Research Paper

Investigating the Development and Psychometric Testing of the Information and Communication Technology Use Scale in Iranian Patients With Chronic Conditions

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Citation Izadi-Avanji, F. S. & Esmaeli. T., 2024. Investigating the Development and Psychometric Testing of the Information and Communication Technology Use Scale in Iranian Patients With Chronic Conditions. *Journal of Client-Centered Nursing Care*, 10(1), pp. 15-24. https://doi.org/10.32598/JCCNC.10.1.280.6

https://doi.org/10.32598/JCCNC.10.1.280.6

Article info:
Received: 01 Jul 2023
Accepted: 15 Oct 2023
Published: 01 Feb 2024

Keywords:
Chronic disease, Information and communication technology, Reliability, Validity, Scale

ABSTRACT

Background: The high prevalence and associated costs of chronic diseases have challenged global community health. The use of information and communication technology offers patients and healthcare providers the ability to respond to healthcare needs. This study develops an information and communication technology use scale for patients with chronic diseases and evaluates its psychometric properties.

Methods: This exploratory sequential mixed-method study was conducted in Kashan City, Iran from September 2020 to July 2021. In the qualitative phase, 18 patients with chronic conditions were recruited via the purposeful sampling method. The initial pool of 33 items was extracted in this phase. Psychometric evaluation of the scale was examined through face, content, and construct validity. The internal consistency of the scale was assessed with the Cronbach α and its stability was examined by the test re-test. To evaluate the scale's construct validity, a cross-sectional study was performed with 300 patients referring to hospital wards and private centers that provide services to patients with chronic diseases. A sequential sampling method was used to select the subjects. The exploratory factor analysis was performed using principal component analysis and the varimax rotation method in the SPSS software, version 16.

Results: The initial version of the scale consisted of 33 items. A total of 6 items were removed in the face and content validity evaluation phase. Factor analysis with the removal of 4 items resulted in the extraction of 4 factors that explained 67.45% of the variance in the total scale score. The Cronbach α coefficient and intra-class correlation coefficient were estimated at 0.93 and 0.88, respectively.

Conclusion: The scale developed in this study is a valid and reliable tool for measuring formation and communication technology use (including its dimensions) in patients with chronic diseases.

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Highlights

• Information and communication technology (ICT) facilitates patients with chronic diseases to receive appropriate medical care and enables them to better manage their condition. Therefore, it is necessary to have tools to measure the use of ICT by these patients.

• The social and economic status of each region affects the type and extent of ICT use by patients with chronic diseases.

• There is no tool to measure ICT use in patients with chronic diseases that considers the differences in the social and economic context of Iran.

• This study led to the development and psychometric measurement of ICT use in patients with chronic diseases in Iranian society.

Plain Language Summary

The management and control of chronic diseases require the use of information and communication technology. This study developed and psychometrically evaluated the scale of use of information and communication technology scale in Iranian patients with chronic diseases. Based on the research results, the scale designed with 23 items and four factors is a valid and reliable tool to measure the use of information and communication technology in patients with chronic diseases.

Introduction

Chronic diseases or non-communicable diseases (NCDs) are considered an invisible epidemic that jeopardizes the future of global health by the World Health Organization (WHO) (Dadgar & Joshi, 2018). NCDs take the lives of 41 million people annually, which is equivalent to 74% of all deaths globally (WHO, 2022). The increasing prevalence of chronic diseases has brought challenges for patients, healthcare providers, and global society. As technology evolves, healthcare providers are looking for innovative solutions to address these challenges (Zare & Jebraeily, 2018). Using information and communication technology (ICT) is an opportunity for patients and their families to improve the quality, access, and efficacy of healthcare (Kumar et al., 2022). The extensive use of ICT to provide healthcare facilitates access to health-related information even for patients living in remote areas (Afshar et al., 2014; Al-Shorbaji, 2021; Antoun, 2016).

ICT refers to technology that provides access to information and communication through a wide range of communication tools (Kaware & Sain, 2015). In the present study, ICT means access to this technology through various devices, such as computers, laptops, the Internet, and smartphones. WHO defines eHealth as the cost-effective and safe use of ICT in health support and health-related fields, including healthcare services, health surveillance, health literature, and health education, knowledge, and research (WHO, eHealth). Although technological advances in eHealth improve self-management and disease control and reduce costs, patients often avoid using these advances, perhaps because they are often overlooked in the design of these technologies (Dodgar & Joshi, 2018), they are inadequate familiar with them, or their access is limited (Izadi-Avanji et al., 2022; Yazdani-Darki et al., 2020). According to WHO, the Eastern Mediterranean region consists of different levels of maturity and readiness to use eHealth as a key element in the delivery of health care services (WHO, eHealth).

