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Review

Indigenous mental health and climate change: A systematic literature review

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ABSTRACT

Indigenous Peoples are among the most vulnerable to adverse mental health impacts resulting from climate change globally. In the context of a continually changing climate, an understanding of the diverse risks, impact, and responses of Indigenous communities to climate related mental health impacts is timely. The present study conducted a systematic literature review on the related effects, mechanisms of vulnerability, and adaptive responses and coping strategies to climate change related mental health impacts specific to global Indigenous Peoples. This review systematically selected articles from Scopus, MEDLINE, and Google Scholar, published since 2000. Twenty-three original studies were included for full review. The results confirmed direct impacts commonly caused by cumulative changes in climate increased non-clinical mental health impacts with the potential to develop to clinical mental illnesses with repeated, ongoing exposure. Also, indirect impacts further exacerbated various mechanisms of vulnerability amongst Indigenous communities, introducing unique intangible losses relating to place attachment, culture, food security and other socio-economic disadvantages. These results were dominated by specific regions, with few quantitative studies. This review emphasises the importance of engaging with Indigenous communities in responding to climate change, incorporating both qualitative and quantitative methods to capture indirect impacts to mental health, and understanding the priorities and existing adaption strategies that could integrate Indigenous cultures and knowledge.

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1. Introduction

Climate change poses one of the greatest challenges to human health in the 21st century [1]. The capacity for climate change to disrupt critical determinants of psychological wellbeing and health has been recognised as a key interface amongst bourgeoning research [2–4]. The social and emotional impacts to mental health and wellbeing, arising from climate change are often understood through two key causal pathways, either directly or indirectly (Fig. 1) [5]. The most immediate direct implications are associated with an increased frequency and severity of acute or longer term physical weather events, such as floods or cyclones, or gradual impacts such as changing temperatures [2,6]. The experience of such events may contribute to immediate trauma resulting from loss of life, damage to personal property, and other acute psychological conditions, such as post traumatic stress disorder [5]. Changes in climate can also indirectly impact physical and mental health in societies through disruption such as to infrastructure, sense of place [7], social environment, or displacement [8,9]. These observational changes in the environment with uncertainty about potential risks of the future have been demonstrated to evoke varying emotional responses from distress, or hopelessness, to more clinical mental health disorders.

Across the globe, Indigenous communities are among the most vulnerable, and disadvantaged groups, with varying degrees of decreased health and social outcomes [10]. Indigenous Peoples unique distinctive culture, language and social systems often go unrecognised, and are subject to widespread violations of human rights, and land dispossession globally [11]. These historical traumas are further intensified by ongoing socio-cultural and economic disadvantages that are reflected in higher rates of psychological illness, suicide, and behavioural issues including alcoholism, and substance abuse [12–14]. However, unlike western models of health, the land and sea are key determinants of general health, psychological, and cultural wellbeing for Indigenous communities globally [15]. This intrinsic connection and reliance on natural environments is seen as vital for facilitating health, strength, and cultural wellbeing. Further reliance on the land and sea extends to the practice of cultural traditions and aspects of livelihood that are important contributors to health [15]. However, climate change threats actively disrupt these

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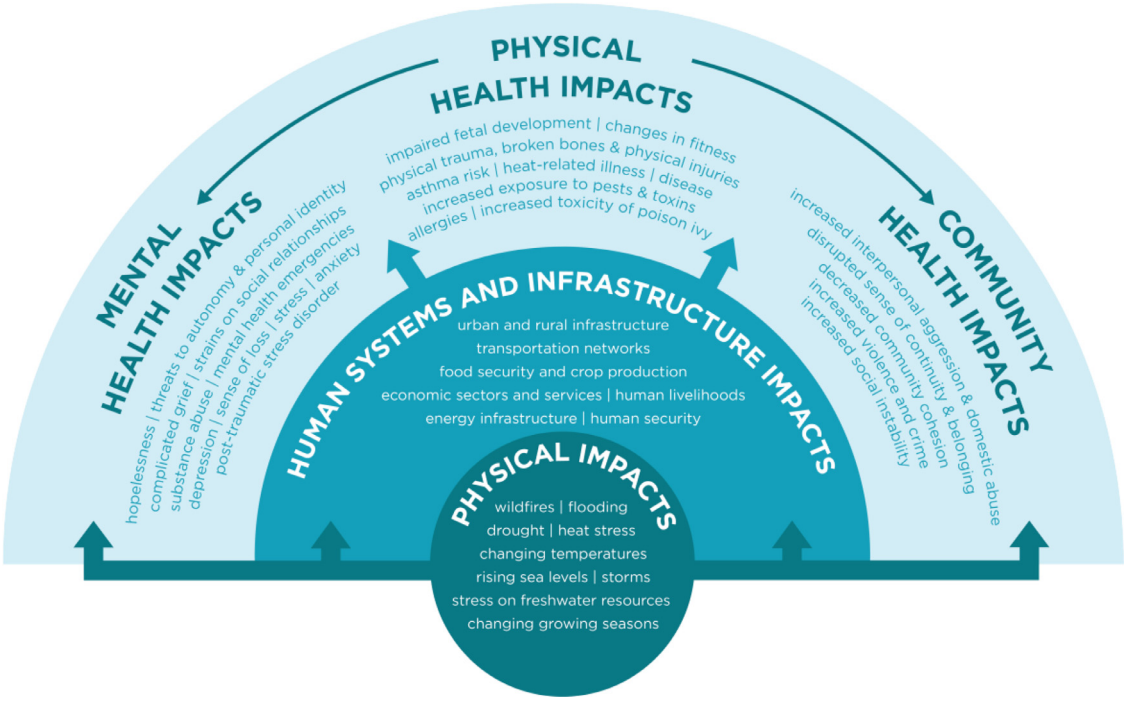

