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REVIEW ARTICLE

Review: The impact of climate change awareness on children's mental well-being and negative emotions – a scoping review

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Background: Climate change is a threat to children's physical health, but there are also implications for mental well-being. Additionally, children may experience negative emotional responses stemming from an overarching awareness of the imminent threats to the planet due to climate change. **Method:** Using a scoping review, we examined the impact of climate change awareness on children's mental well-being and negative emotions. Our aim was to identify and describe the existing literature and highlight priorities for future research. Three specific objectives guided the review: (1) to identify and provide an overview of research regarding the impact of climate change awareness on children's mental well-being and negative emotions; (2) to summarize and clarify the terminology related to climate change awareness and children's mental well-being and negative emotions; and (3) to make recommendations for areas of future research. **Results:** Thirty-three articles were included in a narrative synthesis. Many articles were reviews or editorials/commentaries. Of the empirical research, most were from Europe, North America, and Australia. The articles emphasized a large range of negative emotions that children felt about climate change, with anxiety and worry being the most researched and discussed. **Conclusions:** The research on the impact of awareness of climate change on children's mental well-being and negative emotions is in its early phases. Efforts are needed to advance conceptual clarity and operationalize concepts. Additionally, there is a need for research into the impact of climate change awareness on children's mental well-being and negative emotions among a greater diversity of people and places. Existing studies provide an encouraging basis from which to develop future research.

Key Practitioner Message

- There is an indication that an overarching awareness of the imminent threats to the planet due to climate change impacts children's mental well-being and emotions.
- Most empirical studies examining the impacts of an awareness of climate change on children's mental well-being and negative emotions were from high-income countries.
- Anxiety and worry related to climate change awareness were prevalent in many child populations, although there was heterogeneity in how anxiety and worry were measured.
- Future research should examine how to support children experiencing impacts on their mental well-being and negative emotions from climate change awareness, and explore the role of practitioners, schools, parents and guardians, and communities in this.

Keywords: Adolescence; school children; environmental health; mental health; emotion; climate change

Introduction

Climate change has, and will continue to have, a profound effect on human health (Stott, Smith, Williams, & Godlee, 2019). The United Nations Intergovernmental Panel on Climate Change (IPCC) states that the detrimental consequences of climate change include extreme weather, rising sea levels, species loss, wildfires, drought, and reduced air quality (IPCC, 2018). The IPCC (2018) further warned that these events will increase

water- and vector-borne diseases, illnesses, and injuries. While climate change is a well-established threat to physical health, there are also implications for mental health and well-being (Berry, Bowen, & Kjellstrom, 2010; Hayes, Blashki, Wiseman, Burke, & Reifels, 2018; Manning & Clayton, 2018; Reser & Swim, 2011). In 2017, the American Psychological Association (with the organizations Climate for Health and ecoAmerica) released a report detailing how climate change is a fundamental issue for mental health (Clayton, Manning, Krygsman, & Speiser, 2017). The potential impacts are extensive, including anxiety, distress, depression, violence, a sense of helplessness, and intense feelings of loss (Clayton et al., 2017; Fritze, Blashki, Burke, & Wiseman, 2008). Broadly, it is considered that climate change impacts mental well-being in three ways (Hayes et al., 2018). First, acute climate events can *directly* impact the mental well-being of those in affected communities, such as trauma from experiencing a climate change-related extreme weather event. Second, *indirect* effects may occur due to shifts in social, economic, and environmental determinants of mental well-being, such as stress stemming from reduced income security. Third, people may also experience negative emotional responses, such as distress, stemming from an *overarching awareness* of the imminent threats to the planet due to climate change, even when they have not directly experienced a climate change-related event (Fritze et al., 2008; Hayes et al., 2018).

Herein, we use the term mental well-being broadly and not to refer specifically to any clinical diagnosis. There is no universally accepted definition of mental well-being, but generally it is thought to include an overall positive state of emotions, life satisfaction, fulfillment, and positive functioning (CDC, 2018; Courtwright, Flynn Makic, & Jones, 2020). It is vital to note up front that experiencing negative emotional responses (e.g., worry, anxiety, etc.) to the climate crisis is a rational, and potentially functional, reaction to the serious issues facing the planet (Clayton, 2020; Royal College of Psychiatrists, 2020). Emotional reactions to climate change may be adaptive or maladaptive. For example, anxiety can be adaptive and functional in signaling an oncoming threat so that an individual can prepare (Clayton, 2020). As Ojala and Bengtsson (2019, p. 926–927) state, 'climate change is one of the most serious environmental problems, and if it is not seen as a threat, people will hardly feel motivated to search for solutions to this problem and act'. However, negative emotional responses to an awareness of climate change and its potential consequences may also be overwhelming and difficult for people to deal with (Royal College of Psychiatrists, 2020), and can also be maladaptive by interfering with an individual's ability to function (Clayton, 2020).

Learning about climate change, and its impending effects, is an emotional experience (Ojala, 2012b). The distress, anxiety, worry, and/or fear that stem from an overarching awareness of climate change are often considered to be related to the broader concept of 'psychoterratic syndromes'. This concept was first introduced by the environmental philosopher, Glenn Albrecht, and is defined broadly as 'psychological responses to negative changes to the state of the Earth' (Albrecht, 2011, p. 48). Terms such as eco anxiety, climate anxiety, and eco distress are often used to describe these negative responses. Also, the related term 'solastalgia', broadly defined as distress from the transformation and degradation of one's home environment, also falls into psychoterratic syndromes (Albrecht, 2019; Albrecht et al., 2007; Galway, Beery, Jones-Casey, & Tasala, 2019). Such concepts are gaining traction in print and online media (Rao, 2019; Taylor & Murray, 2020). For example, Grist Magazine declared climate anxiety as the biggest pop-culture trend of the year in 2019 (McGinn, 2019). Additionally, there is a growing recognition of the impact of climate change awareness on mental well-being among researchers and mental health professionals. For instance, the American Psychological Association has defined eco anxiety as 'a chronic fear of environmental doom' (Clayton et al., 2017, p.68); while the Royal College of Psychiatrists defines eco distress among young people as 'the wide range of emotions and thoughts young people may experience when they hear bad news about our planet and the environment' (Royal College of Psychiatrists, 2020, para. 3). Moreover, mental health professionals have reported counseling individuals dealing with distress about climate change (Clayton et al., 2017; Royal College of Psychiatrists, 2020).

