Assessment of the Quality of Technophilia and Technophobia Validated Questionnaires for Management of Digital Health Interventions: Systematic Review and Delphi Consensus.

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Abstract

Background: Digitization has experienced a great growth in the last years and has emerged as a very promising tool for health interventions, but it is necessary to evaluate the variables that may influence the results of this intervention and are related with the patients such as rejection, addition, or stress due to the use of technological devices. In these terms, there is a evidence gap due to the fact there is no consensus regarding the questionnaires or scales to evaluate these variables.

Objective: To synthesize the evidence about the relationship between patients and technological devices, and develop a questionnaire to measure levels of technophilia, technophobia and technostress.

Methods: The systematic review included studies focused on the use of different questionnaires to evaluate the influence of technology on people. During the analysis, the data selected from each study were scale used, main variable, country and language used, sample size and study setting. In addition, for the development of the new questionnaire, Delphi procedure was used through the recruitment of ten experts, including software engineers, medical doctors, professors, and patients who completed two rounds of questionnaires.

Results: Seven studies with a total of 3505 subjects were included. Among the studies, three of them evaluated technostress; two focused on technophobia, one assessed technophilia, and the other two studies combined the evaluation of technophobia and technophilia. Regarding the domains and items used, these were evaluated using Cronbach's alpha scoring a range between 0.82 and 0.95. However, these results were greatly minor using other domains such as techno-communication avoidance device (0.491). Taking into account these domains, a questionnaire was constructed a priori and was refined through the two rounds of the Delphi panel, obtaining a new scale with three domains and eight items, establishing a minimum degree of agreement of 60% for priority items and 40% for secondary items.

Conclusions: A panel of experts were able to develop, based on the previous systematic review and on their own judgment, the eight items and the three domains to be included in the TECHNO-PROMS questionnaire, establishing a specific level of consensus, in order to plan a validation study for this scale.

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TITLE

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ABSTRACT

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KEYWORDS

Technophilia, technophobia, technostress, questionnaires, health informatics, public health, digital health.

INTRODUCTION

In recent decades, digitization has experienced unprecedented growth, generating a great impact on society, both in the workplace and interpersonal relationships, as well as in the fields of research and health [1]. So much so that the World Health Organization has developed good practices guide for the application of digital health [2], which is defined as the provision of healthcare through the use of different technologies, including both the care of patients and the health data storage [3].

The fact that digital health interventions are increasingly booming is due to the multitude of benefits that it provides both at the clinical level, as well as in relation to efficiency and cost-effectiveness. However, it may have a negative impact at the individual level, whether due to rejection, addiction, or psychological stress, variables that should be evaluated [4].

Technophobia refers to avoiding the use of technological devices, accompanied by negative attitudes and emotional responses, and although it does not imply fear like the traditional concept of phobia, it generates irrational behaviour in individuals against the pressing digitization [5]. This term has become a very relevant parameter, since it has not only been possible to establish a relationship with computer anxiety, but it has also been shown that high levels of technophobia result in reduced autonomy and functional independence [6].

In contrast, technophilia mean attraction to the use of technological devices with a good predisposition and adaptation, along with positive emotional responses [5]. Nonetheless, this position is not ideal either, since it is usually related to an excessive use of technologies, and even stands as a risk factor for addiction [7].

In addition, technostress is the inability to deal with new technologies in a healthy way, giving rise to symptoms such as anxiety, insomnia, mental fatigue and even physical somatization, either due to the constant struggle to adapt to digitization or over-identification with the digital world [8].

The possible development of any of these maladaptive responses makes it necessary to take many parameters into account when creating a digital health application [9], but currently there is no consensus about the scale to be used that includes all these variables for the development and management of digital health interventions.

For these reasons, the aim of this study has a double side. On the one hand, to synthesize the validated tools in relation to the measurement of technophobia and technophilia, comparing their psychometric properties to assess their quality. And on the other hand, to carry out a Delphi panel to

reach a consensus of experts in the development of a new scale that could be validated in the future.

METHODS

Search strategy

This study was reported following the Preferred Reporting Items for Systematic Reviews (PRISMA) statement.

To carry out this review, the authors conducted a literature search on July 2023 using the Pubmed, Scopus, Embase and Google Scholar databases. For the first three databases two search strings were established: one using the terms “validation” AND “questionnaire” AND “techno”; and the other one using “technophobia” OR “technophilia” AND “validation”; and in both the title and abstract filters were added. For Google Scholar, the search string was “technophobia OR technophilia scale”.

