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Investigating the impact of climate change on mental health among Libyan Arabs: a validation study of the Hogg Eco-Anxiety Scale

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Abstract

Anxiety, especially within the realm of eco-anxiety, has become an increasingly significant focus of research. In our exploration of eco-anxiety within the Arab Libyan population, we employed a cross-sectional approach and successfully validated the Hogg Eco-Anxiety Scale (HEAS-13). Across two separate subsamples, both Exploratory ($n = 790$) [M = 21.64 (SD = 3.51), % women = 86.8] and Confirmatory Factor Analysis ($n = 829$) [M = 22.24 (SD = 3.76), % women = 84.6] confirmed the validity of HEAS-13. This scale effectively captured four distinct dimensions of eco-anxiety: affective symptoms, rumination, behavioral symptoms, and anxiety regarding one's negative impact on the planet. Moreover, the total HEAS-13 and its dimensions had good internal consistency coefficients, ranging from 0.65 to 0.82. The findings highlight significant correlations between eco-anxiety subscales, behavioral symptoms, and rumination, indicating distinct profiles of eco-anxiety. Additionally structural equation modelling analysis revealed that eco-anxiety dimensions serve as a significant predictor of various psychological symptoms, climate change perception and climate value, emphasizing the interconnectedness between eco-anxiety and psychological distress. Furthermore, Sex-specific differences in eco-anxiety and its associations with climate change perceptions are explored, suggesting heightened awareness and involvement among females. The results emphasize eco-anxiety as a quantifiable psychological phenomenon, demonstrably measured through our 13-item eco-anxiety scale and associated with the mental health outcomes.

Highlights

- Confirmed 4-factor structure of HEAS-13, aligning with previous studies.
- Significant correlations indicate distinct eco-anxiety profiles among Libyan Arabs.
- Eco-anxiety linked with stress, depression, and anxiety, showing interconnectedness.
- Sex-specific differences highlight heightened female awareness and involvement.
- Urges for longitudinal studies, broader representation, and tailored interventions.

Keywords Eco-Anxiety scale · Climate change · Psychological symptoms · Psychometrics

Introduction

Climate change is a perilous global phenomenon characterized by sustained alterations in temperatures and weather patterns, predominantly attributed to human activities (Padhy et al., 2015; Cianconi et al., 2020). This crisis poses existential threats to human survival, as evidenced by projections from the World Health Organization (2021), indicating an anticipated annual increase of 250,000 deaths between 2030 and 2050 due to malnutrition and heat stress (WHO, 2023).

The mental health repercussions stemming from environmental crises are extensive, ranging from profound loss and

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grief to emotional and behavioral issues and psychopathology (Hogg et al., 2021; Cianconi et al., 2020; Corvalan et al.,2022). A systematic literature review spanning 1994 to 2014 revealed consistent evidence, both in developing and developed countries, linking floods to heightened rates of anxiety and depression (Fernandez et al., 2015). Furthermore, concerns about diminishing land areas due to flooding and coastal erosion have led to ongoing mental health challenges, such as disturbances in adaptive capacity, anxiety, and depression, particularly in small island nations like those in the Indian or Pacific Oceans (Cianconi et al., 2020; Bei et al., 2013; Eisenman et al., 2015).

The United States also has reported numerous cases linking climate-related psychological distress to deteriorating mental health and elevated mortality rates, especially among individuals with pre-existing mental health conditions, in the face of events such as heatwaves, humidity, wildfires, and floods (Charlson et al., 2021; Stanley, 2023; Padhy et al., 2014; Eisenman et al., 2015). In Australia, a significant number of people have reported direct experiences with climate change-related events, with young individuals experiencing high rates of environmental anxiety and pre-traumatic symptoms (Patrick, 2022). In addition, emotional responses to climate change consistently emerge as influential factors in predicting climate change risk perceptions, engagement in mitigation actions, and adaptation behaviors (Brosch, 2021). Limited studies in Arab countries, such as Saudi Arabia, revealed perceptual differences in climate change impacting emotional responses, particularly among younger individuals (Arnout, 2022).

Libya, being one of the driest regions globally with over 85% of its area covered by deserts, faces considerable challenges due to low rainfall rates and the threat of desertification in its coastal strip (Schilling et al., 2020; Bindra et al., 2013). Given Libya's location in the Mediterranean basin, identified by the Intergovernmental Panel on Climate Change (Mbow et al., 2017) as one of the most sensitive regions to climate change, the recent disaster in the Eastern Province in the city of Derna, coupled with a dilapidated infrastructure resulting in significant casualties and death over 5300 persons (Dadouch, 2023), underscores the urgency of understanding the psychological impact of climate change in the country.

In recent years, efforts have been made to better understand climate and environmental anxiety (Lutz et al., 2023). Environmental anxiety is broader than climate anxiety, encompassing concerns about various interconnected environmental problems (Passmore et al., 2022). Researchers describe these anxieties as rational responses to the deteriorating state of the planet, acknowledging that experience may vary along a continuum from mild to severe and overwhelming (Hickman, 2020; Lutz et al., 2023).

The literature has shown mixed results regarding the relationship between climate and environmental anxiety, well-being, and behavior, contributing to conceptual challenges. Many researchers caution against pathologizing environmental concern (Lutz et al., 2023), where also climate and environmental anxiety are not classified as mental health disorders (Clayton, 2020; Hickman, 2020). However, these anxieties may play a significant role in people's health and behavior. While climate and environmental anxiety align with poor mental health outcomes such as anxiety, depression, stress related conditions (Clayton & Karazsia, 2020; Hogg et al., 2021; Ogunbode et al., 2022; Schwartz et al., 2022; Stanley et al., 2021; Berry et al., 2010; Hayes & Poland, 2018), feelings of despair and hopelessness may coexist with hope and resilience (Nairn, 2019; Pihkala, 2020; Verplanken et al., 2020), while others may engage more actively with environmental problems and solutions (Albrecht, 2011; Schwartz et al., 2022; Coffey et al., 2021).

