



Climate change anxiety positively predicts antenatal distress in expectant female parents

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ABSTRACT

Clinical and subclinical levels of anxiety and depression are common experiences during pregnancy for expectant women; however, despite rising awareness of significant climate change anxiety around the world, the extent to which this particular type of anxiety may be contributing to overall antenatal psychological distress is currently unknown. Furthermore, the content of concerns that expectant women may have for their existing or future children remains unexplored. To address this gap in knowledge, 103 expectant Australian women completed standardised assessments of antenatal worry and depression, climate change anxiety, and perceived distance to climate change, and responded to several open-ended questions on concerns they had for their children. Results indicated that climate change anxiety accounted for significant percentages of variance in both antenatal worry and depression scores and, unexpectedly, neither child number nor perceived distance to climate change moderated these relationships. Content analysis of qualitative data highlighted the significant health-related anxieties for participants' children related to climate change (e.g., disease, exposure to extreme weather events, food/water insecurity). Given the escalating nature of climate change, further investigation of this relatively new stressor contributing to the experience of anxiety and distress, particularly in uniquely vulnerable groups such as expectant women, is urgently needed.

1. Introduction

Converging evidence points to advancing climate change posing a significant threat to human health worldwide (Anderko et al., 2020; IPCC, 2022; WHO, 2021). To date, much of the research in this area has explored the anticipated consequences of climate change to physical health. However, a growing body of literature has begun to consider and explore the potential *mental health* effects as well. Various models and frameworks have been proposed to categorise and predict the specific types of threats engendered by climate change, along with their expected mental health sequelae (e.g., Berry et al., 2010; Berry et al., 2018; Bourque & Cunsolo Willox, 2014; Doherty & Clayton, 2011). Though a detailed review of these models is beyond the scope of the current study, most delineate between direct and indirect mental health effects following exposure to acute (e.g., wildfires, floods), subacute (e.g., drought, heatwaves) and chronic (e.g., biodiversity loss, sea level rise) weather and climatic events. A large body of literature supports the mental health sequelae—including posttraumatic stress disorder, depression, anxiety, and substance misuse—of direct exposure to these

extreme weather and climatic events (see Clayton, 2020; Clayton et al., 2021; Hayes et al., 2018; Lawrance et al., 2021 for reviews).

Empirical research examining one of the indirect pathways—that of the effects of climate change *awareness*, irrespective of direct exposure to a climate change-related event—is, from an historical perspective, still relatively new, though it has been receiving increasing attention over the past 15 years (Clayton, 2020). *Climate change anxiety* refers to the anticipatory anxiety experienced as a result of the existential threat posed by climate change (Ogunbode et al., 2021), also referred to as “the chronic fear of environmental doom” (Clayton et al., 2017). Debates continue as to whether climate change anxiety should be conceptualised as a reasonable reaction to a genuine threat or as a unique pathology unto itself; where the tipping point may lie between functional and pathological climate change anxiety; how climate change interacts with mental health and diagnosable psychiatric disorders; and what the best ways are to provide supportive interventions for distressed persons (Heeren & Asmundson, 2023), highlighting that much more research in this space is needed going forward.

Many researchers have also observed the distinctive existential

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qualities associated with the experience of climate change anxiety. Writing in 2008, Fritze et al. stated that, "...at the deepest level, the debate about the consequences of climate change gives rise to profound questions about the long-term sustainability of human life and the Earth's environment" (pg. 9). Hayes et al. (2018) also noted that even beyond concern for one's own personal health and well-being, many people experience climate change as an existential threat to civilization—that climate change threatens the fundamental conceptions of not only our current social systems, but of the future of life itself (Reser & Bradley, 2017). In Soutar and Wand's (2022) systematic review of the qualitative literature, major overarching themes included worry about apocalyptic futures and threats to one's livelihood (e.g., water scarcity, disruptions to food supply), as well as worry for future generations, including one's own children and grandchildren—a theme particularly prominent in participants from Western countries. This deeper flavour of worry experienced by many has led at least one researcher to conclude that climate change anxiety is not a clinical manifestation of worry, but rather an existential one (Pihkala, 2018). Researchers are actively working on these issues, but whichever way the field eventually leans, what is clear is that many people are struggling with worries for a future that feels increasingly threatening and dangerous.

