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Abstract

The purpose of the present study was to examine the psychometric properties of the eHealth Literacy Scale (eHEALS) using classical test theory and modern test theory among elderly Iranian individuals with heart failure (HF). Individuals with objectively verified HF (n=388; 234 males; mean age=68.9±3.4) completed the (i) eHEALS, (ii) Hospital Anxiety and Depression Scale, Short-Form 12, (iii) 9-item European Heart Failure Self-care Behavior Scale, and (iv) 5-item Medication Adherence Report Scale. Two types of analysis were carried out to evaluate the factorial structure of the eHEALS: (i) confirmatory factor analysis (CFA) using classical test theory and (ii) Rasch analysis using modern test theory. A regression model was constructed to examine the associations between eHEALS and other instruments. CFA supported the one-factor structure of the eHEALS with significant factor loadings for all items. Rasch analysis also supported the unidimensionality of the eHEALS with item fit statistics ranging between 0.5 and 1.5. The eHEALS was significantly associated with all the external criteria. The eHEALS is suitable for healthcare providers to assess eHealth literacy for individuals with HF.

Keywords: classical test theory; eHealth literacy; heart failure; Iran; modern test theory

Contemporary technology allows individuals to seek health information on the internet via devices such as WiFi-enabled smartphones, tablets, and laptops. The Pew Research Internet Project estimates that more than 85% of American adults use the internet, and nearly three-quarters of them have searched for health information online (Pew Research Center, 2016). However, searching for health information is different from interpreting health information. More specifically, individuals may lack sufficient knowledge to interpret the health information they access and read online. Therefore, assessing eHealth literacy is deemed a prerequisite for healthcare providers to promote eHealth resources to patients who may need them (Norman and Skinner, 2006).

eHealth literacy is defined as "the ability to navigate the internet for health information (p2)" (Nguyen et al., 2016). eHealth literacy can be challenging for patients given the many different core skills or literacies that exist including: (i) traditional literacy; (ii) health literacy; (iii) information literacy; (iv) scientific literacy; (v) media literacy; and (vi) computer literacy (Norman and Skinner, 2006). More specifically, patients should have the knowledge to access, retrieve, evaluate, and appraise the information they gain online (Norman and Skinner, 2006). Patients are likely to obtain different types and quality of information that they need to further compare and evaluate. Moreover, given the rapid change of both care routines and technology, health information is updated quickly. That is, health information yesterday may not be good practice today (Norman and Skinner, 2006).

In order to appropriately use online resources for health purposes, Norman and Skinner (2006) developed the eHealth Literacy Scale (eHEALS) for clinical decision-making. Because of the brevity and utility of the eHEALS, it has been translated into different languages, including Japanese (Mitsutake, Ai, Ishii & Oka, 2012), Chinese (Koo, Norman & Chang, 2012), Dutch (Van der Vaart et al., 2011), and Spanish (Aponte & Nokes, 2015, 2017)

and validated in different populations. However, given that elder people may have barriers or problems to learn and use e-resources (aportzis, Clausen, & Gow, 2017), it is unclear whether the eHEALS is a practical and valid tool for elders. Specifically, to the best of our knowledge, the eHEALS has never been applied to individuals with heart failure (HF), who are usually elderly and need to have good self-care behaviors.

HF is often associated with several comorbidities and fluctuations of the condition causes frequent rehospitalizations (Benjamin et al., 2017; Gheorghiade, Vaduganathan, Fonarow & Bonow, 2013; Grady, 2008). Therefore, an individual with HF needs sufficient knowledge about (for example) how to handle signs and symptoms, self-care actions and potential changes of pharmacological treatment to handle their situation. This knowledge could either be obtained from healthcare providers or via the internet. Furthermore, adherence to medication and self-care actions in HF have found to be poor, and a variety of factors are understood to affect self-care behaviors, of which knowledge is one (Lee et al., 2018; Jaarsma, Cameron, Riegel & Stromberg, 2017; Sedlar et al., 2017). In addition, individuals with HF are usually elderly and are likely to have insufficient ability in using online resources. A recent study (Melholt et al., 2018) stated that individuals with HF may gain benefits from eHealth literacy. Therefore, a validation of the eHEALS in this population would increase possibilities to provide good patient education and (in the long run) prevent re-hospitalizations. More specifically, after establishing the psychometric properties of the eHEALS, healthcare providers can use the eHEALS to identify whether an individual with HF has sufficient competence to seek health information via the internet, or if a face-to-face provided intervention is needed (e.g., individual patient education about self-care).

