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BASIC RESEARCH ARTICLE

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Mental health impacts of climate change and extreme weather events on mothers

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ABSTRACT

Background: The perinatal period is a time of increased vulnerability for perinatal mood and anxiety disorders (PMADs). Emotional trauma is a risk factor for PMAD development and is common among survivors of extreme weather events (EWEs), which are becoming more frequent and intense as the climate crisis progresses. EWE-related stress and anxiety have not been extensively studied in the perinatal population. However, the limited available data suggest a negative impact of EWE exposure on perinatal mental health, warranting further investigation and investment.

Objective: To address this knowledge gap, we interviewed new Australian mothers to understand how EWEs affect the mental health of the perinatal population.

Method: Australian mothers (18 years of age or older) with a baby under 12 months of age were recruited to participate in a single virtual focus group session (seven group sessions were run in total) and complete an anonymous survey. Participants were asked questions regarding their concerns about extreme weather and its impact, as well as their general maternal functioning. Maternal functioning, depression, and climate distress were measured via the survey.

Results: The study sample comprised 31 Australian mothers ($M_{age} = 31.74$, $SD = 4.86$), predominantly located in Queensland. Findings from the focus groups suggested six key themes; however, of focus to this study are three themes related to maternal mental health: health and well-being, helplessness and avoidant coping, and resilience and adaptation. Predominant subthemes focused on trauma resulting from EWE exposure, economic and heat concerns, social isolation, hopelessness about the future, and feelings of resilience.

Conclusions: The evidence linking adverse perinatal mental health outcomes with climate change and EWEs highlights the urgent need for interventions in this context to protect perinatal mental health and well-being. By acknowledging the traumatic impact of these experiences on mothers, this study supports advocacy for policies that specifically address this issue.

Los impactos del cambio climático y los fenómenos meteorológicos extremos en la salud mental de las madres

Antecedentes: El periodo perinatal es un momento de mayor vulnerabilidad a los trastornos de ánimo y ansiedad perinatales (PMADs por sus siglas en ingles). El trauma emocional es un factor de riesgo para el Desarrollo de PMAD y es común entre los sobrevivientes de fenómenos meteorológicos extremos (EWEs por sus siglas en ingles), los cuales son cada vez más frecuentes e intensos a medida que avanza la crisis climática. El estrés y la ansiedad relacionado con EWEs no se han sido estudiado exhaustivamente en la población perinatal. Sin embargo, los datos limitados disponibles sugieren un impacto negativo de la exposición a los EWEs en la salud mental perinatal y por lo tanto justifican una mayor investigación e inversión.

Objetivo: Para abordar esta brecha de conocimiento, entrevistamos a recientes madres australianas para comprender cómo EWEs afecta la salud mental de la población perinatal.

Método: Se recluto madres australianas (de 18 o más años) con un bebé menor de 12 meses para participar en una única sesión individual de grupo focal virtual (7 en total) y completar una encuesta anónima. A las participantes se les hicieron preguntas sobre sus preocupaciones acerca de fenómenos meteorológicos extremos y su impacto, así como también su funcionamiento maternal general. El funcionamiento maternal, depresión y malestar climático se midieron a través de la encuesta.

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PALABRAS CLAVE
Salud mental perinatal; eventos climáticos extremos; cambio climático; madres australianas

HIGHLIGHTS

- The extra consideration of navigating climatic events with children represented a complicating factor in addition to the demands of motherhood.
- Heat presented as a serious concern for participants, often as part of maintaining the balance between protecting their children's health and well-being and preserving their own mental health.
- Mothers simultaneously were disengaged from climate-related discussion or action and expressed feelings of helplessness in the face of the magnitude of climate change.

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Resultados: La muestra del estudio estuvo compuesta por 31 madres australianas (Edad *M* = 31.74, *DS* = 4.86) localizadas predominantemente en Queensland. Los hallazgos del grupo focal sugirieron seis temas claves, sin embargo, en este manuscrito se centran en tres temas relacionados con la salud mental materna: salud y bienestar, impotencia y enfrentamiento evitativo, y resiliencia y adaptación. Los subtemas predominantes se centraron en el trauma resultante de la exposición a EWE, preocupaciones económicas y del calor, aislamiento social, desesperanza sobre el futuro y sentimientos de resiliencia.
Conclusiones: La evidencia que vincula los resultados adversos de salud mental perinatal con el cambio climático y los EWEs enfatizan la urgente necesidad de intervenciones en este contexto para proteger la salud mental y bienestar perinatal. Al reconocer el impacto traumático de estas experiencias en madres, se apoya la promoción de políticas que aborden específicamente este problema.