Fig. 1. Linking the physical and psychological impacts of climate change.
Clayton, S., C.M. Manning, and C. Hodge, Beyond Storms and Droughts: The Psychological Impacts of Climate Change. 2014, American Psychological Association and ecoAmerica; p.13.

unique key determinants of health and psychological wellbeing, especially for those communities in remote or rural areas [16–20].

With both climate change and the global burden of mental health predicted to rise [21], these inequalities are expected to increase, alongside new challenges for Indigenous communities globally. However, despite the importance of and need for research on this topic, few studies have focused on Indigenous communities, looking specifically at the mental health impacts associated with climate change on a global scale. Those that have attempted to review this issue, have been specific to regions, such as the Arctic or Circumpolar North [22,23], Australia [24] or Europe [25]. One scoping review of the global literature presented a broad overview of these themes, limited in articles between 2007 and 2018 [26].

This study aimed to systematically review literature relating to climate change and mental health among Indigenous communities globally to understand the risks and impact of climate change on mental health, their mechanisms of vulnerability, adaptive responses, and coping strategies to these impacts. Understanding the diverse risks, impact, and responses of Indigenous communities to climate change globally is timely, informing decision making, policy and proactive action in this study area. The aims guide the key research questions of this review – How does climate change affect the mental health and wellbeing of Indigenous communities globally? What factors contribute to this vulnerability? What could we learn to better understand and respond to climate change related impacts on Indigenous communities?

2. Material and methods

The methodological framework of the systematic review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [27].

2.1. Search strategy

Search terms and strings used were informed by keywords used in similar research, using an online thesaurus, and keywords suggested by the study supervisor. The final search string intended to capture all articles discussing the experience of climate change, and its relation to mental health outcomes, specifically among Indigenous or native populations globally (Table 1).

Two electronic databases were used in this review: SCOPUS and MEDLINE via OVIDSP. Google Scholar was also used as an additional supporting database, where possible combining key words and similar groupings of “climate change”, “mental health” and “Indigenous People”. The initial search was conducted on the 29th April 2020, with subsequent searches up to June 22nd 2021. A manual search of the reference list of included articles was conducted to identify any relevant papers not captured in database searches. Results were limited to the English language. Publications after January 2000 were included.

Table 1
Search terms used in SCOPUS and MEDLINE via OVIDSP.

Main Terms	Expanded Terms
Climate change/variability	“changing climate” OR "climat* chang*" OR "climat* risk" OR "climat* variabilit*" OR "climat* extrem*" OR "climat* uncertaint*" OR "global warming" OR "temperature ris*" OR "sea level ris*" OR "heat wave" OR "flood*" OR "bushfire*" OR "drought" OR "natural disaster"
Indigenous Peoples	"indigenous people*" OR "indigenous communit*" OR "indigenous group*" OR "native* people*" OR "primitive* people*" OR "primitive* communit*" OR "primitive* group*" OR "aboriginal* people*" OR "aboriginal* communit*" OR “inuit” OR “maori”
Mental Health	"post-traumatic stress disorder" OR "panic" OR "anxi*" OR "mental" OR "depress*" OR "fear" OR "mental illness" OR "mental wellbeing*" OR "psych" OR "emotion*" OR "solastalgia" OR "mental health" OR "PTSD" OR “grief”

2.2. Screening and eligibility

Prior to screening articles, duplicates were removed. Articles were considered eligible if: Indigenous population or relevant were the primary subjects; climate change, variability or conditions were discussed; mental health outcomes were discussed; and the relation between mental health and climate change was considered. No exclusions were placed on location. Articles also needed to be orignial studies, excluding reviews or commentaries.

2.3. Quality appraisal and synthesis

The critical appraisal was directed by two guidelines: The Critical Appraisal Skills Programme checklist for qualitative research, and quantitative (where appropriate) [28], and The Guidelines for the Critical Appraisal of Qualitative Studies adapted from Greenhalgh and Taylor [29]. Articles were independently reviewed by two reviewers. Any disagreements were discussed between reviewers. In synthesising the qualitative and quantitative findings, an inductive thematic analysis with a constant comparative approach was used, following the guideline developed by Braun and Clarke [30], to identify themes and subthemes across the included articles, with similar or related ideas pooled during analysis [31].