According to a study in the United States, although the benefits of using ICT were numerous, doctors rarely used technologies, such as e-mail, to communicate with patients, and most patients were dissatisfied (Antoun, 2016). In Iran, the use of ICT in health is not as much as in developed countries (Farahmandian et al., 2015). Physical and mental limitations, the lack of proper knowledge and awareness, limited access to technology, and unfavorable attitudes toward technology are among the factors that have reduced its use (Yazdani-Darki et al., 2020). Considering the ever-increasing growth of information and communication technology and the importance of its use in the health sector, it is necessary to evaluate the use of technology in different populations,

especially chronic diseases, to facilitate the formulation of strategic and operational plans and the allocation of realistic resources in this field (Hemmat et al., 2019). To help manage chronic diseases using ICT, it seems necessary to have a comprehensive tool that is developed based on the direct experience of patients (Ekeland et al., 2010). Based on the available contents of national and international electronic scientific databases, no comprehensive tool has yet been designed to measure the use of ICT among patients with chronic diseases. Most of the existing designed tools are related to the use of ICT in the field of education (Odhiambo & Onyango, 2015; Torres et al., 2013). The instruments to measure which kind of ICTs are available to patients and how patients use them are yet to be mapped in the literature (Tahsin et al., 2023). Considering the role of ICT in enabling and supporting patients with chronic diseases (Tahsin et al., 2023) and its innovative impact on the provision of health services and quality of life (Achampong, 2012), as well as the increasing growth of chronic diseases, it is necessary to design a tool to measure the use of ICT in patients suffering from chronic diseases. Based on this, the present study develops a scale for the use of ICT in patients with chronic conditions and evaluates its psychometric properties. The results of the survey based on such a tool can provide health policymakers with valuable evidence for planning and providing health care using ICT.

Materials and Methods

Study design, setting, and sample

This exploratory sequential mixed-method study was conducted in two consecutive stages in Kashan Province, Iran, in 2021. The participants consisted of patients with chronic conditions, such as ischemic heart disease, diabetes, hypothyroidism, hypertension, multiple sclerosis, and cancer. The inclusion criteria were having 20 years of age or more, the ability to verbally communicate with the researcher, a definite diagnosis of chronic disease by an expert, the ability to read and write, and the willingness to participate in the study.

First stage

During the first phase, a qualitative study was conducted with patients referred to internal wards of Shahid Beheshti Hospital and private centers serving patients with chronic diseases in Kashan Province, Iran. A total of 18 patients with chronic diseases were selected based on the purposive sampling method and the data were collected through semi-structured face-to-face interviews. The main interview questions were as follows: 1) "Explain what using technology means to you." and 2) "Explain how health-related technologies can help you." The interviews were conducted after coordination with the patients in private rooms of the research environment and each session lasted approximately 20 to 30 min. With the consent of the participants, the interviews were recorded using a digital audio recorder. The data collection continued until data saturation and no new code generation occurred (Braun & Clarke, 2021). Interviews were transcribed verbatim and analyzed using conventional content analysis, and scale items were extracted using the method presented by Waltz et al. (2010). Finally, a preliminary instrument of 33 items was developed based on the interviews.

Second stage

In the second step, psychometric tests of the primary instrument were performed. To determine the quantitative face validity of the tool, 10 patients with chronic diseases who were referred to the internal wards of Shahid Beheshti Hospital filled in the importance of each item on a 5-point Likert scale ranging from "not very important" to "very important". Subsequently, impact scores for each item were calculated using the Equation 1:

1. Impact scores=Prevalence (%)×Importance.

If items had an impact score above 1.5, the item was kept (Polit & Beck, 2010). The quantitative content validity of the tool was verified by determining the content validity ratio (CVR) and the content validity index (CVI). CVR indicates the necessity of each element on a scale (Almanasreh et al., 2019) calculated based on the Lawshe table (Lawshe, 1975). The scale was rated by 12 experts, eight of whom had PhDs in nursing with experience in tool development and four were experts in medical information technology. Experts identified the necessity of each item on a 3-point Likert scale (from 1=not necessary, 2=useful but not necessary, 3=necessary). The CVR of each subject was then calculated. To assess the CVI, the tool was administered to the same experts and asked to rate the importance of each item on a 4-point Likert scale (ranging from 1=not important to 4=completely important). Modified Kappa values were then estimated.

