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Original Article

Investigating the Feasibility of a Mobile Phone–Based Self-Care Training Program for Individuals with Lower Limb Amputations

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ABSTRACT

Background: Mobile phone–based self-care programs are increasingly recognized as effective tools for addressing patients' educational and self-management needs. Given the complex and unique challenges faced by individuals with lower limb amputations who use prostheses, there is a need to provide accessible educational resources to enhance self-care and improve quality of life. This study aimed to evaluate the feasibility of a mobile phone–based self-care training program for individuals with lower limb amputations.

Methods: This descriptive cross-sectional study was conducted in two stages. In the first stage, 10 rehabilitation specialists participated in the expert evaluation. In the second stage, 30 individuals with lower limb amputations participated in the usability assessment. Data collection instruments included the Persian version of a smartphone application usability questionnaire for experts, the System Usability Scale (SUS) for amputees, and the Usefulness, Satisfaction, and Ease of Use (USE) questionnaire for amputees.

Results: The mean age of the participants was 45.37 ± 13.80 years. From the experts' perspective, the mean usability score of the smartphone application was 7.07 ± 1.15, indicating an acceptable level of usability. From the amputees' perspective, the mean System Usability Scale (SUS) score was 88.75 ± 8.27, indicating excellent usability. The overall mean score on the Usefulness, Satisfaction, and Ease of Use (USE) questionnaire was 4.50 ± 0.24, reflecting high levels of perceived usefulness, satisfaction, and ease of use.

Conclusion: The findings suggest that the developed mobile phone–based self-care application is a feasible and highly usable tool for individuals with lower limb amputations. It has the potential to enhance self-care knowledge, support rehabilitation management after amputation, and contribute to improved quality of life and reduced amputation-related complications.

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Introduction

With advances in science and technology, disease patterns and healthcare needs have evolved. One of the major challenges in the fields of medicine and rehabilitation is lower limb amputation, which may result from various causes, including diabetes, trauma, accidents, and cancer [1]. Lower limb amputation not only impairs physical function but also has profound psychological and social consequences, including reduced quality of life and a negative body image. These challenges can make the process of adaptation and reintegration into daily life considerably more difficult [2].

According to the World Health Organization (WHO), approximately 57.7 million people worldwide were living with limb amputations in 2017 [3]. In Iran, more than three million people were living with diabetes in 2011, and according to the WHO, this number is projected to increase to approximately seven million by 2030 if effective preventive measures are not implemented [4]. Regardless of the underlying cause, lower limb amputation often necessitates the use of a prosthesis to restore mobility, promote independence, and facilitate participation in daily activities. However, the WHO estimates that only 5% of individuals with limb amputations in developing countries have access to prosthetic services [5]. These statistics highlight the urgent need for effective interventions to improve the quality of life of this population. Previous studies have also demonstrated the importance of providing psychological and social support to individuals with amputations to facilitate successful rehabilitation and community reintegration [6].

One of the most effective strategies for improving the quality of life of individuals with chronic conditions, including those with lower limb amputations, is the implementation of self-care programs. Self-care refers to the activities individuals undertake to maintain their health, manage their condition, and improve their quality of life. These activities may include lifestyle modifications, disease management, and the prevention of complications and adverse effects [7]. Active participation in self-care programs promotes behavioral change and improves health outcomes [8]. Furthermore, healthcare systems allocate substantial financial resources to patient care. Empowering individuals to assume a more active role in self-care can improve overall health outcomes, enhance patient engagement in the care process, and ultimately reduce healthcare costs [9].

With the rapid advancement of digital technologies, various approaches have been developed to promote patient education and self-care. One such approach is the use of mobile phone–based educational programs [10]. Given the widespread availability and accessibility of mobile phones, these programs provide patients with continuous access to educational resources and support regardless of time or location [11]. Consequently, they may be particularly beneficial for individuals living in remote or underserved areas where access to healthcare services is limited [12]. Owing to their diverse functionalities, smartphones have become valuable platforms for delivering eHealth and self-care interventions. These devices facilitate efficient communication between healthcare providers and patients and enable users to access accurate, timely health information through dedicated applications. In addition, mobile phone–based programs can support self-management by providing personalized health recommendations and rehabilitation guidance [13,14].

Studies have shown that the use of such programs can positively impact patients' quality of life. Mobile health programs designed to support individuals with chronic conditions, such as diabetes and lower limb amputation, have played an important role in improving disease management and promoting self-care [15].

