

Examining psychometric properties Iranian Version of the Health Literacy of Caregiver Scale- Cancer (HLCS-C)

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Abstract

Background and Objective: Caregiver's health literacy is a crucial factor in fulfilling caregiving responsibilities for patients with cancer. Assessing different dimensions of caregiver health literacy can help identify educational needs and guide targeted interventions to improve patient care outcomes. The Health Literacy of Caregiver Scale–Cancer (HLCS-C), the only disease-specific instrument for assessing caregiver health literacy, has not previously been validated in Iran. This study aimed to examine the psychometric properties of the Iranian version of the Health Literacy of Caregiver Scale–Cancer (HLCS-C).

Materials and Methods: This methodological cross-sectional validation study was conducted between March 2023 and January 2024 among 354 family caregivers of patients with breast cancer recruited through convenience sampling. The total sample was randomly divided into two independent subsamples: 172 participants for exploratory factor analysis (EFA) and 182 participants for confirmatory factor analysis (CFA). Content validity was assessed using the Content Validity Index (CVI) and Content Validity Ratio (CVR). Internal consistency was evaluated using Cronbach's alpha, and test–retest reliability was assessed using the Intraclass Correlation Coefficient (ICC).

Results: The CVI and CVR of the HLCS-C were 0.92 and 0.98, respectively. Although the original HLCS-C consists of 10 dimensions, EFA in the Iranian sample identified a 9-factor structure, explaining 57% of the total variance. CFA confirmed the adequacy of the 9-factor model (CFI = 0.94, TLI = 0.93, χ^2/df = 2.48, RMSEA = 0.06, SRMR = 0.07). The overall Cronbach's alpha coefficient was 0.93, and the ICC was 0.89 (95% CI: 0.79–0.95), indicating excellent reliability.

Conclusion: The Persian version of the HLCS-C is a valid and reliable instrument for assessing caregiver health literacy among Iranian family caregivers of patients with cancer. The identified 9-factor structure suggests a culturally adapted construct in the Iranian context. This instrument can be used in clinical practice and research to identify caregivers' health literacy needs and to design targeted educational and supportive interventions.

Keywords: Breast cancer, Family caregiver, Health literacy, Health literacy of Caregiver Scale-Cancer (HLCS-C), Iran, psychometrics.

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Introduction

Cancer is a leading cause of death worldwide, affecting millions of people each year. According to the World Health Organization (WHO), one in five men and one in six women will develop cancer during their lifetime (1). Among various cancers, breast cancer is the most common cancer in women in both developed and developing countries (2). In 2020, breast cancer was the most commonly diagnosed cancer worldwide, with an estimated 2.26 million new cases, accounting for 12.5% of all cancers in women (3). Breast cancer affects nearly 12% of women in the United States during their life (4). In Iran, breast cancer is also the most prevalent cancer among women (5).

The increasing number of breast cancer patients, their prolonged survival due to advances in diagnostic and treatment methods, and the need for continuous care at home have prompted family members to take on more responsibility for patient care (6). Consequently, breast cancer care has shifted towards outpatient and family-centered care, and the family caregiver has become the primary source of support for cancer patients (7, 8).

Family caregivers play a fundamental role in the treatment and recovery of cancer survivors (9). A family caregiver is defined as an unpaid supporting individual who is involved in every stage of the diseases, including diagnosis, treatment, follow-up, and monitoring of side effects (10, 11). Caregivers are the first to assess patients' symptoms and play a critical role in early hospital referrals, treatment receipt, and enhancing quality of life (12). Family caregivers of cancer patients have a significant role in making decisions about care (13); however, their level of involvement is strongly dependent on their health literacy needs (14). A cancer diagnosis is a primary reason for an individual's need for a caregiver, and almost all cancer patients are accompanied by a caregiver during clinical visits. Complex medical terminology, challenging communication between the physician and caregiver, lack of collaboration and educational support for the caregiver are some of the multiple challenges faced by family caregivers in oncology (15).

Health literacy has recently been recognized as a critical construct in oncology for understanding and improving disease outcomes (16, 17). Health literacy influences individuals' health behaviors (18) and refers to the personal characteristics and social resources needed by individuals and communities to access, understand, evaluate, and use information and services to make health decisions (19). In fact, health literacy encompasses individuals' knowledge, motivation, and skills to access, understand, evaluate, and apply health information to make informed judgments and decisions in everyday life about health care, disease prevention, and health promotion to maintain or improve quality of life across the life course (20-22). Health literacy of cancer caregivers plays a significant role in fulfilling the unique roles and responsibilities associated with caring for cancer patients (23). By supporting care recipients in accessing health information, communicating with healthcare providers, processing information, and making health decisions, caregivers play a key role in promoting patient health outcomes. The quality of care provided by caregivers is directly linked to their health literacy level (9).

Given the crucial role of family caregivers in patient care, it is essential to understand how their health literacy can impact their caregiving capabilities. A scoping review of caregiver health literacy focused on describing health literacy levels among caregivers of older adults and those with heart failure, diabetes, stroke, and cancer. The review highlighted the need to address caregiver health literacy but did not provide sufficient detail on caregiver health literacy needs to guide the development of effective responses (9). One potential reason for the limited availability of caregiver health literacy research is the lack of instruments that adequately assess caregiver-specific health literacy needs. Notably, previous studies have assessed health literacy using general instruments such as the Test of Functional Health Literacy in Adults (TOFHLA) and the Rapid Estimate of Adult Literacy in Medicine (REALM), which have been criticized for focusing primarily on reading comprehension, word recognition, and numerical calculation skills (24, 25). While these tools are useful for screening basic literacy in general patient populations, they are insufficient for assessing the health literacy of cancer caregivers. Cancer caregiving requires a broader set of competencies, including active information-seeking about complex treatment protocols and side effects, effective communication with multiple healthcare providers, collaboration with family members in treatment decision-making and navigating the healthcare system. Additionally, caregivers face unique psychosocial challenges such as supporting the patient's emotional and physical needs, engaging in shared decision-making, and maintaining their own self-care while fulfilling caregiving responsibilities, none of which are captured by general health literacy instruments. Therefore, the need for a dedicated, multidimensional instrument that comprehensively assesses cancer caregiver health literacy is well-justified. In 2018, Yuen et al. developed a valid and reliable 46-item, 4- and 5-point Likert scale instrument to assess cancer caregiver health literacy in Australia. The instrument comprises ten domains: Proactivity and determination to seek information, Adequate information about cancer and

cancer management, supported by healthcare providers to understand information, social support, Cancer-related communication with the care recipient, understanding care recipient needs and preferences, Self-care, Understanding the healthcare system, Processing health information, Active engagement with healthcare providers (26). This instrument provides a comprehensive assessment of caregiver health literacy and can be used to guide the development of targeted interventions to improve caregiver knowledge, skills, and confidence in caring for their loved ones.

