

Design and evaluation of a mobile-based self-care application for chronic kidney disease patients

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Article Info	ABSTRACT
Article type: Research	Introduction: The global prevalence of chronic diseases, including chronic kidney disease (CKD), is on the rise, leading to numerous challenges for patients, their families, and governments. Mobile health interventions have the potential to improve quality of life in chronic patients. This study aimed to design and evaluate a mobile-based self-care application for CKD patients.
Article History: Received: 2026-05-10 Accepted: 2026-06-29 Published: 2026-07-26	Material and Methods: This study was conducted in three phases in 2024. Initially, by reviewing previous studies and specialized guidelines, the informational needs and capabilities of the self-care application were extracted and validated through a questionnaire distributed to 25 physicians and 15 CKD patients at teaching hospitals in Iran. Then, the application was designed based on the validated needs using Basic4Android (B4A) environment. The usability of the application was evaluated by 60 patients using the user interface satisfaction (QUIS) questionnaire.
* Corresponding author: Seyed Ali Fatemi Aghda Student Research Committee, School of Health Management and Information Sciences, Iran University of Medical Sciences, Tehran, Iran Email: afatamy@gmail.com	Results: The validated informational elements were categorized into five main domains: clinical history, disease information, lifestyle, medication and application functions, with 55 out of 61 items being approved. The usability evaluation of the application, conducted by the patients, received an average score of 8.16 ± 0.48 out of 9 and was reported to be good.
Keywords: Chronic Kidney Disease Educational Needs Assessment Mobile Health (mHealth) Self-Management Health Apps Smartphone	Conclusion: The use of mobile health, taking into account the views of physicians and patients, leads to better design, increased usability and user satisfaction of the application.

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INTRODUCTION

Chronic kidney disease (CKD) is a long-term condition that leads to a gradual loss of kidney function. Over time, it can cause irreversible physical and psychological complications. CKD is a prevalent and costly health condition worldwide. The global prevalence of CKD is 13.4% [1]. The incidence of chronic kidney failure is significantly increasing globally, particularly in developing and emerging economies [2]. A global study estimates that this number could reach 2.2 million by 2040. In Iran, research indicates that over 14 million people suffer from this silent disease, with an annual increase of

2% to 5% [3]. According to the National Kidney Foundation, CKD progression is divided into 5 stages. Patients in stages 1-3 often experience minimal discomfort and mild symptoms such as fatigue and nocturia [4]. However, if not properly managed, stages 4 and 5 can lead to impaired kidney function, resulting in heart failure, hyperkalemia, central nervous system disorders, and ultimately, death [5].

The total annual cost of the End-stage renal disease (ESRD) program in the United States is approximately \$66,000 per patient [1]. The annual cost per hemodialysis session in Iran is estimated at \$12,500 [6]. The prevalence of CKD is steadily rising

due to increasing rates of diabetes, hypertension, and an aging population [3]. It is a significant risk factor for cardiovascular diseases and imposes a substantial physical and psychological burden on patients, leading to negative emotions [7]. Prevention and management of complications are crucial for delaying the progression of chronic kidney disease. Due to the chronic nature of the disease, the patient requires continuous care, consumption of various medications, and lifestyle modification [8]. Self-management, as an active and informed patient involvement in their treatment, is an integral part of their lives. In recent decades, educational approaches have undergone significant changes with the emergence of new technologies [9]. Today, the rapid growth of information and communication technology (ICT) has significantly impacted all aspects of human life. The achievements of ICT in healthcare include improving patient safety, optimizing management, and increasing access to healthcare services, enhancing the quality of care, reducing costs, and improving decision-making processes [10-12]. Traditional education is limited by time and place, whereas the use of technological tools like mobile phones, which do not have such constraints, is transforming the education system. These tools can improve teaching techniques and quality, as well as increase motivation for continuous learning. Mobile applications, with their unique features such as clinical awareness, medication reminders, and tracking of daily nutrition and activities, facilitate improved self-management [13, 14].

