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Adaptation of Extended eHealth Literacy Scale (eHEALS-E) in Turkish: validity and reliability analysis

Ugurcan Sayili [a], Ayse Sultan Kaya [a], and Sumeyye Nur Aydin [b]

[a]Department of Public Health, Cerrahpaşa Faculty of Medicine, Istanbul University-Cerrahpaşa, Istanbul, Türkiye; [b]Directorate of Public Health, Istanbul Provincial Health Directorate, Ministry of Health, Republic of Türkiye, İstanbul, Türkiye

ABSTRACT

The aim of the study is to adapt the "Extended eHealth Literacy Scale" (eHEALS-E) into Turkish, a critical component of health promotion activities, and to evaluate the scale's validity and reliability. This methodological study was conducted as an online survey between December 2–9, 2024, with 395 participants. The study included three main components: demographic information, the eHEALS-E, and the European Health Literacy Survey Questionnaire (HLS-EU-Q47). Psychometric properties were assessed through exploratory factor analysis (EFA) for construct validity, correlation analysis with HLS-EU-Q47 for convergent validity and known-groups comparisons. Reliability was evaluated using Cronbach's alpha for internal consistency, and test-retest reliability was assessed with a subset of participants after seven weeks. After removing problematic items, the Turkish version of eHEALS-E demonstrated strong psychometric properties. The final 20-item scale exhibited high internal consistency (Cronbach's alpha = 0.896 and McDonald's $\omega = 0.900$) and strong test-retest reliability ($r = 0.794$, $p < .001$). EFA revealed a four-factor structure explaining 58.9% of the total variance. The scale showed good convergent validity, with a significant correlation with HLS-EU-Q47 ($r = 0.514$, $p < .001$). This tool can serve as a valuable resource for healthcare professionals and researchers in assessing eHealth literacy levels and designing targeted interventions for Turkish-speaking populations.

KEYWORDS

E-health literacy; health literacy; survey; validity; reliability; Turkish

Background

Health literacy, recognized as one of the key components of health promotion and improvement, is defined as the cognitive and social skills required for individuals to access, understand, interpret, and utilize health-related information in their decision-making processes.[1,2] Definitions of health literacy emphasize the ability to access, comprehend, interpret, and evaluate information to enhance both individual and societal quality of life, as well as to promote and improve health outcomes.[3] As a multifaceted concept, health literacy has, since its introduction, played a pivotal role in encouraging individuals and communities to engage with healthcare services and in strengthening resilience within health systems. This concept holds significant potential to improve health outcomes at both individual and societal levels. Conversely, low health literacy is often associated with poor health status, increased utilization of healthcare services, higher mortality rates, and negative health behaviors, such as smoking and insufficient physical activity.[4–7]

The widespread use of the internet as a source of health information has transformed the traditional concept of health literacy, giving rise to the concept of eHealth literacy.[8] First conceptualized in 2006,

CONTACT Ugurcan Sayili ugurcan.sayili@iuc.edu.tr; drugurcansayili@gmail.com Department of Public Health, Cerrahpasa Faculty of Medicine, Istanbul University-Cerrahpaşa, Istanbul, 34098, Türkiye

eHealth literacy refers to the ability to access, understand, evaluate, and utilize health information through electronic resources to address health-related issues. It represents a critical skill set that influences the process of acquiring health information. Additionally, social and cultural contexts are believed to play a significant role in shaping eHealth literacy.[9] eHealth literacy is a broad term that encompasses internet-based health information and communication technologies. It includes a variety of electronic and mobile applications that provide health and medical information without the limitations of time or place. According to the World Health Organization (WHO) Regional Office for Europe, 91% of participants from forty member states, including Türkiye, reported using social media to seek information about health issues.[10] Similarly, 2024 data from the Turkish Statistical Institute (TURKSTAT) indicate that 64.5% of internet users in Türkiye access the internet to search for health-related information, such as topics on injuries, diseases, nutrition, and health improvement.[11]

Information and communication technologies play a crucial role in promoting health literacy by providing quick and convenient access to health information.[12] However, the quality and reliability of health information obtained from the internet can vary significantly. Insufficient health literacy may lead to the misuse of such information, potentially resulting in negative health outcomes. In this context, the concept of eHealth literacy underscores the importance of the ability to search for, understand, and critically evaluate online health information.[13] Accessing health information from the internet can be highly beneficial for individuals who are able to distinguish between reliable and unreliable sources. Nevertheless, a study conducted in Türkiye revealed that approximately 70% of the population has inadequate or limited health literacy.[14] Similarly, a large-scale study conducted in the United States in the same year found that approximately 40% of adults have inadequate health literacy.[15] Individuals with adequate health literacy are more likely to make informed health-related decisions, such as adhering to medical treatments, adopting healthy behaviors to prevent diseases, and seeking medical assistance when necessary.[16] Therefore, it is essential to approach health literacy research systematically and employ advanced measurement tools. Selecting measurement tools that align with societal and individual health needs can significantly contribute to improving health literacy.[4]

The existing scales used to assess eHealth literacy in Türkiye are insufficient in addressing the rapid advancements in digital health technologies and the evolving needs of users. Furthermore, there is currently no Turkish adaptation of the eHEALS-E, a modern and comprehensive tool for assessing eHealth literacy. Current assessment tools lack the comprehensiveness needed to evaluate the multi-faceted nature of eHealth literacy in today's digital health landscape. Given that 64.5% of Turkish internet users seek health information online, having a validated, culturally appropriate instrument is essential for healthcare professionals and researchers to accurately assess eHealth literacy levels and design targeted interventions. This study fills this critical gap by providing the first validated Turkish version of the eHEALS-E, enabling accurate assessment of eHealth literacy levels and supporting the development of targeted interventions for Turkish-speaking populations. In this context, the aim of this study is to adapt the "Extended eHealth Literacy Scale" into Turkish, a critical component of health promotion efforts, and to evaluate the validity and reliability of the scale.

Materials and methods

Study design

The study was conducted as an online survey using the LimeSurvey platform between December 2–9, 2024, with a total of 395 participants. A retest phase followed on January 20–27, 2025, with 38 participants. Ethical approval for the study was obtained from the Clinical Research Ethics Committee of Istanbul University-Cerrahpaşa (December 2, 2024–1159006). Upon clicking the survey link, participants were directed to a page introducing the study and presenting the informed consent

form. Only those who clicked the "I agree to participate in the study" button were granted access to the questionnaire and scale.