Consequently, the present study aimed to investigate the psychometric properties of the eHEALS among individuals with HF. Moreover, an attempt was made to strengthen the

robustness of the psychometric findings of the eHEALS by utilizing two different psychometric theories (i.e., classical test theory and modern test theory). Classical test theory has a strong assumption that the Likert-type scale scores (a type of ordinal scale) are additive although the nature of Likert-type scales are non-additive. Nevertheless, classical test theory provides information that most healthcare providers are familiar with (e.g., Cronbach's α and factor loading). In contrast, modern test theory such as Rasch analysis uses the probabilities of answering a specific category in the Likert-type scale to convert all Likert-type scales into ratio scales. Using the converted ratio scales, which are additive scales in nature, psychometric properties such as item and person separation reliability can be computed in the Rasch models. Therefore, using different theories helps expand knowledge regarding the psychometric properties of the eHEALS.

Methods

Design, participants, and procedure

The present methodological study was conducted at three university hospitals in two cities (Tehran and Qazvin) during 2017 and 2018. Patients referred to these hospitals were assessed by two physicians in terms of their eligibility for study inclusion. The inclusion criteria for the study were: (i) being aged 65 years or older, (ii) having a confirmed diagnosis of HF by echocardiographic and physical examination according to the International Classification of Diseases (tenth revision), (iii) having the ability to speak and write Persian, and (iv) having access to the Internet at least once a month (via smartphone, tablet and/or computer). Patients were excluded from the study if they had dementia (determined by a Mini-Mental Status score of less than 25), or diagnosed as having Alzheimer's dementia or Parkinson's disease. Clinical data were obtained from medical records. Left ventricular ejection fraction was determined by echocardiography performed according to clinical routines at the current hospital and analyzed by experienced cardiologists.

Among 458 approached patients, 47 patients were not eligible to be included in the study and 23 patients declined to participate. Consequently, 388 patients participated in the study with a response rate of 84.7%. Additionally, test-retest reliability was carried out across a two-week interval. More specifically, 388 participants were contacted by research assistants and invited to complete the eHEALS again two weeks after their first administration. In the retest, 43 patients declined to complete the retest (11.1% drop-out rate). Therefore, data from the retained 345 patients were used for test-retest reliability.

Translation procedure

The validated English version of eHEALS (Norman & Skinner, 2006) was translated into Persian based on international guidelines of cross-cultural adaptation (Lin et al., 2018). The translation procedure was performed in several steps. In the first step, the English version of the eHEALS was translated into Persian by two bilingual translators whose mother tongue was the Persian language. In the next step, the translated versions were compared and discrepancies were resolved in order to synthesize them into an interim Persian version. Two bilingual translators then independently translated the interim Persian version into the English language. Both translators with English language as their native language were not aware of original English version of the eHEALS. An expert committee (comprising a cardiologist, cardiovascular nurse, psychometrician, and psychologist) then reviewed all translated versions and any discrepancies were discussed to produce a prefinal version. The prefinal version was then piloted on 21 patients with HF (9 women and 11 men with mean age of 68.6±8.4 years). The patients were asked to read the questionnaire items as well as the instructions. A cognitive interview was conducted to test the feasibility and understanding of the items. All necessary changes were made and the final Persian eHEALS was administered to 388 HF patients to assess the psychometric properties of the newly translated scale.