Children are a disproportionately at-risk, yet understudied, group when it comes to the effects of climate change. While this population will become the decision-makers of the future and be left with the consequences of the changing climate, research largely overlooks the impact climate change has on their mental well-being (Fritze et al., 2008; Manning & Clayton, 2018; Ojala, 2012b, 2013; Ojala & Bengtsson, 2019). Late childhood and early adolescence are argued to be key developmental timeframes for gaining interest in global environmental issues, and studies indicate that learning about global problems, like climate change, may trigger feelings of anxiety, helplessness, and hopelessness (Ojala, 2012a). Thus, it is imperative we better understand how children experience climate change on a psychological level (Ojala, 2013).

In the modern society, children grow up hearing about climate change and projections for the future, and they have an awareness of how this affects, or will affect, themselves and others. For example, the National Center for Science Education reported that approximately 75% of American science teachers in public middle and high schools devoted at least one class to climate change (Plutzer et al., 2016). Among those teachers, the majority emphasized potential solutions and/or actions individuals can take to address climate change, although some (25%) gave equal time to perspectives that reject the scientific consensus of climate change being caused by human activities (Plutzer et al., 2016). Furthermore, from 2007 to 2017, media coverage of climate change increased by 78% worldwide (Hayes et al., 2018; Watts et al., 2018).

While children are increasingly aware of climate change and its detrimental effects, they have limited political agency to see their will enacted, as most children are not eligible to vote in national elections. This may further contribute to feelings of low mood, frustration, anxiety, guilt, helplessness, and hopelessness (Royal College of Psychiatrists, 2020; Taylor & Murray, 2020). Over half (57%) of pediatric psychiatrists surveyed in England have counseled children distressed about the climate crisis, according to a survey from the

Royal College of Psychiatrists (Royal College of Psychiatrists, 2020). Additionally, in March 2019, hundreds of thousands of students in 2000 cities across 123 countries left school in an act of protest about political inaction regarding climate change, titled Fridays for Future (Stott et al., 2019). This action has since mobilized over 14 million people in 8200 cities globally (Fridays for Future, 2021). The engagement of so many children in these strikes underscores the importance of this issue to this population.

Despite recent indications that an overarching awareness of climate change may impact children's mental well-being and emotions, this issue is not well understood. Due to the immediate impact that climate change might be having on children's mental well-being and negative emotions, a review of the current state of the literature is timely. The objectives of this review were to: (a) identify and provide an overview of research regarding the impact of climate change awareness on children's mental well-being and negative emotions; (b) summarize and clarify the terminology related to climate change awareness and children's mental well-being and negative emotions; and (c) make recommendations for areas of future research.

Methods

A scoping review was conducted to meet the research objectives of this study. Scoping reviews prove useful when the goal is to map the current state of knowledge in a specific research area (Peters, Godfrey, et al., 2020; Peters, Marnie, et al., 2020). Due to the emerging and interdisciplinary nature of research examining the impact of climate change on children's mental well-being and negative emotions, such an approach is appropriate as it can identify and bring together research from various fields and disciplines. A protocol was previously published outlining the planned scoping review process (Martin, Reilly, & Gilliland, 2020).

Inclusion and exclusion criteria

This review considered articles that reported on school-aged children (aged 3–19 years). The upper limit was operationally defined in accordance with the World Health Organization's (2013) definition of a child as a person 19 years of age or younger. Both published and unpublished empirical studies, reviews, editorials/commentaries, and opinion papers were included. This incorporates, but is not limited to, quantitative (e.g., experimental, quasi-experimental, prospective, and retrospective cohort, case–control, and cross-sectional), qualitative (e.g., phenomenology, ethnography, qualitative description, action research, and feminist research), and mixed-methods studies. Articles that covered or discussed adult populations in addition to child populations were included if children were reported on separately.

The context of this review is global, so no inclusion/exclusion criteria were set for geographic region of study; however, the search was limited to articles published in English. No date restrictions were implemented in the search. Articles that did not examine the impact of an overarching awareness of climate change on mental well-being or negative emotions, but rather only direct impacts of an extreme weather event that may be related to climate change were excluded. This was due to the distinct experiences of specific communities that directly experienced an extreme weather event. Where an article included considerations of direct impacts of climate change in addition to impacts from an overarching awareness of climate change on mental well-being or negative emotions, the article was included. In these instances, how studies distinguished overarching awareness of climate change from direct impacts was noted.

As this is a scoping review with the purpose being to summarize the current state of evidence about this issue, rather than to identify and present the highest-quality evidence, no quality assessment was conducted; therefore, no studies were excluded due to quality.

Search strategy

Searches were conducted in eight academic databases (Cochrane Database of Systematic Reviews, CINAHL, Embase, GreenFILE, PubMed, PsycINFO, Web of Science, and Scopus) and three unpublished/grey literature databases (ProQuest Dissertations and Theses, GreyLit.org, and OpenGrey) on January 10th, 2020. Additionally, backward reference selection was conducted to identify articles; this was decided on post hoc as another means of identifying grey literature, because much of the grey literature cited in articles identified from the academic databases was not identified through the grey literature databases. Moreover, an updated search was conducted on April 10th, 2021, to identify more recent studies. The search architecture (Table 1) was developed through a preliminary search of published manuscripts, through discussions by the research team, and following peer reviewer comments on the review protocol (Martin et al., 2020).

Study selection process

All identified records were collated and uploaded into the reference manager software Zotero version 5.0.66, and duplicates were removed. The article details were then imported into the systematic review software Covidence. Titles and abstracts were screened by two reviewers for assessment against the inclusion/exclusion criteria (GM and HE). After screening the titles and abstracts, articles were further assessed for eligibility through full-text screening, and the reason for exclusion was noted. Because disagreements that arose between the reviewers at each stage of the selection process were resolved through discussion, involving a third reviewer to resolve disagreements was not necessary. The results of the search and screening are presented in a Preferred Reporting Items for Systematic Reviews and Meta-analyses Extension for Scoping Reviews (PRISMA-ScR) flow diagram (Tricco et al., 2018) (Figure 1).

