BMC Medical Informatics and Decision Making

RESEARCH

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The persian version of mhealth app usability questionnaire (MAUQ) for patients: a psychometric assessment study

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Abstract

Introduction The growing importance of mobile apps in osteoporosis management highlights the crucial need for evaluating their utility and usability, particularly for Osteoporosis support apps. Addressing this need, the mHealth App Usability Questionnaire (MAUQ) was crafted in four different versions, categorized based on the nature of the app (interactive or standalone) and the intended user (patient or provider). Due to its usage by diverse users with varying languages, this questionnaire requires psychometric assessment in multiple languages. This study aimed to translate and validate the Persian version of MAUQ for patients.

Method After translating the standalone and interactive versions of MAUQ into the Persian language, face validity, content validity, and factor analysis were conducted. Ten patients with osteoporosis were involved for face validity, and ten experts in medical informatics and health information technology were invited to assess content validity by completing a questionnaire. A total of 99 patients with osteoporosis participated in the factor analysis. The reliability of the questionnaires was assessed by calculating Cronbach's alpha.

Results The face validity and the content of the Persian version of MAUQ were confirmed. Factor analysis of the standalone version of MAUQ showed 18 items in three dimensions: easy to use (7 items), user interface and satisfaction (6 items), and usefulness (5 items). Factor analysis of the interactive version of MAUQ showed 21 items in two dimensions: easy to use and satisfaction (11 items) and information arrangement and usefulness (10 items). The Cronbach's alpha of the questionnaire for standalone and interactive applications was 0.90.

Conclusion The psychometric assessment of the Persian MAUQ established its validity and reliability among osteoporosis patients, affirming its efficacy as a robust tool for evaluating mHealth app usability.

Keywords Iranian version of MAUQ, mHealth, Questionnaire validation, Reliability, Usability

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Introduction

Osteoporosis, a common and debilitating bone disease, poses significant challenges to individuals and healthcare systems worldwide [1]. Characterized by the gradual loss of bone density and deterioration of bone tissue, osteoporosis increases the risk of fractures, particularly in the hip, spine, and wrist. This condition often advances silently, with symptoms becoming noticeable only after a fracture occurs [2, 3]. A sedentary lifestyle, poor nutrition, and certain medications can contribute to its development [4]. Early detection remains a hurdle, as there is a lack of routine screening protocols, leading to delayed intervention. The economic burden of osteoporosis is substantial, given the costs associated with fractures, rehabilitation, and long-term care [5, 6]. mHealth apps can be utilized to address these challenges by providing diverse educational services, supporting self-care processes, enhancing awareness, and improving access to preventive measures and treatments, ultimately reducing the prevalence of osteoporosis among individuals [7, 8].

Moreover, mHealth apps offer convenient access to healthcare services, enabling individuals to seek medical advice, schedule appointments, and access health records remotely [9]. They facilitate remote monitoring, empowering patients to track their vital signs and medication adherence while allowing healthcare providers to intervene as needed [9, 10]. Moreover, these apps promote patient engagement through personalized health recommendations, educational resources, and self-management tools, leading to improved health outcomes and increased patient satisfaction [9–11]. Despite their potential, mHealth apps face usability challenges that hinder their effectiveness and user engagement [12]. Complex interfaces, limited personalization options, inconsistent performance, poor integration with healthcare systems, and lack of user support contribute to difficulties in app navigation, customization, reliability, data sharing, and user satisfaction [13–15]. Addressing these challenges is vital for maximizing the potential of mHealth apps in healthcare delivery.

Although there are various other methods available for evaluation; usability questionnaires are the most commonly utilized approach for assessing the usability of mobile applications and identifying issues, owing to their ease of implementation and simplicity in data analysis [16]. Multiple questionnaires are available to assess the usability of mHealth applications effectively. The System Usability Scale (SUS), Mobile Application Rating Scale (MARS), and Post Study System Usability Questionnaire (PSSUQ) are among the most popular and widely used questionnaires for evaluating the usability of mHealth applications [16]. While these questionnaires can evaluate certain aspects of the usability of mobile health applications, they may not offer sufficient insights into the distinctive factors that are specific to these applications [17]. The mHealth App Usability Questionnaire (MAUQ) is specifically designed to address the unique factors of mHealth applications and can provide relevant information regarding their usability [18]. It offers four distinct versions tailored for assessing interactive or stand-alone mHealth applications from the perspectives of both patients and healthcare providers [18].