1. Introduction

Climate change represents a global health risk, with profound implications for both population well-being and healthcare systems (Ebi et al., 2021). The impact of climate change and extreme weather on people's mental health and well-being is well documented in the literature (e.g. Barkin et al., 2021; IPCC, 2022; Willox et al., 2012). Changes in weather patterns and the increasing frequency of extreme weather events (EWEs) can create a sense of fear and helplessness, leading to psychological trauma and post-traumatic stress (Barkin et al., 2021). In addition, the associated loss from such events, for example one's home, livelihood, or health, can exacerbate feelings of grief and depression (Cunsolo & Ellis, 2018). The uncertainty surrounding climate change (as it pertains to the future of our planet) can also lead to eco-anxiety, defined as 'a cluster of emotional distress syndromes about climate impacts and the inadequacy of the human response' (Rothschild & Haase, 2023). Despite these impacts being felt worldwide, some populations are disproportionately affected. For example, women and mothers are at an increased risk of experiencing burden due to climate change (Al Gasseer et al., 2004; Barkin et al., 2022; IPCC, 2014; Sato et al., 2016). This increased risk is in part due to the distribution of roles, resources, and decision-making power of this population, particularly in low- and middle-income countries (Sorensen et al., 2018).

Women shoulder an extra burden, as traditionally they fulfil the role of primary caregiver and advocate for their family's health. In fact, their own self-care often suffers as a result of their caregiving role, which disproportionately focuses on the well-being of one's family rather than oneself (Barkin et al., 2010; Barkin & Wisner, 2013; Ciciolla & Luthar, 2019). During the perinatal period, women are vulnerable to the development of mood and anxiety disorders (PMADs), which are the most common complication of childbirth (Wisner et al., 2013). Hormonal, physical, environmental, and role changes coalesce in ways that challenge mothers' mental health and sense of identity (Barkin et al., 2010; Williamson et al., 2023). PMADs are also associated with a considerable financial and public health burden, costing Australia $877 million annually (PwC, 2019). Taken together, the associated trauma of potential displacement, injury, and/or loss due to climate change can compound the already challenging transition to motherhood. Given the concerning state of mothers in the perinatal period, as well as the increased frequency and intensity of EWEs (IPCC, 2022), the mental health effects of climate change and extreme weather on this population warrant investigation.

While there are many events in a person's lifetime that can qualify as traumatic, including those specifically related to the maternal period (for example, neonatal loss, preterm birth, or traumatic birth experiences), the focus of this piece is the trauma borne out of exposure to EWEs (Jeffers et al., 2022). Earlier reviews on the nexus between environmental disasters and perinatal mental health have shown that the severity of exposure is a predictor of mental health issues, for example, negative mood symptoms, among pregnant and postpartum women (Barkin et al., 2022; Veenema et al., 2023). Evidence suggests that the climate crisis influences women's choices when it comes to deciding whether or not to have children (Smith et al., 2023), and that even indirect experience of weather events is a concern for mothers (Harville et al., 2010). Evidence also indicates that the mental health of the mother after a disaster may influence child development more than any direct effect of disaster-related prenatal stress (Harville et al., 2010). Similarly, the noteworthy 'QF2011' study by Lequertier et al. (2019) investigated pregnant women during the Queensland 2011 floods, and also found that exposure to a natural disaster during pregnancy impacted child development (Lequertier et al., 2019). A recent review on the impact of wildfire exposure found an array of negative impacts on perinatal women, including health-related concerns, stress and trauma responses, changes to relationships,

and financial stress (Evans et al., 2022). Furthermore, greater peritraumatic distress and dissociative experiences resulted in more severe post-traumatic stress disorder-like symptoms, in those who had experienced the 2016 Fort McMurray Wood Buffalo wildfire during or shortly before pregnancy (Verstraeten et al., 2021). A study conducted on pregnant or new mothers during the 2019/2020 Australian bushfires also revealed a number of psychological concerns reported by mothers. Such concerns included re-traumatization, increased anxiety and distress of the event affecting their unborn child, as well as worry about the future climate (Davis et al., 2023). Also of note, recent literature has highlighted that air pollution, which is worsened by global warming, is associated with mental health deterioration during the perinatal period (Surace et al., 2023). The aforementioned studies underscore the multifaceted impact of environmental events on perinatal mental health, showcasing the nuanced relationship between environmental factors, maternal stress, and subsequent child development. Despite these findings, there is a scarcity of research directly focused on the mental health impact of EWEs specifically on women and mothers, or on the unique risk that this population faces, with research often identifying women as a 'subpopulation' of the main study analysis, or mothers as a secondary consideration to their children, or being focused on the experience and impressions of relief workers or clinicians (Barkin et al., 2021, 2022; Tiwari et al., 2022).

