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Validity and reliability of the TechPH scale in assessing Iranian older adults' attitudes toward technology

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Abstract

Background and aim Given the rapid technological advancements and increased usage of digital tools, understanding older people's attitudes toward technology is vital. Assessing their views can help identify barriers and facilitators to adoption. This understanding is essential for developing effective educational strategies and user-friendly technologies that enhance seniors' quality of life. Therefore, the present study aimed to psychometrically evaluate the scale for measuring attitudes—both willingness and anxiety—toward technology (TechPH) in Iranian older adults.

Methods This methodological study was conducted on 420 older individuals (aged 60 and above) in Tehran in 2024 to perform a psychometric test of the attitudes toward technology scale (TechPH). Validation was carried out using translation validity methods, including translation-back translation with bilingual experts ($n=2$), face validity with a sample of the older population ($n=10$), content validity with a panel of 11 experts, and construct validity through Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) ($n=420$). Instrument reliability was determined through test–retest and internal consistency (Cronbach's alpha) methods with a sample of older individuals ($n=30$). Data analysis was performed using SPSS version 16 and EQS 6.4 software.

Results A comparison of Persian and English translations revealed acceptable translation validity and cultural adaptability for the scale. Each item's Content Validity Index (CVI) and Content Validity Ratio (CVR) were determined, with a total average CVI of 0.95. The results of EFA indicated that the sample size was adequate, as shown by the KMO value of 0.754. Additionally, Bartlett's sphericity test demonstrated a significant correlation between the items ($\chi^2=221.819$, df = 15, $P<0.0001$). EFA revealed that two extracted factors explained 41.002% and 18.111% of the total variance. Furthermore, CFA yielded suitable estimates based on the general fit indices of the model (RMSEA = 0.061, IFI = 0.979, GFI = 0.983, CFI = 0.978, CMIN/DF = 1.769, MFI = 0.989, AGFI = 0.942). In evaluating test–retest stability and internal consistency, the values of the Intra-class Correlation Coefficient (ICC) and Cronbach's α were 0.85 and 0.77, respectively, indicating appropriate reliability for the scale.

Conclusion P.TechPH, the first Persian version of the scale for measuring technophilia and technophobia among Iranian older people, has favorable psychometric properties. It can serve as a standard tool for assessing older people's attitudes toward technology in various studies.

Keywords Aged, Technology, Attitude, Psychometrics

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Introduction

Nowadays, advancements in technology have greatly benefited all sub-groups of society by simplifying complex problems [1]. In this context, gerontechnology is an emerging interdisciplinary field [2] focused on developing products to address challenges associated with global aging [3]. Digital technology offers significant opportunities to enhance the health, quality of life, and independence of older individuals through services like remote care and online social support [1, 4, 5]. Increasing participation in digital technology is crucial for improving older people's health and performance [3]. Additionally, technology can combat social isolation by fostering connections and engagement in activities [6]. Evidence suggests that information and communication technologies positively impact mental well-being, promote active aging, and may help maintain cognitive function [7]. The use of new educational methods involving smartphones can be effective in managing diseases and their complications, especially among older adults [8, 9], and in improving self-management for patients with chronic conditions [10]. Overall, various types of technology can lead to a reduction in feelings of loneliness [3, 11, 12], decreased social isolation [4, 6], diminished depressive states [3, 13], enhanced well-being [5, 14], increased independence [6], greater life satisfaction [11, 13], improved social support [11, 15], enhanced self-efficacy [11, 13], as well as an overall improvement in quality of life [5, 6] and self-confidence [6, 15] among older peoples.

In the twentieth century, psychological duality intensified with the exponential growth in various technical fields and the emergence of modern technologies, particularly with advancements in computer science. While modern technologies provide comfort and convenience, they also induce anxiety and fear [16]. Technophilia and technophobia represent the two extremes of the relationship between technology and humans, especially between technology and society [2, 16]. Technophobia refers to an emotional response and a negative attitude toward technology [16]. In contrast, technophilia points to the positive end of the spectrum of attitudes toward technology [2]. A person who is attracted to technology tends to use most technologies positively, enthusiastically adopts new forms of technology, and views these advancements as a means to improve life conditions and address social problems [16]. The fear of technology among older individuals significantly hinders their willingness to use technological tools. This reluctance stems from factors such as; unfamiliarity, privacy concerns, and the perception of complexity. These barriers can lead to hesitance in adopting new technologies [17]. Challenges faced by older adults in using technology include physical limitations, cognitive barriers, lack of familiarity, privacy and security concerns, and complex interfaces. Potential solutions to address these challenges involve user-friendly design, training programs, peer support groups, tailored resources, enhanced security features, accessibility options, and ongoing support [18]. However, basic attitudes and feelings toward technology, such as technophilia, can influence the level of satisfaction with technology as well as the perception of health intervention outcomes [2, 16]. Usability, motivation, and acceptance of a specific technology or service are important factors in evaluating the impact of health technology interventions [2].

