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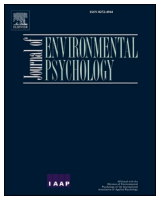

Climate change concerns impact on young Australians' psychological distress and outlook for the future

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ABSTRACT

Aims: Climate change is escalating and will disproportionately affect young people. Research on the mental health consequences of worry or concerns related to climate change are so far limited. This study aims to evaluate the extent of climate change concern in young people aged 15–19, its association with various demographic factors and its impact on psychological distress and future outlook. Understanding the impact of climate concerns on young people's mental wellbeing is crucial for identifying effective measures and building resilience.

Methods: Climate concerns, psychological distress, and future outlook were measured in the *2022 Mission Australia Youth Survey*, Australia's largest annual population-wide survey of young people aged 15 to 19 (N = 18,800). Multinomial logistic regression models were used to map factors associated with climate concerns and assess whether climate concerns are associated with psychological distress and future outlook.

Results: One in four young people reported feeling very or extremely concerned about climate change. Climate concerns were higher among individuals identifying as female or gender diverse, or who self-reported a mental health condition. After controlling for confounding factors, we found those who were very or extremely concerned about climate change to be more likely to have high psychological distress than those not at all concerned (Relative risk ratio (RRR) = 1.81; 95% CI: 1.56–2.11), and more likely to have a negative future outlook (RRR = 1.52; 95% CI: 1.27–1.81). These associations were stronger among participants who reported to be gender diverse, Indigenous or from outer-regional/remote areas.

Conclusion: This study identified associations between climate concerns, psychological distress, and future outlook among young people. Immediate attention from research and policy sectors to support climate change education, communication strategies and targeted interventions is urgently required to mitigate long-term impacts on young people's wellbeing.

1. Introduction

Climate change is a serious human health threat, with substantial impacts on both physical and mental wellbeing (IPCC, 2022). There is growing evidence that extreme climate events caused by climate change, such as wildfires, floods, storms, drought and heat stress, have significant mental-health impacts (e.g., increased rates of post-traumatic stress disorder, depression, and anxiety as well as reductions in general mental wellbeing and emotional resilience) (Bryant et al., 2021; Galea et al., 2007). Concerns about climate change and the environment may also

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adversely affect mental health and wellbeing, evoking negative emotional responses (Albrecht, 2005; Ojala, Cunsolo, Ogunbode, & Middleton, 2021; Ramadan et al., 2023).

Globally, climate change represents a realistic threat to the lives of young people in the foreseeable future, and the effects of traumatic climate events can be significant (World Health Organization, 2022). Adolescents are particularly vulnerable during this sensitive transition phase from childhood to adulthood, characterised by significant physical, mental and social development. Almost half of all mental health disorders onset before age 18 (Solmi et al., 2022), and rates of mental ill-health in adolescents are escalating (ABS, 2022, pp. 2020–2021). Climate concerns and climate anxiety may contribute to the exacerbation of mental ill-health for some young people (Crandon, Scott, Charlson, & Thomas, 2022; Wu, Snell, & Samji, 2020).

In Australia, the escalating climate crisis is manifesting in the form of unprecedented frequent and extreme weather events (Beggs et al., 2021). In the last four years, major record-breaking climate catastrophes have impacted large parts of Australia (e.g., 2019/2020 'black summer' megafires and widespread flooding in 2020, 2021, 2022, and 2023). The 2022 Southeast Queensland and New South Wales flood was one of the most expensive natural disasters with over $5.5 billion in insured damages alone (Insurance Council of Australia, 2022), impacting families and communities in many high-population density areas as well as regional towns with on-going climate-related crises (Rice et al., 2022). A recent study in Australia found more than half of those who experienced climate-related disasters (e.g., severe air pollution exposure, loss of lives, damage to properties, and interruptions to daily living) reported moderate to high levels of impact on their mental health (Climate Council and Beyond Blue, 2023). Many Australians were also impacted by these events indirectly (e.g., media/social media exposure, having family or friends directly impacted, and increases in the cost of living). Ongoing exposure to increasingly severe climate events could increase the psychological burden and, for young people particularly, shape a negative world-view and dampened outlook for the future (Foundations for Tomorrow, 2021).

The negative emotions triggered by climate change (or other ecological issues), both directly and indirectly, can be diverse, ranging from concerns and worries to anxiety, depression, grief, sadness, fear, anger, despair, and helplessness (Ramadan et al., 2023). Several terms have been used over the past decade, sometimes interchangeably, to describe the negative emotions related to climate change such as climate anxiety, climate worry, eco-anxiety, ecological grief, ecological stress, ecoparalysis (helplessness, hopelessness and inability to respond to environmental change), solastalgia (distress caused by lived experiences of environmental change) (Ágoston et al., 2022). These climate change-/eco-emotions can range from healthy and adaptive macro worries or concerns from a moral and ethical perspective to clinically relevant distress that impacts functioning and requires support (Kurth & Pihkala, 2022; Ojala et al., 2021; Pihkala, 2020; Wang et al., 2023). These negative emotions may also dynamically interact with each other as well as with other factors (e.g., direct exposure to climate events, and socioeconomic inequity) (Fritze, Blashki, Burke, & Wiseman, 2008; Ma, Moore, & Cleary, 2022) to impact health and wellbeing in general.

To understand how to support young people and reduce the negative impacts of climate change on mental health, it is critical to delineate how young people respond to climate concerns at a population scale. Thus far, there has been limited literature investigating the mental health consequences of climate-related negative emotions in young people (Ramadan et al., 2023). A few recent studies highlighted the potential links between climate-related concerns and mental health and wellbeing (Galway & Field, 2023; Ogunbode et al., 2022). However, how concerns interact with individual and community level factors on the population level is largely unknown.

The aim of the present study was to describe the extent of climate concerns experienced by young people aged 15 to 19 in Australia, and assess the relationship between climate concerns, psychological distress, and future outlook using data from the largest and most recent annual survey of young people in Australia, the *2022 Mission Australia Youth Survey*.

2. Methods

2.1. Data sources

Conducted annually since 2002, the *Mission Australia Youth Survey* is the largest annual survey of young people across Australia. The aim of the Youth Survey is to learn about the concerns, experiences, and perspectives of young people, and to amplify their voices and experiences. This information is then used to advocate for young people's views, including informing policy-related decisions that will affect their future.

The present study used data from the 2022 survey which included 18,800 young people aged 15–19 years from across all states and territories in Australia and was conducted between 6 April and August 31, 2022. Young people were invited via schools, local governments, community and service organisations, Mission Australia services, and social media promotions via Mission Australia and collaborating bodies and organisations. Young people participated in the survey either online or by paper, voluntarily without incentives. All procedures of the survey were approved by the University of Melbourne Human Research Ethics Committee (#2022-22721-32663), State and Territory Education Departments and Catholic Education Offices.