The number of CKD patients is currently increasing, leading to a decline in service quality, patient confusion, and increased economic burden on families and limited service providers. Moreover, given the chronic nature of the disease and the lack of knowledge and awareness among CKD patients, they require increased knowledge and self-management skills to properly manage their condition. The growing use of mobile phones and the important role of applications in health and self-care facilitate patient education. Based on current research, no study in Iran has focused on the design and evaluation of a self-care application for chronic kidney disease patients. Therefore, considering the significant impact of various parameters such as genetics, race, and ethnicity, it seems essential to design, implement, and evaluate a self-care application based on the perspectives of both patients and physicians.

MATERIAL AND METHODS

This research is a cross-sectional study and was conducted in three steps.

The questionnaire was designed based on previously validated instruments [13, 15-18]. To gather

essential needs for an application for chronic patients, literature review done with keywords: mobile applications, chronic kidney disease, self-care, mhealth, mobile phone, Cellphone, Application OR Software, self-management. Subsequently, specialized guidelines on chronic kidney disease, such as KDIGO (Kidney Disease: Improving Global Outcomes), KDOQI (Kidney Disease Outcomes Quality Initiative), and UK Renal Association Guidelines, were reviewed. Based on the results, a questionnaire was designed to determine the informational elements and capabilities of the application. This questionnaire included two sections: demographic information of participants, informational needs and application capabilities. The section on informational needs and application capabilities of the application included 5 subsections: Clinical History, Disease Information, Lifestyle, Medication, and Application Functions. Face validity and content validity (CVR = 0.81) of the questionnaire were confirmed by 8 experts in health information management and nephrology, and reliability was confirmed with a Cronbach's alpha of 0.83. A total of 25 nephrology specialists and subspecialists from Iran University of Medical Sciences and Kurdistan University of Medical Sciences were selected through simple random sampling from departmental faculty lists. Additionally, 15 patients with chronic kidney disease (CKD) were randomly chosen from the outpatient registry of nephrology clinics using a Simple random sampling. Responses to the questionnaire Items were scored from 1 to 5 (very low = 1, low = 2, moderate = 3, high = 4, and very high = 5). Determining whether the items were essential or inessential was as follows: An item was considered essential if it scored at least 3.57 (75% of the maximum score). When physicians and patients disagreed, the average of their two scores was used to decide whether the item was essential. After completing and returning the questionnaire by all participants, data collection was completed. Data analysis was performed using SPSS version 21 and based on descriptive statistics (mean and standard deviation).

The application was designed and Implemented based on the identified needs in the first stage. First, menus, pages, and program functionality were reviewed and approved by experts (health information management and medical informatics). Then, a prototype of the application was designed using Java in the Basic4Android software environment. After evaluation by the research team, the final version was designed.

The usability of the application was evaluated using the Questionnaire of User Interface Satisfaction (QUIS). This questionnaire includes 5 sections: overall reaction to the software, screen, terminology and system information, learning, and system functions. The validity and reliability Persian version

of the QUIS questionnaire, previously used in similar studies were employed in this study [19, 20]. Following final approval of the application and after obtaining informed consent, the app was installed on the mobile phones of 60 patients with chronic kidney disease (CKD) who were admitted to the nephrology ward of Rasool Akram Hospital. Eligible patients were selected through simple random sampling from the hospital's outpatient registry using a Random number table to ensure unbiased selection. Then, after teaching how to use the application, the participants were asked to complete the usability questionnaire after using it for two weeks. The results from the questionnaire were categorized into three levels (score of 0-3 for poor, 3.33-6 for average, and 6.67-9 for good). Data analysis of the evaluations, like the first stage, was done descriptively (mean and

standard deviation) using SPSS version 21.

RESULTS

In this study, most patient participants were male (n=9, 60%) and aged 60 years and above (n=7, 46.6%). The majority of patients (n=12, 80%) had a diploma or less. Most patients had a disease history of 10-19 years (n=5, 33.3%). Most participating physicians were male (n=21, 84%) and predominantly in the 40-50 age group (n=12, 48%). The majority of physicians worked at Iran University of Medical Sciences Hospital (n=16, 64%). In this study, most physicians specialized in nephrology (n=15, 60%) and had 10-14 years of experience (n=8, 32%) (Table 1).