Aligned with the global trend, Iran's older population is expected to surpass 30% by 2050, making it the second fastest-aging country in the world [19, 20]. Despite a general increase in technology usage among Iranian households, older individuals show limited engagement [21]. Based on a review of the literature, there is a lack of studies investigating the attitudes of Iranian older peoples toward technology. Additionally, there is no suitable and concise tool available to measure technophilia and technophobia in this population. Therefore, it is necessary to develop a valid and reliable tool to assess these concepts. Measuring technophilia and technophobia in older peoples is crucial for understanding their attitudes toward technology. This understanding helps identify the reasons for their reluctance or eagerness to adopt new tools. Such assessments enable the development of targeted interventions, including training programs and support systems, that address specific needs and concerns. Additionally, they highlight barriers, such as fears of privacy or complexity, that hinder technology use [17]. The insights gained from this measurement lead to several benefits: creating user-friendly technologies tailored to older adults, developing resources that alleviate fears and build confidence in technology use, and fostering environments where older individuals feel comfortable using technology, thereby promoting social connectivity. Overall, these measurements contribute to a more digitally inclusive society for older people [17, 22]. A brief scale to measure the attitudes of older individuals toward technology, called TechPH, was developed and validated by Anderberg et al. among the Swedish population in 2019. They utilized data from a sample of individuals in the Swedish National Study of Aging and Care (SNAC), a longitudinal cohort study representing the aging Swedish population, with data collection beginning in 2001 [2]. The present study, as the first attempt of its kind, was conducted to determine the psychometric properties of the TechPH for use in studies involving the Iranian older population.

Materials and methods

Study design & population

This research is a methodological study conducted in 2024 among individuals aged 60 and older under cover of Shahid Beheshti University of Medical Sciences in Tehran. Since completely separate samples were used for exploratory and confirmatory factor analyses, a total of 420 individuals participated in the study. The samples were selected using a multistage random sampling method. In the first stage, each headquarters located in Tehran was considered a class. In the second stage, comprehensive health services centers within each class were randomly selected as clusters in proportion to their total number. In the third stage, based on the older population of each comprehensive health services center, samples within that cluster were selected using systematic random sampling. The inclusion criteria were as follows; participants had to be Iranian, willingness to participate in the research, aged 60 years or older, literate with the ability to complete the questionnaire, have a household file at the covered comprehensive health services centers, and not have cognitive impairment at the time of the study. Due to the general nature of the TechPH items and the absence of specific or complex technologies, financial conditions were not part of the participation criteria, and all participants had access to minimum available technologies. The exclusion criterion was incomplete completion of the questionnaire. At any stage of the study, individuals had the right to withdraw if they chose not to continue their participation.

This research was conducted by obtaining letters of introduction from relevant organizations, and participation was voluntary, ensuring the confidentiality of the information. The Abbreviated Mental Test Score (AMTs), one of the most widely used methods for screening cognitive status in older peoples worldwide due to its brevity, simplicity, speed of execution, and low influence of language and culture [23], was used to assess cognitive status. This test consists of 10 questions, with a maximum possible score of 10. A score of 7 or above indicates the absence of a cognitive problem. Foroughan et al. reported that the Cronbach's alpha coefficient for this questionnaire was 0.9 [24], and they psychometrically evaluated it for use among Iranian older adults. Thus, this tool was employed to screen older individuals eligible for the study. Participants were included in the study after achieving the required number of points. It should be noted that Cronbach's alpha for AMTs was recalculated in our research ($\alpha = 0.82$). To ensure that participants with limited literacy skills could effectively understand technological terms, an explanatory line was added at the beginning of the Persian version of the TechPH questionnaire to clarify the meaning of technology. *(This includes; Note: In the following questionnaire, "technology" refers to computers, tablets, various applications, smartphones, smartwatches,* etc.*)*

Original instrument

Anderberg et al. designed and validated the TechPH for older peoples in Sweden in 2019 to measure their attitudes toward technology. This instrument includes six items, and exploratory factor analysis resulted in two factors. These factors were analyzed and labeled as techEnthusiasm (items 1–3) and techAnxiety (items 4–6). They demonstrated relatively good internal consistency, with Cronbach's alpha values of 0.72 and 0.68, respectively. Each item is rated on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree), with items related to technophobia being reverse scored. The final score ranges from 1 to 5, with higher scores indicating greater technophilia [2]. After corresponding with Professor Dr. Peter Anderberg, the author responsible for the main article on the TechPH scale, and obtaining his permission, this tool was received and entered into the process of translation and psychometric evaluation.