The *Mission Australia Youth Survey* includes a battery of self-reported measures and questions designed to identify the values, aspirations, and issues of concern for young people. A detailed description of the survey design can be found elsewhere (Leung, Brennan, Freeburn, Waugh, & Christie, 2022). Briefly, the survey includes measures of demographics, studying and working status, personal concerns, challenges and engagement in activities, mental health and well-being, supports and connections, as well as housing and financial situation. Each year the survey is modified slightly to reflect current issues or concerns facing young people. Measures used in this study are summarised in Table 1.

2.2. Exposure to climate events

To understand the impact of major local climate events on survey respondents, we mapped residential postcodes (self-reported for the current residential address as a proxy measure for the exposure in their neighbourhood) with extreme weather disaster events data extracted from the Insurance Council of Australia data hub (ICA historical catastrophe list, Oct 2022). The most recent event before the survey occurred in February–March 2022: east-coast floods which affected 641 postcodes across South-East Queensland and New South Wales (CAT 221). We also considered the 2021 March floods (CAT 212, 1089 postcodes affected), the 2020 Southeast coast floods (CAT 202, 729 postcodes affected) and the 2019/2020 black summer fires (CAT 194 and 195, 159 postcodes affected). The Australian Taxation Office also published an extended list of 388 postcodes affected by the 2019/2020 black summer fires, which was an additional data source (Australian Taxation Office, 2021). The total number of postcodes affected in the 2019/2020 fires from the two data sources were 409.

2.3. Data cleaning and imputation

Initial data comprised 18,800 survey responders. Postcodes were checked against state and postcode information from Australia Post. Postcodes that did not match their corresponding state information were converted to missing (n = 167). Additionally, there were 557 entries with missing postcode information. After removing these entries, the final sample for analysis comprised 18,076 survey responders. Among the variables of interest, there were 858 missing data for gender (including 264 "*prefer not to say*"), 5 for age, 454 for indigenous status, 57 for studying status, 214 for working status, 88 for IRSAD, 84 for

Table 1
Detailed information of variable measure and classification.

Variable	Definition
Climate concerns	Young people's concern about climate change was assessed using a question– *In the past year, how personally concerned have you been about climate change?* Answers were on a five-point scale, from *not at all concerned* to *extremely concerned*. This question was part of a grid question with other areas of concern (e.g., mental health, bullying, etc.) For some analyses, this measure was converted to a three-category response representing: "not at all concerned", "slightly/somewhat concerned" and "very/extremely concerned".
Psychological distress	Psychological distress was measured using the Kessler Psychological Distress Scale – 6 item version (K6) (Kessler et al., 2003). K6 consists of six questions used to measure non-specific psychological distress: how frequently in the past four weeks have you felt: 1) nervous, 2) hopeless, 3) restless or fidgety, 4) so sad nothing could cheer you up, 5) that everything was an effort, and 6) worthless. Scores ranged from 6 to 30. Respondents were classified into three groups: low (<14), moderate (14–18) and high (>18) psychological distress, in accordance with establish population norms and classifications used by the Australian Institute of Family Studies (Hilton et al., 2008; Rioseco, Warren, & Daraganova, 2020).
Future outlook	Young people were asked to rate their outlook for the future ('future outlook') in a question *How would you describe your feelings when you think about the future?* with a five-point scale from *very negative* to *very positive*. For some analyses, this measure was converted to a three-category response representing "very negative/negative", "neither negative nor positive" and "very positive/positive".
Gender	Self-identified gender options included *female*, *male*, *non-gendered*, *non-binary gender*, *transgender*, *not listed* and *prefer not to say*. Non-gendered, non-binary gender, transgender, and not listed were grouped as "gender diverse". *Prefer not to say* were grouped together with missing values.
Financial difficulties	Participants were determined as experiencing financial difficulties if they had answered *Yes, Mission Australia, Yes, a different charity or foundation*, or *No, but I needed support or assistance* to the question *In the past year, have you and/or your family received support or assistance from a charity or foundation?* or answered *Could not pay bills or car expenses*, *Could not pay rent/mortgage*, *Gone without a meal*, *Could not afford school supplies or go on school excursions*, or *Sought financial help from family, friends or a charity* to the question *In the past year, have you and/or your family experienced any of the following because of money concerns?*
Housing instability	Participants were determined as experiencing housing instability if they had answered *Yes* to any of the following: *Have you experienced a time when you had no fixed address or lived in a refuge or transitional accommodation within the last year? Within the last year, have you spent time away from home because you felt you couldn't go back?* or *In the past year, have you ever worried about having a safe place to stay?*
Index of Relative Socio-economic Advantage and Disadvantage	Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) information were obtained from the Australian Bureau of Statistics (ABS) by matching participants' residential postcodes. IRSAD is an area-based socioeconomic status measure that summarises census information about the economic and social conditions of residents, including measures of both relative advantage and disadvantage (higher deciles indicate relative lack of disadvantage and greater advantage in general) (ABS, 2018).
Remoteness	Remoteness information were obtained from the Australian Bureau of Statistics (ABS) by matching participants' residential postcodes to one of five categories: *Major Cities of Australia*, *Inner Regional Australia*, *Outer Regional Australia*, *Remote Australia*, *Very Remote Australia*. The latter three are combined in our analyses as "Outer regional, remote or very remote".

remoteness, 810 for mental health condition, 667 for psychological distress (K6), 325 for future outlook, and 448 for concerns about climate change. We used the "mice" R package to perform multiple imputation on the missing values 20 times, with the predictive mean matching method. The internal consistency of the six items that make up the K6 score was good (Cronbach's alpha = 0.89).

