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Research article

Developing a climate change health literacy scale: A methodological study in Turkish adults

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A R T I C L E I N F O

Keywords:
Climate change health impact
Climate change health literacy
Climate change scale, Health literacy assessment

A B S T R A C T

Introduction: This study aimed to develop a valid and reliable measurement tool assessing attitudes and behaviors of individuals aged 18 and above regarding the health impacts of climate change, supporting existing literature, field studies, and climate change mitigation efforts.

Methods: In this methodological study, the "Climate Change Health Literacy Scale (CCHLS)" item pool was created, followed by content validity testing and validity and reliability analyses of the 31-item scale based on expert opinions. The scale was administered to 318 adults, revealing a four-factor structure with 24 items and explaining 67.03 % of the total variance through exploratory and confirmatory factor analyses.

Results: Confirmatory factor analysis indicated acceptable goodness-of-fit values (χ^2/sd = 2.31, RMSEA = 0.06, CFI = 0.94, SRMR = 0.04). The Cronbach's alpha coefficient was 0.94 for the entire scale, and sub-dimensions ranged from 0.75 to 0.93, indicating high reliability. Differentiation assessment between groups with the highest and lowest 27 % scores confirmed the discriminative and valid nature of all scale items, with no observed floor or ceiling effects.

Conclusions: CCHLS, which was developed in Turkish and analyzed in Turkiye to assess adults' attitudes and behaviors towards climate change, is a valid and reliable tool, and its translation into other languages and dissemination will support individuals in society in assessing their knowledge and increasing their awareness about the effects of climate change on health.

1. Introduction

The term climate change refers to alterations in the natural processes of climates, particularly resulting from industrial activities, agriculture, transportation, and even sectors like health, or natural events such as volcanic eruptions and ocean currents. These changes are associated with an increase in greenhouse gases, such as carbon dioxide (CO2), methane (CH4), and nitrogen oxides (NOx), emitted into the atmosphere [1].

There is a robust scientific consensus that the rise in greenhouse gases leads to variations in natural climate processes. The outcomes include phenomena like heatwaves, rising sea levels, severe weather events, and alterations in habitats. These changes can contribute to various health issues, ranging from the spread of infectious diseases to reduced food sources and an increase in certain non-communicable diseases [2].

The Intergovernmental Panel on Climate Change (IPCC) has emphasized that increasing climate literacy, including health dimensions, is crucial to promote effective adaptation and mitigation strategies, especially as health impacts such as heat-related diseases, infectious disease spread and food insecurity become more widespread [3]. However, when we conducted a review of the literature on climate change and health, we found no scales assessing climate change-related health literacy. We found there are many different scales such as the "climate change perceptions scale" developed in Sweden to assess people's perceptions of climate change; the "global awareness and concern scale" developed by Yale University to investigate the relative impact of sociodemographic characteristics, geography, perceived well-being and beliefs on public climate change awareness and risk perceptions at national scales, and the "climate change awareness" scale developed for high school students [4–6]. The need for a climate change health literacy scale stems from critical gaps in public understanding of the link between climate change and the health of people and communities.

It is sometimes difficult for society to make a link between climate change and health. Existing scales, such as the Climate Change Perceptions Scale or the Global Awareness and Concern Scale, focus on perceptions, awareness or attitudes about climate change, but do not adequately address how these factors influence health-related behaviors and resilience.

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The relationship between climate change and health is more complex, and the ultimate requirement from societies is not only that awareness is increased but also that behavioral changes based on acquired knowledge are fostered.

The literature has demonstrated a correlation between higher levels of health literacy and the adoption of healthier lifestyles [7]. For instance, a study conducted by Sorensen et al. emphasized that health literacy enhances individuals' ability to access, comprehend, and apply health information, leading to more effective risk management behaviors [8]. Similarly, the hypothesis of this study posits that individuals who understand the health impacts of climate change will be more likely to engage in preventive measures and adaptation strategies. Therefore, this study, planned for individuals aged 18 and above in Türkiye, aims to address a critical gap in the literature by developing a standardized scale to assess the relationship between climate change and health at the individual level. This scale will provide an evidence-based and traceable methodology for future research, facilitating further studies in this field.

