Negative emotions about climate change are related to insomnia symptoms and mental health: Cross-sectional evidence from 25 countries

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Abstract

Climate change threatens mental health via increasing exposure to the social and economic disruptions created by extreme weather and large-scale climatic events, as well as through the anxiety associated with recognising the existential threat posed by the climate crisis. Considering the growing levels of climate change awareness across the world, negative emotions like anxiety and worry about climate-related risks are a potentially pervasive conduit for the adverse impacts of climate change on mental health. In this study, we examined how negative climate-related emotions relate to sleep and mental health among a diverse non-representative sample of individuals recruited from 25 countries, as well as a Norwegian nationally-representative sample. Overall, we found that negative climate-related emotions are positively associated with insomnia symptoms and negatively related to self-rated mental health in most countries. Our findings suggest that climate-related psychological stressors are significantly linked with mental health in many countries and draw attention to the need for cross-disciplinary research aimed at achieving rigorous empirical assessments of the unique challenge posed to mental health by negative emotional responses to climate change.

Keywords Climate anxiety · Emotions · Insomnia · Mental health · Climate change · Eco-anxiety

Introduction

Climate change has important implications for mental health. These implications may arise from the physical, social and economic impacts of extreme and acute climatic changes or the psychological distress and anxiety evoked by awareness of the short- and long-term impacts of climate change (Cunsolo & Ellis, 2018; Fritze, Blashki, Burke, & Wiseman, 2008; Hayes, Blashki, Wiseman, Burke, & Reifels, 2018). Previously, research has strongly focused on how direct exposure to adverse environmental conditions such as high

temperatures, drought, and flooding affect mental health (Burke et al., 2018; Evans, 2019; Graham, White, Cotton, & McManus, 2019; Obradovich, Migliorini, Paulus, & Rahwan, 2018). Yet, for most people, exposure to climate change is indirect; occurring via media representations of ongoing environmental changes and impacts occurring around the world (Doherty, 2018; Doherty & Clayton, 2011). Given the growing rates of media coverage of climate change in many countries (Schmidt, Ivanova, & Schäfer, 2013), rising public consciousness of the risks posed by climate change, rather than direct exposure to unfavourable environmental conditions, is likely to be a pervasive pathway by which climate change affects mental health.

Presently, a large majority of people across the world see climate change as a major threat and are worried about its projected consequences (Fagan & Huang, 2019; Gustafson, Bergquist, Leiserowitz, & Maibach, 2019). Worry about

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climate change is an important determinant of pro-environmental actions and support for climate policies (Smith & Leiserowitz, 2014; Wang, Leviston, Hurlstone, Lawrence, & Walker, 2018), but it is also associated with psychological distress (Searle & Gow, 2010). The concept of climate change anxiety has recently gained prominence in discussions of the various negative emotions, including worry, that people are experiencing in response to climate change (Clayton, 2020; Clayton & Karazsia, 2020). While climate change anxiety has been the subject of considerable media attention, there is a dearth of empirical evidence regarding how such negative emotions relate to mental health. Further, although negative impacts on mental health are recognised as a part of a range of intangible harms inflicted globally by climate change (Tschakert, Ellis, Anderson, Kelly, & Obeng, 2019), the current discourse regarding climate change anxiety has largely centred on its manifestation in Western countries (BBC, 2019b, 2020; Clayton & Karazsia, 2020; Nugent, 2019). Consequently, the significance of negative climate-related emotions for mental health remains unclear in a global context. In the present study, we conducted a cross-national empirical investigation of the relationship between negative climate-related emotions and mental health, with an additional focus on how negative climate-related emotions relate to sleep.