To the best of our knowledge, the Persian version of the MAUQ has not yet been translated and validated. However, there have been studies that successfully translated and validated the MAUQ into various languages such as Chinese [19], Malay [20], Spanish [21], and German [22]. These studies have reported high reliability and validity, akin to the original English version of the questionnaire. The objective of the current study is to conduct a psychometric assessment of the patient version of the MAUQ in the Persian language. This assessment aims to evaluate the reliability and validity of the Persian version of the MAUQ for assessing the usability of mobile health applications among patients with osteoporosis.

Methods

Study design

This cross-sectional study aimed to translate and validate the standalone and interactive versions of MAUQ for Persian-speaking patients. Initially, permission was obtained from the main developers of the MAUQ (English version) via email.

MAUQ

In 2019, Zhou, et al. [18], developed the MAUQ in the English language to evaluate the usability of standalone and interactive mHealth applications. The questionnaire is designed for patients and healthcare providers, with two versions available for standalone and interactive applications. The standalone application version, intended for both patients and providers, comprises 18 items divided into three sections: ease of use, interface and satisfaction, and usefulness. The interactive application version, designed for both patients and providers, comprises 21 items distributed across three sections: ease of use and satisfaction, system information arrangement, and usefulness. Each question in the MAUQ is based on a 7-point scale (1 (strongly disagree) to 7 (strongly agree)). The MAUQ demonstrated correlation with the PSSUQ ($r = 0.8448$) and the SUS ($r = 0.6425$), confirming its criterion and construct validity. Factor analysis also revealed acceptable validity. The reliability of the MAUQ was confirmed with a Cronbach's alpha of more than 0.80 [18].

Questionnaire translation and adaptation

The Forward-Backward method was used to translate two versions of MAUQ for patients (standalone and

interactive) from English to Persian [23]. In the forward translation stage, two proficient translators, fluent in both English and Persian, independently translated two versions of the MAUQ. After consolidating the initial translations into a single version, two translators independently performed the backward translation stage, translating the Persian version back into English. Ultimately, the research team conducted a meeting to review and achieve consensus on the two translated versions (Persian and English).

Validity and reliability of persian version

Face validity, content validity index (CVI), and factor analysis were calculated to assess the validity of both standalone and interactive versions of the MAUQ. The online-translated questionnaires were distributed to ten patients with osteoporosis, who were instructed to rate the importance of each question on a 5-level scale (1 (not important at all) to 5 (highly important)) for face validity evaluation. The impact score for each item in the completed questionnaires was then calculated using the following formula:

Impact score = Frequency (%) * Importance

The impact scores > 1.5 were considered acceptable [24].

The online translated questionnaires were sent to 10 experts in medical informatics and health information technology and asked them to answer the questions in 4 level (1 (not related) to 4 (highly related)) scales for the CVI calculation. The CVI was calculated for each item using the following formula:

$$\mathrm{CVI} = \frac{\text{number of raters giving a rating of 3 or 4}}{\text{total number of raters}}$$

Finally, the modified kappa (K*) statistic was calculated using CVI and the probability of chance agreement (Pc) using the following formula [25]:

$Pc = [(N!/A!)(N-A)!] * 0.5^{N}$

$K^{*} = (CVI-Pc)/(1-Pc)$

If the value of K* for each item was > 0.74 considered as excellent, 0.60 to 0.74 considered as good, < 0.60 considered as fair and the item should be omitted from questionnaire.

