Climate Change: An Example from Erub Island, Torres Strait. *Ecohealth*. 2011;8 (2):233–6. https://doi.org/10.1007/s10393-011-0698-6

372. Sheth C, McGlade E, Yurgelun-Todd D. Chronic Stress in Adolescents and Its Neurobiological and Psychopathological Consequences: An RDoC Perspective. *Chronic Stress*. 2017;1. https://doi.org/10.1177/2470547017715645

373. Sampaio F, Sequeira C. Climate anxiety: trigger or threat for mental disorders? *Lancet Planet Health*. 2022;6 (2):e89. https://doi.org/10.1016/S2542-5196(22)00008-0

374. Wu J, Snell G, Samji H. Climate anxiety in young people: a call to action. *Lancet Planet Health*. 2020;4 (10):e435–6. https://doi.org/10.1016/S2542-5196(20)30223-0

375. Sanson AV, Van Hoorn J, Burke SEL. Responding to the Impacts of the Climate Crisis on Children and Youth. *Child Dev Perspect*. 2019;13 (4):201–7. https://doi.org/10.1111/cdep.12342

376. Brulle RJ, Norgaard KM. Avoiding cultural trauma: Climate change and social inertia. *Environ Polit*. 2019;28 (5):886–908. https://doi.org/10.1080/09644016.2018.1562138

377. Ebi KL, Paulson JA. Climate Change and Children. *Child Health Environ Part II*. 2007;54 (2):213–26. https://doi.org/10.1016/j.pcl.2007.01.004

378. Solmi M, Radua J, Olivola M, Croce E, Soardo L, Salazar de Pablo G, et al. Age at onset of mental disorders worldwide: large-scale meta-analysis of 192 epidemiological studies. *Mol Psychiatry*. 2022;27 (1):281–95. https://doi.org/10.1038/s41380-021-01161-7

379. Whitmarsh L, Player L, Jiongco A, James M, Williams M, Marks E, et al. Climate anxiety: What predicts it and how is it related to climate action? *J Environ Psychol*. 2022;83:101866. https://doi.org/10.1016/j.jenvp.2022.101866

380. Searle K, Gow K. Do concerns about climate change lead to distress? *Int J Clim Change Strateg Manag*. 2010;2 (4):362–79. https://doi.org/10.1108/17568691011089891

381. Middleton J, Cunsolo A, Jones-Bitton A, Wright CJ, Harper SL. Indigenous mental health in a changing climate: A systematic scoping review of the global literature. *Environ Res Lett*. 2020;15 (5):053001. https://doi.org/10.1088/1748-9326/ab68a9

382. Bourque F, Cunsolo Willox A. Climate change: The next challenge for public mental health? *Int Rev Psychiatry*. 2014;26 (4):415–22. https://doi.org/10.3109/09540261.2014.925851

383. Manning C, Clayton S. Threats to mental health and wellbeing associated with climate change. In: *Psychology and climate change*. Elsevier; 2018. p. 217–44.

384. Eisenman D, McCaffrey S, Donatello I, Marshal G. An Ecosystems and Vulnerable Populations Perspective on Solastalgia and Psychological Distress After a Wildfire. *Ecohealth*. 2015;12 (4):602–10. https://doi.org/10.1007/s10393-015-1052-1

385. Sanson A, Dubicka B. Editorial: The climate and ecological mental health emergency – evidence and action. *Child Adolesc Ment Health*. 2022;27 (1):1–3. https://doi.org/10.1111/camh.12540

386. Reser JP, Swim JK. Adapting to and coping with the threat and impacts of climate change. *Am Psychol*. 2011;66 (4):277–89. https://doi.org/10.1037/a0023412

387. Macy J, Johnstone C. Active hope: How to face the mess we're in without going crazy. *New World Library*; 2012. 256 p.

