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Global priorities for climate change and mental health research

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ABSTRACT

Background: Compared with other health areas, the mental health impacts of climate change have received less research attention. The literature on climate change and mental health is growing rapidly but is characterised by several limitations and research gaps. In a field where the need for designing evidence-based adaptation strategies is urgent, and research gaps are vast, implementing a broad, all-encompassing research agenda will require some strategic focus.

Methods: We followed a structured approach to prioritise future climate change and mental health research. We consulted with experts working across mental health and climate change, both within and outside of research and working in high, middle, and low-income countries, to garner consensus about the future research priorities for mental health and climate change. Experts were identified based on whether they had published work on climate change and mental health, worked in governmental and non-governmental organisations on climate change and mental health, and from the professional networks of the authors who have been active in the mental health and climate change space.

Results: Twenty-two experts participated from across low- and middle-income countries (n = 4) and high-income countries (n = 18). Our process identified ten key priorities for progressing research on mental health and climate change.

Conclusion: While climate change is considered the biggest threat to global mental health in the coming century, tackling this threat could be the most significant opportunity to shape our mental health for centuries to come because of health co-benefits of transitioning to more sustainable ways of living. Research on the impacts of climate change on mental health and mental health-related systems will assist decision-makers to develop robust evidence-based mitigation and adaptation policies and plans with the potential for broad benefits to society and the environment.

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1. Introduction

The evidence linking climate change to detrimental health impacts is now overwhelming. Increasing temperatures, more frequent and intense extreme weather events, and air pollution have all been linked to worsened physical health, from respiratory conditions to infectious diseases (Watts et al., 2020). However, compared with other health areas, the mental health impacts of climate change have received less research attention (Berry et al., 2010; Hayes et al., 2018; Charlson et al., 2021).

Climate change and mental health research is an emerging field and has, to date, been dominated by reviews and commentaries rather than robustly designed empirical studies. The significant research gaps identified in our previous systematic review on the topic (Charlson et al., 2021) may exist because of a lack of research funding and capacity as well as because of various methodological challenges when assessing the relationship between climate change and mental health; however, the literature on climate change and mental health is growing rapidly. The existing literature clearly points to the detrimental impact climate change is having on a number of mental health outcomes. However, this literature is characterised by several limitations and research gaps. For example, it has largely focused on quantifying and characterising the association between climate change-related stressors and mental health without much focus on applied research aimed at identifying interventions and policies to safeguard mental health in the face of climate change. Additionally, most research to date is hindered by methodological limitations concerning study design, including the operationalisation of climate change and mental health and wellbeing constructs. Finally, there is currently an overwhelming focus on high-income countries, despite the higher risk and vulnerability to climate change in low- and middle-income countries.

The World Health Organization (WHO) has recommended that research on climate change and health should be wide-ranging, including basic, epidemiological, and academic public health research that examines exposure–response relationships, estimates the current and potential future health impacts of climate change, and informs risk perception and risk communication. Research should also aim to evaluate the overall impacts and cost-effectiveness of specific policies and programs to protect and promote health in relation to climate change (World Health Organization. 2009). However, in a field where the need is urgent, and research gaps are vast, implementing a broad, all-encompassing research agenda will require some strategic focus.

It remains unclear what the future research priorities in the field of climate change and mental health should be. This is somewhat in contrast to other areas of health where more systematic attempts have been made to generate consensus on climate change and health research priorities. For example, in 2012, a Delphi study of international opinion leaders in public health was conducted to identify research priorities for non-communicable disease (NCD) prevention in the face of climate change (Colagiuri et al., 2015). This led to identifying three key research priorities: water security, transportation, and the conceptualisation of NCD harms to support policy formation. Several other successful examples of identifying research priorities regarding health and climate change exist, from the health of coastal human communities (Friedman et al., 2020) to occupational health (Adam-Poupart et al., 2013).

In this paper, we propose a structured approach to prioritise future climate change and mental health research.