Measures

e-Health Literacy Scale (eHEALS). The eHEALS (sample item: *Know how to find helpful health resources on the Internet*. Refer to Table 2 for other item descriptions) is a self-report tool that can be administered by healthcare providers with little or no training (Norman & Skinner, 2006). The eHEALS comprises eight items rated on a five-point Likert scale (scores 1 as *strongly disagree*; scores 5 as *strongly agree*), where a higher score indicates a higher level of confidence in the ability of finding, evaluating, and using health information to make health-related decisions. In short, a higher score represents greater perceived eHealth literacy (Paige, Krieger, Stellefson & Alber, 2017). Also, the one-factor structure (or unidimensionality) of the eHEALS has been supported by prior confirmatory factor analysis (CFA) and Rasch analysis among patients with chronic diseases including cardiovascular diseases (Paige et al., 2017).

Hospital Anxiety and Depression Scale (HADS). The HADS is a frequently used self-report tool comprising 14 items (7 items on anxiety and 7 on depression) rated on a four-point Likert scale ranging from 0 to 3, where a higher score indicates a higher level of anxiety or depression. The two-factor structure of the HADS has been supported by CFA, and the unidimensionality of each factor has been found in Rasch analysis among Iranian patients with epilepsy (Lin & Pakpour, 2017).

Short-Form 12 (SF-12). The SF-12 is a self-report tool that assesses the generic quality of life of an individual. The SF-12 comprises 12 items across two domains rated on a variety of response scales, including 2 to 6 categories (i.e., two-point to six-point Likert-type scales). All the item scores are converted into a 0-100 scale, where a higher score indicates better quality of life. Moreover, the SF-12 can be divided into two dimensions of physical-health composite score (PCS) and mental-health composite score (MCS). The two-factor structure

of the SF-12 has been supported by principal component analysis and CFA among Iranian individuals aged 15 years or older (Montazeri, Vahdaninia, Mousavi & Omidvari, 2009).

European Heart Failure Self-care Behavior Scale 9-item version (EHFScB-9). The EHFScB-9 is a self-report tool comprising nine items rated on a five-point Likert scale ranging from 1 (*completely agree*) to 5 (*completely disagree*), where a higher score indicates better self-care of a patient with HF (Jaarsma, Årestedt, Mårtensson, Dracup & Strömberg, 2009). Different factorial structures have been proposed for the EHFScB-9, and the latest consensus describes a two-factor structure that includes adherence to regimen (five items) and consulting behavior (four items) (Paige et al., 2017). More specifically, the two-factor structure of the EHFScB-9 has been supported by CFA, and the unidimensionality of each factor has been found in Rasch analysis among Iranian HF patients (Paige et al., 2017).

5-Item Medication Adherence Report Scale (MARS-5). The MARS-5 is a self-report tool comprising five items rated on a five-point Likert scale ranging from 1 to 5, where a higher score indicates a higher level of medication adherence. The one-factor structure of the MARS has been supported by both CFA and Rasch analysis among Iranian stroke patients. Moreover, the MARS-5 has strong relationship with the medication possession rate ($r = 0.7$) (Lin, Nikoobakht, BROSTRÖM, Arestedt & Pakpour, 2018).

Ethical considerations

The investigation conformed to the principles outlined in the Declaration of Helsinki. All participants gave their written consent to participate in the study, and the study protocol was approved by the Ethics Committee at Qazvin University of Medical Sciences in Iran.

Data analysis

After using descriptive analyses for the participant characteristics, robust psychometric testing was applied using both classical test theory and modern test theory (i.e., Rasch analysis) to examine both item and scale properties of the eHEALS. In psychometric testing utilizing classical test theory, a number of measures were tested: (1) the ceiling and floor effects with a value < 20% indicating acceptable; (2) internal consistency using Cronbach's α with a value > 0.7 indicating acceptable; (3) corrected item-total correlation with a value > 0.4 indicating acceptable; (4) test-retest reliability using Pearson correlation coefficient with a value > 0.4 indicating acceptable; (5) average variance extracted (AVE) with a value > 0.5 indicating acceptable); (6) composite reliability (CR) with a value > 0.6 indicating acceptable); (7) standard error of measurement with a lower value indicating better); and (8) concurrent validity using a regression model to examine the associations between eHEALS and the following external criteria: depression, anxiety, PCS, MCS, adherence to regimen, consulting behavior, and medication adherence.