Considering the increasing use of mobile phones in Iran and the urgent need to improve awareness and empower individuals with lower limb amputations, a clear gap remains in the availability of appropriate rehabilitation tools. Currently, there is no comprehensive and practical mobile application for amputee rehabilitation in Iran. Therefore, we sought to further develop the software previously designed at the Research Office of Isfahan University of Medical Sciences by incorporating expert feedback and to evaluate its usability among individuals with lower-limb amputations.

Methods

Study Design

This descriptive cross-sectional study included orthotics and prosthetics specialists, physiotherapists, and occupational therapists working with individuals with lower-limb amputations, as well as individuals with lower-limb amputations who were using prostheses and were referred to prosthetic service centers in Isfahan and Tehran, Iran.

Procedure

The inclusion criteria for participants with lower limb amputations were as follows: ownership of an Android mobile phone (version 4.0 or later) and the ability to use it (i.e., familiarity with at least two or three mobile applications); the ability to read and write to use the software and complete the questionnaires; a minimum of five years since amputation; regular use of a prosthesis for daily activities; and willingness to participate in the study. The exclusion criteria were withdrawal from the study, pelvic (Canadian) or finger amputation, and failure to complete the questionnaires.

The inclusion criteria for rehabilitation specialists were as follows: for orthotics and prosthetics specialists, at least five years of clinical experience in the field of lower limb prosthetics and employment at a prosthetic service center; and for physiotherapists and occupational therapists, either faculty membership or at least five years of clinical experience in the rehabilitation of individuals with lower limb amputations. The exclusion criterion for specialists was working as a prosthesis manufacturer on an intermittent or occasional basis (e.g., once per year).

Sampling was performed using a convenience sampling method and included 10 rehabilitation specialists and 30 individuals with lower limb amputations. Data collection instruments consisted of a demographic questionnaire (age, sex, education,

occupation, and place of residence) and three assessment questionnaires: (1) a smartphone application usability questionnaire completed by the specialists, (2) a smartphone application usability questionnaire completed by the participants with lower limb amputations, and (3) a questionnaire evaluating participants' satisfaction with the application.

In the first stage, the software was installed on the mobile phones of the rehabilitation specialists, including faculty members and clinicians in orthotics and prosthetics, physiotherapy, and occupational therapy. During a face-to-face session, the researcher explained the application's functions, after which both the specialists and the participants with lower limb amputations used the application for a predetermined period. The application was developed by the authors at the Research Office of Isfahan University of Medical Sciences. It was initially pilot-tested with a single individual with a lower-limb amputation. The educational content was presented in three formats: text, images, and video.

The educational content included stump and prosthesis care, care of the residual limb, stump preparation, therapeutic exercises and stretching, prosthesis maintenance, and general recommendations for the safe and effective use of the prosthesis in different environments.

Data were collected using the **Software Usability Assessment** questionnaire in the first stage. This questionnaire comprised nine domains: system usefulness (6 items), ease of use (10 items), ease of learning (8 items), satisfaction (5 items), display and content output (5 items), system terminology and information (4 items), user interface customization (2 items), error management (3 items), and system capabilities (7 items). Responses were rated on a 10-point Likert scale ranging from 0 to 9.

In the second stage, the software application was provided to participants with lower-limb amputations to assess its usability. The application was installed on their mobile phones during a face-to-face session, in which the researcher provided instructions on its proper use. After using the application at least three to four times over two weeks, the participants attended a second face-to-face session, during which their experiences were evaluated using two questionnaires.

The first questionnaire was the System Usability Scale (SUS), a widely used 10-item instrument based on a 5-point Likert scale [16, 17]. Participants rated each item on a scale ranging from "strongly disagree" to "strongly agree." The SUS yields a total score ranging from 0 to 100, with 68 generally considered the average benchmark; higher scores indicate better perceived usability.

The second questionnaire was the Usefulness, Satisfaction, and Ease of Use (USE) questionnaire, which consists of four domains: usefulness (7 items), satisfaction (6 items), ease of use (7 items), and ease of learning (6 items). Each item is rated on a 5-point Likert scale, and the mean score is calculated for each domain. According to the questionnaire's scoring criteria, scores above 50 indicate an acceptable level of usability [18].

In addition, participants were provided with a daily log to complete throughout the study while using the application.

All stages of this study were conducted in accordance with the ethical principles of the Declaration of Helsinki and were approved by the Ethics Committee of Isfahan University of Medical Sciences (Ethics Code: IR.MUI.MED.REC.1402.224).