The inclusion criteria for the study were being over 18 years of age, having the ability to understand and communicate in Turkish, and agreeing to participate in the study. The exclusion criterion was being a medical doctor or medical student.

Data collection procedures

The questionnaire consisted of three sections: (1) 13 questions addressing demographic, socioeconomic, and lifestyle characteristics; (2) the 26-item eHEALS-E scale; and (3) the 47-item European Health Literacy Survey Questionnaire (HLS-EU-Q47). To ensure participant attention and response reliability, two control questions were included in the second section and three in the third section (e.g., "This question is a control question. Please choose "Disagree (2)").

Prior to implementation, the electronic questionnaire underwent comprehensive pilot testing with 30 individuals from the researchers' immediate network, representing diverse socioeconomic backgrounds. These participants were briefed about the study and explicitly instructed to abstain from participating in the main survey if they encountered it later. However, no formal mechanism was in place to enforce this restriction. The pilot testing aimed to evaluate the instrument's clarity, comprehensibility, and technical functionality. Based on pilot feedback, several refinements were made to the final instrument: (1) minor wording adjustments were made to improve clarity of three questions, (2) the survey interface was optimized to ensure consistent display across different devices. This preliminary phase was conducted independently of the main data collection and was excluded from the final analysis.

The data collection process was carried out by sharing the survey link on various social media platforms, including WhatsApp and Instagram, and participants completed the questionnaire online. The survey platform was configured to prevent duplicate responses using cookie tracking, and participants were explicitly instructed to complete the survey only once. Before accessing the questionnaire, participants were presented with a detailed information form outlining the study's objectives, data confidentiality measures, estimated completion time, and the voluntary nature of participation. The survey interface ensured that all questions were displayed in a consistent order, with mandatory response requirements and a back-button feature allowing participants to review and modify their answers. The collected data were downloaded and stored in a password-protected file, and the survey links were subsequently deactivated.

Of the 1,577 individuals who clicked on the survey link, 555 completed the survey in full, resulting in a response rate of 35.2%. Participants who failed to respond appropriately to the control questions ($n = 17$) and those who were medical doctors or medical students ($n = 143$) were excluded from the study. After applying these exclusion criteria, the final analysis was conducted on data from 395 participants. The survey questions (demographic characteristics, health-related variables, and self-perception) and the eHEALS-E scale items were designed as mandatory questions. As a result, there were no missing data for these items. Similarly, the eHEALS retest also consisted of mandatory questions, ensuring no missing data.

For the test-retest reliability assessment, participants were invited to complete a follow-up survey at the end of the initial questionnaire. They were informed that the eHEALS-E scale would be readministered after eight weeks to evaluate the reliability of the Turkish adaptation, with participation being entirely voluntary. Participants willing to take part in the retest phase were asked to provide a valid e-mail address. Of the initial 395 participants, 159 provided their e-mail addresses for the retest. Seven weeks after their initial response, these participants were sent the retest survey link via e-mail, followed by two reminder e-mails-one after three days and another after five days. The retest phase, conducted over a one-week period, consisted solely of the 26-item eHEALS-E scale and resulted in 38 completed responses (response rate: 23%). The research flow diagram is presented in Figure 1.

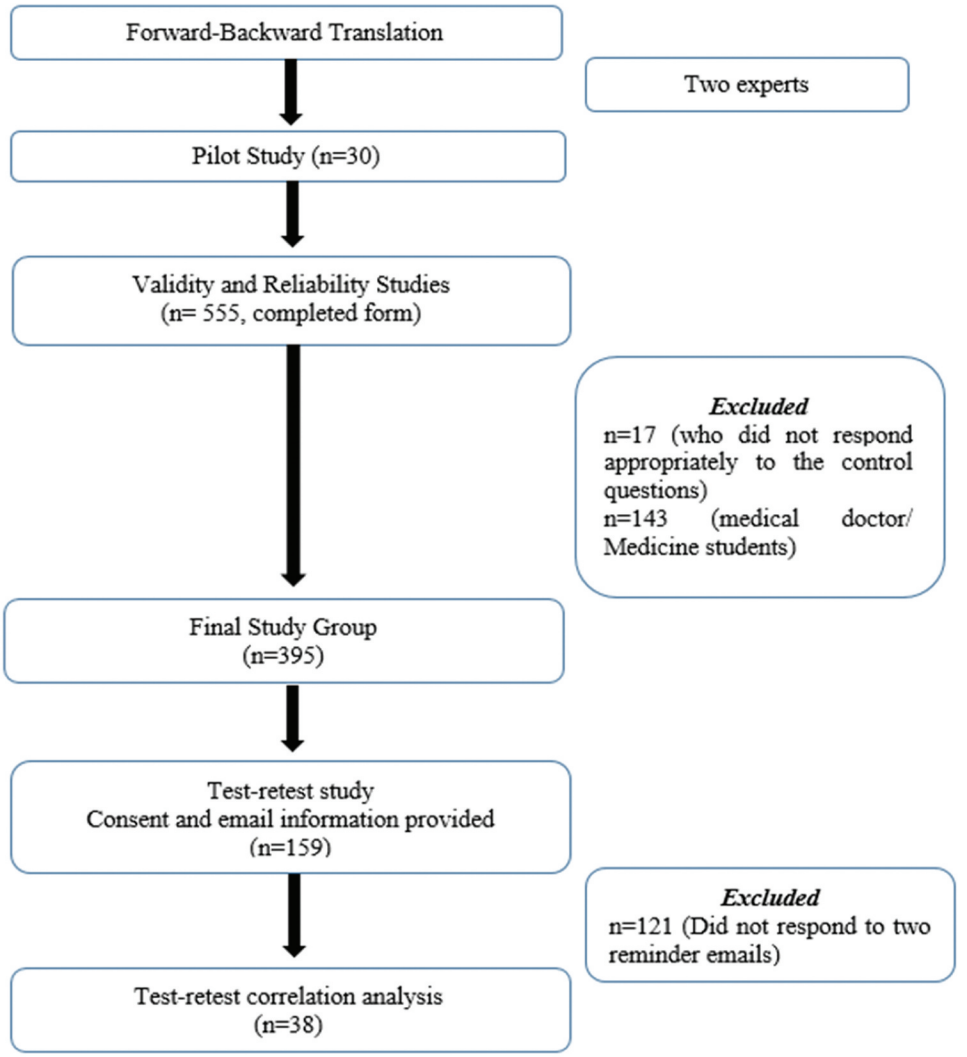

Figure 1. Flow-diagram of the study.