Climate change anxiety is often used interchangeably with the broader concept of *eco-anxiety*, which is defined as a chronic fear of ecological doom (Albrecht, 2011; Clayton, Manning, Krygsman, & Speiser, 2017). The accounts provided by individuals living with climate change anxiety support a definition of the phenomenon as a profound negative emotional response to anticipated trauma (BBC, 2019b; Bednarek, 2019). People affected by climate change anxiety commonly speak of emotional distress evoked by perceived negative changes in valued physical and natural spaces (Kielland & Larssen, 2019), a paralysing fear of the end of the world (BBC, 2019b), and of a deep sense of despair about how future generations may be harmed by climate change (BBC, 2019a). Anxiety about a future Earth made unliveable by climate change is also linked to a growing number of individuals deciding not to have children (Hunt, 2019; Schneider-Mayerson & Leong, 2020). With the growing frequency of abnormal weather and climatic events attributed to global climate change, scholars suggest that climate-related negative emotions can be expected to have a significant impact on mental health, even among people who are not directly exposed to these climatic events (Clayton & Karazsia, 2020).

Many negative mental health outcomes associated with climate change may be theoretically linked with sleep (Obradovich & Migliorini, 2018). Sleep problems are a common cause and symptom of various mental health disorders, including affective and anxiety disorders (Baglioni et al., 2016). The role of sleep in mental health disorders is partly attributed to a reciprocal relationship between sleep and emotion dysregulation, whereby high negative emotional arousal leads to sleep disturbance, which can in turn amplify negative emotional responses to stress-inducing stimuli (Harvey, Murray, Chandler, & Soehner, 2011). Previously, sleep has not figured strongly in the climate change literature. However, there is some indication that climate change has significant impacts on sleep quality. A recent review of the literature reports that rising temperatures and extreme weather events, particularly hurricanes, flooding and wildfires are linked to sleep disruption and diminished sleep duration (Rifkin, Long, & Perry, 2018). According to Obradovich, Migliorini, Mednick, and Fowler (2017), a 1 °C rise in monthly night-time temperatures is associated with an increase of three nights of insufficient sleep per 100 people in the United States. Zhen, Quan, and Zhou (2018) also showed that traumatic exposure to flooding is associated with sleep problems, and that this association is mediated by fear and depression. Negative emotions regarding climate change have yet to be empirically linked to sleep, but evidence of a link between negative emotions and sleep problems is strongly established (Baglioni, Spiegelhalder, Lombardo, & Riemann, 2010). In light of this literature, we anticipate that negative climate-related emotions are associated with sleep problems.

The primary aim of this study was to determine how negative climate-related emotions relate to mental health across a broad range of national contexts extending beyond Western countries. We hypothesized that negative climate-related emotions will be negatively related to mental health (H1) and positively related to sleep problems (H2). Sleep problems were operationalised in the study using an index of insomnia symptoms.

Method

Data

We tested our hypotheses using data from two large cross-sectional questionnaire surveys. The first survey, conducted in autumn 2019, involved a diverse sample of individuals from 25 countries spanning all the inhabited continents ($N = 10,143$; $M_{age} = 23.4$ years, $SD_{age} = 7.3$, Males = 33.7%, Females = 63.4%). Respondents were recruited from university research participant pools using opportunity sampling. In non-English speaking countries, the questionnaire was translated into local languages by competent bilingual speakers using the translation-back-translation method (Brislin, 1970). Ethics approval for the survey was granted by the De Montfort University University, Health and Life Sciences Faculty Research Ethics Committee (FREC; ref.: 3434).

The second survey was conducted in spring 2020 with a representative sample of residents in Norway ($N = 1015$;

M_{age} = 46.3 years, SD_{age} = 17.5, Males = 47.7%, Females = 52.3%). The respondents were recruited via a commercial research panel provider. The design and administration of the survey was fully compliant with the British Psychological Association code of Research Ethics and Conduct (BPS, 2018). Participants in the two surveys were provided with information about the nature of the study, including how the data were to be used, and asked to indicate their consent to participate before proceeding to complete the questionnaire. Full demographic information for the samples recruited in both surveys is provided as supplementary data (Tables 1 and 2, File S1).

Measures

Research participants in both surveys completed a questionnaire including items measuring negative climate-related emotions, insomnia symptoms and self-rated mental health.