Given the critical role of health literacy in cancer family caregivers' ability to provide care, and considering the lack of a standardized instrument for measuring it in Iran, this study aimed to determine the psychometric properties of the Health Literacy Caregiver Scale-Cancer (HLCS-C) in Iranian breast cancer caregivers.

Materials and Methods

The Persian version of the Health Literacy Caregiver Scale-Cancer (HLCS-C) was developed through several steps, including translation, content validity, face validity, and psychometric evaluation for construct validity and reliability.

Study Design

This methodological cross-sectional validation study aimed to validate and determine the reliability of the HLCS-C as a measurement tool.

Study Participants

The study was conducted on 354 family caregivers of breast cancer patients who were referred to selected oncology and radiotherapy centers in Tabriz, Iran, for chemotherapy and radiotherapy.

Eligibility criteria:

To be eligible for the study, participants had to meet the following criteria: Providing care for a patient with a confirmed diagnosis of breast cancer established by a medical oncologist, Cancer diagnosis within the past two years, Caregiving for a patient undergoing treatment (chemotherapy, surgery, radiotherapy), Being the primary caregiver and aware of the patient's cancer diagnosis, Age 18 years or older, Ability to read and write. Participants were excluded from the study if they had: Previous caregiving experience for a cancer patient, Experienced a major life event in the past three months (e.g., death of a loved one, divorce) and self-reported history of mental illness.

Sample size:

There are many contradictions regarding the sample size required for factor analysis. Based on a rule of thumb, the sample sizes for exploratory factor analysis (EFA) can be classified as very poor (50), poor (100), fair (200), good (300), very good (500), and excellent (1000) (27). For confirmatory factor analysis (CFA), Hair et al. (2014) state that the sample size should be greater than 100, and based on the strategy proposed by Hair et al., the minimum sample size required is 3 observations per item, and the maximum is 20 observations per item (28).

Considering the number of 46 items, and considering 7 observations per item, and assuming a 10% sample attrition, the sample size was set at 354. Finally, 354 eligible family caregivers were selected.

Participant Recruitment

For this study, researchers recruited participants through a convenience sampling method. They visited selected oncology and radiotherapy centers in Tabriz and approached caregivers of breast cancer patients. After explaining the research goals and procedures, the researchers invited caregivers to participate voluntarily. Potential participants underwent an initial screening to assess their eligibility based on predetermined criteria. Those who qualified received detailed information about the study's rationale, potential benefits, expected outcomes, data confidentiality measures, and the research process itself. If caregivers agreed to participate, they signed an informed consent form. The study employed two questionnaires: Demographic questionnaire and the Health Literacy Caregiver Scale-Cancer (HLCS-C). Questionnaires were completed anonymously in private rooms at the participating centers through face-to-face interviews. Researchers assured participants that all information collected would be kept confidential.

Instruments

1. Demographic Questionnaire:

This nine-item questionnaire collected information on the caregiver's age, sex, marital status, relationship to the patient, living separately or with patient, Income adequacy, education level, Job, and care days per week.

2. Health Literacy Caregiver Scale- Cancer (HLCS-C)

The Health Literacy Caregiver Scale-Cancer (HLCS-C) was developed by Yuen et al. (2017) to measure the health literacy of cancer caregivers. The original instrument consists of 46 items organized into 10 conceptual domains. Subscales 1 to 8 are scored using a 4-point Likert scale (1 = "strongly disagree" to 4 = "strongly agree") and subscales 9 and 10 are scored using a 5-point Likert scale (5 = "very easy" to 1 = "cannot do"). The reliability and validity of the scale have been demonstrated in a sample of cancer caregivers in Australia. The total score range for the instrument is 46-192, with higher scores indicating higher health literacy (26).

The Translation Process

To translate the questionnaire, permission was first obtained from the developers, Yuen et al. (26). The original version was then translated using the forward-backward method. In the first stage, the English form of the questionnaire was independently translated by two experienced translators. In addition to being fluent in English, these translators were also acquainted with the concept of health literacy in cancer caregivers. After the translation, the translators discussed and debated any discrepancies or differences of opinion. Finally, the Persian version of the questionnaire was created by combining the two translations. Then the Persian version of the questionnaire was given to an English translator fluent in Persian to be translated back into English. The forward-backward versions were then compared to the

original version. In case of any inconsistency, the Persian version was consulted and the necessary corrections were made (29).

Face validity

This concept refers to the rationality of a test from the perspective of respondents who seek to imagine the target group's similar understanding of questions in line with the researcher's intent, the target group's agreement with the expressions used, and the general nature of the tool from the target group's perspective. Furthermore, the items in the research tool should be simple and clear with appropriate sequence and elegant font and design so that the target group can complete the questionnaire without any ambiguity. To this end, formal validity was examined with two qualitative and quantitative approaches (30).