Many of the aforementioned studies focus on the physical and clinical health of children. Receiving less attention has been the health and well-being of mothers, who often serve as the primary carer or family health advocate. Only recently has the effect of the climate crisis on the perinatal population received attention, with both the Intergovernmental Panel on Climate Change (IPCC) and the Royal Commission into National Natural Disaster Arrangements explicitly stating that pregnant women are a vulnerable group in the face of extreme weather (Commonwealth of Australia, 2020; IPCC, 2023). Furthermore, scant research has examined the Australian context in particular, with the recognition of climate change potentially impacting the mental health of Australians being a relatively recent development (Bradshaw et al., 2023). In this context, heatwaves are becoming more prolonged, and droughts are causing detrimental impacts on water supplies across the country (Beeson, 2020; Gleick, 2012; Pearce et al., 2013). In addition, bushfires have destroyed habitats and threatened human lives in the south and north of Australia, and intense rainfall events have triggered flash floods, leading to widespread infrastructure damage and community displacement (Commonwealth of Australia, 2020). In the present article, we aim to explore the negative mental health consequences of climate change and/or EWEs as reported by new Australian mothers, to develop a further understanding about what places this population at a heightened health risk in this context.

2. Method

2.1. Design

An explorative design was employed. Participants recruited via purposive sampling completed a short quantitative survey that first gathered the demographic characteristics of participants, as well as quantitative data pertaining to participant-reported depression, climate distress, and maternal functioning. This was followed by participation in a one-time focus group session, which aimed to gather deeper insights into participants' functioning in the context of extreme weather and to develop understanding of one's experience with EWEs as a new mother. In the formulation of our qualitative research questions, a collaborative effort was undertaken by our research team, which collectively possesses extensive experience in the fields of medicine, perinatal mental health, and environmental psychology. The objective was to craft questions that would effectively delve into the nuances of this underresearched topic. Purposive sampling was employed, whereby when no new information or themes emerged from subsequent focus group sessions, this indicated that the data collection process had successfully captured the depth and breadth of the subject matter. Ethical approval was obtained through the James Cook University Human Ethics Committee (approval number H8916).

2.2. Setting and participants

Recruitment sites included online social media networks (Twitter, Facebook, and Reddit) and university networks. Potential participants were presented with a URL where they could sign up to be part of the study. If individuals met the eligibility criteria (18 years old or over, residing in Australia, with a baby $\leq$ 12 months old), they were contacted by the principal investigator (PI). Through staged and appropriate timed communication, the PI sent the participants the Information Sheet, the link to the anonymous survey (where consent was obtained), and a link to participate in the focus group session via Microsoft Teams. Participants completed the anonymous survey via the Qualtrics online platform, and statistical analyses were performed in SPSS version 27. Participants received an AUD$35 Amazon giftcard in return for their participation.

Seven focus group sessions were held between February and April 2023. Before the start of each focus group, participants received a brief about the study,

including a description of the focus group procedure, measures for confidentiality, and the opportunity to ask questions. Each focus group session lasted for 60–90 minutes. A moderator (the PI) led the focus group sessions and was assisted by one or two study investigators.

The focus group sessions were facilitated by a semi-structured question guide (see Appendix I), including the following content areas: the impact of extreme weather on the participant as an individual and as a mother, the most worrying aspects of climate change or extreme weather, and the ability to protect family and children. The guide was not used as a strict manual, but rather as a conceptual framework aiming to direct or expand the discussions. The moderator used open-ended questions and probes, such as 'can you explain further?', and participants were also encouraged to discuss freely anything in mind. All focus group sessions were audio recorded and transcribed using Microsoft Teams.

2.3. Survey measures

Table 1 shows each of the survey measures for the current study. Each scale used in the study was intended to gather descriptive insights regarding the mental health-related information of the population. Specifically, the Barkin Index of Maternal Functioning (BIMF) scale was included to assess a broad range of aspects related to a mother's well-being, including emotional, social, and practical functioning, allowing us to capture a comprehensive picture of the impact of climate change on the mental health and overall functioning of new mothers. The Center for Epidemiologic Studies Depression (CES-D) scale was added to assess symptoms and severity of depression. This specificity allows us to quantify the impact of climate change on maternal mental health in terms of depressive symptoms. To address the study objective specifically, the Climate Distress Index (CDI) was added to assess the psychological and emotional impact of climate-related stressors. This allows for a more nuanced and focused examination of how climate change affects mental health in the perinatal population.

2.4. Analysis

At the completion of each focus group discussion, a small debriefing took place. During the debriefing, the facilitator and other study investigators convened to discuss prominent study themes. The audio files were transcribed automatically using Microsoft Teams. The transcriptions were reviewed while listening to the recordings to check for accuracy, and amended as necessary. These were saved as large text files, with over 8 hours of focus group conversations resulting in 165 pages of text data.

Data analysis was undertaken using the reflexive thematic analysis approach, as adopted by Braun and Clarke (2022). Themes were identified inductively (i.e. on the basis of insight rather than any established theory), using a reflexive thematic approach. Specifically, analyses included an initial stage of familiarization with the focus group transcripts, listening to audio recordings, and generating an initial code guide. Initial codes were created by identifying units of text that referred to the same or similar semantic content. Following this, the entire data set was systematically coded by the lead author, and a tentative framework of themes was identified. A series of

Table 1. Quantitative measures used in the study survey.