3. Results and discussion

3.1. Characteristics of the included studies

As shown in the PRISMA flow diagram (Fig. 2), from the initial 95 articles identified through database and other resource searches, 15 duplicates were removed, leaving 80 articles for an initial screen of title and abstract. From this screening 38 were excluded, as papers identified only two of the three themes being climate change, mental health and Indigenous populations, with often a single or no mention of the final third theme. Forty-two had the full text screened, 19 were removed for reasons including; not having Indigenous Peoples or communities as the primary subject, not primary literature, not relevant to mental health, not relevant to climate change, or the full text could not be accessed. For the final synthesis 23 articles were included.

Research in this field is emerging. The data collection period for the majority of studies (n = 13) took place between 2008 and 2010. Among the final 23 articles, the study types were as follows: 14 qualitative, 7 mixed methods, and 2 quantitative studies. The included articles were from the following regions: 12 (52.2%) conducted from Canada (6 Rigolet, 1 Iqualit, 1 Nain, 1 Nunatsiavut & NunatuKavut, 2 Nunatsiavut, 1 various regions), 5 (21.7%) from Australia (2 Queensland, 1 Torres Strait Islands, 1 New South Wales, 1 Northern Territory), 1 (4.3%) from Sweden, 1 (4.3%) from Taiwan, 1 from Greenland

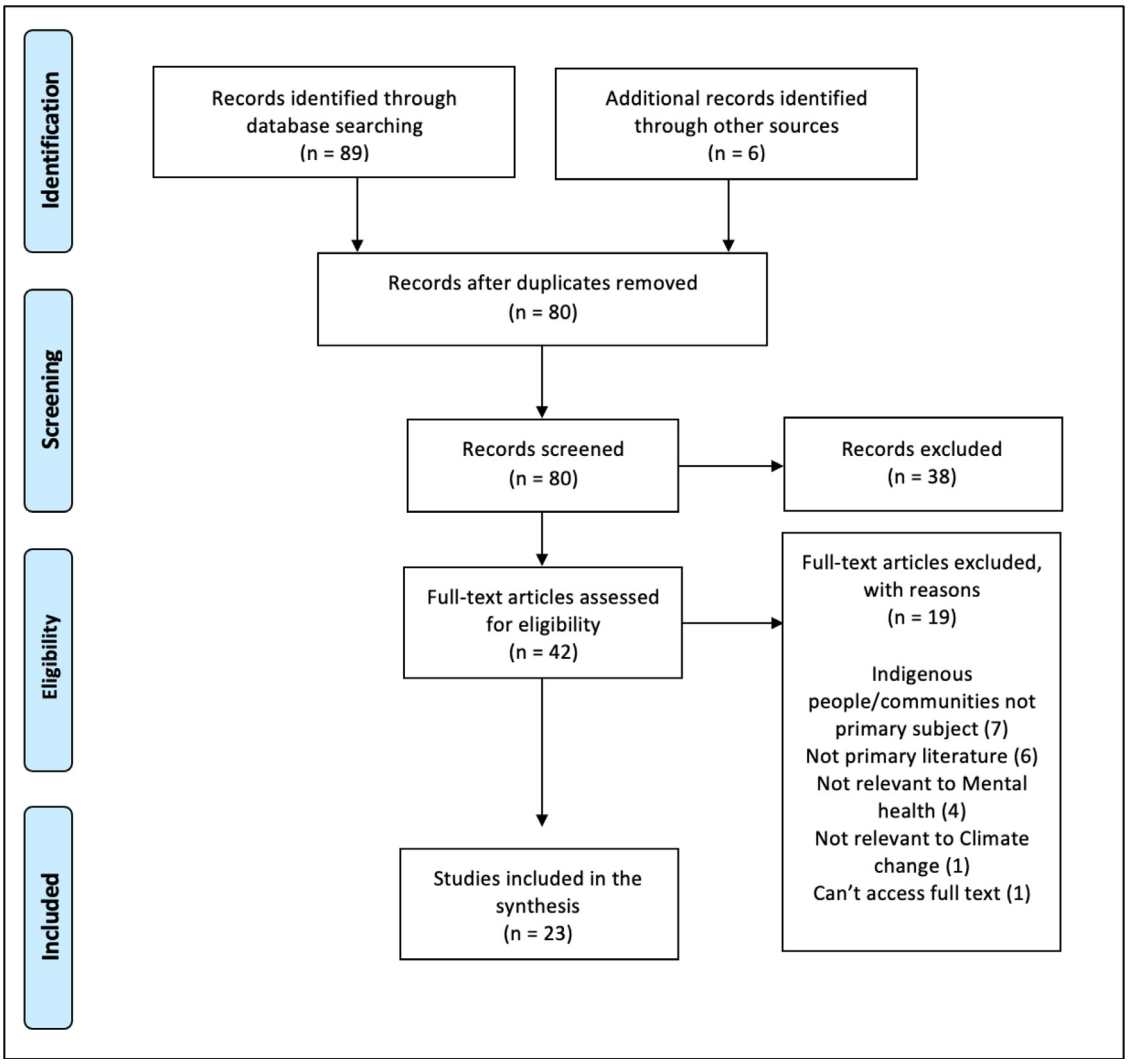

Fig. 2. PRISMA flow diagram.