388. Whitcomb I. Climate anxiety and PTSD are on the rise. Therapists don't always know how to cope. The Guardian [Internet]. 2021 Apr 20 [cited 2022 May 1]; Available from: https://www.theguardian.com/environment/2021/apr/20/climate-emergency-anxiety-threapists

389. Bragg E. Activist ecopsychology. *Ecopsychology*. 2014;6 (1):16–8. https://doi.org/10.1089/eco.2013.0096

390. Pihkala P. The Cost of Bearing Witness to the Environmental Crisis: Vicarious Traumatization and Dealing with Secondary Traumatic Stress among Environmental Researchers. *Soc Epistemol*. 2020;34 (1):86–100. https://doi.org/10.1080/02691728.2019.1681560

391. Helm SV, Pollitt A, Barnett MA, Curran MA, Craig ZR. Differentiating environmental concern in the context of psychological adaption to climate change. *Glob Environ Change*. 2018;48:158–67. https://doi.org/10.1016/j.gloenvcha.2017.11.012

392. Pihkala P. Eco-Anxiety and Environmental Education. *Sustainability*. 2020;12 (23):10149. https://doi.org/10.3390/su122310149

393. Verplanken B, Marks E, Dobromir A. On the nature of eco-anxiety: How constructive or unconstructive is habitual worry about global warming? *J Environ Psychol*. 2020;72:101528. https://doi.org/10.1016/j.jenvp.2020.101528

394. Cunsolo Willox A, Harper SL, Ford JD, Landman K, Houle K, Edge VL. "From this place and of this place:" Climate change, sense of place, and health in Nunatsiavut, Canada. *Soc Sci Med*. 2012;75 (3):538–47. https://doi.org/10.1016/j.socscimed.2012.03.043

395. Cunsolo Willox A, Harper SL, Ford JD, Edge VL, Landman K, Houle K, et al. Climate change and mental health: an exploratory case study from Rigolet, Nunatsiavut, Canada. *Clim Change*. 2013;121 (2):255–70. https://doi.org/10.1007/s10584-013-0875-4

396. Alam M. Double Exposure and Fractal City: Cultural Disengagement and Disembodied Belonging due to Outdoor Thermal Changes. *J Reg City Plan*. 2018;29 (1):67–82. https://doi.org/10.5614/jrcp.2018.29.1.6

397. Marshall N, Adger WN, Benham C, Brown K, Curnock MI, Gurney GG, et al. Reef Grief: investigating the relationship between place meanings and place change on the Great Barrier Reef, Australia. *Sustain Sci*. 2019 May;14 (3):579–87. https://doi.org/10.1007/s11625-019-00666-z

398. Tschakert P, Tutu R. *Solastalgia: Environmentally Induced Distress and Migration Among Africa's Poor Due to Climate Change*. 2010. 57–69 p. (Afifi T, Jager J, editors. Environment, Forced Migration and Social Vulnerability).

399. Clayton S. Mental health risk and resilience among climate scientists. *Nat Clim Change*. 2018;8 (4):260–1. https://doi.org/10.1038/s41558-018-0123-z

400. Coyle KJ, Van Susteren L. The psychological effects of global warming on the United States: and why the US mental health care system is not adequately prepared [Internet]. National Wildlife Federation; 2012. (National Wildlife Federation Climate education Program). Available from: https://nwf.org/~/media/PDFs/Global-Warming/Reports/Psych_effects_Climate_Change_Ex_Sum_3_23.ashxncbi

401. Lee K, Gjersoe N, O'Neill S, Barnett J. Youth perceptions of climate change: A narrative synthesis. *WIREs Clim Change*. 2020;11 (3):e641. https://doi.org/10.1002/wcc.641

402. Kreslake J, Price K, Rudolph L, Sarfaty M. Developing effective communication materials on the health effects of climate change for vulnerable groups. In: APHA 2016 Annual Meeting & Expo (Oct 29-Nov 2, 2016). APHA; 2016.

403. Barrett S. Local level climate justice? Adaptation finance and vulnerability reduction. *Glob Environ*

Change. 2013;23 (6):1819–29. https://doi.org/10.1016/j.gloenvcha.2013.07.015

404. Kielland N, Simeone T. Current issues in mental health in Canada: the mental health of First Nations and Inuit communities [Internet]. Library of Parliament Ottawa; 2014. (In Brief series). Report No.: 2014-02-E. Available from: https://publications.gc.ca/collections/collection_2014/bdp-lop/eb/2014-02-eng.pdf

405. Schlanger Z. Psychologists from 40 countries pledged to use their jobs to address climate change [Internet]. Quartz. [cited 2021 Jan 26]. Available from: https://qz.com/1749577/psychologists-sign-pledge-to-address-climate-change/

406. Berry HL, Peel D. Worrying about climate change: is it responsible to promote public debate? *BJPsych Int*. 2015;12 (2):31–2. https://doi.org/10.1192/s2056474000000234

407. Hamilton C, Kasser T. *Psychological Adaptation to the Threats and Stresses of a Four Degree World*. In Oxford, UK; 2009. p. 10.