To acknowledge participants' contributions and enhance response rates, a charitable donation incentive was incorporated into the study design. Upon completing the survey, participants were given the opportunity to select a preferred charitable organization from a provided list of three options. This approach was chosen to express gratitude for participation while maintaining ethical research practices and promoting social responsibility. Donation preferences were collected at the end of the survey, and the research team fulfilled these charitable commitments following the data collection phase.

Sample size and sampling

Following DeVellis's (2016) guidelines, which recommend "a ratio of 5 to 10 participants per item, up to 300 participants" to ensure validity and reliability in factor analytic studies, we aimed to recruit at least 300 participants within a two-week timeframe. Recruitment was concluded after one week, as sufficient numbers were reached, with no new responses recorded on the final day.[17] Participants were recruited using a convenience sampling method by sharing online survey links on social media

platforms, including WhatsApp and Instagram. This method was selected for its ease of access and time efficiency.

Measures

Extended eHealth Literacy Scale (eHEALS-E)

The Extended eHealth Literacy Scale (eHEALS-E) was developed by Petrič et al. in 2024 to address the limitations of the original eHEALS scale. The scale comprises six dimensions and 26 items: Awareness of Online Sources, Validating Online Information, Recognizing Quality and Meaning of Online Information, Perceived Efficiency, Being Smart on the Net, and Understanding Online Information. It employs a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). The scale demonstrated good structural validity, with factor loadings greater than 0.5, Root Mean Square Error of Approximation (RMSEA) = 0.064, Standardized Root Mean Square Residual (SRMR) = 0.070, and Comparative Fit Index (CFI) = 0.90. Internal consistency reliability for the overall scale was high, with Cronbach's alpha = 0.89.

For convergent validity, significant correlations were observed with Health Literacy ($r = 0.418$, $p < .001$) and Navigational Health Literacy ($r = 0.349$, $p < .001$). The dimensions also exhibited good internal consistency, with Cronbach's alpha values ranging from 0.69 to 0.85 and composite reliability (omega) values ranging from 0.70 to 0.82 for the subscales.[18]

eHEALS-E translation process

The adaptation of the Extended eHealth Literacy Scale (eHEALS-E) into Turkish was carried out with the explicit permission of its original developer, Gregor Petrič. To ensure semantic equivalence and linguistic accuracy, the forward-backward translation method was employed. An independent bilingual translator first performed a forward translation from English to Turkish, followed by a back translation from Turkish to English by another translator. The translations were then carefully reviewed, and any discrepancies were systematically addressed during a reconciliation meeting involving both translators. During this meeting, the translators discussed and resolved differences in language and meaning to ensure that the Turkish version accurately preserved the core concepts and intent of the original scale.

Other measures and variables

European health literacy survey questionnaire. The European Health Literacy Survey Questionnaire (HLS-EU-Q47) was developed by the European Health Literacy Survey (HLS-EU) Consortium as part of the European Health Literacy Project (2009–2012). The scale consists of 47 items designed to measure health literacy across three domains – healthcare, disease prevention, and health promotion – and four information-processing competencies: accessing, understanding, appraising, and applying health-related information. These competencies are based on the underlying theoretical framework of health-relevant decision-making and tasks. The scale uses a 4-point Likert-type response format, ranging from "very difficult (1)" to "very easy (4)," with total scores ranging from 47 to 188.[19]

The Turkish validation study of the HLS-EU-Q47 was conducted by Abacigil et al. in 2014 in Aydın, Türkiye. The study demonstrated that the HLS-EU-TR is a valid and reliable tool for measuring health literacy. Internal consistency, assessed using Cronbach's alpha, showed very high reliability ($\alpha = 0.95$). The subdimensions also exhibited strong reliability, with Cronbach's alpha values ranging from 0.86 to 0.91, and item-total correlations ranging from 0.360 to 0.683. Additionally, significant positive correlations between the HLS-EU-TR and the Health Awareness Scale (HAS) provided evidence for its convergent validity.[20]

The HLS-EU-Q47 scores were standardized to a unified metric ranging from 0 to 50. This was achieved by calculating the mean of all item responses provided by each participant and applying the following formula:

$$Index = (Mean - 1)x\frac{50}{3}$$

In this formula, "Mean" represents the average score of all validly answered items, "1" is the minimum possible value of the mean, "3" is the range of the mean, and "50" is the maximum value of the standardized metric. This standardization ensured that the resulting index values ranged from 0, indicating the lowest health literacy, to 50, indicating the highest health literacy. Index scores were calculated only for respondents who provided valid responses to at least 80% of the items.[20]

Other variables. The questionnaire included measures of demographic characteristics, health-related variables, and self-perception. Demographic variables encompassed gender, age, marital status (single/married/other), educational status (primary school/secondary school/high school/university and above), occupation (open-ended), and perceived income level (very low/low/middle/high/very high).

Health-related variables included height and weight, which were used to calculate Body Mass Index (BMI), the presence of chronic diseases requiring medication (yes/no), and physical activity level, measured by the number of days (0–7) in the past week with at least 60 minutes of physical activity.

Several self-perception measures were also assessed. Self-reported health status was evaluated on a four-point scale (excellent/good/moderate/poor). Body image perception was measured using a five-point scale (very overweight/slightly overweight/about the right size/slightly underweight/very underweight). Quality of life was assessed using a numerical rating scale ranging from 0 to 100, with higher scores indicating better quality of life.

Life satisfaction was measured using the Cantril ladder method, which presents a pictorial ladder with 11 steps ranging from 0 ("worst possible life") to 10 ("best possible life"). Participants were asked to indicate their current position on the ladder, reflecting their overall life satisfaction.

Statistical analyses

The Statistical Package for the Social Sciences (SPSS) version 25.0 for Windows (IBM Corp., Armonk, NY, USA) was used for data analysis, and confirmatory factor analysis (CFA) was subsequently performed using Jamovi version 2.4.11. Categorical variables were presented as frequencies (n) and percentages (%), while numerical variables were reported as the mean ± standard deviation (SD) and median (interquartile range [IQR]). The Kolmogorov–Smirnov test was applied to assess the normality of continuous variable distributions.