Measure	Description	Items	Cronbach's alpha (α)
Barkin Index of Maternal Functioning (BIMF) (Barkin et al., 2010, 2014)	Maternal functioning Participants are asked to select the response that best reflects their experience over the past 2 weeks	20 items Seven-point Likert scale (0 = Strongly Disagree to 6 = Strongly Agree) Reverse-coded items 16 and 18 Score range 0–120 (higher scores represent better functioning), a score of 120 represents perfect functioning (*The Barkin Index of Maternal Functioning*, 2023)	Original study $\alpha = .87$; current study $\alpha = .82$
Center for Epidemiologic Studies Depression (CES-D) scale (Radloff, 1977)	Depressive symptomology Participants are asked to select the response that best indicates the frequency of their symptomology in the past week	20 items Five-point Likert Scale [0 = Rarely or none of the time (less than 1 day) to 4 = Most or all of the time (5–7 days)] Reverse-coded positive items (4, 8, 12, and 16) Score range 0–60 (higher scores represent the presence of more depressive symptomology), with scores above 16 indicative of 'significant' depressive symptomology (Radloff, 1977)	Current study $\alpha = .89$
Climate Distress Index (CDI)-16[a]	Climate distress Participants are asked to select the response that best reflects their feelings	16 items Seven-point Likert scale (0 = Strongly Disagree to 6 = Strongly Agree) Reverse-coded items 1–6 Score range 0–96 (higher scores represent higher climate-related distress)	Current study $\alpha = .81$

Note: [a]The development process for the CDI-16 will be the primary focus of a separate, detailed article.

discussions was then held involving other coauthors. During this process, meaning and interpretations were discussed, and themes were redefined, recategorized, and restructured, and some were removed, based on discussions about the aims and objectives of the study.

In conducting the qualitative data analysis for this study, it is important to note that the lead researcher, who facilitated the focus groups and conducted the analysis, approached the data with a commitment to impartiality and objectivity. It is recognized that the lead investigator is Australian and has experienced EWEs, but she is not a mother herself, thus maintaining a neutral perspective throughout the analysis, allowing the voices and experiences of this population to shape the findings.

3. Results

The sample was comprised of 31 Australian mothers ($M_{age} = 31.74$, $SD = 4.86$), predominantly located in the state of Queensland ($n = 22$). On average, the participants' youngest child was 5 months of age ($SD = 3.28$) and 14 participants (45%) had two or more children, with the remainder of the sample having only one child. Fourteen participants indicated that they lived in a metropolitan area and 10 in a rural area, while seven participants were unsure of their area classification. Globally, participants reported moderately impaired maternal functioning ($M = 81.26$, $SD = 10.95$), mild depression symptoms ($M = 11.47$, $SD = 9.12$), and moderate ratings of climate distress ($M = 56.37$, $SD = 11.42$).

3.1. Focus group findings

Focus groups consisted of two to seven participants in each group. Overall, the focus group discussions resulted in six themes related to the impact of extreme weather on mothers in the perinatal period: health and well-being, helplessness and avoidant coping, resilience and adaptation, cost, education, and receptivity and awareness. The current paper focuses on three of these six themes (health and well-being, helplessness and avoidance coping, and resilience and adaptation), as they pertain to the mental health concerns of mothers in relation to extreme weather and climate change, as well as specific trauma-related content which underpins much of the data in this study (Figure 1). The themes of cost, education, and receptivity and awareness, although prominent discussion points, did not directly encapsulate the mental health objectives of the current research and thus will be presented in future work.

Although the dialogue related to each theme in the focus groups was abundant, selected quotations have been chosen to illustrate the mental health concerns of this population of new mothers.

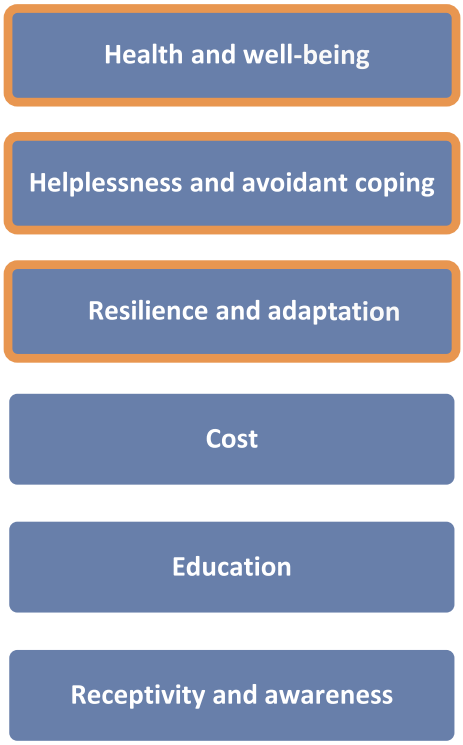

Figure 1. Major themes resulting from focus group discussions. Themes discussed in the current paper are highlighted. The six boxes show the six themes resulting from the data analysis (health and well-being, helplessness and avoidant coping, resilience and adaptation, cost, education, and receptivity and awareness). The themes of health and well-being, helplessness and avoidant coping, and resilience and adaptation are highlighted to indicate that they are the key themes discussed in the current paper. The themes of cost, education, and receptivity and awareness, although prominent discussion points, did not directly encapsulate the mental health objectives of the current research and thus will be presented in future work.