Negative climate-related emotions were measured with a 7-item index loosely based on the state anxiety component of the State-Trait Anxiety Inventory (Spielberger, 1983). Participants were instructed to collect their thoughts and focus on their feelings about climate change, after which they were directed to rate how much they feel *calm*, *tense*, *relaxed*, *anxious*, *peaceful*, *worried* and *terrified* about climate change at the present moment. Ratings for each item were recorded using a 5-point scale ranging from 1 (not at all) to 5 (extremely). Responses to the 'calm', 'relaxed' and 'peaceful' items were reversed prior to analysis. The scale showed adequate internal consistency across all the countries surveyed with Cronbach's α values ranging from .72 to .92 (Table 1).

Insomnia symptoms were measured with the Bergen Insomnia Scale (Pallesen et al., 2008). This scale has previously been validated against subjective and polysomnographic data and across various cultural groups (Bay & Ergun, 2018; Naher, Johora, Alam, & Ahmed, 2019; Pallesen et al., 2008). Examples of items included in the scale are: 'During

Table 1 Descriptive and reliability statistics for measured variables (negative climate-related emotions, insomnia symptoms and self-rated mental health)

Country	Negative climate-related emotions		Insomnia symptoms		Mental health
	M(SD)	α	M(SD)	α	
Australia	3.22 (0.91)	0.90	3.33 (1.78)	0.86	3.01 (1.12)
Brazil	3.76 (0.91)	0.91	3.32 (1.57)	0.78	2.78 (0.99)
Canada	3.12 (0.78)	0.88	3.30 (1.53)	0.80	2.93 (1.01)
Chile	3.31 (0.74)	0.83	3.60 (1.72)	0.83	2.50 (1.05)
China	2.86 (0.81)	0.89	2.71 (1.42)	0.78	3.05 (0.97)
Finland	3.26 (0.96)	0.92	2.53 (1.40)	0.79	2.96 (1.01)
Germany	3.39 (0.84)	0.87	2.54 (1.42)	0.81	3.04 (0.92)
Italy	3.41 (0.73)	0.89	3.13 (1.52)	0.83	3.08 (0.82)
Indonesia	3.32 (0.68)	0.84	3.69 (1.32)	0.71	2.49 (0.86)
Iran	3.32 (0.84)	0.86	2.59 (1.27)	0.64	3.07 (1.01)
Japan	3.05 (0.65)	0.73	2.39 (1.33)	0.73	2.62 (1.09)
Malaysia	3.06 (0.71)	0.86	2.74 (1.52)	0.80	3.03 (0.89)
Netherlands	3.20 (0.78)	0.88	2.42 (1.41)	0.81	3.06 (1.03)
Nigeria	2.84 (0.73)	0.71	3.17 (1.44)	0.81	3.53 (0.98)
Norway	3.09 (0.81)	0.87	2.32 (1.40)	0.81	3.20 (1.04)
Pakistan	3.03 (0.80)	0.81	3.85 (1.54)	0.84	2.80 (0.97)
Philippines	3.55 (0.73)	0.85	4.03 (1.44)	0.73	2.82 (0.96)
Portugal	3.43 (0.77)	0.87	3.64 (1.48)	0.83	3.02 (0.95)
Romania	2.90 (0.84)	0.86	2.83(1.44)	0.80	3.33 (0.99)
Russia	2.71 (0.62)	0.75	2.96 (1.64)	0.76	3.19 (0.97)
Slovakia	3.00 (0.77)	0.83	3.25 (1.48)	0.79	3.17 (0.94)
Spain	3.66 (0.72)	0.86	2.72 (1.56)	0.83	2.86 (1.00)
Tanzania	2.91 (0.72)	0.75	3.38 (1.40)	0.73	3.74 (0.97)
Uganda	3.18 (0.87)	0.84	3.22 (1.47)	0.76	3.43 (0.93)
United Kingdom	3.26 (0.80)	0.88	3.84 (1.53)	0.80	2.67 (1.07)
Total	3.23 (0.83)	0.86	3.18 (1.58)	0.80	3.01 (1.03)
Norway (Representative)	2.50 (0.76)	0.88	2.12 (1.60)	0.83	3.39 (1.11)

Table 2 Multilevel models of negative climate-related emotions, insomnia symptoms and mental health