Data extraction

Data were extracted from articles included in the scoping review by two data extraction tools that were developed for this review by the authors (Martin et al., 2020). These were modified from the Joanna Briggs Institute data extraction form (Peters, Godfrey, et al., 2020; Peters, Marnie, et al., 2020). Data were extracted by one reviewer (GM) and confirmed for accuracy by a second (KR). Details about the population, concepts of mental

Table 1. Search term strategy employed in the scoping review

Search number	Search terms
#1	noft('climate change') OR noft('global warming')
#2	noft('mental health') OR noft('mental illness') OR noft('mental disorder') OR noft('wellness') OR noft('well-being') OR noft('wellbeing') OR noft ('cognitive function') OR noft('eco-anxiety') OR noft('ecoanxiety') OR noft('pretraumatic') OR noft('environmental grief') OR noft('solastalgia') OR noft('ecoparalysis') OR noft('ecostalgia') OR noft('psychoter*') OR noft('cope') OR noft ('coping') OR noft('worry') OR noft('distress') OR noft('anxiety') OR noft('psychoterraticratic')
#3	('child*') OR ('kid*') OR ('adolescen*') OR ('teen*') OR ('youth') OR ('young people') OR ('school children*') OR ('schoolchildren*') OR ('school age*') OR ('school-age*')
	#1 AND #2 AND #3

noft, not full text (i.e., only abstract, title, and key words).

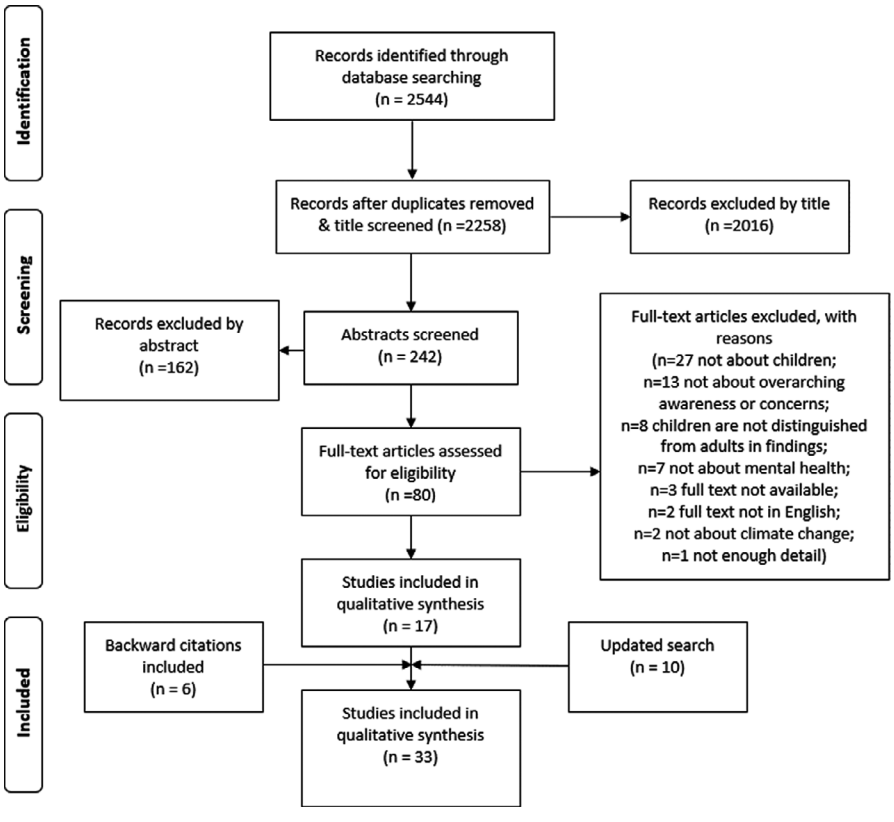

Figure 1. PRISMA flow diagram of article identification and selection

well-being/negative emotions, geographic location of the study, methodological approach, and key findings relevant to the review objectives and questions were extracted. Specifically, data were extracted from each article, including the following information: author(s); year of publication; country of the study; purpose; population; sample size; methodology; concepts of interest; outcomes/relationships with other factors; and identified knowledge gaps.

Synthesis

A narrative approach was used to synthesize the findings from the scoping review using textual descriptions of the articles (Popay et al., 2006).

Results

The search, conducted in January 2020, yielded a total of 2258 unique documents. Two authors (HE and GM) independently reviewed the titles and had 91% agreement on inclusion for abstract screening (agreed on 2056/2258). Where reviewers did not agree, discussion led to agreement. At the abstract phase, agreement was lower (agreed on 172/242, 71%). But again, all disagreements were easily resolved through discussion. Upon screening the full texts of the 80 articles, 17 met the inclusion criteria and were included in the narrative synthesis (Figure 1). Backwards selection found six articles that met the inclusion criteria, and the search update found an additional ten articles.

Article characteristics

Table 2 presents the data extracted on article characteristics. Of the 33 articles identified, 11 were reviews; nine of these were not systematic, but theoretical in nature (Burke, Sanson, & Van Hoorn, 2018; Chalupka, Anderko, & Pennea, 2020; Clayton, 2020; Fritze et al., 2008; Gifford & Gifford, 2016; McMichael, 2014; Ojala, 2015; Palinkas & Wong, 2020; Sanson, Van Hoorn, & Burke, 2019) and two were scoping reviews (Clemens, von Hirschhausen, & Fegert, 2020; Galway et al., 2019). One scoping review was a broader review of the concept of solastalgia (the authors in this review found few studies that included children and included this as a point of discussion, and it was therefore included) (Galway et al., 2019). The other scoping review examined the broader impacts of climate change on children's mental health and focused on Europe (Clemens et al., 2020). Additionally, there were five editorials/commentaries and one tutorial identified (Cunsolo et al., 2020; Pinsky, Guerrero, & Livingston, 2020; Sanson, Burke, & Van Hoorn, 2018; Stanley & Farrant, 2015; The Lancet Child & Adolescent Health, 2021; Wu, Snell, & Samji, 2020). Of these 17 articles, all except 1 (Clemens et al., 2020) addressed the global context, while 1 other was global but focused largely on Northern Europe (Ojala, 2015); some reviews and editorials/commentaries emphasized that the impacts of climate change awareness are mostly researched in developed (Burke et al., 2018; Sanson et al., 2019) or high-income countries (McMichael, 2014; Palinkas & Wong, 2020).