2.4. Statistical analysis

All analyses were performed in R version 4.2.1 (2022-06-23). Descriptive statistics were used to summarise the demographic profile of participants. As the proportional odds assumptions were not met for most of the ordinal scale outcomes, multinomial logistic regression models were used. Variables on a 5-point scale were collapsed to a 3-point scale to facilitate easier interpretation of results. Results on the 5-point scale are shown in the Supplementary. Univariate multinomial logistic regression models were first used to explore patterns of climate concerns, psychological distress, and future outlook among the different demographic groups. Multivariate multinomial logistic regression models were then fitted to explore which factors were independently associated with climate concerns. To further explore the role of climate concern and mental health, we fit three additional multivariate logistic regression models with confounders including common social determinants of mental health available in the survey: gender, age, Indigenous status, student status (full-time), paid employment, IRSAD, remoteness, unstable housing and financial difficulties (Alegría, NeMoyer, Falgàs Bagué, Wang, & Alvarez, 2018; Allen, Balfour, Bell, & Marmot, 2014). We also included existing mental health condition as a confounding factor to control for the effects of pre-existing distress. **Model 1** tested whether climate concerns were associated with psychological distress adjusting for confounders, **Model 2** tested whether climate concerns were associated with future outlook adjusting for confounders, and **Model 3** evaluated whether climate concerns were associated with future outlook, adjusting for participants' psychological distress along with other confounders. To further understand the effects on different demographic groups, stratified analyses of Models 1, 2 and 3 were also conducted stratified by gender, indigenous status, remoteness, housing stability, financial difficulties, and self-reported mental health condition. Relative Risk Ratio (RRR) and corresponding 95% confidence intervals were reported for all models. Estimates using the imputed datasets were averaged using the *mice::pool* function in R.

3. Results

3.1. Participants' characteristics

A total of 18,076 survey responders aged 15 to 19 were included in this analysis (724 were excluded due to a lack of valid postcode information to map a few key parameters). A summary of participants' characteristics is provided in Table 2. Compared to the 2021 Australian census data for individuals aged 15 to 19, our sample comprised a higher proportion of females (62% versus 49% in the census), non-Indigenous (95% versus 90% in the census), and full-time students (86% versus 72% in the census). The proportion of residents of major cities in Australia was comparable to the census (72% for both data sources).

About 15% of participants reported experiences of unstable housing and 23% experienced financial difficulties. Slightly less than one in five (18%) participants self-reported having a mental health condition. Most participants were at least slightly concerned about climate change (67%), with one in four (26%) reporting they were very or extremely concerned about climate change. A higher proportion of those who reported being very or extremely concerned about climate change, as compared to those not at all concerned, also listed the environment as one of the most important issues in Australia (77% versus 28%, 51%

Table 2
Participant characteristics (N = 18076).

Characteristics factors	Statistics	Total sample
Gender		
Male	n (%)	5791 (33.6%)
Female	n (%)	10701 (62.2%)
Gender diverse	n (%)	726 (4.2%)
Age		
15–17	n (%)	16583 (91.8%)
18–19	n (%)	1488 (8.2%)
Age	Mean (SD)	16.2 (0.9)
Indigenous status		
Non-Indigenous	n (%)	16819 (95.4%)
Indigenous	n (%)	803 (4.6%)
Currently studying		
Yes, full-time	n (%)	15526 (86.2%)
Yes, part-time	n (%)	1298 (7.2%)
No, not studying	n (%)	1195 (6.6%)
Paid work		
Yes	n (%)	9649 (54.0%)
No, but I'm looking for work	n (%)	4564 (25.6%)
No, and I'm NOT looking for work	n (%)	3649 (20.4%)
IRSAD decile	Mean (SD)	7.1 (2.8)
Remoteness		
Major Cities	n (%)	12934 (71.9%)
Inner Regional	n (%)	2977 (16.5%)
Outer regional/remote/very remote	n (%)	2081 (11.6%)
Unstable housing		
No	n (%)	15391 (85.1%)
Yes	n (%)	2685 (14.9%)
Financial difficulties		
No	n (%)	13962 (77.2%)
Yes	n (%)	4114 (22.8%)
Climate concerns		
Not at all concerned	n (%)	5865 (33.3%)
Slightly concerned	n (%)	3574 (20.3%)
Somewhat concerned	n (%)	3670 (20.8%)
Very concerned	n (%)	2594 (14.7%)
Extremely concerned	n (%)	1925 (10.9%)
K6 category		
Low	n (%)	7392 (42.5%)
Moderate	n (%)	4997 (28.7%)
High	n (%)	5020 (28.8%)
Future outlook		
Very positive	n (%)	1925 (10.8%)
Positive	n (%)	6970 (39.3%)
Neither	n (%)	5814 (32.8%)
Negative	n (%)	2367 (13.3%)
Very negative	n (%)	675 (3.8%)
Mental health condition		
No	n (%)	11803 (68.4%)
Prefer not to say	n (%)	2283 (13.2%)
Yes	n (%)	3180 (18.4%)

overall). Slightly less than one in five (17%) participants reported having a negative or very negative outlook for the future, and 29% have high psychological distress.

3.2. Impact by extreme weather events

Approximately 82% of the participants from New South Wales and Queensland resided in one of the affected postcodes from the most recent extreme weather event (flooding in NSW and SE Queensland, Feb–Mar 22). When we considered other major extreme weather events in the last three years including the 2019/2020 black summer fires, and flooding in 2020, 2021 and 2022, almost all participants from New South Wales, Queensland, and Australian Capital Territory resided in affected postcodes, while those from Victoria, Western Australia, Tasmania, and Northern Territory were largely unaffected. Because the severity of climate-related impacts in different postcode areas cannot be determined in the available data, we did not further delineate the role of climate events on individual level concerns or experiences due to insufficient exposure assessments.

3.3. Risk factors associated with young people's climate concerns

Participants who identified as either female (Relative Risk Ratio = 3.3, comparing very/extremely concerned to not at all concerned) or gender diverse (RRR = 7.6), older (RRR = 1.3), non-Indigenous (RRR = 1.9), full-time students (RRR = 2.2), living in a suburb with relative lack of disadvantage (RRR = 1.1), from major Australian cities (RRR = 1.6, comparing to those in outer regional), experienced unstable housing (RRR = 1.1), had financial difficulties (RRR = 1.1), or self-reported a mental health condition (RRR = 2.7) were more likely to report higher climate concerns (Table 3, univariate associations, see Table S1 for estimates on the five-point scale for climate concerns and future outlook).

In a multivariate model of climate concerns against all demographic variables, being female (Relative Risk Ratio = 2.5, comparing very/extremely concerned to not at all concerned) or gender diverse (RRR = 4.1), older (RRR = 1.1), non-Indigenous (RRR = 1.8), full-time students (RRR = 2.1), living in a suburb with relative lack of disadvantage (RRR = 1.1), and having a self-reported mental health condition (RRR = 2.0) remained associated with higher climate concerns (Table 4, multivariate associations, see Table S2 for estimates on the five-point scale). Some of these factors were also associated with higher levels of psychological distress and negative future outlook (e.g., gender, unstable housing, financial difficulty, and existing mental health conditions), whereas others show reversed directions (e.g., living in areas with a lack and negative future outlook, see Table 3).

