Research Paper:
Development and Psychometric Testing of the Older Adults' Technology Use at Home Scale

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ABSTRACT

Background: Aging is associated with changes in some capabilities. Using technology can help older adults to continue living independently at home. This study aimed to develop the Older Adults' Technology Use at Home Scale (OATUHS) and evaluate its psychometric properties in the Iranian context.

Methods: It was a sequential-exploratory mixed-method study for the development and psychometric testing of OATUHS. A draft scale with 15 items was generated based on a literature review and interviews with 20 older adults. The psychometric properties were assessed by testing the scale on 200 older adults referring to the Urban Comprehensive Health Service Centers of Kashan province, Iran. The multistage cluster sampling method was used to recruit the participants. Then, the face, content, and construct validities as well as internal consistency and stability reliability were assessed. The obtained data were analyzed using the SPSS, version 16. Also, the exploratory factor analysis was conducted using the principal component analysis and the varimax rotation method to determine the factors of the scale.

Results: The OATUHS consisted of 12 items. Exploratory factor analysis resulted in two factors explaining 69.6% of the variance. The internal consistency of the scale was acceptable (r=0.88); it was 0.93 for the "in-kitchen technologies" and 0.87 for "out-of-kitchen technologies" dimensions. Besides, an intraclass correlation coefficient of 0.95 was estimated between the test and retest scores.

Conclusion: The OATUHS is a valid and reliable tool for the measurement of the use of technology by older adults at home, in daily life.

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Highlights

- Aging leads to changes in many human capabilities.
- Technology is one of the ways that help older adults to preserve independence.
- A review of the literature showed that there is no tool in Iran to measure the use of technology at home by older adults.
- This study developed the "Older Adults' Technology Use at Home Scale" and evaluated its psychometric properties in an Iranian context.

Plain Language Summary

The aging process commonly decreases the physical and mental functions of older adults. However, the use of technology can improve the cognitive, sensory, and motor functions of older adults. This study discusses the development of a scale that measures the use of technology at home by older adults, in an Iranian context. Study results showed that the older adults' technology use at home scale is a valid and reliable tool for the measurement of the use of technology by older adults at home, in daily life.

1. Introduction

Aging is a significant period of life, and it is socially necessary to consider the needs of this period. At this period of life, attention should be paid to the health-promoting behaviors, maintaining independent performance, and quality of life (Jamshidi et al., 2018). Technology can support older adults in their daily life to preserve independence and enhance the quality of life and also their welfare and safety (Lange et al., 2010; Sin et al., 2014). The use of technology can potentially contribute to the improvement of the cognitive and sensory-motor function of older adults (Heerink et al., 2010; Lange et al., 2010). Most activities of the older adults occur in the home environment, and technology can support them in this area (Mitzner et al., 2010).

Technology is rapidly advancing (Dickinson & Gregor 2006) and it is one of the ways that can support older adults in their daily life and home activities and provide them with welfare and safety (Ahn, Beamish & Goss 2008; Wang, Rau & Salvendy 2011). Using technology, older adults are striving to achieve benefits, such as maintaining or promoting health, independence (Wang, Rau & Salvendy 2011), and increasing social participation (Şar et al., 2012). Therefore, it is necessary to prepare the elderly population consistent with the economic and social shifts of society to achieve well-being (United Nations 2017).

However, a review of articles shows a profound gap between the older adults and the use of technology (Barnard et al., 2013; Mokhberi & Sahaf 2013). A study on Greek older adults showed that the television remote control was the only device that all participants used (Roupa et al., 2010). Also, a study in China found that only 1.9% of internet users in 2009 were older adults (Wang, Rau & Salvendy 2011). While a study in Lisbon reported that 37% of internet users were aged between 55 and 74 years (Neves & Amaro 2012). Yet, the technology using rate in the daily life of the elderly population has not been studied in Iran. But a study on internet users shows the average internet penetration rate of 6.4% and less than 0.1% for the age groups of 50 to 74 years and over 75 years, respectively (Yearbook 2013).