The data were collected from 99 patients attending two osteoporosis clinics in Kerman City (Mehregan and Samenalhojaj), Kerman, Iran, from April to June 2023 for factor analysis. Participants who use smartphones were included in this study, while those unwilling to participate or afflicted with severe conditions such as blindness, deafness, or mental disorders were excluded. Patients willing to partake in the study were provided with explanations regarding the research, instructions on using the application, and guidance on completing the paper questionnaire. Following this, the "osteoporosis" standalone and interactive application was installed on the participants' smartphones. To standardize user interaction and ensure consistent data collection, each participant actively engaged with the application for a dedicated period of 30 min. This application serves as a comprehensive resource offering insights into osteoporosis, covering symptoms, diagnostic methods, complications, treatment options, and preventive measures. In addition to providing essential information, the application facilitates remote counseling through diverse channels such as email, web-based services, and telephone consultations. Patients can connect with healthcare professionals via email for written exchanges, utilize web-based services for virtual consultations, or opt for telephone consultations for direct communication.

After completing questionnaire by 99 patients with osteoporosis, the Kaiser-Meyer-Olkin (KMO) index and Bartlett's test of sphericity were used to evaluate sampling adequacy. Then, factor analysis of the questionnaires was performed using Principal Components Analysis with Promax and Direct oblimin rotations.

The Cronbach's alpha as the internal consistency index was used to evaluate the reliability of the questionnaires. Cronbach's alpha ≥ 0.70 was considered acceptable [26].

Data analysis of participants demographic

To assess the correlation between participants' demographic traits and the MAUQ questionnaire in both standalone and interactive versions, statistical analyses were conducted utilizing t-tests and ANOVA. The data underwent examination using Microsoft Excel 2016 and SPSS version 22.

Ethical considerations

This study was registered with the ID = 401,000,906 at Kerman University of Medical Sciences (KMU) and was approved by the ethical committee of the university. The ethics approval code is IR.KMU.REC.1401.518. All methods were performed in accordance with the relevant guidelines and regulations of the ethical committee of KMU. Moreover, informed consent was obtained from all participants.

Results

The face and content validity of the Persian version of the MAUQ for standalone and interactive applications is shown in Tables 1 and 2, respectively. All items were valid because they obtained the impact score more than 1.5 for face validity and the k* value more than 0.60 for content validity.

Ninety-nine patients participated in this study, and their demographic information is presented in Table 3. The majority of participants were female ($n = 80$, 81%).

Table 1 The face and content validity of the Persian version of the MAUQ for standalone application

Item	Impact score	K*
I1: The app was easy to use.	5	1
I2: It was easy for me to learn how to use this app	4.8	1
I3: When moving between the screens of the application, the navigation was consistent.	4.7	0.79
I4: The interface of this app gave me the possibility to use all provided features (such as entering information, response to reminders, viewing information).	4.8	1
I5: Whenever I made a mistake in using the app, I could correct my mistake easily and quickly.	5	1
I6: I like the interface of the app	4.9	1
I7: Information in the app was well organized; therefore, I could easily find information I needed.	4.9	1
I8: This app has verified and provided enough information for me to know the progress of my activity.	4.7	0.89
I9: I feel comfortable using this app in public.	4.05	1
I10: The time required to use this application was suitable for me.	4.9	0.66
I11: I will use this app again.	4.8	1
I12: Overall, I am satisfied with this app.	4.9	0.89
I13: This app will be useful for my health and well-being.	4.8	1
I14: This app improved my access to healthcare services.	4.8	1
I15: This app helped me manage my health effectively.	5	1
I16: This app has all the features and functions that I expected.	4.8	1
I17: I could use this app even when the internet was weak or not connected.	4.14	1
I18: This app provides an acceptable way to receive healthcare services such as accessing educational materials, tracking my activities, and performing self-assessments.	4.8	1

Table 2 The face and content validity of the Persian version of the MAUQ for interactive application