Validity

Translation and cross-cultural validity

The standard method proposed by the WHO was used to translate the questionnaire [25]. To determine translation validity, the original questionnaire was first translated from English to Persian by two experts fluent in English in a double-blind manner. Then, two specialists skilled in English back-translated the Persian version into English. During the translation process, the wording of some items was modified to enhance cultural relevance, but the wording was not significantly changed; thus, the translated version still corresponded to the original TechPH scale. After these adjustments, the first Persian version of the questionnaire for measuring attitudes toward technology (P.TechPH, as an acronym for Persian TechPH) was prepared.

Face validity

To determine qualitative face validity, the first version of P.TechPH was completed by 10 older people (5 older women and 5 older men) to evaluate its fluency, transparency, clarity, and appropriateness. Based on their feedback, a few changes were made to enhance the clarity and understanding of the items. It should be noted that these 10 individuals were not included in the main part of the study (exploratory and confirmatory factor analysis).

Content validity

For qualitative content validity, P.TechPH was evaluated by 11 experts in related fields (including 3 in health education and health promotion, 3 in technology and media, and 5 in geriatrics). Their feedback on grammar and the writing of Persian was recorded for each question. In terms of quantitative content validity, the Content Validity Ratio (CVR) and Content Validity Index (CVI) were assessed [26]. To determine CVR, experts were asked to review each item based on a three-part spectrum: "*Not necessary*," "*Useful but not necessary*," and "*Necessary*." The responses were then calculated using the following formula [26, 27].

$$CVR = \frac{n_E - \frac{N}{2}}{\frac{N}{2}}$$

n_E = the number of experts who answered the necessary option/N = the total number of experts.

To calculate the CVI, experts assessed each item based on three criteria: simplicity, relevance, and clarity, using a 4-point Likert scale (for example, *1: not simple*, *2: somewhat simple*, *3: simple*, and *4: quite simple*). The CVI score was calculated by summing the favorable scores for each item that received a ranking of 3 or 4 (the highest scores) and dividing this total by the number of experts [26, 28]. Ultimately, the acceptance criteria for items based on the CVI were greater than 0.79, while the CVR was greater than 0.59.

Construct validity

Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were employed to determine construct validity. For EFA, several methods were utilized, including the Kaiser–Meyer–Olkin measure of sampling adequacy (KMO), Bartlett's Test of sphericity (BT), Principal Component Analysis (PCA), scree plot, and varimax rotation. PCA is a widely-used statistical technique for reducing dimensionality by transforming a dataset into orthogonal components that capture the maximum variance. It identifies principal components from the eigenvectors of the covariance matrix, with the first component explaining the most variance [26]. To enhance interpretability, researchers often apply rotation methods such as varimax rotation. This approach maximizes the variance of squared loadings across variables, simplifying the interpretation of factors and effectively distinguishing underlying structures in correlated data [29].

To retain an item in the EFA, a cutoff point of 0.5 was established. After extracting the factors and identifying the items within each factor, their alignment with the main concepts and dimensions of attitudes toward technology was assessed. Goodness-of-fit indices were then utilized for CFA.

Reliability (Stability & internal consistency)

To evaluate the stability of the tool using the test–retest method, the P.TechPH was completed by 30 older peoples (15 women and 15 men) in two stages, with a time interval of 15 days. The Intra-class Correlation Coefficient (ICC) and Cronbach's alpha were then calculated to assess stability and internal consistency.

Results

In this research, data were collected, coded, and entered into a computer for 420 older people. The analysis was conducted using SPSS (Version 16.0) [30] and EQS 6.4 software. The participants were categorized into age groups: 60–64 years (34.8%), 65–69 years (40%), and 70 years and older (25.2%). Among them, 198 individuals (47.1%) were women, while 222 (52.9%) were men. Most participants were married (76%), held a diploma (33.1%), and lived with their spouses (41.2%). A job survey indicated that 136 individuals (23.4%) were employed, while 284 (67.6%) were unemployed. In terms of economic conditions, 262 participants (62.4%) reported average conditions, 32 (7.6%) reported poor conditions, and 126 (30%) reported good conditions. Regarding self-assessment of phone skills, 127 individuals (30.23%) reported low skill, 177 (42.14%) reported average skill, and 116 (27.61%) reported good skill (Table 1).