408. Ojala M. Adolescents' Worries about Environmental Risks: Subjective Well-being, Values, and Existential Dimensions. *J Youth Stud*. 2005;8 (3):331–47. https://doi.org/10.1080/13676260500261934

409. Ojala M. Hope in the Face of Climate Change: Associations With Environmental Engagement and Student Perceptions of Teachers' Emotion Communication Style and Future Orientation. *J Environ Educ*. 2015;46:133–48. https://doi.org/10.1080/00958964.2015.1021662

410. Ojala M. How do children cope with global climate change? Coping strategies, engagement, and well-being. *J Environ Psychol*. 2012;32 (3):225–33. https://doi.org/10.1016/j.jenvp.2012.02.004

411. Ojala M. Hope and climate change: the importance of hope for environmental engagement among young people. *Environ Educ Res*. 2012;18 (5):625–42. https://doi.org/10.1080/13504622.2011.637157

412. Zawadzki SJ, Steg L, Bouman T. Meta-analytic evidence for a robust and positive association between individuals' pro-environmental behaviors and their subjective wellbeing. *Environ Res Lett*. 2020;15 (12):123007. https://doi.org/10.1088/1748-9326/abc4ae

413. Kaida N, Kaida K. Pro-environmental behavior correlates with present and future subjective well-being. *Environ Dev Sustain*. 2016;18 (1):111–27. https://doi.org/10.1007/s10668-015-9629-y

414. Rush E. What 500,000 Americans hit by floods can teach us about fighting climate change | Elizabeth Rush. The Guardian [Internet]. 2019 Aug 30 [cited 2020 May 4]; Available from: https://www.theguardian.com/commentisfree/2019/aug/30/what-500000-americans-hit-by-floods-can-teach-us-about-fighting-climate-change

415. Randall R. Loss and climate change: The cost of parallel narratives. *Ecopsychology*. 2009;1 (3):118–29. https://doi.org/10.1089/eco.2009.0034

416. Brown K, Kasser T. Are Psychological and Ecological Well-Being Compatible? The Role of Values, Mindfulness, and Lifestyle. *Soc Indic Res*. 2005;74:349–68. https://doi.org/10.1007/s11205-004-8207-8

417. De Young R. Some psychological aspects of reduced consumption behavior: The role of intrinsic satisfaction and competence motivation. *Environ Behav*. 1996;28 (3):358–409. https://doi.org/10.1177/0013916596283005

418. De Young R. Some psychological aspects of living lightly: Desired lifestyle patterns and conservation behavior. *J Environ Syst*. 1990;20 (3):215–27. https://doi.org/10.2190/030Q-Q4KE-7YFB-4Q0F

419. Cunsolo A, Harper SL, Minor K, Hayes K, Williams KG, Howard C. Ecological grief and anxiety: the start of a healthy response to climate change? *Lancet Planet Health*. 2020;4 (7):e261–3. https://doi.org/10.1016/S2542-5196(20)30144-3

420. Stanley SK, Hogg TL, Leviston Z, Walker I. From anger to action: Differential impacts of eco-anxiety, eco-depression, and eco-anger on climate action and wellbeing. *J Clim Change Health*. 2021;1:100003. https://doi.org/10.1016/j.joclim.2021.100003

421. Bouman T, Verschoor M, Albers CJ, Böhm G, Fisher SD, Poortinga W, et al. When worry about climate change leads to climate action: How values, worry and personal responsibility relate to various climate actions. *Glob Environ Change*. 2020;62:102061. https://doi.org/10.1016/j.gloenvcha.2020.102061

422. Goldberg MH, Gustafson A, Ballew MT, Rosenthal SA, Leiserowitz A. Identifying the most important predictors of support for climate policy in the United States. *Behav Public Policy*. 2021;5 (4):480–502. https://doi.org/10.1017/bpp.2020.39

423. Smith N, Leiserowitz A. The Role of Emotion in Global Warming Policy Support and Opposition. *Risk Anal*. 2014;34 (5):937–48. https://doi.org/10.1111/risa.12140

424. Van Zomeren M, Spears R, Leach C. Experimental evidence for a dual pathway model of coping with the climate crisis. *J Environ Psychol*. 2010;30:339–46. https://doi.org/10.1016/j.jenvp.2010.02.006

425. Feinberg M, Willer R. Apocalypse soon? Dire messages reduce belief in global warming by contradicting just-world beliefs. *Psychol Sci*. 2011;22 (1):34–8. https://doi.org/10.1177/0956797610391911