Item	Impact score	K*
I1: The app was easy to use.	4.9	1
I2: It was easy for me to learn how to use this app.	4.8	1
I3: I like the interface of the app.	4.9	1
I4: Information in the app was well organized; therefore, I could easily find needed the information I needed.	4.9	1
I5: I feel comfortable using this app in public.	4.05	1
I6: The time required to use this application has been suitable for me.	4.8	0.79
I7: I will use this app again.	5	0.89
I8: Overall, I am satisfied with this app.	4.8	1
I9: Whenever I made a mistake in using the app, I could correct my mistake easily and quickly.	5	1
I10: This app provides an acceptable way to receive healthcare services.	5	0.89
I11: This app has verified and provided enough information for me to know the progress of my activity.	4.8	0.79
I12: When moving between the screens of the application, the navigation was consistent.	4.8	0.89
I13: The interface of this app gave me the possibility to use all provided features (such as entering information, response to reminders, viewing information).	4.9	1
I14: This app has all the features and functions that I expected.	4.9	0.89
I15: This app will be useful for my health and well-being.	4.8	0.66
I16: This app improved my access to healthcare services.	4.8	0.89
I17: This app helped me manage my health effectively.	5	1
I18: This app made it easy for me to communicate with my healthcare provider.	5	0.79
I19: I had many more opportunities to communicate with my healthcare provider using this app.	4.7	0.89
I20: I was confident that any information I sent to my healthcare provider using this app would be received.	4.8	1
I21: I felt comfortable communicating with my healthcare provider using this app.	5	1

The mean age of the participants was 59.5 years, and more than half of them ($n = 59$, 59.5%) held a diploma degree.

The Kaiser-Meyer-Olkin (KMO) value obtained 0.93 and Bartlett's test of sphericity obtained < 0.0001 that shows the adequacy of samples for factor analysis.

Factor analysis of Persian version of the MAUQ for standalone applications with Promax rotation showed three factors (Table 4). The variance interpretation rates of the three factors for standalone applications were 58.47%, 8.39%, and 5.66%, respectively.

Table 3 The demographic characteristics of participants

Characteristic		Frequency (%)
Gender	Female	80 (81)
	Male	19 (19)
Age	18–28	4 (4)
	29–38	7 (7)
	39–48	12 (12)
	49–58	17 (17)
	59–68	31 (31)
	69–78	20 (20)
	79–85	8 (8)
Education level	Under diploma	11 (11)
	Diploma	59 (59.5)
	Associate Degree	3 (3)
	Bachelor	15 (15.5)
	Master	10 (10)
	PhD	1 (1)

Table 4 Factor analysis of the Persian version of MAUQ for standalone applications

Item of the Persian version	Factor loadings		
	Factor 1 (Easy to use)	Factor 2 (User interface and satisfaction)	Factor 3 (Usefulness)
I2: It was easy for me to learn how to use this app.	**0.961**	-	-
I4: The interface of this app gave me the possibility to use all provided features (such as entering information, response to reminders, viewing information).	**0.924**	-	-
I3: When moving between the screens of the application, the navigation was consistent.	**0.853**	-	-
I1: The app was easy to use.	**0.801**	-	-
I7: Information in the app was well organized; therefore, I could easily find information I needed.	**0.734**	-	-
I6: I like the interface of the app.	**0.731**	-	-
I5: Whenever I made a mistake in using the app, I could correct my mistake easily and quickly.	**0.399**	-	-
I8: This app has verified and provided enough information for me to know the progress of my activity.	-	**0.945**	-
I12: Overall, I am satisfied with this app.	-	**0.882**	-
I11: I will use this app again.	-	**0.850**	-
I10: The time required to use this application was suitable for me.	-	**0.749**	-
I13: This app will be useful for my health and well-being.	-	**0.608**	-
I9: I feel comfortable using this app in public.	-	**0.438**	-
I18: This app provides an acceptable way to receive healthcare services such as accessing educational materials, tracking my activities, and performing self-assessments.	-	-	**0.935**
I16: This app has all the features and functions that I expected.	-	-	**0.867**
I17: I could use this app even when the internet was weak or not connected.	-	-	**0.746**
I15: This app helped me manage my health effectively	-	-	**0.686**
I14: This app improved my access to healthcare services.	-	-	**0.486**

The factor analysis of the Persian version of the MAUQ for interactive applications with Direct Oblimin rotation revealed two factors (Table 5). The variance interpretation rates of the two factors for interactive applications were 63.93% and 5.24%, respectively.