Following this, CFA was performed using weighted least squares and adjusted means and variances (WLSMV) estimation to test the one-factor structure of the eHEALS using the following fit indices to indicate acceptable data-model fit: a nonsignificant χ^2 test; a comparative fit index (CFI) and a Tucker-Lewis index (TLI) > 0.9; a root-mean square error of approximation (RMSEA), and a standardized root mean square residual (SRMR) < 0.08 (McDonald & Ho, 2002). Furthermore, three nested models were conducted to test the measurement invariance of the eHEALS across gender and across New York Heart Association (NYHA) classifications (NYHA II vs. NYHA III and IV) using multigroup CFA (Paige et al., 2017). The three models were a configural model, a model constrained by all factor loadings equal across group, and a model constrained by all factor loadings and item intercepts equal across group. The measurement invariance (i.e., testing whether different groups share the same or similar concept in a specific instrument) was supported using the

following fit indices: ΔCFI>-0.01, ΔSRMR<0.02, and ΔRMSEA<0.015 (Chen, 2007).

In psychometric testing under Rasch analysis, the item difficulty was reported; information-weighted fit statistic (infit) mean square (MnSq), and outlier-sensitive fit statistic (outfit) MnSq (with range between 0.5 and 1.5 indicating acceptable); item and person separation reliability (with a value > 0.7 indicating acceptable); item and person separation index (with a value > 2 indicating acceptable); and differential item functioning (DIF) contrast (with a value < 0.5 indicating acceptable) across gender and across NYHA classifications (NYHA II vs. NYHA III and IV) (Lin et al., 2018). All statistical analyses were performed using Mplus (version 7.4; Los Angeles, CA) and Winstep 4.1.0 software (winsteps.com, Beaverton, OR).

Results

The sample of 388 participants included 234 males (60.3%), 59 current smokers (15.2%), and 243 having NYHA classification II (62.6%). In addition, the mean age of the participants was 68.9 years (SD=3.4) with 6.4 years of education (SD=3.2) and a body mass index of 28.2 kg/m^2 (SD=5.0). On average, participants had suffered from HF for 5.5 years (SD=3.6) with an average left ventricular ejection fraction of 30.2% (SD=7.4). Table 1 presents other HF characteristics of the sample.

(Insert Table 1 here)

The responses to each eHEALS item are summarized in Supplementary Table S1. In brief, most participants endorsed items in the range 3 (*undecided*) to 5 (*strongly agree*), and relatively few participants endorsed responses 1 (*strongly disagree*) and 2 (*disagree*) for all the items apart from Item 6. On eHEALS Item 6, a few participants endorsed response 5. Additionally, the mean and SD of each eHEALS item are presented in Supplementary Table S1 with the lowest mean being 3.21 and the highest being 4.30.

All eight items of the eHEALS showed promising item properties as indicated by the strong factor loadings (0.60 to 0.79), satisfactory corrected item-total correlation (0.66 to 0.82), and high test-retest reliability (0.79 to 0.92) from classical test theory. Using modern test theory, Rasch analysis indicated adequate infit and outfit MnSq (0.84 to 1.36 and 0.78 to 1.34, respectively) and acceptable DIF contrast across gender (DIF contrasts between -0.24 and 0.22). The DIF contrasts were all acceptable across NYHA classification, except for Item 5 (DIF contrast=-0.56). In addition, the item difficulties ranged between -0.41 and 0.63 (Table 2).

(Insert Table 2 here)

In terms of the scale-level, all the psychometric properties of the eHEALS were satisfactory using classical test theory (ceiling effect=2.8%; floor=1%; Cronbach's α=0.89; CFI=0.987; TLI=0.979; RMSEA=0.053; SRMR=0.029; AVE=0.51; CR=0.89; standard error of measurement=2.09; test-retest reliability=0.85) or using Rasch analysis (item separation reliability=0.93; item separation index=3.62; person separation reliability=0.86; person separation index=2.36) (Table 3). Psychometric testing from classical test theory also showed that eHEALS was significantly correlated to different external criteria, including depression (β=-0.12), anxiety (β=-0.09), PCS (β=0.14), MCS (β=0.17), adherence to regimen (β=0.13), consulting behavior (β=0.10), and medication adherence (β=0.27) (Supplementary Table S2).

