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# A COSMIN systematic review of the psychometric properties of instruments that measure climate change-related distress

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## ABSTRACT

Awareness of the climate crisis has been linked to a range of distressing emotions and multiple measurement tools have been created to assess climate change-related distress. A systematic review of psychometric properties of climate-related distress measures was conducted following the Consensus-based Standards for the Selection of Health Measurement Instruments (COSMIN) guidelines. Forty-four studies assessing seven measures were evaluated based on their results and the methodological quality of the studies testing each psychometric property. The measures varied with regard to the climate-related distress construct they assessed. Content validity was poor for most measures due to the methods of their development and strict COSMIN criteria; an exception was the Eco-Anxiety Questionnaire, which had promising results but was only assessed in one study. Most of the studies ( $n = 29$ ) evaluated the Climate Change Anxiety Scale, which had inconsistent results for structural validity, but was the only measure to have some evidence of cross-cultural validity. Selection of a measure should be informed by the construct of interest to the researcher or clinician, or other features of the measure. Further research is required in different subgroups, across cultures, evaluating more psychometric properties in higher quality studies. All measures would benefit from improvements in content validity.

**KEYWORDS** Climate distress; climate anxiety; eco anxiety; psychometric properties; psychometrics; COSMIN; literature review

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## 1. Introduction

There is scientific consensus that we are in the midst of climate and ecological emergencies that threaten the collapse of our societies and the extinction of our species (McGrath, 2021). Human-induced changes in the Earth's atmosphere and damage to the more-than-human world are taking effect on human life, with effects predicted to escalate rapidly if significant action is not taken (Intergovernmental Panel on Climate Change [IPCC], 2023).

An awareness of the threats that the climate crisis poses to human well-being and survival has been linked with a range of distressing emotions (Pihkala, 2022). Reviews have explored how particular extreme climate events (e.g., a flood) can lead to post-traumatic responses (Clayton, 2021; Dastidar, 2023), but also that psychological distress may arise in the absence of a personally experienced climate event (Harper et al., 2022; Ojala et al., 2021). The terminology for climate-related distress in the research literature includes "eco-anxiety" (e.g. Usher et al., 2019), "eco-angst" (Goleman, 2009), "ecological grief" (Cunsolo & Ellis, 2018), "environmental distress" (Higginbotham et al., 2006) and "solastalgia" (Albrecht, 2005; Coffey et al., 2021; Pihkala, 2022). "Eco-anxiety", for example, has been described as a "chronic fear of environmental doom" (Clayton et al., 2017) characterized by hopelessness for the future and poorer quality of life. Each of these terms differs slightly in their definitions but there are overlaps between the conceptual constructs and all refer to negative emotional states related to the climate crisis. For ease, the term "climate-related distress" will be used throughout this review.

Distress about the reality of the climate crisis is considered an adaptive and healthy response to an abnormal situation (e.g. Clayton, 2020; Cunsolo et al., 2020; Luce, 2021; O'Brien & Elders, 2021). It has been acknowledged that climate-related distress should not be pathologised as a mental health condition, but instead recognised as a rational reaction to a real-life stressor or a "pre-trauma" (Kaplan, 2020). Some climate-related distress may provide a useful catalyst for pro-environmental engagement (Clayton & Ogunbode, 2023), but high levels of distress may overwhelm and disable people from taking such action (Landry et al., 2018). High levels of distress can also be debilitating for daily functioning (Stanley et al., 2021).

Climate-related distress has been explored within trauma, stress or grief frameworks (Dailianis, 2021), as well as being regarded as an understandable response to a collective cultural trauma impacting upon our societies (Morgan et al., 2022; Woodbury, 2019). Experiences of climate-related distress can include worry about threats to livelihood for self and others, and anger regarding the lack of governmental response to climate change. It can involve anxiety-like responses and feelings of helplessness and disempowerment (Soutar & Wand, 2022).

It has been suggested that certain groups are more likely to be affected by climate-related distress depending on age, profession, and geographical factors. Sanson and Bellemo (2021) suggested that younger people anticipate harsher consequences of human-induced climate change, despite contributing the least to it. Hickman et al. (2021) found that 45% of a sample of 10,000 young people across 10 countries reported negative impacts on daily functioning due to worries about climate change. The percentage was considerably lower in the UK (28%) compared to Nigeria (66%) and the Philippines (74%), countries that are more vulnerable to the impacts of climate change (Eckstein et al., 2019). Research has suggested that those who work more closely with the natural world and therefore are confronted with the reality of climate change in their work, such as climate scientists or farmers, might be particularly likely to experience distress (Hoggett & Randall, 2018; Howard et al., 2020; Pihkala, 2020). It has been predicted that, over time, the experiences of distress related to the climate crisis will increase in the population overall, and clinicians and researchers have been urged to address this in their work (Cunsolo et al., 2020; Doherty & Clayton, 2011).

Access to a validated, reliable measure of climate-related distress is important if researchers are to explore the magnitude of distress in the population and provide evidence to policy makers to support pro-environmental action (Dailianis, 2021; Hamilton, 2019). A measure could also help to explore potential correlates of climate-related distress to understand its impacts and who is more or less affected by it (Clayton & Karazsia, 2020). Clinicians could benefit from using such a measure to understand and formulate clients' distress meaningfully (Hickman et al., 2021) and methods of supporting those in distress could be evaluated for an evidence base (Dailianis, 2021).