To measure the use of technology, researchers have developed various tools, including the Everyday Technology Use Questionnaire (ETUQ), Technology Implementation Questionnaire (TIQ), and Technology-Activities of Daily Living Questionnaire (Munoz-Neira et al., 2012; Wozney, Venkatesh & Abrami 2006; Rosenberg et al., 2009). Some of these tools are specifically developed to measure the use of technology in individuals with cognitive disorders, and some others are developed to measure the use of technology in general. Moreover, these questionnaires are developed in countries where the technology penetration rate is high for all age groups. However, some of these tools have not completed the psychometric process (Munoz-Neira et al., 2012; Wozney, Venkatesh & Abrami 2006; Rosenberg et al., 2009). The develop-

ment of some tools is also limited to a specific device, such as the automated teller machine (Mokhberi & Sahaf 2013), smartphone (Elhai et al., 2017), and tablet (Vaportzis, Giatsi Clausen & Gow 2018).

The increasing number of older people, especially in developing countries, and the advancement and penetration of technology in daily life arise an essential question that how much older people use technology in daily life? Although there are some scales to measure the seniors' computer proficiency (Boot et al., 2015), older adults' information technology ability, and older people's attitudes toward technology (Anderberg, Ivazzadeh & Berglund 2019), no comprehensive tool was found to answer this question. Therefore, this study aimed to develop and psychometrically test the Older Adults' Technology Use at Home Scale.

2. Materials and Methods

This sequential-exploratory mixed-method study was conducted in Kashan province, Iran, in 2019, and included two stages. The first stage involved item generation and the preparation of the initial design of the scale, and the second stage included item reduction and psychometric assessment.

First stage

At this stage, a qualitative study was conducted on elderly adults referring to the Urban Comprehensive Health Service Centers of Kashan province, Iran. Using purposeful sampling, 20 older adults were recruited. Inclusion criteria were the age of over 60 years, willingness to share experiences, residing in their own home, and the lack of known mental or cognitive disorders. Also, data were collected via face-to-face semi-structured interviews. The main interview questions were "think about your daily life; which electrical household appliances you use during your daily life?" The interview sessions were performed at participants' preferred time and in the private rooms of the study setting, and each session lasted 20 to 25 minutes. With the participants' consent, the interviews were recorded using a digital voice recorder. Data collection was continued up to data saturation, when no new data (device) was mentioned by the participants. The interviews were transcribed word by word and analyzed using conventional content analysis. Also, a literature review was performed in Scopus, PubMed, ScienceDirect, Google Scholar, IranMedex, and SID databases with the keywords of questionnaire, usage, technology, elderly, and home (and the same words in Persian), between 2000 and 2018. Then, the items of the scale were generated based on the interviews and literature review, and the initial design of the scale was prepared.

Second stage

The psychometric properties of the scale were evaluated as follows:

Quantitative face validity was assessed with the item impact method. The scale was given to 20 older adults to determine the importance rate of each item on a 5-point Likert scale: 1. "extremely not important"; 2. "not important"; 3. "moderately important"; 4. "important"; and 5. "extremely important". Then, the item impact was determined by the formula (impact score= frequency × importance). If the item impact was over 1.5, the item would be kept (Zamanzadeh et al., 2015).

The content validity of the scale was evaluated using the Content Validity Ratio (CVR) and the Content Validity Index (CVI). The CVR represents the extent of the necessity for each item in the scale and is calculated based on the Lawshe table (Zamanzadeh et al., 2015). The scale was given to 12 experts, including six PhD in nursing education, two tool development specialists, and four PhD in geriatric nursing. The experts identified the necessity rate of each item on a three-point rating scale: 1. "the item is not necessary"; 2. "the item is useful, but not necessary"; and 3. "the item is necessary" (Lawshe, 1975).

The CVI is the relevance rate of each item. The scale was provided to 10 experts; they were asked to rate each item on a 4-point Likert scale: 1. "the item is irrelevant"; 2. "the item is partly relevant"; 3. "the item is relevant"; and 4. "the item is completely relevant". Also, a modified Kappa coefficient of higher than 0.74 was considered for accepting an item (Zamanzadeh et al., 2015).