The psychometric properties of the Turkish version of eHEALS-E were evaluated through various validity and reliability analyses.[21,22] For construct validity, exploratory factor analysis (EFA) and confirmatory factor analyses (CFA) were conducted. The CFA model fit was evaluated using several fit indices, including the root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), comparative fit index (CFI), and Tucker-Lewis index (TLI). Acceptable thresholds for model fit were considered as RMSEA < 0.08, SRMR < 0.08, and CFI/TLI > 0.90. In EFA, factors were identified based on eigenvalues greater than 1. Direct oblimin rotation, an oblique rotation method, was applied to allow for potential correlations between factors and to improve the interpretability of the factor structure.[21,22] Items with factor loadings below 0.3 or with cross-loading differences of less than 0.1 were excluded. Convergent validity was assessed using Spearman's correlation analysis between eHEALS-E and the HLS-EU scores. Known-groups validity was evaluated by comparing scale scores across different demographic and socioeconomic groups. Binary comparisons were conducted using the independent samples t-test or Mann-Whitney U test, while multiple group comparisons were performed using one-way ANOVA or Kruskal-Wallis tests, depending on the normality of the data distribution.

Reliability analyses included internal consistency assessment using Cronbach's alpha and McDonald's ω coefficients for both the overall scale and its subscales. Test-retest reliability was evaluated using Spearman's correlation coefficient and the intraclass correlation coefficient (ICC)

with 95% confidence intervals between the initial test and retest scores, which were collected from a subset of participants after a four-week interval. A p-value < .05 was considered statistically significant.

Results

A total of 395 participants were included in the study. The majority of participants were female (347, 87.8%), and the mean age was 36 ± 9.9 years (median: 35 years; IQR: 28–42) (Table 1).

In the confirmatory factor analysis (CFA), the standardized factor loadings were found to be statistically significant ($p < .001$) and mostly above 0.50. When examining the factor covariances, significant and strong relationships ($r > 0.60$) were generally observed between the factors. However, the relationships of Factor 5 with other factors were found to be weak or negative. The overall model fit was evaluated using various fit indices. The RMSEA value was 0.0654 (90% CI: 0.0598–0.0710), and the SRMR value was 0.0810. The CFI and TLI values were 0.870 and 0.851, respectively. While these values are slightly below the ideal thresholds, they are still considered acceptable.

Table 1. Sample characteristics ($N = 395$).

Variable	*n* (%)
Sex	
Male	48 (12.2%)
Female	347 (87.8%)
Age mean ± SD (Median, $25^{th} - 75^{th}$ percentile)	36 ± 9.9 (35, 28–42)
BMI	
<25	208 (52.7%)
≥25	187 (47.3%)
Education	
Secondary school or less	49 (12.4%)
Higher education	346 (87.6%)
Family Status	
Single	177 (44.8%)
Married	200 (50.6%)
Other	18 (4.6%)
Income Level	
Low	81 (20.5%)
Medium	274 (69.4%)
High	40 (10.1%)
Health Issue/Chronic disease	
Yes	145 (36.7%)
No	250 (63.3%)
Physical Activity	
<2	215 (54.4%)
≥2	180 (45.6%)
Health Status	
Poor-moderate	185 (46.8%)
Good-excellent	210 (53.2%)
Body perception	
Very underweight	31 (7.8%)
Slightly underweight	186 (47.1%)
Perceived as normal weight	178 (45.1%)
Quality of life	
<70	245 (62.0%)
≥70	150 (38.0%)
Life satisfaction	
<7	230 (58.2%)
≥7	165 (41.8%)
European Health Literacy Scale – HLS-EU	
Inadequate Health Literacy	63 (15.9%)
Problematic-Limited Health Literacy	190 (48.1%)
Sufficient Health Literacy	100 (25.3%)
Excellent Health Literacy	42 (10.6%)

The 26-item initial eHEALS-E scale had a Cronbach's alpha value of 0.872, indicating a high level of internal consistency. Corrected Item-total correlations ranged from −0.002 to 0.681. The Corrected Item-Total Correlation values of items 18, 19 and 21 were low. These items demonstrated low correlations with the other items, and Cronbach's alpha values increased when they were removed from the scale. It was deemed appropriate to remove these 3 items because they negatively affected the reliability of the scale. After removing these items, an exploratory factor analysis (EFA) was conducted to evaluate the changes in the factor structure of the scale. In the EFA, the five-factor structure explained 58.8% of the total variance (Factor 1: 32.0%, Factor 2: 8.8%, Factor 3: 7.3%, Factor 4: 5.7%, Factor 5: 5.0%). The Kaiser-Meyer-Olkin (KMO) value was 0.906, and Bartlett's test of sphericity was significant (p <.001). EFA revealed that item 2 loaded onto two different factors, with a factor loading difference of less than 0.10. Due to its cross-loading on both factors, the item was removed from the scale. In addition, the removal of item 2 increased the explained variance to 60.2% (Factor 1: 32.6%, Factor 2: 9.1%, Factor 3: 7.7%, Factor 4: 5.8%, Factor 5: 5.0%). Subsequently, the factor structure formed by items 20 and 22 was removed entirely due to Cronbach's alpha value of 0.40 and McDonald's ω value of 0.425 (Table 2).

The final version of the scale has 20 items and Cronbach's alpha value was found to be 0.896, while McDonald's ω coefficient was calculated as 0.900, indicating a high level of internal consistency. Corrected Item-total correlations ranged from 0.238 to 0.694. The removal of any item did not lead to a significant increase in Cronbach's alpha and McDonald's ω. Cronbach's alpha values of the four factors ranged between 0.708–0.829; while McDonald's ω coefficients ranged between 0.722–0.834. In the EFA, the four-factor structure explained 58.9% of the total variance (Factor 1: 35.2%, Factor 2: 9.5%, Factor 3: 7.9%, Factor 4: 6.3%). The Kaiser-Meyer-Olkin (KMO) value was 0.908, and Bartlett's test of sphericity was significant (p <.001). All items had factor loadings > 0.30 and did not load on two factors with a difference of <0.10 (Table 3).

In the confirmatory factor analysis (CFA) of four-factor structure, the standardized factor loadings were found to be statistically significant (p <.001) and above 0.50. When examining the factor covariances, significant and moderate-strong relationships (r > 0.50) were observed between the factors. The RMSEA value was 0.0728 (90% CI: 0.0652–0.0805), and the SRMR value was 0.0619. The CFI and TLI values were 0.893 and 0.874, respectively. While these values are slightly below the ideal thresholds, they are still considered acceptable.