Of the 33 articles, 13 academic articles empirically addressed the impact of climate change awareness on children's mental well-being and negative emotions, seven used quantitative approaches (Harker-Schuch, Lade, Mills, & Colvin, 2021; Kuang & Root, 2019; Ojala, 2012b, 2013; Ojala & Bengtsson, 2019; Stevenson & Peterson, 2016; Strohmeier et al., 2017), three used mixed methods (Baker, Clayton, & Bragg, 2020; Bangsund, 2018; Ojala, 2012a), and three used qualitative

Table 2. Data extraction table of article characteristics

Author(s)	Year	Research purpose/question(s)	Population (sample size)	Research type	Country	Cultural context	Geographic setting
Baker et al.	2020	Explore caretaker perceptions of children's climate change emotions, and the needs and challenges around supporting children.	Parents and teachers (n = 141)	Mixed methods (survey with open and closed questions)	Australia	Parents and teachers recruited through environmental, community, or teacher Facebook groups.	National
Bangsund	2018	How does the use of humor in secondary students' communications about climate change relate to their feelings and actions toward climate change?	Grade 11 students in a leadership program (Sustainability 11) (n = 17)	Thesis (mixed methods)	Canada	The leadership program accepted students from the whole city (i.e., providing socioeconomic diversity) – authors note the students are an engaged population.	Vancouver, British Columbia
Burke et al.	2018	Review recent evidence on the psychological effects of climate change on children, covering both direct and indirect impacts, and discuss children's psychological adaptation to climate change.	All children – specific ages not given (NA)	Literature Review (not systematic)	Global	All children – authors note children in 'developing' countries are more vulnerable to impacts of climate change, but concerns and beliefs are mostly researched in more 'developed' countries.	Includes any geographic setting
Chalupka et al.	2020	Review of climate change, climate justice, and children's mental health	All children – specific ages not given (NA)	Literature Review (not systematic)	Global	All children – authors note the sense of loss is especially felt in Indigenous and subsistence communities and that gradual environmental degradation is especially detrimental to the well-being of children in communities with deep cultural or working ties to the land.	Includes any geographic setting
Clayton et al.	2017	Help increase awareness of how climate change can impact mental health and provided guidance to engage the public. The report is intended to inform and empower health and medical professionals, community and elected leaders, and the public.	No limits – distinguishes children but specific ages not given (NA)	Grey literature (report)	Global	NA	Includes any geographic setting
Clayton	2020	Discuss the nature of climate anxiety and some evidence for its existence and speculate about ways to address it.	No limits – distinguishes children and young people but specific ages not given (NA)	Literature Review (not systematic)	Global	NA	Includes any geographic setting
Clemens et al.	2020	Provide an overview of potential mental health consequences in children and adolescents from climate change.	All children – specific ages not given (NA)	Scoping review	Europe	NA	Focused on Europe
Cunsolo et al.	2020	A comment on ecological grief and anxiety.	No limits – distinguishes children and young people but specific ages not given (NA)	Comment	Global	NA	Includes any geographic setting

(continued)

Table 2. (continued)

Author(s)	Year	Research purpose/question(s)	Population (sample size)	Research type	Country	Cultural context	Geographic setting
Fritze et al.	2008	Introduce emerging evidence and debate about the relationship between climate change and mental health.	No limits – distinguishes children and young people but specific ages not given (NA)	Literature Review (not systematic)	Global	NA	Includes any geographic setting
Galway et al.	2019	Review scholarly literature on solastalgia and advance conceptual clarity, synthesize the literature, and identify priorities for future research.	No limits – distinguishes children and young people but specific ages not given (NA)	Scoping review	Global	NA	Includes any geographic setting
Gifford and Gifford	2016	Describe some of the effects of climate change on mental health, who is most vulnerable to them, some of the social factors involved, and offers some suggestions for possible solutions.	No limits – distinguishes children and young people but specific ages not given (NA)	Literature Review (not systematic)	Global	NA	Includes any geographic setting
Harker-Schuch et al.	2021	Determine the current opinion state of 12- to 13-year-olds with regard to whether climate change (a) is something to worry about ('concern'), (b) predominantly has anthropogenic causes ('anthropogenic'), and (c) is happening now ('imminence').	12- to 13-year-olds (n = 463; 78 Austrian and 375 Australian students)	Quantitative	Australia and Austria	Public school students	Central urban centers
Kowalczewski and Klein	2018	Assess the impact of climate change on Sámi youth health, health care access, and health-seeking behavior.	Sámi high school students 16–19 years old (n = 9)	Qualitative (focus groups)	Norway	Both reindeer herding and non-herding teenagers included in focus groups	Kautokeino Municipality
Kuang and Root	2019	Assess adolescent awareness of climate change as a global issue and whether this awareness leads to symptoms of anxiety and to preliminarily characterize anxiety symptoms if they are present.	Patients (ages 12–18 years) in an outpatient child/adolescent psychiatry practice; those acute psychosis or significant developmental delay was excluded (n = 83)	Quantitative	Not reported	Patients in an outpatient child/adolescent psychiatry practice	Not reported
MacKay et al.	2020	Share the outcomes of research with Indigenous youth (along with family and teachers) from the Mackenzie River Basin who attended the 2018 Conference of the Parties on Climate Change in Katowice to determine the value of their experience.	Youth grades 10–11 (n = 4)	Qualitative (interviews)	Canada	Indigenous youth	Mackenzie River Basin, Alberta
McMichael	2014	A review of climate change and children and risks and gain from inaction/action	All children – specific ages not given (NA)	Literature Review (not systematic)	Global	All children – author notes many millions of children in 'poor countries' live with the threats of climate change but hear little news.	Includes any geographic setting

