

ORIGINAL ARTICLE

Knowledge, Attitude and Practice on Chronic Kidney Disease Progression Prevention and Readiness of Mobile Health Applications Usage Among Early Stages of Chronic Kidney Disease Patients at Island Hospital, Penang

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ABSTRACT

Introduction: Chronic kidney disease (CKD) is a major global health issue, necessitating early detection and to prevent progression, especially in early stages (Stage 1 and 2). Assessing patients' knowledge, attitude, and practice (KAP) is crucial for managing the disease and utilizing mHealth apps technology, which aids patient care. **Objective:** This study aimed to evaluate the level of KAP, readiness for mHealth apps (RMHA), and associated factors among early-stage CKD patients. **Method:** This study consisted of 2 phases. The respondents were early-stage CKD patients. For Phase 1, 200 respondents participated in the questionnaire validation for the Malay version of RMHA. The instrument used for the RMHA was the mHealth apps Malay version that originally in english version by Handayani et al. (2020). For Phase 2, 169 respondents completed the questionnaires to measure the KAP level and the readiness to use the mHealth apps. A cross-sectional study was conducted in Phase 2 and the researcher used convenience sampling to select eligible respondents for this study. Data collection involved questionnaires for RMHA and KAP, analyzed using SPSS 27 and Mplus 8.0. **Results:** For the Malay version of RMHA, 200 participants contributed to the questionnaire validation, with a mean age of 51.71 (SD=14.05) and predominantly female (57.5%). The Malay version was confirmed valid and reliable through confirmatory factor analysis and internal consistency reliability (Cronbach's alpha ranged from 0.866 to 0.968). Another 169 participants completed the KAP questionnaires for the association study, with a mean age of 53.18 (SD=15.39) and mostly female (51.4%). Results indicated that most respondents had high knowledge (71.0%) and attitude (84.0%) levels but low practice (76.9%) regarding CKD. Factors significantly associated with m-health readiness included gender ($p < 0.001$), knowledge ($p = 0.027$), people readiness ($p < 0.001$), engagement readiness ($p < 0.001$), and motivational readiness ($p < 0.001$). **Conclusions:** The study concluded that early-stage CKD patients had good knowledge and attitude but poor practice, with technological, engagement and people readiness positively related to mHealth readiness.

Malaysian Journal of Medicine and Health Sciences (2025) 21(SUPP10):5-9. doi:10.47836/mjmhs.21.s10.2

Keywords: Attitude, Early-stage CKD, Knowledge, Mobile Health Applications, Practice

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INTRODUCTION

Chronic kidney disease (CKD) is a global health concern, ranked 19th among the leading causes of morbidity (3), with 1 to 2 million deaths annually due to renal failure.

Early detection and treatment can prevent disease progression and complications (14). Understanding knowledge, attitudes, and practices (KAP) related to CKD prevention is essential for effective management (1). Insufficient knowledge about CKD risk factors and preventive measures can hinder early-stage management (2,13). Patients with positive attitudes are more likely to adopt preventive strategies, while effective practices, such as regular monitoring and lifestyle modifications, help slow disease progression (4).

However, there are gaps in assessing KAP related to CKD prevention and in understanding how mHealth apps can enhance self-management. mHealth apps are useful tools for patient education and self-care but are still underutilised in Asia (15). These apps improve patient knowledge (12), encourage medication adherence, and promote healthy behaviors (9). Despite their potential, awareness of their benefits remains low. Few studies have explored the relationship between KAP on CKD prevention and readiness to use mHealth apps among early-stage CKD patients.

The CKD Screening Index assesses KAP related to CKD prevention. It also promotes early detection. The original version, validated by (Khalil et al., 2014) (4), demonstrated strong psychometric properties. Additionally for RMHA questionnaire developed by Handayani et al. (2020) (10), evaluates technological, people, motivational and engagement readiness for mHealth apps adoption. This study aims to assess KAP on CKD prevention and readiness to use mHealth apps among early-stage CKD patients. Identifying gaps in knowledge, attitudes, and practices will provide insights into leveraging digital health solutions to enhance CKD self-management and slow disease progression.

MATERIALS AND METHODS

This study consisted of two phases: 1) validation and reliability assessment of the RMHA Malay version questionnaire and 2) a cross-sectional survey to assess KAP on CKD prevention and RMHA. The RMHA questionnaire, originally developed by Handayani et al. (2020), is designed to assess patients' readiness to adopt mobile health applications across four key domains: technological readiness, people readiness, motivational readiness, and engagement readiness. Technological readiness refers to an individual's ability to operate mobile phones, including tasks such as sending and receiving text messages, using voice messaging features, and accessing internet-based functions (5). People readiness refers to an individual's understanding of how mobile phones and mHealth apps function, reflecting their preparedness to use these technologies effectively (5). Motivational readiness refers to the user's willingness and drive to take action in order to achieve a specific goal or desired outcome (6). Engagement readiness assesses how familiar individuals are with the concept of e-health and the extent to which they actively discuss its potential advantages and disadvantages (8).