A significant positive correlation was found between eHEALS-E and HLS-EU (r = 0.514; p <.001), significant correlations were observed between sub-factors of eHEALS-E and the HLS-EU, with correlation coefficients ranging from 0.315 to 0.458. A total of 38 participants completed the retest procedure. The eHEALS-E scale demonstrated a strong and significant test-retest correlation (r = 0.794; p <.001). Test-retest correlations for all sub-factors were moderate to strong and statistically significant, with coefficients ranging from 0.466 to 0.764 (p <.001) (Table 4, Figure 2). The eHEALS-E scale demonstrated strong test-retest reliability with an ICC of 0.883 (95% CI: 0.774–0.939). In addition, the Bland-Altman plot shows that only one observation is outside the ± 1.96 limits (Figure 3).

In terms of the relationship between eHEALS-E and its factors, eHEALS-E demonstrated strong and significant correlations with all factors (p <.001). The highest correlation was observed with F2 (r = 0.821), followed by F1 (r = 0.781) and F4 (r = 0.771), while the lowest correlation was with F3 (r = 0.607). The table presents the correlations between the eHEALS-E scale and its factors (F1, F2, F3, F4). Significant positive correlations were observed among all sub-factors (p <.001). The strongest correlation was found between F1 and F4 (r = 0.556; p <.001), the weakest correlation was between F3 and F4 (r = 0.352; p <.001) (Table 5).

There are no significant differences in eHEALS-E scores were observed based on sex (p = .248), BMI (p = .272), family status (p = .369), having chronic disease (p = .905), health status (p = .512), or body perception (p = .424) (Table 6).

Participants with university and higher education had significantly higher eHEALS-E scores [73; 66–79] compared to those with secondary school education or less [68; 57–75] (p <.001). Income level was also significantly associated with eHEALS-E scores (p = .002), with participants in the high-

Table 2. Cronbach's alpha reliability coefficients and exploratory factor analysis (EFA) for the EHEALS-E scale.

	All items				Items 18, 19, 21 removed					Items 2, 18, 19, 21 removed			
Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha	McDonald's ω	F1	F2	F3	F4	F5	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha	McDonald's ω
1	0.478	0.866	0.753	0.773				0.573		0.485	0.887	0.780	0.787
2	0.423	0.868						**0.374**	**0.439**				
3	0.398	0.869						0.851		0.420	0.889		
4	0.514	0.865						0.789		0.540	0.885		
5	0.647	0.861						0.685		0.671	0.881		
6	0.537	0.865	0.720	0.722			0.515			0.527	0.885	0.720	0.722
7	0.349	0.870					0.800			0.351	0.890		
8	0.260	0.872					0.791			0.243	0.892		
9	0.534	0.865					0.533			0.562	0.885		
10	0.681	0.861	0.763	0.780		0.453				0.691	0.881	0.708	0.726
11	0.383	0.869				0.609				0.413	0.889		
12	0.645	0.861				0.600				0.672	0.881		
13	0.638	0.863			0.365					0.664	0.883	0.829	0.831
14	0.559	0.864	0.816	0.817	0.729					0.597	0.884		
15	0.376	0.869			0.911					0.422	0.888		
16	0.431	0.868			0.831					0.476	0.887		
17	0.609	0.863			0.517					0.652	0.882		
18	**−0.004**	0.879	0.686	0.709								**0.404**	**0.425**
19	**−0.002**	0.879											
20	0.366	0.870							0.609	0.310	0.893		
21	**0.105**	0.876											
22	0.291	0.871							0.763	0.199	0.893		
23	0.495	0.866	0.781	0.787		0.600				0.472	0.887	0.781	0.787
24	0.467	0.867				0.739				0.472	0.887		
25	0.462	0.867				0.570				0.473	0.887		
26	0.532	0.865				0.807				0.572	0.884		
Total			0.872	0.882								0.891	0.896

Table 3. Cronbach's alpha reliability coefficients and exploratory factor analysis (EFA) for the final version of the EHEALS-E scale.

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha	McDonald's ω	F1	F2	F3	F4
1	0.496	0.892	0.780	0.787				0.545
3	0.439	0.894						0.907
4	0.557	0.890						0.820
5	0.684	0.886						0.682
6	0.520	0.891	0.720	0.722			0.550	
7	0.348	0.895					0.826	
8	0.238	0.898					0.818	
9	0.543	0.891					0.545	
10	0.694	0.886	0.829[a]	0.834[a]		0.441		
11	0.417	0.894				0.458		
12	0.678	0.886				0.544		
13	0.671	0.888	0.829	0.831	0.349			
14	0.614	0.888			0.727			
15	0.437	0.893			0.910			
16	0.497	0.892			0.829			
17	0.668	0.887			0.510			
23	0.437	0.894	0.829[a]	0.834[a]		0.767		
24	0.452	0.893				0.850		
25	0.459	0.893				0.650		
26	0.572	0.890				0.791		
Total			0.896	0.900				

[a]In the final model, items 10, 11, 12, 23, 24, 25, 26 were evaluated under a single factor.

Table 4. Correlations between eHEALS-E dimensions and European health literacy scale – HLS-EU and retest.

	HLS-EU ($N = 395$)	Retest ($N = 38$)
F1	0.381**	0.720**
F2	0.458**	0.764**
F3	0.315**	0.466**
F4	0.377**	0.547**
eHEALS-E	0.514**	0.794**

Note: **$p < .01$.

income group scoring the highest [77; 72–82] compared to the medium [72; 65–77] and low-income groups [71; 63–77] (Table 6).

Physical activity levels showed a significant association with eHEALS-E scores ($p = .002$). Participants engaging in ≥2 hours of physical activity per week had higher scores [74; 68.5–80] compared to those with <2 hours activity [72; 63–77]. Quality of life (QoL) was another significant factor ($p < .001$), participants reporting QoL scores ≥ 70 having higher eHEALS-E scores [75; 68–81] compared to those with QoL <70 [72 64–77]. Life satisfaction was also significantly associated with eHEALS-E scores ($p = .002$), with participants reporting life satisfaction scores ≥ 7 scoring higher [74; 67–82] than those with scores <7 [72;65–77] (Table 6).