Table 1: Demographic characteristics of participants

	Variable	Category	N (%)
Patients	Gender	Female	6 (40)
		Male	9 (60)
	Age	Less than 30 years	1 (6.7)
		30-39 years	1 (6.7)
		40-49 years	3 (20)
		50-59 years	3 (20)
		60-69 years	5 (33.3)
		70 years and above	2 (13.3)
	Education	Below Diploma	6 (40)
		Diploma	6 (40)
		Bachelor's Degree	1 (7)
		Master's Degree	2 (13)
	Disease Duration	Less than 5 years	4 (26.7)
		5-9 years	3 (20)
		10-19 years	5 (33.3)
		20 years and above	3 (20)
Physicians	Gender	Male	21 (84)
		Female	4 (16)
	Age	Less than 40 years	5 (20)
		40 to 50 years	12 (48)
		Above 50 years	8 (32)
	Specialty	Nephrology & Urology	15 (60)
		General Practitioner & Surgeon	10 (40)
	Workplace	Iran University of Medical Sciences.	16 (64)
		Kurdistan University of Medical Sciences	9 (36)
	Work Experience	Less than 5 years	2 (8)
		5-9 years	4 (16)
		10-14 years	8 (32)
		15-19 years	6 (24)
		20 years and above	5 (20)

The self-care needs addressed by the chronic kidney disease mobile application were designed based on five domains: clinical history, disease information,

lifestyle, medication, and application functions (as summarized in Table 2-6). Both physicians and patients identified 55 out of 61 informational and functional needs as essential.

Table 2: Average ratings of participant's responses about the clinical history

Items	Physicians		Patients	
	Mean	SD	Mean	SD
Time of Diagnosis	5	0	5	0
Treatment Start Time	5	0	5	0
Kidney Disease Stage	5	0	5	0
Medical History	5	0	5	0
Hypertension	4.8	0.12	4.3	0.47
Diabetes	4.8	0.09	3.9	0.89
History of tobacco use	4.3	0.47	3.9	1.05
History of drug use	4.1	0.63	2.9	1.6
History of alcohol use	4.2	0.48	3.5	1.25
Kidney Disease Medication	5	0	5	0
Drug Allergy	5	0	5	0
Excessive Sleep and Fatigue	5	0	4.6	0.17
Proteinuria	5	0	4.1	0.8
Elevated Creatinine	5	0	4.3	0.5
Urine Color	5	0	3.8	0.95
Edema of the extremities and face	5	0	4.1	0.73
Changes in Urination Frequency	5	0	4.5	0.38
Note: Data presented as Mean $\pm$ Standard Deviation (SD). Ratings were based on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree)."				

Table 3: Physician and patient ratings on disease knowledge and awareness

Items	Physician		Patients	
	Mean	SD	Mean	SD
Understanding the structure and function of the kidney	4	0.79	3.4	1.26
Knowledge of Damage Prevention of kidney	5	0	5	0
Knowledge of Different Types of Kidney Disease	5	0	5	0
Understanding of Disease Causes	5	0	5	0
Understanding of Disease Progression Stages	5	0	5	0
Awareness of Disease Complications	5	0	5	0
Awareness of Diagnosis Methods	5	0	5	0
Knowledge of Clinical, Care, and Treatment Approaches	5	0	5	0
Awareness of Prevalence	5	0	5	0
Education on Self-Care after Kidney Failure	5	0	5	0
Note: Data presented as Mean $\pm$ Standard Deviation (SD). Ratings were based on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree)."				