The studies identified in the search were selected through three phases. Firstly, duplicated articles were removed; secondly, the titles and abstracts were evaluated; and thirdly, the full text of the shortlisted articles was analysed by two independent researchers (L. R. P. and A. I. C. V.).

Elegibility criteria

All studies that met the following inclusion criteria were selected:

a. Studies that include questionnaires related to the acceptance and individual impact of technological tools.
b. Focused on the validation of technophobia, technophilia or technostress scales.
c. Available in English or Spanish.

However, studies that presented any of the following exclusion criteria were eliminated from the review:

a. Studies that used previously validated scales in the same population.

Data extraction

Data extraction was done independently by two reviewers (L. R. P. and A. I. C. V.), collecting the following data: (1) name of the scale; (2) main variable; (3) country; (4) language of the questionnaire; (5) number of participants; (6) setting; (7) number of items; (8) domains; (9) psychometric properties.

Delphi procedure

For this study, the Delphi consensus methodology was used. The Delphi panel aims to collect the

opinions of experts to develop a new questionnaire of the highest possible quality, reducing the number of confounding variables.

The experts were selected within the iGame project consortium (H2020 “Multi-dimensional Intervention Support Architecture for Gamified eHealth and mHealth Products”), ensuring representation of all parties involved: academics, clinicians from the public system, and private companies; as well as a transdisciplinary approach: software engineers, biomedical engineers, physiotherapists and doctors. Furthermore, there was representation of patients suffering from the three pathologies included on this study: breast cancer, low back pain and mental health disorders.

An online Delphi procedure was performed over two rounds. Questionnaires were completed using the online tool Google Forms and consisted of a list of items from which the experts had to choose those that seemed most relevant to them. In each round, panel members were contacted by email with a link to the survey. The results of the questionnaires of the first round were reported to participants in the second round to obtain the most supported final scale.

In the final questionnaire those items that presented an agreement equal or greater than 60% were included as priority items and those that presented an agreement between 40% and 60% were included as secondary items. The rest of the items were deleted.

The Conducting and Reporting Delphi Studies (CREDES) checklist was used to demonstrate the quality of the study design.

RESULTS

Characteristics of included studies

Regarding the review, 13773 studies were found, of which 29 were reviewed in full-text. Following evaluation, 7 studies were selected for qualitative synthesis (Figure 1). Of papers included, three instruments assessed technostress [11,13,16], two scales focused on technophobia [12,15], one questionnaire evaluated technophilia[10], and the remaining analysed both technophilia and technophobia [14].

The studies included a total of 3505 participants from a wide variety of countries: Sweden, Poland, United States, Spain, Mexico, France, Great Britain, Brazil, Estonia, India and Austria (Table 1).

Regarding the structure, this was also very heterogeneous. The range of dimensions and items went from two dimensions and six items, as in the TechPH [10], up to eight dimensions and thirty-six items, as in the Technostress Creators and Technostress Inhibitors Scale [13].

In relation to the psychometric properties, all studies bet on the Cronbach’s alpha to assess the internal consistency, providing an alpha value for each of the domains instead of for the overall scale.

The values obtained were between 0.491 in the sub-scale “techno-communication avoidance device” [13], up to, 0.95 in the domain “technophobia” of the TTQ [14]. Nonetheless, if only the generic domains technophobia, technophilia and technostress are observed, the values remain in a range between 0.82 and 0.95 [10-16].

Delphi consensus

15 experts were invited to joint this Delphi procedure. The response rates in the rounds were 100% in the first round and 100% in the second round.

In relation to the characteristics of the experts, gender, country of residence, specialty and level of experience are shown in Table 3.

Table 4 shows the description of the expert responses, from which we are able to extract that after the two rounds, 11 items were removed. Among the included items, 5 items were considered as priority items and 3 items were selected as secondary items. Furthermore, the items were classified into three domains that were technophilia with three priority items, technophobia with one priority item and one secondary item, and technostress with one priority item and three secondary items. The final questionnaire is shown in Textbox 1.

Table 1. Characteristics of studies.

Reference	*Scale*	*Main variable*	*Country*	*Language*	*Sample size*	*Setting*
Anderberg et al (2019) [10]	TechPH	Technophilia	Sweden	Swedish	374	People aged 65 years or older
González-Veiga et al (2022) [11]	Technostress questionnaire	Technostress	Brazil	Portuguese	138	Gynecologists and obstreticians
Khasawneh et al (2018) [12]	Technophobia scale	Technophobia	United States	English	112	Small and local businesses
Kot et al (2022) [13]	Technostress Creators and Technostress Inhibitors Scale	Technostress	Poland	Polish	632	Professionally active people
Martínez-Córcoles et al (2017) [14]	TTQ	Technophobia and technophilia	Poland and Estonia	English	534	People between 15 and 72 years old
Sinkovics et al (2022) [15]	Technophobia measure	Technophobia	United States, Spain, Great Britain, France, Mexico, India and Austria	English, Spanish, French, German and Hindi	1503	Adult population
Vega-Muñoz et al (2022) [16]	TS4US	Technostress	Chile	Spanish	212	University students

Table 2. Psychometric properties of studies.