Recently, multiple instruments have been developed to assess climate-related distress as research in this field gains momentum. In this relatively new, rapidly developing area, there is a lack of consensus or clarity on which instrument is best suited for measuring climate distress. It is crucial to understand each measure and their quality, validity and reliability in assessing climate-related distress, before we can select the most appropriate tool. Systematic reviews of psychometric properties are considered the best way to select the most reliable and valid instrument (Scholtes et al., 2011). They involve evaluating the psychometric properties of an instrument and the quality of studies that assess those properties, then synthesising the findings from all studies. Standardised methods for this include the Consensus-based Standards for the Selection of Health Measurement Instruments (COSMIN) guidelines (Prinsen et al., 2018). To our knowledge, there is no published review of the psychometric properties of measures of climate-related distress.

## 1.1. Aim

The aim of this review was to evaluate the psychometric properties of measures of climate-related distress. The objectives were to :

- 1) understand the constructs that each instrument is based on, to further understand ways of conceptualizing climate-related distress,
- 2) consider which instrument may be psychometrically most reliable or valid for use clinically or in research for climate-related distress, and
- 3) identify areas where further psychometric assessment studies need to be carried out.

## 2. Methods

### 2.1. Systematic literature search

The review followed the steps of the COSMIN guidelines (Prinsen et al., 2018): systematic literature search, evaluation of methodological quality of studies, evaluation of psychometric properties of instruments, and selection of the most suitable instrument(s).

### 2.2. Literature search

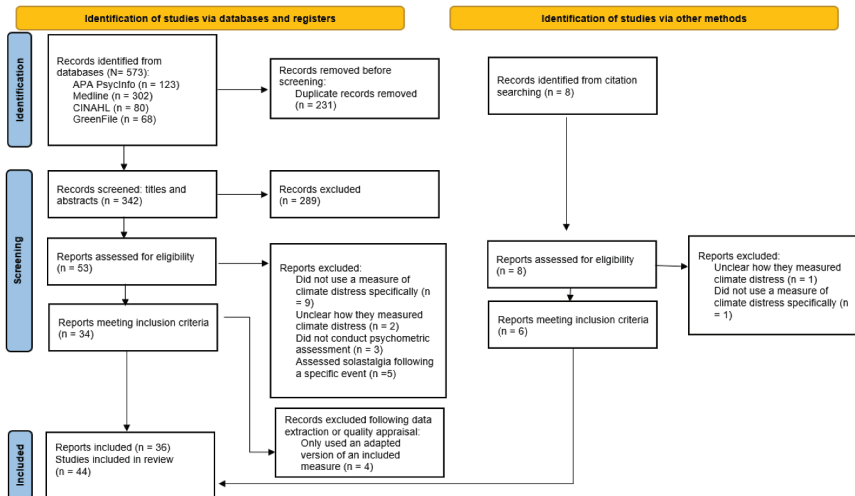
Systematic searches of APA PsycInfo, Medline, CINAHL and GreenFile were conducted three times (February 20 October 2022 and June 2023) using the following terms:

“Climate anxiety” OR eco-anxiety OR ecostress OR eco-stress OR eco-distress OR “ecological grief” OR eco-anger OR eco-angst OR “climate trauma” OR “environmental distress” OR solastalgia

The search strategy was intentionally broad to allow the inclusion of as many relevant articles as possible. Keywords related to psychometrics such as “reliability” or “validity” were not used to avoid excessively restricting the search output. No limits were applied. Articles were eligible for inclusion if they were empirical studies that:

- (a) Assessed a measurement tool of climate-related distress;
- (b) Reported results for at least one of the psychometric properties within the COSMIN taxonomy;
- (c) Were available in English.

Citation searching was conducted on articles that reported on the development of a new instrument, and reference lists of other reviews in the field were also searched.



**Figure 1.** PRISMA flowchart.

See [Figure 1](#) for an illustration of the process of the systematic search (PRISMA Flowchart; [Page et al., 2021](#)). Reasons for exclusion included not using a measure specific to climate distress, for example, asking participants to think about climate-related distress whilst completing measures relating to other forms of distress such as the State-Trait Anxiety Inventory (e.g. [Maran & Begotti, 2021](#)), Patient Health Questionnaire-9 or General Anxiety Disorder-7 (e.g. [Schwaab et al., 2022](#)). Others were excluded for asking about climate distress as part of a survey, without providing psychometric properties (e.g. [Gunasiri et al., 2022](#)). Although “solastalgia” had been included in our search terms, articles that assessed solastalgia (e.g., using the Solastalgia Scale; [Eisenman et al., 2015](#)) were excluded at full-text screening because they assessed distress following a specific climate event, rather than general distress related to the climate and ecological emergencies.

Seven measurements of climate distress were included. Six articles that had met the inclusion criteria had amended the measure by removing items. Articles were retained when modifications were undertaken with the intention of improving a measure’s psychometric properties ([Cruz & High, 2022](#); [Feather & Williams, 2022](#); [Wullenkord et al., 2021](#)), but were excluded if modifications were made for other reasons or non-specified reasons (see [Appendix A](#) for details). In total 36 articles, covering 44 studies, were included in the review.