(4.3%), 1 from Fiji (4.3%), 1 from West Africa (4.3%) and 1 (4.3%) from Russia.

Of the studies detailing gender, the majority of studies included female participants. All but three studies exclusively identified Indigenous populations as the study sample. The remaining three studies combining an Indigenous sample and a non-Indigenous group or participants [32–34]. Further characteristics of the included studies are available in Table 2.

3.2. Quality appraisal

The majority (n = 14) of studies used a qualitative case study design which could better capture underlying reasons and determinants to local stories. All but two incorporated semi-structured interviews. The use of conversational formats throughout qualitative methods was justified (n = 12) by allowing greater variability in responses, and increasing the opportunity for participants to contextualise personal experiences.

There were several applications of quantitative studies. The use of a Post-traumatic stress disorder (PTSD) Symptom Scale Interview (PSSI) in the Taiwan quantitative study adequately revealed mental illness consequences of climate change [32]. However, this application may be limited in overlooking other potential risk factors or mechanisms of vulnerability, such as social support that could be revealed through qualitative methods. In contrast, the use of the Environmental Distress Scale in one mixed methods study [35] gave quantified findings that complemented and supported sentiments revealed through qualitative measures. This approach aided in its adaption for use in the local environment and cultural context of the study, reducing risk of bias.

The cultural identification of the researcher within the study population was made clear in only four included studies. This potentially limited the methodological quality, with potential bias of non-indigenous researchers, or bias in the use of non-culturally appropriate research methods [36]. The use of trusted or familiar local researchers in data collection, or supporting Indigenous led initiatives may mitigate hesitations in the disclosure of often stigmatised topics of mental health.

Purposive non-random sampling strategies (n = 14) based on recommendations or recruitment by government officials, or community leaders were commonly used. These methods limited recruitment to those who were known to spend considerable amount of time on the land or sea, community leaders, or those who have a greater reliance on the land for financial livelihood [37–41]. These sampling methods often had smaller sample sizes and captured a majority of female participants with few distinctions between gender

Table 2
Study characteristics of 23 included articles in the literature review.

Author(s)	Year	Study Type	Location	Method	Data Collection Period	Number of Participants (Female/male)	Age range in years (median)
Adaawen [49]	2021	Qualitative	West Africa - Rural Savannah	Interviews, Survey, FGDs	Not stated	157 (36/121)	Not Stated
Boulanger-Lapointe et al. [38]	2019	Qualitative	Canada - Various areas	Interviews, Achieves	2007–2011	138 (81/57)	46 - 90
Borish et al. [37]	2021	Qualitative	Canada - Nunatsiavut & NunatuKavut	Video interviews	2019 Jan – April	84	Not Stated
Bunce et al. [45]	2016	Mixed Methods	Canada - Iqaluit, Nunavut	Interviews, FGDs	2015 June	42 (42/0)	24–80 (39)
Chen et al. [31]	2011	Quantitative	Taiwan	Interview - PTSD symptom scale	2009 Nov - 2010 Feb	120 (72/48)	55 - (67)
Cunsolo Willox et al. [35]	2012	Mixed Methods	Canada - Rigolet	Interviews, EDS survey	2009 Nov- 2010 Oct	184 (103/81)	9 - 85+
Cunsolo Willox et al. [42]	2013a	Qualitative	Canada - Rigolet	Interviews	2010 Jan - Oct	67 (40/27)	9 - 80+
Cunsolo Willox et al. [39]	2013b	Qualitative	Canada - Rigolet	Interviews	2009 Nov - 2010 Oct	57 (33/24)	9 - 60+
Durkalec et al. [53]	2015	Mixed Method	Canada - Nain	Interviews, FGDs	July 2010 / Nov 2010	32	Not Stated
Furberg et al. [46]	2011	Qualitative	Sweden	Interview	2009 Mar - June	14 (3/11)	16 - 75 (56)
Graybill [33]	2013	Qualitative	Russia	Interviews	2009–2010	20 (11/9)	24 - 85
Green & Martin [54]	2017	Qualitative	Australia, Aurukun, QLD	Interview - Individual + group	2009–2015	Not Stated	Not Stated
Harper et al. [47]	2015	Mixed Methods	Canada - Rigolet	Interview, FGDs, PhotoVoice Workshop, Survey,	2010	97 (45/54)	<20 - 50+
McMichael & Powell [50]	2021	Qualitative	Fiji - Vunidogola	Interviews	Nov - Dec 2015 / 2016 June / 2019 May / 2020 March	27 (13/14)	20 - 84
McNamara et al. [51]	2010	Qualitative	Australia, Erub Island, Torres Strait,	Interviews	2009 Sept- 2010 May	13 (13/0)	Not Stated
Middleton et al. [55]	2021	Quantitative	Canada - Nunatsiavut	Multi-level, multivariable negative binomial regression	2012 – 2018	Not Stated	Not Stated
Ostapchuk et al. [44]	2015	Mixed Methods	Canada - Rigolet	Questionnaire/ Interview	2009 Nov	50 (28/22)	50+
Pearce et al. [34]	2015	Mixed Methods	Australia, Mount Isa Region, QLD	Interview/ Questionnaire/FGD	2013	14	Not Stated
Petheram et al. [43]	2010	Qualitative	Australia, NE Arnhem Land, NT	Interviews	2008–2010	21 (9/12)	Not Stated
Petrasek-Macdonald et al. [41]	2015	Qualitative	Canada - Nunatsiavut (5 communities)	Interviews	2012 Nov - 2013 March	17	15 - 25
Petrasek-Macdonald et al. [40]	2013	Qualitative	Canada - Rigolet	Interviews	2010 Jan - Oct	13 (8/5)	15 - 25
Rigby et al. [52]	2011	Qualitative	Australia, NSW	Consultative forums	2008 July-Sept	166	Not Stated
Timlin et al. [48]	2021	Mixed Methods	Greenland – Disko Bay	Questionnaire,	2019 – Feb - April	Not stated	< 18–65 >