Many studies have also highlighted which groups of people are likely to be disproportionately vulnerable to the negative mental health effects of climate change. Many of the groups identified are those who already experience social and/or political disadvantage, including women, children and young people, older people, Indigenous peoples, Communities of Colour, migrants, and those of low socioeconomic advantage and/or who have a history of mental or physical illness (Berry et al., 2018; Clayton, 2020; Doherty et al., 2022; Doherty & Clayton, 2011; Hayes et al., 2018; Hrabok et al., 2020; Lawrance et al., 2021). Other groups considered to be at higher risk include those living in disaster-prone areas, whose work involves direct climate and/or disaster exposure (e.g., first responders, agricultural workers), and those living in developing countries that are at higher than average risk of experiencing significant climatic impacts (e.g., Small Island Developing States) (T. Doherty et al., 2022; T.J. Doherty & Clayton, 2011; Hayes et al., 2018; Lykins et al., 2023; Lawrance et al., 2021). Of course, none of these groups is mutually exclusive from each other, underlining the potential compounding effects of intersectional disadvantage in mental health outcomes.

1.1. Climate change and family planning

Given the existential nature of the threat posed by climate change and the concomitant higher rates of climate change anxiety in younger people (e.g., Clayton & Karazsia, 2020; Swim et al., 2022), it follows that persons of child-bearing ages may consider the potential future impacts of climate change when making family planning decisions. Emerging research somewhat bears this out. In a convenience sample of 607 25- to 45-year-olds recruited from online forums targeting climate and reproductive justice, Schneider-Mayerson and Leong (2020) found that 96.5% of respondents reported being "very" or "extremely" concerned about the impacts that climate change would have on their existing or expected children, and 11% reported feeling unsure as to whether they intended to have children due to climate change concerns. Conversely, in a smaller (N = 325) statistically representative sample of 18- to 35-year-olds from the United Kingdom, Gordon (2021) found no significant association between the decision to procreate and climate change concerns.

The patterns of results for those who had already made the decision to have one or more children are somewhat mixed as well. Ekholm (2020) reported that fathers worried significantly more than nulliparous men about climate change, and that women worried more than men about climate change in general. Further, parents reported greater worry about climate change than nulliparous participants. However, in the "very" and "extremely" worried respondents in the Schneider-Mayerson

and Leong (2020) study, undecided nulliparous adults had the highest level of concern, followed by expectant parents, and lastly existing parents. These results indicate that while expectant and existing parents may still experience significant concern about the future due to climate change, having already committed to parenthood may function to lessen this anxiety to some degree.

1.2. Antenatal mental health and climate change anxiety in expectant women

The transition to parenthood can be an intense and overwhelming period, fuelled by an increase in responsibilities and uncertainties. Some near-term fears and anxieties are quite normal at this stage (Johnson & Slade, 2003; Saisto & Halmesmaki, 2003); however, these changes also increase the risk for clinically diagnosable levels of anxiety and depression—especially in first-time parents—irrespective of a person's history of mental illness (Boyce et al., 2007; Leach et al., 2015). Estimates indicate that approximately 20% of women meet the diagnostic criteria for a depressive disorder (Milgrom & Gemmill, 2015), and 15% meet the diagnostic threshold for an anxiety disorder (Goodman et al., 2016), during the antenatal period. Critically, prevalence rates of antenatal anxiety are more than double the average when the woman has been diagnosed with antenatal depression (Milgrom & Gemmill, 2015). This distress can also negatively affect the physical development of the foetus in utero, potentially leading to low birth weight and small head circumference at birth in some children (Grigoriadis et al., 2018; Milgrom & Gemmill, 2015).

By definition, anxiety is characterised by the fear and/or worry that something may happen in the short- or long-term future. As such, it stands to reason that concerns about future events may contribute to more generalised anxiety during pregnancy, particularly now that with the birth of one's offspring, future generations are less abstract given one's child(ren) will be a member of one of them. Supporting this connection, research has shown that intolerance of uncertainty (Carleton et al., 2012) is one of the key factors linked to the aetiology of antenatal distress (Wenzel & Stuart, 2011). Given the high rates of comorbidity between anxiety and depressive disorders (Kaufman & Charney, 2000), it is reasonable to posit that anxieties and fears about the future may contribute to increased rates of antenatal depression. Crucially, anxieties about the uncertainty of what the future holds may increase even more following greater awareness of the potential impacts of climate change on the world and its inhabitants.