In the qualitative method, the perspective of the target population was considered. In this way, through interviews with 10 breast cancer patient caregivers, items such as Difficulty in understanding questions and concepts, Relevancy of questions, Clarity and Avoidance of Ambiguity in question meanings were assessed. Then, based on the feedback from the target group, revisions were made to the items in terms of grammar, appropriate and clear vocabulary usage, according to the Iranian society. The reliability of the questionnaire was assessed using the Item Impact Method, which is a quantitative approach to face validity. Based on the feedback received to determine the Importance of items, a Likert scale with 5 importance levels was used: Strongly Important (score 5), Quite a lot important (score 4), Moderate importance (score 3), slightly important (score 2), and Not at all important (score 1). The questionnaire was then distributed to 10 members of the target group for feedback. The Impact Score was calculated using the formula: $\text{Impact Score} = \text{Frequency (\%)} \times \text{Importance}$.

In this formula, Frequency (%) represents the percentage of caregivers who gave a score of 4 or 5 to the specific item, and Importance is the average score of respondents' responses to that item. An Impact Score above 1.5 is considered acceptable (31).

Content validity

Content validity refers to whether the content of the tool adequately reflects the structure being measured or not. To assess content validity, two qualitative methods were used based on expert committee evaluation and quantitative methods based on calculating Content Validity Ratio (CVR) and Content Validity Index (CVI). For this purpose, the questionnaire items related to determining content validity were placed in the relevant form. In the qualitative assessment, questionnaires were given to 10 experts in breast cancer research and patient care, including Oncologists, Nurses, and Health Researchers. They reviewed the items in terms of Grammar, Wording, Item Allocation, and Scaling. Based on their feedback, revisions were made to the questionnaire. The content validity assessment also utilized CVR and CVI. A checklist with two sections was designed for each expert. The first part calculated CVI, evaluating the Simplicity, Relevancy, and Clarity of each item on a 4-point Likert scale. The second part calculated CVR, evaluating the Necessity of each item on a 3-point Likert scale

from Not necessary to Essential. According to Lawshe table and for a panel of 10 experts, a CVR above 0.62 and a CVI above 0.79 were considered valid (32).

Construct validity

Construct validity refers to the degree of correspondence between a measurement and the theoretical concepts it is intended to represent. In other words, construct validity assesses the appropriateness of a scale to measure whether the items of the scale can support the theoretical and operational definitions of the concept. Construct validity is always associated with the question: "What construct does the scale measure?" To determine construct validity, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) methods were used (33). EFA is used to summarize data and group variables that are correlated with each other. However, CFA tests hypotheses about the structure of variables (34). The total sample ($n = 354$) was randomly divided into two independent subsamples. The first subsample ($n = 172$) was used for exploratory factor analysis (EFA), whereas the second subsample ($n = 182$) was used for confirmatory factor analysis (CFA) to avoid overfitting and to provide independent validation of the factor structure.

Exploratory factor analysis

To perform exploratory factor analysis (EFA) and assess the suitability of data for factor analysis, the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity were used (34). The KMO test is a statistic that indicates the proportion of variance in the questions that is due to the main factors. In general, values between 0.8 and 1 indicate that the data sampling is sufficient for factor analysis. However, if the value of the statistic is less than 0.7, it indicates that the sampling is not sufficient and that corrective measures need to be taken (35).

Another statistical test that is relatively common for diagnosing the suitability of data for factor analysis is Bartlett's test of sphericity. The significance of this test means that the correlation matrix between the items is confirmed and the factor analysis model is appropriate (36). Factor extraction was performed using exploratory factor analysis (EFA) with the principal axis factoring extraction method. Because the underlying latent constructs were expected to be correlated, Direct Oblimin rotation was applied. Factors were retained based on eigenvalues greater than 1, inspection of the scree plot, and interpretability of the factor solution. Pattern coefficients of ≥ 0.30 were considered acceptable. (33).

Confirmatory factor analysis

Confirmatory factor analysis (CFA) was conducted to evaluate the structure of the factors extracted from the exploratory factor analysis (EFA). Specifically, CFA was performed to evaluate the extracted 9-factor structure of the 46-item Persian HLCS-C. All items showed acceptable standardized factor loadings on their corresponding latent factors; therefore, no items were removed from the final measurement model. In CFA, the maximum likelihood method is used to estimate the model fit indices and a set of indices are used to assess the model fit. The following indices were used to assess model fit in CFA: Root Mean Square Error of Approximation (RMSEA) less than 0.08, Comparative Fit Index (CFI) equal to or greater than

0.90, Tucker–Lewis index (TLI) equal to or greater than 0.90, Normed chi-square (χ^2 / df) less than 5 and standardized root mean square residual less than 0.10 (37, 38). The significance of the model coefficients and the correlation test between the factors were also examined in CFA (39).

Reliability Assessment

To determine the reliability of the questionnaire, test-retest reliability and internal consistency were used. To determine the test-retest reliability, the questionnaire was completed by 30 randomly selected caregivers over a two-week interval (the time interval between two tests should be long enough to allow for some forgetting of the questionnaire questions, but not so long that changes in the phenomenon under study occur. This time interval is typically two weeks to one month). The Intraclass Correlation Coefficient (ICC) and its confidence interval were calculated for the scores obtained from the two administrations of the questionnaire, for each factor and the entire questionnaire. To determine the internal consistency, Cronbach's alpha coefficient and McDonald's omega coefficient were calculated for each factor and the entire instrument. The aim of this is to examine the correlation between the variables that make up the construct or scale. In the present study, a Cronbach's alpha coefficient above 0.7 was considered acceptable (32). McDonald's omega total (ω_t) was estimated for each factor and for the total score. Test–retest reliability was estimated using a two-way mixed-effects, absolute-agreement, single-measure intraclass correlation coefficient [ICC(A,1)], because the same measurement procedure was applied to all caregivers and agreement between individual scores across the two administrations was of interest.

The correlation between the scores obtained from the two surveys was determined using the Intra-class correlation coefficient (ICC) and its 95% confidence interval. If the ICC value is higher than 0.6, the level of stability is considered to be good (0.0-0.40 = poor, 0.40-0.59 = fair, 0.60-0.74 = good, and 0.75-1.0 = excellent) (40).