2. Methods

A process of global research priority setting specific to mental health and climate change was undertaken to inform and guide future research on the topic. The published literature guided the research priority setting process on this topic (Sibbald et al., 2009; Viergever et al., 2010). We selected the Delphi method of gaining consensus on research priorities as it is highly suitable to health research, particularly where there are a small group of experts in the field who are geographically dispersed (de Meyrick, 2003). In brief, the Delphi method is a process of systematically gathering input from relevant experts on a topic.

In this paper, we take a broad definition of 'mental health' encompassing a range of mental health outcomes and constructs shown to be impacted by climate change (Charlson et al., 2021), including psychological distress, symptoms of psychiatric disorders, psychiatric hospital admissions, psychiatric-related mortality, self-harm, suicide, solastalgia, climate anxiety, ecological grief, and social and emotional wellbeing.

We consulted with experts working across mental health and climate change, both within and outside of research, to garner consensus about the future research priorities for mental health and climate change (de Meyrick, 2003). Experts were identified from searches of published literature on climate change and mental health, and governmental and non-governmental organisations known to be active in climate change and mental health. A second stage of recruitment used a snowball approach to draw upon the professional networks of these experts. Other than being currently active in the field, there were no other inclusion or exclusion criteria for selecting participants.

We approached 38 experts to participate in this study. Twenty-two experts agreed to participate in the first survey and represented low- and middle-income countries (n = 4) and high-income countries (n = 18). The group also had representatives across sectors, including health service providers (n = 4), government and non-governmental organisations (n = 5), policymakers (4), funding agencies (1) and academia (n = 13) (note, these groups are mutually exclusive). The expert group consisted of 15 females and 7 males. 15 participants anonomyously completed the second survey.

The process started with an online survey asking experts to list what they believed were the research priorities in climate change and mental health. This survey's results were thematically collated and sorted by the authors and anonymously fed back to the participants via a second survey where participants were asked to rate how much they believed each research priority was relevant and appropriate on a 5-point Likert scale (from very inappropriate/irrelevant to very appropriate/relevant) and to provide feedback on wording if necessary. The authors then refined the final research priorities and fed these back to participants for final comment.

Ethics approval was granted by the University of Queensland Instiutional Human Ethics Review Committee.

3. Results

Our process identified ten key priorities for progressing research on mental health and climate change. Each priority encapsulates contributions from all those consulted, either in the research priority wording itself or in the accompanying text. The final research priorities can be found in Table 1 (note, the list order does not specify an order of importance or significance).

Research priority 1: Understand, characterise and quantify the full range of (past, present and future) mental health outcomes impacted by climate change-related exposures

While research exploring the impact of climate change on mental health represents the largest proportion of original research identified in a recent scoping review (Charlson et al., 2021), it often suffers from methodological weaknesses that limit the claims of attribution that other health areas have successfully demonstrated. These include limitations in the measurement of mental health constructs, in the measurement of the climate exposure, and in the measurement of the association between climate change and mental health. Studies have explored a range of climate change-related exposures, including drought, flood, fire, and heat; however, there is an overall need to improve the measurement of climate change related exposures within the mental health field. Many mental health studies rely on self-report

Table 1
Key future research priorities.

1. Understand, characterise and quantify the full range of (past, present and future) mental health outcomes impacted by climate change-related exposures.
2. Understand what factors increase vulnerability and resilience to the mental health impacts of climate change.
3. Develop appropriate and validated quantitative measures of climate change-related mental health impacts.
4. Define and quantify the causal pathways, including modifying and mediating factors, between climate change exposures and mental health outcomes.
5. Assess the appropriateness, feasibility, effectiveness, and scalability of mental health and psychosocial interventions (clinical and non-clinical) in the context of climate change.
6. Understand how communication around climate change can impact mental health.
7. Explore the interaction between engagement in activities that support climate change mitigation and adaptation and mental health outcomes.
8. Explore the association between, and potential co-benefits of, climate change mitigation and adaptation practices and mental health outcomes.
9. Understand how the evidence-base from mental health research influences decision-making related to climate change.
10. Understand and quantify the economic costs of the mental health impacts of climate change.