Discussion

This study aimed to adapt the "eHealth Literacy Scale (eHEALS-E)" into Turkish to assess eHealth literacy, an important component of health promotion activities, and to evaluate the validity and reliability of the adapted scale. The Cronbach's alpha value for the overall scale was 0.896, with sub-dimension values exceeding 0.70 (between 0.720–0.829). Similarly, McDonald's ω values for the overall scale was 0.900 and sub-dimensions were exceeding 0.70 (between 0.722–0.834) indicating high reliability. Cronbach's alpha and McDonald's ω values between 0.70 and 0.90 are generally considered "satisfactory to good" for internal consistency reliability, and the results of this study

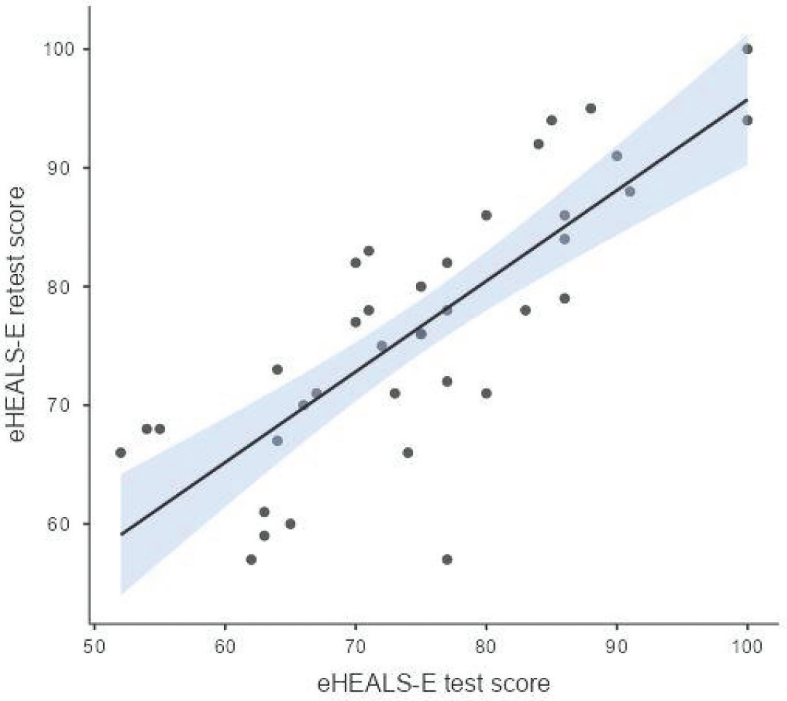

Figure 2. eHEALS-E test-retest score correlation graph.

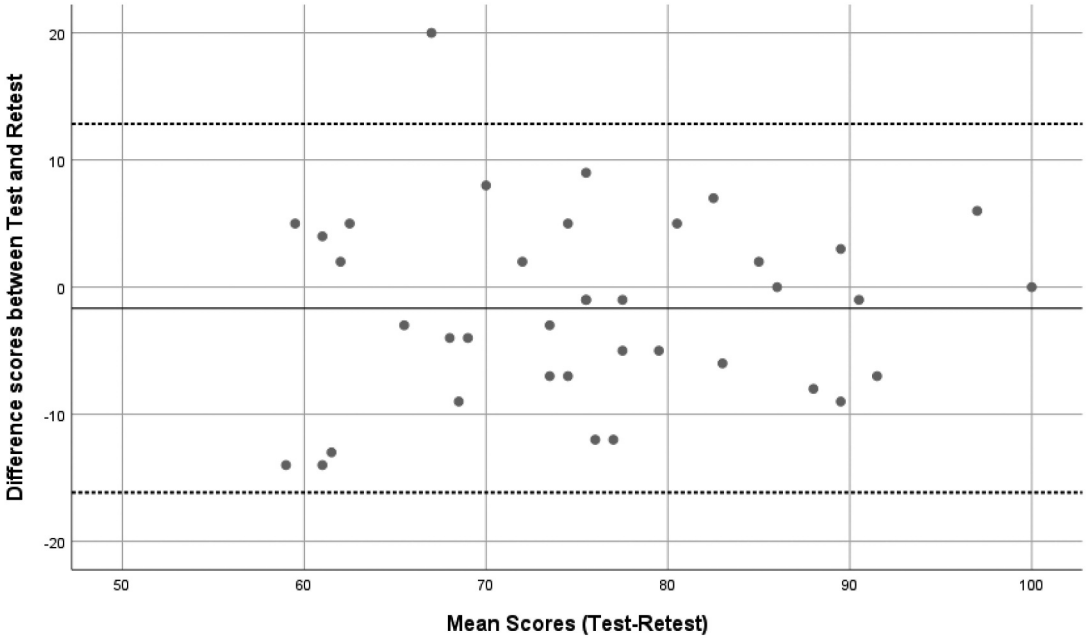

Figure 3. The Bland-Altman plot for eHEALS-E test-retest scores.

Table 5. Correlations between eHEALS-E dimensions and eHEALS-E.

	F1	F2	F3	F4
F1	1.000			
F2	0.482**	1.000		
F3	0.420**	0.355**	1.000	
F4	0.556**	0.494**	0.352**	1.000
eHEALS-E	0.781**	0.821**	0.607**	0.771**

Note: **p <.01.

Table 6. Comparison of eHEALS-E scores by demographic and health-related Factors

Variable	eHEALS-E score Median (Percentile 25–75)	p value
Sex		
Male	72(64.5–76.5)	0.248[a]
Female	73(65–78)	
Age		
<35	96 (87–103)	**0.023**[a]
≥35	94 (85–101)	
BMI		
<25	73(66–79)	0.272[a]
≥25	72(65–77)	
Education		
Secondary school or less	68(57–75)	**<0.001**[a]
University and upper	73(66–79)	
Family Status		
Single	73(66–80)	0.369[b]
Married	73(65–77)	
Other	70.5(64–80)	
Income Level		
Low	71(63–77)	**0.002**[b]
Medium	72(65–77)	
High	77(72–82)	
Having chronic disease		
Yes	72(65–79)	0.905[a]
No	73(66–77)	
Physical Activity		
<2	72(63–77)	**0.002**[a]
≥2	74(68.5–80)	
Health Status		
Poor-moderate	72(65–78)	0.512[a]
Good-excellent	73(66–78)	
Body perception		
Very underweight	75(63–81)	0.424[b]
Slightly underweight	72(65–78)	
Perceived as normal weight	73(66–77)	
QoL		
<70	72(64–77)	**<0.001**[a]
≥70	75(68–81)	
Life satisfaction		
<7	72(65–77)	**0.002**[a]
≥7	74(67–82)	

[a]Mann-Whitney U test. [b]Kruskal-Wallis test.

confirm that the scale's reliability falls within this range. Notably, the Cronbach's alpha value for the original scale, developed by Gregor Petrič et al., was 0.89, which closely aligns with the findings of this study.[18] Similarly, in the validity and reliability study conducted by Areti et al., the Cronbach's alpha values for the sub-dimensions ranged from 0.62 to 0.89, consistent with the results of this study.[23] Additionally, the KMO value for factor analysis was 0.908, and Bartlett's test of sphericity was significant, indicating that the sample size was adequate and the model fit was acceptable.