426. Gifford R. The dragons of inaction: Psychological barriers that limit climate change mitigation and adaptation. *Am Psychol*. 2011;66 (4):290. https://doi.org/10.1037/a0023566

427. Spence A, Poortinga W, Butler C, Pidgeon NF. Perceptions of climate change and willingness to save energy related to flood experience. *Nat Clim Change*. 2011;1 (1):46–9. https://doi.org/10.1038/nclimate1059

428. Ogunbode CA, Bohm G, Capstick SB, Demski C, Spence A, Tausch N. The resilience paradox: flooding experience, coping and climate change mitigation intentions. *Clim Policy*. 2019;19 (6):703–15. https://doi.org/10.1080/14693062.2018.1560242

429. Daryanto A, Song Z. A meta-analysis of the relationship between place attachment and pro-

environmental behaviour. *J Bus Res.* 2021;123: 208–19. https://doi.org/10.1016/j.jbusres.2020.09.045

430. Leiserowitz A, Maibach E, Roser-Renouf C, Feinberg G, Howe P. Global warming's six Americas, September 2012 [Internet]. New Haven, CT: Yale University and George Mason University.; 2013. (Yale Project on Climate Change Communication). Available from: https://climatecommunication.yale.edu/about/projects/global-warmings-six-americas/

431. McCright AM, Dunlap RE. Cool dudes: The denial of climate change among conservative white males in the United States. *Glob Environ Change.* 2011;21 (4):1163–72. https://doi.org/10.1016/j.gloenvcha.2011.06.003

432. Costello A, Maslin M, Montgomery H, Johnson AM, Ekins P. Global health and climate change: moving from denial and catastrophic fatalism to positive action. *Philos Trans Math Phys Eng Sci.* 2011;369 (1942):1866–82. https://doi.org/10.1098/rsta.2011.0007

433. Mayer A, Smith EK. Unstoppable climate change? The influence of fatalistic beliefs about climate change on behavioural change and willingness to pay cross-nationally. *Clim Policy.* 2019;19 (4): 511–23. https://doi.org/10.1080/14693062.2018.1532872

434. Stoll-Kleemann S, O'Riordan T, Jaeger CC. The psychology of denial concerning climate mitigation measures: evidence from Swiss focus groups. *Glob Environ Change.* 2001;11 (2):107–17. https://doi.org/10.1016/S0959-3780(00)00061-3

435. Devine-Wright P. Think global, act local? The relevance of place attachments and place identities in a climate changed world. *Glob Environ Change.* 2013; 23 (1):61–9. https://doi.org/10.1016/j.gloenvcha.2012.08.003

436. Hadarics M. The palliative function of climate change denial is stronger in more exposed countries. *Ecopsychology.* 2021;13 (1):48–54. https://doi.org/10.1089/eco.2020.0031

437. Norgaard KM. Cognitive And Behavioral Challenges In Responding To Climate Change [Internet]. The World Bank; 2009 [cited 2022 May 2]. 76 p. (Policy Research Working Papers). Available from: https://doi.org/10.1596/1813-9450-4940

438. Cruwys T, Berry H, Cassells R, Duncan A, O'Brien L, Sage B, et al. Marginalised Australians: Characteristics and predictors of exit over ten years 2001-10 [Internet]. University of Canberra, Australia.; 2013. (Curtin Research Publications). Available from: http://hdl.handle.net/20.500.11937/4383

439. Priebe S, Matanov A, Schor R, Straßmayr C, Barros H, Barry MM, et al. Good practice in mental health care for socially marginalised groups in Europe: a qualitative study of expert views in 14 countries. *BMC Public Health.* 2012;12 (248). https://doi.org/10.1186/1471-2458-12-248

440. MacKay M, Parlee B, Karsgaard C. Youth engagement in climate change action: Case study on indigenous youth at COP24. *Sustainability.* 2020;12 (16): 6299. https://doi.org/10.3390/su12166299

441. Ojala M. Confronting macrosocial worries: Worry about environmental problems and proactive coping among a group of young volunteers. *Futures.* 2007; 39 (6):729–45. https://doi.org/10.1016/j.futures.2006.11.007

442. Schwartz SEO, Benoit L, Clayton S, Parnes MF, Swenson L, Lowe SR. Climate change anxiety and mental health: Environmental activism as buffer. *Curr Psychol* [Internet]. 2022 Feb 28 [cited 2022 May 22]; Available from: https://doi.org/10.1007/s12144-022-02735-6