FDGs = Focus group discussion.

in the results (Table 2). These methods have inherent bias in that the sample is unlikely to be representative of the population being studied, which resulted in weak conclusions and less ability to make generalisations from the samples to the study population. An invitation to participate extending to all members of the study area was made clear in only three studies [35,39,42], potentially introducing non-response bias in other studies.

The age of participating Indigenous Peoples may be an important consideration in interpreting the quality of results. An Australian study amongst Yolngu Indigenous Peoples, noted that due to differing roles in the community, older members were able to disclose greater knowledge and information than others [43]. This was an important consideration, although it was not disclosed or may not be relevant to other study areas. As the median age of respondents was unknown for many studies, it was difficult to determine the applicability of potential bias in responses.

It is noted that previous research is limited to specific regions each with unique culture, climate perceptions and experiences. Thus, caution should be taken in extrapolating results beyond case study areas. In particular, the research was dominated by Canada and the Arctic regions. The heterogeneity of the included studies is limited due to the common use of same authors. It's noted that five papers in the review [35,39,40,42,44] were all parts of a larger, multi-year research project in Rigolet, Canada. The inclusion of all these studies in the review had the potential to skew overall results, or repeat the same findings.

There were some issues in data collection and analysis of the included studies. The duration and season of data collection could potentially introduce bias into the study design, such as by excluding participation of those who may be engaging in land-based activities (e.g., harvesting during specific seasons), or limited to experience of particular seasons that cannot be generalised to other time frames. The process of qualitative data analysis was rigorous with analytical steps to ensure quality control in some of the included studies, such as double coding, discussion with research teams and respondent or local leader validation. However, seven studies did not provide the clear steps taken during data analyses, which reduced the reliability of their results.

3.3. Evidence synthesis

The following three key themes were identified in the analysis: evidence of impacts on mental health through physical changes in the environment, mechanisms of vulnerability, and adaptation responses and coping strategies. Five additional subthemes within the key theme of the mechanisms of vulnerability included perception and understanding of climate change, place attachment, disruption to culture, food insecurity, and existing socio-economic disadvantages.

3.3.1. Evident mental health risks and impacts of climate change

Direct physical experiences of an enduring and cumulative changing climate were depicted most notably through variability in the abundance, quality and stability of ice and snow [35,39,40,44–48], rainfall [49], rising sea tides [50,51], droughts [34,49,52] and increasing temperatures [45,53]. In addition, changes were recognised in the variability of animal and insect populations, including caribou [37], mosquitos [45], salmon [33], feral pigs [54] turtles, and birds [51].

Exposure to these direct cumulative changes in their environments were linked with decreased mental wellbeing through the expression of sadness, worry, fear, decreased sense of self-worth and emotional distress. Other emotional responses varied in their experience across regions. Across rural Savannah, West Africa, participants expressed frustration regarding the erratic weather changes [49]. Similarly, in Rigolet Canada, responses to changes included anger and frustration [35,39,41]. Across Australia, a rise in aggression, community and domestic violence were frequently noted as emotional responses to climate changes [34,52,54]. Whereas in Russia, despite changes in the environment, anthropogenic climate change was associated with bitter humour and confusion [33].

Ongoing exposure to these direct climate changes, combined with other indirect climate related stressors such as decreased access to land and less opportunity to pass on traditional knowledge, demonstrated the potential for increased need for mental health services [42,47], and engagement in substance abuse or violence as evident in Rigolet Canada, low lying coastal villages in Fiji, and various regions in Australia [34,42,44,50,52,54]. Across two studies involving youths in Rigolet Canada, increasing travel restrictions due to climate change introduced feelings of boredom, and consequently increases in alcohol and substance use [40,41]. Furthermore, Indigenous Australians in rural New South Wales experiencing ongoing years of extreme drought, revealed their substance use was related to deflated emotional wellbeing, and threats of self-harm or suicide [52].