According to Polit and Beck (2010), the modified Kappa values were as follows: Fair=0.40-0.59, good=0.6 to 0.74, and excellent k >0.74. To measure the CVI of the scale, the average of the content validity indices of all items was calculated. Items with a score of <0.70 were not considered acceptable and were removed. Items with

scores >0.79 were considered appropriate and items with scores between 0.79 and 0.70 were modified (Polit & Beck, 2010).

To assess qualitative content validity, the scale was administered to 12 experts who provided opinions on grammar, wording, item alignment, scaling, clarity, and simplicity. Finally, by removing 2 items in the face validity phase and 3 items in the content validity phase, a 28-item construct validity scale was produced. Exploratory factor analysis (EFA) was used to assess the construct validity of the scale (Taherdoost et al., 2022). For this purpose, the scale was given to 300 patients with chronic diseases to complete it. These patients were recruited by sequential sampling. The number of samples needed to perform EFA varies from the perspective of different researchers. The minimum sample size for each item was 5-10 subjects (Nguyen & Waller, 2022). In this study, 10 subjects (280 patients) were considered for each item; however, 300 questionnaires were completed to reduce the possibility of error. After obtaining the necessary consent, the patients were selected based on the inclusion criteria and completed a questionnaire on demographic characteristics and the developed scale. EFA was performed using principal component analysis with varimax rotation.

To determine the factors, an eigenvalue greater than 1.0 and for removing items a factor loading lower than 0.4 were considered. Meanwhile, 5 items with factor loadings <0.4 were removed, resulting in item reduction.

The internal consistency of the scale and its subscales was calculated using the Cronbach α coefficient (Alkhadim, 2022). The test re-test method was used to measure the stability of the scale. The scale was administered to 15 chronically ill patients twice at two-week intervals, and the correlation coefficient between the results of the two tests was calculated (Ten Hove et al., 2022).

Data analysis

Data analysis was performed using the SPSS software, version 16. The normality of quantitative data was performed using the Kolmogorov-Smirnov test. Descriptive statistics, including frequency, Mean±SD, variance, and range of scores were used to summarize the study patients' characteristics. The Bartlett test of sphericity and the Kaiser-Meyer Olkin test of goodness of fit were used to determine the suitability of data for exploratory factor analysis. All analyses considered a significance level of <0.05.

3. Results

The initial version of the scale had 33 items in four domains as follows; familiarity with ICT (6 items), access to ICT (6 items), receive of services (14 items), and health information seeking (7 items). Examining the impact scores of the items revealed that two items scored below 1.5 and were removed from the tool.

Assessing the quantitative content validity, the CVR of the two items (0.56) was lower than the indicator of Lawshe and these items were also removed. Examining the item CVI revealed that one item had a score below 0.70 and was removed.

The scale CVI average was 0.91. Overall, a preliminary version of the 28-item tool was produced during the first phase of psychometric evaluation with modifications to determine construct validity.

The analysis of the demographic characteristics of the 300 patients showed that the subjects ranged in age from 20 to 85 years, with a mean age of 44.57±9.59 years, which is summarized in Table 1. Based on the Kaiser-Meyer Olkin test (0.85), the sample size was adequate, and the Bartlett test also showed that the correlation matrix between the items of the scale did not interfere with factor analysis. The factor analysis identified four factors, removing 4 items with factor loadings <0.4 and one item with cross-factor loadings. These factors were named under the titles of familiarity with ICT, access to ICT, receiving of services, and health information seeking, which explained 67.45% of the variance of the tool's total score (Table 2).

The internal consistency of the scale was assessed using the Cronbach α method at 0.93. The Cronbach α coefficients for the subscales were calculated between 0.84 and 0.94 (Table 3). The scale stability was calculated by test re-test (0.88). The intraclass correlation coefficient for subscales ranged from 0.77 to 0.81 (Table 3). Finally, a 23-item, four-factor instrument was developed, rated on a 5-point Likert scale.