Statistical analysis

SPSS version 16 and JASP version 18.3.0 were used for data analysis. Descriptive statistics including mean (SD) for quantitative variables and frequency (percent) for qualitative variables were used to describe the individual-social characteristics and other research variables. Content validity was assessed by calculating CVR and CVI. Face validity was assessed by calculating the impact score. Construct validity was assessed using EFA and CFA. Finally, reliability was assessed using Cronbach's alpha coefficient, McDonald's omega coefficient, and ICC. McDonald's omega was specified as omega total (ω_t), and ICC was estimated using a two-way mixed-effects, absolute-agreement, single-measure model [ICC(A,1)].

Ethical considerations

This study has been approved by the Ethics Committee of the Tabriz University of Medical Sciences, Tabriz, Iran (code number: IR.TBZMED.REC. 1401.1099). Before using the CRS, the required permission was obtained from Prof. Yuen via email. In this study, written informed consent was obtained from all participants. The participants were assured that their



information and names will be held in confidence in the report. They were also informed that they can leave the study at any stage.

Results

Participants *characteristic*

From five radiotherapy oncology centers in Tabriz, Iran, 354 family caregivers of breast cancer patients were enrolled in the study between March 2023 and January 2024. The mean (standard deviation) age of the participants was 40.35 (12.44) years. Most of the caregivers were spouses (34.7%) or children (41.8%) of the patients, and almost half of the participants (43.5%) had a university education. Other demographic characteristics of the participants are presented in Table 1 (Table 1).

Table 1. Characteristics of the study participants (354)

Characteristics	Mean (SD)
Age	40.35±12.44
Characteristics	N (%)
Sex	
Male	162 (45.8)
Female	192 (54.2)
Marital status	
Married	265 (74.9)
Single	76 (21.5)
Widowed by death and divorce	13 (3.6)
Relative	
Husband	123 (34.7)
Mother	15 (4.3)
Daughter	148 (41.8)
Sister	55 (15.5)
Other	13 (3.7)
Living separately from the patient	
Yes	153 (43.2)
No	201 (56.8)
Caregiver's personal income adequacy (n=153)	
Not at all sufficient	20 (13.1)
Relatively sufficient	108 (70.6)
Completely sufficient	25 (16.6)
Educational level	
High school or below	89 (25.1)
Diploma	111 (31.4)
University	154 (43.5)
Caregiver Job	
Freelance job	115 (32.5)
Employee	75 (21.2)
Housewife	135 (38.1)
Retired	29 (8.2)
Care days per week	
1-2 Days	13 (3.7)



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3-4 Days	55 (15.5)
More than 5 days	286 (80.8)
Note: 201 caregivers reported no personal income. Percentages for personal income adequacy are based on the 153 caregivers who reported personal income.	

Face and content validity

In the qualitative face validity assessment, all items were described as relevant, unambiguous, and without difficulty. In the quantitative assessment and calculation of the impact score, all items received a minimum score of 1.5. In the content validity assessment, all items also obtained the minimum acceptable CVI and CVR values, which were 0.92 and 0.98 for the entire instrument, respectively (Table 2).

Table 2. The impact score, CVI, and CVR for questions

Items	Face validity	Content validity	
	Impact score	CVR	CVI
1	4.6	1	1
2	3.52	0.9	0.73
3	4.05	1	0.9
4	4.6	1	1
5	3.87	1	0.96
6	3.68	1	0.93
7	3.6	1	0.96
8	2.87	1	0.96
9	4.9	1	0.96
10	4.5	1	1
11	4.6	1	0.93
12	4.9	1	1
13	4.6	1	0.86
14	2.66	0.9	0.93
15	2.66	0.9	0.9
16	3.04	0.9	0.96
17	4.5	1	0.93
18	4.14	1	0.9
19	4.32	1	0.9
20	4.05	1	0.9
21	4.4	0.9	0.76
22	3.87	1	0.93
23	4.4	0.9	0.73
24	4.8	1	0.93
25	3.69	1	0.93
26	3.6	1	1
27	4.9	1	1
28	2.28	1	0.9
29	2.22	1	1
30	2.28	1	0.86
31	4.6	1	0.93
32	2.8	1	1



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33	4.8	1	0.86
34	4.7	0.9	0.83
35	4.6	1	0.93
36	4.8	1	0.86
37	4.7	1	0.93
38	4.05	1	1
39	4.8	1	0.93
40	4.7	1	1
41	4.8	0.9	0.83
42	4.7	1	0.96
43	4.6	0.9	0.83
44	4.7	1	0.93
45	4.9	1	0.93
46	4.9	1	0.93

CVI: Content Validity Index, CVR: Content Validity Ratio

In Press

Construct validity

The construct validity was assessed using EFA and CFA on 354 family caregivers of breast cancer patients. EFA was performed on the first 172 samples, and CFA was performed on the next 182 samples. In the exploratory factor analysis, the Kaiser-Meyer-Olkin (KMO) measure was 0.88, indicating good sampling adequacy and that the data were suitable for factor analysis. Bartlett's test of sphericity was statistically significant ($p < .001$), confirming that the correlation matrix was appropriate for factor analysis. Based on the scree plot and eigenvalues, a nine-factor structure with a total variance of approximately 57% was obtained (**Figure 1**).

The first factor comprised Information Acquisition and Adequacy, consisting of 8 questions explaining 8% of the total variance. The second factor was related to Supported by Healthcare Providers, with 5 questions explaining 8% of the total variance. The third factor was about Family/Friends Advocacy and Collaboration, with 4 questions explaining 6% of the total variance. The fourth factor was associated with Cancer-Related Communication with the Patient, including 5 questions explaining 6% of the total variance. The fifth factor was related to Understanding Patients' Needs and preferences, with 5 questions explaining 6% of the total variance. The sixth factor was about Self-care, comprising 5 questions explaining 6% of the total variance. The seventh factor was about Understanding the Healthcare System, consisting of 6 questions explaining 6% of the total variance. The eighth factor was related to Evaluating Information critically, with 4 questions explaining 6% of the total variance. Finally, the ninth factor was associated with Active Engagement with Healthcare Providers, comprising 4 questions explaining 5% of the total variance (**Table 3**).