Results

Among the 10 rehabilitation specialists included in the study, the mean age was 28.0 ± 4.24 years, and the mean clinical experience was 6.50 ± 2.99 years. Five specialists (50%) were male, and five (50%) were female. Of the participants, four (40%) were orthotists and prosthetists, three (30%) were physiotherapists, and three (30%) were occupational therapists.

The results of the smartphone application usability questionnaire, which evaluated nine domains from specialists' perspectives, showed that the overall mean usability score for the self-care application for individuals with lower-limb amputations was 7.07 ± 1.15. The mean scores for the individual domains were as follows: system usefulness, 6.95 ± 1.06; ease of use, 7.12 ± 1.18; ease of learning, 7.23 ± 1.22; satisfaction, 7.02 ± 0.92; display and content output, 7.52 ± 1.37; terminology and information, 7.19 ± 1.09; user interface customization, 6.60 ± 2.09; error management, 7.16 ± 1.47; and system capabilities, 7.07 ± 1.28 (Table 1).

In the second phase, the mobile phone–based self-care application was provided to individuals with lower limb amputations, and its usability and user satisfaction were evaluated after two weeks of use. Among the 30 participants, the mean age was 45.37 ± 13.80 years. Twenty-five participants (83.3%) were male, and five (16.7%) were female. Regarding educational attainment, one participant (3.3%) had completed lower secondary education, 19 (63.3%) had a high school diploma, 2 (6.7%) had a postgraduate diploma, 7 (23.3%) held a bachelor's degree, and 1 (3.3%) held a doctoral degree.

The results regarding the side and level of amputation, type of prosthesis, duration since amputation, and duration of prosthesis use are presented in Tables 2 and 3. The mean duration since amputation was 20.63 ± 13.14 years, and the mean daily duration of prosthesis use was 8.17 ± 2.57 hours.

The System Usability Scale (SUS) results from the participants' perspective showed an overall mean score of 88.75 ± 8.27, indicating excellent usability of the mobile phone–based self-care application in terms of effectiveness, efficiency, and user satisfaction. In addition, the Usefulness, Satisfaction, and Ease of Use (USE) questionnaire yielded mean scores of 4.48 ± 0.36 for usefulness, 4.46 ± 0.51 for satisfaction, 4.56 ± 0.25 for ease of use, and 4.52 ± 0.37 for ease of learning.

The daily application usage logs showed that participants most frequently accessed the "Exercise and Special Exercises" section, whereas the "General Recommendations" section was used least frequently (Table 4).

Table 1: Results of the Smartphone-Based Application Usability Questionnaire from the Experts' Perspective

Questionnaire components	mean ± standard deviation
Usefulness	6.95 ± 1.06
Ease of use	7.12 ± 1.18
Ease of learning	7.23 ± 1.22
Satisfaction	7.02 ± 0.92
Screen	7.52 ± 1.37
Terminology and information	7 ± 1.0
Personalization of user environment	6.60 ± 2.09
Error management capability	7.16 ± 1.47
System capabilities	7.07 ± 1.28
Overall average score	7.07 ± 1.15

Table 2: Side and Level of Amputation Among the Participants

Variable		Value
Side of Amputation	Right	(46.7%) 14
	Left	(43.3%) 13
	Both legs (double)	(10%) 3
Total		(100%) 30
Level of Amputation	Below the knee	(76.6%) 23
	Knee Disarticulation	(6.7%) 2
	Above the knee	(16.7%) 5
Total		(100%) 30

Table 3: Duration Since Amputation and Duration of Prosthesis Use Among the Participants

Duration of amputation(years)	20.63±13.14
Duration of prosthesis use (hours/day)	8.17±2.57

Table 4: Results of the Daily Application Usage Log

Variable	General recommendations	Introduction	Protecting the residual limb	Caring for the prosthesis	Preparing the foot	Exercise and special exercises
Value(min)	1.93±1.01	2±0.74	2.10±1.15	2.23±1.10	2.27±1.08	2.57±0.89

Discussion

The findings of this study showed that the mean usability score assigned by the rehabilitation specialists for the lower limb amputation self-care application exceeded the predetermined acceptable level, indicating that the specialists approved both the technical features and the educational content of the application. Furthermore, the self-care program demonstrated high levels of effectiveness, efficiency, and user satisfaction among individuals with lower limb amputations. The participants also rated the application favorably for usefulness, satisfaction, ease of use, and ease of learning.