	Insomnia symptoms		Mental health	
	Estimate (SE)†	95%CI	Estimate (SE)	95%CI
Fixed effects				
Negative climate-related emotions	0.25 (0.02)*	0.21, 0.28	−0.24 (0.013)*	−0.27, −0.22
Age	−0.01 (0.00)*	−0.02, −0.01	0.01 (0.00)*	0.00, 0.01
Gender (Female)	0.19 (0.03)*	0.12, 0.25	−0.13 (0.02)*	−0.18, −0.09
Intercept	3.11 (0.10)*	2.91, 3.30	3.01 (0.05)*	2.91, 3.11
Random effects	Variance	Std. dev.	Variance	Std. dev.
Country (intercept)	0.23	0.48	0.06	0.25
AIC	34,924.2		26,824.0	
Marginal R^2	0.03		0.05	
Conditional R^2	0.12		0.11	
N	9683		9705	

*$p < .001$, †Estimates are linear coefficients

the past month, how many days a week has it taken you more than 30 minutes to fall asleep after the light was switched off?' and 'During the past month, how many days a week have you been awake for more than 30 minutes between periods of sleep?'. The Bergen Insomnia Scale comprises a total of six items. It showed acceptable levels of internal consistency across countries with Cronbach's α values ranging from .64 to .86 (Table 1).

Self-rated *mental health* was measured with a single-item scale adopted from the mental health supplement of the Ontario Health Survey (see Ahmad, Jhajj, Stewart, Burghardt, & Bierman, 2014). Participants were instructed to rate their overall mental health on a 5-point scale (1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent).

Analysis

Relationships between negative climate-related emotions, insomnia symptoms and mental health across countries were initially assessed in the cross-national data using correlation analysis. Due to the nested nature of the data (individuals within countries), linear multilevel regression models with random intercepts were estimated using the R package lme4 (Bates, Maechler, Bolker, & Walker, 2014) to test our hypotheses. Level 1 fixed effects were negative climate-related emotions, age and gender. At level 2, we modelled participants' country as random effects (intercepts). All independent variables were grand mean centred.

In the first stage of model building, we estimated an unconstrained model with no level 1 predictors. This null model was used to estimate the intraclass coefficient (ICC). The null model showed a significant amount of variance in insomnia symptoms ($\Upsilon_{00} = 3.10$, $t(25.05) = 31.44$, $p < .001$) and mental health ($\Upsilon_{00} = 3.01$, $t(25.04) = 51.39$, $p < .001$) across the data.

The random effects part of the model showed a substantial degree of within-country ($\tau_{00} = 2.20$) and between-country ($\sigma = .24$) variance for insomnia symptoms, yielding an intraclass coefficient $\rho = 0.10$. Similarly, we observed substantial within-country ($\tau_{00} = 0.97$) and between-country ($\sigma = .08$) variance in self-rated mental health, which yielded a $\rho = 0.08$. These ICC estimates mean that around 10% of the variance in insomnia symptoms and 8% of the variance in mental health is explained by participants' country. In other words, participants from the same country are more similar in their insomnia symptoms and self-rated mental health scores than participants from different countries. Although, these ICC values are somewhat smaller than those been obtained in other cross-cultural research in environmental psychology (e.g., Schultz et al., 2014), we concluded that there is a clustering effect in our data and we cannot treat scores within countries as independent. Thus, the use of a multilevel approach to our hypothesis testing was justified.

There was a small amount of missing data in the cross-national survey (<5%). List-wise deletion was applied in all our analyses. For the purpose of comparisons across Western and non-Western countries, we used the following classification: Australia, Brazil, Canada, Chile, Finland, Germany, Italy, Netherlands, Norway, Portugal, Spain and the United Kingdom were classed as Western countries while China, Indonesia, Iran, Japan, Malaysia, Nigeria, Pakistan, Philippines, Romania, Russia, Slovakia, Tanzania and Uganda were classed as non-Western countries.

Our hypotheses were further tested with data from the Norwegian representative survey using weighted least squares regression. The main purpose of the Norwegian data analysis was to determine the degree to which the findings from the cross-national sample replicate in the absence of sampling

biases such as the overrepresentation of females, young respondents and university students. Here, we also included age and gender as covariates.