3.1.1. Health and well-being

Discussions related to health and well-being were focused on both the mother/individual and the child's well-being. Overall, in terms of mothers' current emotional and mental health and well-being, participants expressed feeling a sense of 'overwhelm' and 'pressure' in managing the challenges of weather alongside motherhood, as well as feelings of 'anxiousness' and 'worry' pertaining to the health implications of extreme weather. Subthemes impacting mothers' health and well-being were also clustered around specific worries; for example, trauma, economic concern, specific heat-related worry, and apprehension related to isolation and separation in EWEs. These topics formed the majority of conversations regarding mother and family health.

3.1.1.1. Exposure to extreme events can be traumatic.

Several of the participants described traumatic

environmental events that they had experienced during their lifetime. For example, one participant shared her traumatic experience with an event that she encountered during her pregnancy:

> So I was in the 2022 floods … I was 20-something weeks pregnant and … everything floated around us … [I had] no power, we didn't have electricity, no running water, so we had to go to friend's house … we had to sleep on a blow-up mattress for like four days, maybe five until power was restored and we could actually come back home. So to me, yeah, that was scary because it was the first time I was … in an area where it actually flooded. I … [was] also very uncomfortable because … having the belly and you get all sorts of pains and aches here and there, having to sleep on a blow-up mattress.

Women also discussed fears of being displaced with a family in tow:

> … when I was in Townsville for the big Townsville floods, … we actually lost our rental. And so [we were] trying to find a new house at the same time as hundreds of other people also trying to find a new house. But that was hard enough … let alone adding a kid into the mix, worrying about being homeless and everything like that.

The cumulative effect of exposure was also noted during focus group sessions, with participants even reflecting on past traumatic events. For example, one mother reflected on a cyclonic event she had experienced as a child:

> … we had to evacuate during the cyclone because the roof of our house was being lifted. So we've actually had to have family members come and pick us up in the middle of the cyclone and drive us to safety … We were downstairs trying [to] sort of get protection … on the lower floor. But it got to a point where we had to leave altogether. So that was pretty scary.

3.1.1.2. Economic concern due to extreme weather/climate change. There was significant dialogue pertaining to personal economic concerns over climate change and extreme weather, which also impacted family health. For example, one mother expressed concerns about managing temperature in the household:

> … as a single parent, everything adds up … and obviously you will do whatever it takes to make sure that they're [children] … safe and healthy but it's always in the back of your head that gosh, this is really gonna back up [financially] quite a bit at the end of the quarter … it's uncomfortable. … I think you're always worrying, you know, that your baby, especially when they're not able to regulate their temperature quite well, it's always … a worry.

Others also expressed concern around the affordability of nutritious and healthy foods, the waste that occurs when feeding their baby, or the future of food security for their country. For example:

> I think for me the most [worry] is definitely food security and the cost around food … We've learned a lot about toxins and the way that they impact on their [babies'] bodies and stuff, and I think having really good quality nutritious foods for my son growing up is definitely a big priority for me. And yeah, I'm a bit nervous about you know what the food situation is gonna look like [in] five, ten, fifteen years from now [due to climate change].

3.1.1.3. Maternal worry regarding the impacts of heat exposure. The health implications of heat exposure were a major concern across all focus groups, with children's health and well-being weighing on mothers. Participants repeatedly reported concerns about children being outside during extreme heat and worry regarding their hydration, body temperature, and also general sickness. For example:

> My baby was born in December, so in the middle of the WA heat wave … I think the adjustment to obviously new parenting, but also thinking about, OK, [I've] got to make sure my child doesn't overheat. What does that look like? What am I looking for? Is he drinking enough? Obviously [he is] exclusively breast fed. You know, am I drinking enough? And then there was a few times where he did get way too hot and warm. And I'm like, oh my gosh have I done something wrong? … We make sure he's in the air con [air conditioning]. Make sure he's got layers on. But you know … there's that whole mum guilt of ohh it must be my fault …

As evidenced by the above remark, there was a prominent sense of 'guilt' expressed by mothers related to their ability to safeguard their child's health. This predominantly concerned how the activity of their children was constrained by weather conditions (in particular, heat). For example, one mother stated:

> … on those really hot days you don't wanna go outside and then trying to entertain three kids inside on a really hot day is difficult too. Then we end up doing more screen time than what I probably would prefer because we're inside and we're a bit wild … And then you feel guilty that you've set the kids inside to watch TV because it's so hot …

The concern over increasing temperature also played a large role in impacting a mother's general disposition or mood, with mothers stating that they felt 'frustrated' or 'uncomfortable'. One mother indicated that the impacts of heat on one's ability to enjoy nature were negative, as 'Everyone's happier when you're outside'.