Reference	*Number of items*	*Domains*	*Cronbach alpha*

Anderberg et al (2019) [10]	6	Techno-enthusiasm Techno-anxiety	0.72 0.68
González-Veiga et al (2022) [11]	17	Techo-overload Techno-invasion Techno-complexity Job satisfaction	0.845 0.804 0.838 0.833
Khasawneh et al (2018) [12]	16	Techno-paranoia Techno-fear Techno-anxiety Techno cybernetic revolt Techno-communication device avoidance	0.776 0.806 0.714 0.707 0.491
Kot et al (2022) [13]	36	Techno-overload Techno-invasion Techno-complexity Techno-insecurity Techno-uncertainty Literacy facilitation Technical support provision Involvement facilitation	0.86 0.82 0.84 0.85 0.85 0.89 0.95 0.90
Martínez-Córcoles et al (2017) [14]	32	Technophobia Technophilia - Enthusiasm - Dependency - Technoreputation	0.95 0.82 0.91 0.77 0.78
Sinkovics et al (2022) [15]	13	Personal failure Human vs machine-ambiguity Convenience	0.88 0.80 0.66
Vega-Muñoz et al (2022) [16]	21	Needs-Supplies Resources Person-People Factor Abilities-Demands Techno-Educational	0.886 0.754 0.922

Table 3. Demographic and professional characteristics of participants.

	Total	*of*	*Physiotherapist*	*Engineers*	*Medical*	*Patients*

	participants	*s*		*doctors*	
Number of participants (%)	10 (100%)	2 (20%)	4 (40%)	1 (10%)	3 (30%)
Age - Mean (SD) [min – max]	46.2 (13.5) [29 – 69]	40.5 (10.6) [33 – 48]	48.5 (16.4) [29 – 69]	65 (0) [65 -65]	40.7 (10.1) [29 – 47]
Gender (Female) – n (%)	5 (50%)	1 (50%)	2 (50%)	0 (0%)	2 (66.67%)
Country of residence					
- Spain	6 (60%)	2 (100%)	0 (0%)	1 (100%)	3 (100%)
- Hungary	2 (20%)	0 (0%)	2 (50%)	0 (0%)	0 (0%)
- North Macedonia	2 (20%)	0 (0%)	2 (50%)	0 (0%)	0 (0%)
Level of experience					
- Patient	3 (30%)	0 (0%)	0 (0%)	0 (0%)	3 (100%)
- Specialized professional (Private)	4 (40%)	0 (0%)	4 (100%)	0 (0%)	0 (%)
- Consultant (Public System)	1 (10%)	0 (0%)	0 (0%)	1 (100%)	0 (0%)
- Professor (University)	2 (20%)	2 (100%)	0 (0%)	0 (0%)	0 (0%)

Table 4. Description of expert responses.

ITEM	*FIRST ROUND*		*SECOND ROUND*	
	YES	*NO*	*YES*	*NO*
1.1. I think it's fun to use new technological gadgets	6 (60%)	4(40%)	7(70%)	3(30%)
1.2. Using technology makes life easier	9(90%)	1(10%)	10(100%)	0(0%)
1.3. New technologies are very intuitive and easy for me to learn	8(80%)	2(20%)	6(60%)	4(40%)
1.4. I think that I need to acquire the latest models for being updated	2(20%)	8(80%)	1(10%)	9(90%)
1.5. I love spending my free time using technological devices	1(10%)	9(90%)	0(0%)	10(100%)
1.6. I feel more identified and surer of myself with the virtual world than with the real one	0(0%)	10(100%)	0(0%)	10(100%)
2.1. I usually feel uncomfortable when I have to use technology	1(10%)	9(90%)	3(30%)	7(70%)
2.2. I am afraid of not being able to adapt to the new technological devices	4(40%)	6(60%)	6(60%)	4(40%)
2.3. I feel insecure when I have to carry out some activity related to technology alone	1(10%)	9(90%)	3(30%)	7(70%)
2.4. I try to avoid the use of technological devices unless it is essential	6(60%)	4(40%)	2(20%)	8(80%)
2.5. My ability is insufficient to handle technology	0(0%)	10(100%)	1(10%)	9(90%)
2.6. Digitization has made my life more complicated	3(30%)	7(70%)	3(30%)	7(70%)
2.7. I feel that digitization has increased my loneliness	3(30%)	7(70%)	4(40%)	6(60%)
3.1. Digitization means that I cannot disconnect from the work even while on vacation	1(10%)	9(90%)	4(40%)	6(60%)
3.2. I feel I have lost independence because I need help managing technology	2(20%)	8(80%)	1(10%)	9(90%)
3.3. I feel frustrated when I am not able to understand how technology works	4(40%)	6(60%)	4(40%)	6(60%)
3.4. I am forced by the technology to work much faster in my job	1(10%)	9(90%)	3(30%)	7(70%)
3.5. Technology complexity increases my workload	5(50%)	5(50%)	5(50%)	5(50%)
3.6. The use of technology makes me unable to relax	1(10%)	9(90%)	1(10%)	9(90%)