Results

Cross-National Survey

Negative climate-related emotions were positively correlated with insomnia symptoms ($r_{pooled} = 0.16$, $p < .001$, $N = 10,098$) across all 25 countries represented in the cross-national survey (Fig. 1). This relationship was significant at the conventional significance threshold of $p < .05$ in all countries except China, Italy, Japan, Malaysia, Norway, Slovakia and Tanzania. Negative climate-related emotions were inversely correlated with mental health across the cross-national data ($r_{pooled} = -0.24$, $p < .001$, $N = 10,131$) but this correlation was not significant in Italy, Japan, Malaysia and Tanzania. The correlation between negative climate-related emotions and insomnia symptoms in Western countries ($r_{pooled} = 0.18$, $p < .001$, $N = 4336$) and non-Western countries ($r_{pooled} = 0.17$, $p < .001$, $N = 5763$) was roughly equivalent ($z = 0.51$, $p = .608$). However, the correlation between negative climate-related emotions and self-rated mental health was different in Western countries ($r_{pooled} = -0.25$, $p < .001$, $N = 4361$) compared with non-Western countries ($r_{pooled} = -0.21$, $p < .001$, $N = 5756$), with this correlation being significantly stronger in Western countries ($z = -2.10$, $p = .035$).

In line with the correlation analysis, the multilevel regression models revealed that negative climate-related emotions

positively predicted insomnia symptoms and negatively predicted mental health (Table 2). Further, insomnia symptoms were inversely related to age and positively related with gender. Female respondents reported higher levels of insomnia symptoms on average. Age and gender were also significantly related with self-rated mental health, whereby older respondents reported better mental health and females reported poorer mental health on average. Using the 'MuMIn' package for R (Barton, 2013), we estimated that the level 1 fixed effects: negative climate-related emotions, age and gender, explained around 3% and 5% of the variance in insomnia symptoms and self-rated mental health respectively.

Norwegian Representative Survey

The overall pattern of correlations observed across the cross-national data was replicated with the Norwegian representative data where we observed a significant positive correlation between negative climate-related emotions and insomnia symptoms ($r = 0.17$, $p < .001$, $N = 1015$) and a negative correlation between negative climate-related emotions and self-rated mental health ($r = -0.16$, $p < .001$, $N = 1015$). We tested our hypotheses using weighted least squares regression and including participants' age and gender as covariates. The results revealed that negative climate-related emotions were positively related to insomnia symptoms (H1) and negatively related to mental health (H2) among the Norwegian nationally-representative sample (Table 3). Further, age was negatively related to insomnia symptoms and positively related to mental health, while gender was only significantly related to insomnia symptoms. Similar to the cross-national sample, females in the Norwegian nationally-representative sample reported greater insomnia symptoms than males.

Discussion

The primary purpose of this study was to determine how negative emotions regarding climate change relate to mental health in a global context. Based on the trends observed across non-representative samples of individuals from 25 countries and one nationally-representative sample from Norway, our data show that negative climate-related emotions have a modest but consistent negative relationship with a subjective measure of mental health around the world. In most countries surveyed, negative climate-related emotions showed a significant positive correlation with insomnia symptoms (72% of the countries), and a significant negative correlation with self-rated mental health (84% of the countries). This indicates that negative emotions regarding climate change have relevance for mental health at a global level.
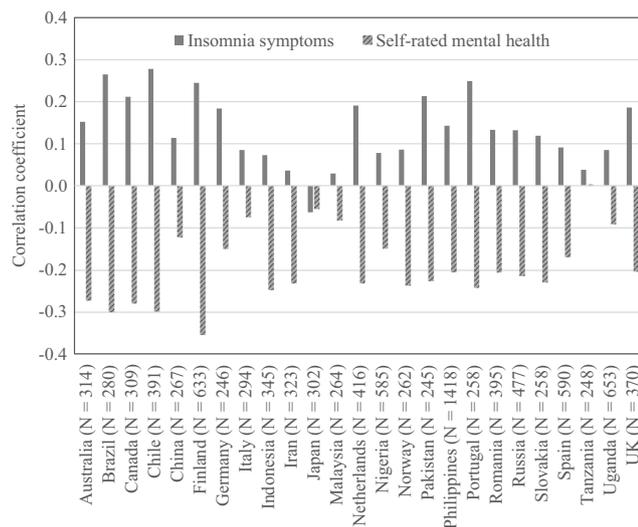