(Insert Table 3 here)

Multigroup CFA corresponded to the DIF findings in that measurement invariance was supported across gender (nonsignificant findings between configural model and model with all factor loadings constrained [$\Delta\chi^2$=2.539; *df*=8; *p*=0.96]; between model with all factor loadings constrained and model with all factor loadings and all item intercepts constrained [$\Delta\chi^2$=4.295; *df*=8; *p*=0.83]) and across NYHA classifications (nonsignificant findings between configural model and model with all factor loadings constrained [$\Delta\chi^2$=12.728; *df*=8; *p*=0.12]; between model with all factor loadings constrained and model with all factor

loadings and all item intercepts constrained [$\Delta\chi^2$=4.441; *df*=8; *p*=0.82]). Moreover, the ΔCFI, ΔSRMR, and ΔRMSEA all supported the measurement invariance of the eHEALS across gender and across NYHA classification (Supplementary Table S3).

Discussion

The internet has become increasingly ubiquitous in society, and many websites have been developed for educating individuals with HF in disease management and symptom prevention (Orlowski, Oermann & Shaw, 2013). However, this does not mean that all patient education should be provided via the internet, especially since self-care in HF is highly complex (Sedlar et al., 2017). Jaarsma et al. (2017) stress that the three key concepts of self-care – self-care maintenance (e.g., adherence to medication), self-care monitoring (e.g., regular check of body weight), and self-care management (e.g., actions in response to symptoms) – are affected by (among other things) access to care and cognitive abilities. Therefore, ensuring an individual with HF has sufficient ability to use online resources is crucial. Furthermore, given the fact that the population contains mostly elderly people, sometimes with impaired cognitive function (Cannon et al., 2017) and depression (Rustad, Stern, Hebert & Musselman, 2013) even further increases the importance of individualized patient-centered care.

Given that Normand and Skinner (2006) indicated that “eHealth literacy promotion takes place within a larger learning context” (p.5), they further proposed that psychometric studies on eHEALS should test the relationship between eHEALS and other measures, such as social functioning, health, and quality of life. In order to respond to the aforementioned recommendation, the present study used a regression model to assess the relationship between eHEALS and relevant measures on individuals with HF. The significant associations found in the regression model were as anticipated. More specifically, higher scores on the

eHEALS were associated with lower levels of anxiety and depression, with higher levels of quality of life, and with better HF self-care behaviors. Using a relatively large sample of patients with HF, the results of the present study demonstrated promising psychometric properties of the eHEALS. In other words, the use of the eHEALS was supported, and healthcare providers are therefore encouraged to use the eHEALS to evaluate the eHealth literacy for individuals with HF. Through such practice, healthcare providers may understand whether an individual with HF has sufficient ability to use online resources for health improvement and/or maintenance.

The present study found that both CFA and Rasch analysis supported a one-factor structure (i.e., unidimensionality) of the eHEALS, suggesting that healthcare providers can use eHealth literacy as a whole in a clinical assessment. The one-factor structure is important for eHEALS because this indicates that summing the eHEALS item scores into a total score is appropriate (Chang et al., 2018). With the summated single total score of eHELAS, healthcare providers can quickly and easily understand the eHealth literacy of an individual. The finding of a unidimensional construct also aligns with most previous studies using either principal component analysis, exploratory factor analysis, or Rasch analysis on different populations (Aponte & Nokes, 2015, 2017; Diviani et al., 2017; Koo et al., 2012; Mitsutake et al., 2012; Nguyen et al., 2016; Norman & Skinner, 2006; Paige et al., 2017; Rosalie et al., 2011). However, the unidimensional finding contradicts the results of two recently published studies (Hyde, Boyes, Evans, Mackenzie & Sanson, 2018; Sudbury, FitzPatrick & Schulz, 2017), which proposed a three-factor structure for the eHEALS. More specifically, Sudbury-Riley et al (2017) used CFA to compare one- and three-factor structures of the eHEALS and found that the thee-factor structure outperformed one-factor among baby boomers born between 1946 and 1964 in the US, UK, and New Zealand. Hyde et al. (2018) conducted another CFA on medical imaging outpatients and further supported the three-factor

structure with minor amendments (i.e., dropping one item).