(continued)

Table 2. (continued)

Author(s)	Year	Research purpose/question(s)	Population (sample size)	Research type	Country	Cultural context	Geographic setting
Ojala	2012a	Explore how Swedish young people cope with worry and promote hope in relation to climate change.	Convenience sample of young people in late childhood/early adolescence (n = 90), and mid-to-late adolescence (n = 146). Early adulthood was also included but results were reported separately.	Mixed methods (questionnaires)	Sweden	No focus on a particular group – children answered a questionnaire at school.	Central Sweden in and around a medium-sized municipality
Ojala	2012b	Explore how Swedish 12-year-olds cope with climate change, and how different coping strategies relate to environmental engagement and well-being.	12-year-olds (n = 293)	Quantitative (classroom survey)	Sweden	Early adolescence	Five municipalities in central Sweden
Ojala	2013	Explore how Swedish late adolescents cope with global climate change and how these coping strategies relate to subjective well-being (positive affect, negative affect, and life satisfaction) and environmental engagement (environmental efficacy and proenvironmental behavior)	Late adolescents (n = 321)	Quantitative (classroom survey)	Sweden	Late adolescence – To attain a representative distribution with respect to socioeconomic factors, both college preparatory and vocational classes, were included in the study.	Five municipalities in central Sweden
Ojala	2015	Investigate what emotions young people experience, how they cope, and how coping strategies are related to environmental efficacy, environmental engagement, and subjective wellbeing.	All children – specific ages not given (NA)	Literature Review (not systematic)	Global	NA	Mainly focused on Northern Europe
Ojala and Bengtsson	2018	Examine how coping with climate change among Swedish adolescents relates to proenvironmental behavior, as well as to communication patterns with parents and friends about societal and environmental issues.	Senior high school students in 39 schools (n = 705)	Quantitative (online survey)	Sweden	Late adolescence –Both vocational and college-preparatory classes were targeted.	From the North to the South of Sweden
Palinkas and Wong	2020	Summarize recent developments in understanding mental health impacts of three forms of climate change to mental health: (1) extreme weather events; (2) subacute weather events (e.g., droughts or heatwaves lasting for months or years), (3) existential threats from long-lasting changes.	No limits – distinguishes children and young people but specific ages not given (NA)	Literature Review (not systematic)	Global	Authors note young people in high-income countries are especially vulnerable to psychoterratic syndromes.	Includes any geographic setting
Pinsky et al.	2020	Discuss child and adolescent psychiatrists in the era of the climate crisis.	All children – specific ages not given (NA)	Editorial	Global	NA	Includes any geographic setting

(continued)

Table 2. (continued)

Author(s)	Year	Research purpose/question(s)	Population (sample size)	Research type	Country	Cultural context	Geographic setting
Sanson et al.	2018	Draw together research on the impacts of climate change on children and youth, and suggests how parents, and parenting researchers, educators, and professionals, can engage in climate change.	All children – specific ages not given (distinguishes between younger children vs. older children and adolescents) (NA)	Tutorial	Global	NA	Includes any geographic setting
Sanson et al.	2019	A review of the impacts of climate change on children and youth including responses to support them from a child development professional perspective	All children – specific ages not given (distinguishes between younger children vs. older children and adolescents) (NA)	Literature Review (not systematic)	Global	All children – authors distinguish between 'developed' and 'developing'.	Includes any geographic setting
Stanley and Farrant	2015	Describe the likely impacts on children's health and well-being from climate change based on the solid science of environmental child health.	All children – specific ages not given (NA)	Commentary	Global	NA	Includes any geographic setting
Stevenson and Peterson	2016	Examined how climate change hope, despair, and concern predict proenvironmental behavior	Middle school children (aged 11–15) (n = 1486)	Quantitative (school survey)	US	School children	North Carolina
Strife	2012	To fill the scholarly gap in our understanding of children's environmental concerns by voicing children's feelings about environmental problems	School children (aged 10–12) (n = 50)	Qualitative (interviews)	US	School children	Denver
Strohmeier et al.	2017	Investigate whether demographic variables, efficacy beliefs, visions, and worries are associated with four different forms of (dis) engagement with the European Union (EU)	European students (aged 16–19) (n = 2361); data were also collected for students aged 20–25 but results were separated.	Quantitative	Albania, Austria, German, Italy, Romania, Spain, UK	Broader study reporting worries for the EU	Not stated
The Lancet Child and Adolescent Health	2021	Address anxiety and other negative emotions in children and youth in terms of climate change.	All children – specific ages not given (NA)	Editorial	Global	All children	Includes any geographic setting
Tucci et al.	2007	Seek the views of children and young people about their experiences of childhood in Australia today.	Nationally representative sample of children (aged 10–14) (n = 600)	Grey literature (report)	Australia	All children	National study
UNICEF	2013	Condense both the evidence and the awareness of children as to climate changes impact on their future lives	All children – specific ages not given (NA)	Grey literature (report)	Global	All children – noted that developing countries are currently hit hardest by climate change impacts.	Includes any geographic setting
Wu et al.	2020	A call to action regarding climate anxiety in young people	All children, young people, and youth (NA)	Comment	Global	NA	Includes any geographic setting

approaches (Kowalczewski & Klein, 2018; MacKay, Parlee, & Karsgaard, 2020; Strife, 2012). Many of these studies were from Europe ($n = 6$, with four from Sweden), four were from North America (two from the United States and two from Canada), one was from Australia, one was from both Australia and Austria, and one (a conference abstract) did not specify a region of study. Most studies did not focus on a particular subgroup of the population, with the exceptions of Kowalczewski and Klein (2018), who researched Sámi high school students; MacKay et al. (2020), who researched Indigenous youth living in the Mackenzie River Basin; and Kuang and Root (2019), who focused on patients in an outpatient child and adolescent psychiatry practice. Empirical work largely examined adolescents rather than younger children (Table 2).