High rates of suicide amongst Indigenous Australian Pastoralists was also noted, although no prevalence rates or direct linkage to climate change was provided [34]. Both qualitative and quantative exploratory studies in Canada noted that definitive links between climate change and suicide were not yet possible, due to the myriad of other contributing factors and stressors [42,55]. In contrast, the experience of more extreme weather events and subsequent risk factors contributing to PTSD symptomology were evident in Taiwan [32].

Variance in impact and experience differed across some genders and age groups. Women were identified as more vulnerable in Iqaluit Canada [45], and similarly less able to cope to environmental changes in Russia [33]. Several papers specifically among women suggested they experienced high levels of 'sadness', that was not noted in other mixed gender studies [35,45,51]. In Taiwan, being a woman was identified as an independent risk factor for PTSD (OR = 3.63, 95% CI: 1.11−11.88), and PTSD or being a woman was noted more common amongst older community members [32]. Similarly, emotions of anger, fear, frustration, and increased stress were suggested as greater in women than men in Rigolet Canada [35,47]. Men were also less likely to take actions to deal with stressors, or talk about them [45]. In Rigolet, youth (15−25 years) voiced concern for Elders and seniors in the community, who faced rapid changes in culture and technology, exacerbated by a lack of access to the land, and expressed their own anticipatory concerns for their future [40]. This was also reflected by Indigenous Elders across regions in Canada and Disko Bay Greenland, expressing their concern for the next generation and fears for their connection to their culture and the land [37,44,48]. Unique to Greenland, being of a younger age was positively associated with reporting 'very good wellbeing' compared to older age groups [48]. The reason for the different views among younger generations may be related to unique local environmental, social and cultural factors, which need further investigations.

3.3.2. Mechanisms of vulnerability

Five subthemes were identified that affected the vulnerability to climate change related mental health effects experienced by Indigenous Peoples and communities.

Perceptions and understandings of climate changes: All populations were aware of changes in climate or the environment but they were often depicted as 'unrecognisable', 'unpredictable', 'strange' or 'wild'. The perception, understanding, recognition and experience of the changes differed across regions. In the Fijian village of Vunidogoloa, rising sea levels and coastal erosion were attributed to climate change and their rationale for relocation to higher ground [50]. However, an understanding of 'anthropogenic climate change' was scarce in the literature. In Russia, this notion of anthropogenic climate change was not recognised, and current climatic related outcomes not expected to be significant [33]. In Rigolet Canada, 96% of the Indigenous Elder's identified they were aware of the term 'climate

change' or 'global warming', although the accuracy of their understanding was not made clear [44]. There were limited discussion on the causes of the changes in climate. In rural Savannah, West Africa, the cutting down of trees for charcoal and fuelwood was noted as a contributor to observed changes, as well as punishment from God [49].

Climate change as a threat was perceived as a distant or less immediate concern amongst communities in Canada [45], Australia [43] and Sweden [46]. Instead, these communities pronounced food security, housing shortages, alcoholism, adaptive capacities and high suicide rates as some of their more immediate threats or priorities. This notion was also relevant to anthropogenic climate change scepticism, particularly amongst men in Russia [33]. In contrast, mental health was identified as a climate-sensitive health priority in the region of Nunatsiavut Canada [47].

Place attachment: Place attachment and the importance of the land emerged as the second subtheme, as a mechanism for added vulnerability to climate related mental health outcomes. A strong cultural, and spiritual connection to the land amongst Indigenous communities underpinned all articles. Time spent on the land or ice was positively associated with various psychological factors. This included a sense of identity, particularly amongst Canadian Inuit, expressed as "part of them" [35,39,40,42,43]. Similarly, the land was associated with increased self-worth [39] and exercising important cultural practices, such as hunting, fishing, socialising [37,53,54], and maintaining relationships [41] that were positively associated with good mental health.

Intrinsic connection and attachment to the land as a determinant of health and wellbeing [47] was also associated as a protective factor for mental health. The land was noted as having capabilities to alleviate stress, and provide mental clarity [45,53]. In Australia, this was reflected in the land as an opportunity to escape feelings of despondency and negative social environments, such as drinking, and violence that was increasing in the community [54]. On a grander scale, disruptions to time spent on land also associated with depressive symptoms, on both an individual and community level. In Rigolet Canada, it was noted that Elders' perceived sense of depression throughout the community was associated with decreased access to the cabin [44]. 'Boredom' resulting from lack of access and capacity to work on the land was attributed to increases in alcohol consumption amongst Indigenous Australian Pastoralists [34]. Whereas, increases in alcohol consumption and family violence amongst Fiji villagers following relocation was attributed to a disruption to place and consequently mental wellbeing [50].