Table 4: Physician and patient ratings on lifestyle management

Items	Physician		Patients	
	Mean	SD	Mean	SD
Consumption of Major Food Groups (grains, fruits, vegetables, meat, dairy)	5	0	5	0
Low-Sodium, Low-Phosphorus Diet	5	0	4.8	0.08
Balanced Diet	5	0	4.4	0.62
Dietary Diversity	5	0	3.7	1.24
Avoiding Processed Foods and Fast Food	5	0	5	0
Antioxidant-Rich Diet	5	0	5	0
Consumption of Vitamin D and Omega-3	5	0	5	0
Protein Restriction	4.3	0.48	3.8	1.18
Managing Potassium, Phosphorus, Sodium, and Protein Intake	5	0	4.5	0.49
Limiting Sugar and Sweet Drinks	3.9	0.64	5	0
Following a Personalized Diet Plan	5	0	3.9	0.83
Number of meals per day	3.6	1.2	2.7	1.68
Regular Physical Activity	4.6	0.18	4.2	0.74
Weight Management	4.2	0.61	4.4	0.43
Physical Activity	4.3	0.69	3.9	1.16
Sleep Duration	4.6	0.28	4.1	0.74
Social Connections	4	0.74	4.8	0.13
Physical and Mental Health	4.2	.78	5	0
Note: Data presented as Mean $\pm$ Standard Deviation (SD). Ratings were based on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree)."				

Table 5: Physician and patient ratings on medication adherence and knowledge

Items	Physician		Patients	
	Mean	SD	Mean	SD
Correct use of medication (ACE inhibitors or ARBs)	4.3	.68	3.8	0.98
Drug Knowledge	4.8	0.15	4.1	0.85
Drug Side effects	5	0	5	0
Drug Interactions	5	0	4.6	0.18
correct method of use	5	0	5	0
Dosage	5	0	5	0

Note: Data presented as Mean $\pm$ Standard Deviation (SD). Ratings were based on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree)."

Table 6: Physician and patient ratings on application functions

Items	Physicians		Patients	
	Mean	SD	Mean	SD
Patient Demographic Information (Name, Surname, Family Medical History, Kidney Disease Severity (1-5), Age, Gender, Ethnicity, Occupation, Marital Status, Place of Residence)	5	0	5	0
Recording and Viewing (Blood Pressure, Cholesterol, Medication, Test Results, Physician Visits)	5	0	5	0
Reminder (Physician Appointments, Medication Usage)	5	0	5	0
Security and Privacy	3.6	0.53	4.3	0.31
Educational Videos	3.3	1.17	4.1	0.29
Reporting (Blood Pressure, Cholesterol)	4.6	0.32	5	0
Customization of App Interface	4.1	0.84	4.4	0.54
Introduction of Specialized Medical Centres and physicians	3.9	0.49	4.2	0.76
Interpretation of Laboratory Data	3.1	0.75	3.7	0.82
Communication with peers	3.8	0.68	3.5	0.48

Note: Data presented as Mean $\pm$ Standard Deviation (SD). Ratings were based on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree)."

From the perspectives of both patients and physicians, the average importance score for educational content in the "Clinical History" domain was 4.84 and 4.34, respectively.

While there was general agreement between physicians and patients, there was a disagreement regarding the "History of drug use" and "History of alcohol use" components. Based on the average scores of physicians and patients, the "History of alcohol use" component in a mobile application was deemed inessential (average score 3.5 out of 5). From the perspectives of both patients and physicians, the average score for educational content in the "Disease Information" domain in the application was 4.84 and 4.90, respectively. This domain received the highest average score among all other domains in the questionnaire. Except for the component "understanding the structure and function of the kidneys," all items within this domain achieved the highest average scores. There was a disagreement between physicians and patients regarding the 'understanding the structure and function of the kidneys' component, which ultimately was not considered essential, with an average score of 3.7 for both groups.

Within the "Lifestyle" domain, most items were

deemed essential. The average score for this domain was 4.56 and 4.11 for physicians and patients, respectively. The component "Amount of meals per day" was considered inessential by both groups. There was disagreement between physicians and patients regarding the item "Dietary Diversity". After checking the average score, it was found with average scores of 4.35. All items of the "Medication" domain were considered essential by both physicians and patients, with average scores of 4.85 and 4.53, respectively. The items of "drug side effects, correct method of use, and dosage" received the highest scores from both groups.