### 3. Data extraction

The following data were extracted using COSMIN template tables from each included article:

Study population characteristics  
Instrument characteristics  
Results of psychometric assessments

### **3.1. Quality appraisal**

The COSMIN Risk of Bias (RoB) checklist (Mokkink et al., 2018a) was used to evaluate the quality of included studies. This is a standardised checklist containing items concerning the quality of the assessment of separate psychometric properties in a particular study. Each item is ranked on a 4-point rating scale: 1 = inadequate, 2 = doubtful, 3 = adequate and 4 = very good (Mokkink et al., 2018a). Following the guideline's "worst score counts" principle, the lowest score on any of the checklist items determines the overall rating for the assessment of a specific psychometric property (e.g., if 4/5 checklist items for internal consistency are marked "very good" for a given study, but 1/5 is "doubtful", then the methodological quality of assessment of internal consistency in that study is "doubtful"). Quality assessment was used to inform critical appraisal rather than to exclude lower quality studies from the review.

Inter-rater reliability of RoB was assessed on six (14%) of total included articles, selected at random. Fleiss's Kappa was calculated for five articles that were reviewed independently by three reviewers. Further, Cohen's Kappa was calculated for another article reviewed independently by two reviewers. Kappa statistics ranged from .61 to .93, suggesting the level of agreement was between "moderate" and "almost perfect" (McHugh, 2012; see Appendix B for scores). Disagreement predominantly related to whether a study had assessed hypothesis testing for construct validity, as some studies explored associations between climate distress without specifying hypotheses. One reviewer suggested the review team generate hypotheses, as suggested in the COSMIN guidelines. The other two reviewers suggested this could be problematic because of the increased risk of Type 1 errors in exploratory analyses that do not specify a priori hypotheses. After discussion, we agreed we would only assess this criterion if the authors explicitly stated hypotheses testing construct validity. This subsequently increased our inter-rater reliability, and the remaining articles were assessed by one reviewer, using this agreed upon method for applying COSMIN criteria. Where one disagreement remained after discussion, regarding the methodological quality of a factor analysis, a decision was made to accept the majority decision.

### **3.2. Evaluation and synthesis of psychometric properties**

Following RoB assessment, the psychometric properties reported in each article were rated based on COSMIN criteria for good measurement

properties (Prinsen et al., 2018). Studies were given ratings of “sufficient”, “indeterminate”, “insufficient” or “inconsistent”, indicated by a “+”, “?”, “-” or “±”, respectively. Inconsistent ratings were given in cases where there was more than one result for a psychometric property in a study, with one test statistic indicating “sufficient” properties, but another statistic indicating “insufficient” or “indeterminate” results. Content validity was assessed separately by considering how the instrument was developed, in accordance with the RoB checklist. Ratings of good measurement properties and the quality of the evidence across all studies were synthesised by measure, to reach an overall judgement of each separate measure’s good measurement properties.

## 4. Results

### 4.1. Characteristics of included studies

Characteristics of the included studies, including the study population and setting, are presented in Appendix C. The majority ( $n = 31$ , 70%) utilized online opportunity samples, recruited using social media and research recruitment platforms. Nine recruited exclusively within school or university networks and seven recruited both online and within school/university, one of which additionally used snowball sampling. The majority were cross-sectional, although two studies assessing test–retest reliability employed longitudinal elements: Innocenti et al. (2021) and Stewart (2021) retested after 3 months and 2 weeks, respectively. Thirty-six studies (82%) were solely conducted in Westernised nations such as Australia, Germany and the USA. Of the remaining eight studies, one was conducted in South Korea (Jang et al., 2023), one in Mexico (Ramírez-López et al., 2023) and two in the Philippines (Reyes et al., 2021; Simon et al., 2022). Tam et al. (2023) recruited samples from China, India, and Japan as well as the USA; and there were some French-speaking participants in the studies by Heeren et al. (2022) and Mougouama-Daouda et al. (2022); two studies), from countries including Algeria, Congo, Gabon, Morocco and Rwanda.

### 4.2. Characteristics of included instruments

See Table 1 for the characteristics of the included instruments, which were all self-report measures. The most frequently examined instrument was the Climate Change Anxiety Scale (CCAS; Clayton & Karazsia, 2020), used in 29 (66%) of the included studies. The items in the Climate Change Anxiety Scale (CCAS) were informed by existing measures of rumination and functional impairment (Clayton & Karazsia, 2020). Three of these used modified versions of the CCAS; Cruz and High (2022) changed the response options from a 5-point to a 7-point scale to increase sensitivity, Wullenkord et al. (2021)



**Table 1.** Characteristics of included instruments

Instrument (First Author, Year)	Construct description	Target population	Population it was developed with	Dimensions	Subscale (s) (number of items)	Response options	Original language	Available translations	No of studies evaluating the instrument	Full Copy available
BCCDS (Latkin et al., 2022)	Climate change distress	NR	NR	Unidimensional	5 items	5-point response	English	N/A	1	Yes
CCAS (Clayton, 2020)	Climate change anxiety	NR	USA citizens	2 = Cognitive-emotional impairment (CEI), functional impairment (FI)* Some studies have explored a factor structure with 1, 2, 3 and 4 factors.	13 items, (CEI: 9 items; FI: 4 items)**	5-point response	English	Icelandic, Italian, Korean, Polish, French, Finnish, Spanish, Chinese, Japanese, German***	29**	Yes
CCDS (Searle & Gow, 2010)	Climate change distress	Australian general population	Australian university students and general population	2 = climate change anxiety (CCA), climate change hopelessness (CCH)	12 items, (CCA: 9 items; CCH 3 items)	4-point response	English	German***	1	Yes
CCDIS (Hepp, 2023)	Climate distress (anger, anxiety, sadness) and impairment	NR	German general population	2 = distress (DIS), impairment (IMP)	23 items, (DIS: 15 items; IMP 8 items)	5-point response	English	German	5	Yes
CCWS (Stewart, 2021)	Climate change worry	NR	NR	Unidimensional	10 items	5-point scale	English	N/A	4	Yes