In CFA, considering the Root Mean Square Error of Approximation (RMSEA) of 0.06; Standardized root mean square residual (SRMR) of 0.07; Tucker-Lewis Index (TLI) of 0.93; Comparative Fit Index (CFI) of 0.94; and Chi-square/df (normed chi-square) of 2.488, this model had a good fit. Therefore, the factorial structure can be confirmed (**Table 4**). A path diagram with standardized factor loadings for the confirmatory factor analysis model for the conceptual model considered is shown in **Figure 2**.

Reliability

At the total-scale level, Cronbach's alpha was 0.93 and McDonald's omega total (ω_t) was 0.86, indicating excellent and good internal consistency, respectively. The two-week test-retest ICC(A,1) was 0.89 (95% CI: 0.79–0.95), indicating excellent stability. Domain-specific and total-scale reliability estimates are presented in **Table 5**.

Table 3. Pattern matrix from the exploratory factor analysis of the HLCS-C

Scale item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9
Factor 1: Information Acquisition and Adequacy									
1. I regularly search for up to date information about the cancer	0.96								
2. I keep searching until I find information that I understand	0.83								
3. I look for new opportunities to get information about the cancer	0.87								
4. To help the person I care for, I actively search for information about cancer	0.88								
5. I have all the information I need to help look after the health of the person I care for	0.41								
6. I have enough information to understand the potential side effects of treatment	0.38								
7. I know how to manage the side-effects of treatment	0.39								
8. I feel I have good information about the cancer	0.44								
Factor 2: Supported by Healthcare Providers									
9. At least one healthcare provider has helped me understand information about cancer		0.68							
10. Healthcare providers include me in discussions to help me understand information about cancer		0.78							
11. At least one healthcare provider makes sure I understand enough information about the cancer		0.79							
12. Healthcare providers have helped me understand information about treatments		0.75							
13. Healthcare providers have helped me understand supports and services available for the person I care for		0.63							
Factor 3: Family/Friends Advocacy and Collaboration									
14. I have at least one person who understands and supports me			0.79						
15. I have strong support from at least one family member or friend			0.99						
16. If I need help, I have at least one person I can rely on			0.90						
17. I have at least one family member or friend who can help me understand health information			0.54						
Factor 4: Cancer-Related Communication with Patient									
18. I have honest talks with the person I care for about how the cancer may impact on the future				0.81					
19. To help make decisions, I discuss all of the healthcare options with the person I care for				0.73					
20. I have honest talks with the person I care for about the cancer information given to us by healthcare providers				0.999					
21. After appointments, I discuss the information given by healthcare providers with the person I care for				0.75					
22. I understand how much information about the cancer, the person I am caring for wants to know				0.39					

Factor 5: Understanding Patients Need and Preferences									
23. I always know when to let the person I am caring for do things for themselves in their own time					0.60				
24. I know what the person I care for can and cannot do physically during treatment					0.70				
25. I know how much help to give the person I care for					0.83				
26. I always understand the needs of the person I care for					0.77				
27. I know which everyday activities the person I care for can do					0.77				
Factor 6: Self-Care									
28. I make sure I get enough rest						0.53			
29. I spend quite a lot of time actively managing my own health						0.83			
30. I make plans for what I need to do to be healthy						0.80			
31. I make sure I see healthcare providers for my own health						0.51			
32. Despite other things in my life, I make sure I regularly exercise						0.41			
Factor 7: Understanding the Healthcare System									
33. I know who can provide the right healthcare for the person I care for							0.59		
34. I understand what healthcare services the person I care for is entitled to							0.66		
35. I know where to find the right healthcare for the person I care for							0.86		
36. I know the right place to get the healthcare the person I care for needs							0.85		
37. I know how to make healthcare appointments for the person I care for							0.81		
38. I know how to find healthcare providers who can help the person I care for							0.83		
Factor 8: Evaluating Information Critically									
39. Find out if the information that I have received is reliable								0.54	
40. Decide where the trustworthy places are to get information about cancer								0.80	
41. Work out which sources have information that is relevant for the person I care for								0.84	
42. Decide which health information is relevant for the person I care for								0.38	
Factor 9: Active Engagement with Healthcare Providers									
43. Have good discussions with healthcare providers about the health of the person I care for									0.62
44. Ask a healthcare provider to explain things to me									0.90
45. Discuss things about the cancer with healthcare providers until I understand all I need to									0.84
46. Ask questions if I don't understand the information given to me by healthcare providers									0.55
% Variance Explained	8	8	6	6	6	6	6	6	5
Total score	57								

Note: Values are pattern coefficients from the Direct Oblimin solution. Because pattern coefficients are standardized regression coefficients rather than simple item–factor correlations, they may occasionally exceed 1.00 when factors are correlated; accordingly, the coefficient of 1.05 for item 20 was retained after review.

Table 4. Confirmatory factor analyses fit Index of the HLCS-C (n=182)

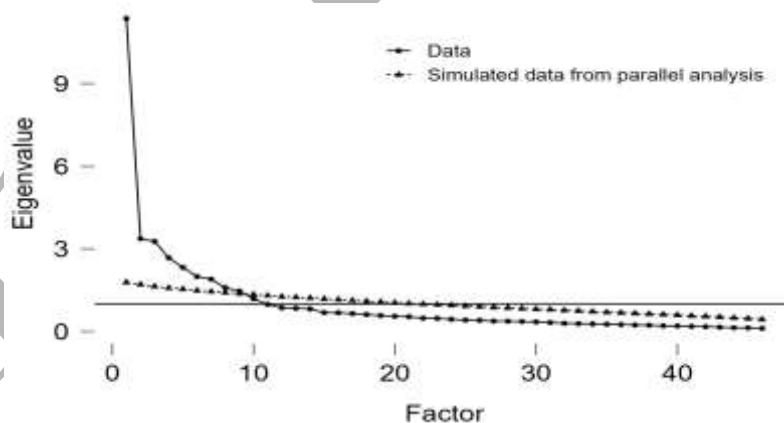
Fit Indices	Fit
χ^2	2371.23
df	953
χ^2/df	2.488
P-value	< 0.001
CFI	0.94
TLI	0.93
RMSEA (90% CI)	0.06 (0.06 , 0.07)
SRMR	0.07