The corrected item-total correlation values ranged from −0.002 to 0.681, with most items demonstrating acceptable correlations with the total score. However, items 18 and 19 exhibited negative corrected item-total correlations, while item 21 showed a low corrected item-total correlation, indicating potential issues with these items. Additionally, item 2 loaded onto two separate factors, and its removal increased the explained variance. The factor structure formed by items 20 and 22 demonstrated low internal consistency, which led to their removal. As a result, the final scale consisted of 20 items with a four-factor structure. All items had factor loadings greater than 0.30, and the four-factor structure explained 58.9% of the total variance. In the final analysis, no items had corrected item-total correlations below 0.20, ensuring the reliability and validity of the scale. The removal of items was primarily based on statistical indicators such as low corrected item-total correlations and cross-loadings; however, certain cultural and linguistic factors may also help explain the weak psychometric performance of these items in the Turkish context. For example, items referring to access to medical research may have been perceived as overly technical or foreign, as most people in Türkiye are more accustomed to general health content than academic literature. Similarly, the item suggesting that online systems automatically distinguish between low- and high-quality health information reflects a level of technological awareness or abstract reasoning that may not align with participants' actual digital experiences. In 2024, the percentage of individuals using the internet in Türkiye was 88.8%, while the percentage of individuals who engaged in learning activities online for educational, professional, or personal purposes in the last 3 months was 13.9%.[11] Items implying general trust in online health information or satisfaction with the first source accessed may have triggered socially desirable responses, as participants may have been reluctant to endorse careless or non-critical behaviors. Furthermore, even if the translation was linguistically accurate, subtle changes in meaning may have occurred during item adaptation, altering how participants interpreted the statements. These observations highlight the importance of assessing both statistical validity and conceptual-cultural equivalence when adapting psychometric instruments across different populations.

In the present study, four of the original six dimensions of the scale were found to be valid and reliable when adapted to Turkish. While this may be considered a limitation in terms of the scale's capacity to comprehensively assess individuals' strategic thinking and content quality evaluation skills within digital environments, the retained four sub-dimensions are deemed to capture the essential components of eHealth literacy. Therefore, the adapted version is considered to preserve a theoretically valid and psychometrically sound structure. Sub-dimensions were defined in alignment with the original scale's dimension names: *Perceived Efficiency* (F1), *Understanding Information and Recognizing Quality* (F2), *Information Verification* (F3), and *Awareness of Resources* (F4). In this study, the "Understanding Information and Recognizing Quality" dimension (F2) loaded as a single factor rather than two separate factors, as in the original scale. Additionally, item 13 ("I can find useful tips to address my health issues from the information on the internet") was classified under the *Perceived Efficiency* sub-dimension instead of the *Recognizing Quality* sub-dimension. This reclassification may be attributed to participants interpreting the item as related to the practical use of information, thereby influencing their responses in this direction.

Items evaluating the *Smart on the Net* dimension were removed. These items primarily assessed skills and abilities required to navigate the digital information environment. In the original scale, the *Smart on the Net* dimension demonstrated low correlations with other sub-dimensions and the total scale.[18] While some studies suggest that internet health information usage habits enhance eHealth literacy,[24] it is important to note that eHealth literacy, although closely related to digital literacy, encompasses distinct social and individual components. Therefore, the absence of the *Smart on the Net* dimension in the adapted scale was not considered a limitation.[3] In addition to statistical reasons, the removal of the 'Smart on the Net' dimension also reflects to broader cultural and contextual differences in how e-health literacy is conceptualized in the Turkish context. This dimension aims to measure strategic, social, and individual skills in the online environment, such as navigating between different sources, comparing information, and critically filtering digital content. In Türkiye, digital health is generally used in a more functional, practical, and results-oriented manner (e.g., viewing

health reports and test results, making appointments through online public portals). In this context, skills related to digital strategies may not be actively used by users. This may have contributed to the statistical performance in the measurement of this dimension. Furthermore, it reveals that the concept of e-health literacy is prioritized and structured in different ways depending on the cultural context; therefore, it emphasizes that measurement instruments need to be adapted in a way that is sensitive to such cultural differences.

The Turkish adaptation of the eHEALS-E demonstrated high convergent validity, as evidenced by its significant positive moderate correlation with the HLS-EU ($r = 0.514$; $p < .001$). This correlation suggests that, while both instruments measure related constructs, the eHEALS-E specifically captures unique aspects of electronic health literacy that differ from the general health literacy assessed by the HLS-EU. From a psychometric perspective, this supports the convergent validity of the instrument while also emphasizing its unique contribution to measuring skills that are increasingly critical in the context of digital health. Furthermore, all four factors of the eHEALS-E showed significant correlations with the HLS-EU, with coefficients ranging from 0.315 to 0.458 ($p < .001$). These findings are consistent with previous validation studies of eHealth literacy scales, including the original eHEALS-E study by Petrič et al. (2024), which reported a correlation of $r = 0.418$ with health literacy measures.[18]

Test-retest reliability was assessed with 38 participants over a seven-week interval, yielding a strong correlation coefficient ($r = 0.794$; $p < .001$), indicating excellent temporal stability. The test-retest reliability coefficients for individual factors ranged from moderate to strong ($r = 0.466$ to 0.764; $p < .001$), with Factor 2 demonstrating the highest stability. The high ICC value of 0.883 (95% CI: 0.774–0.939) demonstrates excellent test-retest reliability, with the confidence interval indicating that the true reliability coefficient lies within an acceptable range for clinical and research applications. Additionally, the Bland-Altman plot confirmed good agreement between test and retest measurements, with only one observation falling outside the ± 1.96 standard deviation limits. These findings suggest that the Turkish version of the eHEALS-E provides consistent measurements over time, establishing it as a reliable tool for longitudinal studies and program evaluations in Turkish-speaking populations.