*(Continued)*

**Table 1. (Continued).**

Instrument (First Author, Year)	Construct description	Target population	Population it was developed with	Dimensions	Subscale (s) (number of items)	Response options		Available translations		No of studies evaluating the instrument*
						options	scale	Original language	Available translations	
EAQ (Ágoston et al., 2022)	Eco-anxiety	NR	Hungarian general population	2 = habitual ecological worry (HEW); negative consequences of eco- anxiety (NEG)	22 items; (HEW: 13 items; NEG: 9 items)	4-point	scale	English	Hungarian	No of studies evaluating the instrument* 1
EAS (Hogg et al., 2021)	Eco-anxiety	NR	Australians and New Zealanders; general population	4 = affective (AF), behavioural (BEH), rumination (RUM), anxiety about personal impact (IMP)	13 items; (AF: 4 items; BEH: 3 items; RUM: 3 items; IMP: 3)	4-point	scale	English	N/A	4

BCADS: Brief Climate Change Distress Scale. CCAS: Climate-Change Anxiety Scale. CCDS: Climate Change Distress Scale. CCDI: Climate Change Distress and Impairment Scale. CCWS: Climate-Change Worry Scale. EAQ: Eco-Anxiety Questionnaire. EAS: Eco-Anxiety Scale. s1: study 1, s1 sa 1: study 1, sample 1. NR: Not reported. N/A: not applicable. \*The original version of the CCAS initially had 22 items and 4-factors (CEI, FI, plus behavioural engagement and experience of climate change), but its authors concluded only the two CEI and FI factors across 13 items constituted the CCAS; the others were correlates. \*\*Three articles used modified versions of the CCAS for psychometric reasons discussed in text; 1 removed 1 item (Wullenkord et al., 2021). 1 removed 6 items (Feather & Williams, 2022), and 1 changed the response options from a 5-point to a 7-point scale. \*\*\*No information available on German translation.

removed one item that performed as a statistical outlier in their study, and Feather and Williams (2022) removed six items that they judged to be of “poor face validity”. The excluded items were judged by the researchers as reflective of “rumination” rather than anxiety.

Constructs captured by the instruments included “eco-anxiety”, “climate distress”, or “climate change worry”. The Brief Climate Change Distress Scale (BCCDS; Latkin et al., 2022) includes questions aiming to capture low mood, anxiety, worry, and feelings of helplessness and hopelessness when thinking about the climate crisis. The Climate Change Distress Scale (CCDS; Searle & Gow, 2010) was based upon other studies that had tailored existing measures of anxiety to their research topic. It asks participants to rate, using a list of different emotions, how they feel about climate change. The Climate Change Distress and Impairment Scale (CCDIS; Hepp et al., 2023) was designed to measure impairment in, for example, social or work life, as well as different affective reactions to climate change such as anxiety, anger or sadness. The items on the Climate Change Worry Scale (CCWS; Stewart, 2021) focus on worried thoughts about the climate crisis: the author distinguished “worry” from “anxiety” based on the theory of worry as a mainly cognitive experience, whilst arguing “anxiety” involves bodily sensations (e.g. Borkovec et al., 1983; Szabo; Szabó, 2011). The Eco-Anxiety Questionnaire (EAQ-22; Ágoston et al., 2022) was designed based on participants’ responses when asked about their attitudes and emotions related to climate change and environmental issues, such as pollution. The EAQ-22 was created alongside the development of separate scales for “eco-guilt”, and “ecological grief”. Finally, the items on the Eco-Anxiety Scale (EAS; Hogg et al., 2021) were influenced by the items on a widely used measure of generalised anxiety (GAD-7; Spitzer et al., 2006) and asked about emotional reactions to climate change and other environmental issues, such as ecological degradation.

Many of the development studies did not explicitly state their target population. Studies that did provide this information reported that participants were sampled from Westernised, overdeveloped nations. All instruments were originally designed in English. Within the included articles, three of the instruments (CCAS, CCDIS and EAS) had been translated into another language. The methods for translation varied and this was evaluated as part of the quality appraisal.

### **4.3. Methodological quality of included studies**

The COSMIN provides a Risk of Bias (RoB) checklist (Monkkink et al., 2018) that supports evaluation of the methods used to assess a specific psychometric property in a given paper. RoB is assessed ahead of the value of the psychometric properties themselves. The results of the RoB quality assessment are given in Appendix D.

#### 4.4. Content validity

The COSMIN manual regards content validity as the most important psychometric property and draws upon guidance by Terwee et al. (2018) to assess the development of “Patient Rated Outcome Measures” (PROMs) in two parts. Part 1 relates to how authors identified relevant items for the instrument; and part 2 is concerned with how PROM development was refined through piloting. None of the included PROM development studies utilised a cognitive interview study/pilot test, and therefore Part 2 was not completed in the RoB assessment. The worst-score-counts principle was again used for rating the quality of content validity.