443. Nairn K. Learning from Young People Engaged in Climate Activism: The Potential of Collectivizing Despair and Hope. *YOUNG.* 2019;27 (5):435–50. https://doi.org/10.1177/1103308818817603

444. Barasi L. Guest post: Polls reveal surge in concern in UK about climate change. Retrieved May. 2019;21: 2019.

445. Global Action Plan UK and Unilever. Generation Action: How to unleash the potential of children and young people to take positive action and create a better world for all. [Internet]. Global Action Plan Advisors, Unilever Global Sustainability Team and OMO Global Brand: London, UK; 2021. Available from: https://www.globalactionplan.org.uk/files/generation_action_-_unleash_the_potential_of_children.pdf

446. Godsmark CN. Inspiring climate action without inducing climate despair. *Lancet Planet Health.* 2020;4 (5):e169–70. https://doi.org/10.1016/S2542-5196(20)30102-9

447. Hornsey MJ, Fielding KS. A cautionary note about messages of hope: Focusing on progress in reducing carbon emissions weakens mitigation motivation. *Glob Environ Change.* 2016;39:26–34. https://doi.org/10.1016/j.gloenvcha.2016.04.003

448. Kaida N, Kaida K. Facilitating Pro-environmental Behavior: The Role of Pessimism and Anthropocentric Environmental Values. *Soc Indic Res.* 2016;126 (3):1243–60. https://doi.org/10.1007/s11205-015-0943-4

449. Nickerson C. The Yerkes-Dodson Law and Performance [Internet]. Simply Psychology. 2021. Available from: https://www.simplypsychology.org/what-is-the-yerkes-dodson-law.html

450. Baudon P, Jachens L. A Scoping Review of Interventions for the Treatment of Eco-Anxiety. *Int J Environ Res Public Health.* 2021;18 (18):9636. https://doi.org/10.3390/ijerph18189636

451. Carbon Conversations [Internet]. [cited 2022 May 3]. Available from: http://www.carbonconversations.co.uk/

452. Force of Nature | Mobilising mindsets for climate action [Internet]. Force of Nature. [cited 2022 May 3]. Available from: https://www.forceofnature.xyz

453. About [Internet]. Good Grief Network. [cited 2022 May 3]. Available from: https://www.goodgriefnetwork.org/archive/about/

454. IPCC – Red Cross Red Crescent Climate Centre [Internet]. [cited 2022 Mar 6]. Available from: https://www.climatecentre.org/ipcc/

455. Augustinavicius JL, Greene MC, Lakin DP, Tol WA. Monitoring and evaluation of mental health and psychosocial support programs in humanitarian settings: a scoping review of terminology and focus. *Confl Health*. 2018;12:9. https://doi.org/10.1186/s13031-018-0146-0

456. Climate Outreach [Internet]. [cited 2022 Sep 20]. Available from: https://climateoutreach.org/

457. Budziszewska M, Jonsson SE. From Climate Anxiety to Climate Action: An Existential Perspective on Climate Change Concerns Within Psychotherapy. *J Humanist Psychol*. 2021;0022167821993243. https://doi.org/10.1177/0022167821993243

458. Home [Internet]. Climate Psychology Alliance. [cited 2022 May 3]. Available from: https://www.climatepsychologyalliance.org/

459. Climate Café® – Welcome to the Climate Café® Hub [Internet]. [cited 2022 Sep 20]. Available from: https://www.climate.cafe/

460. The Resilience Project [Internet]. [cited 2022 Sep 20]. Available from: https://www.theresilienceproject.org.uk/

461. Homepage [Internet]. sustyvibes. [cited 2022 Sep 20]. Available from: https://sustyvibes.org/

462. Sawatzky A, Cunsolo A, Harper SL, Shiwak I, Wood M. "We have our own way": exploring pathways for wellbeing among Inuit in Nunatsiavut, Labrador, Canada. In: *Routledge Handbook of Indigenous Wellbeing*. Routledge; 2019. p. 223–36.

463. Cunsolo A, Shiwak I, Wood M. "You Need to Be a Well-Rounded Cultural Person": youth mentorship programs for cultural preservation, promotion, and sustainability in the Nunatsiavut Region of Labrador. In: *Northern sustainabilities: understanding and addressing change in the circumpolar world*. Springer; 2017. p. 285–303.