In response to the increasing interest in climate and environmental experiences, a research group has recently developed measures to assess anxiety related to these issues: the Climate Anxiety Scale (CAS; Clayton & Karazsia, 2020) and the Hogg Environmental Anxiety Scale (HEAS; Hogg et al., 2021). The creation of these tools is a significant step forward in facilitating research on climate and environmental anxiety, along with exploring their associated factors. However, there remains a need for clarity in the conceptual framework and validation of these measures to advance in the field.

Research Goals:

1. To validate the HEAS-13 in the Arab Libyan context by examining its reliability and factor structure.
2. To explore the relationship between eco-anxiety and other psychological symptoms such as anxiety, depression, and stress.
3. To examine the association between Eco anxiety scales, climate change perception and climate change value.

Research Hypothesis:

1. We expect to capture the four dimensions of the eco-anxiety scale through factor analysis.
2. We expect to find significant correlations with psychological symptoms variables to increment its validity.
3. We also expect that Eco anxiety can be a predictor of psychological distress, climate change perception and climate change value.

Method

Participants

The study included total sample of 1619 Libyan citizens aged between 17 and 50 years (M = 22.07, SD = 3.65), who actively participated by completing an online google form. The total sample represented diverse age and Sex groups, with 231 males and 1388 females, reflecting the demographic composition of Libyan society across four regions. see Table 1.

Instruments

Demographic details were collected, encompassing participant information regarding Sex (male, female), date of birth, social status, educational attainment, and residential region.

Hogg Eco-Anxiety Scale (HEAS-13)

The HEAS-13 is a 13-item self-report measure that assesses four dimensions of eco-anxiety: affective symptoms, rumination, behavioral symptoms, and worry about one's negative impact on the environment. Four item affective symptoms of eco-anxiety measure, three supplementary items measure ruminative thoughts associated with environmental concerns (e.g., "Persistent thoughts about future climate change and other global environmental problems"), three items focused on impairment to behavioral and social functioning (e.g., "Experiencing difficulty in work and/or study"), and three items addressed anxiety related to one's impact on the planet (e.g., "Feeling anxious about the consequences of personal behaviors on the Earth"). Responses were recorded using the same 4-point frequency scale (0 = not at all, 3 = nearly every day). (Hogg et al.,2021). Refer to Supplementary material for the complete 13-item scale Arabic version.

Depression anxiety stress scale (DASS-8)

The DASS-8 is a short form of the DASS-21, measuring symptoms of depression, anxiety, and stress. It consists of 8 items, each rated on a 4-point scale Ali et al. (2017). The DASS-8 exhibits robust reliability, as indicated by Cronbach's alpha values for its subscales: Stress (α = 0.55), Anxiety (α = 0.69), Depression (α = 0.67), and the overall scale (α = 0.83).

Climate Change Perception Questionnaire (CCPQ)

The CCPQ assesses individuals' perceptions of climate change, categorized into three dimensions of Climate Change Perception: cognitive, emotional, and evaluative (Arnout, 2022). It contains 21 items rated on a 5-point Likert scale. The three subscales of the CCPQ demonstrate commendable reliability, as evidenced by their respective Cronbach's alpha values: Emotional (α = 0.80), Appraisal (α = 0.76), and Cognitive (α = 0.69). Additionally, the total score, encompassing all subscales, exhibits strong reliability with an alpha value of 0.88.

Table 1 Demographic information

Demographics	Total		sub-1		sub-2	
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
Sex						
Male	231	14.3	104	13.1	127	15.3
Female	1388	85.7	686	86.8	702	84.6
Age (Mean ± SD)	(22.07 ± 3.65)		(21.89 ± 3.15)		(22.24 ± 3.76)	
Range	(18–54)		(18–50)		(18–54)	
Geographic location						
Western regions	1290	79.7	6.8	76.9	682	82.2
Eastern region	119	7.3	63	7.9	56	6.7
Southern region	73	4.5	82	10.3	55	6.6
Middle region	137	8.5	37	4.6	36	4.3
Marital status						
Single	1416	87.5	658	83.2	758	91.4
Married	193	11.9	126	15.9	67	8.0
Engaged	17	1.0	5.7	6	0.7	4
Divorced	10	0.6	0	0	0	0
Education						
Primary	47	2.9	40	5.06	7	0.8
Secondary	526	32.5	260	32.9	266	32.0
Bachelor	1001	61.8	465	58.8	536	64.6
Master or higher	45	2.8	25	3.1	20	2.4

Climate values questionnaire (CVQ)

The CVQ measures personal values related to climate change, including ecological concern and commitment to environmental action (Arnout, 2022). It includes 10 items rated on a 5-point scale. Cronbach's alpha values is 0.83, further emphasizing the consistent and reliable measurement across various dimension of climate change value.

Translation of the original English HEAS into Arabic

The methodology initiates with the translation of the original English HEAS-13 (Hogg et al., 2021) into Arabic, following the approach outlined by Beaton et al. (2000). Two proficient translators independently translated the questionnaire from English to Arabic, and their translations underwent expert review and revision to ensure precision accuracy and appropriateness. The expert committee comprised a clinical psychologist and a university professor specializing in Arabic language literature. Any disparities between the two translators were resolved through consensus.

Subsequently, the final step involved back-translation and validation of the translated questionnaire by an English teacher who is a native speaker of the Arabic language, ensuring accuracy and comprehension. This meticulous process is crucial for establishing the validity of the questionnaire and is an integral phase in the research endeavor. The expert committee reviewed the back translations, leading to the creation of the pre-final version of the questionnaire.

Once adapted, the questionnaire was administered to a small sample of individuals ($n=30$) with characteristics similar to the target population to assess its accuracy and clarity. Participants were encouraged to provide feedback on the questions and report any challenges faced during completion of the questionnaire. Subsequently, the questionnaire underwent refinement based on the results from the testing phase. This testing of the adapted questionnaire aimed to comprehend the attitudes and behaviors of individuals with diverse cultural backgrounds, ensuring its accuracy and comprehension for the target population (Beaton et al., 2000).

