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Development and validation of a scale to measure older adults' information technology acceptance

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Abstract

Background: Despite the importance of technology in older adults' quality of life, there is no standard scale for measuring the technology acceptance for Iranian older adults.
Objective: To develop an ICT acceptance questionnaire and assess the validity and reliability of this scale among the older adults' population of Tehran.
Methods: To develop a valid and reliable questionnaire initial item pool derived from existing questionnaires. These items translated into the Persian language. The content and face validity and the structural validity of the questionnaire were assessed.
Results: The item-level content validity index (I-CVI) was between 0.87 and 1.00, and the scale-level content validity index (S-CVI/Ave) was 0.98. After confirmatory factor analysis, the scale includes 22 items classified into five dimensions. The Cronbach's alpha for the scale was 0.88. The construction of such a tool has been carried out for the first time in Iran.
Conclusion: Considering the appropriate psychoanalytic features of the scale, its use can stimulate conducting applied research in the field of technologies that facilitate aging.

Keywords: Older adults, digital divide, Technology Acceptance Model, quality of life

Introduction

According to the statistics, Iran is one of the developing countries that will face the challenges of ageing in the near future (Basakha, Yavari, Sadeghi, & Naseri, 2013). In Iran, this problem can be partly attributed to the population growth policies adopted in the 1980s, which led to unprecedented population growth in that decade. According to United Nations forecasts, Iran ranks third globally in terms of population ageing growth. According to this report, one-third of Iran's population is expected to be 60 years and older in 2050(United-Nations, 2010).

The emergence and expansion of information and communication technologies (ICT)provide a huge potential to achieve difficult goals more easily. ICT has increased the sharing of information and transformed many of the traditional economic and social concepts(McCausland & Falk, 2012).

Widespread use of computers, internet, smartphones, and other ICT tools, make it now possible to serve and support the older adults in ways that were thought impossible formerly. Remote care, ICT-based health services, and online social support are some of the most important services that have affected health(Wiklund-Axelsson, Melander-Wikman, Näslund, & Nyberg, 2013), education(Ng, 2007), quality of life(Delello & McWhorter, 2017) and personal autonomy (Chalghoumi, Cobigo, & Jutai, 2017) of the older adults. But it should be noted that the use of these services and taking advantage of their benefits depends on the technology acceptance and the ability to use it in practice by the older adults (McCreadie & Tinker, 2005).

The ever growing population of older people and the significant benefits of ICT for this demographic group (Chen & Chan, 2011) have encouraged an effort to increase the penetration rate of these tools among the older adults. According to Iranian household statistics, despite the increased penetration rate of ICT use among different age groups, this increase has been very limited among the older age groups. For example, while the average penetration rate of internet use in Iran is 30 percent, it is only 4.6 percent among people aged 50-74 years and 0.1 percent among people older than 75. This is also true for the use of computers, laptops, and tablets, which have an average penetration rate of about 35 percent, while this rate is only 10 percent among people older than 50(SCI, 2015). One of the best ways to deal with this issue is to lay the groundwork for

Table 1.1. Content validity measures of the technology acceptance questionnaire assessment.

No.		Item	CVR	I-CVI	Pc	K*
1		If I need information, I can find it on the internet.	1	1	0.004	1
2		Most of the time, if there is a problem with my mobile phone, I can fix it myself.	0.5			
3	**Independence of user**	I have no trouble working with a smartphone.	1	1	0.004	1
4		If someone teaches me how to do something with a smartphone, I'll learn it	0.75	1	0.004	1
5		I'm not up to date with smartphones.	0.75	0.75	0.109	0.72
6		I can learn some functions of the smartphone by trial and error	1	1	0.004	1
7		In general, it is easy for me to work with smartphones and internet.	1	1	0.004	1
8		Using smartphones is a little intimidating for me.	1	1	0.004	1
9	**Perceived ease of use**	It is easy and fun to use different smartphone apps.	1	1	0.004	1
10		I need to focus to use smartphones.	1	1	0.004	1
11		I do not know much about what can be done with smartphones and internet.	0.75	1	0.004	1
12		It is difficult for people my age to work with smartphones.	1	1	0.004	1
13		It is an interesting idea to use computers, smartphones and internet in everyday life.	1	1	0.004	1
14		Using computers, smartphones, and internet makes me nervous.	0.75	1	0.004	1
15	**Attitude to use**	I am not inclined to use computers, smartphones, and internet in my everyday life.	0.75	1	0.004	1
16		I like searching on the Internet.	0.75	1	0.004	1
17		Friends and acquaintances always encourage me to use computers and internet.	1	1	0.004	1