464. Eaton J, Nwefoh E, Duncan J, Sangare O, Weekes K. Climate change, mental health and wellbeing: Examples of practical inclusive practices. [Internet]. CBM global disability inclusion; 2021 [cited 2022 May 3]. Available from: https://www.cbmuk.org.uk/wp-content/uploads/2021/10/Climate-change-and-Mental-Health_CBMGlobal-1.pdf

465. Meyers D, Allen CE, Dunn D, Wennerstrom A, Springgate BF. Community Perspectives on Post-Katrina Mental Health Recovery in New Orleans. *Ethn Dis*. 2011;21 (3 0 1):S1–S52–7.

466. Jennings N, Fecht D, Matteis SD. Mapping the co-benefits of climate change action to issues of public concern in the UK: a narrative review. *Lancet Planet Health*. 2020;4 (9):e424–33. https://doi.org/10.1016/S2542-5196(20)30167-4

467. Haines A. Health co-benefits of climate action. *Lancet Planet Health*. 2017;1 (1):e4–5. https://doi.org/10.1016/S2542-5196(17)30003-7

468. WHO (World Health Organisation). Operational framework for building climate resilient health systems [Internet]. World Health Organization Geneva; 2015 [cited 2922 May 3]. Available from: https://www.who.int/publications/i/item/9789241565073

469. Schramm PJ, Al Janabi AL, Campbell LW, Donatuto JL, Gaughen SC. How Indigenous Communities Are Adapting To Climate Change: Insights From The Climate-Ready Tribes Initiative. *Health Aff (Millwood)*. 2020;39 (12):2153–9.

470. Reifels L, Pietrantoni L, Prati G, Kim Y, Kilpatrick DG, Dyb G, et al. Lessons learned about psychosocial responses to disaster and mass trauma: an international perspective. *Eur J Psychotraumatology*. 2013;4: https://doi.org/10.3402/ejpt.v4i0.22897

471. Lock S, Rubin GJ, Murray V, Rogers MB, Amlôt R, Williams R. Secondary stressors and extreme events and disasters: a systematic review of primary research from 2010-2011. *PLoS Curr*. 2012;4. https://doi.org/10.1371/currents.dis.a9b76fed1b2dd5c5bfcfc13c87a2f24f

472. Stanke C, Murray V, Amlôt R, Nurse J, Williams R. The effects of flooding on mental health: Outcomes and recommendations from a review of the literature. *PLoS Curr*. 2012;4: e4f9f1fa9c3cae–e4f9f1fa9c3cae.

473. Adini B, Ohana A, Furman E, Ringel R, Golan Y, Fleshler E, et al. Learning lessons in emergency management: the 4th International Conference on Healthcare System Preparedness and Response to Emergencies and Disasters. *Disaster Mil Med*. 2016 Oct 28;2 (1):16.

474. Nahar N, Blomstedt Y, Wu B, Kandarina I, Trisnantoro L, Kinsman J. Increasing the provision of mental health care for vulnerable, disaster-affected people in Bangladesh. *BMC Public Health*. 2014;14 (1):708. https://doi.org/10.1186/1471-2458-14-708

475. Le Brocque R, De Young A, Montague G, Pocock S, March S, Triggell N, et al. Schools and natural disaster recovery: The unique and vital role that teachers and education professionals play in ensuring the mental health of students following natural disasters. Alisic, editor. *J Psychol Couns Sch*. 2017;27 (1):1–23. https://doi.org/10.1017/jgc.2016.17

476. Taylor LK, Goldberg MG, Tran MHD. Promoting Student Success: How Do We Best Support Child and Youth Survivors of Catastrophic Events? *Curr Psychiatry Rep*. 2019;21 (9). https://doi.org/10.1007/s11920-019-1067-3

477. Walker-Springett K, Butler C, Adger WN. Wellbeing in the aftermath of floods. Adger, editor. *Health Place*. 2017;43:66–74. https://doi.org/10.1016/j.healthplace.2016.11.005

478. Ramsay T, Manderson L. Resilience, spirituality and posttraumatic growth: reshaping the effects of climate change. *Clim Change Hum Well-Being*. 2011; 165–84.