(e.g., asking people how acutely they have been affected by a weather event out of several possible exposure items), which frequently trade ease of use for poor psychometric performance, or refer to non-specific impacts of climate change or specific weather events, such as sea-level rise or wildfires.

Robust epidemiological research that clearly describes and quantifies the mental health impacts of climate change will be a key tool for advocacy and progress; for example, it may facilitate the inclusion of a mental health indicator used to highlight and track the impact climate change is having on human health as part of the Lancet Countdown on Health and Climate Change – an annual global monitoring report on health and climate indicators (Watts et al., 2020). It is also a precursor to, and enabler of, several other research priorities discussed in this paper.

Research priority 2: Understand what factors increase vulnerability and resilience to the mental health impacts of climate change

This research priority aims to explore how climate change interacts with social determinants of mental health (Lund et al., 2018) to shape aspects of vulnerability and resilience, and how communities and sub-populations are experiencing mental health impacts differently. It is recognised that climate change exacerbates existing social, economic and demographic inequalities, doubling down on the major risk factors for poor mental health outcomes (Lund et al., 2018; Watts et al., 2018a, 2018b; Diffenbaugh and Burke, 2019).

The unequal distribution of the mental health impacts of climate change has been explored among people with pre-existing mental health disorders (Jones et al., 2012; Page et al., 2012; Trang et al., 2016), Indigenous populations (Rigby et al., 2011; Cunsolo Willox et al., 2013), specific occupational groups such as farmers (Berry et al., 2011), and young people (Majeed and Lee, 2017; Anderko et al., 2020; Wu et al., 2020). Yet, many other potentially vulnerable populations remain overlooked by current research activities, such as migrants, conflict-affected populations, workers in certain occupations (e.g., outdoor workers, people employed in the extractive industry, etc.), people living in poverty, women and girls, those experiencing racism and other forms of discrimination, and populations with needs specific to particular contexts and geographies.

Equally important is to understand how and why individuals and communities show resilience in the face of climate-related stressors and climate change. Indeed, the disaster mental health literature indicates that community resilience and social cohesion are powerful protective factors for communities' mental health (Bonanno et al., 2010). Those seeking to address issues at the intersection of climate change and mental health should build on existing resilience and positive coping strategies within communities.

Research priority 3: Develop appropriate and validated quantitative measures of climate change-related mental health impacts

Several constructs relating to negative mental health outcomes in response to climate change were identified in our systematic review (Charlson et al., 2021), including psychological or environmental distress, solastalgia, and climate change-related anxiety. However, besides some notable exceptions (Clayton and Karazsia, 2020), these new constructs remain poorly operationalised in research. While some studies utilised existing symptom scales such as the Kessler Psychological Distress Scale (*K*10), the Short-Form 36 (SF-36) Health Survey (mental health domain) and the Strength and Difficulties Questionnaire (SDQ), most other concepts were qualitatively described. Furthermore, much research uses population-level proxy indicators of poor mental health, such as psychiatric hospital admissions or mortality rates. This inconsistency may have contributed to hindering the production of meaningful estimates of the mental health impacts of climate change and the development of a standardised mental health indicator for inclusion in global monitoring efforts, such as the Lancet Countdown on Health and Climate Change.

One of the challenges in developing appropriate quantitative measures is the risk of pathologising common, transitory and possibly adaptive reactions to abnormal events (Verplanken and Roy, 2013; Luber et al., 2014; Verplanken et al., 2020). For example, it has been argued that grief is a natural and legitimate response to ecological loss, which could potentially motivate environmental behaviour (Cunsolo and Ellis, 2018; Cunsolo et al., 2020; Comtesse et al., 2021). While some level of concern and anxiety in relation to climate change likely reflects a realistic threat perception and may serve a functional, adaptive purpose, there are more extreme forms of negative emotions that can interfere with the ability to carry out the activities of daily life (Clayton and Karazsia, 2020). Many existing quantitative tools for assessing mental health symptoms or psychological distress include thresholds that indicate probable disorder, or more severe problems and functional impairment. As new constructs are identified to describe reactions to climate change, such as ecological grief and climate change anxiety, care will need to be taken in developing a thorough understanding of such constructs and identifying subsets of the population in need of services. Previous attempts at measuring the psychological impacts of climate change have been made, including a survey of the general population of Australia and Great Britain (Reser et al., 2012), where the researchers acknowledged that their immediate focus was more related to broader impacts and less diagnostic, treatment or epidemiology-focused. The most advanced efforts include a recently developed climate change anxiety scale and climate change worry scale (Clayton and Karazsia, 2020; Stewart, 2021).