2. Methods

This study is methodological research aimed at developing the "Climate Change Health Literacy Scale" (CCHLS). Ethical approval for the study was received from the Gazi University Faculty of Medicine Ethics Committee on May 23, 2023 with the research code 2023–721. Informed consent was obtained from all participants and the study was conducted in accordance with the principles of the Declaration of Helsinki.

A group of 14 experts, including 7 medical doctors, 3 public health experts, 2 scale development experts and 2 environmental engineers, were asked to develop a scale to investigate the level of health literacy on the effects of climate change on health and to write the questions they thought should be included in this scale.

Expert opinions were collected online via the expert opinion form. The modified Lawshe Method was used to evaluate the expert opinions. Content Validity Ratio (CVR) and Content Validity Index (CVI) were calculated. No item had a negative CVR value. Four items with a CVR of 0 were removed from the scale. Items with CVR values greater than 0 were considered statistically significant with a value of 0.571 reported for 14 expert opinions. As a result, 18 items below this threshold were also removed from the scale [9,10].

After receiving expert opinions and conducting content validity analyses, the remaining 31-item "pilot scale" had CVR values ranging from 0.572 to 0.857. After 22 items were removed from the initial pool of 53 items, psychometric analyses were conducted on the draft scale.

The pilot scale consisting of 31 items was applied face to face as a pre-test to 82 adults consisting of randomly selected Gazi university students and non-academic staff in order to determine the comprehensibility of the items. As a result of this pilot application evaluation, the comprehensibility and clarity of the items were confirmed.

In psychometric analysis studies, it is recommended to reach a sample size ranging from 5 to 10 times the number of items in the scale and not to fall below this number [11,12]. In order to reach people from different segments of society and professions, university students in Kırşehir, Ankara and Aydın provinces were trained on the survey. 25 university students who volunteered to work as surveyors and 430 literate people over the age of 18 were reached on the busiest streets of the city. The survey was applied face to face, and 318 adults with informed consent forms and complete survey responses were included in the study.

2.1. Statistical analysis

Exploratory and confirmatory factor analyses were conducted to assess the structural validity of the scale.

The suitability for factor analysis was assessed through the Keiser-Meyer-Olkin test [KMO coefficient], and the adequacy of the sample size was examined using the Bartlett Sphericity Test. Exploratory Factor Analysis was conducted to test the normal distribution of data, determine the structural validity of the scale, and identify factors. The Principal Component Factor Analysis method was employed, and factor loadings were calculated. The Varimax rotation method was used for analysis. The CCHLS revealed a 4-dimensional structure consisting of 24 items. The items contained in the obtained sub-dimensions from the exploratory factor analysis were examined, and naming was performed. The sub-dimensions were named as follows: Health Impact Dimension, Monitoring Dimension, Behavioral Dimension, and Prevention-Support Dimension.

The 24-item, 4-dimensional CCHLS was confirmed through confirmatory factor analysis. The Chi-Square Goodness-of-Fit Test, Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Standardized Root Mean Square (SRMR), Goodness of Fit Index (GFI), Incremental Fit Index (IFI), Tucker-Lewis Index (TLI), Akaike Information Criterion (AIC), Consistent Akaike Information Criterion (CAIC), and Expected Cross-Validation Index (ECVI) were utilized to reveal the model fit in the context of confirmatory factor analysis [13].

Due to the multifactorial structure of the developed scale, analyses of convergent and discriminant validity were conducted to assess the independent and distinct structures of these factors. The analyses included calculating the Average Variance Extracted (AVE), Composite Reliability (CR), Maximum Shared Variance (MSV), Average Shared Square Variance (ASV), and inter-factor correlation coefficients.