technology acceptance among the older adults.

The review of literature related to technology acceptance in Iran shows that some studies have examined technology acceptance in the

Table 1.2. Content validity measures of the technology acceptance questionnaire assessment.

No.		Item	CVR	I-CVI	Pc	K*
18		My peers who use computers, smartphones, and internet have a more comfortable life.	1	1	0.004	1
19		Using computers, smartphones, and internet helps me do things faster.	0.75	1	0.004	1
20	**Perceived usefulness**	Communication tools such as smartphones and internet have brought people closer to each other.	1	1	0.004	1
21		Computer, smartphones, and internet have made life much easier.	1	0.87	0.031	0.87
22		By using smartphones and internet, I can live a better life.	0.5			
23		Smartphones and internet make it easier to call for help when needed.	1	1	0.004	1
24		I also recommend friends and acquaintances to use computers, smartphones and internet.	0.25			
25		It is worth it to learn computer and internet.	1	1	0.004	1
26	**Intention to use**	If I have access to computers, smartphones and internet, I will use them.	1	1	0.004	1
27		If possible, I would love to have a smartphone.	1	1	0.004	1
28		I am going to learn more about computers and smartphones and I am going to use them.	1	1	0.004	1

Questions No. 2, 22 and 24 were removed because of low CVR and question No. 5 was removed because of low kappa index

Table 2.1. Final instrument items, Alpha coefficients, and factor loadings.

No.		Item	Mean	Standard deviation	Alpha Coefficients	Average Variance Extracted	Factor loading
1	Independence of user	If I need information, I can find it on the internet.	3.21	1.11	0.83	0.78	0.70*
2		I have no trouble working with a smartphone.					0.80*
3		If someone teaches me how to do something with a smartphone, I'll learn it					0.73*
4		I can learn some functions of the smartphone by trial and error					0.74*
5	Perceived ease of use	In general, it is easy for me to work with smartphones and internet.	3.26	0.71	0.72	0.81	0.79*
6		Using smartphones is a little intimidating for me.					¡
7		It is easy and fun to use different smartphone apps.					0.67*
8		I need to focus to use smartphones.					¡
9		I do not know much about what can be done with smartphones and internet.					0.29*
10		It is difficult for people my age to work with smartphones.					0.15*
11	Attitude to use	It is an interesting idea to use computers, smartphones and internet in everyday life.	3.31	1.01	0.76	0.73	0.58*
12		Using computers, smartphones, and internet makes me nervous.					0.34*
13		I am not inclined to use computers, smartphones, and internet in my everyday life.					0.49*
14		I like searching on the Internet.					0.64*
15		Friends and acquaintances always encourage me to use computers and internet.					0.32*

field of banking(Zanjirchi, Konjkave, Hataminasab, Noori, & Sattarzade, 2012), smart buildings (Hojjati & Khodakarami, 2016), or others have assessed the e-shopping tendency of the general population(Rezaei Dolatabadi, Kkazaei, & Shibani, 2012); but none of the previous works have studied the technology acceptance among the Iranian older population.

Considering the importance of ICT acceptance by the older adults and the lack of any standardized instrument for measuring this variable, the goal of this study was to develop an ICT acceptance questionnaire and assess the validity and reliability of this scale among the older adults population of Tehran.