Nevertheless, using the findings of the present study on individuals with HF, it is argued that the eHEALS should be treated as having one-factor rather than three-factor because studies using Rasch analysis (or other analysis under modern test theory) support the one-factor structure (Diviani et al., 2017; Nguyen et al., 2016; Paige et al., 2017). Given that CFA under classical test theory has the characteristics of being sample-dependent (i.e., psychometric results vary in different studied samples) (Chang, Wang, Tang, Cheng, Lin, 2014), the different factorial structures found in the previous studies (Diviani et al., 2017; Nguyen et al., 2016; Paige et al., 2017) were very likely due to the sample characteristics. In contrast, Rasch analysis with sample-independent characteristics is not influenced by the threat of sample characteristics (Chang et al., 2014). Consequently, studies using Rasch analysis (Diviani et al., 2017; Nguyen et al., 2016; Paige et al., 2017) together with the Rasch findings presented in the present study, demonstrate consistent unidimensional results for the eHEALS.

Additionally, healthcare providers should be cautious using eHEALS when comparing individuals with HF who have minor severity (NYHA class II) and those who have severe severity (NYHA classes III and IV) because eHEALS Item 5 displayed DIF. Our DIF results indicated that those with minor severity had the tendency to answer this item (*I know how to use the health information found on the Internet to help me*) higher. A possible explanation is that those in NYHA class II follow recommendations (which is positive), but those with severe HF cannot. From a clinical perspective, those with severe HF (NYHA III and IV) may not have the capacity to follow recommendations due to their symptoms and poor cardiac function. However, there is no empirical evidence to support such speculation, and future qualitative studies are warranted to investigate whether our postulation is supported.

Limitations

There are some limitations in the present study. Firstly, given that only Iranian individuals with HF were recruited, the classical test theory results cannot be generalized to other populations regardless of their diseases or ethnicities. Secondly, although it is proposed that healthcare providers can use the eHEALS to decide whether using internet resources is appropriate for their patients with HF, the study findings did not provide any suggested cutoff for their reference. The results of the present study only provided information that eHEALS scores are robust and reliable. However, it is unclear how an individual with HF scores the eHEALS is a potential candidate to be recommended to use online resources. Future studies are warranted to determine the cutoff. More specifically, an intervention design using online resources should be conducted to observe individuals with HF and to which eHEALS score respond the best to the intervention. Consequently, healthcare providers would have good insight of using eHEALS score in clinical decision-making. Thirdly, eHEALS may not fully capture the complex concept of the eHealth literacy, and thus, eHEALS may not be a comprehensive tool for in-depth understanding of eHealth literacy. Nevertheless, the benefits of eHEALS (e.g., the strong psychometric properties, brevity, and utility) outweigh its shortcoming, and the eHEALS arguably serves as a convenient tool for health practitioners in busy clinical settings. Finally, all the instruments used in the present study, including eHEALS, were self-report in nature. Therefore, the research team was unable to control well-known biases such as social desirability and memory recall.

Conclusion

In conclusion, the eHEALS is a promising and useful tool for healthcare providers to capture the eHealth literacy for individuals with HF. Healthcare providers may use the eHEALS score to further make clinical decisions as to whether their patients with HF should

use (or not use) online resources in health promotion and maintenance. Anecdotally, it is also worth noting that some healthcare providers claim that their patients trust information they find online more than information recommended by their doctors or nurses. Consequently, some patients decide to mix particular drugs or stop taking specific prescribed drugs without notifying any healthcare providers. Thus, it is especially important for patients to know how to evaluate online information they find and to use the information correctly to make good decisions given that health-related information found on the internet can be wrong, exaggerated, unverified, unproved, or commercial.