Scoring of the subscale of familiarity with ICT was as follows: Very much=4, much=3, somewhat=2, little=1, and not at all=0. Other subscales (health Information seeking, receiving services, and access to ICT) were scored as follows: Always=4, often=3, sometimes=2, rarely=1, and never=0. To calculate the total score of the scale, the scores of each item were summed. The minimum and maximum points of the scale were 0 to 112, respectively. Higher scores indicated better use of ICT (Table 3). A summary of the stages of the study and its results are presented in Table 4.

Table 1. Sociodemographic characteristics of the participants (n=300)

Qualitative Variables	Category	No. (%)
Gender	Male	144(48)
	Female	156(52)
Marital status	Single (single, divorced, and widowed)	68(22.7)
	Married	232(77.3)
Education	Elementary	14(4.7)
	Diploma	125(41.7)
	University	161(53.7)
Satisfaction with income	Satisfied	131(43.7)
	Dissatisfied	169(56.3)
Smoking	Yes	65(21.7)
	No	235(78.3)
Location	City	282(94.0)
	Suburb	18(6.0)
Job	Employee	100(33.3)
	Retired	37(12.3)
	Housekeeper	104(34.7)
	Self-employed	59(19.7)
Quantitative Variables	**Domain**	**Mean±SD**
Age (y)	20-70	44.57±9.5
Illness duration (m)	2-332	42.41±39.5

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Table 2. Eigenvalues, variance explained by factors, and total variance explained

Factors Extracted	Eigenvalues	Variance Explained
Factor 1 (5 items)	8.992	39.097
Factor 2 (7 items)	2.762	12.008
Factor 3 (6 items)	2.402	10.444
Factor 4 (5 items)	1.357	5.902
Total variance		67.451

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Notes: Factor 1=Information seeking; Factor 2=Receiving services; Factor 3=Familiarity with information communication technology; Factor 4=Access to information communication technology.

Table 3. Developed a scale for measuring information communication technology use in patients with chronic conditions

	Items of Information Communication Technology Use Scale in Patients With Chronic Diseases	Factor 1	Factor 2	Factor 3	Factor 4
	Health Information Seeking				
1	I get information about the type of physical activity.	0.893			
2	I get information about the level of my physical activities.	0.892			
3	I get information about the complications of my disease.	0.853			
4	I get information about my medicines.	0.763			
5	I get information about my diet.	0.746			
	Receive Services				
6	I use information and communication technology to get imaging results.		0.762		
7	I use information and communication technology to get my test results.		0.755		
8	I use information and communication technology to make an appointment to visit a doctor.		0.726		
9	I use information and communication technology to find a qualified doctor.		0.719		
10	I use information and communication technology to choose well-equipped medical centers.		0.712		
11	I use information and communication technology to communicate with my doctor.		0.617		
12	I use information and communication technology to renew my prescriptions.		0.595		
	Familiarity With Information Communication Technology				
13	I am familiar with interactive voice response phones, smart mobile phones, the internet, computer or laptop, and applications.			0.808	
14	I know how to use a computer or laptop.			0.781	
15	I know how to connect to the Internet.			0.692	
16	I know how to use a smartphone.			0.653	
17	I know how to use interactive voice response (interactive voice response) phones.			0.640	
18	I know how to use health-related applications.			0.540	
	Access to Information Communication Technology				
19	I have access to a computer or laptop when needed.				0.785
20	I have access to the Internet when I need it.				0.721
21	I have access to health-related social media platforms.				0.638
22	I am connected to a health-related short message service system.				0.636
23	I have access to health-related applications.				0.533
	Cronbach α Coefficient for Each Factor	0.94	0.86	0.92	0.84
	ICC	0.77	0.78	0.81	0.80

Notes: Factor loadings <0.4 are deleted in the table.

ICC: Intra-class correlation coefficient.