3.4. Climate concerns associated with mental health and outlook for the future

Young people with higher climate concerns tended to have a more negative outlook about the future (Fig. 1a), and also report higher psychological distress (Fig. 1b). After adjusting for various potential confounding factors (gender, age, Indigenous status, full-time studying, paid work, IRSAD, remoteness, unstable housing, financial difficulties, and self-reported mental health condition), we found young people who were very concerned about climate change had significantly higher psychological distress (adjusted RRR 1.81; 95% CI: 1.56–2.11, Table 5: model 1). The effect of climate change concerns on psychological distress was more pronounced among those who were gender diverse (adjusted RRR 4.42; 95% CI: 2.31–8.47), Indigenous (adjusted RRR 2.43; 95% CI: 1.37–4.32), those living in outer regional, remote or very remote areas of Australia (adjusted RRR 2.36; 95% CI: 1.33–4.20), and those without a pre-existing mental health condition (adjusted RRR 2.02; 95% CI: 1.74–2.34) (Fig. 2). Young people who were very concerned about climate change also reported more negative feelings about the future, especially among those without a pre-existing mental health condition (adjusted RRR 1.52; 95% CI: 1.27–1.81 among all participants, Table 5: model 2, adjusted RRR 1.85; 95% CI: 1.58–2.18 among participants without mental health condition, Fig. 3). Even though there was a strong positive association of psychological distress with negative feelings about the future, high climate concerns still impacted young peoples' negative outlook for the future, even after accounting for psychological distress (adjusted RRR, 1.26; 95% CI: 1.05–1.52, Table 5: model 3). Consistent with the above, this association was strongest among those without a pre-existing mental health condition (adjusted RRR 1.46; 95% CI: 1.23–1.73, Fig. 4). Results based on five-point scale for climate concerns were provided in Table S3.

4. Discussion

Using data from the *2022 Mission Australia Youth Survey*, the most recent iteration of the largest population-wide annual survey of young people in Australia, we evaluated the extent of climate change concerns experienced by young people. Our analysis showed that most young Australians (67%) reported being at least slightly concerned about climate change; notably, they ranked the environment as one of the most

Table 3
Risk factors for climate concerns, psychological distress and future outlook estimated from univariate multinomial logistic regression.

Risk factors	Climate concerns		Psychological distress (K6)		Future outlook	
	Slightly/somewhat concerned vs. Not at all concerned	Very/extremely concerned vs. Not at all concerned	Moderate vs. Low	High vs. Low	Neutral vs. Positive	Negative vs. Positive
Gender (Ref: Male)						
Female	**2.08 (1.93–2.24)**	**3.29 (3.01–3.60)**	**2.19 (2.02–2.37)**	**3.66 (3.36–4.00)**	**1.17 (1.09–1.25)**	**1.40 (1.27–1.54)**
Gender diverse	**2.30 (1.85–2.86)**	**7.57 (6.12–9.36)**	**3.05 (2.40–3.88)**	**11.71 (9.46–14.51)**	**1.81 (1.49–2.20)**	**5.08 (4.19–6.15)**
Age	1.12 (0.98–1.27)	**1.25 (1.08–1.44)**	1.13 (0.99–1.28)	1.04 (0.92–1.19)	0.92 (0.82–1.04)	0.99 (0.86–1.15)
Indigenous (Ref: Non-Indigenous)	**0.63 (0.54–0.75)**	**0.53 (0.43–0.64)**	0.93 (0.78–1.12)	**1.21 (1.02–1.43)**	1.15 (0.98–1.34)	1.08 (0.89–1.32)
Currently studying (Ref: Full-time)						
Part-time	**0.66 (0.58–0.75)**	**0.45 (0.38–0.53)**	0.96 (0.83–1.10)	1.08 (0.94–1.24)	**1.28 (1.13–1.45)**	**1.17 (1.00–1.38)**
Not studying	**0.57 (0.50–0.65)**	**0.47 (0.40–0.55)**	**0.81 (0.70–0.94)**	**0.76 (0.65–0.88)**	1.04 (0.91–1.19)	1.05 (0.89–1.23)
Paid work (Ref: Yes)						
No, but looking	1.00 (0.92–1.08)	1.06 (0.96–1.16)	0.96 (0.88–1.04)	1.05 (0.96–1.14)	**1.34 (1.24–1.45)**	**1.39 (1.26–1.53)**
No, not looking	1.05 (0.96–1.15)	1.05 (0.95–1.17)	**0.89 (0.81–0.98)**	**0.76 (0.69–0.84)**	1.07 (0.98–1.17)	**1.23 (1.10–1.36)**
IRSAD	**1.06 (1.04–1.07)**	**1.10 (1.08–1.11)**	**0.98 (0.97–0.99)**	**0.94 (0.93–0.95)**	**0.97 (0.96–0.98)**	**0.96 (0.95–0.98)**
Remoteness (Ref: Major cities)						
Inner Regional	**0.80 (0.73–0.87)**	**0.72 (0.65–0.80)**	0.96 (0.87–1.06)	1.00 (0.90–1.10)	0.99 (0.90–1.08)	0.88 (0.79–0.99)
Outer Regional	**0.79 (0.71–0.88)**	**0.64 (0.56–0.72)**	1.12 (1.00–1.26)	**1.16 (1.04–1.30)**	1.09 (0.98–1.21)	0.93 (0.81–1.06)
Unstable housing (Ref: No)	**1.12 (1.01–1.23)**	1.09 (0.98–1.22)	**2.43 (2.15–2.75)**	**6.24 (5.58–6.98)**	**1.76 (1.59–1.94)**	**3.67 (3.31–4.08)**
Financial difficulties (Ref: No)	1.04 (0.96–1.13)	**1.13 (1.03–1.24)**	**1.71 (1.56–1.87)**	**2.61 (2.40–2.85)**	**1.30 (1.20–1.41)**	**1.84 (1.68–2.02)**
Mental health condition (Ref: No)						
Prefer not to say	**1.41 (1.26–1.57)**	**2.06 (1.83–2.32)**	**3.31 (2.90–3.78)**	**9.06 (7.96–10.30)**	**2.21 (2.00–2.45)**	**3.96 (3.50–4.47)**
Yes	**1.63 (1.48–1.81)**	**2.66 (2.38–2.96)**	**3.58 (3.17–4.05)**	**14.16 (12.59–15.93)**	**1.83 (1.67–2.01)**	**4.65 (4.19–5.16)**

Note: Relative risk ratios (RRR) and corresponding 95% confidence intervals estimated from univariate multinomial logistic regression analysis. $P < 0.001$ are in bold. There were 858 missing data for gender, 5 for age, 454 for indigenous status, 57 for studying status, 214 for working status, 88 for IRSAD, 84 for remoteness, and 810 for mental health condition. Missing data were addressed using multiple imputation. RRR=Relative risk ratio; IRSAD=Index of relative socio-economic advantage and disadvantage.