Generalisability is a particularly important issue to consider. The majority of these psychological measures have only been utilised with people living in a limited number of high-income countries, failing to take into account important cultural and contextual differences (Henrich et al., 2010). Further work is needed to validate measures across diverse samples and in different contexts. The development of valid and reliable measures of climate change-related mental health outcomes would also allow researchers to quantitatively investigate how constructs such as climate anxiety or ecological grief overlap with or differ from common mental disorders such as depression and anxiety.

Research priority 4: Define and quantify the causal pathways, including modifying and mediating factors, between climate change exposures and mental health outcomes

In addition to establishing the causal link between climate change-related environmental exposures and mental health discussed in

research priority 1, it is crucial to understand and document the causal pathways and networks. Berry et al. (2018) have proposed a top-level causal process diagram of the broad climate change-mental health system using systems thinking, which they highlight as a particularly useful approach in terms of the complexity of the causal networks involved (Berry et al., 2018). Some work has explored possible causal pathways underpinning the relationship between climate change and mental health (Vins et al., 2015; Thoma et al., 2021), however this work has been largely theoretical in nature and original research is needed to ground it in real world data.

Importantly, the mental health impacts of climate change and are likely to extend well beyond those that are more direct, e.g., post-traumatic stress disorder resulting from extreme weather events. The indirect impacts may be more significant and far-reaching. For example, climate change exacerbates natural hazards or droughts which are associated with an increase in displacement and migration (Hoffmann et al. 2020), armed conflicts (Burke et al., 2015), and gender-based violence (Thurston et al., 2021) – which impact housing, employment, security, and food availability – which ultimately impact mental health (Lund et al., 2018). By understanding the mechanisms that connect climate change to mental health at multiple levels (e.g. individual, community, etc.), possible leverage points can be identified that could be addressed by interventions.

Research priority 5: Assess the appropriateness, feasibility, effectiveness, and scalability of mental health and psychosocial interventions (clinical and non-clinical) in the context of climate change

As shown in our recently published systematic review (Charlson et al., 2021), there has been very limited development of treatment, prevention, or promotion interventions addressing mental health in the context of climate change. Currently, no research investigates the potential of existing or adapted mental health or psychosocial interventions in this area.

Some existing brief, scalable and transdiagnostic psychological interventions might be suitable candidates for addressing the mental health impacts of climate change. Advantages of these include broad population reach, the ability to address multiple/common problems and ease of implementation in terms of training needs and resources required, which is particularly important as resources become increasingly strained with the predicted economic costs of climate change. Examples include scalable psychological interventions for people affected by adversity developed by WHO, such as Problem Management Plus (PM +) and Self-Help Plus (SH +), or the Common Elements Treatment Approach (CETA) (World Health Organization. 2017; Purgato et al., 2019; de Graaff et al., 2020; Hamdani et al., 2020; Tol et al., 2020). The Mental Health Innovation Network (MHIN) has also compiled a toolkit for low-intensity psychosocial interventions for communities affected by adversity (MHIN, 2020). While this toolkit does not include projects specific to climate change, it includes interventions that are likely to be relevant to climate change, such as disaster response and Disaster Risk Reduction (DRR) interventions. Evidence from psychological therapies for treating mental disorders and psychosocial programs (Purgato et al., 2018; ELHRA. 2020; Haroz et al., 2020; Ryan et al., 2021) in humanitarian settings might also provide valuable insights for mental health and psychosocial response in the context of climate change.