Within Part 1, there are questions on “General design requirements” (e.g. “Is a clear description provided of the construct to be measured? Is the origin of the construct clear: was a theory, conceptual framework or disease model used or a clear rationale provided to define the construct to be measured? Is a clear description provided of the context of use? Was the PROM development study performed in a sample representing the target population for which the PROM was developed?”) which were completed for all seven instrument development studies. The development studies for the CCAS, CCDIS, CCWS, EAQ-22, and the EAS received “adequate” for these questions. They did not receive “very good” because it was not explicitly stated whether the participants were representative of the target population for the PROM. Latkin et al. (2022) and Searle and Gow (2010) did not provide any information on the instrument development or rationale for the selection of items, therefore the BCCDS and CCDS received “inadequate” for PROM development at this stage.

Next in Part 1, there are questions on “Concept elicitation” (relevance and comprehensiveness), (e.g., “Was an appropriate qualitative data collection method used to identify relevant items for a new PROM? Were skilled group moderators/interviewers used? Were the group meetings or interviews based on an appropriate topic or interview guide? Etc.). Only one of the included PROM development studies (EAQ-22; Ágoston et al., 2022) conducted data collection and analyses to identify items for the instrument and received “very good” for these questions. Using the worst-score-counts principle, the EAQ-22 received an overall rating of “adequate” for PROM development. Hepp (2023; CCDIS) sought feedback on their items but did not describe any methods for developing their measure based on collection or analysis of data, therefore the CCDIS received an “inadequate” rating. The remaining development studies (Clayton & Karazsia, 2020; Hogg et al., 2021; Latkin et al., 2022; Searle & Gow, 2010; Stewart, 2021) did not collect primary data but instead designed their measures based on research literature, existing tools and/or emotion theories. Keeping to the COSMIN criteria, these studies therefore received “inadequate” ratings for concept elicitation.

#### 4.5. Other psychometric properties

The COSMIN RoB tool was then used to assess the risk of bias for the measurement of internal consistency; measurement invariance; test–retest reliability; structural validity; and hypothesis testing for construct validity. All studies that assessed internal consistency received a quality rating of “very good” for this property. There was greater variance in quality for construct validity due to a lack of psychometric data on comparison measures. Most studies did not report on measurement invariance and test–retest, and no studies assessed the remaining psychometric properties in the COSMIN taxonomy. Studies that reported on the translation of a measure or its use in another country were not regarded as providing evidence of cross-cultural validity because evidence of this construct requires comparisons of multiple samples from different cultures (Mokkink et al., 2018b). The exception to this was Tam et al. (2023) who assessed measurement invariance between culturally different samples.

#### 4.6. Translation of measures

The COSMIN manual (Mokkink et al., 2018b) does not state explicit standards for the methodological quality of the translation of instruments. The tool does, however, have a question for each property asking, “Were there any other important flaws in the design or statistical methods of the study?”, against which we included ratings of the translation quality. Thus, a rating of either, “very good”, “adequate”, “doubtful” or “inadequate” was given, based on how closely the study appeared to follow the World Health Organisation’s (World Health Organization [WHO], 2021) good practice guidance for translating measures. The guidelines suggest there should be four steps in translation: forward translation, bilingual panel discussion, back-translation and then pre-testing. Ideally, the individual(s) forward and back-translating should be translating to their native language and those back-translating should be independent of the study with no prior knowledge of the measure. The pre-testing involves interviews or focus groups with the target group to explore the quality of translation (e.g. “What does this question mean to you?”; WHO, 2021).

The Korean (Jang et al., 2023) and Spanish (Ramírez-López et al., 2023) translations of the CCAS provided the strongest evidence of adhering to the WHO (2021) guidelines and were the only two to describe a pre-test of the translated measure with the target group. They were both rated as “very good”. The Italian (Innocenti et al., 2021) and the German (Wullenkord et al., 2021) translations of the CCAS were rated as “adequate” as they used forward and back-translation with independent translators but could have been improved if the translators were native speakers and if they had conducted

a pre-test. Half of the translated measures (CCAS: Larionow et al., 2022; Mougouama-Daouda et al., 2022; Niskanen, 2022; CCDIS; Hepp et al., 2023; EAS; Uzun et al., 2022) were rated as “doubtful” because it was not clear whether the back-translators were independent of the study. The Icelandic (Porsteinsdóttir, et al. 2021), and Chinese and Japanese (Tam et al., 2023) translations of the CCAS were rated as “inadequate” on translation because the authors provided little or no description of their methods and did not appear to follow guidelines.

#### ***4.7. Psychometric properties and quality of evidence of the instruments***

Following the RoB assessment, the criteria for good measurement properties (Prinsen et al., 2018) were used to evaluate whether the test statistics in each paper supported specific psychometric properties of the measures. See Appendix E for results. Many studies received an “indeterminate” rating for internal consistency, despite reporting Cronbach’s Alpha values  $> .70$ . This is because the COSMIN manual requires sufficient evidence of structural validity for a rating of “sufficient” for internal consistency. Sufficient evidence of structural validity according to COSMIN’s Good Measurement Properties requires confirmatory factor analysis with a comparative fit index or Tucker-Lewis index of  $> .95$ , Root Mean Square Error of Approximation of  $< 0.06$ , or Standardized Root Mean Residuals of  $< 0.082$ . “Insufficient” ratings were given for hypothesis testing for construct validity where there was only support for 50% of researchers’ hypotheses (COSMIN states that “sufficient” ratings require  $> 75\%$  of hypotheses to be met).