Method

Questionnaire design

This paper was a methodological study for scale development which was conducted in 2018 and the study population was the people older than 60 years in Tehran. To create a technology acceptance measurement tool, first, the technology acceptance literature was comprehensively reviewed and the most important factors related to technology acceptance were identified. Next, the questionnaire was structured based on the

Table 2.2. Final instrument items, Alpha coefficients, and factor loadings.

No.		Item	Mean	Standard deviation	Alpha Coefficients	Average Variance Extracted	Factor loading
16	Perceived usefulness	My peers who use computers, smartphones, and internet have a more comfortable life.	3.31	0.84	0.85	0.69	0.70*
17		Using computers, smartphones, and internet helps me do things faster.					0.76*
18		Communication tools such as smartphones and internet have brought people closer to each other.					0.64*
19		Computer, smartphones, and internet have made life much easier.					0.76*
20		Smartphones and internet make it easier to call for help when needed.					0.75*
21	Intention to use	It is worth it to learn computer and internet.	3.68	1.15	0.89	0.84	0.85*
22		If I have access to computers, smartphones and internet, I will use them.					0.59*
23		If possible, I would love to have a smartphone.					0.85*
24		I am going to learn more about computers and smartphones and I am going to use them.					0.83*

*: p<0.01; Item is deleted in confirmatory factor analysis because of insignificant t value.

Table 3. Scale inter-item correlations.

	Scale	Factor				
		1	2	3	4	5
Factor 1: Independence of user	0.85*	-				
Factor 2: Perceived ease of use	0.58*	0.52*	-			
Factor 3: Perceived usefulness	0.84*	0.60*	0.28*	-		
Factor 4: Attitude to use	0.82*	0.56*	0.40*	0.67*	-	
Factor 5: Intention to use	0.88*	0.67*	0.34*	0.63*	0.68*	-

* p<0.01

theoretical foundations of the technology acceptance model(Davis, 1989; Venkatesh & Davis, 2000)and the empirical studies that employed this model (Berkowsky, Sharit, & Czaja, 2018; Heart & Kalderon, 2013; Liu & Yang, 2014; Marupping, Bala, Venkatesh, & Brown, 2017; Quaosar, Hoque, & Bao, 2018; Zhou & Teo, 2017). Necessary adjustments were made in phrases and criteria according to the target population in order to ensure that the instrument meets the face validity criteria. Finally, an initial item pool including 28 questions was prepared and printed.

Questionnaire validity

A preliminary draft was shared with a group of experts in the fields of geriatrics, social welfare, and information technology management to assess the necessity and relevance of each item. Items were rated by these experts in a 3- point scale for necessity (1=completely unnecessary, 2=useful but unnecessary, and 3=completely necessary) and 4 point scale for relevancy (1=completely irrelevant, 2=needs essential revision, 3=relevant but needs some modifications, and 4=completely relevant). Finally, the content validity ratio (CVR), content validity index (CVI), and modified kappa index was calculated.

After removing items with undesirable content validity, the questionnaire was further refined. In the end, 24 questions were deemed suitable for inclusion in the questionnaire. This 24-item questionnaire was distributed among 20 older people in a central district of Tehran to ensure that the elder can understand the questions. After making minor changes in the wording of some questions, the final 24-item questionnaire was subjected to confirmatory factor analysis to assess construct validity. All answers to the questionnaire were designed based on a 5-point Likert scale (completely agree with a score of 5 to completely disagree with a score of 1).

Statistical population and sample

The population of this study was Tehran residents aged over 60 years. This group has a population of1328443 and constitutes approximately 10 percent of Tehran's total population(SCI, 2015). In order to assess technology acceptance and determine the indices of a desirable questionnaire, Multi-stage sampling was carried out. In the first stage of sampling, all 22 zones of Tehran was divided into four area based on municipal development zoning (Rafieian & Shali, 2014) and then a random district was selected from each zone (2, 5, 12 and 19). In the second stage, the neighborhoods of the selected districts were identified and two neighborhoods were randomly selected from each district. Finally, the questioners were distributed among the older adults of the selected neighborhoods (assemblies, parks, gardens, shops and mosques).