Table 4
Risk factors for climate concerns estimated from multivariate multinomial logistic regression.

Risk factors	Outcome: Climate concerns			
	Slightly/somewhat concerned vs. Not at all concerned		Very/Extremely concerned vs. Not at all concerned	
	RRR	P-value	RRR	P-value
Gender (Ref: Male)				
Female	**1.89 (1.74–2.05)**	<0.001	**2.72 (2.44–3.03)**	<0.001
Gender diverse	**1.94 (1.54–2.45)**	<0.001	**5.36 (4.12–6.96)**	<0.001
Age	1.01 (0.97–1.05)	0.515	**1.09 (1.04–1.14)**	<0.001
Indigenous (Ref: Non-Indigenous)	**0.72 (0.60–0.86)**	<0.001	**0.65 (0.51–0.83)**	<0.001
Currently studying (Ref: Full-time)				
Part-time	**0.78 (0.69–0.89)**	<0.001	**0.60 (0.50–0.71)**	<0.001
Not studying	**0.65 (0.57–0.75)**	<0.001	**0.57 (0.48–0.68)**	<0.001
Paid work (Ref: Yes)				
No, but looking	1.07 (0.98–1.17)	0.141	1.16 (1.05–1.28)	0.003
No, not looking	1.05 (0.96–1.15)	0.317	1.05 (0.94–1.17)	0.396
IRSAD	**1.05 (1.03–1.06)**	<0.001	**1.09 (1.07–1.11)**	<0.001
Remoteness (Ref: Major cities)				
Inner Regional	0.96 (0.86–1.06)	0.382	0.98 (0.87–1.11)	0.77
Outer Regional	1.01 (0.89–1.14)	0.898	0.96 (0.83–1.11)	0.586
Unstable housing (Ref: No)	1.05 (0.94–1.17)	0.369	0.86 (0.76–0.98)	0.024
Financial difficulties (Ref: No)	1.03 (0.95–1.13)	0.454	1.09 (0.98–1.20)	0.113
Mental health condition (Ref: No)				
Prefer not to say	**1.31 (1.16–1.49)**	<0.001	**1.83 (1.59–2.11)**	<0.001
Yes	**1.38 (1.20–1.58)**	<0.001	**2.01 (1.73–2.33)**	<0.001

Note: Multivariate multinomial logistic regression of climate concerns against gender, age, Indigenous status, full-time studying, paid work, IRSAD, remoteness, unstable housing, financial difficulties, and mental health conditions. Missing data were addressed using multiple imputation. IRSAD=Index of relative socio-economic advantage and disadvantage. Relative risk ratio and 95% confidence intervals are shown; $P < 0.001$ in bold.

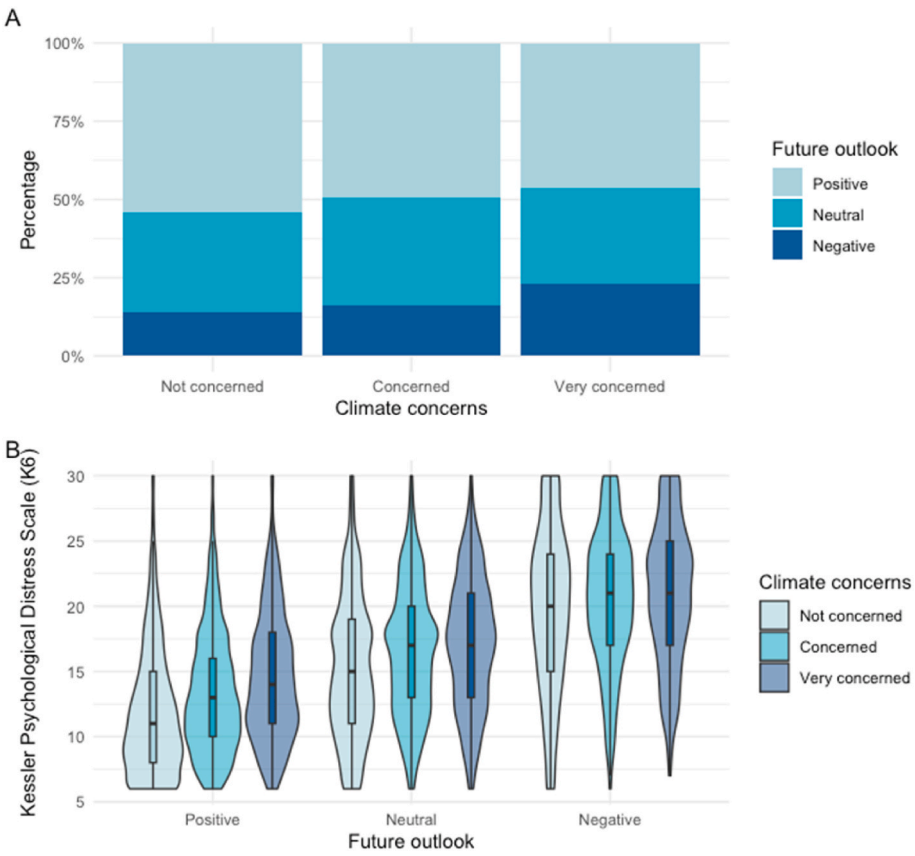

Fig. 1. **(A)** Alluvial plot showing the number and proportion of young people with different levels of climate concerns, psychological distress, and outlook for the future. **(B)** Distribution of K6 (range 5–30) among young people with different levels of climate concerns and outlook for the future. Note: For climate concerns: "Not concerned", "Concerned" and "Very concerned" represent "Not at all concerned", "Slightly/somewhat concerned" and "Very/extremely concerned", for future outlook: "negative", "neutral" and "positive" represent "very negative/negative", "neither negative nor positive" and "very positive/positive".

Table 5
Association of psychological distress and future outlook with climate concerns.