In considering the potential impacts of climate change anxiety on offspring, one cognitive mechanism that expectant and existing parents may use to reduce climate change anxiety is that of psychological distancing. Research has shown that perceived proximity of risk to the effects of climate change is often (though not always) associated with level of concern about climate change, such that higher perceived proximity is often related to higher levels of concern (and vice versa) (McDonald et al., 2015). It has been argued that, when faced with the kind of existential threat that climate change poses, one method of coping may be to psychologically distance oneself from its effects (Reser & Swim, 2011). While not outright denial, psychological distancing functions to move the negative impacts away from oneself geographically, temporally, and/or socially (Jones et al., 2017). These types of distancing may serve to assuage the anxiety that parents might otherwise experience related to the effects of climate change on their existing or expectant children, thus serving as a protective factor.

1.3. Current study

While climate change has been acknowledged as a significant threat to human health in general, pregnant women and their developing children have been noted as being at a disproportionately high risk of experiencing these negative impacts (Ha, 2022; Poursafa et al., 2015). With increasing global concerns about climate change, it is urgent that

we consider the possible impacts of climate change-related anxiety on society's most vulnerable groups, including pregnant women. If climate change is a contributing factor to antenatal psychological distress, this information would be of benefit to those involved in antenatal healthcare as a new risk factor for antenatal anxiety and depression.

To contribute to this knowledge base, the current study aimed to assess the contribution of climate change anxiety to antenatal worry and depression using both quantitative and qualitative methodology. To our knowledge, this study is the first examination of these relationships in expectant women. Based on the extant literature, we hypothesised that: 1) climate change anxiety would account for a significant percentage of variance in antenatal worry and depression scores; 2) child number (i.e., whether this was the participant's first child or not) would moderate the relationship between climate change anxiety and antenatal worry and depression, such that the positive correlation between climate change anxiety and antenatal distress would be attenuated in primi/multiparous women; and 3) perceived psychological distance to climate change would moderate the relationship between climate change anxiety and antenatal worry and depression, such that the positive correlation between climate change anxiety and antenatal distress would be attenuated in women reporting a higher perceived distance to climate change. Lastly, we invited participants to respond to several open-ended questions in order to further understand the nature of any climate-related concerns for their children moving into the future.

2. Material and methods

2.1. Participants

Research exploring the association between climate change anxiety and indicators of distress (i.e., depression, anxiety, and stress) in an Australian university student sample revealed small effect sizes of $r = .22$ – $.28$ (Searle & Gow, 2010). Therefore, for the current study, we assumed a small effect size of $f^2 = .20$, alpha level of .05, power of .95, with 4 predictors for a planned multiple regression. A power analysis using G*Power 3.1 (Faul et al., 2009) indicated that a minimum of 98 participants was required for the study. One hundred and three expectant women were recruited for the study; ages ranged from 19 to 45 years ($M = 30.84$, $SD = 4.87$). Twenty-one women (20.4%) were in the first trimester of pregnancy, 30 (29.1%) in the second trimester, and 52 (50.5%) in the third trimester. The current pregnancy was the first child for 69 (67.0%) participants, the second child for 22 (22.3%) participants, the third child for 10 (9.7%) participants, and for 1 participant, this was the fourth or more child. Most women (91.3%) were married or in a de facto relationship.

2.2. Measures

The following measures were used in the present study. Total scale mean scores or weighted item mean scores (where indicated by specific scale scoring instructions) are presented in Table 1.

2.2.1. Socio-demographic Questionnaire

Participants were asked to indicate their age, gender, trimester of pregnancy, child number, relationship status, and annual household income.

2.2.2. Edinburgh Postnatal Depression Scale

The Edinburgh Postnatal Depression Scale (EPDS) (Cox et al., 1987), a 10-item self-report measure, was used to assess the intensity of antenatal depression over the preceding week. Items ask about experiences of low mood, (in)ability to experience joy, anxiety/worry/panic, sleep problems, feelings of overwhelm, and thoughts of self-harm (e.g., "In the past 7 days, I have felt sad or miserable"). Participants responded to statements on a four-point Likert scale ranging from 0 (*yes, most of the time*) to 3 (*no, not at all*), most of which were then reverse-scored as per

scoring guidelines so that higher scores were associated with greater endorsement of depressive symptoms. The EPDS was originally developed for use in postpartum women (Kozinszky & Dudas, 2015) but has since been validated for use with pregnant women (Matthey et al., 2013). While this measure is generally used as a screener for depression, three items (items 3, 4, and 5) have also been found to load on an anxiety factor (Matthey et al., 2013). Various cut-off scores are used with respect to the EPDS, but a recent systematic review and meta-analysis suggested that both sensitivity and specificity are maximised (.81 and .88 respectively) with a cut-off of 11 or higher (Levis et al., 2020), compared to the commonly used cut-off of 13 used in postpartum samples (Cox et al., 1987). Overall, the EPDS has been found to be a valid and reliable measure of antenatal depression (Kozinszky & Dudas, 2015). Cronbach's α in the current sample was .88.