Place disruption due to relocation, and reduced mobility was a common notion. Unplanned relocation following cumulative or extreme weather events were also reported, and associated with feelings of 'loss' and 'fear'. Encroaching high tides in the Torres Strait Islands threatened relocation, the upheaval of homes, and cultural identity inflicted fear amongst female Elders [51]. Emotions associated with relocation were also identified risk factors for PTSD and depression amongst Taiwanese communities following exposure to a typhoon [32].

Disruption to culture: With limited access to the land as a result of a changing climate, increasing disruptions to Indigenous culture from decreased land access, and the associated impacts on mental wellbeing emerged as the third subtheme. Globally, Indigenous traditional and local knowledge underpinned a variety of important social and cultural activities such as fishing, hunting, herding, sewing, and art [37,42,45,46,51]. Without access onto the land or sea, concern was heightened about an inability to pass on traditional practice and local knowledge from Elders to youth [37,47,54]. Canadian youth in Rigolet sharing these concerns, with fears for their own future cultural identity [41], expressed stress and worry in "if I was not Inuit, what am I?" [40]. The inability to heal on the land, or perform traditional practice, was highlighted as an additional stressor for anxiety [39] and toward suicide ideation in a Rigolet exploratory study [42]; however, no measure of prevalence or incidence of these impacts were gathered by the included studies. Additionally, in Australia, the inability for female Elders to collect shells or participate in traditional Indigenous art was associated with psychological distress and confusion [51].

Food insecurity: Food insecurity was a common pathway highlighting the interface between climate variability and mental health [37,38,45]. Disruptions to the quality, accessibility and availability of harvests, and other country foods were associated with mental health outcomes across various locations. Food insecurity rose concerns of malnutrition in the community [49]. The practice of sharing food was identified as an important cultural tradition amongst Canadian Inuit, Fijian, and Australian Indigenous communities [38,50,52]. For Inuit women, country food was an important positive reinforcement of their culture and mental health through its' connection with the land and it would allow them to de-stress, and socialise with other women and children [38,45]. Accessibility was also a concern, due to increased climate related restrictions. Increases in travel to locate quality harvests introduced stress for individuals' safety on new routes [45], financial pressures across Canada [38] and distress for family and friends in Russia [33].

Existing socio-economic disadvantages: Broader social injustices faced by Indigenous communities were identified as another mechanism for vulnerability. In Australia, the experience of drought limited employment opportunities. A lack of alternative skills or qualifications exacerbated unemployment and was associated with decreased self-worth and an inability to earn and provide. These emotions led to despair, alcohol use, and violence, including domestic violence [34,52]. In addition, Swedish Sami reindeer herders expressed facing additional disadvantage due to decreased land availability from cumulative changes. This resulted in competing businesses on the land, such as for tourism, leaving them with a sense of powerlessness and resignation towards authorities. This experience was associated with a sense of deflation and frustration in the perception that their traditional cultural practice was no longer valued or validated, despite personal and community importance [46]. Similar experiences were felt amongst Greenlandic people, expressing increased distress by the lack of job opportunities particularly in the winter, growing competing tourism, and poor infrastructure [48].

3.3.3. Adaptive responses and coping strategies

Throughout the articles, the notions of adaptation and coping strategies in response to mental health adversities, relating to climate change were observed. These strategies differed significantly across cultures.

The notion of maintaining and sharing cultural traditions and time spent on the land was consistently noted as a coping mechanism to experienced climate changes. In Australia, the need to utilise traditional environmental knowledge and practice to adapt to climate related health adversities and minimise further escalation of socio-cultural problems was identified [43,54]. These included engagement in music, art and dance as important strategies to ensure the continuation of traditional teachings while boosting emotional wellbeing amongst Australian Aboriginal and Torres Strait Islander Peoples [43,52]. These practices were associated with decreased climate related distress and increased community resilience [34]. Similarly, Canadian youth in Rigolet identified time spent on the land and amongst family and friends they trusted as key strategies to improve mental health outcomes [41].

Engagement with youth to ensure the passing down of traditional ecological knowledge was an important consideration to ensure the future strength and resilience of an Indigenous way of life. In Australia the need to utilise traditional environmental knowledge and practice to adapt to climate related health adversities and minimise further escalation of socio-cultural problems was identified [43,54].

Similarly, despite their anticipatory concerns, youth in Rigolet recognised that Inuit communities had continuously adapted to adversities, giving them a mentality of preparedness, adaptability and resilience to "deal with it" [41]. These youth suggested strategies in response to inabilities to access the land for traditional activities, such as land camps to pass on knowledge, moving cabins closer to Rigolet to reduce travelling far distances, and increasing activities in town that were not dependant on the land [40,41]. Similarly, Innuit youth and Elders noted sourcing alternative wild food, such as moose instead of Caribou as a response to ensuring the knowledge and culture of Caribou hunting was maintained [37].