The exploratory factor analysis was used to assess the construct validity (Streiner, Norman & Cairney 2015). The study population was selected from the older adults referring to the Urban Comprehensive Health Service Centers of Kashan province, Iran, from 2018 to 2019. The minimum sample size per item was between 5 and 10 people, therefore, 200 cases were enrolled in the study.

The multistage cluster sampling method was used to recruit participants. Considering 21 centers situated in Kashan province, two centers were randomly selected from each district in the north, south, east, west, and downtown (10 centers in total). Then, older adults' health records were numbered in each center, and potential participants were randomly selected in each center, based on the quota sampling method. Next, the potential participants were invited to the Urban Comprehensive Health Services Center by phone. They would be invited to

participate in the study if they met the inclusion criteria for this study. Also, if the participants were illiterate, the second author of the article would read the questions and help them to complete the survey. The adequacy of the sample size was confirmed through the Kaiser-Meyer-Olkin test, also, the Bartlett test was performed to determine the correlation matrix (Thompson & Daniel 1996).

The internal consistency of the scale was determined using the Cronbach alpha coefficient. Moreover, the stability of the scale was confirmed by the test-retest method. The scale was completed twice by 20 older adults with a 12-day interval. The Intraclass Correlation Coefficient (ICC) was used for the competition of scores. An ICC of more than 0.8 indicates an appropriate level of stability (Dunn, Baguley & Brunsden 2014).

Data analysis was performed using the SPSS, version 16. The normality of the data was evaluated by the Kolmogorov-Smirnov test. Besides, the exploratory factor analysis was used to determine the factors of the scale. Factor analysis was conducted using principal component analysis and the varimax rotation method.

3. Results

First phase

After interviews with 20 older adults and literature review, 15 items (smartphone, cellphone, desktop computer, laptop, tablet, flat-screen TV, digital radio and CD/DVD player, mixer, blender, oven, microwave, toaster, vacuum cleaner, automatic washing machine, and dishwasher) were generated. Lastly, the primary scale was prepared for the evaluation of its psychometric properties.

Second phase

Face validity: In this stage, all the participants confirmed that all the scale items were simple, clear, and related to the objectives. The impact scores of the laptop, tablet, and toaster items were less than 1.5, thus, these items were deleted.

Content validity: The Lawshe table suggests an acceptable CVR of 0.62 for 10 experts (Zamanzadeh et al., 2015). In this study and according to the 10 experts, CVR was 0.67, and the mean of CVR was 0.86 for the whole scale. Besides, the CVI for each item (I-CVI) ranged from 0.92 to 1, and the mean of CVI (S-CVI) was 0.95 for the whole scale.

Construct validity: The results showed that the Mean±SD age of the participants was 67.53±6.56 years. Also, most participants were male (54.5%) and married (84%) (Table1). The exploratory factor analysis was performed using principal component analysis. The Kaiser-Meyer-Olkin test value was 0.85 indicating the suitability of the samples. Moreover, the Bartlett test showed a significant relationship between the items (P<0.001). Two factors with an eigenvalue of more than one were extracted and explained 69.6% of the variance. After varimax rotation, the first and second factors explained 35.7% and 33.9% of variances, respectively (Table 2). Also, the scree plot showed that the two factors had the required adequacy to explain the factorial construct validity of the scale (Figure 1). The minimum load factor to maintain the item was considered as 0.4, therefore, a scale with 12 items and two factors was developed (Table 3). The first factor was named "in-kitchen technologies", and the second factor was named "out-of-kitchen technologies" (Table 2). The scoring of this 4-point Likert scale is as follows: I use the devices daily= 3, I use the devices at least once a week= 2, I use the devices at least once a month= 1, and I don't use the devices at all= 0. The scale's total scores range from 0 to 36. A greater score indicates higher usage of the devices.

Reliability: The present scale had a Cronbach alpha coefficient of 0.88, which indicates a desirable level of internal consistency. Also, stability testing was carried out through the test-retest method with a time interval of two weeks. Then, the scores of the two stages were compared using the ICC test. An ICC of 0.95 represents a satisfactory level of stability (Table 4).