In the "Application Functions" domain, the average scores were 4.14 and 4.42 for physicians and patients, respectively. The items of "patient demographic information, reminders, recording and viewing" received the highest scores from all participants. There was a difference of opinion between physicians and patients regarding the items of "security and privacy, educational videos, communication with peers." Based on the average scores, the "security and privacy" component was deemed essential with an average of 3.95, while the "educational videos" and "communication with peers" items were considered inessential with average scores of 3.7 and 3.65, respectively. The

"interpretation of laboratory data" component was deemed inessential by both groups.

Considering that the self-care mobile application for chronic kidney disease patients was based on the Android operating system, the Java programming language was used within the Basic4Android (B4A) environment (Fig 1). After designing and approving the final prototype of the mobile application, it was provided to 60 chronic kidney disease patients for usability evaluation (Table 7).

Fig 1: Some views of the designed application



Table 7: Demographic characteristics of patients participating in the evaluation phase

Variable	Group	n	%
Gender	Male	37	61.6
	Female	23	38.4
Age	Under 30 years	3	5
	30-39 years	5	8.3
	40-49 years	17	28.4
	50-59 years	21	35
	60-69 years	8	13.3
	70 years and over	6	10
Education	Below Diploma	17	28.4
	Diploma	27	45
	Bachelor's	10	16.6
	Master's	6	10
Duration of Illness	Less than 5 years	4	6.6
	5-9 years	19	31.7
	10-19 years	28	46.7
	20 years and more	9	15

The evaluation results were obtained using the QUIS questionnaire (Table 8). The average score obtained in the five domains was (8.16 ± 0.48 ; 95% CI: 8.04–8.28), which is considered good. The highest average usability score was for the "Screen functions" domain (8.5 ± 0.28 ; 95% CI: 8.43–8.57), and the lowest average score was for the "Terminology and System Information" domain (7.9 ± 0.7 ; 95% CI: 7.72–8.08).

DISCUSSION

The aim of this study was to design and evaluate a mobile-based self-care application for patients with CKD. The findings indicated that among 61 identified informational and functional items, 55 (over 90%) were confirmed as essential by both physicians and patients. Furthermore, the usability evaluation of the developed application using the QUIS questionnaire showed a mean score of 8.16 out of 9, which falls within the "good" range and reflects a high level of user satisfaction and a user-friendly design. The highest score was obtained in the "Screen" domain, whereas the lowest score was related to "Terminology and System Information." These results suggest that the design of mobile health applications through active user participation (particularly the involvement of both physicians and patients) can substantially enhance user interface quality, acceptance, and overall patient satisfaction.

Table 8: Mean score of participants' answers to the usability questionnaire

Scale	Mean	Standard Deviation	Satisfaction Level
Overall Reactions to the Software	8	0.4	Good
Screen functions	8.5	0.28	Good
Terminology And System Information	7.9	0.7	Good
Learnability of the program	8.3	0.43	Good
System Capabilities	8.1	0.61	Good
Average Overall Rating	8.16	0.48	Good
Note: Data presented as Mean $\pm$ Standard Deviation (SD). Ratings were based on a 10-point Likert scale (0 = Strongly Disagree, 9= Strongly Agree)."			

According to the authors' information, no application based on mobile phones has been carried out in Iran considering the self-care needs of these patients. Sheikhtaheri et al. identified 16 key parameters in chronic kidney disease, including age, systolic blood pressure, diastolic blood pressure, calcium, and phosphorus levels, history of hypertension, diabetes, and family history of CKD [15]. Borhani et al. developed and evaluated a mobile application to investigate survival rates after kidney transplantation. The results indicated the impact of body mass index, advanced stages of the disease, gender, and other factors on post-transplant survival [21]. The use of mobile health and applications has enhanced patients' roles in disease management, increased patient satisfaction, and improved self-care outcomes [7, 22]. Common challenges faced by CKD patients in studies include impaired kidney function, multiple medication use, and frequent visits to healthcare facilities. Telemedicine has facilitated easy access to healthcare, promoted health equity, and enhanced individuals' education and skills [23, 24]. A systematic review and meta-analysis conducted by Peng and colleagues demonstrated that self-care

among non-dialysis CKD patients resulted in improved physical activity, blood pressure control, C-reactive protein levels, and reduced urinary protein. These benefits were observed within a one-year timeframe. However, self-care was not significantly associated with other kidney benefits or outcomes, such as reduced CKD-related mortality [25].