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Table 4. Summary of tool development stages

Stage 1. Questionnaire Construction		
Qualitative study (n=18 patients) Literature review	Item generation	33 Items developed.
Stage 2. Evaluating Psychometric Properties of the Scale		
Evaluation by patients with chronic conditions (n=10)	Face validity	1) Qualitative face validity: 6 items were edited in terms of wording. 2) Quantitative face validity: 2 items with an impact score of <1.5 were deleted.
Evaluation by experts (n=12)	Content validity	1) Qualitative content validity: 10 items amended in terms of grammar, wording, scaling, clarity, and simplicity. 2) Content validity ratio (necessity): 2 items had CVR <0.65 and were deleted. 3) Content validity index (relevancy): I-CVI value of 1 item was <0.70 and was removed. S-CVI/Ave=0.91.
Main study (n=300)	Structural validity	4-factor model - Health Information seeking (5 items) - Receive of services (7 items) - Familiarity with ICT (6 items) - Access to ICT (5 items) Developed scale=23 items (final version)
Scale Reliability and Stability		
The subsample of patients (n=15)	Internal consistency	Cronbach α=0.93
The subsample of patients (n=15)	Test re-test reliability	ICC=0.88 (95% CI, 0.83%–0.91%)

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Abbreviations: CVR: Content validity ratio; I-CVI: Item content validity index; S-CVI/Ave: Scale-content validity index/average; ICC: Intra-class correlation coefficient.

Discussion

This study developed an instrument to measure the use of ICT by patients suffering from chronic diseases. The results showed that the developed scale is a valid and reliable tool with four subscales that include health information seeking (5 points), receiving services (7 points), familiarity with ICT (6 points), and access to ICT used by the Iranian population (5 items). The present study has highlighted that two factors of health information-seeking and receiving services have the highest factor load among the four factors of using ICT. Simultaneously, the other two factors of familiarity with ICT and access to ICT are less important in the use of ICT.

The importance of these factors is highlighted by some similarities and differences in previous studies. In line with our results, other studies in Iran and Spain demonstrated that most patients use ICT for health information seeking and receiving education (Alarcon et al., 2006; Zare & Jebraeily, 2018). In the present study, the health information seeking of patients was focused on the type and intensity of physical activity, dietary guidelines, and the side effects of the drugs used, which is consistent with the results of other studies (Apolinário-Hagen et al., 2017; Frontini & Sousa, 2019). However, a study in Portugal showed that the most important reason for patients to use ICT was to receive services, such as receiving test results, renewing prescriptions, instructions about treatment, and receiving information about how to take their medications (Santana, 2007). Another study stated that the most important reason for the willingness of patients to use ICT were having independence, managing chronic conditions, and having access to health information sources at any time and place (Vassli & Farshchian, 2018).

ICT is an important technology for patients to communicate with health resources and receive health care, but its acceptance is influenced by the variables of perceived usefulness, ease of use, and attitude (AlQudah et al., 2021; Nazari-Shirkouhi et al., 2023; Tabares-Tabares et al., 2020; Zin et al., 2023). These features are consistent with what was found in the present study.

The internal consistency of the whole scale was 0.93. According to Nawi et al. (2020), the internal consistency of higher than 0.90 indicates that some items may be redundant (Nawi et al., 2020). Therefore, a confirmatory factor analysis is suggested. This method shows whether the number of items in a structure is correctly selected. In other words, it determines the appropriateness of each item in a factor (Brown, 2015).

Conclusion

The developed scale with subscales of health information seeking, receiving services, familiarity with ICT, and access to ICT is a valid and reliable tool for measuring the use of ICT by patients with chronic diseases. Developed as a research tool, the scale provides healthcare professionals with the information needed to identify digital health challenges for patients with chronic diseases.

Therefore, the current scale is a cost-effective way to grow health-related knowledge and improve self-care in patients with chronic conditions.

The findings should be interpreted cautiously because there are limitations in the scale in the qualitative and quantitative phases of development. The data were collected by self-reporting and non-probability sampling methods were used to select the participants; therefore, the sample may not be representative of all patients with chronic conditions. Accordingly, further studies are required to evaluate the reliability and stability of the scale and its structure validity in different regions. Due to the relatively small geographical area in which the data were collected, the wider generalization of the present results may be limited.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of Kashan University of Medical Sciences (Code: IR.KAUMS.NUHEPM.REC.1399.041). All the participants were assured about the anonymity and confidentiality of information and audio files. Written informed consent was obtained from the participants.

Funding

This study was financially supported by Kashan University of Medical Sciences, Iran (Grant No.: 99096).

Authors' contributions

Methodology: Fatemeh Sadat Izadi-Avanji; Conceptualization, supervision Investigation, writing: All authors

Conflict of interest

The authors declared no conflict of interest.

Acknowledgments

The authors express their gratitude to Kashan University of Medical Sciences.

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