2.2.3. The Cambridge Worry Scale

The Cambridge Worry Scale (CWS) (Green et al., 2003) is a 17-item self-report questionnaire that was used to assess the content and extent of worries during pregnancy, including topics such as housing, finances, health of self and others, birth, and miscarriage, among others (e.g., "Your relationship with your partner"). Participants rated statements on a six-point Likert scale ranging from 0 (*not a worry*) to 5 (*major worry*). The CWS has good psychometric properties, with satisfactory international consistency across three time points within pregnancy (.76–.79), high test-retest reliability, and established concurrent and discriminant validity (Green et al., 2003). In the current sample, Cronbach's alpha was good ($\alpha = .84$).

2.2.4. Climate change anxiety

Clayton and Karazsia (2020) devised a 22-item self-report measure that assesses psychological responses to climate change (e.g., "Thinking about climate change makes it difficult for me to concentrate"), which is comprised of four subscales: cognitive-emotional impairment, functional impairment, experience of climate change, and behavioural engagement. For the current study, we were only interested in the cognitive-emotional and functional impairment subscales (8 and 5 items, respectively), which together constitute the climate change anxiety scale. Respondents rated items on a five-point Likert scale ranging from 1 (*never*) to 5 (*almost always*). Cronbach's α for the whole scale was greater than .80 in the original psychometric assessment sample (Clayton & Karazsia, 2020). In the current sample, Cronbach's alphas were found to be .87 for cognitive-emotional impairment and .74 for functional impairment – together .90 for climate change anxiety.

2.2.5. Psychological Distance Scale

The Psychological Distance Scale (PDS) (Jones et al., 2017) is a measure of perceived psychological distance to climate change impacts across four domains: geographic (location of climate change impacts), temporal (recency of climate change impacts), social (climate change impacts on self and those one identifies with), and uncertainty (of climate change outcomes). In the current study, respondents rated the 16 items (e.g., "If things continue on their present course, we will soon experience a major ecological catastrophe") on a five-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The measure has good internal consistency ($\alpha = .81$ – $.93$) across all subscales (Jones et al., 2017); in the current sample, Cronbach's α was .86 for the entire 16-item scale.

2.2.6. Open-ended questions on child-related concerns

Three open-ended questions were included at the end of the survey. These included: "Do you have any concerns about your child's health in relation to climate change?", "Do you have any concerns about the future for your children due to climate change impacts?", and "Do you have any concerns about your child's health and/or safety in relation to climate change?".

2.3. Research ethics

Ethical aspects of this study were approved by the Human Research Ethics Committee of the University of New England (HE21-040). Participants were provided with an information sheet and had the opportunity to freely provide implied online consent prior to commencing the survey. No incentives were offered for participation.

2.4. Procedure

An online survey was administered using the Qualtrics survey software platform. Participants were recruited via various pregnancy and expectant parent social media networking sites. Participants were eligible for the study if they were 18 years of age or older, identified as female, and were currently pregnant/expecting the birth of a child. Apart from the socio-demographic questions, which were presented at the start, the other questionnaires listed above were presented to participants in a randomised manner.

2.5. Data analyses

Items were scored according to the instructions for each scale, which included reverse scoring for specific items on the EPDS and PDS scales. The EPDS total scale score was used in the analyses; unweighted item mean scores were used in analyses for all other scales (i.e., CWS, CCAS, PDS), as per scoring instructions. All data were analysed using IBM SPSS Statistics 29.0 using *t*-tests, correlational analyses, regression analyses, and moderation analyses (using Hayes PROCESS macro v4.3). The responses to the three open-ended questions were subject to conventional content analysis (Hsieh & Shannon, 2005). Data were examined across that dataset in order to provide insight into the key elements of concern related to climate change and the participants' child(ren). Responses were inductively coded. The initial codes were refined and then developed into categories that reflected the core essence of responses. The number of responses fitting each category was then quantified based on the total number of participants endorsing each category across any of the three questions, with exemplars of each category also identified (where a single response covered more than one category, it was counted in both categories). Content analysis was performed by one author and then verified by a second.