Convergent validity was assessed based on the AVE, CR, MSV, and ASV values. The square of the highest correlation coefficient between factors was calculated to obtain the MSV value, while the ASV value was determined by taking the arithmetic mean of the squares of the correlation coefficients between factors. Discriminant validity was evaluated by considering that the AVE value of each factor should be greater than the square of the correlation coefficient between these factors. Additionally, MSV was expected to be smaller than the AVE value, and ASV greater than the MSV value [14].

Reliability Analyses in a measurement tool refers to the sensitivity, consistency, and stability of measurement results concerning the intended property. In this study, measuring reliability was assessed using Cronbach's alpha coefficient, the split-half method, item-total correlations, item analysis based on the difference between the lower 27 % and upper 27 % group means, and examining the floor and ceiling effects of the scale. An independent samples *t*-test was conducted between the upper 27 % group, which received the highest scores, and the lower 27 % group, which received the lowest scores. Reliability assessment was conducted using the Spearman-Brown and Guttman reliability coefficients calculated through the split-half method in the SPSS program.

To test the reliability of test items, item analysis procedures were performed using the Pearson Product-Moment Correlation Technique. The relationship between each item and the total test score was examined, and the correlation between the item total and the value obtained by subtracting each item's value from the total was analyzed.

When examining the floor and ceiling effects of the scale, it was determined that the percentages of participants obtaining the lowest (floor) score of 24 and the highest (ceiling) score of 120 within the entire group should be <20 %, according to the recommendation [15]. Confirmatory factor analysis was performed using the AMOS program (Version 24.0), while other analyses were conducted using SPSS (Version 22.0).

3. Results

The Content Validity Index (CVI) of the 31-item "pilot" form of the developed scale, as determined by expert opinions, has been calculated as 0.737. Since the obtained CVI value is greater than the Content Validity Ratio (CVR) (CVI > CVR), it indicates that the remaining items in the scale have statistically significant content validity. Therefore, the remaining items in the scale are considered to have content validity, and validity and reliability analyses were conducted based on the 31-item "draft form" [9,16].

In the construct validity analysis of the scale, both exploratory and confirmatory factor analyses were conducted. The data's suitability for factor analysis was evaluated using the Kaiser-Meyer-Olkin (KMO) coefficient, which was found to be 0.94, exceeding the threshold of 0.90, indicating its appropriateness for factor analysis. Furthermore, Bartlett's Test of Sphericity yielded a chi-square value of 5079.32 with a p-value < 0.001, confirming the sample size's adequacy for factor analysis.

To demonstrate the construct validity of the scale and determine the factors, the Principal Component Analysis (PCA) and Direct Oblimin rotation technique, which is the most commonly used method, were employed. The factor loading threshold for items was set at 0.30. The "Communalities" table, which represents the sum of the squared factor loadings for each variable, indicates the variance shared by the item with the factor structure. It is known that this value should be greater than 0.50. Considering that items with communalities below 0.50 are generally recommended to be excluded from the analysis, and the factor analysis should be repeated [17], items 2, 3, 4, 15, 28, and 29, with extraction values of 0.454, 0.452, 0.483, 0.491, 0.439, and 0.481, respectively, were removed from the scale. Subsequently, the factor analysis was repeated with the remaining 25 items.

The analysis identified collinearity in items by examining their factor loadings. Item 24 exhibited a high loading value above the accepted threshold of 0.30 in multiple factors. With a difference in loading values <0.10 between factors, it was concluded that the item was collinear. Consequently, Item 24 was removed, and factor analysis was re-conducted. Factors with eigenvalues exceeding 1 indicated a significant four-factor structure, explaining 67.03 % of the total variance. Examination of eigenvalues revealed a slowing decline after the fourth factor, supporting the scale's four-factor structure.

Table 1 presents the demographic characteristics of the study group and Table 2 presents the final version of the CCHLS after item extraction from the draft scale, including factor loadings and explained variances. The total explained variance of the scale is 67.03 %. The first factor accounts for 43.52 % of the variance, the second factor for 12.41 %, the third factor for 6.62 %, and the fourth factor for 4.48 %.