Fig. 1 Cross-national zero-order associations of negative climate-related emotions with insomnia symptoms and self-rated mental health. Estimates are Pearson product moment correlation coefficients

Table 3 Insomnia symptoms and mental health regressed on negative climate-related emotions

	Insomnia symptoms		Mental health	
	B(SE)	Sig.	B(SE)	Sig.
Negative climate-related emotions	0.26 (.07)	<.001	−0.19 (0.04)	<.001
Age	−0.01 (0.00)	<.001	0.01 (0.00)	<.001
Gender (Female)	0.44 (0.10)	<.001	−0.10 (0.07)	.146
F	19.74	<.001	18.05	<.001
Adj. R^2	.05		.05	
N	1015		1015	

Cell entries are unstandardised linear regression estimates

Implications

The continuing consolidation of scientific evidence of the dangerous near- and long-term implications of unabated global warming, such as is presented in the 2018 IPCC special report on 1.5 °C global warming, fosters heightened public concern and perceived threat from climate change (Ogunbode, Doran, & Böhm, 2020). Escalating public concerns about climate change were recently evidenced by the widespread protests witnessed globally in 2019 involving millions of children, youth and adults calling for an urgent societal response to the emerging climate crisis. However, negative emotions about the anticipated consequences of climate change may not only serve to galvanise mass climate action. Our data suggest that negative emotions regarding climate change may also undermine mental health and cause people to lose sleep, which is itself a key component of healthy psychological functioning and wellbeing.

This study is the first to examine the relationship between climate change-related emotions and mental health with cross-national data that captures a broad range of cultural backgrounds. We observed that negative climate change-related emotions have a slightly stronger correlation with self-rated mental health in Western countries compared with non-Western countries, but the magnitude of the correlation between negative climate change-related emotions and insomnia symptoms was equivalent across the two categories of countries. Possibly, this reflects differences in the precision of the measures used to capture mental health and insomnia symptoms in the study. The self-rated mental health measure opens the door to a degree of ambiguity by allowing respondents define what they subjectively understand as constituting their mental health. Lay understandings of mental health differ significantly across cultural groups (Giosan, Glovsky, & Haslam, 2001), and the subjective understandings of mental health and negative emotions may be more conceptually proximate among Western individuals than non-Western individuals. However, the index of insomnia symptoms is less ambiguous and the equivalence of the relationship between negative climate-related emotions and insomnia symptoms

across Western and non-Western countries has important implications for further research on climate change and mental health.

Although climate change anxiety is not currently classified as a mental health disorder, dysregulated negative emotional responses to environmental problems can significantly impair individuals' health and psychological functioning (Clayton, 2020). Sleep disturbance is a common symptom of a wide range of mental ill-health conditions (Harvey et al., 2011). Given the equivalent relationship between negative climate-related emotions and insomnia symptoms observed across Western and non-western countries in this study, and the previously established relationship between sleep disturbance and poor mental health, we suggest that sleep disturbance or insomnia symptoms may be considered a cross-culturally diagnostic index of mental health-threatening negative emotional responses to climate change.

There is already a great deal of evidence that climate change affects mental health directly through natural disasters and gradual environmental changes. For example, communities affected by ecological disasters such as hurricanes, flooding, droughts and wildfires show increased rates of post-traumatic stress disorder (PTSD), anxiety, depression and substance abuse (Morganstein & Ursano, 2020). Rising temperatures have also been linked with increased rates of suicide and hospitalisation for mental health problems (Burke et al., 2018; Carleton, 2017; Obradovich et al., 2018). However, our findings reinforce an understanding that climate change poses a challenge for mental health through other channels than direct exposure to impacts from biophysical phenomena. Negative emotions arising from recognition of the current and future threat posed by climate change are also potent psychological stressors for individuals and communities (Clayton, 2018; Cunsolo Willox et al., 2015). Among some especially vulnerable communities, exposure to severe ecological events exacerbated by climate change combines with anxiety about future climate change impacts to generate levels of psychological distress that significantly impair key aspects of day-to-day life (Gibson, Barnett, Haslam, & Kaplan, 2020). The challenge for researchers

remains to further establish how, and to what degree, negative emotional responses to climate change are affecting people's mental health across broad cultural and geographical scales.