Outcomes	Risk factor: Climate concerns			
	Slightly/somewhat concerned vs. Not at all concerned		Very/extremely concerned vs. Not at all concerned	
	RRR (95% CI)	P-value	RRR (95% CI)	P-value
Model 1: K6 ~ Climate concerns				
Moderate vs. Low K6	**1.44 (1.31–1.58)**	<0.001	**1.62 (1.44–1.81)**	<0.001
High vs. Low K6	**1.33 (1.19–1.49)**	<0.001	**1.81 (1.56–2.11)**	<0.001
Model 2: Future outlook ~ Climate concerns				
Neutral vs. Positive	1.13 (1.04–1.23)	0.004	1.04 (0.94–1.15)	0.478
Negative vs. Positive	1.11 (0.97–1.28)	0.142	**1.52 (1.27–1.81)**	<0.001
Model 3: Future outlook ~ Climate concerns (adjusting for K6)				
Neutral vs. Positive	1.06 (0.98–1.16)	0.161	0.94 (0.84–1.04)	0.227
Negative vs. Positive	1.01 (0.87–1.17)	0.925	1.26 (1.05–1.52)	0.018

Note: All models were further adjusted for gender, age, Indigenous status, full-time studying, paid work, IRSAD, remoteness, unstable housing, financial difficulties, and mental health conditions. Missing data were addressed using multiple imputation. RRR=Relative risk ratio; IRSAD=Index of relative socio-economic advantage and disadvantage.

important issues in Australia. Climate change concerns were also independently associated with both psychological distress and negative future outlook, the latter highlighting the impacts of climate change concerns on the concerns and wellbeing of young people even in the absence of high psychological distress. Climate concerns and worries, in combination with other ongoing societal mega-trends (such as increasing social-media use, COVID-19 pandemic, economic uncertainty), may be contributing to the increasing prevalence of mental ill-health both in Australia and globally (AIHW, 2022; Goodwin, Weinberger, Kim, Wu, & Galea, 2020; Krokstad et al., 2022; Patel et al., 2022). Our findings highlight the urgent need to better understand the direct and indirect impacts of climate change and climate concerns on the mental health of young people, to identify effective ways to mitigate the impact and build resilience, as well as to advocate for improved and immediate climate action.

Certain demographic factors were associated with concern for climate change; for example, males reported concern in lower numbers, which is consistent with previous studies (Lorraine Whitmarsh, 2022; Sarah Sunn Bush, 2022; Seale & Gow, 2010). Other demographic factors associated with higher levels of concern included being older and in full-time education, and those with a self-reported mental health condition, in line with previous studies that found generalised anxiety to be

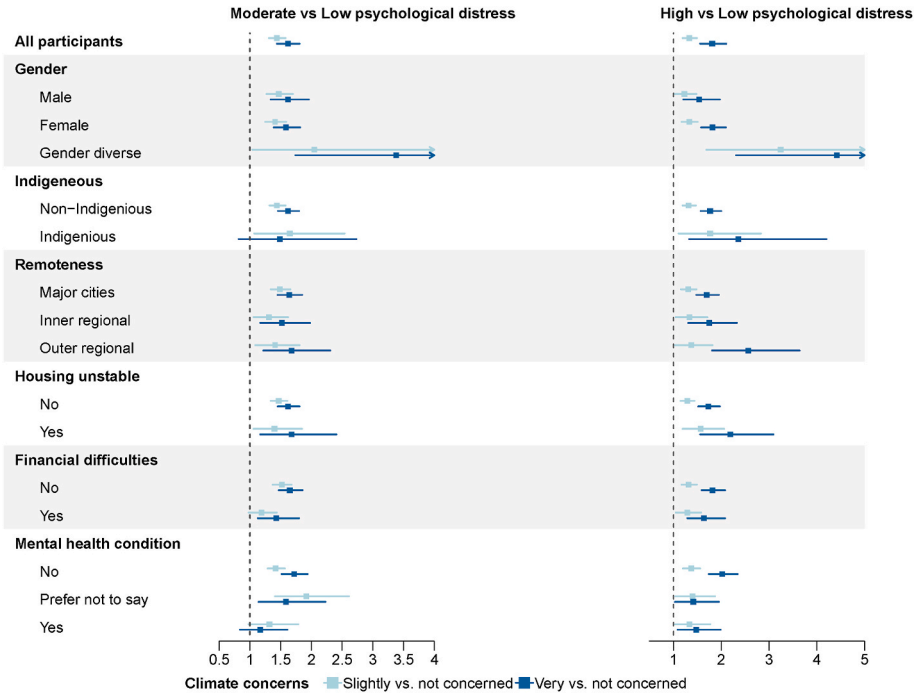

Fig. 2. Relative risk ratios (RRR) and corresponding 95% confidence intervals estimated from multinomial logistic regression analysis of **K6 (outcome) against climate concerns**, adjusted for gender, age, Indigenous status, full-time studying, paid work, IRSAD, remoteness, unstable housing, financial difficulties, and mental health conditions in the full dataset ("All") and stratified by gender, Indigenous status, remoteness, housing stability, financial difficulties, and mental health condition. The stratified models were adjusted for the same variables except for the variable it is stratified by. Missing data were addressed using multiple imputation.

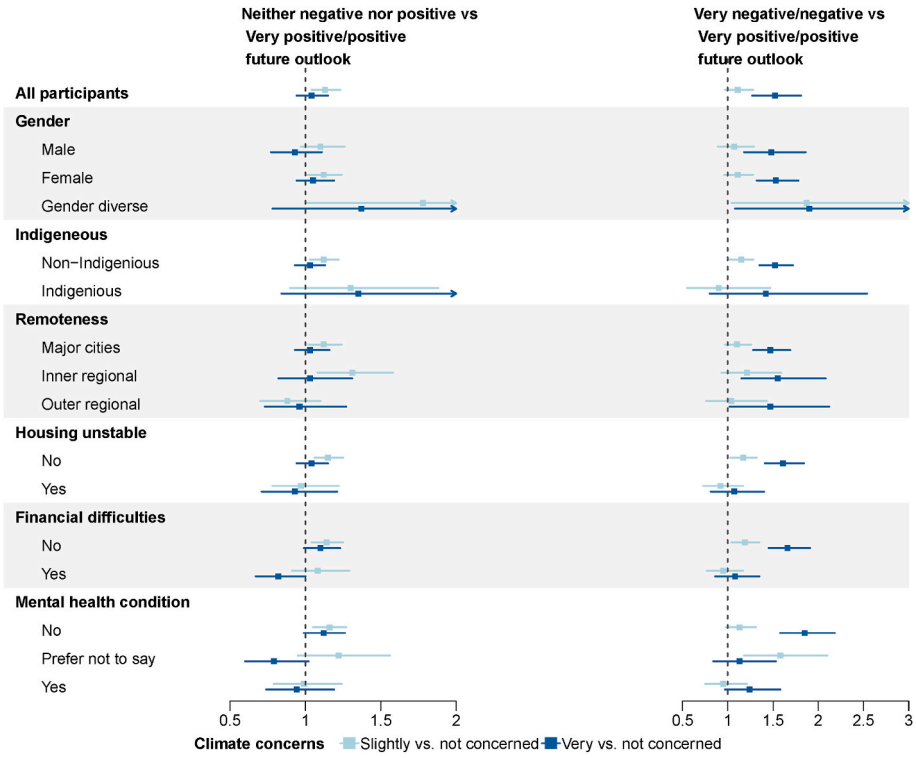

Fig. 3. Relative risk ratios (RRR) and corresponding 95% confidence intervals estimated from multinomial logistic regression analysis of **outlook for the future (outcome) against climate concerns**, adjusted for gender, age, Indigenous status, full-time studying, paid work, IRSAD, remoteness, unstable housing, financial difficulties, and mental health conditions in the full dataset ("All") and stratified by gender, indigenous status, remoteness, housing stability, financial difficulties, and mental health condition. The stratified models were adjusted for the same variables except for the variable it is stratified by. Missing data were addressed using multiple imputation.