The first factor, denoted as the "Health Impact Dimension," comprises items 1, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14 (11 items), depicting situations related to the health effects of climate change. The second factor, termed the "Tracking Dimension," is shaped by items 16, 17, 18, 19, 22, and 23 (6 items), representing the monitoring of health effects of climate change. The third factor incorporates items 30 and 31 (2 items), portraying behaviors linked to the health effects of climate change, and is labeled the "Behavioral Dimension." The fourth factor, identified as the "Protection-Support Dimension," includes items 20, 21, 25, 26, and 27 (5 items), encompassing expressions related to protection and support concerning the health effects of climate change.

The four-factor structure of the developed scale was examined through confirmatory factor analysis, and the obtained model fit indices are presented in Table 3. When the first-level confirmatory factor analysis of the scale was conducted, it was observed that model fit values such as X2/sd, SRMR, TLI, etc., were at an acceptable level. New covariances were created for residuals with high covariance among them. The confirmatory factor analysis model and the path diagram are presented in Fig. 1. According to the created covariances, the chi-square fit test value was 2.31, RMSEA value was 0.06, CFI value was 0.94, SRMR value was 0.04, IFI value was 0.94, and TLI was 0.93. While the GFI value was slightly below the acceptable fit value ($\geq$0.90) at 0.87, all other indices met the accepted values, confirming the four-factor structure of the CCHLS (Table 3).

The AVE, CR, MSV, ASV values calculated for the convergent/divergent and discriminant/construct validity analyses of the scale are presented in Table 4. The AVE value is above the acceptable threshold of 0.50 for all factors. All CR values are above the acceptable threshold of 0.70. Additionally, it is observed that CR values are greater than AVE values, as preferred. Therefore, in terms of convergent/divergent validity, the scale is considered appropriate. Regarding discriminant/construct validity, it is observed that the AVE value for each of the compared two factors is greater than the square of the correlation coefficient (r2) between the two compared factors. The calculated MSV value (0.43) is smaller than the AVE values, and the condition ASV < MSV ($0.26 < 0.43$) is met. Therefore, it is accepted that the factors of the scale are independent of each other, and the scale has discriminant/construct validity, indicating that it can measure different structures.

Examining scale score differences based on research group characteristics for scale discriminant validity revealed variations related to age, gender, occupation, and education. Notably, individuals aged 30 and above, females, and those in health professions exhibited significantly higher scale scores ($p = 0.002$, $p = 0.002$, and $p = 0.022$, respectively). Conversely, individuals with a bachelor's degree had lower scores compared to others ($p = 0.002$). Table 1 presents the distributions of scale score means, inter-group mean differences, and effect sizes based on sociodemographic characteristics.

Reliability analyses, as presented in Table 5, included calculated Cronbach Alpha values for the scale. The Cronbach alpha coefficient was 0.94 for the entire scale and ranged from 0.75 to 0.93 for subdimensions, indicating high reliability. Item removal did not increase Cronbach alpha values, confirming the scale's high reliability with 24 items. All item-total correlations were consistently above 0.30, ranging between 0.43 and 0.71. The Hotelling T2 test indicated significant differences in scale item mean scores, confirming that items measured different tendencies, attitudes, and behaviors related to distinct subdimensions, supporting the scale's four-subdimension structure (Hotelling T2 = 485.30; $F = 19.64$; $p < 0.001$).

Reliability analysis using the split-half method yielded a reliability coefficient of 0.96 according to the Spearman-Brown formula. Calculated Lambda values for the Guttman Test ranged between 0.77 and 0.96. Both the Spearman-Brown and Guttman Tests confirmed high internal reliability. Among groups representing the highest and lowest 27 % of scale scores, differences in each scale item's averages were observed, confirming that all items in the scale were distinctive and valid in measuring the intended characteristic (Table 5).