Furthermore, mothers expressed their discomfort and health concerns with breastfeeding their baby outside, citing not only health concerns but also social

isolation, all of which impact a mother's mental health and well-being. For example,

> … it is really sometimes distressing to try and breast-feed when it's really hot, because then the baby starts sweating. You start sweating … And then you don't want to cover them up either or yourself up because it's way too hot. So then you're worried about what other people are thinking. I know you shouldn't worry about that. But you do … And then what ends up happening is, you know, you might catch up with people at your house. Which is fine, but then again, you're still stuck in your house and you know you don't get that outing … So it's like this real kind of catch 22 …

3.1.1.4. Fear of isolation from healthcare and support systems due to EWEs. Beyond day-to-day concerns, mothers also expressed feelings of isolation and fears of separation should a large-scale weather event occur. Many mothers reported having experienced such events, for example floods or cyclones, where they were impacted in terms of being cut off from general society, healthcare services, and utilities (e.g. power and water), as well as from loved ones or support systems. One mother, who had experienced EWEs without children, reflected on the challenges she would now have, if these events were to occur again with her young family:

> I think about what happens if I'm separated from … my partner and I've got to … , you know, juggle two children in the middle of a huge weather event. I can't have both of them, you know, on my arms …

Another mother reflected on a time she was impacted by extreme weather, with children:

> … so I experienced the Townsville floods in 2019 … at the time I had two kids and I can definitely say that there was added stress. It just puts a different perspective on … your basic needs and that was the need for safety … Like the kids and I were in the house and we were pretty much stuck in the house … Getting supplies and getting things like food … we didn't know when it was gonna finish …

Although there was significant discussion regarding concerns around being separated from healthcare access during EWEs, much of the conversation regarded mothers' concerns during the prenatal period. For example:

> I was in Brisbane for the 2022 floods and I was 37 weeks pregnant. No water, no electricity, couldn't get out of my house and thinking well, that would be interesting if I go into labor. So yeah, it was very distressing to me … I had a panic attack. Not that was gonna solve anything. But that was my body's reaction to the event. Luckily, my baby stayed in and I didn't go into labor.

A secondary stress appeared evident among participants, with many alluding to their apprehensions regarding the insufficiency of governmental or community support for families' basic needs in the face of climate crises, as evidenced in the above quotations.

3.1.2. Helplessness and avoidant coping regarding the future of the planet

Among participants, there was considerable discussion regarding the acceptance of climate change or weather fluctuations and the amount of information available via the media and social media channels. Participants frequently reported feeling helpless. For example, one participant reflected on her behaviours (or lack of) that she engaged in to reduce her worry about climate change:

> … obviously you try to do it as much as you can to prepare … you can't do too much … I'll just tell myself well, it's gonna happen. You know … you can't avoid the inevitable.

Two participants even specifically stated the challenges of voicing their opinions as mothers; for example, one participant stated:

> I think realistically we all know the effects of climate change, even the people that don't seem to consider it a priority … But as an individual going to a representative voicing my concerns as a mother I don't think they'll [local government officials] take it as seriously, no matter … how well or … how emotional the impacts could be …

Many mothers also reported being completely 'disconnected' or physically 'switching off' any media related to climate change, because of the excessive exposure. For example:

> I just get over it like you hear the same thing over and over. So I'll watch the news in the morning for an hour or two, and then you turn it off because there's nothing new. And then that's the end of it, like and I think you gotta take what they say with a grain of salt and if people don't or can't read into certain things that also impacts on it too, like you gotta be a bit cynical or bit pragmatic about what they're actually reporting on …

There were also expressions of difficulty talking to others, including family members, as well as struggles with people who were avoidant of conversations about weather or climate change. One mother reported that because she was not knowledgeable enough herself and had no 'proof', she chose not to converse about the topic at all: 'I acknowledge that it's happening, but it's not something that I can have a conversation with someone about because I don't know how to like, prove my point … '.

3.1.3. Resilience and adaptation in the face of climate change and extreme weather

Despite the numerous adverse mental health effects stemming from climate change expressed by mothers,

there was a notable presence of resilience and adaptability among participants who had encountered environmental hardships, demonstrating their ability to overcome them. There were also reflections in terms of how stress or worry about the weather did not occupy thoughts or emotions on a constant basis, which perhaps evidenced experience-based resilience. For example, one mother reported that she has experienced both flooding and cyclonic events: ' … I don't really get too stressed about I think cause I've been exposed to it. And it is stressful, I guess at the time, but it's not something I sort of think about all the time'.