Overall, studies have shown varying results regarding the impact of mobile health on improved disease management and increased awareness. Study [26] found no significant effect of mobile health on medication adherence or reducing the burden of kidney disease, while studies [17, 27] demonstrated a positive impact of mobile health on medication adherence. These discrepancies can be attributed to limitations in the studies, such as sample size, genetics, ethnicity, and confounding variables. Therefore, in the current study, an attempt has been made to collect data on a wider range of parameters using a questionnaire.

The study by Collado-Borrell et al. demonstrated that mobile applications led to improved condition management. In addition to reducing complications and hospital resource utilization, these applications resulted in better medication adherence and improved quality of life for patients [8]. Li et al. in their evaluation of digital health interventions (DHIs), found that this technology had a positive impact on health-related quality of life (HRQoL), lifestyle, and improved physical activity [28]. Ong et al. investigated the effectiveness of two applications, eKidneyCare and MyMedRec, for medication management (dosage, timing, interactions, and side effects). The results showed that eKidneyCare significantly improved drug interactions and medication management [29].

Most studies have shown that mobile health (mobile phones, telemedicine) can increase knowledge, improve self-care, and enhance treatment outcomes. This aligns with the objectives of the current study, which aims to design and evaluate a mobile application for CKD patients.

Ong et al.'s study examined the impact of a self-care application on the care of CKD patients. This application included items for monitoring vital signs, symptoms, medication and treatment management, and laboratory result evaluation and follow-up. The results showed an improvement in the identification of medication discrepancies and errors [10]. Yan Du et al. conducted a study examining online forum posts from CKD patients. The results were categorized into several domains. The challenges expressed included comorbidities (diabetes, hypertension, misdiagnosis of CKD with similar diseases), symptoms (fatigue, stress, anxiety, tiredness, itchy skin, and general discomfort), disease management (diet, exercise, medications, supplements, and lifestyle), and the effects of CKD on work, stress, emotions, and family

[16]. Neale et al., in their systematic review and meta-analysis, investigated the impact of lifestyle on risk factors and the progression of CKD. Results showed that lifestyle interventions had a significant impact on various aspects of life, including cognitive function, physical function, vitality, mental function, fatigue, sleep, social interaction quality, and work status in CKD patients [13]. Chae et al. designed and evaluated a self-management mobile application (SMA) for adult peritoneal dialysis patients. This app included self-management information for patients, such as medication and health behaviors, exercise, diet, etc. The evaluation was conducted in three domains: assessment of self-management knowledge, health behaviors, and biomarkers, as well as health-related quality of life (HRQoL). The results showed improvements in knowledge and health behaviors related to albumin and hemoglobin and an improvement in the HRQoL index [30]. In line with previous studies, the expressed educational needs and functionalities of the application were collected and categorized into five domains after analysis. These were then presented to experts and patients for validation.

Ong et al. reported that the 'Kidney Health Digital Counseling Program' (ODYSSEE Kidney) encouraged CKD patients to engage in self-care and improve their disease management. The identified information needs of this program were categorized into three domains: disease content, nephrology care, and technical features. Evaluation results showed that participants were satisfied with the self-care content, the app's layout, and described its impact on managing their condition as valuable [31]. Tsai et al. used the iCKD app to investigate the knowledge and self-care behaviors of CKD patients. The app included domains on information needs such as risk factors and complications of the disease, symptoms, understanding kidney function, nutrition education (dos and don'ts), demographic characteristics (gender, education level, age, smoking, alcohol consumption, marital status), and clinical characteristics (history of heart disease and diabetes, antihypertensive medication use, initial diagnosis, and duration of treatment for CKD). Its features included interpreting test results, care and treatment alerts, a personalized dashboard, educational videos, outpatient visit reminders, and warning tracking. Self-care assessment of patients was done through interviews and the CKD Self-Care (CKDSC) questionnaire. Results showed that the use of mHealth by CKD patients increased their knowledge level but did not lead to improved self-care behaviors [18].