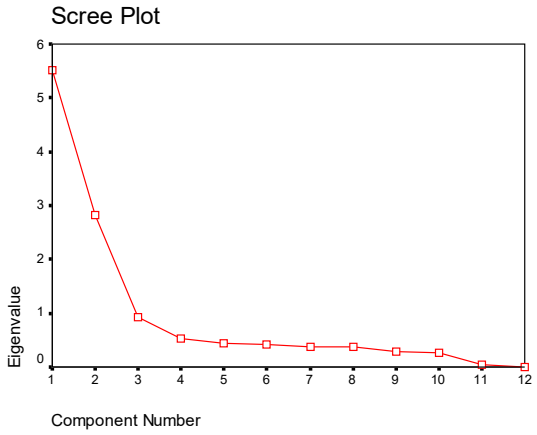

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Figure 1. Scree plot of the distribution of identified factors in exploratory factor analysis

Table 1. Study sample characteristics (N=200)

Variables		No. (%)
Gender	Female	91 (45.5)
	Male	109 (54.5)
Education	Illiterate	118 (59)
	Literate	82 (41)
Marital status	Married	168 (84)
	Single (Widow, Divorced)	32 (16)
Income level	Poor	38 (19)
	Medium	123 (61.5)
	Optimal	39 (19.5)
Living arrangement	Alone	20 (10)
	Spouse	159 (79.5)
	Children	21 (10.5)
Chronic conditions	Yes	152 (76)
	No	48 (24)
Age, y	Mean±SD	Range
	67.53±6.56	60-86

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4. Discussion

This study was carried out to develop a valid instrument for measuring the use of technology at home, among older adults. It was required that the instrument should be based on the social, economic, cultural context, and demographic characteristics of the Iranian older adults. The final version of this scale includes 12 items in two subscales, including "in -kitchen technologies" and "out-of-kitchen technologies". The results revealed acceptable reliability and validity for the whole scale and the subscales in the Iranian older population. The psychometric evaluation of the instrument in the stage of quantitative face validity showed that the impact scores of the items of toaster, laptop, and tablet were less than 1.5, therefore, they were deleted (Zamanzadeh et al., 2015).

The use of technology at home by older adults indicates an increase in the quality of their life. However, barriers, such as the lack of knowledge, unfavorable attitude towards technology, and also structural and instructional limitations have affected the use of some devices, such as smartphones or computers and tablets in the older adults (Gitlow 2014; Padilla-Góngora et al., 2017; Vaportzis, Giatsi Clausen & Gow 2017; Yazdani-Darki et al., 2020). Furthermore, age-related changes, such as vision and hearing loss (Gitlow 2014; Yazdani-Darki et al., 2020), and the decline of cognitive and physical ability can limit the use of certain types of technology, such as information and communication technology (Peek et al., 2016).

Several researches have been done in the field of making measuring instruments of different dimensions of technology use in the elderly.

Booth et al. (2015) developed a new tool Computer Skills Questionnaire (CPQ) to measure computer proficiency of seniors. To evaluate the reliability and validity of CPQ, a sample of 276 older adults who were unable or incapacitated to use a computer were selected and asked to complete the CPQ. The tool had outstanding reliability (Cronbach's α=0.98) and the reliability of its subscales ranged from 0.86 to 0.97. Factor analysis identified three main skills factors related to the use of the Internet and e-mail, communication, and information entry and the basics of computers.

Table 2. Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.525	46.040	46.040	5.525	46.040	46.040	4.284	35.704	35.704
2	2.834	23.618	69.658	2.834	23.618	69.658	4.074	33.954	69.658
3	0.920	7.665	77.323						
4	0.524	4.367	81.690						
5	0.447	3.725	85.415						
6	0.417	3.471	88.886						
7	0.382	3.184	92.070						
8	0.365	3.045	95.114						
9	0.290	2.415	97.529						
10	0.254	2.120	99.649						
11	0.034	0.282	99.931						
12	0.008	0.069	100.000						

Extraction method: Principal component analysis.