χ^2 : chi-square; df: degrees of freedom; χ^2/df : normed chi-square; CFI: Comparative Fit Index; TLI: Tucker–Lewis index; RMSEA: root mean square error of approximation; SRMR: standardized root mean squared residual

Table 5. Reliability and descriptive statistics of the Persian HLCS-C

Scale/domain	Cronbach's alpha	McDonald's ω	ICC(A,1) (95% CI)	Mean (SD)
Information Acquisition and Adequacy	0.87	0.85	0.89 (0.78 to 0.94)	22.60 (4.55)
Supported by Healthcare Providers	0.85	0.83	0.88 (0.77 to 0.94)	13.05 (3.0)
Family/Friends Advocacy and Collaboration	0.88	0.89	0.88 (0.77 to 0.94)	12.57 (2.78)
Cancer-Related Communication with the Patient	0.86	0.88	0.84 (0.69 to 0.92)	12.23 (3.12)
Understanding Patients' Needs and Preferences	0.86	0.86	0.78 (0.59 to 0.89)	16.53 (2.26)
Self-Care	0.75	0.78	0.89 (0.78 to 0.94)	13.20 (2.85)
Understanding the Healthcare System	0.89	0.89	0.84 (0.69 to 0.92)	18.72 (3.10)
Evaluating Information Critically	0.83	0.85	0.80 (0.62 to 0.90)	14.51 (3.17)
Active Engagement with Healthcare Providers	0.85	0.87	0.92 (0.85 to 0.96)	16.52 (2.92)
Total score	0.93	0.86	0.89 (0.79 to 0.95)	142.97 (17.23)

Note: ω = McDonald's omega total. ICCs were calculated in 30 caregivers over a two-week interval using a two-way mixed-effects, absolute-agreement, single-measure model [ICC(A,1)]

**Figure 1. Scree plot**

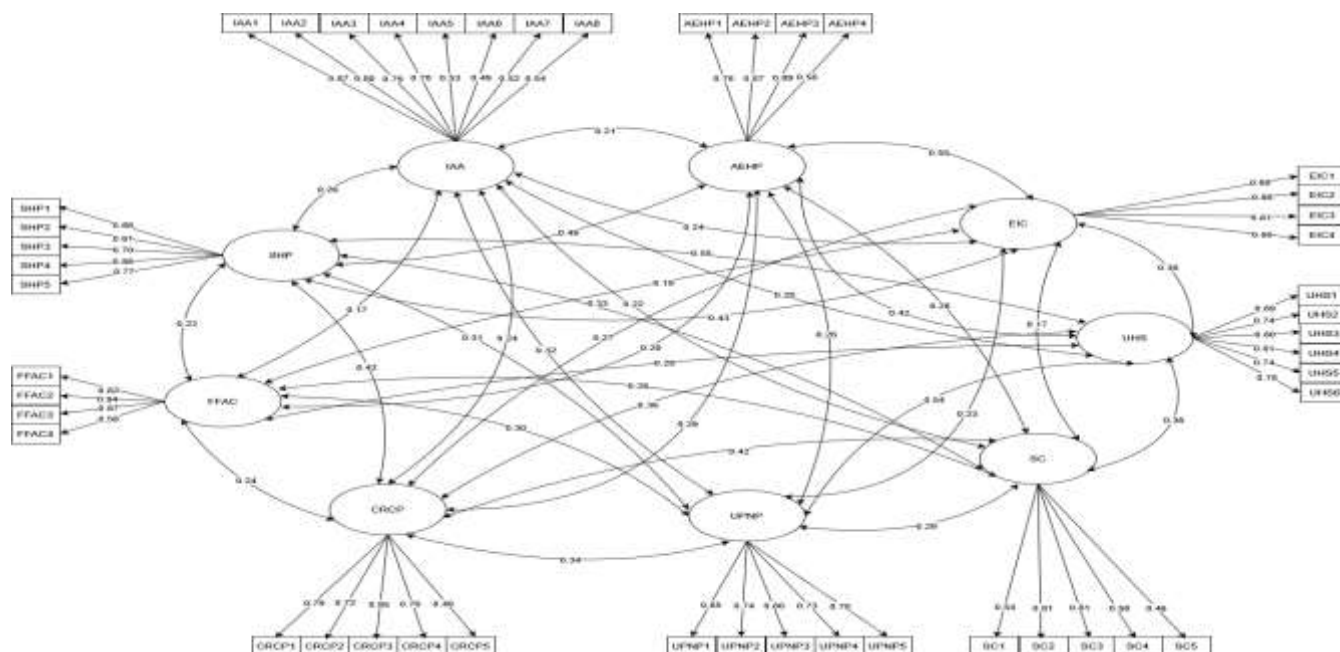


Figure 2. Factor structure model of the HLCS-C based on CFA (All factor loadings are significant at $p < 0.001$)

Discussion

The present study was conducted with the aim of psychometric evaluation of the health literacy questionnaire for breast cancer family caregivers. The results of the study indicate that the Persian version of this questionnaire is a valid and reliable tool for assessing health literacy among cancer caregivers in the Iranian community. Using this tool, the level of health literacy among cancer caregivers can be evaluated across various dimensions, identifying existing weaknesses and taking actions to enhance the health literacy of family caregivers.

The present validation study was conducted among family caregivers of patients with breast cancer, as this group represents one of the largest and most accessible caregiver populations in Iran. Breast cancer is the most common cancer among Iranian women and requires prolonged treatment and long-term family involvement (6), making these caregivers an appropriate population for the initial psychometric evaluation of the HLCS-C. Nevertheless, the experiences and health literacy needs of caregivers may differ across cancer types because of differences in disease trajectory, patient demographics, and caregiving responsibilities.