Other conversations also focused on participants' increased capacity to manage/navigate around weather patterns. For example, one participant evidenced adaptation by centring her nature connection, despite frequent limitations:

> I guess in terms of rainy days and like, you know, what can I do to prevent the impact of … the weather and I try and keep them [children] booked into activities where you know it's winter. So I've got … [baby] going to swimming on a Friday and he's doing some sort of gym … activity on a Monday. So at least I've done one activity outside where he's being active on each of these days that I have him …

Mothers also reflected on the 'bigger picture', drawing on past success with a sense of hopefulness about the future:

> … we humans, we overcome things, … the fact that if there is a natural disaster, people pull together and look after each other … that care factor and that love factor and … the outpouring of hope and wanting to help people … and I look at my girls and go, you know what? There's gotta be good things in the future for you … I grew up in the 80s. They told us the that the hole in the ozone layer was gonna take over the globe. We were all gonna burn to a crisp … we've got amazing young minds who are going to solve these problems. … I hope my girls are gonna be part of that when they grow up … And I think just instilling in them that sense of, there's always hope. There's always happiness. And there's always good things around …

4. Discussion

This study aimed to investigate how climate change and EWEs affect the mental health and well-being of mothers in Australia, filling an important gap in the existing research. In this article, the negative mental health consequences of climate change were in focus, as well as resilience and adaptability in the context of EWE-related psychological reactions, including trauma.

Specific to environmental-related trauma, participants recalled traumatic experiences with acute EWEs, many of which occurred when they were children themselves or prior to having children. It would seem that there are two categories of climate stress/trauma: those that are associated with anyone who is confronted with climate change and exposed to EWEs, and those associated with motherhood. However, during these reflections, it became evident that the 'extra' consideration of children or navigating these events with children represented a serious complicating factor. This is arguably yet another 'invisible' burden shouldered by mothers, in addition to navigating the demands of motherhood, which forefront family health and well-being, often at the expense of the mother herself (Barkin & Wisner, 2013). With this in mind, trauma borne out of exposure to EWEs is a very real consideration for this population, not only impacting the core of the family unit (i.e. the mother) but also extending to the entire household. During the events themselves, mothers faced significant concerns regarding direct access to support and healthcare services for their children, and indirectly these events influenced the activity choices for the family and created financial strain – all of which is evident in previous literature (e.g. Barkin et al., 2022; Evans et al., 2022; Harville et al., 2010; Smith et al., 2023; Veenema et al., 2023). Given the 'domino' effect of this impact, the known mental health impact of EWE exposure on the perinatal population, and the limited research specifically focusing on maternal mental health in this context (Barkin et al., 2021, 2022; Tiwari et al., 2022; Veenema et al., 2023), it is imperative that exploration and consideration in this space continue.

A key area or theme to arise from the focus groups was that of heat concern. The results suggest the impact of heat on personal health (a concern that most would face in this circumstance), but an additional and pertinent worry for participants in the study is the health of children, with mothers expressing apprehensions regarding dehydration, body temperature, and rising household electricity bills. Evidence has long suggested the benefits of children spending time in the environment, with outdoor play being advantageous for physical activity and overall well-being (Kruger et al., 2010), which is now even more important in the digital age (Yin et al., 2022). However, as evidenced in the current study, mothers are faced with a predicament between nature being restorative and beneficial for one's health, yet also being the cause of significant health concerns. Mothers find themselves torn between allowing their children to enjoy the outdoors but exposing them to potential heat-related dangers, and keeping them indoors to safeguard their health. This paradox may be an additional 'domino' affecting the family unit, where keeping children cooler indoors for long periods impacts the mother's health and well-being in addition to increasing economic concerns over rising electricity

costs for the household. Furthermore, the current study showed that the physical discomfort that mothers experience as a result of heat has significant direct health implications, as it may potentially contribute to a decrease in breastfeeding rates. As a result, mothers may find themselves grappling with feelings of powerlessness and frustration as they navigate the complexities of protecting their children's health and well-being, while attempting to preserve their own mental health amid the climate crisis. This may further suggest that the mental well-being of a mother following a traumatic event has an impact on a child's development (Harville et al., 2010; Lequertier et al., 2019).

Mothers are aware of the challenges posed by climate change, yet, in the study sample, they were largely disengaged from climate-related discussion or action, and expressed feelings of helplessness in the face of its magnitude. As in the general population, the scale and complexity of climate change can leave individuals with a sense of powerlessness or an overwhelming sense of fear, perceiving the issue as beyond their control and unmanageable on an individual level (Lorenzoni et al., 2007; O'Neill & Nicholson-Cole, 2009). This is further exacerbated by a perceived lack of agency and voice, where mothers believe that their individual actions cannot make a meaningful impact, a feeling explicitly expressed by focus group participants in this study. As the primary caregivers, mothers possess valuable knowledge about the needs of their families. By excluding their voices, this may have a detrimental impact on the mental health of mothers themselves. Australia prides itself on its resilient identity, characterized by its ability to recover from EWEs. However, this notion of resilience often overlooks the toll it takes on the mental well-being of mothers. By neglecting their perspectives and experiences, this reinforces the expectation for mothers to silently bear the burdens of climate change or EWEs without adequate support. This perpetuates a cycle of marginalization, where mothers' mental health concerns can go further unaddressed.