In order to calculate the suitable sample size, a pilot questionnaire was distributed among 20 older people in Tehran. The standard deviation of ICT acceptance score in the pilot study was 0.88. Regarding the error level of 5 percent and one-fifth of the variance as a margin of error (0.18), the suitable sample size was calculated to 309 persons. To deal with complete questionnaires and data deficiency, eventually, a total of 330 questionnaires were distributed. Given the limitations that people living in nursing homes may have regarding the use of ICT tools, this group of older adults was not included in the sample.

Questionnaire reliability

Using Cronbach's alpha and Cicchetti's classification (Cicchetti & Sparrow, 1981) the internal consistency of the questionnaire as a whole, and its subscales were evaluated. According to Cicchetti, a Cronbach's alpha of less than or equal to 0.4 means weak, 0.41-0.59fair,0.60-0.74 good, and equal to or greater than 0.75 means excellent reliability. According to this classification, the reliability of different dimensions of the scale was excellent. Data analysis was performed using SPSS v21 (for the assessment of content validity and Cronbach's alpha) and AMOS v18 (for confirmatory factor analysis).

Results

The content validity of the questionnaire was evaluated using CVI for items (I-CVI) as well as the whole scale (S-CVI). CVI of the entire questionnaire was calculated to 0.98 (*Table 1*). Based on the CVR and Lawshe's minimum acceptable values(Lawshe, 1975), items 2, 22, and 24 were removed from the initial item pool.

The second criterion used to assess the validity of the questionnaire was CVI, which roughly represents the agreement among the experts on the relationship of items with different dimensions of the questionnaire. The results regarding this index are also presented in *Table 1*. The minimum threshold of acceptance for items was that the experts agree on a CVI of greater than 0.5(Lynn, 1986). After removing the items in the previous stage, no item was removed based on the CVI.

Table 4. Model fit indices.

Indices	CMIN/df	GFI	CFI	NFI	TLI	RMSEA
Obtained values	2.93	0.848	0.888	0.841	0.870	0.077

The next step was to calculate the modified Kappa index, which represents the chance of agreement for each of the items. This index is called "*modified*" because it considers the experts' agreement on the "*relationship*" of the items and does not take into account the opinions that see the items as unrelated. The items were classified as "*excellent*", "*good*" and "*moderate*" according to the modified Kappa index values. This classification was performed based on the following ranges: 0.4 to 0.59 for "*moderate*", 0.6 to 0.74 for "*good*", and greater 0.75 for "excellent"(Cicchetti & Sparrow, 1981). Based on the obtained Kappa index values, the fifth item was also eliminated.

The finalized questionnaire was distributed among the targeted respondents and the collected data was then used for confirmatory factor analysis. Based on the results of confirmatory factor analysis, the factor loadings of all items except items 6 and 8 were significant at 1 percent level. Therefore, items 6 and 8 were removed and confirmatory factor analysis was performed again without these two items.

Cronbach's alpha coefficient for the entire questionnaire was 0.88, which reflects the excellent reliability of the instrument (*Table 2*). Reliabilities of each construct ranged between 0.72 and 0.89, which exceed the minimum criteria for internal consistency(Nunnally & Bernstein, 1994). The Average Variance Extracted(AVE) for each construct exceeds the threshold value of 0.50(Fornell & Larcker, 1981).

The presented scale consisted of five dimensions as "*independence of user (IOU)*", "*perceived usefulness (PU)*", "*perceived ease of use (PEU)*", "*attitude to use (ATU)*", and "*intention to use (ITU)*" of ICT. Correlation analysis shows that there is a high correlation between the ICT acceptance and its dimensions. The strongest correlation between the dimensions of ICT acceptance was related to the "*intention to use*". In addition, the inter-dimension correlation ranges between 0.28 to 0.68 and reveals that while the dimensions are reasonably homogenous; they do contain sufficiently unique variance so as to not be isomorphic with each other (*Table 3*).