3. Results

Responses on the child number were categorised into participants who were expecting their first child and those who were existing parents expecting a subsequent child to assess whether antenatal distress differed between first-time and existing parents. Next, the suggested cut-off score of 11 on the EPDS in the antenatal period (Levis et al., 2020) was utilised to discriminate between cases of clinical and non-clinical cases of depression. The EPDS scores indicated that 28.2% of respondents fell into the clinical range for depression.

3.1. Preliminary analyses

Independent samples *t*-tests revealed no significant differences across measures of antenatal distress (worry, $p = .121$; depression, $p = .270$) nor climate change anxiety ($p = .783$) between first-time parents and existing parents. *T*-tests examining differences between clinical and non-clinical cases as determined by the EPDS total score revealed that the clinical cases scored significantly higher on antenatal worry (as assessed by CWS); $t(101) = 5.80, p < .001$, a mean difference of .89 (95% CI .59 to 1.19) and climate change anxiety $t(101) = 3.16, p = .002$, a mean difference of .32 (95% C I.12 to.53). A logistic regression was conducted to ascertain the effects of climate change anxiety on whether participants met the clinical cut-off for antenatal depression. The logistic regression model was statistically significant ($B = 1.39, p = .007, CI =$

1.46 – 11.04), explaining 11.9% (Nagelkerke R^2) of the variance in antenatal depression and correctly classifying 76.7% of likely clinical cases.

3.2. Correlational analyses

Pearson's correlations were calculated on study variables (Table 1). Age was negatively correlated with perceived psychological distance from climate change impacts, indicating that older expectant women were more likely to feel less psychologically distanced from the impacts of climate change than younger expectant women. Antenatal depression and antenatal worry were significantly, positively correlated. The negative correlation between climate change anxiety and psychological distance was also significant, revealing that the greater the perceived distance from climate change effects, the less climate change anxiety reported. However, psychological distance did not appear to have a relationship with either antenatal depression or worry. Therefore, although perceived psychological distance from the impacts of climate change might mitigate climate change anxiety, it did not influence the experiences of antenatal distress among expectant women.

3.3. Regression and moderation analyses

Two linear regression analyses were conducted with the two measures of antenatal distress as dependent variables—antenatal depression (EPDS) and antenatal worry (CWS)—with climate change anxiety as a predictor (Table 2). Climate change anxiety predicted 13.4% of the variance in antenatal depression scores ($R = .38, R^2 = .14, Adj R^2 = .13$), and 8.6% of the variance in antenatal worry scores ($R = .31, R^2 = .10, Adj R^2 = .09$). In examining the corresponding beta coefficients, climate change anxiety explained a statistically significant amount of unique variance in both antenatal depression scores (14.2%) and antenatal worry scores (9.5%). Given the significant correlation between antenatal worry and depression, a third regression analysis was conducted to assess the independent contribution of climate change anxiety to antenatal depression, beyond the contribution of antenatal worry (Table 3). The overall model was significant, ($R = .58, R^2 = .34, Adj R^2 = .33, p < .001$), indicating that together, climate change anxiety and antenatal

Table 1

Correlation matrix of age, antenatal depression (EPDS), antenatal worry (CWS), climate change anxiety (CCAS), and psychological distance to climate change (N = 103).

	Edinburgh Postnatal Depression Scale (EPDS)	Cambridge Worry Scale (CWS)	Climate Change Anxiety Scale (CCAS)	Psychological Distance Composite
Age	-.07	-.02	.00	-.27 **
Edinburgh Postnatal Depression Scale		.54 * **	.37 * **	-.13
Cambridge Worry Scale			.31 * *	.00
Climate Change Anxiety Scale				-.31 * **
Mean scale scores (SD) ¹	6.99 (5.23)	1.64 (0.80)	1.39 (0.49)	2.17 (0.59)
Observed range	0 – 23.00	0.19 – 4.25	1.00 – 4.15	1.31 – 4.31

31 * $p < .05$, ** $p < .01$, * * $p < .001$, ¹ Please note that total scale mean scores and standard deviations are reported here for the EPDS; unweighted item mean scores and standard deviations are reported for the CWS, CCAS, and the Psychological Distance Composite score.

Table 2
Predicting antenatal depression and worry from climate change anxiety.