For the CCAS, there were varying results for different factor structures. The original version of the CCAS had four factors: cognitive-emotional impairment (CEI), functional impairment (FI), behavioural engagement (BE) and experience of climate change (ECC). However, Clayton and Karaszia concluded that the BE and ECC subscales were correlates and that the CCAS subscales consisted of CEI and FI only. Accordingly, no study reported sufficient results for a four-factor structure (Clayton & Karaszia, 2020; McBride, 2022; Mougouama-Daouda et al., 2022). Clayton’s proposed two-factor structure had support from some studies (Feather & Williams, 2021; Larionow et al., 2022; Simon et al., 2022; two of the four samples in study by; Tam et al., 2023) but did not meet criteria for sufficiency in others (Cruz & High, 2022; Innocenti et al., 2021; Jang et al., 2023; Mougouama-Daouda et al., 2022; Nadarajah et al., 2022; Niskanen, 2022; two of the four samples in study by; Tam et al., 2023). Three studies that tested a unidimensional factor structure reported sufficient results (Feather & Williams, 2021; Larionow et al., 2022; Mougouama-Daouda et al., 2022) and two did not (Cruz & High, 2022; all four samples in study by; Tam

et al., 2023). The only study to test a three-factor structure (Larionow et al., 2022) found support. The three factors were described as “intrusive symptoms”, “reflections on climate anxiety” and “functional impairment”, which the authors stated were more theoretically linked to the items on the CCAS (Larionow et al., 2022). The overall ratings and the quality of the evidence for each psychometric property per instrument were pooled and are presented in [Table 2](#).

The overall rating for an instrument consists of the majority rating, which was given when >75% of studies of a particular measure provided the same rating for a given property. In cases where there was not a majority, overall ratings are marked as “inconsistent”. As for individual studies, many instruments received an overall rating of ‘indeterminate’ in the evidence for good internal consistency due to low/inconsistent evidence for structural validity.

The quality of evidence (RoB) was graded using the GRADE approach (Mokkink et al., 2018b): All instruments begin with “high” quality evidence and then are downgraded if, for example, there are studies of doubtful/inadequate quality, or if there are inconsistencies in quality between studies assessing a given measure. For example, the CCWS was downgraded from “high” to “moderate” quality of evidence for internal consistency because of unexplained inconsistency of results, whereas the CCAS retained a “high” quality rating as the quality of the assessment was consistently high across studies for this property.

## 5. Discussion

The aim of this review was to evaluate the psychometric properties of instruments measuring constructs related to climate-related distress. The objectives were to understand the constructs that each instrument is based upon ([Section 5.1](#)); consider which instrument may be the most psychometrically sound for use, clinically or in research ([Section 5.2](#)); and to identify areas where further psychometric assessment is required ([Section 5.5](#)).

### 5.1. Constructs

There is no consensus agreement in the field as to a singular definition of climate distress, which is perhaps appropriate given the range of understandable emotions people experience (Pihkala, 2022). The included measures were based upon the constructs of “rumination” and “functional impairment” (CCAS), “generalised anxiety” (EAS), “anxiety” (EAQ-22) and “worry” (CCWS). Two measures aimed to capture a variety of emotional responses such as “depression”, anxiety and anger, as well as “helplessness” and “hopelessness” (BCCDS, CCDS). One measure was designed to assess similar emotions to these, plus impairment in social or work life (CCDIS).

**Table 2.** Overall ratings of psychometric properties and quality of evidence per instrument

Instrument	Psychometric Property													
	Internal Consistency			Measurement Invariance			Test-Retest			Structural Validity			Hypotheses Testing	
	Overall rating	Quality of evidence	Overall rating	Quality of evidence	Overall rating	Quality of evidence	Overall rating	Quality of evidence	Overall rating	Quality of evidence	Overall rating	Quality of evidence	Overall rating	Quality of evidence
<b>BCCDS</b>	?	High	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
<b>CCAS</b>	?	High	+	High	+	Low	+	1-F - 2-F +/- 3-F + 4-F -	Very low High High High High Moderate	- + - -	NR NR	NR NR	NR NR	High High
<b>CCAS:</b>	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	Low
<b>Modified 1</b>	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
<b>CCAS:</b>	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
<b>Modified 2</b>	?	High	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
<b>CCAS:</b>	?	High	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
<b>Modified 3</b>	?	High	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
<b>CCDS</b>	+/-	High	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	Moderate
<b>CCDIS</b>	+/-	High	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	Moderate
<b>CCWS</b>	+/-	Moderate	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	Moderate
<b>EAQ-22</b>	+	High	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	Very low
<b>EAS</b>	+/-	Moderate	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	Moderate

BCCDS: Brief Climate Change Distress Scale. CCAS: Climate-Change Anxiety Scale. CCDS: Climate-Change Distress Scale. CCDI: Climate Change|Distress and Impairment Scale. CCWS: Climate-Change Worry Scale. EAQ: Eco-Anxiety Questionnaire. EAS: Eco-Anxiety Scale. NR = not reported in study. The psychometric properties were rated using the criteria for good measurement properties (Pinsen et al., 2018) as reported in COSMIN: + = sufficient; ? = indeterminate, - = insufficient; ± = inconsistent (in case of more than one result per psychometric property within a study). The COSMIN GRADE approach was applied for grading the quality of evidence (high, moderate, low, very low).