Liu et al., using the KidneyOnline mobile app and artificial intelligence, provided early warnings, lifestyle intervention suggestions, and personalized follow-up plans for CKD patients. Study results showed that continuous online follow-up led patients

to adhere to medication regimens, engage in physical activity, maintain a healthy BMI, adopt healthy eating habits, quit smoking, and overall lead a healthier lifestyle, resulting in a significant reduction in adverse disease outcomes [32]. El Khoury's study evaluated a dietary mobile app that provided nutrition education through guidelines, podcasts, and notifications. The app's usability and acceptability were assessed using the User Mobile App Rating Scale (uMARS), but the results were questionable as all participants consistently rated the app very highly [33]. Warner et al. found that CKD patients considered the Telemonitoring Blood Pressure app to be a useful and acceptable method for managing their condition. The app was evaluated using the System Usability Scale (SUS) and received scores of 84.9 and 84.2 (out of 100) at 30 and 90 days, respectively, indicating high levels of user satisfaction [34]. This study differed from previous studies in several ways. Similar to previous studies, the current study evaluated a mobile application. However, this study differed by assessing the app's usability using a QUIS-based questionnaire.

Future directions

Future studies could focus on assessing the long-term effects of the self-care application on clinical outcomes and quality of life among CKD patients. Further development could also include adding predictive alerts using artificial intelligence, expanding the app for iOS platforms. Additionally, to increase the generalizability and scalability of the application, it is recommended that collaborative research be conducted across multiple centers.

Limitations

One of the limitations of this research was the lack of cooperation from specialist physicians. Given the small number of specialist physicians in this field, the small sample size was another limitation of this study. Due to time and cost constraints, the software was only implemented for the Android platform. To provide better coverage, it is suggested that an iOS version be designed and evaluated as well. Implementing the app only on the Android platform might have influenced usability perceptions. Another limitation of this study was the evaluation of usability based solely on patient feedback. The use of self-report questionnaires can lead to response bias. It is recommended that in future studies, in addition to assessing the perspectives of various stakeholders (healthcare providers, family members) during the evaluation of the application, the impact of the intervention on improving patient outcomes and cost-effectiveness should also be investigated. Moreover, potential selection bias may have occurred, as participants were recruited from two

specific hospitals. Also, the number of participating doctors and patients was small, which might limit the generalizability of the results.

Additionally, information bias is possible because usability data were self-reported by patients, which may have led to overestimation or underestimation of the actual usability experience.

CONCLUSION

This study demonstrated that a mobile-based self-care application designed based on the needs of both physicians and patients can achieve high usability and user satisfaction. Improving patient education and disease management, such applications can support remote monitoring and continuity of care. Future efforts should focus on integrating these tools into clinical information systems, expanding their use to other chronic conditions, and evaluating their long-term impact on patient outcomes and healthcare costs.

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AUTHOR'S CONTRIBUTION

MJ: Conceptualization, methodology, validation, writing original draft; BM: Formal analysis, data curation, validation, resources, writing original draft; SH: Data curation, visualization, writing original draft; VV: methodology, resources, visualization, writing original draft; SAFA: Conceptualization, methodology, software, writing original draft; MHL: Data curation, visualization, writing original draft.

All authors contributed to the literature review, design, data collection, drafting the manuscript, read and approved the final manuscript.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest regarding the publication of this study.

ETHICAL APPROVAL

This study was reviewed and approved by the review board and the ethics committee of Iran University of Medical Sciences (IR.IUMS.REC.1400.172).

FINANCIAL DISCLOSURE

No financial interests related to the material of this manuscript have been declared.

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