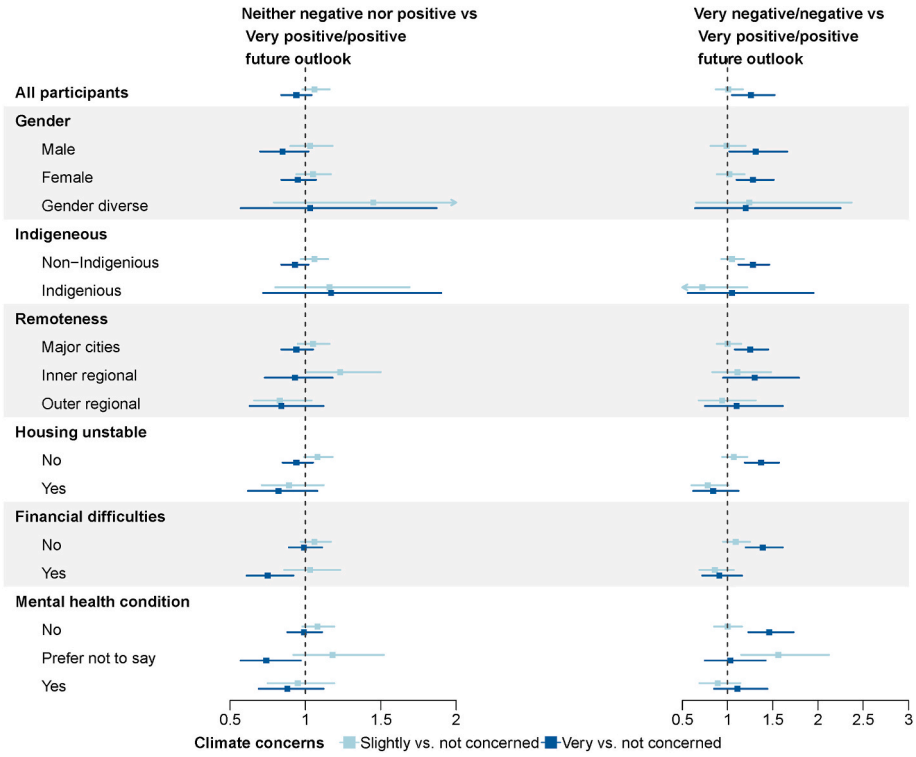

Fig. 4. Relative risk ratios (RRR) and corresponding 95% confidence intervals estimated from multinomial logistic regression analysis of **outlook for the future (outcome) against climate concerns**, adjusted for gender, age, Indigenous status, full-time studying, paid work, IRSAD, remoteness, unstable housing, financial difficulties, mental health conditions, **and K6** in the full dataset ("All") and stratified by gender, Indigenous status, remoteness, housing stability, financial difficulties, and mental health condition. The stratified models were adjusted for the same variables except for the stratification variable. Missing data were addressed using multiple imputation.

associated with higher climate anxiety (Reyes, Carmen, Luminarias, Mangulabnan, & Ogunbode, 2021; Wullenkord, Tröger, Hamann, Loy, & Reese, 2021). Living in areas with a lack of socioeconomic disadvantage was also associated with higher levels of climate concerns, but interestingly, with lower levels of distress and a better outlook for the future. There may be greater levels of environmental education and awareness in higher socioeconomic areas, which promote concerns about climate change. However, higher socioeconomic areas do facilitate greater access to resources, support systems and adaptive capacities that may buffer against the psychological impacts of climate concerns. However, this may be the opposite for lower socioeconomic areas, where young people with general concerns regarding climate change, or an experience of being directly impacted by climate events, are less able to obtain the necessary supports for their mental health and wellbeing (Islam & Winkel, 2017). The intersect of socioeconomic status and climate-related challenges is an important point to address; fostering more resilient and connected communities capable of addressing climate change, and reacting to the impacts of climate change, may mitigate the relationship between climate change concerns and psychological distress for those living in lower socioeconomic areas (Islam & Winkel, 2017).

We also found that young people with higher levels of climate concerns were more likely to experience higher levels of psychological distress after controlling for potential confounding factors. Similar findings have been reported elsewhere, for example, in a global survey of adults in 32 countries (Ogunbode et al., 2022), in Phillippine and Canada (Galway & Field, 2023; Reyes et al., 2021). There was also some evidence supporting the longitudinal relationship between climate change concerns and poor mental health (McBride, Hammond, Sibley, & Milfont, 2021). A recent Orygen and YouGov survey of 1000 young Australians found that 67% of participants say climate concerns have a negative impact on their mental health (Fava, Gao, & Baker, 2023).

While the cross-sectional design of the present study limits the ability to draw a causal link between climate concerns and psychological distress, similar to many existing studies (Ramadan et al., 2023), it is likely that the association is bidirectional, where concerns about climate change contribute to young people's psychological distress (e.g., climate anxiety), and pre-existing psychological distress increases the likelihood of worry and concerns, including about climate change. Interestingly, the association between climate change concerns and psychological distress was more pronounced for young people who did not report a mental health condition. Despite the cross-sectional nature of the data, this does lend significant weight to the idea that climate change concerns themselves may be a direct contributor to psychological distress for young people and more pronounced among young people without existing mental health issues, which could be due to plateaued or attenuated effects of increasing risk factors (Roberts, Roberts, & Chan, 2009).