Three of the 33 articles were grey literature reports (Clayton et al., 2017; Tucci, Mitchell, & Goddard, 2007; UNICEF, 2013). Tucci et al. (2007) presented empirical findings from a study with Australian children, while reports from UNICEF (2013) and the American Psychological Association (Clayton et al., 2017) were broader reports about the impacts of climate change on children and mental health, respectively.

Twenty-three of the 33 articles were published in 2016 or later. Terms such as solastalgia, climate anxiety, eco grief, and eco anxiety appeared most often in these more recent articles (Clayton, 2020; Clayton et al., 2017; Clayton et al., 2017; Cunsolo et al., 2020; Galway et al., 2019; Gifford & Gifford, 2016; Palinkas & Wong, 2020; Pinsky et al., 2020; The Lancet Child & Adolescent Health, 2021; Wu et al., 2020). The most common negative emotions and mental well-being impacts addressed in all articles were as follows:

- anxiety (Baker et al., 2020; Bangsund, 2018; Burke et al., 2018; Chalupka et al., 2020; Clayton, 2020; Clemens et al., 2020; Cunsolo et al., 2020; Fritze et al., 2008; Gifford & Gifford, 2016; Kowalczewski & Klein, 2018; Kuang & Root, 2019; MacKay et al., 2020; Palinkas & Wong, 2020; Pinsky et al., 2020; Sanson et al., 2018, 2019; Stanley & Farrant, 2015; The Lancet Child & Adolescent Health, 2021; Wu et al., 2020) and
- worry (Burke et al., 2018; Clayton, 2020; Gifford & Gifford, 2016; Kowalczewski & Klein, 2018; Kuang & Root, 2019; MacKay et al., 2020; McMichael, 2014; Ojala, 2012a, 2012b, 2013, 2015; Ojala & Bengtsson, 2019; Sanson et al., 2018, 2019; Strohmeier et al., 2017; Tucci et al., 2007; UNICEF, 2013).

It was also noted in the articles that children experience distress, fear, guilt, powerlessness, hopelessness, helplessness, anger, despair, phobia, grief, and sadness due to their awareness of climate change (see Table S1).

Summary of terminology related to climate change awareness and children's mental well-being and negative emotions

Multiple reviews and editorials/commentaries defined concepts related to climate change awareness, children's mental well-being, and negative emotions but in varying ways (Table S1). For example, Gifford and Gifford (2016) distinguished between eco anxiety and habitual ecological worrying, defining habitual ecological worrying as associated with proactive behavior, and eco anxiety as severe and potentially leading to loss of appetite, sleeplessness, and panic attacks. In an editorial in The Lancet Child and Adolescent Health (2021), eco anxiety was characterized by low mood, disturbed sleep, panic attacks, and feelings of anger, guilt, or helplessness. Additionally, in their 'Call for Action', Wu et al. (2020) state symptoms associated with climate anxiety in young people include panic attacks, insomnia, and obsessive thinking. Despite growing interest in children's mental well-being and negative emotions due to an awareness of climate change, there is little consensus regarding how these phenomena are conceptualized and defined; however, loss of sleep and panic attacks featured in multiple definitions.

Anxiety and worry featured most prominently in empirical studies that operationalized concepts of mental well-being and negative emotions stemming from climate change awareness, although there was heterogeneity in terms of how these were measured (Table S1). For example, Kuang and Root (2019) operationalized *anxiety from hearing about climate change* as including frequent worrying, anxiety about the future, and trouble sleeping. Baker et al. (2020) asked parents and teachers to rate, on a 5-point Likert scale, their student's or child's *stress/anxiety about climate change*. In measuring worry about climate change, Strohmeier et al. (2017) asked children about their worries for the future (they were asked to picture themselves in 2038); climate change and environmental or natural disasters were grouped into *climate change worries*. Ojala (2012a) measured *how much worry was felt about climate change* on a 6-point scale, ranging from not at all to very much. Ojala (2012b, 2013) measured worry about climate change using five items that asked how much children worried about negative consequences caused by climate change for themselves, their close ones, future generations, people living in economically deprived countries, and animals/nature. In contrast to the other studies, Harker-Schuch et al. (2021) used a more collective measure of *climate change worry* and asked if 'climate change is something we all should worry about?'

In addition to anxiety and worry, one empirical study measured climate change despair and two measured climate change concern. Stevenson and Peterson (2016) examined climate change despair using the following four items: I feel helpless to solve problems caused by climate change; the actions I can take are too small to help solve problems caused by climate change; problems caused by climate change are out of my control; climate change is such a complex problem, we will never be able to solve it. The authors also measured climate change concern. For this they used the following items: how worried are you about global warming; how much do you think global warming will harm you personally; when do you think global warming will start to harm people in the United States; and how much do you think global warming will harm future generations of people. Of note, this scale included one item about worry, suggesting overlap between concern and worry. In contrast, Kuang and Root (2019) used a single item, asking about how much of concern climate change was for the study participants. These studies show that there are alternative operationalizations of children's mental well-being and

negative emotions stemming from climate change awareness, beyond worry and anxiety.

Summary of empirical findings

Studies suggest that the mental well-being impacts and negative emotions that stem from climate change awareness may be common among child populations. For example, approximately two thirds of teachers/parents said their child(ren) were experiencing at least moderate stress/anxiety about climate change (Baker et al., 2020). Additionally, 85% of Austrian and 89% of Australian adolescents reported climate change was probably or definitely something we should worry about (Harker-Schuch et al., 2021). Moreover, the majority (66.3%) of patients in an outpatient child/adolescent psychiatry practice reported symptoms of anxiety because of hearing about climate change and 87.9% reported either a lot or a little concern about climate change (Kuang & Root, 2019).