Dependent variables	M (SD)	B	95% CI for B		r	sr ²
			LB	UB		
Antenatal depression (EPDS)	6.99 (5.23)	4.05	2.09	6.00	.38 * **	.14
Antenatal worry (CWS)	1.64 (.80)	.51	.20	.82	-.31 * **	.09

B = unstandardised beta, CI = confidence interval, LB = lower bound, UB = upper bound, r = correlation coefficient, sr² = squared semipartial correlation coefficient
* ** p < .001

Table 3
Predicting antenatal depression from antenatal worry and climate change anxiety.

Predictors	M (SD)	B	95% CI for B		r	sr ²
			LB	UB		
Climate change anxiety (CCAS)	1.39 (.49)	2.50	.68	4.31	.54 * **	.05
Antenatal worry (CWS)	1.64 (.80)	3.05	1.95	4.15	.37 * **	.20

B = unstandardised beta, CI = confidence interval, LB = lower bound, UB = upper bound, r = correlation coefficient, sr² = squared semipartial correlation coefficient
* ** p < .001

worry accounted for 32.8% of the variance in antenatal depression. Climate change anxiety accounted for a unique 4.66%, and antenatal worry a unique 19.89%, of the variance in antenatal depression scores.

Model 1 for simple moderation was used to separately determine whether child number (i.e., whether this is the person’s first child or not) or psychological distance moderated the relationship between climate change anxiety and overall antenatal depression or worry. With respect to the model run with child number as a moderator and EPDS as the dependent variable, the overall model was statistically significant, $F(3,99) = 5.57, p = .001, R^2 = .14$, but the moderation effect was not significant ($b = -1.01, t(99) = -.44, p = .66$). The same model was run with CWS as the dependent variable, and resulted in a statistically significant overall model $F(3,99) = 3.49, p = .02, R^2 = .10$, with a non-significant moderation effect ($b = -.08, t(108) = -.23, p = .81$). Therefore, child number did not moderate the relationship between climate change anxiety and antenatal depression or worry.

With respect to the model run with psychological distance as a moderator and EPDS as the dependent variable, the overall model was again statistically significant, $F(3,99) = 5.70, p = .001, R^2 = .15$, but the moderation effect was not significant ($b = 1.88, t(99) = .75, p = .46$). The same model was run with CWS as the dependent variable instead, and resulted in a statistically significant overall model $F(3,99) = 4.90, p = .003, R^2 = .13$, with another non-significant moderation effect ($b = .66, t(99) = 1.67, p = .09$). While climate change anxiety did significantly increase antenatal worry ($b = .81, t(99) = 3.67, p < .001$), psychological distance did not moderate the relationship between climate change anxiety and antenatal depression or worry.

3.4. Content analysis

Forty-nine participants provided any responses to the open-ended questions. There were no significant differences between those who did and did not complete open-ended questions on any demographics or study variables. Responses highlighted that climate change impacted some respondents’ views around having children (e.g., “I once thought I wouldn’t have children because of the belief that humans are ruining the planet” P8; “I have often thought that it is a very selfish thing to bring another

child into the world. Partly because she will have to endure environmental disaster” P16). Across responses to the open-ended questions, nine respondents (18.4%) reported that they had no concerns regarding climate change and their child(ren)’s future, with the remaining respondents (81.6%) outlining a series of climate change-related concerns for their children (see Table 4).

In particular, these concerns pertained to future air quality, especially in relation to future bushfires, and the increasing frequency of natural disasters and extreme weather events. Food security and quality due to climate-related changes in agricultural production was another key concern. Further concerns related to uncertainty over the future and what the worsening climate crisis might mean for their children, a lack of access to resources into the future, and the anticipated loss of the environment and nature for children to enjoy. Additional worries included environmental degradation and pollution increasing diseases, the impacts of increased sun exposure, financial insecurity, and reduced access to clean water. Concerns around a reduced quality of life due to the impacts of climate change and poor mental health were also reported.

4. Discussion

This study found that climate change anxiety was significantly associated with both antenatal depression and worry, previously unexplored relationships, supporting the first hypothesis. Further exploration of these relationships revealed that, after controlling for the contributions of antenatal worry, climate change anxiety contributed significant unique variance to antenatal depression, and climate change anxiety explained approximately 12% of the variance in clinical levels of

Table 4
Categories of responses to the open-ended questions.