In terms of qualitative face validity, the opinions of older people regarding P.TechPH were evaluated. Based on their feedback, necessary changes were made to enhance the clarity and expressiveness of the items. After a thorough review of the instrument and an assessment of qualitative content validity, experts confirmed that the questions were both expressive and clear. The CVI was calculated, yielding a relevance score of 1, a clarity score of 0.92, and a simplicity score of 0.95, resulting in a total average of 0.95. The lowest value of the CVR was 0.63, while the highest was estimated at 1, leading to a total average of 0.906. Consequently, all items of the scale were retained, and none were deleted (Table 2).

The exploratory factor analysis of the scale was conducted with the participation of 210 Iranian older people. The Kaiser–Meyer–Olkin (KMO) value was 0.754, confirming the adequacy of the sample size. Additionally, the results of Bartlett's test of sphericity indicated a significant correlation between the items ($\chi^2 = 221.819$, df = 15, $P < 0.001$), justifying the factor analysis (Table 3). Figure 1 displays the scree plot. Based on the findings in Table 4, two factors were extracted from the scale: technophilia (items 1 to 3), which accounted for a variance of 41.002%, and technophobia (items 4 to 6), which accounted for a variance of 18.111%. A cutoff point of 0.5 was established for factor loadings.

Table 1 Demographic characteristics of the samples and the mean and standard deviation of the TechPH index

Variables/Groups		N (%)	TechPH Index Mean (SD)
Age	60–64	146 (34.8)	3.72 (0.32)
	65–69	168 (40.0)	3.54 (0.40)
	70 & More	106 (25.2)	3.46 (0.41)
Gender	Male	222 (52.9)	3.57 (0.39)
	Female	198 (47.1)	3.60 (0.40)
Marital Status	Have spouse	319 (76.0)	3.60 (0.38)
	Have no spouse	101 (24.0)	3.54 (0.42)
Number of children	0	27 (6.4)	3.64 (0.38)
	1	49 (11.7)	3.69 (0.40)
	2	105 (25.0)	3.70 (0.36)
	3	157 (37.4)	3.55 (0.380)
	4	82 (19.5)	3.41 (0.382)
Education level	Under Diploma	78 (18.6)	3.47 (0.44)
	Diploma	139 (33.1)	3.58 (0.40)
	Academic	203 (48.3)	3.63 (0.35)
Employment status	Employed	136 (32.4)	3.65 (0.33)
	Non-Employed	284 (67.6)	3.55 (0.41)
Economic status	Weak	32 (7.6)	3.40 (0.46)
	Average	262 (62.4)	3.58 (0.39)
	Good	126 (30.0)	3.64 (0.35)
Who do you live with?	lone	48 (11.42)	3.58 (0.41)
	With spouse	173 (41.2)	3.57 (0.38)
	With children	37 (8.8)	3.54 (0.46)
	With spouse and children	140 (33.33)	3.63 (0.36)
	Nurse and others	22 (5.25)	3.55 (0.38)
Internet use frequency	Less than once a week	36 (8.57)	3.27 (0.46)
	At least once a week but not daily	101 (24.04)	3.54 (0.38)
	Daily	283 (67.38)	3.64 (0.36)
Self-assessed technical skill	Low	127 (30.23)	3.44 (0.39)
	Medium	177 (42.14)	3.64 (0.40)
	Good	116 (27.61)	3.66 (0.30)

Table 2 Content validity ratio and content validity index of P. TechPH scale

No	Items	CVR[a]	CVI[b]		
			Relevance	Clarity	Simplicity
1	I think it's fun with new technological gadgets	1	1	0.9	1
2	Using technology makes life easier for me	1	1	0.9	1
3	I like to acquire the latest models or updates	0.63	1	1	1
4	I am sometimes afraid of not being able to use the new technical things	1	1	0.9	1
5	Today, the technological progress is so fast that it's hard to keep up	1	1	1	1
6	I would have dared to try new technical gadgets to a greater extent if I had	0.81	1	0.82	0.73
Average			0.95		

[a] Content Validity Ratio

[b] Content Validity Index

Table 3 Exploratory factor analysis: KMO[a] and Bartlett's Test (210 Older People)

Kaiser–Meyer–Olkin Measure of Sampling Adequacy		0.754
Bartlett's Test of Sphericity	Approx. Chi-Square	221.819
	Df[b]	15
	Sig	0.001

[a] Kaiser–Meyer–Olkin

[b] Degree of freedom

Additionally, confirmatory factor analysis of the questionnaire was conducted with the participation of 210 older people, which is a different sample from that used in the EFA. According to the model fit indices (RMSEA = 0.061, IFI = 0.979, CFI = 0.978, GFI = 0.983, CMIN/DF = 1.769, MFI = 0.989, AGFI = 0.942), a factor related to each question was identified. The 6-item instrument, comprising two factors—technophilia and technophobia—demonstrated an acceptable fit (Table 5). Furthermore, there was a negative and significant correlation (r = -0.78, P < 0.001) between the two factors of technophilia and technophobia (Fig. 2).