While existing interventions may prove useful, the continued understanding of the climate change - mental health system (research priority 4) may necessitate their adaptation or the development of new interventions. Identifying and promoting specific protective factors and coping mechanisms in the context of climate change (research priority 2) will also provide important intervention targets (Berry, 2009). Co-defining and designing intervention with communities vulnerable to climate change impacts will be essential.

Importantly, the utility of mental health and psychosocial interventions in the context of climate change will be limited if the social and ecological determinants of mental health are not simultaneously addressed (Lund et al., 2018). For this reason, the integration of mental health and psychosocial interventions with programming and policies in other areas, such as health, livelihoods, sustainability, protection, and education, will be essential. This approach has been highlighted in recent publications describing the integration of mental health and psychosocial support and DRR (Gray et al., 2020, 2021; IASC Reference Group on Mental Health and Psychosocial Support, 2021).

It is also important to encourage more empirical work focusing on evaluating the effectiveness of existing policies such as early warning systems on various mental health outcomes. In this context, capitalizing on the timing or thresholds that are used to trigger such actions as natural experiments, as done for other health outcomes (Benmarhnia et al., 2016, 2019; Alari et al., 2021), could provide useful insights about preventive strategies to minimize the mental health impacts associated with climate-related stressors that will continuously increase in the context of climate change.

In addition to understanding intervention effectiveness, an implementation science approach to understanding the institutional and structural factors that facilitate or hinder effective implementation and scale-up of any interventions will also be required (Troup et al., 2021).

Research priority 6: Understand how communication around climate change can impact mental health

The media coverage of distressing events can at times lead to anxiety, uncertainty, and under certain circumstances, drive additional media consumption in an attempt to mitigate these feelings and instead create a cycle of distress (Neria and Sullivan, 2011; Thompson et al., 2019). Past research has found that the confirmation and validation of the unfolding impacts of climate change in the media had strong emotional impacts on the respondents sampled (Reser et al., 2012).

However, a large study in Australia found that, while most respondents reported feeling worried about climate change, there was no evidence to suggest that this worry was linked to mental health problems in the general population, concluding that respectful, calm, considered public debate about how to respond to climate change is unlikely to be harmful to population mental health (Berry and Peel, 2015). Indeed, many psychological reactions may not be pathological but may actually be adaptive (Verplanken et al., 2020). The solution is not to stop reporting on climate change but to systematically investigate how to ensure constructive reporting that promotes a feeling of agency and self-efficacy while maintaining consistent messaging on the urgency and severity of the climate crisis as a health threat.

A review of the state of climate change communication (Moser, 2016) has highlighted other important research needs relevant to the mental health effects of climate change, in particular how to communicate effectively with the growing sense of being overwhelmed and hopeless in an increasingly climate-changed world. Consistent with the concern for increasing negative mental health impacts of climate change communication, there have been calls to move away from negative fear-based messaging that might increase distress. However, the empirical evidence for or against this type of communication is limited (Reser and Bradley, 2017). One study has shown, for example, that presenting optimistic rather than pessimistic or neutral messages about progress on climate change reduced distress but also lowered motivation to act on climate change (Hornsey and Fielding, 2016). There is a clear need for research that identifies what content and channels will work best for specific stakeholders. For example, optimistic messages may be needed for climate change activists at risk of climate anxiety, whereas 'fear appeals' that increase concern and motivation may be needed in other groups. It is critical that climate change communication does not have the unintended effect of lowering distress over climate change while reducing motivation to contribute to climate change mitigation and adaptation.

In response to the COVID-19 pandemic, a set of research priorities for the mental health field has been proposed, with a section dedicated to the effect of repeated media consumption about COVID-19 on mental health (Holmes et al., 2020). Many of these research priorities (e.g., understanding the role of repeated media consumption in amplifying distress and anxiety, and optimal patterns of consumption for wellbeing) are also applicable to climate change, and future research should more systematically explore the association between climate change reporting and mental health and whether media reporting hinders or promotes action, among whom and how.