The Cronbach's alpha of questionnaire for standalone applications was 0.90. The Cronbach's alpha for "Easy to use", "User interface and satisfaction", and "Usefulness" factors was 0.66, 0.93, and 0.92, respectively.

The Cronbach's alpha of questionnaire for interactive applications was 0.97. The Cronbach's alpha for "Easy to use and satisfaction" and "Information arrangement and usefulness" factors was 0.95 and 0.94 respectively.

Additionally, in the standalone version, there were no noteworthy correlations found between the demographic characteristics of the participants and factors 1 and 2, as displayed in Appendix A Table 1.

Moreover, in the interaction version, there were no significant correlations observed between the participants' demographic characteristics and factors 1, 2, and 3, as shown in Appendix A Table 2.

Discussion

This study detailed the process of translating and validating the Persian version of the mHealth App Usability Questionnaire (MAUQ) for patients. The findings of

Table 5 Factor analysis of the Persian version of MAUQ for interactive applications

Item of the Persian version	Factor loadings	
	Factor 1 (Easy to use and satisfaction)	Factor 2 (Information arrangement and usefulness)
I6: The time required to use this application has been suitable for me.	**0.936**	-
I4: Information in the app was well organized; therefore, I could easily find needed the information I needed.	**0.933**	-
I8: Overall, I am satisfied with this app.	**0.892**	-
I11: This app has verified and provided enough information for me to know the progress of my activity.	**0.881**	-
I3: I like the interface of the app.	**0.748**	-
I9: Whenever I made a mistake in using the app, I could correct my mistake easily and quickly.	**0.741**	-
I7: I will use this app again.	**0.705**	-
I1: The app was easy to use.	**0.657**	-
I2: It was easy for me to learn how to use this app.	**0.623**	-
I10: This app provides an acceptable way to receive healthcare services.	**0.532**	-
I5: I feel comfortable using this app in public.	**0.483**	-
I14: This app has all the features and functions that I expected.	-	**0.949**
I18: This app made it easy for me to communicate with my healthcare provider.	-	**0.914**
I15: This app will be useful for my health and well-being.	-	**0.847**
I17: This app helped me manage my health effectively.	-	**0.832**
I19: I had many more opportunities to communicate with my healthcare provider using this app.	-	**0.733**
I21: I felt comfortable communicating with my healthcare provider using this app.	-	**0.664**
I16: This app improved my access to healthcare services.	-	**0.647**
I20: I was confident that any information I sent to my healthcare provider using this app would be received.	-	**0.639**
I13: The interface of this app gave me the possibility to use all provided features (such as entering information, response to reminders, viewing information).	-	**0.552**
I12: When moving between the screens of the application, the navigation was consistent.	-	**0.480**

our study on patients with osteoporosis indicated that both the independent MAUQ and the interactive variant designed for patients demonstrated a significant level of face and content validity. The individual items exhibited strong face validity (with an impact score of at least 1.50) and content validity (with k* values of 0.60 or higher). Additionally, the sampling adequacy was confirmed by a Kaiser-Meyer-Olkin (KMO) value of 0.93, and the Bartlett's test of sphericity yielded a result of less than 0.001, further supporting the appropriateness of the sample. Moreover, the Cronbach's α coefficient exceeded 0.90 for both the stand-alone and interaction domains of M-MAUQ, underscoring its high reliability.