The National Cancer Institute (NCI) has emphasized the critical role of family caregivers in treatment, care planning, and patient health outcomes (41). Family caregivers typically assume a wide range of roles and responsibilities throughout the caregiving period (42). Enhancing the health literacy of family caregivers is a key strategy for facilitating caregiving responsibilities. Health literacy among caregivers can play a fundamental role in fulfilling roles and responsibilities related to caring for cancer patients (9). With the increasing number of individuals diagnosed with cancer, identifying the health literacy of caregivers is more important than ever, necessitating the presence of a valid and reliable tool for its assessment. To determine the psychometric properties of the instrument, its validity was assessed using content validity (quantitative and qualitative), face validity (qualitative and quantitative), and

construct validity (exploratory and confirmatory factor analysis). The reliability of the instrument was also examined and confirmed through internal consistency (Cronbach's alpha coefficient and McDonald's omega), and test-retest reliability. The Cronbach's alpha coefficient obtained for the questionnaire was 0.93, indicating a satisfactory internal consistency of the questionnaire. In line with this finding, Yuen et al. reported a reliability of 0.86 for the overall questionnaire and a range of 0.78 to 0.92 for its 10 factors (26). The overall omega total was lower than Cronbach's alpha (0.86 versus 0.93), which is plausible because omega accommodates unequal item loadings, whereas alpha relies on the stronger tau-equivalence assumption. Both coefficients nevertheless supported satisfactory internal consistency.

Exploratory factor analysis (EFA) is a crucial statistical tool for validating questionnaires. In this study, EFA was conducted to verify the structure of the 46-item questionnaire. The results revealed a nine-factor structure, in contrast to the original 10-factor structure of the questionnaire. The variance explained by the factors for measuring the intended concept in the questionnaire was approximately 57% (9 factors). Furthermore, the KMO value, the significance of Bartlett's test, and the RMSEA value of 0.06 confirmed the adequacy of the model. The extracted factors of the present questionnaire are in line with the results of some studies conducted in this field. In a study aimed at developing a conceptual model of health literacy for cancer caregivers, the identified study factors include access to information, understanding information, communication with healthcare providers, communication with care recipients, management of healthcare system challenges, and support (43). Although the original HLCS-C was developed with a 10-factor structure, the Persian version yielded a 9-factor solution. The reduction from ten to nine factors suggests that the conceptual organization of caregiver health literacy may differ across cultural contexts. This difference may reflect cultural and linguistic differences, variations in caregivers' experiences, and differences in the interpretation of questionnaire items within the Iranian context. In Iran, caregiving is predominantly family-centered, and family members often share caregiving responsibilities and rely on informal support networks. Consequently, some domains that emerged as distinct constructs in the original Australian version may have been perceived as conceptually overlapping, resulting in their integration into a single factor. During the exploratory factor analysis, some items demonstrated different loading patterns or conceptual overlap, resulting in a more parsimonious nine-factor structure. Despite this structural difference, the extracted factors remained conceptually meaningful and consistent with the theoretical framework of the original instrument, supporting the construct validity of the Persian HLCS-C. These findings suggest that the Persian version preserves the conceptual foundation of the original HLCS-C while reflecting the cultural characteristics of Iranian family caregivers. Quantitatively, the total-scale Cronbach's alpha in the Persian version (0.93) was higher than the 0.86 reported for the original Australian validation, while the domain-specific alpha coefficients in the present study (0.75–0.89) were broadly comparable with the original range (0.78–0.92) [23]. The Persian solution retained all 46 items, explained 57% of the total variance, and reorganized the construct from 10 to 9 factors.

Published cross-cultural validation evidence for the HLCS-C remains limited; therefore, further independent validations are needed before firm cross-cultural conclusions can be drawn.

Information Acquisition and Adequacy is the first major factor identified in cancer caregiver health literacy. This dimension consists of eight items related to searching for cancer-related information to care for the patient, having sufficient information about cancer, treatment side effects, and their management. Adequate information for caregivers is a vital component in coping with cancer. Caregivers need up-to-date information about the patient's health and treatment (44). Studies show that caregivers have many unmet informational needs while providing care and support to cancer patients and must search for information to complete their informational needs (45). The results of another study showed that caregivers of cancer patients searched for the information they needed from the internet and healthcare professionals. The results of this study also showed that the three main topics that caregivers searched for were disease, treatment, and side effects, which confirms the items of this factor in the questionnaire (46).

Supported by Healthcare Providers is the second major factor that plays an important role in cancer caregiver health literacy. This dimension consists of five items related to healthcare providers' support of family caregivers in understanding cancer-related information, understanding treatment-related materials, and referring to available care services. In line with this, a study stated that caregivers of cancer patients do not receive adequate information and support from healthcare professionals (47). The findings of a recent qualitative study on family caregivers of cancer patients emphasize the importance of healthcare professionals taking time for caregivers, listening, and sharing caregiving information with family caregivers, which is in line with the present study (48).

Family/Friends Advocacy and Collaboration is the third major factor identified in cancer caregiver health literacy. This dimension consists of four items related to support and understanding of the caregiver by family and friends, having someone to rely on when help is needed, and having a family member or friend to understand cancer-related information. In line with this, a systematic review study of breast cancer caregivers found that the need for family and friend support was the most common need expressed by caregivers. Caregivers reported that they did not receive enough social support from their family and friends. Specifically, caregivers described the need to share caregiving responsibilities with other family members and friends. The results of this study also showed that some caregivers stated that they felt isolated and unsupported by family and friends, which increased the burden associated with their caregiving roles (6).