The apparent disjunction between the outlined adverse mental health repercussions of climate change and the optimistic discourse surrounding resilience amid adverse weather events could perhaps be explained, in part, by the mental health status of the women, that being the moderate climate distress, maternal functioning, and depression findings expounded upon in the survey. In general, discourse around resilience amid adverse weather events often focuses on the human capacity to adapt and recover. It tends to highlight stories of triumph and community resilience in the face of adversity, with these accounts also present in the current work. However, this narrative often overlooks or minimizes the intricate mental health implications that individuals, particularly women, experience during and after these events. The survey's identification of climate distress, maternal functioning issues, and depression brings attention to the often-neglected psychological toll of such environmental crises. These nuanced findings of the survey shed light on a possible link between individuals' psychological well-being and the seemingly contradictory discourse on adverse mental health consequences of climate change versus narratives of resilience. Understanding these complexities can pave the way for more comprehensive approaches to addressing mental health concerns in the context of environmental challenges and enhancing genuine resilience at individual and community levels.

While the current data present considerable evidence regarding resilience and hope for the future in our sample, the pressure to embody this 'tough' Australian identity may create an additional load for mothers already dealing with the challenges of motherhood. The physical and emotional toll of EWEs, coupled with society's expectations of the mother's 'role', can lead to feelings of isolation and overwhelm – both of which are evident in the current sample. It is vital to recognize the impact of climate change and EWEs on mothers and to provide them with tailored support and resources to navigate the emotional and practical challenges that they may face, ensuring that their own well-being is the priority. To the authors' knowledge, such resources do not currently exist. Perhaps, the increased recognition of terms such as 'eco-anxiety' in the perinatal context could have a two-fold impact of allowing mothers to reframe such distress as normative (Davis & Athan, 2023) and to encourage specific education and intervention in this space.

4.1. Strengths and limitations

The current study benefits from a robust qualitative sample size, which enhances the validity and reliability of its findings. However, despite the arguably large qualitative sample, the majority of participants (70%) were from the state of Queensland, Australia. Even though Queensland is subject to many EWEs, for example, floods and droughts, such events are largely on the coastline and water related. This may impact the generalizability of the findings owing to a potentially biased sample. While this study aimed to achieve data saturation to ensure a thorough exploration of the research topic, and efforts were made to include a diverse range of participants, it is possible that some perspectives or nuances may not have been fully captured.

Another potential limitation, as with all qualitative research, is the potential bias of the investigators. To overcome this, the PI and primary analyst had a number of peer debriefing sessions with investigators, both after each focus group and when analysing the results,

in an attempt to achieve a balanced interpretation of the data.

An inherent limitation of this study is the unavailability of the psychometric properties for the CDI. As this scale is scheduled for publication elsewhere, the comprehensive psychometric assessment remains pending, potentially affecting the robustness and reliability of the measurements employed in the current research. Consequently, the results should be interpreted with caution, recognizing the need for further validation once the scale's psychometric properties have been established.

Lastly, a notable strength of the current study is its investigation of the perinatal population in the environmental context, an underexplored population in this context. This study not only addresses a significant gap in the existing literature but also offers valuable insights into a previously overlooked group.

4.2. Recommendations

EWEs and climate change can impact the health and well-being of mothers in Australia. However, these issues are not commonly discussed or addressed in everyday conversations or healthcare settings (Whiley et al., 2019), and this is something explicitly stated by participants in the current study. In addition to conducting more research in the area, a recommendation arising from this study may be for healthcare professionals to initiate conversations about how weather can affect a mother's mental health and well-being during the perinatal period. For example, the relationship between extreme heat and behaviour is well documented (e.g. Bi et al., 2011; Limaye, 2023), but not well discussed in clinical settings or elsewhere. By acknowledging and addressing this concern, healthcare professionals can better support new mothers and help them to navigate challenging times with their children.

5. Conclusion

Current evidence linking adverse perinatal mental health outcomes and climate change and EWEs underlines the necessity for recognizing this complex challenge. To begin addressing the urgent need for interventions that protect perinatal mental health and well-being in this context, it is crucial to hear the voices of mothers, promote open dialogue on the subject including within healthcare settings, and recognize the traumatic impact that these experiences can have on this population as they also navigate the other considerable demands of motherhood. Unchecked, climate change and extreme weather will continue to threaten the mental health of the perinatal population. Therefore we, including those in healthcare settings, must prepare accordingly. Recognizing and addressing the implications of this additional burden are crucial for promoting the mental health of mothers not only in Australia, but worldwide.

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Appendix I

Focus group interview guide

1. How has climate change/EWEs affected your life individually?
   a. As a mother?
2. As a mother, what aspects of climate change or extreme weather worry you the most?
   a. Why do these aspects worry you the most?
3. Do your children worry about climate change or extreme weather?
   a. Which aspects/How so? Describe.
4. Do you feel able to protect your children/family from the effects of climate change/EWEs?
   a. If so, how do you protect them?
   b. If you feel unable to protect them, explain why.
5. How does climate change or extreme weather impact your ability to care for your family/function as a mother?