Category	N	Example
Future air quality	15	“I worry about bushfires and my children developing asthma and other health problems. I worry that they won’t have the same air quality that we have now” P7
Exposure to increasing extreme weather and natural disasters	15	“Potential natural disaster due to climate change could impact my future children negatively” P45
Food security and quality	10	“I worry about access to food items as climate change continues to impact the agricultural industries around the world” P96
Uncertainty over the future	8	“I’m not sure what the future will bring with climate change. I worry that my child and my child’s children will not be able to have an earth to live on” P76
Lack of resources	8	“Potential for changes in resources and availability” P39
Loss of the environment and nature for children to experience	7	“My kids won’t see the great barrier reef, they won’t see animals that are going extinct; our world and animals are dying and soon there will be no natural beauty for children to grow up with and experience” P7
Future increases in diseases	7	“I worry that their world as I know it will be vastly different for the worse. Environmental contamination causing cancer or other diseases.” P85
Sun exposure	6	“I think the increase in their ailments ... related to climate change and easily sunburnt is worrying” P15
Access to clean water	5	“Poor water quality” P31
Financial insecurity	5	“Life will become more expensive... Jobs will be harder to get” P11
Reduced quality of life	5	“It will seriously impact their lives negatively” P40
Mental health impacts	2	“Mental health due to stress of surviving and thriving in a complex and scary world” P8

antenatal depression, correctly categorising over 76% of likely clinical cases. Results thus extend the emerging body of research highlighting relationships between climate change anxiety and mental health in the general adult population (Curl et al., 2022; Feather & Williams, 2022) by demonstrating that climate change anxiety is also uniquely and independently related to antenatal psychological outcomes. Interestingly, there were no differences found in climate change anxiety between nulliparous and primi/multiparous women, and child number did not moderate the relationship between climate change and antenatal distress. Additionally, while perceiving greater psychological distance from climate change was linked to lower climate change anxiety, psychological distance was not related to antenatal distress outcomes, either directly as a moderator. Thus, the second and third hypotheses were not supported. Echoing aspects of Souter and Wand's (2022) results, content analysis of women's worries regarding climate change underscored the existential quality in responses, indicating that participants were concerned about future impacts for their child(ren), especially in regard to health and disease, extreme weather events, food insecurity, lack of access to resources, and the overall viability of the planet in the future.

Consistent with prior research (Milgrom & Gemmill, 2015), antenatal worry and depression were positively correlated in our sample, and both were also positively associated with climate change anxiety. It previously has been argued that climate change anxiety is likely to exacerbate existing stressors and symptoms, in turn increasing the prevalence of psychological disorders (Berry et al., 2010). Models of antenatal distress propose that psychological vulnerabilities are a key aetiological factor (Wenzel & Stuart, 2011). In addition to contributing independently to antenatal distress, climate change anxiety likely also exacerbates such existing vulnerabilities, thereby increasing psychological distress (such as worry and depression). For instance, intolerance of uncertainty is one identified predisposing vulnerability for antenatal distress (Wenzel & Stuart, 2011). Intolerance of uncertainty might be exacerbated by climate change anxiety, where there is little certainty as to the future and exactly how future generations will be impacted (though predictions continue to be relatively dire). However, ongoing longitudinal research to explore the directionality of the observed association is needed to better understand climate change anxiety's link with antenatal distress.

Notably, whilst the present study demonstrated a relationship between climate change anxiety and antenatal worry, previous research has shown little consistent association between climate change anxiety and pathological worry (Innocenti et al., 2022; Stewart, 2021; Verplanken et al., 2020). Thus, results might reflect a unique association in pregnant women that is not observed in the general population. However, differences in findings may relate to the assessment tools used, with previous studies assessing trait worry, whereas the present study assessed state worry. Thus, climate change anxiety appears to relate more to current perceptions of dread or threat, rather than a general tendency to worry. Only limited research to date has examined the content of worries in the antenatal period as experienced by women with perinatal depression or anxiety, indicating that key areas of concern typically relate to health of the baby, pregnancy and birth complications, bodily changes, and ability to care for the infant (Williams & Koleva, 2018). The present study extends these findings by also reporting on specific content of worries associated with climate change. These worries largely focused on the health and well-being of the child, especially in relation to future climate events and natural disasters, and the impact of climate change on resources and food security.