Research priority 7: Explore the interaction between engagement in activities that support climate change mitigation and adaptation and mental health outcomes

This research priority would explore whether mental health is influenced by views and engagement in activities that support climate change mitigation and adaptation, and vice versa. Climate action movements have gained considerable momentum in recent years (Gulliver et al., 2020), particularly among young people, but their relationship with mental health remain unclear. Engagement in climate action could engender hope through the solidarity and achievements of these movements and foster a sense of agency. Conversely, it could negatively impact mental health, for example, by creating hopelessness and burnout among people who are more aware of the gravity of the climate crisis and the lack of progress. Although some anecdotal evidence points to climate change activism playing a positive role in mental health among young people (Busby, 2019) and acting as a source of resilience (Noorani, 2020), there is no original research on this topic to the best of our knowledge.

Engaging less formally in activities that contribute to climate change adaptation and mitigation has been associated with positive mental health impacts. For example, a study examined environmental volunteering as a planetary health strategy with co-benefits for the environment and mental health (Patrick et al., 2021). Other studies have described how participating in community gardening programs may be beneficial for both mental and physical health (Hartwig and Mason, 2016). Understanding how different forms of engagement impact mental health, and how mental health informs engagement, is an important avenue for future research with a high potential for policy impact.

Research priority 8: Explore the association between and potential co-benefits of climate change mitigation and adaptation practices and mental health outcomes

Research on mental health and climate change should also focus on climate change adaptation and mitigation actions which may, in themselves, also impact mental health (Berry et al., 2010). To do this, multidisciplinary research will be required across sectors, including transport, water, energy, agriculture, and infrastructure. Current research is limited to one quantitative study assessing the impacts of decisions made in one sector (energy) on mental health (Wong-Parodi, 2020). Furthermore, studies assessing the effectiveness of climate change mitigation and adaptation strategies should start to regularly include mental health indicators as part of their assessments.

Research could further explore the potential mental health benefits of mitigation and adaptation actions taken by individuals and policies that encourage such actions, such as active transport, increased physical activity, and healthier diets (Rebar et al., 2015; Khalid et al., 2016; Wegner et al., 2020). There is a growing body of evidence to support the association between nature experience and mental health benefits (Bratman et al., 2019; Dillman-Hasso, 2021). Opportunities exist to make use of natural experiments in urban greening projects by assessing mental health impacts (South et al., 2018). Importantly, any such intervention should consider socioeconomic and racial-ethnic disparities in acess to urban green space (Rigolon et al., 2018), highlighting the need to understand the impact of mitigation and adaptation strategies on mental health in the broader context of the social determinants of mental health. Additionally, most of the research on exposure to green and blue spaces has been conducted in high-income countries and has often relied on a very particular conceptualisation of 'nature' which might not necessarily translate to cultures and countries that might have different relationships with and understanding of the natural world (Coscieme et al., 2020).

Policies aiming to address behaviour change when behaviour change is possible (e.g., encourage the use of public transport where public transport infrastructure exists, reduce unsustainable dieting habits if socioeconomic conditions allow, cut down flights among those who have the resources to travel) could draw upon insights on behaviour change such as ensuring people clearly know what to do, feel motivated to do it, and have the skills and opportunities to enact these changes (Michie et al., 2011). The contribution that mental health science can provide in addressing crises through behaviour change and adherence to behavioural advice was spelled out clearly in the context of the COVID-19 pandemic (Holmes et al., 2020).

Research priority 9: Understand how the evidence-base from mental health research influences decision-making related to climate change

Mental health is notably absent from impact assessments and policies related to climate change vulnerability and health risks. One multi-country assessment from the Pacific region identified psychosocial ill health as a priority among climate change-related health risks (McIver et al., 2016); however, to the best of our knowledge, no other regions or countries have included mental health in similar types of assessments. This reflects a broader omission of mental health within climate change and health policy and decision-making mechanisms. One study that explored policy documents on climate change in twelve countries highlighted how these documents made little mention of several vulnerable groups, including people with mental illness (Seidel and Bell, 2014). Out of the 16 national health adaptation strategies reviewed by the Lancet Countdown report in 2018 (Watts et al., 2018a, 2018b), mental health was the least considered climate-sensitive health outcome, mentioned by only 5 of the 16 national health adaptation strategies.