The needs assessment revealed that most of the proposed educational topics and application features were considered essential by the participants. Accordingly, the application was designed to include functions such as complication management, lifestyle support, and other features tailored to users' rehabilitation needs. The usability and satisfaction assessments further demonstrated high levels of user acceptance. To the best of our knowledge, this is the first study in Iran to evaluate the feasibility of a mobile phone–based self-care application for individuals with lower limb amputations.

McLaren et al. emphasized the importance of educational interventions for both healthcare providers and patients [19]. Previous research has shown that mobile phone–based interventions integrating patient education, monitoring, feedback, and achievable goals can effectively enhance self-management [20]. Although the present study is the first to evaluate a self-care application for individuals with lower limb amputations, its findings are consistent with those of studies investigating mobile health interventions for other chronic conditions. These studies have similarly emphasized the importance of addressing patients' needs through comprehensive educational content, a finding supported by the present study. For example, Shahsavari et al. highlighted the importance of supportive care programs for women undergoing chemotherapy for breast cancer, particularly in addressing their physical care needs [21].

In the present study, no significant associations were found between patients' perceived educational needs and demographic variables, including occupation, age, and educational level. Regardless of these characteristics, participants generally did not perceive a need for self-care education [22]. Egbering et al. demonstrated that a mobile phone application that enabled continuous symptom monitoring improved symptom-reporting accuracy and increased patient awareness, highlighting the potential of mobile health technologies to support collaboration between patients and healthcare professionals [23]. Similarly, Meyer et al. developed a mobile phone–based self-care program for women with breast cancer–related lymphedema, which was well accepted by patients [24]. Likewise, Moradian et al. reported that 80% of participants expressed high motivation and positive attitudes toward a self-care program, as assessed through semi-structured interviews and questionnaires [25].

Other studies have also demonstrated that mobile application–based interventions can effectively promote physical activity and self-care behaviors, particularly when they are tailored to patients' preferences [26, 27]. Kooij et al. (2021) further

reported that mobile self-care applications can help control disease symptoms, facilitate the early identification of symptom exacerbations, and support timely intervention, thereby reducing hospital visits and readmissions [28]. In addition, a 2023 study on a mobile phone–based pulmonary rehabilitation program found that this approach reduced psychological distress among caregivers [29]. Similarly, in a 2020 systematic review, Liu et al. reported that mobile phone–based self-care interventions improved blood glucose and blood pressure control among individuals with diabetes and hypertension [30].

Supporting individuals with lower limb amputations through a mobile phone–based self-care program can enhance their knowledge and self-management skills by providing timely guidance for addressing rehabilitation-related problems. Because these programs facilitate the structured monitoring and organization of health-related information [31, 32], they may also increase patients' confidence in managing their own health [33]. These findings are consistent with the high levels of satisfaction, usability, and ease of use reported by the participants in the present study.

In addition, mobile phone–based self-care programs facilitate active patient participation by fostering closer collaboration among patients, therapists, and family members, thereby promoting patient-centered care in the management of lower limb amputation [34]. They also encourage consistency in self-care practices among both patients and caregivers [35]. These advantages are consistent with the high levels of effectiveness, efficiency, user satisfaction, and overall usability observed in the present study.

Another advantage of the application is its accessibility. Individuals living in remote areas or those who may forget instructions provided during in-person consultations can access the program whenever needed, regardless of time or location.

However, this study had several limitations. First, the relatively short duration of application use may not have been sufficient to identify challenges that emerge only during prolonged use or under different physical and environmental conditions. Therefore, future studies should include longer follow-up periods, ideally extending to 1 year, to evaluate the application's long-term usability, acceptability, and user satisfaction. In addition, future research should assess the program's usability among individuals with varying levels of lower-limb amputation and expand its availability across other mobile operating systems, such as iOS and Microsoft Windows.

Conclusion

Mobile phone–based applications represent an effective tool for increasing awareness and promoting self-care among individuals with lower limb amputations. The advantages of the application include easy installation and accessibility, practical educational content, a user-friendly interface suitable for users with different educational backgrounds, the ability to communicate with therapists, and motivational features such as reminder notifications and access to relevant healthcare professionals. Collectively, these features contribute to the application's usability and high levels of user satisfaction. The findings of this study suggest that the self-care application can effectively increase patients' awareness, support the management of rehabilitation-related challenges following amputation, improve quality of life, and help reduce amputation-related complications among individuals with lower limb amputations.

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