479. Connerton CS, Wooton AK. Building Community Resilience to Mitigate Mental Health Effects of Climate Change. *Creat Nurs*. 2019;25 (3):E9–14. https://doi.org/10.1891/1078-4535.25.3.e9

480. Bistricky SL, Long LJ, Lai BS, Gallagher MW, Kanenberg H, Elkins SR, et al. Surviving the storm: Avoidant coping, helping behavior, resilience and affective symptoms around a major hurricane-flood. *J Affect Disord*. 2019;257:297–306. https://doi.org/10.1016/j.jad.2019.07.044

481. Climate Risk and Early Warning Systems (CREWS) [Internet]. 2019 [cited 2022 Sep 20]. Available from:

https://public.wmo.int/en/climate-risk-and-early-warning-systems-crews

482. Early warning, early action | IFRC [Internet]. [cited 2022 Sep 20]. Available from: https://www.ifrc.org/early-warning-early-action

483. Monsell A, Krzanowski J, Page L, Cuthbert S, Harvey G. What mental health professionals and organisations should do to address climate change. *BJPsych Bull*. 2021;45 (4):215–21. https://doi.org/10.1192/bjb.2021.17

484. NHS England » Green social prescribing [Internet]. [cited 2021 Apr 21]. Available from: https://www.england.nhs.uk/personalisedcare/social-prescribing/green-social-prescribing/

485. Maxwell J, Blashki G. Teaching about Climate Change in Medical Education: An Opportunity. *J Public Health Res*. 2016;5 (1):jphr.2016.673. https://doi.org/10.4081/jphr.2016.673

486. Kim EJ. Frames and games : testing a public health orientation to climate adaptation planning [Internet] [Thesis]. Massachusetts Institute of Technology; 2018 [cited 2022 May 3]. Available from: https://dspace.mit.edu/handle/1721.1/115710

487. Gibson K, Haslam N, Kaplan I. Distressing encounters in the context of climate change: Idioms of distress, determinants, and responses to distress in Tuvalu. *Transcult Psychiatry*. 2019;56 (4):667–96. https://doi.org/10.1177/1363461519847057

488. Tcymbal A, Demetriou Y, Kelso A, Wolbring L, Wunsch K, Wäsche H, et al. Effects of the built environment on physical activity: a systematic review of longitudinal studies taking sex/gender into account. *Environ Health Prev Med*. 2020;25 (1):1–25. https://doi.org/10.1186/s12199-020-00915-z

489. How transport offers a route to better health - The Health Foundation [Internet]. [cited 2022 May 3]. Available from: https://www.health.org.uk/publications/long-reads/how-transport-offers-a-route-to-better-health

490. Kelly P, Williamson C, Niven AG, Hunter R, Mutrie N, Richards J. Walking on sunshine: scoping review of the evidence for walking and mental health. *Br J Sports Med*. 2018;52 (12):800-+. https://doi.org/10.1136/bjsports-2017-098827

491. Ambrey CL. Greenspace, physical activity and wellbeing in Australian capital cities: how does population size moderate the relationship? *Public Health*. 2016;133:38–44. https://doi.org/10.1016/j.puhe.2015.11.013

492. Heesch KC, Burton NW, Brown WJ. Concurrent and prospective associations between physical activity, walking and mental health in older women. *J Epidemiol Community Health*. 2011;65 (9):807–13. https://doi.org/10.1136/jech.2009.103077

493. Knott CS, Panter J, Foley L, Ogilvie D. Changes in the mode of travel to work and the severity of depressive symptoms: a longitudinal analysis of UK Biobank. *Prev Med*. 2018;112:61–9. https://doi.org/10.1016/j.ypmed.2018.03.018

494. Humphreys DK, Goodman A, Ogilvie D. Associations between active commuting and physical and mental wellbeing. *Prev Med*. 2013;57 (2):135–9. https://doi.org/10.1016/j.ypmed.2013.04.008

495. Martin A, Goryakin Y, Suhrcke M. Does active commuting improve psychological wellbeing? Longitudinal evidence from eighteen waves of the British Household Panel Survey. *Prev Med*. 2014;69: 296–303. https://doi.org/10.1016/j.ypmed.2014.08.023

496. Shiue I. Daily walking > 10 min could improve mental health in people with historical cardiovascular disease or COPD: Scottish Health Survey, 2012. *Int J Cardiol*. 2015;179:375–7. https://doi.org/10.1016/j.ijcard.2014.11.058

497. Evans M. Rewilding European urban spaces. *Eur J Public Health*. 2021;31 (Supplement_3):ckab165.217.

498. Dick J, Carruthers-Jones J, Carver S, Dobel AJ, Miller JD. How are nature-based solutions contributing to priority societal challenges surrounding human well-being in the United Kingdom: a systematic map. *Environ Evid*. 2020;9 (1):25. https://doi.org/10.1186/s13750-020-00208-6

499. Bratman G, Anderson C, Berman M, Cochran B, de Vries S, Flanders J, et al. Nature and mental health: An ecosystem service perspective. *Sci Adv*. 2019;5: eaax0903.