In this study, the factor analysis for standalone version revealed three factors with acceptable Cronbach's α coefficient and we labeled them as "Easy to use", "User interface and satisfaction" and "Usefulness". In this study, factor analysis for standalone applications unveiled three factors displaying acceptable Cronbach's α coefficient. These factors were designated as "Ease of use," "User interface and satisfaction," and "Usefulness." Notably, the factors in our questionnaire resemble those of the original MAUQ, which consisted of three factors (subscales): "Ease of use," "Interface and satisfaction," and "Usefulness" [18]. The robustness and consistency of these dimensions across diverse studies, such as the Malay version of the M-MAUQ [20] and the Chinese Version of the M-MAUQ [19], further reinforce their universal relevance. These cross-cultural adaptation and validation studies also identified and validated dimensions aligning with "Easy to use," "User interface and satisfaction," and "Usefulness," underlining the transferability of these factors across different languages and cultural backgrounds. This parallelism across diverse linguistic and cultural contexts highlights the inherent consistency of user experience evaluation criteria, regardless of the specific environment in which the mobile applications are being utilized.

Moreover, this parallelism indicates the robustness and replicability of these dimensions across different contexts and assessments. The consistency in factor structure between the current study and the MAUQ further underscores the importance of these dimensions in evaluating user perceptions and interactions with standalone applications [18]. The implications of these findings extend to both academia and health industry, offering a comprehensive framework for evaluating and improving standalone applications [17, 27]. Incorporating a user-centered design approach that prioritizes the identified factors can lead to the creation of applications that not only fulfill functional requirements but also resonate with users on a deeper level [28]. Kramer et al. [29], noted that

user-centered design is driven by a focus on understanding and addressing the needs, preferences, and behaviors of end users, which can create products or systems that enhance usability and overall user satisfaction. McCurdie et al. [30], also reported that user-centered design for mobile applications enhances user satisfaction by tailoring features to meet the needs, preferences, and behaviors of users, ultimately improving usability and fostering a positive user experience. By considering the aspects of user-centered design, developers can effectively link the features under development with the challenges users may face during both initial use and sustained adoption [31]. Additionally, a user-centered approach promotes brand loyalty and positive word-of-mouth, as satisfied users are more likely to recommend and advocate for the application within their social circles [32]. Jakobsen et al. [8], also stressed the significance of user-centered and participatory design in creating a self-management app for women with osteoporosis. They highlighted the need for continuous user engagement and a focus on user needs for effective app design. Derived from action research, participatory design integrates qualitative research strategies to drive change and improve practices.

Furthermore, the exploratory factor analysis conducted on interaction applications in this study unveiled two factors exhibiting a satisfactory Cronbach's α coefficient. These factors were denoted as "Ease of use and satisfaction" and "Arrangement of information and utility." Moreover, the dimensions within our questionnaire closely resemble those of the original MAUQ, which comprised solely three factors (subscales) [18]; however, we reconfigured them into distinct groupings: "Ease of use and satisfaction" and "Arrangement of information and utility." Angelucci et al. [33], assessed an app designed to enhance patients' adherence to osteoporosis therapy using MAUQ. Their findings revealed statistical differences in "ease of use and satisfaction," "system information arrangement," and "usefulness." The most significant difference (0.93) was observed in the ease of use and satisfaction category, with the usability testing group providing the lowest average score for the system information arrangement dimension. One possible reason for the observed difference could be the evolving nature of mobile applications and user expectations over time. As technology advances, the landscape of mobile apps has become increasingly diverse and complex. Users now interact with a wide range of apps that serve various purposes, from entertainment and communication to productivity and health [34]. Souza-Júnior et al. [35], highlighted that individuals can oversee aspects of their finances, travel plans, entertainment, health, and education through the utilization of their smartphones, especially through the use of progressively interactive applications (apps).This expanded scope of applications may have led to a need for more specific and tailored dimensions for assessing usability.