To determine the scale's reliability, two methods were employed: internal consistency and stability. The maximum Cronbach's alpha was 0.77. The Intra-class Correlation Coefficient (ICC) was 0.85, indicating significant agreement between the first and second test scores (P = 0.001). This confirms the repeatability of both the sub-scales and the entire questionnaire, demonstrating high stability in the P.TechPH (Table 6).

Discussion

This research was designed based on a psychometric process and includes various stages for evaluating the validity and reliability of the measurement tool. Initially, translation validity was assessed, indicating that the tool is well adapted for the Iranian population. To confirm content validity, feedback from a panel of experts was utilized. In this section, both quantitative and qualitative content validity were affirmed, demonstrating comprehensive coverage of the intended construct. Subsequently, minor revisions to the questions were made based on feedback from older participants, and face validity was also confirmed. In the construct validity section, exploratory factor analysis revealed two main factors: technophobia and technophilia. Following this,

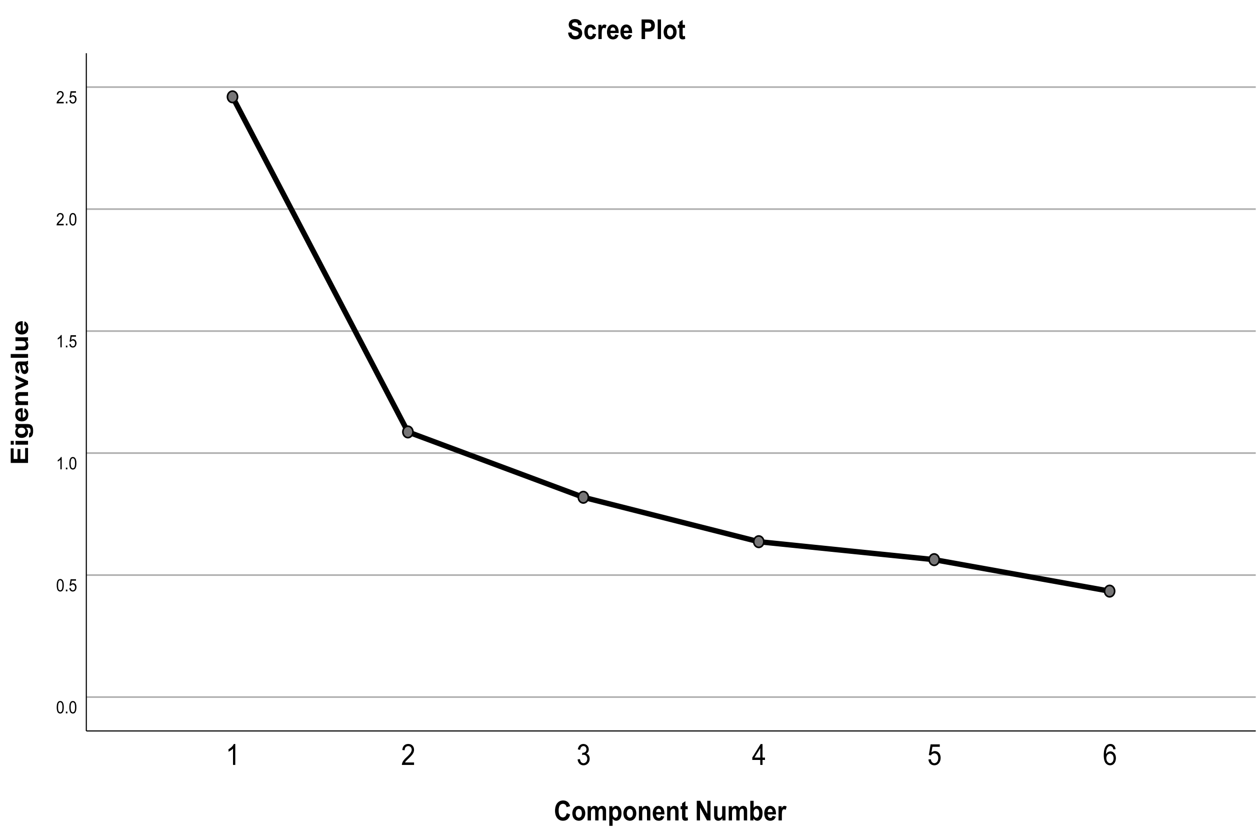

Fig. 1 Scree Plot

Table 4 Factor loading of P. TechPH scale items

Items		Components	
		1	**2**
1	I think it's fun with new technological gadgets	**0.757**	-0.027