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Table 1 Participants characteristics (N=388).

	Mean±SD or n (%)
Demographic variables	
Age (year)	68.9±3.4
Gender (male)	234 (60.3)
Gender (female)	154 (39.7)
Years of education	6.4±3.2
Body mass index (kg/m^2)	28.2±5.0
Current smoker	59 (15.2)
Heart failure characteristics	
Duration of heart failure (years)	5.5±3.6
NYHA classification (II)	243 (62.6)
NYHA classification (III)	91 (23.5)
NYHA classification (IV)	54 (13.9)
Left Ventricular Ejection Fraction (%)	30.2±7.4
Medication	
Diuretic	189 (48.7)
Beta blockers	242 (62.4)
ACE inhibitors	301 (77.6)
SBP, mm Hg	143.1 ±30.5
DBP, mm Hg	82.3 ± 22.7

NYHA= New York Heart Association; SBP= Systolic blood pressure; DBP= diastolic blood pressure.

Table 2 Psychometric properties of the eHealth Literacy Scale in item level (N=388).

Item #	Analyses from classical test theory			Analyses from Rasch				
	Factor loading[a]	Item-total correlation	Test-retest reliability[b]	Infit MnSq	Outfit MnSq	Difficulty	DIF contrast across gender[cd]	DIF contrast across NYHA classification[ce]
eHEALS1: I know how to find helpful health resources on the Internet.	0.66	0.72	0.80	1.06	1.05	-0.04	0.22	0.18
eHEALS2: I know how to use the Internet to answer health questions.	0.78	0.82	0.79	0.84	0.79	-0.18	0.03	-0.24
eHEALS3: I know what health resources are available on the Internet.	0.78	0.80	0.84	0.85	0.78	0.16	0.07	0.42
eHEALS4: I know where to find helpful health resources on the Internet.	0.64	0.66	0.92	1.36	1.34	0.63	0.01	-0.23
eHEALS5: I know how to use	0.79	0.80	0.88	0.86	0.87	-0.09	-0.07	0.44

the health information found on the Internet to help me.								
eHEALS6: I have the skills to evaluate the health resources found on the Internet.	0.70	0.75	0.83	0.94	0.93	0.06	-0.12	0.35
eHEALS7: I can tell high quality from low quality health resources on the Internet.	0.60	0.69	0.86	1.14	1.09	-0.13	-0.24	-0.37
eHEALS8: I feel confident in using information from the Internet to make decisions.	0.74	0.78	0.90	0.97	0.92	-0.41	0.08	-0.56

[a] Based on confirmatory factor analysis.
[b] Using Pearson correlation.
[c] DIF contrast > 0.5 indicates substantial DIF.
[d] DIF contrast across gender=Difficulty for Females-Difficulty for males.
[e] DIF contrast across NYHA classification = difficulty in class II – difficulty in classes III and IV
MnSq=mean square error; DIF=differential item functioning.
NYHA= New York Heart Association

Table 3 Psychometric properties of the eHealth Literacy Scale in scale level.

Psychometric testing	Value	Suggested cutoff
Ceiling effects (%)	2.8	<20
Floor effects (%)	1	<20
Internal consistency (Cronbach's α)	0.89	>0.7
Confirmatory factor analysis		
χ^2 (*df*)	37.75 (20)*	Nonsignificant
Comparative fit index	0.987	>0.9
Tucker-Lewis index	0.979	>0.9
Root-mean square error of approximation	0.053	<0.08
Standardized root mean square residual	0.029	<0.08
Average Variance Extracted	0.51	>0.5
Composite Reliability	0.89	>0.6
Standard error of measurement	2.09	The smaller the better
Item separation reliability from Rasch	0.93	>0.7
Item separation index from Rasch	3.62	>2
Person separation reliability from Rasch	0.86	>0.7
Person separation index from Rasch	2.36	>2
Test-retest reliability by Pearson correlation	0.85	>0.4

*p<0.001