## 5.2. Recommendations for the most suitable measure

Based on the analyses in this review, no measure was clearly identified as the most suitable for assessing climate-related distress. Utilizing the stringent criteria of COSMIN, risk of bias was indicated for most of the measures with regards their development and most measures had poor evidence of content validity. The EAQ-22 is promising due the methodology for developing the measure; however, there has been little exploration of its psychometric properties to date. The CCAS (Clayton & Karazsia, 2020) was used the most frequently, with some positive results for cross-cultural and construct validity. However, there were discrepancies in the evidence for structural validity of the CCAS, due to inconsistent results for a unidimensional or two-factor structure, and one study indicating evidence for a three-factor structure. Attempts to improve the psychometric properties of the CCAS by removing some items did not produce superior results. Further validation studies are needed across all measures.

The selection of an instrument for use must be informed first by the underlying concept or construct one intends to measure (Prinsen et al., 2018). Researchers and clinicians seeking a measure of climate-related distress could select one of the reviewed tools based on the particular construct they are interested in, taking into consideration the limitations of the measures. For example, researchers hoping to explore the impact on anxiety-levels, worry, or low/depressed mood might select measures that were informed by those constructs; the EAS, CCWS, or CCAS, respectively. Note that the CCAS, whilst suggestive of “anxiety” in its name, focuses on rumination which has been linked to “depression/low-mood”, so may be a measure of distress beyond solely anxiety (Wullenkord et al., 2021), though research has previously highlighted the problems of trying to disentangle “anxiety” from “low-mood” (Cromby et al., 2013). Alternatively, for a measure that is based upon participants’ descriptions of their experiences of climate-related distress, the EAQ-22 may be the most preferable as the items were based on participants’ responses in interviews. Some of the instruments (CCAS, CCDIS, EAQ-22, and EAS) consider functional impact, which may be important for understanding the effect the distress has on people’s lives. This could be useful for clinicians hoping to understand their clients’ distress, and also to further research into associations between climate distress and pro-environmental behaviour, for which there is currently a complex picture (e.g. Landry et al., 2018; Stanly et al., 2021).

Alternatively, researchers and clinicians might select measures based upon other features. Briefer measures (e.g. BCCDS, 5-items) might be beneficial for reducing participant burden in population surveys where other questionnaires are being used. The option for a translated version of a measure may be important in the selection, and there are 10 different language options

available for the CCAS, a German version of the CCDIS, and a Hungarian version of the EAQ-22. However, caution should be used with the quality of the translations and the paucity of evidence for cross-cultural validity across the measures.

### **5.3. Limitations of included studies and measures**

The most significant concern for all included measures is that of poor content validity, which is considered the most important psychometric property (Mokkink et al., 2018b). The majority of the measures were not designed based upon data collected from participants, but instead informed by research literature or existing constructs such as “anxiety” and “depression”, and we do not know if climate-related distress is qualitatively different from these constructs. These issues affect the content validity of the measures.

The translated versions of some of the measures are potentially flawed as most did not follow guidelines for the translation of instruments. A common issue was where translators were fluent, but not native speakers, of the language to which they were translating. However, this is understandable given limited resources within many research teams. Most of the translated measures (except Tam et al., 2023) were not used to compare different groups (e.g., English-speakers and German-speakers) for measurement invariance, therefore there is a lack of evidence for cross-cultural validity for these measures. This is an important concern given the global impacts of climate change and related distress and the need for more research outside of Westernised nations.

The sampling of participants is another limitation of the studies. All studies used convenience sampling, and many recruited only university students and/or within Westernised overdeveloped nations, so the generalizability of results to other cultures and populations is limited. However, this sampling would be appropriate if the measures were designed and intended for use in those populations. Countries vary considerably in the degree to which climate change has current, acute impacts (Eckstein et al., 2019) and cultural backgrounds may affect how people experience associated distress (e. Barnwell et al., 2020).

The majority of studies recruited online. Whilst this had practical benefits, this may have excluded individuals without regular access to online platforms. However, some studies that used the CCAS did target recruitment at those hypothesized to have increased experiences of climate distress: young people (Þorsteinsdóttir, 2021; Nadarajah et al., 2022, Simon et al., 2022), people residing in countries particularly vulnerable to climate change (The Philippines: Reyes et al., 2021; Simon et al., 2022) and people who live in the four highest emitting countries, which have varying levels of vulnerability and resilience to climate change (USA,

China, Japan, India: Tam et al., 2023). These studies can provide useful insight into the use of the CCAS in populations who may experience increased distress compared to the general population. Finally, attempts made to modify the CCAS based on removing items due to researchers' concerns about face validity did not result in improved psychometric properties.