Upon completion of the pilot testing stage, participants' feedback was meticulously analyzed and discussed, leading to the development of the final version of the questionnaire.

Procedure

Participants completed an online survey consisting of the HEAS-13, DASS-8, CCPQ, and CVQ. The questionnaire's ultimate version was distributed via various social media platforms such as Facebook and Twitter, as well as the official websites of numerous Libyan community organizations and universities throughout the country. To enlist participants, we also employed a blend of convenience and snowball sampling techniques. The questionnaire remained accessible over a span of two weeks, running from 8th November to 24th November 2023.

The study underwent thorough scrutiny and approval by the Ethical Committee of the researcher institution under reference number **KTQ/145**. The objectives of the study were elucidated to participants in the initial segment of the online survey, wherein they were subsequently invited to partake in the survey. Subsequently, participants provided their consent through a structured informed consent questionnaire.

Data analytic plan

Initially, we conducted an analysis of the descriptive statistics of the participants. Continuous data were presented as means and standard deviations (SD), while categorical variables were presented as frequencies and percentage.

In accordance with established guidelines for rigorous analysis (Worthington and Whittaker, 2006; Comrey and Lee, 1992: Kline, 2015), the research employed Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) on two distinct sub-samples drawn from the larger participant pool ($N=1,619$) Specifically, the first sub-sample 790 participants formed the exploratory factor analysis (EFA) sub-sample, while the second sub-sample 829 were allocated for confirmatory factor analysis (CFA).

During EFA, the sampling adequacy for factor analysis was assessed using KMO and Bartlett's tests. The EFA employing Minimum residuals (minres) as the estimation method with Oblimin rotation. Minres is a preferred choice for parameter estimation in situations where the assumption of normality is not met, as highlighted by previous research (Revelle, 2018; Kline, 2015; Westland, 2010). The determination of the number of factors extracted was predicated on the outcomes of a parallel analysis. Indices such as the comparative of Fit Index (CFI), the Tucker Lewis index (TLI), and Root Mean Square Error of Approximation (RMSEA) were used, with values above CFI > 0.95, TLI >. 90 and RMSEA < 0.05 considered indicative of a good fit (Hu & Bentler, 1999; Byrne, 1994).

For CFA, Robust Weighted Least Squares (WLSM) with Oblimin rotation was employed. WLSM is a robust estimation method that is less sensitive to non-normality data, with fewer biases, and/or with categorical variables (Di Stefano & Morgan, 2014; Mîndrilă, 2010; Li, 2016; Byrne, 2016). A model with four correlated factors was tested due to correlations between dimensions. Fit indices included Comparative of Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square of Error Approximation (RMSEA),

and Standardized Root Mean Square Residual (SRMSR), with acceptable fit indicated by TLI > 0.90 and CFI > 0.95, RMSEA < 0.05, and SRMSR < 0.06 (Hu & Bentler, 1999; Byrne, 1994).

Additionally, the reliability of HEAS-13 dimensions and total scores were examined using Classical Test Theory (McDonald's ω coefficient). To assess the HEAS-13's validity evidence in relation to other variables, Spearman's correlations were calculated between HEAS-13, DASS-8, CCVC and CCV subscales to test the questionnaire validity.

A Structural Equation Model (SEM) was extended from the CFA and constructed to examine the association between HEAS-13, DASS-8, CCVC subscales and the CV scale. An eco-anxiety latent variable was formulated using scores derived from the four subscales of the HEAS-13 scale. The latent variable for psychological symptoms was formed using scores obtained from the subscales of DASS-8. The latent variable for climate change perception was established using scores from the three subscales of the CCV scale. Additionally, the manifest variable for climate value was created using the total score of the CV scale. In the SEM model, eco-anxiety latent variable served as a direct predictor for psychological symptoms, climate change perception and climate change value. The model was assessed using Diagonally weight least square (DWLS) estimator, recommended for its reduced biases (Li, 2016) and better suitability even for non-normal data, and is suitable for interval-level data. (Byrne, 2016; Kline, 2015; Di Stefano & Morgan, 2014). Acceptable model fit criteria were defined as $\chi 2/df$ below 5 and CFI, and TLI > 0.90 (Kline, 2010). An RMSEA with an upper boundary < 0.10 and an SRMR lower than 0.08 were considered indicative of acceptable model fit (Kline, 2010).

The Mann-Whitney U also was performed to test disparities between two distinct groups. This test is pivotal in determining whether the means of two populations are equivalent, especially in scenarios where there exist discrepancies in their variances and sample sizes are uneven (Nachar, 2008). In our study, we applied this method to gauge disparities in the HEAS-13, CCPQ, CVQ and DASS-8 dimensions between male and female participants. We established a statistical significance threshold at $p < .05$.

All analyses, including descriptive statistics, Spearman's correlations, EFA, CFA, and reliability coefficients SEM model include Mann-Whitney U test, were performed using Jamuvi project software (2023). (Versione 2.4)

Results

Demographic characteristics of subsamples

Subsample 1, consisting of 790 participants, was randomly selected from those who took part in the survey from 8-11-2013 to 11-11-2013. This subset (86.8% female, mean age = 21.64 years, SD = 3.51) was utilized for EFA of the eco-anxiety scale, ensuring compliance with minimum EFA sample size requirements (Comrey and Lee, 1992).

Subsample 2, comprising 829 participants, was drawn from those who participated in the survey between 11-11-2013 to 24-11-2013. This subset (84.6% female, mean age = 22.24, SD = 3.76) was specifically designated for conducting CFA on the eco-anxiety scale, with the sample size exceeding the minimum threshold for this analysis ($N > 200$) (Kline, 2015). See Table 1.