One individual, comprising 0.4 % of the group, scored the minimum possible 24 points on the scale, while 15 individuals, accounting for 4.7 % of the group, scored the maximum 120 points. The distribution of individuals scoring at the floor and ceiling did not exceed 20 % of the group. Consequently, it was determined that the scale does not exhibit floor and ceiling effects.

As a result of statistical evaluations, a scale comprising 24 validated questions was developed to assess individuals' knowledge, attitudes, and behaviors regarding the health effects of climate change using a 5-point Likert scale. The scale has a minimum score of 24 and a maximum score of 120, with higher scores indicating greater knowledge, more positive attitudes, and improved behaviors concerning the health impacts of climate change.

4. Discussion

Limaye, in his study adapting the US government's climate literacy guidelines, identified a definition and corresponding set of elements for a concept called climate and health literacy, and emphasized the need for educational models that prepare students and future leaders to recognize the complex health consequences of a changing climate [18].

Health literate individuals are more likely to engage in health-promoting behaviors and social actions for public health. For example, poor health literacy has been associated with inappropriate or inadequate medication use and associated costs, and is associated with lower understanding of preventive care and access to preventive services [19]. Similarly, awareness of the health impacts of climate change will enable individuals to act more cautiously.

Table 1
Demographic characteristics of the research group.

Characteristics	n	%	Scale Score (Mean±SD)	P	Effect Size
Age (years)					
< 30	167	52.5	97.1 ± 14.2		
30 ≤	151	47.5	102.6 ± 16.6	0.002	*Chen's d* = 0.36
Gender					
Male	152	47.8	96.9 ± 18.0		
Female	166	52.2	102.4 ± 12.6	0.002	*Chen's d* = 0.41
Profession					
Health professional	117	33.6	102.5 ± 16.0		
Other	39	66.4	98.3 ± 15.3	0.022	*Chen's d* = 0.27
Education					
High School	18	5.7	102.2 ± 10.4		
Bachelor's degree	211	66.4	97.6 ± 16.2		
Master's degree	89	28.0	104.3 ± 14.1	0.002	$\eta 2$=0,19
Total	318	100.0			

Table 2
Factor loadings and variances explained by the items of the CCHLS.

Item Number	Statements	Factors*			
		F1	F2	F3	F4
10	Unexpected premature deaths may increase as a result of climate change.	0.830			
6	Climate change may lead to the emergence of new, previously unknown diseases.	0.810			
9	Climate change may lead to an increase in allergic diseases.	0.786			
13	Climate change may lead to an increase in lung diseases such as asthma, chronic obstructive pulmonary disease (COPD) and respiratory infections.	0.763			
5	Climate change may increase infectious diseases such as malaria, Zika virus and dengue fever.	0.761			
8	Climate change may lead to an increase in non-communicable diseases (heart disease, some types of cancer, etc.).	0.757			
12	Climate change may lead to an increase in health problems such as diarrheal diseases, malnutrition, food poisoning, etc. due to deterioration in the quality of water and food resources.	0.735			
14	Climate change can weaken/affect the economy at different scales: international, national, regional and local.	0.731			
11	Climate change may lead to an increase in mental health problems such as irritability, depression and post-traumatic stress disorder.	0.730			
7	Climate change may cause vectors such as mosquitoes and ticks that carry infectious diseases to humans to spread to larger areas or other regions.	0.703			
1	Climate change has multiple impacts on human health.	0.671			
17	I know how to access resources on the health impacts of climate change.		0.928		
19	I follow the work of responsible organizations to reduce the health impacts of climate change.		0.776		
16	I follow expert opinions on the effects of climate change on health; printed, visual and audio resources.		0.762		
18	I can decide whether the sources on the health impacts of climate change are reliable or not.		0.726		
22	I read sources on the effects of natural events (heat waves, strong winds, extreme precipitation, etc.) on health due to climate change.		0.629		
23	I have attended/participate in scientific studies such as seminars, panels, conferences on the effects of climate change on health.		0.562		
30	I consume more water/liquid in very hot weather.			0.793	
31	I pay more attention to the storage conditions of my food in hot weather.			0.772	
27	I take precautions to prevent climate change from affecting my health.				0.852
25	I do what is necessary to protect my health when natural events related to Climate Change (heat waves, strong winds, excessive rainfall, increased UV radiation, etc.) occur.				0.851
26	I warn others about the effects of climate change on human health.				0.724
21	I share what I have learned about the health impacts of climate change with other people.				0.666
20	I support public institutions, associations, etc. working to reduce the health impacts of climate change.				0.475
Percentage of variance explained by the factor		43.52	12.42	6.62	4.48
Cumulative Variance Percentage		43.52	55.9	62.6	67.03
Total variance explained		**67.03**			
Keiser-Meyer-Olkin (KMO)		**0.94**			
Bartlett's Test Chi-square		**5079.32**			
Degrees of freedom		**276**			
p-value		**<0.001**			