A better understanding is required of how key groups of decision-makers – from national policymakers to public health professionals to individual citizens – perceive the mental health risks posed by climate change, and whether perceived risk influences decision-making. This should include the full spectrum of mental health risks and potential responses; from evaluating how well policymakers outside of the mental health sector understand the mental health implications of their decisions, to how individuals perceive and respond to messages around the mental health risks from heatwaves or other extreme events. For example, a study from China describes how perceiving environmental pollution and ecological degradation as a risk for mental health played a strong role in determining participants' attitude and intention to submit an environmental complaint, more so than perceiving environmental pollution and ecological deterioration as a risk for physical health (Wang et al., 2019).

Research priority 10: Understand and quantify the economic costs of the mental health impacts of climate change

The economic impacts of climate change on health are substantial, with the economic burden deriving from the health impacts of climate change exceeding $800 billion per year in the US alone (Alwis and Limaye, 2021). Estimates of the economic costs of the mental health impacts of climate change are largely absent yet are likely to be substantial and crucial for informing decision-making in climate mitigation and adaptation strategies. Research into the economics of climate

change-induced mental health outcomes can and should consider the magnitude and distribution of economic impacts on individuals and families (health, productivity, workforce participation, school attendance), communities (anti-social behaviour, employment, investment), and health care systems across the short and longer-term.

Policy and service responses can be informed by mental health costs at all levels: primary prevention – policies to mitigate climate change; secondary prevention – policies to reduce the mental health impacts of climate change (e.g. protection/support programs, adaptation via urban planning, building codes, income safety net policies); and treatment – timely and effective interventions aimed at addressing the mental health impacts of climate change. For example, cost-effective interventions for people suffering from mental health problems have been identified (World Health Organization, 2019), and investment in mental health is characterised by a high return on investment with conservative estimates pointing to a return of US$5 for every US$1 spent on depression and anxiety care alone (Chisholm et al., 2016). However, no research has explored resource implications or investments to provide the required capacity to care for the mental health consequences of climate change nor how the return on investment to treat climate change-induced mental health conditions compares to these estimates (Charlson et al., 2021). More studies are also needed to understand the cost-effectiveness of evidence-based mental health and psychosocial support interventions (as described in research priority 5).

4. Discussion

Climate change represents the biggest health threat of the 21st century (Watts et al., 2018a, 2018b). There is an urgent need to advance our understanding of how climate change impacts mental health and what can be done to prevent mental health problems and promote mental health in the context of climate change through clinical, social, and political work at the individual, community, and societal level. Through consultation with experts, this paper has defined contemporary research priorities for the field of climate change and mental health. It is anticipated that the research originating from these priorities will inform interventions and policies on climate change and mental health resulting in evidence-based practices to safeguard mental health.

Several cross-cutting issues arose throughout this study. Firstly, it was noted that there was a lack of integration of mental health into the broader climate and health research agenda and vice versa. This represents both a large gap in assessing the evolving health impacts of climate change and a missed opportunity to protect population mental health.

Secondly, research to-date has been predominantly conducted in high-income countries. It is widely acknowledged that the impacts of climate change are disproportionately affecting the health of vulnerable populations and people in low- and middle-income countries (LMICs) (Hayes et al., 2018; Watts et al., 2018a, 2018b). Furthermore, LMICs have some of the highest treatment gaps for mental health conditions, leading to a double-burden of worsening climate change-related events and a lack of resources to cope with the likely mental health consequences (Patel et al., 2007). The harms of climate change can only be properly understood in the context of the social and economic systems, such as colonialism, capitalism and institutional discrimination, that both create and perpetuate inequalities and fuel the climate crisis (Klein, 2014; Zhang et al., 2021). Therefore, a climate justice approach is needed, recognising the structural and intersectional nature of pre-existing inequalities in mental health, with actions rooted in health equity and active hope (Hayes et al., 2018; Ingle and Mikulewicz, 2020). It will be important to remain mindful that the relationship between climate change and mental health will vary across communities and individuals. To be most effective, intervention development, adaptation, and implementation will need to reflect unique contexts and environmental challenges. Future research should focus more systematically on investigating climate change and mental health in LMICs and climate vulnerable contexts and marginalised groups in high-income countries.