The importance of engaging with women as active participants in adaptation and passing down of important ecological knowledge was mentioned. In Arnhem Land, Northern Territory, Australia, programs were in place to empower women that involved taking pregnant women on the land to for cultural foods with female Elders to ensure adequate nutrition, passing on ecological knowledge, and maintaining kinship [43]. Similarly, for women in Iqualuit Canada, their contemporary role involved earning an income primarily from country foods and land-based activities such as sewing or berry picking [45]. Experiences and engagement on the land introduced gender specific coping strategies and adaptation methods. In contrast, discussion of maladaptive coping strategies were less common in response to restriction on access to the land and fulfilment of wellbeing.

4. Conclusion

Varying degrees of connection between mental health and climate change amongst Indigenous communities globally are evident although complex. This review demonstrates the mental health impacts of climate change and variability occur in a multifaceted context combining social, cultural, economic, political and spiritual conditions. The combination of these factors shapes the experience, degree of impact, vulnerability, perception, and response to mental health outcomes resulting from climate change.

This review highlights that climate change exacerbates various mechanisms of vulnerability unique to Indigenous Peoples, and introduces further indirect, and intangible mental health effects, often expressed as non-clinical. In particular, the capacity of time spent on the land to fulfil key individual determinants of psychological wellbeing was widespread across the literature, and in some instances extended to entire communities [44]. This review emphasizes the capacity of climate change to threaten this physical and spiritual relationship extending to disruptions to culture, access to country foods, and other social injustices.

Importantly these findings suggest the impact of climate change on the mental health of Indigenous communities expands beyond the expected rates of incidence and prevalence of mental illness. Various indirect impacts associated with climate change have the potential to be extremely detrimental to the socio-cultural wellbeing of Indigenous communities. These findings also emphasize the difficulty and inability in attributing cause and effect between cumulative, indirect and intangible experiences of climate change and mental health [56].

Underpinning these mental health impacts is a desire to adapt and respond to climate change amongst Indigenous communities. This review confirms the importance of traditional knowledge, cultural identity, social connections and kinship as key adaptative and coping strategies. The mediating effects of social support and kinship in minimising impacts to mental health and wellbeing as evident in this review, reflect a notion of health beyond the individual. This review depicts that community cohesion and support are a potential protective factor to climate-related mental health outcomes.

This review suggests the value in empowering Indigenous youth and women in determining future responses to climate change. Valuing and harnessing their knowledge and awareness is important in ensuring the strength and capacity of Indigenous communities to cope with adverse health outcomes resulting from climate related disruptions, now and in the future [18]. This review emphasises opportunities to empower both Indigenous youth and women with cultural safety and awareness towards increased resilience to climate change and mental health outcomes.

Future studies need to engage closely with, or support Indigenous driven initiatives, valuing and utilising their knowledge of the land. Also, considering the differing perceptions, experiences and understandings of climate change, with the associated mental health impacts is an important prerequisite to allow a better reflection of Indigenous priorities and success of future policy or research, including perceptions of vulnerability, resilience, and adaptation [57]. Future research could benefit from the convergence of both qualitative and quantitative evidence using mixed methods designs. Incorporating culturally appropriate assessment strategies in mixed-methods research can be beneficial to support future policy and research in this area.

The results presented in this systematic literature review extend the findings of an earlier scoping review [26] by providing updated, collated evidence specific to focused research questions including, not only mental health impacts and vulnerability, but also responses to climate change. However, there are several limitations in our study. A major limitation is the use of articles published only in the English language. This is evident in exposing the disparities in the literature with information concentrated to a small number of researchers across regional areas of Canada and the Oceania. This review identified few population specific understandings of the vulnerabilities of other Indigenous communities, and noted only two papers from the largest Indigenous populations across Africa and Asia. Further, specific focus to regional or remote areas, with no identification for Indigenous communities in more urban areas of living, where effect and vulnerabilities may differ is another limitation.

In conclusion, there has been increased research on Indigenous mental health and climate change since the IPCC Fourth Assessment Report released in 2007, although limited to specific ethnic groups with few quantitative studies. In synthesising the research relevant to Indigenous mental health and climate change, this review has highlighted the complex ways climate change can affect mental health and emotional wellbeing through physical changes in the environment, and in exacerbating existing vulnerabilities affecting capacity to respond. There are both direct and indirect impacts of climate change and these often-intangible losses introduce a myriad of disruptions to critical determinants of psychological wellbeing and health amongst Indigenous communities, and increase susceptibility to climate-related mental health impacts. The awareness and responses of Indigenous communities to these climate-related mental health impacts should not be discounted. Rather, greater engagement and understanding of key priorities, and adaptation strategies relevant to specific Indigenous groups is necessary. Due to the research gap identified in the global south, we call for more research on this topic in the global south, considering the high cultural diversity and health challenges from climate change in this region. Moreover, this should be a priority for regional and global research funding agencies.

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.

CRediT authorship contribution statement

Emily Ann Vecchio: Data curation, Formal analysis, Writing – original draft. **Michelle Dickson:** Supervision, Writing – review &

editing, Visualization. **Ying Zhang:** Conceptualization, Methodology, Supervision, Writing – review & editing, Visualization.

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