Limitations and Future Directions

Causal relationships cannot be established with the data examined in this article due to their cross-sectional nature and there are potential alternative explanations for the pattern of associations observed in our data. For example, irrespective of climate change concerns, poor sleep can arise from various lifestyle factors including job stress, alcohol consumption, smoking, insufficient physical activity and excessive use of electronic media (Hafner, Stepanek, Taylor, Troxel, & van Stolk, 2017). Sleep is also an important determinant of mental health and a key influence on ability to regulate negative emotions (Harvey et al., 2011). Consequently, the current findings may reflect the concurrent influence of poor sleep on mental health and individuals' ability to regulate negative emotional responses to a broad range of stressors including consciousness of climate change-related risks. Further research involving experimental and longitudinal designs is needed to determine the direction of causal links between negative climate-related emotions and sleep proposed here.

Related to the above consideration is also the question of how negative emotional responses to climate change conceptually relate to poor mental health. Negative emotions such as a sustained state of heightened worry can be indicative of an underlying mental health disorder (Hirsch & Mathews, 2012). Thus, it can be argued that strong feelings of worry about climate change could simply be a manifestation of poor mental health. However, previous research has shown that habitual worrying about ecological problems is unrelated to pathological worry (Verplanken & Roy, 2013). Further, worrying about climate change in particular, while being dysfunctional for some individuals, is generally associated with a suite of factors including pro-environmental values, 'green' identity and environmental threat perception that in combination indicate an adaptive pro-environmental response (Verplanken, Marks, & Dobromir, 2020). Therefore, the hypothesized decremental effect of negative climate-related emotions on mental health is clearly justified by the existing empirical literature.

It is important to note that our study is limited by the use of a single-item measure of mental health. This measure afforded the benefit of brevity in administration of the questionnaire. However, it is impossible to determine the reliability of the measure or the degree to which it appropriately reflects the complex experiences of mental health across the range of cultural contexts represented in our study. Previous research has recorded moderate correlations between the single-item mental health measure and multi-item scales such as the K6 psychological distress scale and the mental health subscale of the short form survey (SF-12) (see Ahmad et al., 2014). However,

the single-item mental health measure is not directly equivalent to established multi-item mental health scales and caution must be exercised in drawing definite conclusions from findings based on the single-item measure.

Finally, the sample obtained in our cross-national survey was based on a convenience sampling strategy rather than probability sampling of individuals within the countries represented. This means that the findings may not necessarily generalizable to the broader national populations from which these samples were drawn. The close replication of findings across the non-representative cross-national sample and the nationally-representative sample of Norwegian residents is a basis for confidence in the overall findings from the study. Nonetheless, subsequent replication with representative samples in non-Western countries is needed to further establish the relationship between negative climate-related emotions and mental health in a global context.

Conclusions

Care should be taken to not to overstate the global significance of negative climate-related emotions for mental health in the absence of substantive empirical evidence. On average, we observed a modest amount of shared variance between negative climate-related emotions and self-rated mental health among our cross-national (6%) and representative Norwegian (3%) samples. There are myriad situational and contextual factors that contribute to determining individuals' mental health, of which negative emotions regarding climate change may be a significant component. Yet, there are compelling theoretical and empirical indications supporting a notion that negative climate-related emotions act as a pathway for the negative mental health impacts of climate change. This notion is further supported by findings of our research which show that negative climate-related emotions are associated with insomnia symptoms and self-rated mental health across a diverse sample of individuals. Importantly, what our study most strongly reflects is the continuing need for cross-disciplinary and cross-cultural scholarship to develop more rigorous empirical assessments of the unique burden of disease that can be attributed to negative climate-related emotions in the mental health domain across the world.

Compliance with Ethical Standards

Conflict of Interest The authors declare no conflict of interest.

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