Subsample 1 EFA results

In the initial subsample (N.=790), the adequacy of the data fit for Exploratory Factor Analysis (EFA) with minimum residual (minres) as the estimation method, and Oblimin rotation was supported by both the Kaiser-Meyer-Olkin measure (KMO = 0.78) and Bartlett's statistics ($\chi 2 = 3354$; df = 78; $\chi 2/df = 43$, $p < .001$). The EFA results based on parallel analysis indicated that the is a five-dimensional model which demonstrated a satisfactory fit to the data, with a Comparative Fit Index (CFI) of 0.97, Tucker-Lewis Index (TLI) of 0.96, and Root Mean Square Error of Approximation (SRMSR) of 0.041. This model accounted for 90% of the confidence intervals. The majority of the correlations between the items of the HEAS-13 were between 0.31 and 0.98. Upon employing Oblimin rotation, all items loaded similarly to the original HEAS-13, except for item 5 'Unable to stop thinking about future climate change and other global environmental problems', which was loaded on a single fifth factor.

Table 2 displays the factor loadings of each item, revealing correlations between factors ranging from 0.31 to 0.98.

Subsample 2 CFA results

To validate the four-factor structure, a Confirmatory Factor Analysis (CFA) was conducted. Due to the violation of multivariate normality (as evidenced by Mardia's Z = 41.06, $p < .001$), the analysis utilized (WLSM) parameters, and was conducted with a second subsample of 829 participants, incorporating the single loaded items 5 'Unable to stop thinking about future climate change and other global environmental problems' with its related items 6 'Unable to stop thinking about past events related to climate change' and 7

Table 2 Factor loadings from exploratory factor analysis of the 11-item eco-anxiety scale ($n = 790$, subsample one)

Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Feeling nervous, anxious or on edge	0.31				
Not being able to stop or control worrying	0.67				
Worrying too much	0.81				
Feeling afraid	0.34				
Unable to stop thinking about future climate change and other global environmental problems					0.39
Unable to stop thinking about past events related to climate change		0.98			
Unable to stop thinking about losses to the environment		0.88			
Difficulty sleeping			0.35		
Difficulty enjoying social situations with family and friends			0.61		
Difficulty working and/or studying			0.75		
Feeling anxious about the impact of your personal behaviours on the earth				0.39	
Feeling anxious about your personal responsibility to help address environmental problems				0.85	
Feeling anxious that your personal behaviours will do little to help fix the problem				0.52	

Applied rotation method is Oblimin.

Factor 1 = Affective symptoms; Factor 2 = Rumination; Factor 3 = Behavioural symptoms; Factor 4 = Anxiety about personal impact; Factor 5 = Item 5

'Unable to stop thinking about losses to the environment'. The results indicated that the original four-dimensional model proposed by Hogg and colleagues (2021) demonstrated a stronger fit for the 13-items model: factor model = ($\chi2 = 3698$; df = 78; $\chi2/df = 47.29$, p < .001), CFI = .99, TLI = .97, RMSEA = .04 (95% CI [.05,.08]), SRMR = .05; KMO = .80.

Refer to Fig. 1 for the pathway diagram illustrating the four-factor structure of Arabic HEAS-13.

The consistency of the four-factor model across both subsamples provides robust support for the notion that eco-anxiety is a multidimensional construct. This construct encompasses affective symptoms, rumination, behavioral symptoms, and anxiety concerning one's personal impact on the planet.

Reliability and comparative analysis of HEAS-13

Reliability (ω) assessed through Classical Test Theory demonstrated acceptable values for each dimension: ω_ affective symptoms = 0.74, ω_ rumination = 0.82, ω_ behavioral symptoms = 0.69, ω_ anxiety concerning one's personal impact on the planet = 0.65, and ω_HEAS-13 (total score) = 0.82. Moreover, the adjustment indices and reliability scores of the Hogg Eco-Anxiety scale (HEAS) were comparted with those reported in previous studies. Table 3 provides details comparison, highlighting the differences in the adjustment indices (e.g., CFI, TLI, RMSEA) and reliability coefficient (e.g., Cronbach's alpha) between our study and previous validation of similar scales.

The consistency and reliability of the HEAS-13 dimensions across various studies affirm the robustness and validity of the scale in measuring eco-anxiety as a multidimensional construct.

Descriptive statistics and validity of HEAS-13

Table 4 presents descriptive statistics, showing positive correlations between mean scores on HEAS-13, DASS-8, CCVQ subscales, and the CCV scale for Subsample 2.

The validity of the HEAS-13 subscales (behavioral symptoms, rumination, affective symptoms, and personal impact on the planet) was examined in relation to psychological symptoms. Significant correlations were found between HEAS-13 subscales and the DASS-8 subscales (anxiety, depression, stress), highlighting their predictive power for psychological phenomena. Additionally, HEAS-13 subscales correlated more strongly with the three climate change perception subscales (emotional, appraisal, and cognitive) and the climate value dimension, confirming the scale's validity.

Structural equation model (SEM) results

A structural equation model (SEM) using the Diagonally Weighted Least Squares (DWLS) estimation method was employed to predict the eco-anxiety latent variable (HEAS-13) from psychological symptoms (DASS-8), climate change perception (CCVQ), and climate change value latent variables (CVQ). The results of the goodness-of-fit indices yielded that the SEM model fit the data well ($\chi2 = 3389$; df = 36; $\chi2/df = 94.13$, $p < .001$), SRMR = 0.04, RMSEA = 0.06, 95% CI = [0.07, 0.09], TLI = 0.93, CFI = 96.).