Cancer-Related Communication with Patient is another factor that plays an important role in health literacy. This dimension consists of five items and includes honest communication with the patient, sharing information provided by healthcare professionals with the patient, involving the patient in the decision-making process, and being aware of the patient's desires and need to understand cancer-related information. Communication with the patient is a key factor in the treatment process. The results of a study showed that most of the discussions

that took place between couples where one of them had cancer involved information exchange, consultation, and making arrangements rather than expressing emotions (42). These findings emphasize the importance and need to focus on the relationship between the patient and caregivers when they receive a cancer diagnosis, as a supportive relationship can have a protective effect on the treatment process (49).

Understanding Patients' Needs and Preferences is another important factor identified in cancer caregiver health literacy. This dimension consists of five items and includes being aware of the patient's limitations in performing daily and physical activities, understanding the patient's needs, and helping the patient. Wittenberg et al. also emphasized the importance of recognizing the care recipient's needs in their study to optimize the role of informal cancer caregivers in the Development of a communication and health literacy curriculum (50). Given that cancer patients are physically weak and unable to perform daily living activities during treatment, it is important for their needs to be understood and addressed by caregivers. However, little research has been conducted in this area, and most studies have focused on the needs and expectations of caregivers.

Self-Care is the sixth factor obtained through exploratory factor analysis. It consists of five items related to getting enough rest during caregiving, taking enough time for one's own health, exercising, and visiting by healthcare providers. Given that family caregivers of cancer patients are responsible for monitoring and managing symptoms, etc., their time and energy are limited due to caregiving activities, so participating in self-care activities is challenging. According to a study by Nicholas Dionne-Odom and colleagues, self-care practices in cancer caregivers are reported to be poor, which may be partly due to caregivers not having enough time to do so. The results of this study also showed that lower self-care is associated with poorer performance in caregiving activities (51). Another study found that caregivers are less aware of the importance of self-care. This is concerning, as self-care activities are important for the well-being of caregivers and their ability to continue caregiving activities (52).

Understanding the Healthcare System is the seventh major factor identified. This factor consists of six items and includes recognizing the rights of health service recipients, understanding proper healthcare providers, knowing appropriate places to receive healthcare services, and how to make appointments with healthcare professionals. In line with this, a study found that the major challenges for family caregivers of cancer with the healthcare system are the long time between referral and appointment with the doctor and crowded inpatient departments, etc. (53). Understanding these aspects of the healthcare system is essential for individuals to effectively navigate and access healthcare services. With a comprehensive understanding of these aspects of the healthcare system, individuals can make informed decisions and navigate the healthcare landscape more effectively, ultimately leading to improved health outcomes and patient satisfaction.

Evaluating Information Critically is another important factor in cancer caregiver health literacy. This factor has 4 items and includes processing information in terms of reliability, identifying credible sources of information, and reliable sources for accessing information about cancer. Studies results show that most caregivers use websites or social media sites as

a source of cancer-related information (46, 54). However, they do not consider the information obtained online and in the virtual platform to be reliable and use it because of the immediate access to information (54) and consider the information provided by healthcare professionals as a reliable source of information for caregiving (55).

Active Engagement with Healthcare Providers was identified as one of the key factors in caregiver health literacy. This factor consists of four items and includes the caregiver's active engagement with healthcare providers as a personal characteristic, the caregiver's capacity to actively seek information from healthcare providers and ask them questions, and discussing information about care. These are noteworthy because studies have shown that caregivers were actively seeking interaction and information from healthcare providers, and they identified healthcare providers as the most reliable source for obtaining health information (55). In line with this, a study found that caregivers wanted healthcare professionals to hold educational classes (56). However, due to factors such as time constraints for healthcare providers, inadequate communication, and caregivers' work commitments, caregivers are unable to effectively communicate with healthcare providers (46). This can impair the caregiver's ability to understand the illness and provide adequate support to the care recipient and may contribute to poorer health outcomes.

Given the increasing number of people with cancer and the family-centered care of these patients, there is a need for a tool to assess the health literacy of cancer caregivers. This will allow us to identify caregivers' weaknesses and take steps to improve their health literacy in caring for cancer patients. This makes the need for a dedicated tool to measure cancer caregiver health literacy even more important.

Study Limitations and Strengths: One of the strengths of the present study is the psychometric evaluation of the HLCS-C questionnaire for the first time in Iran. Another strength is the use of exploratory and confirmatory factor analyses on two separate datasets. Some limitations should also be acknowledged. The study was conducted only among Azerbaijani family caregivers of patients with breast cancer. Therefore, the findings may not be generalizable to caregivers from other ethnic groups or those caring for patients with other cancer types, such as prostate, colorectal, lung, or childhood cancers, because differences in patient characteristics, caregiving demands, and disease trajectories may influence caregiver health literacy and responses to the HLCS-C. Future studies should validate the Persian version of the instrument in caregivers of other malignancies. Moreover, convenience sampling may have introduced selection bias and limited the generalizability of the findings. In addition, caregivers with previous experience of caring for a patient with cancer were excluded, which may have introduced selection bias and limited the generalizability of the psychometric findings to first-time caregivers. Therefore, the psychometric properties of the Persian HLCS-C should be interpreted cautiously when applied to experienced cancer caregivers, and further validation in this population is recommended.

Conclusion

The HLCS-C questionnaire is a valid and reliable tool for assessing cancer caregiver health literacy. The questionnaire is specific to cancer caregivers and covers a wide range of health literacy domains.

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Availability of data and materials: The datasets will generate and/or analyses during the current study will not be publicly available due to limitations of ethical approval involving the patient data and anonymity but will be available from the corresponding author on reasonable request.

Conflicts of interest: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Consent for publication: Not applicable.

Ethics approval and consent to participate: This study was conducted in accordance with the ethical standards laid down in the Declaration of Helsinki and its later amendments. The research protocol was approved by the Ethics Committee of Tabriz University of Medical Sciences, Tabriz, Iran (approval code: IR.TBZMED.REC.1401.1099). Written informed consent was obtained from all participants prior to their enrolment in the study. All procedures were performed in compliance with the relevant guidelines and regulations. We also express our gratitude to our colleagues in the Clinical Research and Development Unit, Razi Psychiatric Hospital, Tabriz University of Medical Sciences.

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