2	Using technology makes life easier for me	**0.738**	-0.031
3	I like to acquire the latest models or updates	**0.646**	0.130
4	I am sometimes afraid of not being able to use the new technical things	0.477	**0.517**
5	Today, the technological progress is so fast that it's hard to keep up	-0.156	**0.903**
6	I would have dared to try new technical gadgets to a greater extent if I had	-0.004	**0.812**
Eigenvalues		2.460	1.087
Variance (%)		41.002	18.111
Cumulative %		**41.002**	**59.113**

Extraction Method: Principal Component Analysis, Rotation Method: Varimax with Kaiser Normalization

Table 5 Model fit indices of P. TechPH scale

FIT INDICES	CMIN[a]	DF	CMIN/DF	AGFI[b]	GFI[c]	CFI[d]	MFI[e]	SRMR[f]	RMSEA[g]
Results	10.615	6	1.769	0.942	0.983	0.978	0.989	0.042	0.061
Acceptable Domain	-	-	1–3	0 ≥ 0.90	0 ≥ 0.90	0 ≥ 0.90	0 ≥ 0.90	≤ 0.08	≤ 0.08

[a] Chi-square

[b] Adjusted Goodness-of-Fit Index

[v] Goodness-of-Fit Index

[d] Comparative Fit Index

[e] McDonald's Fit Index

[f] Standardized Root Means square Residual

[g] Root Mean Square Error of Approximation

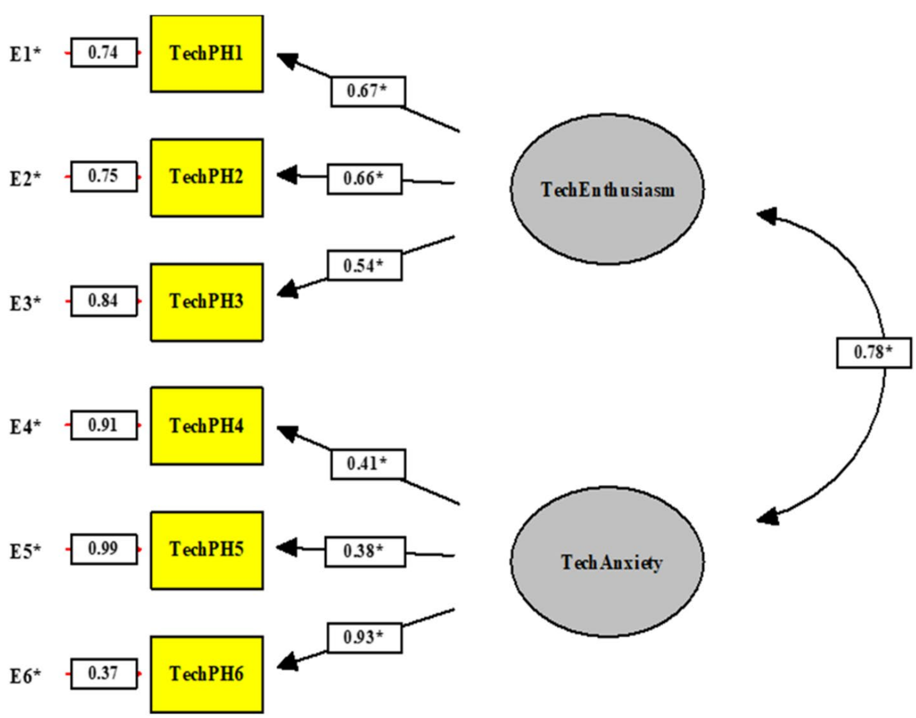

Fig. 2 The Results of Confirmatory Factor Analysis of P.TechPH 6-Item Scale

Table 6 The stability and internal consistency reliability of P.TechPH scale ($n=30$)

Dimensions (Name)	Number of items	Cronbach's α Coefficient	ICC[a]
F1 (Technophilia)	3	0.71	0.94
F2 (Technophobia)	3	0.70	0.89
P. TechPH	6	0.77	0.85