* F1: Health impact dimension, F2: Follow-up dimension, F3: Behavioral dimension, F4: Protection-Support dimension.

Although there is no scale-based study measuring the effects of climate change on health in society, surveys assessing healthcare professionals' knowledge, attitudes, and behaviors exist. Albrecht et al. measured healthcare workers' knowledge of the health effects of climate change, finding that only 12 % of participants reported a very good understanding of the general consequences of climate change. This highlights the need for education on the issue, even among professionals [20].

To address this gap in the literature, a scale was developed in the initial stages of this study, consisting of 51 items in the item pool. The results from the KMO test, where a value below 0.50 is considered unacceptable, and a value above 0.90 is considered excellent [11], indicated that the scale was suitable for factor analysis with a KMO value exceeding 0.90.

Table 3
Confirmatory factor analysis model fit indices of CCHLS.

Fit Indices	Acceptable Fit Values	Analysis Value
X^2 /sd	≤5	2.31
RMSEA	≤0.08	0.06
CFI	≥0.90	0.94
SRMR	≤0.08	0.04
GFI	≥0.90	0.87
IFI	≥0.90	0.94
TLI	>0.80	0.93
AIC	The model with the smallest value is the closest to reality	675.15
CAIC		946.58
ECVI		2.13

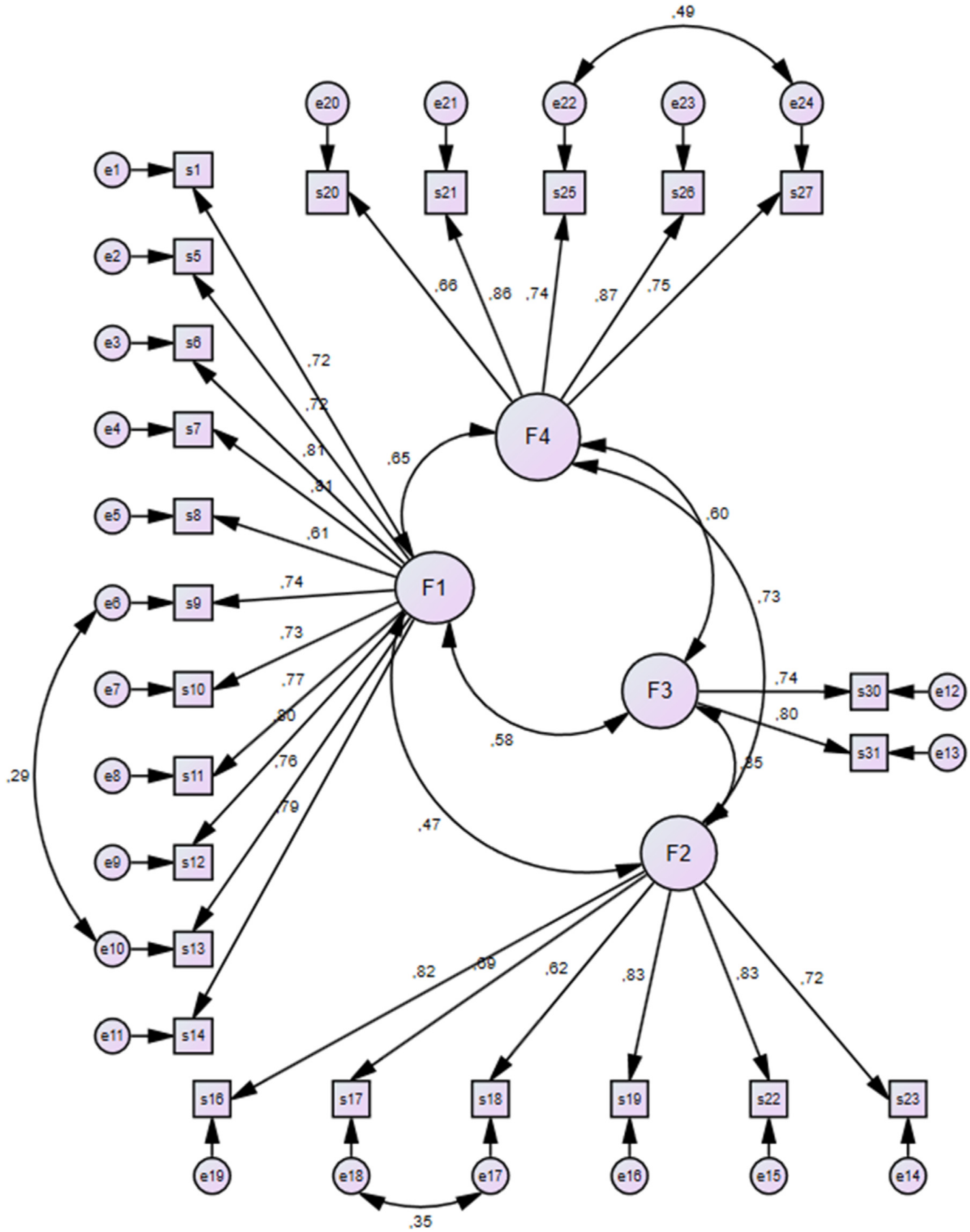

Fig. 1. Confirmatory factor analysis and linkage diagram of the CCHLS (Standard Coefficients).

For construct validity, confirmatory factor analysis was performed using multiple fit indices, including the chi-square goodness-of-fit index, RMSEA, and SRMR. The CCHLS met acceptable thresholds (X^2/df = 2.31, RMSEA = 0.06, SRMR = 0.04), supporting its four-factor structure.