The regression coefficient indicated that the Eco anxiety Rumination dimension could predict negatively psychological symptoms of depression with (Beta [b] = − 0.27; 95% Confidence Interval: [-0.408, -0.135]; $p < .001$) and anxiety with (Beta [b] = − 0.26; 95% Confidence Interval: [-0.385, − 0.131]; $p < .001$) and stress with (Beta [b] = − 0.18; 95% Confidence Interval: [-0.228, − 0.069]; $p < .001$). Anxiety about personal impact dimension could predict negatively psychological symptoms of depression with (Beta [b] = − 0.27; 95% Confidence Interval: [-0.454, − 0.089]; $p < .004$) and

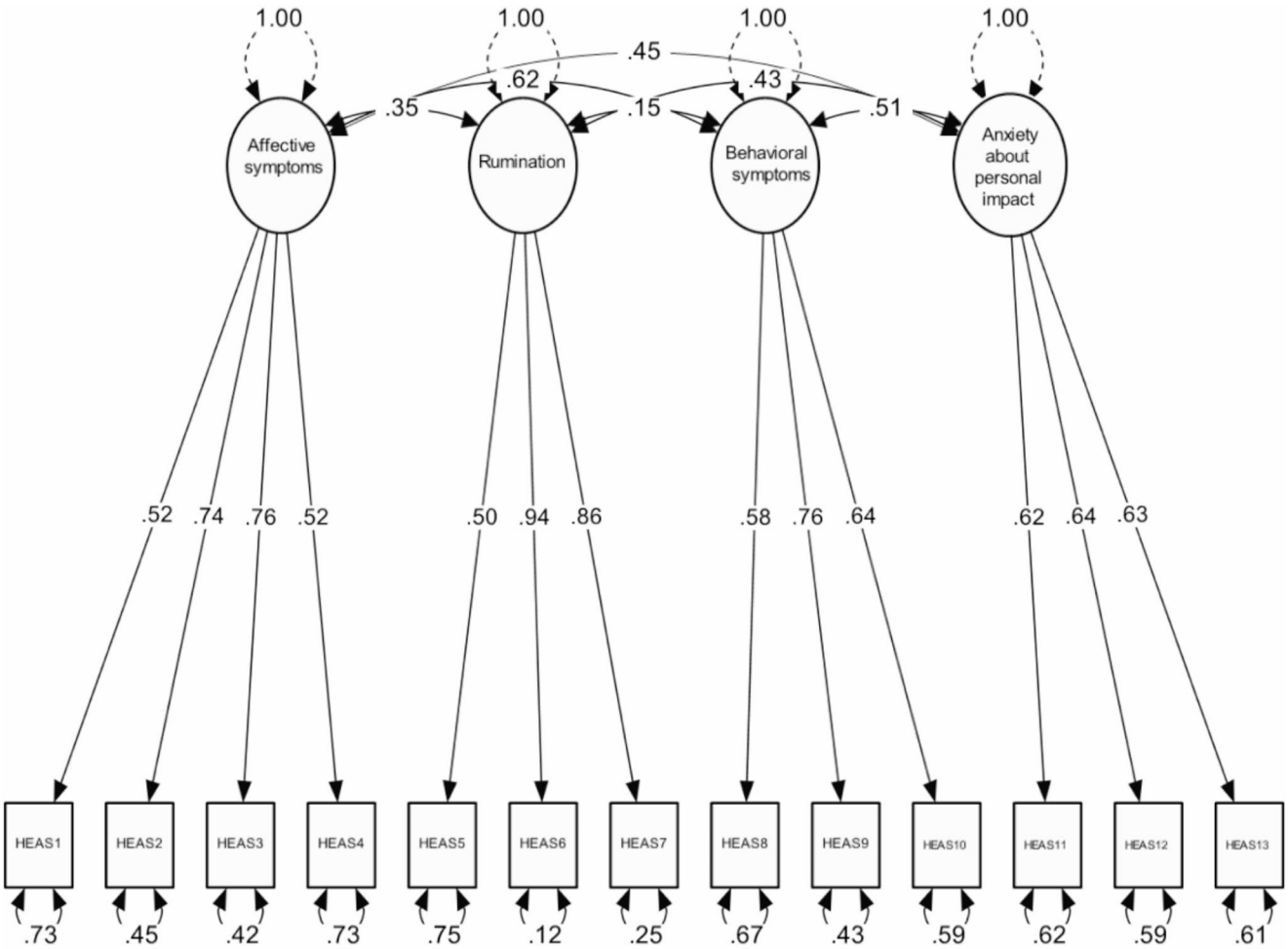

Fig. 1 Shows factor loadings from confirmatory factor Analysis of HEAS-13 scale ($n = 829$, subsample two)

Table 3 Comparison of adjustment indices and reliability coefficients

Measure	Our Study	Sampaio et al.	Hogg et al.	Uzun et al.	Rocchi et al.	Rodríguez et al.	Heinzel et al.
CFI	0.97	0.96	0.96	0.98	0.95	0.97	0.98
TLI	0.99	-	0.95	0.98	-	0.96	0.97
RMSEA	0.04	0.05	0.08	0.05	0.07	0.04	0.05
Cronbach's Alpha (Affective Symptoms)	0.72	0.84	0.92	0.88	0.85	0.78	0.83
Cronbach's Alpha (Rumination)	0.79	0.89	0.90	0.84	0.83	0.81	0.86
Cronbach's Alpha (Behavioral Symptoms)	0.68	0.86	0.86	0.82	0.78	0.71	0.71
Cronbach's Alpha (Worry)	0.65	0.91	0.88	0.88	0.84	0.79	0.83

anxiety with (Beta [b] = − 0.21; 95% Confidence Interval: [-0.383, − 0.045]; $p < .013$) and stress with (Beta [b] = − 0.18; 95% Confidence Interval: [-0.323, -0.039]; $p < .013$). on the other hand, Eco anxiety affective symptoms dimension was not significant with psychological symptoms of depression with (Beta [b] = − 0.15; 95% Confidence Interval: [-0.357, − 0.063]; $p < .269$) and anxiety with (Beta [b] = − 0.037; 95% Confidence Interval: [-0.231, − 0.156]; $p < .705$) and stress with (Beta [b] = − 0.04; 95% Confidence Interval: [-0.206, − 0.117]; $p < .591$). behavioural symptoms dimension personal was also not significant with symptoms of depression with (Beta [b] = − 0.013; 95% Confidence Interval: [-0.147, − 0.121]; $p < .846$) and anxiety with (Beta [b] = − 0.061; 95% Confidence Interval: [-0.186, − 0.064]; $p < .341$), while predicted positively only stress with (Beta [b] = 0.11; 95% Confidence Interval: [-0.006, − 0.222]; $p < .038$).