Some studies addressed demographic differences (age, gender, and ethnicity) in relation to negative emotional responses to climate change (Baker et al., 2020; Harker-Schuch et al., 2021; Kuang & Root, 2019; Ojala, 2012a) (see Table S1). There was indication that anxiety and worry were more prevalent in older adolescents than younger children. For example, Kuang and Root (2019) found older adolescents (ages 15–18 years) were more likely (compared to those ages 12–14 years) to exhibit anxiety because of hearing about climate change, and Baker et al. (2020) found a linear association between child(ren)'s age and the amount of stress/anxiety about climate change reported by their caretakers. Additionally, Ojala (2012a) found the proportion of survey respondents who indicated feeling worry about climate change was 29% for those in late childhood/early adolescence and 62% for late adolescents.

Few studies examined more general measures of mental well-being in relation to an overarching awareness of climate change (Table S1). Kuang and Root (2019) examined the link between anxiety from hearing about climate change and mental health diagnosis. Among a sample of patients in an outpatient child/adolescent psychiatry practice, there were no statistically significant relationships among depression, anxiety, or ADHD with anxiety because of hearing about climate change (Kuang & Root, 2019). Notably, work by Ojala (2012b, 2013) examined coping strategies related to worry about climate change and overall well-being, among Swedish schoolchildren. They found problem-focused coping (trying to find ways to help with the problem of climate change) was statistically significantly and positively related to worry about climate change. Additionally, a higher degree of worry about climate change explained the association between problem-focused coping and general negative affect (Ojala, 2012b, 2013). Meaning-focused coping (positive reappraisal of the issue and trust in social actors) was significantly positively related to general positive affect and life satisfaction among older and younger adolescents (Ojala, 2012b, 2013). Meaning-focused coping was also significantly negatively associated with general negative affect but only among younger Swedish adolescents (12 years of age) (Ojala, 2012b).

It is worth noting that, in addition to mental well-being and negative emotions, some articles also addressed hope (e.g., Bangsund, 2018; MacKay et al.,2020; Ojala, 2012a; Stevenson & Peterson, 2016), optimism (Ojala, 2012b, 2013), and proenvironmental behaviors (Ojala, 2012b, 2013; Ojala & Bengtsson, 2019; Stevenson & Peterson, 2016) (see Table S1). For example, Ojala (2012b;) measured optimism concerning climate change and found that optimism significantly moderated the relationships between climate change coping strategies and general negative affect. Hope and proenvironmental behaviors were both examined by Stevenson and Peterson (2016). They found climate change despair was statistically significantly negatively related to proenvironmental behavior, while concern and hope were significantly positively related to proenvironmental behaviors. Ojala (2012b, 2013) and Ojala and Bengtsson (2019) also examined proenvironmental behaviors and found that they were statistically significantly related to coping strategies, with the direction of the relationship varying by strategy. Specifically, deemphasizing strategies were negatively related to proenvironmental behaviors, and problem-focused and meaning-focused coping strategies were positively related to proenvironmental behaviors (Ojala, 2012b, 2013; Ojala & Bengtsson, 2019).

In summary, empirical work suggests mental well-being impacts and negative emotions from climate change awareness are common among many child populations, but that the pervasiveness of this may vary by demographic characteristics. Furthermore, some studies suggest how children cope with climate change, as well as their sense of hope and optimism, may play a role in both their mental well-being and engagement in proenvironmental behaviors.

Identified gaps in knowledge

The studies in this review identified a wide range of research gaps and areas for future work (Table S1). Here, we outline several key gaps and future directions noted in the articles included in this review.

First, more empirical research on the impacts of an overarching awareness of climate change on children's mental well-being and negative emotions was identified as a need, as this work is in its early phases (Burke et al., 2018; Galway et al., 2019; Gifford & Gifford, 2016; Stanley & Farrant, 2015; Wu et al., 2020). Second, several authors called for more research in developing regions (Burke et al., 2018; Sanson et al., 2018, 2019). Third, many studies stated that future research should also examine how to help children meaningfully cope with negative emotions about climate change and explore the role of practitioners, schools, parents and guardians, and communities in helping children cope; intervention studies in particular are needed (Bangsund, 2018; Burke et al., 2018; Fritze et al., 2008; Galway et al., 2019; Gifford & Gifford, 2016; Kowalczewski & Klein, 2018; McMichael, 2014; Palinkas & Wong, 2020; Sanson et al., 2018, 2019). Fourth, there is a need for longitudinal studies to better infer the temporal nature of relationships between negative emotions about climate change with other factors, such as overall mental well-being (Ojala, 2012b, 2013; Stevenson & Peterson, 2016). Finally, it was noted that studies from a broader range of countries and communities are needed, as there may be differential impacts of climate change on different groups, such as people who may rely on the land and land-based activities for their culture and livelihood

(e.g., Indigenous peoples and farmers) (Chalupka et al., 2020; Cunsolo et al., 2020; Ojala, 2012a, 2013; Ojala & Bengtsson, 2019). The reviewed studies identified many gaps in the literature that highlight where more work is needed to better understand the impact of climate change awareness on children's mental well-being and negative emotions, and how to better support children experiencing these impacts.

Discussion

The main aim of this review was to identify the literature on the impacts of an overarching awareness of climate change on children's mental well-being and negative emotions. We found that much of the work contributing to this topic is theoretical in nature. The majority of empirical works identified in this review examined anxiety and worry related to climate change and found that these emotions are prevalent in many of the populations studied, although there was considerable heterogeneity in how anxiety and worry were measured. While most empirical studies examined children's worry and/or anxiety, other research (empirical and theoretical) addressed a wider range of emotions (e.g., despair, concern, fear, grief, and anger). Given the recent attention to this topic in the media and in more theoretical academic papers, more empirical work is needed (both quantitative and qualitative) to better understand how children are experiencing their awareness of climate change and how this may impact their mental well-being and emotions.

More studies are needed to estimate the prevalence of negative emotional responses and impacts on mental well-being due to an awareness of climate change in children at the population level. To accomplish this, measures should be developed and examined for reliability and validity across and within populations of children (Wu et al., 2020). This is something that has been researched in adult populations (Clayton & Karazsia, 2020), but has yet to be done for children (Wu et al., 2020). From the literature identified in this study, there were measurement tools identified that could be examined for use in other populations or adapted moving forward. For example, survey items regarding worry about climate change utilized in studies of Swedish children might also be valid for children in other countries. Furthermore, as climate change continues, more children will experience acute events or more subtle changes in the environments where they live. Therefore, research should consider that for some children the impacts of climate change on mental well-being will stem from an *overarching* awareness, but that a growing number of children may experience some form of acute event or become aware of more subtle shifts in their environment, and study designs should accommodate this. Clayton and Karazsia (2020), for example, included questions about personal experiences of weather phenomena that may be related to climate change, when examining climate change anxiety among an adult sample; similar questions should be explored for studies with children.