Additionally, it was recognised that stakeholders – including people with lived experience of mental illness, healthcare professionals, communities that are most vulnerable to the mental health impacts of climate change, and decision-makers who are reposnible for developing and implementing policies and programs – should be invited to co-design the prioritisation and implementation of work in this field. This fits in with the CARM framework – collaborate, advocate, research (and educate), and mitigate – that has been proposed as a guide for psychiatrists to act on climate change (Every-Palmer et al., 2016; Zhang et al., 2021). Examples include participatory research that emphasises the voices and priorities of climate-vulnerable individuals and populations, addressing upstream determinants of mental ill-health and strengthening mental health care systems. A review focusing on small island developing states proposed a co-benefits agenda, where in the context of under-resourced health systems and stigmatisation of mental illness, discussions and actions on climate change could open conversations and avenues to address mental health and wellbeing issues in a way that is collaborative and empowers communities (Kelman et al., 2021).

5. Limitations

A number of limitations are present in the current paper. Firstly, the limited sample size may affect the generalisability of our findings. However, due to the embryonal stage at which the climate change and mental health field finds itself, our sample size is likely to have been sufficient to provide enough heterogeneity of perspectives and faithfully capture some important priorities. The diversity of the experts in terms of geographical location, areas of expertise, and occupation attempted to buffer against this risk. The lack of formal consultation with people with lived experience of mental health problems and/or with people and communities directly affected by climate change represents a further limitation of the current piece. While care was taken to represent most of the views and perspectives among the consulted experts, the authors inevitably had to condense many diverging concepts together. While providing feedback on the recommendations at various stages of the process, this may have led to a lack of nuance in certain recommendations. It is also important to note that this paper is limited to the impacts of climate change and does not fully address the equally damaging effects of biodiversity loss, habitat destruction and other forms of environmental degradation, for which additional research agendas are required. We intend for the priorities presented here to serve as a jumping off point and for them to evolve over time as the field of climate change and mental health grows and evolves.

6. Conclusion

While climate change is considered the biggest threat to global mental health in the coming century, tackling this threat could be the most significant opportunity to shape our mental health for centuries to come because of health co-benefits from a transition to sustainability. Research on the impacts of climate change on mental health and mental health-related systems will assist decision-makers to develop robust evidence-based mitigation and adaptation policies and plans with the potential for broad benefits to society and the environment. Progressing this research agenda will require a collaborative and global effort involving methodological innovation that draws upon other disciplines' experiences.

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CRediT authorship contribution statement

Fiona Charlson: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Supervision, Validation, Writing – original draft, Writing – review & editing. **Suhailah Ali:** Data curation, Formal analysis, Investigation, Validation, Writing – original draft, Writing – review & editing. **Jura Augustinavicius:** Methodology, Validation, Writing – original draft, Writing – review & editing. **Tarik Benmarhnia:** Methodology, Validation, Writing – original draft, Writing – review & editing. **Stephen Birch:** Writing – original draft. **Susan Clayton:** Data curation, Writing – review & editing. **Kelly Fielding:** Writing – original draft. **Lynne Jones:** Data curation, Writing – review & editing. **Damian Juma:** Data curation, Writing – review & editing. **Leslie Snider:** Data curation, Writing – review & editing. **Victor Ugo:** Data curation, Writing – review & editing. **Lian Zeitz:** Data curation, Writing – review & editing. **Danhusha Jayawardana:** Writing – original draft. **Andrea La Nauze:** Writing – original draft. **Alessandro Massazza:** Methodology, Supervision, Validation, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

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