Moreover, total score of (HEAS-13) could also predict positively climate change perception and statistically significant with (Beta [b] = 0.55; 95% Confidence Interval: [0.429, 0.667]; $p < .001$) and predict the climate change value with (Beta [b] = 0.40; 95% Confidence Interval: [0.517, 0.280]; $p < .001$) (Table 4).

Table 4 Descriptive statistics and correlations

Variable	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16
1. Sex	—																														
2. Age	0.06		—																												
3. Social status	−0.08	*	0.33	***	—																										
4. University degree	−0.09	*	0.44	***	0.19	***	—																								
5. Region	0.05		0.07	*	−0.00		0.02		—																						
6. Affective symptoms	−0.10	**	−0.05		−0.00		0.00		−0.03		—																				
7. Rumination	−0.03		0.00		0.06		0.00		0.00		0.34	***	—																		
8. Behavioural symptoms	−0.06		−0.07	*	−0.09	**	0.03		−0.07	*	0.45	***	0.14	***	—																
9. Anxiety about personal impact	−0.02		−0.08	*	0.00		0.00		−0.01		0.36	***	0.37	***	0.35	***	—														
10. CCP Emotional	−0.14	***	0.05		0.07	*	0.06		0.02		0.29	***	0.34	***	0.14	***	0.30	***	—												
11. CCP Appraisal	−0.04		0.03		0.10	**	0.05		−0.00		0.20	***	0.32	***	0.07	*	0.29	***	0.61	***	—										
12. CCP Cognitive	−0.07		0.04		0.08	*	0.08	*	−0.01		0.15	***	0.22	***	0.01		0.22	***	0.54	***	0.63	***	—								
13. CV Total	−0.07	*	0.08	*	0.08	*	0.07	*	0.00		0.15	***	0.17	***	0.04		0.20	***	0.57	***	0.62	***	0.63	***	—						
14. Depression	−0.09	**	−0.03		−0.05		0.00		0.02		0.38	***	0.17	***	0.35	***	0.27	***	0.23	***	0.14	***	0.14	***	0.13	***	—				
15. Anxiety	−0.16	***	0.00		0.04		0.02		0.00		0.42	***	0.18	***	0.33	***	0.28	***	0.31	***	0.21	***	0.21	***	0.19	***	0.66	***	—		
16. Stress	−0.07	*	−0.08	*	−0.06		−0.03		0.00		0.43	***	0.20	***	0.43	***	0.29	***	0.24	***	0.21	***	0.15	***	0.18	***	0.59	***	0.54	***	—
Mean	1.1		22.2		1.0		19.9		1.3		3.6		2.0		2.8		2.0		34.7		26.8		10.4		37.9		4.2		3.2		3.1
Std. Deviation	0.36		3.8		0.30		3.7		0.78		2.9		2.2		2.4		2.1		8.9		7.0		3.5		8.7		2.5		2.4		1.8
Skewness	1.9		3.2		3.4		0.19		2.3		0.8		1.2		0.71		1.4		−0.58		−0.06		−0.26		−0.60		0.09		0.53		0.07
Kurtosis	1.7		17.6		11.2		−0.38		4.3		−0.12		1.1		−0.40		1.3		−0.19		−0.38		−0.92		−0.13		-1.0		−0.54		1.1