500. Firth D. Harnessing a wild aesthetic. *Landsc Archit Aust*. 2020; (167):46–53.

501. Fong KC, Hart JE, James P. A Review of Epidemiologic Studies on Greenness and Health: Updated Literature Through 2017. *Curr Env Health Rep*. 2018;5 (1):77–87. https://doi.org/10.1007/s40572-018-0179-y

502. Astell-Burt TE, Feng X. Increasing tree cover may be like a'superfood'for community mental health [Internet]. 2019 [cited 202AD Feb 21]. Available from: https://theconversation.com/increasing-tree-cover-may-be-like-a-superfood-for-community-mental-health-119930

503. Browning M, Lee K, Wolf KL. Tree cover shows an inverse relationship with depressive symptoms in elderly residents living in US nursing homes. *Urban For Urban Green*. 2019;41:23–32. https://doi.org/10.1016/j.ufug.2019.03.002

504. Chong S, Lobb E, Khan R, Abu-Rayya H, Byun R, Jalaludin B. Neighbourhood safety and area deprivation modify the associations between parkland and psychological distress in Sydney, Australia. *BMC Public Health*. 2013;13. https://doi.org/10.1186/1471-2458-13-422

505. Tackling social inequalities to reduce mental health problems | Mental Health Foundation [Internet]. [cited 2022 May 3]. Available from: https://www.mentalhealth.org.uk/publications/tackling-social-inequalities-reduce-mental-health-problems

506. Singh A, Daniel L, Baker E, Bentley R. Housing disadvantage and poor mental health: a systematic review. *Am J Prev Med*. 2019;57 (2):262–72. https://doi.org/10.1016/j.amepre.2019.03.018

507. Balfour R, Allen J. Local action on health inequalities: Fuel poverty and cold home-related health problems [Internet]. UCL Institute of Health Equity & Public Health England; 2014 [cited 2020 Jul 15]. Available from: https://assets.publishing.service.gov.

uk/government/uploads/system/uploads/attachment_data/file/357409/Review7_Fuel_poverty_health_inequalities.pdf

508. Thomson H, Thomas S, Sellstrom E, Petticrew M. Housing improvements for health and associated socio-economic outcomes. *Cochrane Database Syst Rev*. 2013; (2).

509. Friel S, Berry H, Dinh H, O'Brien L, Walls HL. The impact of drought on the association between food security and mental health in a nationally representative Australian sample. *BMC Public Health*. 2014; 14 (1):1102. https://doi.org/10.1186/1471-2458-14-1102

510. Pourmotabbed A, Moradi S, Babaei A, Ghavami A, Mohammadi H, Jalili C, et al. Food insecurity and mental health: a systematic review and meta-analysis. *Public Health Nutr*. 2020/03/16 ed. 2020;23 (10):1778–90.

511. Vermeulen SJ, Campbell BM, Ingram JSI. Climate Change and Food Systems. *Annu Rev Environ Resour*. 2012;37 (1):195–222. https://doi.org/10.1146/annurev-environ-020411-130608

512. Shukla PR, Skeg J, Buendia EC, Masson-Delmotte V, Pörtner HO, Roberts DC, et al. 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 [Internet]. IPCC; 2019. (Climate Change and Land). Available from: https://www.ipcc.ch/srccl/

513. Montgomery DR, Biklé A, Archuleta R, Brown P, Jordan J. Soil health and nutrient density: preliminary comparison of regenerative and conventional farming. *PeerJ*. 2022;10:e12848. https://doi.org/10.7717/peerj.12848

514. Ottinger G. The winds of change: environmental justice in energy transitions. *Sci Cult*. 2013;22 (2): 222–9. https://doi.org/10.1080/09505431.2013.786996

515. United Nations. Just transition of the workforce, and the creation of decent work and quality jobs [Internet]. FCCC/TP/2016/7. UNFCCC; 2016 [cited 2022 Apr 30] p. 72. (Framework Convention on Climate Change). Available from: https://unfccc.int/sites/default/files/resource/Just%20transition.pdf