We found a broad range of concepts and terminology used in the literature regarding mental well-being and emotional responses that are attributed to an awareness of climate change (e.g., eco anxiety, climate anxiety, worry about climate change, and climate despair). It is important that moving forward concepts and terminology are clearly defined. Furthermore, Stanley, Hogg, Leviston, and Walker (2021) caution against conflating multiple eco emotions as they found in their study of adults that different emotions (termed eco anger, eco depression, and eco anxiety) had differential relationships with overall well-being (measured as depression, anxiety, and stress) and climate action behaviors. Similarly, Stevenson and Peterson (2016) found in their study of children from the United States that climate change despair was negatively related to proenvironmental behavior, while climate change concern was positively associated with proenvironmental behaviors. A lack of clarity of concepts has important implications for future research, as it may restrict replicability and comparability of studies and therefore limit growth in the field. Given the wide-range of disciplines engaged in this emerging topic (e.g., psychology, geography, public health, philosophy, and education), an interdisciplinary glossary would be a worthwhile endeavor that could encourage cross-discipline comparability and help move this stream of inquiry forward. This glossary need not only apply to children but could collate work on adult and child populations to highlight where these concepts are distinct or overlap. For example, Pihkala (2020) examined and scrutinized terms and phenomena related to eco anxiety and climate anxiety. From the findings of this scoping review, we suggest distinctions would be useful for the concepts of climate anxiety, concern about climate change, climate distress, climate despair, climate grief, and solastalgia. Furthermore, in such an undertaking, concepts and terminology related to coping strategies, hope, and optimism in relation to climate change should be considered, given that these factors appear in many studies of the mental well-being impacts and negative emotional responses to climate change, and empirical research findings suggest a link between these concepts with overall mental well-being and proenvironmental behaviors (Ojala, 2012a; Ojala & Bengtsson, 2019; Stevenson & Peterson, 2016).

Research that includes diverse communities at both the global and regional level is needed. Much of the research findings may not travel to other regions or fit the experiences of some population groups. It is important to develop studies that address a range of communities and cultural contexts (e.g., urban/rural, geographically vulnerable areas, Indigenous communities, varying levels of socioeconomic status, and different ethnicities) to better understand the impact on mental well-being from an awareness of climate change among diverse populations. Therefore, as measures and indicators are developed and implemented, it is important to examine whether the measures are interpreted in a conceptually similar way by diverse groups.

Another key finding was that most empirical studies were conducted with adolescent populations (aged 10–19 years) rather than younger children. According to a declaration from the United Nations Environment Programme, all people have the right to learn about sustainable development, including climate change, and it may be especially vital to focus on children (Ojala, 2012a). However, how younger children should begin to be taught about climate change or how they respond emotionally is not well established (Baker et al., 2020). As

research is limited, work with younger children may benefit from the use of various study designs to triangulate findings (e.g., observations, use of adult informants, and arts-based approaches). Baker et al. (2020) report on caretaker perceptions of children's stress/anxiety about climate change using a Likert scale. Additionally, they suggest art may be used as an age-appropriate way of supporting young children in action regarding climate change. Similarly, Sanson et al. (2018) suggest younger children may be encouraged to express their concerns about climate change through producing posters. Such approaches may also be useful as tools to better understand younger children's emotional responses to climate change. Therefore, developing a better understanding of how young children experience their awareness of climate change and how this may impact their mental well-being is an important area of future study.

Finally, we recommend that more research is needed to better understand what factors distinguish adaptive from maladaptive emotional responses to an awareness of climate change among children. Meaning-focused coping presents a promising area for future work as it was related to proenvironmental behaviors and general positive affect in Swedish adolescents (Ojala (2012b, 2013). Further work that examines the relationships between negative emotional responses to overall mental health and well-being, coping, and proenvironmental behavior is needed. However, it is a consideration that the relationships between environmental action with mental well-being and negative emotions might be bidirectional. Negative emotions about the climate crisis may lead to action and proenvironmental behaviors (Stevenson & Peterson, 2016); which in turn may then help manage negative emotions and foster hope and optimism (Sanson et al., 2019). However, the potential impact on children's mental well-being when action is not followed by larger societal and political change should also be considered, as well as the potential for burnout (Australian Psychological Society, 2021). More evidence is needed to develop a better understanding of these relationships in order to inform practitioners, schools, parents and guardians, and communities to support children's mental well-being and engagement in proenvironmental actions.

There are several limitations to the present review to consider. First, as the relationship between climate change and children's mental well-being is an emerging area of inquiry, and terminology is being developed and adapted regularly, our search strategy may have missed some emerging terms. Studies in languages other than English were not included. Additionally, media reports were not captured. Given the increased media attention given to this topic, a review of media coverage may be warranted, including what evidence is included in media reports and the scientific rigor of the evidence. Furthermore, studies that included children but did not separate the results from older populations were not included in this review. We suggest future studies that include younger children, adolescents, and adults should report results separately by age groups.

Despite these limitations, this work has several strengths. It is the first scoping review that looks specifically at the impact of an awareness of climate change on children's mental well-being and negative emotions. Additionally, we utilized a systematic and broad search approach to identify and bring together research from a variety of fields and disciplines.

Conclusion

In conclusion, research on the influence of climate change awareness on children's mental well-being and negative emotions is still in its early stages. This is an important area for future inquiry and more work is needed to provide evidence to mental health practitioners, teachers, parents, guardians, and policy makers. Existing studies provide a promising basis from which to develop future research.

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Ethical information

No ethical approval was required for this review.

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Supporting information

Additional Supporting Information may be found in the online version of this article:

Table S1. Data extraction Table 2.

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