Sex 1 = females 2 = males

* $p < .05$, ** $p < .01$, *** $p < .001$

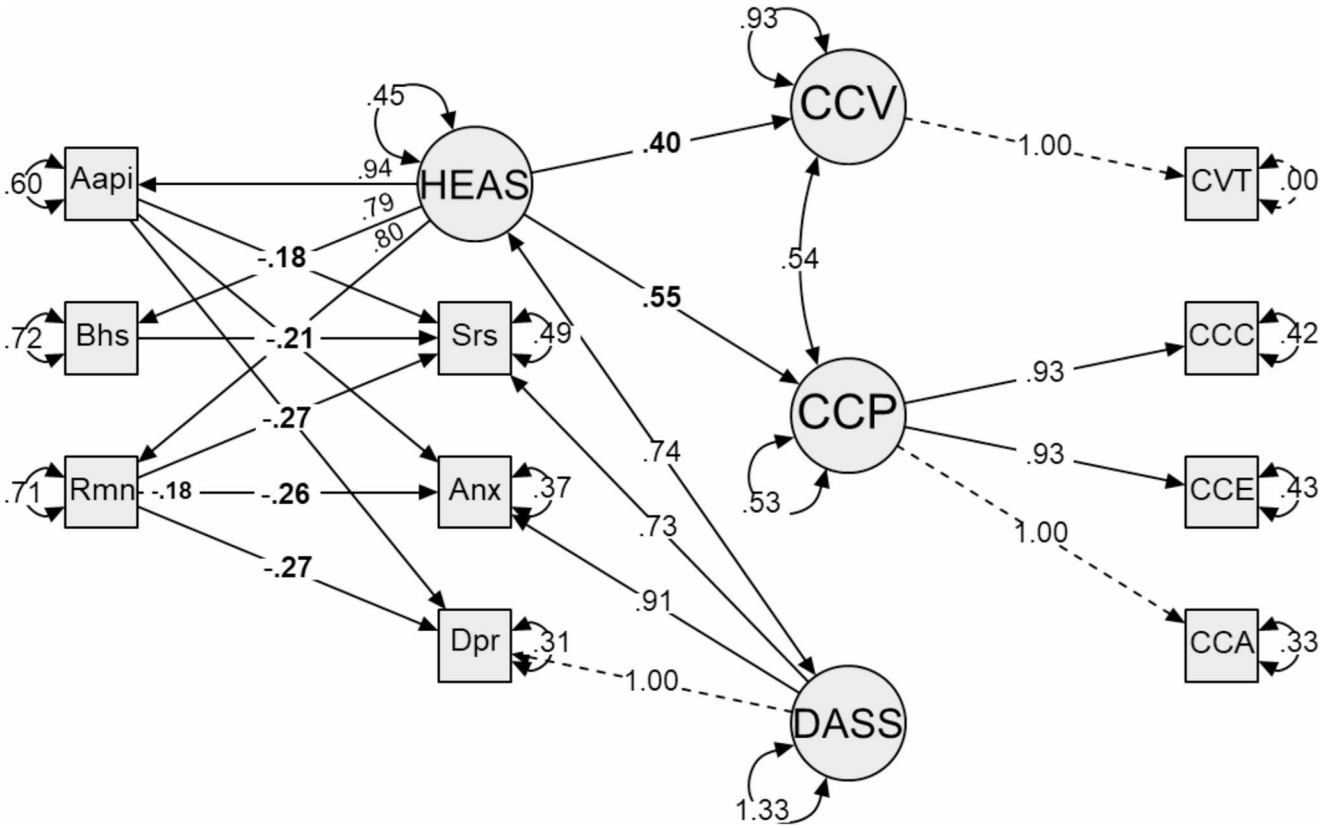

Fig. 2 SEM of Eco anxiety (HEAS-13) dimensions as a predictor of psychological symptoms dimensions (DASS-8), Climate change perception (CCVQ) and climate value (CVQ)

The diagram for the SEM model structure of variables between HEAS-13 dimensions, DASS-8 dimensions, CCVQ and CVQ prediction can be seen in Fig. 2.

Gender differences in psychological responses to climate change

The study revealed notable differences between males and females across various dimensions. Specifically, males and females exhibited variations in affective symptoms within the HEAS-13 scale, emotional perception of climate change, total scores in climate value assessment, and the three dimensions of DASS-8, with females showing notably higher levels of anxiety. See Table 5.

Table 5 Group differences in HEAS-13, CCPQ, CVQ and DASS-8

	Group	N	Mean	SD	*P*
Affective symptoms	1	702	**3.66**	2.85	**0.003**
	2	127	**2.94**	2.78	
Rumination	1	702	2.08	2.21	0.444
	2	127	2.07	2.46	
Behavioural symptoms	1	702	2.94	2.46	0.085
	2	127	2.57	2.40	
Anxiety about personal impact	1	702	2.00	2.09	0.607
	2	127	2.00	2.27	
CCP Emotional	1	702	**35.30**	8.55	**< 0.001**
	2	127	**31.45**	10.04	
CCP Appraisal	1	702	26.88	6.96	0.265
	2	127	25.99	7.27	
CCP Cognitive	1	702	10.44	3.51	0.052
	2	127	9.81	3.38	
CCV total	1	702	**72.63**	16.40	**0.003**
	2	127	**67.25**	18.53	
Depression	1	702	**4.32**	2.54	**0.008**
	2	127	**3.65**	2.61	
Anxiety	1	702	**3.36**	2.38	**< 0.001**
	2	127	**2.35**	2.28	
Stress	1	702	**3.20**	1.82	**0.037**
	2	127	**2.81**	1.73	

1 = females; 2 = males. Significant results were marked in Bold

Discussion

The aim of this study was to test the psychometric properties of the HEAS-13 in Arabic. The exploratory factor analysis (EFA) revealed a satisfactory model with a five-factor structure, where only item 6 loaded on a single factor. The confirmatory factor analysis (CFA) confirmed a stronger model fit with the original four-factor structure consisting of 13 items. This finding supports the four-factor structure of the HEAS-13 as initially reported previous cross-cultural studies (Hogg et al., 2021; Uzun et al., 2022; Sampaio et al., 2023; Rocchi et al., 2022; Rodríguez et al., 2024; Mathé et al.,2023), confirming hypothesis one.

Conforming hypothesis two for HEAS-13 validity, our findings indicate moderately or strongly correlations among eco-anxiety subscales (0.14 to 0.45), also in line with previous research which suggested weak connections between behavioral symptoms and rumination with (0.14) (Hogg, et al., 2021). Therefore, individuals experiencing affective symptoms are also likely to exhibit behavioral symptoms, Individuals who occasionally experience affective symptoms typically do not encounter behavioral impairments.

Moreover, we observed that ruminating on environmental issues may not increase affective and behavioral symptoms. One may experience these symptoms relatively independently on ruminative or personal impact concerns, diverging from previous conclusions (Hogg et al., 2021). The observed patterns of associations may suggest the presence of various profiles of eco-anxiety. These profiles could represent Arab subpopulations characterized by distinct combinations of scores across different dimensions of eco-anxiety, such as low affective/behavioral symptoms or high ruminative/personal impact-focused eco-anxiety.

Confirming hypothesis two for the scale's validity, the observed correlations, affective and behavioral symptoms, rumination, and anxiety about personal impact dimensions demonstrated significant associations with psychological symptoms, including stress, depression, and anxiety. These findings imply that eco-anxiety and psychological symptoms are interconnected and consistently coincide with greater endorsement of the other four eco-anxiety facets and psychological symptoms (Hogg et al., 2021; Hogg et al., 2023; Türkarslan et al., 2023).

Furthermore, our results further indicate that affective symptoms of eco-anxiety is not a unique construct, as they share commonalities with DASS-8 anxiety. Thus, on Contrary to previous research, our study suggests that individuals experiencing other forms of anxiety may still encounter eco-anxiety (Pihkala, 2020). A plausible explanation for this could be found in the experiences of Libyan citizens who faced the devastating impact of Hurricane Daniele in 2023, particularly in the city of Darna, affecting over 5300 people (Dadouch, 2023). Such catastrophic events have been consistently linked to an increase in anxiety symptoms, as reported in various studies (Makawana, 2019; Keya et al., 2023).