The reconfigured dimensions, "Ease of use and satisfaction" and "Arrangement of information and utility ", seem to capture different facets of user experience that might not have been as relevant or distinct in the past [36, 37]. Furthermore, the reconfiguration could reflect a growing recognition of the multifaceted nature of usability. While the original MAUQ's three factors provided a comprehensive overview of usability, the restructured dimensions delve deeper into specific aspects that contribute to overall usability [18]. "Ease of use and satisfaction" encompasses user-friendliness, navigation, and overall contentment, which are critical for a seamless and enjoyable experience [18–20]. On the other hand, "Arrangement of information and utility" delves into the layout, accessibility, and practical value of the information presented in the app. This breakdown allows for a more nuanced evaluation of usability, enabling developers and designers to pinpoint areas of improvement with greater precision. Böhmer et al. [38], also, pointed out that the organization of information on mobile devices facilitates user-friendly interaction with mobile-based applications and enables easy access to desired information. Some studies [39] showed that utility in mobile applications brings heightened user satisfaction through streamlined functionality, addressing specific needs efficiently. These apps foster increased productivity, user-friendly experiences, and customizable solutions, contributing to a positive and tailored user experience. Kastner et al. [40], also assessed the usability of a clinical decision support system for osteoporosis management and concluded that usability is a critical factor in facilitating users' ease of use while reducing errors during operation.

So, it's worth considering the methodological approach of our study as well. The reconfiguration of dimensions might be attributed to a more robust and refined analysis of user feedback and responses. By closely examining user preferences and behaviors, we may have uncovered patterns that prompted the need for distinct groupings. Additionally, advancements in usability research methodologies and statistical techniques might have facilitated a more granular identification of dimensions that significantly influence the overall user experience.

Limitation of the study

There are several shortcomings to this study. To begin with, the selection of osteoporosis patients from a sole city hinders the extension of the outcomes to the broader Iranian populace. Furthermore, the exclusivity of osteoporosis patients in recruitment weakened the persuasiveness of the results. Moreover, the sample size remained insufficient for assuring the broad applicability of the

conclusions. To address these limitations, future research should consider a more diverse and representative sample of osteoporosis patients, as well as patients with other diseases, from multiple cities across Iran. Incorporating a wider range of patients with varying conditions would enhance the robustness of the findings. Moreover, increasing the sample size and diversifying the participant pool could strengthen the generalizability and overall impact of the study's outcomes. As highlighted by recent studies in the field, augmenting the sample size and incorporating a more diverse participant pool, as suggested by Hendrickson et al. [41], could significantly bolster the generalizability and overall impact of the study's outcomes. Moreover, for strengthen the generalizability, it's crucial to consider the specific cultural context of the study participants and the need for further validation in diverse populations [42]. Additionally, addressing potential variations in app usage patterns and preferences across different regions and user demographics will contribute to a more comprehensive understanding of the questionnaire's applicability beyond the studied population.

Conclusion

In light of the findings, the psychometric assessment of the Persian MAUQ has demonstrated its strong validity and reliability within the osteoporosis patient population. These results unequivocally endorse the MAUQ's effectiveness as a dependable and comprehensive instrument for assessing the usability of mHealth applications. Healthcare practitioners and researchers can confidently employ the Persian MAUQ to gain invaluable insights into the user-friendliness and functionality of mHealth apps, thereby enhancing the quality of care and support provided to patients with osteoporosis.

Abbreviations

MAUQ mHealth App Usability Questionnaire

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12911-025-02882-3.

Supplementary Material 1

Acknowledgements

The authors would like to thank all the nurses who voluntarily participated in this study.

Author contributions

S.HG, A.SH and K.M were responsible for concept and design, methodology and interpretation of data. S.HG, K.M and F.D extracted the data and performed the analysis. S.HG, A.SH and K.M drafted the manuscript and created tables. A.SH, and KB reviewed the manuscript. All approved the final version of the manuscript. All authors meet the criteria detailed in Author Instructions.

Funding

This study was supported by Medical Informatics Research Center of Kerman University of Medical Sciences (Code: 401000906). The funder had no roles in study design, data gathering and analysis.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The study was approved by ethical committee of Kerman University of Medical Sciences. The Ethic approval Code is IR.KMU.REC.1401.518. All methods were performed in accordance with the relevant guidelines and regulations. Informed consent was obtained from all subjects.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 2 September 2023 / Accepted: 20 January 2025
Published online: 23 January 2025

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