[a] Intraclass Correlation Coefficient—Confidence Interval 95%

confirmatory factor analysis showed appropriate factor loadings for these two constructs. Finally, the reliability of the instrument was confirmed through internal consistency and test–retest stability over a 15-day interval. Thus, the P.TechPH instrument was developed with adequate validity and reliability for use among Iranian older people. The findings of each phase have been discussed here. The scale translation, conducted by bilingual experts in a double-blind manner, closely resembles the original version. This similarity indicates that the tool has cross-cultural applicability and good effectiveness in different societies. Additionally, the demographic findings revealed that the participants in this study were similar to the overall older population in terms of gender ratio. Consequently, it appears that more realistic results were obtained from the evaluations performed. In the next step, the purpose of evaluating content validity is to determine whether the tool's content effectively measures the defined goal. To achieve this, the judgment of experts, referred to as an expert panel, is utilized in the specialized field. The panel assesses the relevance, simplicity, clarity, and necessity of each item through a questionnaire [26, 28]. In this research, the Content Validity Ratios (CVRs) obtained for each item exceeded the values suggested in the Lawshe table [27]. Additionally, CVI of 0.95 was achieved, which is above the acceptable threshold for items (0.79 and above) [26]. Therefore, the Persian version of the TechPH demonstrates adequate content validity. Face validity is an objective assessment of the structure of an instrument, determining whether the scale has been accepted by respondents [31]. Based on feedback from older participants, only very minor changes were made to enhance the clarity of the items. Overall, however, the scale remained very similar to the original version. Construct validity addresses whether the desired structure can effectively measure the intended goal. This type of validity is also known as factor validity, as it is evaluated using factor analysis methods. Among the common approaches for calculating construct validity are exploratory and confirmatory factor analyses. EFA is a statistical method aimed at discovering dimensions [26, 32]. The EFA results were derived from the KMO and Bartlett's sphericity tests. The KMO value was 0.754, which, according to the acceptable threshold defined for KMO (0.7 and above) [33], confirmed the adequacy of the sample size in this research. Additionally, the results of Bartlett's sphericity test indicated a significant correlation between the items ($\chi^2=221.819$, df = 15, $P<0.001$) [34]. The psychometric properties of the TechPH have thus far been investigated only in Sweden. The results of Anderberg et al.'s study, which involved 374 older peoples aged 65 years and older, are similar to those of the present research (KMO = 0.76 and $\chi^2=554.1$, $P<0.001$) [2]. Additionally, the study by Sinkovics et al., conducted in 2002 with the aim of creating a tool to measure technophobia, supports our findings ($\chi^2=383.075$, df = 62, $P<0.001$) [35]. Overall, exploratory factor analysis provides a suitable model for the current data. Additionally, the results of the confirmatory factor analysis models were as follows: RMSEA = 0.061, SRMR = 0.042, IFI = 0.979, CFI = 0.978, GFI = 0.983, CMIN/DF = 1.769, MFI = 0.989, and AGFI = 0.942. According to the acceptable values for these indices [36], the construct validity of the instrument demonstrates an acceptable fit. The results of Anderberg et al.'s study (RMSEA = 0.067, CFI = 0.97, CMIN/DF = 6.65, SRMR = 0.036, AGFI = 0.95) [2] are similar to those of the present research. Additionally, the findings from Sinkovics et al.'s study (CFI = 0.956, IFI = 0.957, RMSEA = 0.040) [35] further emphasize the acceptability of our results and confirm the confirmatory factor analysis of the Persian version of the TechPH.

Another finding of this study was the appropriate and acceptable reliability of the tool, which was assessed using two methods: internal consistency (calculation of Cronbach's alpha coefficient) and stability (calculation of the intra-class correlation coefficient, ICC). Cronbach's alpha is used to test the reliability of an instrument designed in the form of a Likert scale with multiple-choice responses [37]. The Cronbach's alpha was 0.77, which aligns with the results of Anderberg et al.'s study [2]. Generally, a high Cronbach's alpha indicates good internal consistency of the scale and a strong correlation between the items. In the study by Schnall et al., aimed at validating the Health Information Technology Usability Evaluation Scale (Health-ITUES), all three dimensions of the scale demonstrated very good Cronbach's alpha values (greater than 0.7), with scores ranging from 0.85 to 0.92 [38]. This supports our findings. Finally, the ICC was 0.85, which exceeds the acceptable threshold for this coefficient (greater than 0.7) [39]. Thus, the P.TechPH exhibits both good stability and high internal consistency.