Research further underscores that, in the aftermath of natural disasters, anxiety emerges as a prevalent psychological impact, accompanied by heightened emotional distress levels, disrupted sleep patterns, increased instances of depression and sense of helplessness (Makawana, 2019; Berry et al., 2010; Hayes & Poland, 2018; Albrecht et al., 2007; Clayton et al., 2017). Temporary relocation and evacuation stemming from these disasters contribute to elevated psychological distress, specifically anxiety (Keya et al., 2023). The disruption of essential services, peoples' home environments, employment, or educational pursuits due to the aftermath of such disasters has been linked to a surge in mental health challenges, including anxiety (Berry et al., 2010; Hayes & Poland, 2018; Vins et al., 2015; Hayes et al., 2018).

The three dimensions of eco anxiety Affective symptoms, Rumination, and Anxiety about personal impact were positively correlated with the three climate change perception dimensions (emotional, appraisal, and cognitive) and the climate value dimension. These findings align with an expanding body of research that has extensively documented the occurrence of climate change anxiety. This encompasses a range of negative cognitive, emotional, and behavioral responses linked to concerns about climate change (Schwartz et al., 2023; Hogg et al., 2021).

Additionally, this study found that behavioral symptoms exhibited no significant correlation with the CCPQ dimensions 'appraisal and cognitive' and the CVQ dimension. One potential explanation for this lack of significance is that behavioral symptoms appear to be less stable over time when compared to other dimensions of eco-anxiety (Türkarslan et al., 2023). This lower stability of behavioral symptoms may be attributed to their heightened sensitivity to external factors, including exposure to catastrophic climate events, such as those experienced by the city of Darna, and climate-related information (Dadouch, 2023). Intriguingly, since we identified no correlation between HEAS-13 behavioral symptoms and CCPQ dimensions and CVQ dimension among the Arab population, suggesting the existence of one distinct dimension of eco-anxiety within subpopulations.

Finally, employing structural equation modelling, our analysis revealed that Rumination and anxiety about personal impact dimensions emerged as the sole significant predictors of overall anxiety, depression, and stress, as assessed by the DASS-8 subscales, confirming hypothesis three, while behavioural symptoms dimension could predict only stress. Conversely, the dimensions of affective symptoms

and behavioral symptoms showed no discernible relationship with anxiety. It is noteworthy that, as eco-anxiety is not classified as a pathological illness or clinical disorder, reinforcing the distinction between eco-anxiety and general anxiety (Hogg et al., 2022).

Our results showed also that Eco anxiety (HEAS-13) could predict positively climate change perception and climate value, confirming hypothesis three. Furthermore, the mean scores of the HEAS-13 in our second subsample revealed higher positive intercorrelations between emotional, appraisal, and cognitive climate change perception dimensions (0.6) and moderate levels with behavioral symptoms, anxiety, and stress (0.4). A plausible explanation for these findings could be the influence of climate disasters on the city of Darna, suggesting that elevated levels of these factors might result from heightened exposure to catastrophic climate events and climate information before or during data collection.

The findings of this study indicate that females scored higher specifically in affective symptoms according to the HEAS-13 dimensions (Clayton et al., 2014; Burke et al., 2018; Hickman, 2020). Given that the average age of these participants was 0.22, our research also suggests a negative correlation between younger age and heightened behaviour symptoms and anxiety about personal impact dimensions. In other words, younger individuals are more likely to exhibit behavior symptoms and experience anxiety related to personal impact compared to older individuals (Clayton & Karazsia, 2020; Searle & Gow, 2010; Heeren et al., 2022). This could be due to various factors such as increased maturity, greater life experience, improved coping mechanisms, or changes in priorities and perspectives, as individuals age.

Additionally, our results found only one statistical difference in emotional dimension of perception climate change, and in climate change value in favor of female as well (Arnout in 2022). A possible explanation for these Sex disparities could be attributed to the societal dynamics wherein females often experience limitations in social and economic empowerment compared to males (Heeren et al., 2022). This discrepancy translates into fewer economic resources for females, potentially hindering their access to assistance services during disasters like climate change events. Consequently, females might possess heightened awareness of climate change issues and demonstrate greater involvement in mitigation efforts and climate value initiatives.

Conclusion

In conclusion, this research exhibited that the Hogg Eco-Anxiety Scale (HEAS-13) exhibits a unique four-dimensional structure with high reliability and validity. The dimensions of eco-anxiety displayed varying levels of stability and intriguing patterns of associations with mental health measures, climate change perceptions, and climate values. Arab researchers can utilize this scale to assess the overall eco-anxiety dimensions in the Arab community and monitor changes over time.

Limitations and future research

While this study provides important insights, it is not without limitations. The cross-sectional design precludes causal inferences, and the reliance on self-report measures may introduce bias. Future research should employ longitudinal designs and consider additional measures to capture the dynamic nature of eco-anxiety. Moreover, the two subsamples predominantly comprised young females, limiting the generalizability of the findings. Future research should aim for more representative samples, with a focus on assessing Sex and age invariances within the Libyan Arab or other Arab community using HEAS-13. In the aftermath of significant environmental events like the Darna hurricane. It is recommended to investigate the spectrum of human experiences, examining eco-anxiety and its relationship to psychological symptoms, and provide suitable therapeutic support for individuals experiencing severe eco-anxiety. Furthermore, it is recommended to conduct additional research to understand how eco-anxiety interacts with mental health, considering factors such as psychological distress, potential mediation by religion, and cultural context within this population (Skirbekk et al.,2020; Skalski et al., 2023; Hornsey, 2021; Nartova-Bochaver et al., 2022; Clayton & Manning, 2018). Since the impacts of ecological problems vary significantly among countries, exploring these aspects would provide valuable insights.

Implications of findings

The significant correlations between HEAS-13 scores and other psychological symptoms underscore the interconnectedness of eco-anxiety with general mental health. The higher eco-anxiety scores among females and younger individuals highlight demographic differences that should be considered in future research and interventions.

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Data availability The datasets produced and analyzed in the course of the present study can be obtained upon reasonable request from the corresponding author.

Declarations

Conflict of interest The authors affirm that the research was carried out without the presence of any commercial or financial affiliations that could be perceived as a potential conflict of interest.

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