Previous studies have indicated differences in climate change concern between existing parents and those without children (Ekholm, 2020; Schneider-Mayerson & Leong, 2020), contrasting with the current results which indicated no such differences by current parental status. However, Schneider-Mayerson and Leong (2020) reported differences between those who were uncertain about having children with those who were already parents, while everyone in our sample was committed

to having a child even if none had been born at the time of participation. Accordingly, climate change anxiety might be more pronounced around decisions to reproduce or not, rather than on the number of children even in currently nulliparous pregnant women. Additionally, Schneider-Mayerson and Leong (2020) recruited participants via climate action and reproductive justice groups, which may have resulted in a non-representative participant sample. Further, women were reported to be more concerned about climate change than men (Ekholm, 2020), thus our sample of women only might have limited ability to detect differences by current parental status, which might be more apparent in men.

Our results highlighted that climate change anxiety was related to psychological distance to climate change impacts in that greater perceived distance was associated with lower climate change anxiety, a finding consistent with previous research (Reser & Swim, 2011). In contrast, however, perceived distance to climate change was not related to antenatal psychological distress in this sample. This result may be due to the sample being recruited from Australia, with those living in Western countries largely reported to view climate change as a distant threat (Brugger et al., 2015). Conversely, the results might suggest that psychological distance is less pertinent in this population, where concern appears to largely focus on the anticipated impacts of climate change on their unborn child.

Given that climate change anxiety is related to antenatal distress, and that mental health in the antenatal period is linked with a range of physical and mental well-being outcomes of the infant (Grigoriadis et al., 2018; Rees et al., 2019), increased detection of climate change anxiety during the antenatal period may be valuable. Existing guidelines commonly suggest routine screening of mood and anxiety disorders in the antenatal period (e.g., NICE, 2014). Given its unique role in contributing to antenatal psychological outcomes, the results of this study highlight that the assessment of climate change anxiety also may be of benefit in routine antenatal mental health screening. Such screening might aid in assisting women at unique risk of psychological distress. Further, such women may require tailored support in relation to climate change anxiety, which is not currently a routine part of mental healthcare delivery. However, further validation of climate anxiety scales is warranted to support their use in routine screening. Notably, validated clinical cut-offs for the CCAS are lacking, underscoring the need for further research to develop clinical thresholds to help guide practice and identify those who may require additional support around climate change anxiety.

Currently, practitioners often remain unequipped or less knowledgeable about how to respond to the impact of climate change in clinical practice (Maughan et al., 2014), thus increased training around how to respond to or support pregnant women in relation to climate change anxiety may also be valuable. To guide this training, further research around best practice treatment for climate change anxiety is urgently needed, both in the general population and in antenatal populations. Currently, healthcare settings typically lack sufficient resourcing for mental health care (Berry et al., 2018; Crandon et al., 2022), and unique barriers to accessing mental health care during the antenatal period remain (Goodman, 2009; Millett et al., 2018). Accordingly, prevention efforts such as upskilling coping abilities (Crandon et al., 2022) within antenatal healthcare settings may be valuable.

4.1. Limitations

The present study provides new insights into the experiences of climate change anxiety in a relatively un-investigated population. However, the study is presented with several limitations. Firstly, the study focused on only women, who are reported to have higher levels of climate change concern (Crandon et al., 2022; Ekholm, 2020). We also did not differentiate between pregnant women and female partners of pregnant women in our recruitment. The study used only self-reported

outcome measures; future research with verified mental health diagnoses would also be valuable. Additionally, not all participants completed the open-ended questions and, while there were no differences between those who did and did not respond to study variables, the extent to which these results reflect the broader sample and population is unknown.

5. Conclusion

The results of this study demonstrate that climate change anxiety may be a potential source of distress for expectant mothers, and that it is associated with increased levels of antenatal depression and worry. Consequently, this study identifies expectant women as a new priority group of concern in relation to climate change, along with other already identified groups (e.g., children, Indigenous peoples). Irrespective of factors that theoretically should have attenuated these relationships (e.g., already having children, higher perceived distance to the effects of climate change), the positive relationships between climate change anxiety and antenatal distress remained strong. Climate change anxiety was found to contribute unique variance to antenatal depression, even when accounting for the contributions of antenatal worry, and climate change anxiety scores correctly categorised over 75% of likely cases of clinical antenatal depression. Taken together, the results point to climate change anxiety as a distinct and compounding stressor in expectant mothers that significantly and independently contributes to antenatal psychological distress. Furthermore, participants expressed worries related to the future health and well-being of their children in light of worsening environmental conditions and limited access to resources such as food and water. Accordingly, assessing climate change anxiety amongst antenatal women may be a valuable way to identify support needs and reduce associated distress in these settings.

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Declaration of Competing Interest

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Data availability

Data will be made available on request.

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