The authors also produced a short form with similar features with 21 fewer items (Boot et al., 2015).

Tai-kuei and Cheng- Min Chao in their study, developed a comprehensive model and questionnaire to measure the ability of individual Taiwanese adults' information technology. This reliable tool has 13 items in three factors and acts to assess the ability of older adults' in technology (Yu & Chao 2014). In this study, 396 usable questionnaire were received from 231 men and 165 women with a

Table 3. The items of the older adults' technology use at home scale, after varimax rotation and factor loadings (N=200)

No.	Items	Factor 1	Factor 2
Q1	Smartphone	0.947	
Q12	Flat-screen TV	0.93	
Q2	Cellphone	0.924	
Q11	Digital radio and CD/DVD player	0.922	
Q10	Desktop computers	0.83	
Q3	Mixer		0.82
Q4	Blender		0.816
Q7	Vacuum cleaner		0.81
Q8	Automatic washing machine		0.806
Q5	Oven		0.783
Q6	Dishwasher		0.617
Q9	Microwave		0.553

Table 4. Reliability of the factors and the total score

Scale	Cronbach α	ICC
Factor 1	0.93-89	0.95-89
Factor 2	0.87	0.96-84
Total scale	0.88	0.95

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mean age of 71.66. The authors offered a new perspective on this multidimensional issue, using some of the key factors that affect the ability of older adult information technology (Yu & Chao 2014).

Anderberg, Ivazzadeh and Berglund (2019) conducted a study aiming to develop a concise and refined tool for measuring the attitudes and interest of older people towards technology based on the relevant tools available for measuring technophilia. The new tool needs to be short and simple so that it can be used to evaluate health technology for the elderly. The initial items of the questionnaire were inferred from the content analysis related to the available tools of technophilic measurement. Exploratory factor analysis was performed on a random selection of 374 individuals aged 65 years and older in the first eight items. The scale was reduced to six items and the internal stability and reliability of the scale were examined. Further validation was performed by Confirmatory Factor Analysis (CFA). Exploratory factor analysis led to two factors. These factors were analyzed and labeled by techEnthusiasm and techAnxiety. These factors showed relatively good internal stability (Cronbach's alpha 72 and 0.68, respectively). Factors were confirmed in CFA and showed good model fit (χ^{28}=21.2, $\chi^{2/df}$=2.65, adaptive fit index=0.97, adjusted fit wellness index=0.95, mean square root of approximation error=0.067, residual standard root Mean square=0.036).

It seems in the present study that attitude toward technology, the perceived need for technology, interest in technology, ability or inability to use technology, and the willingness to spend on technology were the factors influencing the removal or keeping some items in our scale. Another factor that may be effective in deleting items of tablets, laptops, and computer is the role of smartphones in people's lives.

5. Conclusion

The sociocultural context that varies from region to region influences every phenomenon and its related factors. Therefore, it is necessary to use a questionnaire designed based on experiences and concepts expressed by individuals living in the same context. According to the findings, the developed 12-item Older Adults' Technology Use at Home Scale is a simple, valid, and reliable tool for the measurement of technology use at home in older adults. This scale can be used by geriatric nurses and caregivers to determine the status of the elderly's use of technology. This tool was made for the context of Iran, thus, there may be limitations regarding the use of the scale in other newly industrialized countries, because of the socioeconomic and cultural differences.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of Kashan University of Medical Sciences, Kashan, Iran (Code: IR.KAUMS.NUHEPM.REC.1397.20). Besides, the participants were informed about the aims and the importance of the study. They were assured about the confidentiality of their information and their freedom to withdraw from the study. Informed consent was obtained from all the participants.

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Authors' contributions

Conceptualization and supervision, investigation, writing – original draft, funding acquisition, resources and writing – review & editing: Both authors; Methodology: Fatemeh Sadat Izadi-Avanji; Data collection: Malihe Yazdani-Darki; Data analysis: Fatemeh Sadat Izadi-Avanji.

Conflict of interest

The authors declared no conflicts of interest.

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