#### **5.4. Limitations of the review**

The standardized approach of the COSMIN methodology was beneficial for this review. COSMIN could be criticized for possibly being overly stringent in some areas of evaluation, for example, PROM development: many measures were downgraded because they did not collect primary data. However, using data collected for the development of constructs such as "generalised anxiety" or "depression", which several measures were based on (e.g. CCAS, CCDS, CCWS, EAS) is arguably more problematic when currently little is known about the potential differences between these constructs and climate-related distress. Therefore, the review team decided to adhere to the rigorous COSMIN criteria.

There were incidences where the review team made decisions for how best to apply the COSMIN criteria, which introduced some subjectivity into the review process. For instance, the manual suggests that the review team could generate hypotheses for studies where these were not explicitly stated by the study authors, and then use these hypotheses to assess construct validity. We decided against this, as many studies that did not specify hypotheses were exploratory in nature and it would be problematic to generate our own hypotheses when there is limited previous research to guide this. For example, we did not feel able to hypothesise the direction of correlation between measures of climate distress and pro-environmental behaviour due to conflicting findings in prior research. We also integrated WHO (2021) good practice guidelines on translation of measures, as this was not something explicitly included within COSMIN criteria.

The exclusion of measures of eco-grief and eco-guilt at face value could be argued as a limitation of the review, given there is no clearly defined construct of climate distress. However, in Hepp et al. (2023)'s development study for the CCDIS, initial items relating to guilt were removed as they performed poorly in the factor analyses, which suggests that guilt is qualitatively different from other aspects of climate distress. Eco-grief appeared similar at face value to solastalgia, which had been excluded as the studies were focused on emotional impacts after specific climate events, rather than general experiences of climate-related distress, which tend to be present or future-focused (Pittaway et al., 2024). Future reviews could consider broadening the scope to include measures of grief, or guilt or other eco-emotions.

The search was restricted to articles available in the English language, due to not having funding for translation. This presents a limitation as some studies might have been excluded, including research conducted in non-English speaking nations that may be at greater risk from climate change. However, efforts were made to include research across different countries with the inclusion of translated versions of measures.

Reviewed measures varied with regard to the stressor they were examining, with some tools including items relating to the ecological emergency as well as climate change. For example, the EAQ-22 asks about concern about the impact of pollution on animals, and the EAQ asks about “climate change and other global environmental conditions (e.g., global warming, ecological degradation, resource depletion, species extinction, ozone hole, pollution of the oceans, deforestation)” (Hogg et al., 2021). Whilst interrelated, it is possible people could be distressed about one rather than the other, presenting further challenges to unpicking constructs being assessed by the tools.

Finally, the decision to include one study (Cruz & High, 2022) that changed the response options on the CCAS from a 5-point to a 7-point scale could be disputed. However, we considered this within the assessment of RoB, and whilst this individual study was downgraded from “very good” to “doubtful”, this did not affect the overall quality rating for the assessment of structural validity on the CCAS. Results from studies that modified the CCAS by removing items were not pooled with the CCAS results.

### **5.5. Implications**

Further high-quality research is needed to evaluate the psychometric properties of all the included measures before a conclusive decision can be made about the most appropriate measure. Specifically, more studies using the EAQ-22 would be helpful, as well as further research to investigate the inconsistencies of findings in factor structure for the CCAS. Conducting research in more samples that are hypothesized to experience climate distress (e.g., climate scientists: Pihkala, 2020) would be useful to test whether the measures are detecting real levels of distress as we would expect. The measures could also be used across different geopolitical contexts, to explore variance in responses in countries with different environmental legislation, or after extreme weather events. Where the measures are compared to others for construct validity, it would be beneficial to ensure the comparator measures have good validity and reliability in the relevant sample.

Ideally, future research could take a “bottom-up” approach to develop a measure that fits with peoples’ experiences of climate distress. Conducting interviews or focus groups with climate-concerned people and using this to develop, pilot, or modify an existing measure would improve the issue of content validity. Finally, further research comparing

groups that differ culturally or by country would be advised for the assessment of cross-cultural validity, though with caution given the important challenges to the idea that psychological constructs exist independent of culture (e.g. Kirmayer, 2012).

## 6. Conclusions

This is a relatively new field of research, with most included measures and studies published within the preceding 3 years. There remains no consensus on what defines climate-related distress as a construct, which creates difficulty for those who are developing and reviewing the measures. However, the experience of climate distress likely differs between people and cultures, and over time; defining a single construct could limit the sense people are able to make of their distress (Morgan et al., 2022). Again, it is important to acknowledge that climate-related distress should not be pathologised and instead recognized as indicative of an ability to remain connected to the urgency of the existential threats humanity and the more-than-human world is facing (e.g. Clayton, 2020; Hickman et al., 2021; O'Brien et al.; 2021; Woodbury et al., 2020).

The reviewed measures can all provide useful data for researching experiences of climate-related distress, though researchers should be mindful of the limitations of the instruments and interpret findings with appropriate caution. Following further research and development, these measures could help to compare rates of distress between different groups and explore why some people are not expressing distress about the reality of the climate crisis (Mertens, 2023). Such research could support arguments for interventions to be delivered: both in terms of climate policies and in supporting people with their distress and engagement with pro-environmental behaviour (e.g. Doherty & Clayton, 2011; Hamilton, 2019; Harper et al., 2022). The further development and refinement of measures for climate distress is therefore of clear importance for its potential impacts on clinicians, researchers, policy makers and citizens, and engagement with the climate crisis more broadly.

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## Data availability statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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