The total variance explained by the scale's four-factor structure was 67.03 %, which meets the recommended threshold of at least 52 % for multifactorial scales [21].

For reliability assessment, item-total correlation analysis was conducted. Correlations of over 0.20 are recommended; otherwise, items should be deleted. For this study, correlations ranged from 0.43 to 0.73, and deletion of items did not improve reliability coefficients, confirming the reliability of the scale as a 24-item measure.

To find out whether items can distinguish between the groups with the desired traits, a comparison between the lower and upper 27 % groups was conducted. All items were statistically significantly different between the two groups, supporting their discriminative validity.

Floor and ceiling effects were also tested since they indicate how much the people are likely to give the same response to each question. Minimum and maximum scores distribution remained below the 20 %

Table 4
Combined reliability (CR), Average Variance Extracted (AVE) and Discriminant validity values of the CCHLS.

Values	Factors			
	F1	F2	F3	F4
CR	0,94	0,89	0,75	0,88
AVE	0,57	0,57	0,59	0,60
Cronbach α	0,93	0,89	0,75	0,89
r*				
F1	1	0,44	0,46	0,57
F2		1	0,29	0,66
F3			1	0,47
F4				1
r^2				
F1	1	0,19	0,21	0,33
F2		1	0,08	0,44
F3			1	0,22
F4				1
MSV**	0,43			
ASV***	0,26			

* r: Pearson correlation coefficient.
** MSV: Maximum Shared Variance, (square of the highest correlation coefficient among factors).