Technophilia and technophobia do not have a single global definition. Osiceanu defines technophilia as the attraction and enthusiasm of individuals toward technology, which is evident through activities such as the application of various advanced technologies in daily life [16]. Martínez-Córcoles et al. argue that passion and desire alone are insufficient to define technophilia; rather, the need to depend on and enjoy the use of new and advanced technology products, as well as their display, should also be considered [40]. Marescotti and colleagues describe technophobia as the fear or irrational anxiety that individuals experience regarding the use of technologies [41]. Ajlouni and Rawadieh view technophobia as a psychological orientation or attitude toward technology that results in limited use or fear of using it [42]. Li and Fuller define technophilia as a person's positive emotional response to a personal Information and Communication Technology (ICT) context [43].

Additionally, Donat et al. described negative emotions toward technology as technophobia, stating that technophilia and technophobia represent two ends of a spectrum in the relationship between humans and technology [44]. This concept was confirmed in the construct validity of our study. When we examine the impact of these two factors based on existing literature, we observe that fear of technology among older adults can lead to social isolation [45], reduced independence [46], increased anxiety [47], missed learning opportunities [48], and negative health implications [49]. Therefore, stakeholders can address these fears through education and support [50], by reducing the complexity of technologies [51], and by designing them based on the needs of older people [52]. This approach can help alleviate the fears of older individuals, regardless of their educational background.

The newly prepared instrument (P.TechPH) provides a general overview and does not focus on advanced technologies. Future research could explore individuals' attitudes toward advanced technology and the technological devices used in daily life, sharing their findings with manufacturing industries. Utilizing this research can positively impact the manufacturing sector; for example, by gaining a better understanding of older people's attitudes toward technology, companies can develop technologies that are more user-friendly and accessible for this age group. Aligned with health literacy principles [53], understanding older people's perspectives on technology can help industries establish more effective communication with this population and provide better services. Conducting ongoing research on older people's attitudes toward technology can assist industries in keeping pace with rapid technological changes and updating their products accordingly. Consequently, paying attention to older people's attitudes toward technology is beneficial not only for older people but also for manufacturing industries, enabling them to offer more suitable and efficient products and services. Additionally, future research in this area could include comparative analyses between generations and comparisons of older people's perspectives with those of younger generations regarding technology, as well as investigating factors that may contribute to differences in these attitudes.

Every study has limitations. One limitation of the present study is the lack of a standard and similar questionnaire in the Persian language, which prevented the performance of concurrent, convergent, and discriminant validities. Another limitation is that, during the psychometric process, older people with minimal reading and writing literacy participated, which may affect the application of the tool in studies involving illiterate older people. Additionally, the self-reporting nature of the instrument is another limitation that is unavoidable in questionnaire-based studies.

Conclusion

P.TechPH, the Persian version of the TechPH scale, demonstrates appropriate face and content validity. Based on the results of factor analysis and similar to the original version of this scale, it comprises two dimensions—technophilia and technophobia—and shows good construct validity as well as acceptable reliability. Thus, it is considered a suitable tool for measuring the attitudes of older people toward technology within the Iranian older population. The application of this scale in various types of research, such as investigations into attitudes toward technology among older people, allows for the comparison of study results across different countries among older adults.

Abbreviations

CVR	Content validity ratio
CVI	Content validity index
EFA	Exploratory factor analysis
CFA	Confirmatory factor analysis
KMO	Kaiser–Meyer–Olkin measure of sampling adequacy
PCA	Principal component analysis
ICC	Intraclass correlation coefficient
RMSEA	Root mean square error of approximation
IFI	Incremental fit index
CFI	Comparative fit index
GFI	Goodness-of-fit index
MFI	McDonald's fit index
AGFI	Adjusted goodness-of-fit index
SRMR	Standardized root means square residual

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Authors' contributions

N.A, S.R, and M.G. contributed to the study's conception and design, and all the authors have read and approved the final manuscript. N.A. contributed to project administration, data collection and analysis, and the writing of the initial draft. S.R. contributed to the methodology, data analysis, interpretation of the data, review, and editing. M.G. contributed to supervision, methodology, data analysis, interpretation of the data, review, and editing.

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Data availability
All data that support the findings of this study are not publicly available due to participants' confidentiality.

Declarations

Ethics approval and consent to participate
This study is the result of a thesis in the field of geriatric health with ethics code IR.SBMU.PHNS.REC.1402.015 from Shahid Beheshti University of Medical Sciences. Initially, the aim of the study was explained to the participants. Then, they were assured that their information would remain confidential. They were also informed that participation is totally voluntary and that they have the right to leave whenever they want. Social and cultural considerations were observed during the research. Finally, the participants gave their informed consent to participate in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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