As shown in *Table 4*, all measures of model fit including Normalized Chi-square (CMIN/df), Goodness of Fit Index (GFI), Comparative Fit Index (CFI), Normed Fit Index (NFI), the Tucker-Lewis Index (TLI), and Root Mean Squared Error of Approximation (RMESA) indicating very good fit of the model.

The assessment of technology acceptance using the developed scale showed that the average score of technology acceptance in the older adults of Tehran is 3.15 (with a standard deviation of 0.75). Theoretically, the minimum and maximum scores of ICT acceptance are 1 and 5, respectively, but for the sample population, the minimum and maximumscoreswere1.17 and 4.63, respectively. The scores of each dimension showed that the dimension IOU with the average score of 3.68 had the greatest score, and the dimension PEU with the average score of 2.63 had the lowest score (*Table 3*).

Discussion

Considering the concerns about the future of Iran's population structure, a valid and reliable instrument to measure ICT acceptance will advance researches and the translation of their findings to practice. This study uses the technology acceptance model theory to develop an ICT acceptance scale. The proposed scale was found to have excellent internal consistency, validity, and a good factor structure model fit. This scale appears efficient in quantifying ICT acceptance among Tehran older adults.

Empirical studies that were conducted based on the technology acceptance model also have similar dimensions to the presented scale. For example, in a study by Money et al. (2015)the dimensions of the technology acceptance questionnaire were considered of "*ease of use*" and "*practical use*" for ICT. In another study by Nayak et al. (2010), the authors used the dimensions "*usefulness*", "*ease of use*", "*attitude to use*", and "*practical use*" for their questionnaire.

The finding of technology acceptance among Tehran's older adults show that the average acceptance score of this older population is 3.15 (out of 5) and slightly higher than the average. The results of other studies also report a similar situation. For example, Liu and Yang (2014)have reported a score of 3.5 (out of 5) for technology acceptance among Taiwan's older adults; and another study reported an acceptance rate of 44 percent for German older people (Dahms & Haesner, 2018).

The study has been conducted with some limitations. One of these restrictions was the exclusion of inactive older adults in sampling. Therefore, considering that the sample includes socially active elders, the generalization of the results of this study should be done carefully. In addition, the acceptance of technology and the use of technology are two completely different concepts. Acceptance of technology involves the formation of positive attitudes toward the technologies, which in turn is influenced by its applicability

and ease of use. But it cannot be equated with practical acceptance and real use of technology. In this study, the "*intention to use*" factor is also considered as an intermediary between the acceptance of ICT technology and its actual use among older adults. However, the growing body of empirical studies has emphasized the strong link between technology acceptance and technology use (Chen & Chan, 2014; Devaraj, Easley, & Crant, 2008; Horton, Buck, Waterson, & Clegg, 2001; Oppenauer, 2009; Yi & Hwang, 2003).

Conclusion

Developing an instrument for ICT acceptance by older adults is likely to stimulate further research in this field. More researches might translate into policies that enable older people to better manage their time, to have more social participation, to promote their social inclusion, and also help them to have easier access to health, education, and social services.

Our developed scale is a short, reliable, and valid instrument to measure ICT tools acceptance among the older population. Therefore, this questionnaire could be used as a reliable instrument for assessing technology acceptance among the Iranian older adults; but further psychometric evaluation is needed among specific groups such as the older adults living in nursing homes or older people with disabilities or physical or mental limitations. Considering that this is the first instrument ever developed for measuring this variable in Iran, this instrument can significantly facilitate applied research in the field of geriatrics in Iran.

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Ethical approval

Ethical approval for the research was obtained from the Research Ethics Committee at the University of Social Welfare and Rehabilitation Sciences (reference IR.USWR.REC.1396.142) on 10 July 2017.

Declaration of conflicting interests

The authors declare no conflicts of interest.

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