Table 5
Reliability of the climate change health literacy scale.

Items	Item-total correlations	Reliability coefficient when item is deleted	Comparison of item averages of the lower-upper 27 % group	
			t- value	p
Factor 1				
S1	0.60	0.94	5.6	<0.001
S5	0.60	0.94	10.5	<0.001
S6	0.67	0.94	9.8	<0.001
S7	0.71	0.94	9.4	<0.001
S8	0.52	0.94	11.2	<0.001
S9	0.62	0.94	9.6	<0.001
S10	0.61	0.94	11.4	<0.001
S11	0.66	0.94	10.8	<0.001
S12	0.69	0.94	10.2	<0.001
S13	0.66	0.94	11.8	<0.001
S14	0.71	0.94	11.8	<0.001
Factor 2				
S16	0.61	0.94	16.1	<0.001
S17	0.55	0.94	12.2	<0.001
S18	0.55	0.94	10.9	<0.001
S19	0.60	0.94	15.6	<0.001
S22	0.65	0.94	14.0	<0.001
S23	0.53	0.94	14.8	<0.001
Factor 3				
S30	0.43	0.94	5.4	<0.001
S31	0.49	0.94	7.4	<0.001
Factor 4				
S20	0.62	0.94	12.0	<0.001
S21	0.73	0.94	12.9	<0.001
S25	0.62	0.94	12.4	<0.001
S26	0.72	0.94	14.5	<0.001
S27	0.62	0.94	11.2	<0.001
Hotelling T^2 = 485,30; F = 19,64; $p < 0.001$				
Cronbach's Alpha Coefficient of all items = 0.94				
Cronbach's Alpha Coefficients of sub-dimensions (F1) = 0,93 - (F2) = 0,89 - (F3) = 0,75 - (F4) = 0,89				

threshold (0.4 %–4.7 %), further guaranteeing the sensitivity and validity of the scale.

One of the limitations of this study was that the scale, once developed, had been tested only in the Turkish language within the Türkiye environment. In the future to allow international use, research would target translation and culture adaptation and further tests of validity and reliability.

5. Conclusions

The efforts to mitigate the health impacts of climate change and enhance adaptation are not solely the responsibility of local governments and authorities but also involve the active participation of individuals in the community. More active participation of citizens can even shape public policies and increase social resilience in the fight against climate change. Assessing and comparing individuals' knowledge, attitudes, and behaviors are crucial aspects for designing effective services and plans in this context.

Until this study, there was no scale measuring health literacy regarding the health effects of climate change in Türkiye, and no similar scale was found in the literature. In the conducted study, the CCHLS demonstrated strong content validity, indicating that efforts to reduce the health impacts of climate change and enhance adaptation are pertinent. The four-factor structure of the scale explained 67.03 % of the total variance.

The criterion validity is positively significant, confirming the relevance of the scale. The final version of the 24-item scale exhibits high reliability, and the discriminatory power of the items is sufficient. Importantly, there is no floor or ceiling effect observed in the scale. Thus, the developed CCHLS can be effectively and reliably utilized to determine individuals' health literacy levels regarding the impacts of climate change on health. The CCHLS can also make a methodological contribution to climate and health literacy research by offering a validated and standardized measurement tool. Designed to assess knowledge, attitudes, and behaviors specifically related to the health impacts of climate change, this scale can be utilized to evaluate the effectiveness of educational interventions and generate evidence-based, quantifiable data to inform policy recommendations.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Tufan Nayir: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Ersin Uskun:** Writing – review & editing, Validation, Supervision, Formal analysis, Conceptualization. **Huseyin Ilter:** Writing – review & editing, Supervision, Methodology, Investigation, Conceptualization. **Secil Ozkan:** Writing – review & editing, Investigation, Data curation, Conceptualization. **Emine Didem Evci Kiraz:** Writing – original draft, Resources, Investigation, Conceptualization.

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Supplementary materials

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