3.7. I don’t stop studying because I feel I’m never trained enough to keep up with technological development	7(70%)	3(30%)	6(60%)	4(40%)

Textbox 1. Final version of TECHNO-PROMS.

TECHNOPHILIA - I think it's fun to use new technological gadgets - Using technology makes life easier - New technologies are very intuitive and easy for me to learn *TECHNOPHOBIA* - I am afraid of not being able to adapt to the new technological devices - I feel that digitization has increased my loneliness *TECHNOSTRESS* - I feel frustrated when I am not able to understand how technology works - Technology complexity increases my workload - I don't stop studying because I feel I'm never trained enough to keep up with technological development
SCORE**:** each sentence will be score from 1 point (completely disagree) to 5 points (completely agree). The final score will be between 8 point and 40 points.

DISCUSSION

Principal results

The development of digital tools for health interventions has been associated with different patient responses related to their behaviour regarding the use of technology. For these reasons, available scientific papers have shown different questionnaires or scales to be able to measure the adaptability of these patients to digital interventions, but there is not enough data to draw a consistent agreement.

Considering the gap in evidence and the need for further agreements in this field, as far as the authors know, it is the first study presenting the development and validation of a questionnaire in terms of technophilia, technophobia and technostress based on a literature review and on a specific group of interest. The final version comprised 8 items divided into three domains, with an estimated completion time between 5 and 10 minutes.

The panel was composed of ten experts, following the recommendations of Streiner et al [17] who proposed that the panel should include a number of experts between 3 and 10. Furthermore, the identity of the panel members was completely anonymous in order to reduce the possibility that they could be influenced by each other's decision [18].

The survey revealed that the number of items selected was small in relation to the previous questionnaires found in the scientific literature. It could be explained for the lack of consensus between the experts due to their differences related to their jobs. However, this fact could be explained by the well-known reason among researchers that long questionnaires generate mental fatigue, thus biasing the results.

Regarding the dimensions of the questionnaire, the experts agreed the decision of maintaining three categories coinciding with the results shown in the previous literature review that chosen technophobia, technophilia and technostress as the main variables.

The questionnaire developed offers a short and easy tool to assess the relationship between patients and technologies in order to use the data in the construction of the application to use digital interventions. Nonetheless, this questionnaire is only a consensus between experts due to the fact there is an absence of a gold standard to evaluate that so it is necessary to validate this scale through a new study with the target population to obtain the psychometric properties and use this feedback to improve the questionnaire.

Strength and limitations

The main strength of this study was the inclusion of different professionals of academic, private, and public system together with the patient perspective, including three types of patients: breast cancer, depression, and low back pain, thus coinciding with the target population of the iGAME H2020 project.

Nevertheless, this project has also limitations. The main criticism point could be the poor consensus, probably caused by the great heterogeneity among experts. This fact means that the consistency of the questionnaire is not ideal.

Conclusions

Currently scientific evidence has shown that technophilia, technophobia and technostress are the main variables in the assessment of the relationship between patients and technology. Due to this fact, these domains constitute the three structural pillars of the new questionnaire.

The ten experts have established eight items to develop the TECHNO-PROMS questionnaire. Nonetheless, further research is needed to assess the psychometric properties of the new scale and make a stratification based on patients' affinity for technological interventions.

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Ramírez-Pérez searched and screened the articles. Moreover, Antonio Ignacio Cuesta-Vargas and Laura Ramírez-Pérez contributed to data analysis and interpretation of the data. Laura Ramírez-Pérez drafted the manuscript, and all authors revised it critically. All authors approved the final manuscript.

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CONFLICTS OF INTEREST

None declared.

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Supplementary Files

Figures

Selection study. PRISMA 2020 Flow Diagram.