Among the sub-dimensions, "Understanding Information and Recognizing Quality" exhibited the highest correlation with the overall scale. This finding aligns with the general definition of eHealth literacy, which encompasses the ability to use digital technologies, communication tools, or networks to locate, evaluate, use, and create information.[25] Similarly, the operational model of eHealth literacy proposed by Paige et al. highlights competencies such as "successful reading" and "assessment of information reliability" as fundamental components of health literacy.[26] Furthermore, the first eHealth literacy scale, developed by Norman and Skinner, conceptualized eHealth literacy as the ability to search for and critically evaluate online information.[9]

The strong correlation between the "Awareness of Sources" and "Perceived Efficiency" dimensions suggests that awareness of health information sources may be influenced by the perceived benefits derived from them. Recent studies have emphasized that perceived benefit, reliability, the importance attributed to information, and satisfaction with information sources are key factors associated with higher digital health literacy.[27,28] For example, a study by Frings et al. found that higher satisfaction with information sources positively influenced eHealth literacy, with official websites being the most frequently used sources of information among participants.[29] Additionally, research suggests that increasing the frequency of using professional health websites can serve as an effective intervention to enhance digital health literacy.[30]

Studies examining the relationship between information sources and digital health literacy consistently indicate that using official sources is associated with higher levels of digital health literacy.[31,32] Official websites typically provide reliable, professional information, reducing concerns about accuracy and enabling users to apply the information effectively in their lives. These findings suggest that awareness of source selection is shaped by the perceived benefits of the information obtained, and the results of this study align with this observation.

The "Validating Information" sub-dimension demonstrated relatively weaker correlations with the other sub-dimensions and the total scale. This may be attributed to the more subjective nature of the

questions included in this sub-dimension. A systematic review has suggested that the use of social media and similar sources is associated with lower eHealth literacy.[33] The frequent use of social media platforms, often perceived as sources of unverified information and misinformation due to their interactive and less regulated nature, may have influenced responses in this sub-dimension. However, this study did not include specific questions to confirm this hypothesis. These findings underscore the importance of improving health literacy, particularly in the area of information verification. This is especially critical given the rapid and widespread dissemination of health misinformation through social media, which can contribute to the development of incorrect health beliefs and behaviors within society.[34]

Strengths and limitations

This study has several limitations. These include the use of convenience sampling, online data collection methods, and a predominantly female sample. The overrepresentation of females and the recruitment through social media platforms may limit the generalizability of our findings to the broader Turkish population, particularly to male populations and individuals with limited social media access. Additionally, the convenience sampling method may have introduced selection bias, as participants were self-selected and may represent individuals with higher interest in health-related topics or greater comfort with online surveys. However, as this is a scale adaptation study, population representativeness was not a primary concern. Of the 159 participants who agreed to participate in the retest and provided their e-mail addresses, 38 completed the retest; the 23% response rate to the retest in our study can be considered a limitation. The divergence of the Turkish version from the original scale structure necessitates careful consideration when making cross-cultural comparisons. These structural differences may reflect genuine cultural variations in eHealth literacy conceptualization, but researchers should account for these dimensional variations when conducting international studies or applying the scale in different contexts to ensure valid interpretations.

Despite these limitations, the study has notable strengths. These include the implementation of a pilot study, the assessment of test-retest reliability, and the use of a systematic and rigorous methodology. Furthermore, the study conducted comprehensive psychometric analyses, incorporated control questions to assess participant attention and response reliability, and largely preserved the conceptual framework of the original scale. These strengths enhance the credibility and applicability of the Turkish adaptation of the eHEALS-E.

Conclusion

In conclusion, the Turkish eHEALS-E is a valid and reliable instrument for assessing eHealth literacy in the Turkish population. The adaptation of the eHEALS-E into Turkish demonstrated high internal consistency, strong test-retest reliability, high convergent validity with the HLS-EU, and a four-factor structure that explained 58.9% of the total variance in exploratory factor analysis. This scale serves as a valuable tool for healthcare professionals and researchers to assess eHealth literacy levels and design targeted interventions for Turkish-speaking populations. Future research should explore the validity of the scale across different age groups and socioeconomic levels, as well as investigate the impact of eHealth literacy on health outcomes. The Turkish version of eHEALS-E can provide practical benefits in both clinical and public health applications. In clinical practice, the scale can be used as a screening tool to identify patients who have difficulty accessing, understanding, or applying health information provided through digital platforms. This can help healthcare professionals adapt their communication strategies and provide additional support to patients with lower digital health literacy. From a public health perspective, the scale can be used in community-based surveys or health promotion programs to determine the population's level of digital health literacy. It can also track changes over time, and evaluate the effectiveness of digital interventions. Additionally, policymakers and program developers can use findings from the scale to design targeted educational initiatives and improve equitable access

to digital health resources. It is recommended that future studies employ the scale to establish the population prevalence of eHealth literacy, or the broader representative application of the scale within the population. Additionally, cross-cultural studies comparing the performance of the original eHEALS-E with the Turkish adaptation would provide valuable insights into cultural differences in eHealth literacy conceptualization and measurement.

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ORCID

Ugurcan Sayili http://orcid.org/0000-0002-5925-2128
Ayse Sultan Kaya http://orcid.org/0009-0008-2733-6897
Sumeyye Nur Aydin http://orcid.org/0000-0002-0891-2587

Authors contributions

US: Conceptualization, Methodology, Supervision, Project administration, writing-original draft, writing-review and editing; **ASK**: Methodology, data curation, formal analysis, writing-original draft; **SNA**: Methodology, data curation, formal analysis, Visualization, writing – original draft. All authors contributed to the final manuscript and have read and approved the final version.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent to participate

Informed consent was obtained from all participants for being included in the study.

Ethics approval

The study was performed in accordance with the Ethics Guidelines of the Helsinki Declaration and was approved by the Clinical Research Ethics Committee of Istanbul University-Cerrahpaşa (approval date/number: December 2, 2024–1159006). All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all patients for being included in the study.

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