Our analysis focused on the level of concerns associated with climate change. The negative emotions that could arise from these concerns can be complex, for example, worry, anxiety, fear, grief, sorrow, guilt, hopelessness, despair, and anger (Diffey et al., 2022). Although concern and worry are appropriate emotional responses to both the threat and direct effects of climate change (Bhullar, Davis, Kumar, Nunn, & Rickwood, 2022), these emotional responses can have a clinically significant impact when they become difficult for young people to manage and impact functioning (Clayton, 2020). The mechanisms through which climate concerns and various emotional states interact and impact young people's mental health, well-being, resilience and hopefulness are largely unknown (Ramadan et al., 2023). Our study suggested that concerns about climate change were independently linked to young people's hopefulness about the future which is not only a driving factor for better coping with climate-related distress as well aspro-environment behaviours (Ojala, 2012, 2023) but also a protective

factor for long-term poor mental health (Ciarrochi, Parker, Kashdan, Heaven, & Barkus, 2015; Schmid et al., 2011). Therefore, we argue that the potential long-term impacts over the lifetime warrant immediately focused attention from research and policy sectors to better support the design of climate change education, communication strategies and targeted interventions to foster hope, motivate actions, and avoid despair. This is critical, especially in light of predictions that the incidence of major climate events will continue to increase in the future (IPCC, 2022).

To our knowledge, this is the first time in Australia that a large-scale survey has enabled the exploration of the association between climate concerns and mental ill-health in minority and marginalised groups. We found trends towards a stronger association of climate change concerns on psychological distress among young people who identified as gender diverse, Indigenous, and those living in outer regional, remote, or very remote areas of Australia. The majority of previous studies, including some of the largest global surveys (Hickman et al., 2021; Ogunbode et al., 2022), have not reported on gender-diverse groups, most commonly due to small numbers. Similarly, studies that focused on, or reported on, Indigenous or regional/remote communities are rare (Ma et al., 2022; Martin, Reilly, Everitt, & Gilliland, 2022). Our findings of a stronger link between climate concerns and mental health in marginalised groups suggest there may be different factors mediating the relationship between climate concerns and psychological distress. These factors could be cognitive, emotional, or physical (e.g., cultural beliefs about nature, direct exposure to climate events). Additionally, these factors may be interacting with minority stress commonly experienced by marginalised groups and known to impact physical and mental health. Further research is needed to explore these possibilities. Indeed, understanding the potential mental health impacts of climate change for minority and marginalised groups should be a priority for future research, given the consistent evidence for poor mental health and service access by these communities.

Certain sub-groups of young people, such as those who reported financial difficulties, and/or mental health conditions, exhibited a weaker association between climate change and psychological distress. Young people from these sub-groups reported higher levels of psychological distress generally, potentially masking any additional increases in distress associated with climate change. It is plausible that for these young people, concerns related to climate change may have only marginally contributed to elevated levels of psychological distress, given pre-existing stressors and concerns. Again, further research is needed to obtain a greater understanding of the impact of climate concerns on young people facing existing social disadvantage and/or mental ill-health.

4.1. Implications and policy opportunities

Climate change is escalating, and the consequences will be disproportionately felt by young people and future generations. It is critical that young people are supported to deal with the direct effects on them including feelings of concern, anxiety and other negative emotions. Opportunities to address these potential repercussions should include mitigating the long-term impact, supporting vulnerable sub-groups, building resilience and hope, as well as empowering young people to engage in climate actions. To achieve this, a better understanding of young people's experiences and how climate concerns and mental ill-health intersect is required.

Given the association between higher levels of psychological distress and climate concern, there is a need for all levels of government to include initiatives that address the mental health impact of climate change in both youth and mental health strategies, and policy responses. Governments should ensure that activities and outcomes tied to these initiatives are informed by research evidence and developed in partnership with young people to help guide the identification, development, and implementation of youth-specific solutions (Bhullar et al., 2022).

In addition, professionals that frequently work with young people, such as but not limited to teachers, mental health clinicians, school wellbeing officers and university counsellors, could play an important role in providing support, promoting help-seeking and enabling the early identification of psychological distress for young people as a direct or indirect impact of climate change. However, there remains a need to understand further what activities and interventions would be most appropriate and effective for supporting young people expressing climate concerns.

Dedicated large-scale research agendas and funding are required to address urgent needs in understanding the intersection of mental health and climate change. This research should include focused opportunities to (i) better understand the dynamics and long-term associations between climate change and mental health in young people, (ii) identify who is most at risk or in need of the support (e.g., those with pre-existing mental health conditions or other risk factors), (iii) develop strategies to improve psychosocial resilience in young people (i.e., effective mitigating actions, strategies for maintaining and building hope), and (iv) establish effective clinical interventions for those who experience climate trauma and severe climate anxiety. These research priorities identified are intended to help inform the development of effective initiatives and policies that address the mental health impact of climate change among young people.

4.2. Strengths, limitations, and future directions

To our best knowledge, this is the largest study focusing on climate change concerns and mental health among young people with over 18,000 young people from diverse backgrounds providing valid responses across a wide range of geographical areas in Australia. The survey aimed to understand the general concerns and perspectives of youth and was not advertised as a study regarding climate change, which reduces the likelihood of self-selection bias in attracting young people with climate concerns. The survey measured a range of domains (e.g., social demographical factors, mental health, hopefulness for the future), which allowed a detailed examination of complex associations.

This study also has a few limitations. It is based on a cross-sectional survey and hence the temporal links and causal evaluation among climate concerns, psychological distress and future outlook cannot be assessed. It is also not a representative population survey (e.g., address or census-based) with lower participation rates from males and those aged 18–19, which were controlled for in the models. The survey was not designed specifically for climate-related concerns, and thus did not specifically measure climate change associated negative emotions (e.g., climate anxiety) and direct impact (e.g., impacted by flood). As such, the current data were inappropriate to investigate the association between climate concerns among those affected by extreme weather events. Climate concerns was also measured based on a one-item measure which could impact its reliability. In the 2023 survey, we have incorporated additional questions to assess if the participants' community or household has been directly impacted by climate events to further delineate these complex associations. Future research should be undertaken in collaboration with young people to seek to understand what matters to them about climate concerns and how they can best be supported to deal with the inevitable changes they will face in the future.

Data sharing

All R codes used for this analysis are shared in https://osf.io/pfr23/?view_only=d01d82d1857b4692b7bc9dbb659a1de8. The data are owned by Mission Australia and any data request should be directed directly to them via youthsurvey@missionaustralia.com.au.

Role of the funding source

Orygen funded the academic paper, which involved data analysis, data interpretation, and writing of this paper. Mission Australia funds and manages the *Youth Survey* study and owns the data.

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Declaration of competing interest

Orygen are funded by the Australian Government Department of Health and Aged Care to provide technical advice and policy direction on a number of youth mental health topics, including social determinants. This is relevant for NF, DB, and VB.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvp.2023.102209.

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