The mHealth apps used by the participants were adopted from existing apps. Examples of the mHealth apps used by the participants were Care for Kidney and myCKDCPG. Care for Kidney mHealth apps is a free health application funded by the National Kidney Foundation (NKF) Malaysia. It is designed to promote kidney health and provide education on CKD. myCKDCPG mHealth apps is an integrated digital tool for a comprehensive,

one-stop platform that offers holistic approaches to your CKD management needs. Both consist of tools that assess the patient's CKD progression risk and provide concise information on CKD management.

Phase 1 involved using confirmatory factor analysis (CFA) to validate the RMHA questionnaire. At least 200 participants were required for the validation process. Reliability was measured using Cronbach's alpha with a minimum acceptable value of 0.65. Pre testing was conducted among 30 CKD patients to refine clarity and improve question comprehensibility. The questionnaire was adapted from Handayani et al. (2020) (10). To ensure its suitability in the local context, the original English version of the RMHA questionnaire underwent a rigorous translation process. This included forward and backward translation process by bilingual experts before final review by nephrology specialists. The final Malay version of the RMHA questionnaire was reviewed by four nephrology experts, including two nephrology nursing lecturers and two senior nephrology nurses, to ensure clarity, accuracy, and appropriateness for the target population.

For Phase 2, a cross-sectional survey was conducted with 169 respondents recruited using a convenience sampling method and were used for mHealth apps readiness and association analysis. Data collection took place at Island Hospital between January and May 2023, using structured, self-administered questionnaires. The study included adult CKD patients (Stages 1-2) who could read and understand Bahasa Melayu or English. Exclusion criteria included illiterate patients. The questionnaire consisted of three sections: 1) socio-demographic data, 2) KAP on CKD prevention, and 3) RMHA. KAP was classified into "Good" and "Poor" based on predefined cutoffs, while RMHA readiness was determined by subscale scores exceeding 50% of the maximum.

Statistical analysis was conducted according to study objectives. For objective 1, CFA was used to assess the validity of the RMHA questionnaire by examining whether observed variables (questionnaire items) aligned with expected underlying factors (technological, people, motivational, and engagement readiness). Cronbach's alpha was used to measure reliability. For objective 2, descriptive statistics, including mean and standard deviation, were used to summarize readiness scores. For objective 3, descriptive statistics were used to compare KAP levels between "Good" and "Poor" categories. For objective 4, multiple regression analysis was performed to determine the relationship between sociodemographic factors (e.g., age, education, CKD stage) and RMHA readiness. These statistical methods ensured methodological rigor and study validity.

Ethical Clearance

This study was approved by Research Ethics Committee,

RESULTS

A total of 200 participants were recruited for the mHealth Readiness validation study, achieving a 100% compliance rate. Compliance rate refers to the proportion of participants who completed the study procedures without missing responses or withdrawing. The CFA models for people, motivational, engagement, technological, and mHealth readiness demonstrated a good fit (CFI > 0.95, TLI > 0.92, SRMR < 0.06), confirming the validity of the model. Cronbach's alpha values exceeded 0.70, ensuring reliability (Refer Table I).

For Phase 2, 169 participants completed the KAP assessment, achieving a 100% compliance rate. Regarding CKD knowledge, 71.0% had good knowledge, while 28.9% had poor knowledge (Refer Table II). For attitude, 84.0% had a good attitude, and 15.9% had a poor attitude (Refer Table III). However, for practice, only 23.0% had good practice, while 76.9% had poor practice (Refer Table IV). The mean and standard deviation for mHealth readiness dimensions were technological readiness (M = 18.2, SD = 4.9), people readiness (M = 48.0, SD = 11.8), motivational readiness (M = 30.3, SD = 7.4), engagement readiness (M = 30.2, SD = 6.2), and overall mHealth readiness (M = 29.0, SD = 7.0). Simple linear regression showed that gender and knowledge were significantly associated with mHealth readiness ($p < 0.05$). However, the study does not analyze the direct interaction between gender and knowledge (for instance, whether males are more knowledgeable or how knowledge impacts mHealth readiness across genders). People readiness, engagement readiness and motivational readiness dimensions were positively correlated with overall mHealth readiness. Multiple linear regression identified people readiness ($\beta = 0.171$, $p = 0.001$), engagement readiness ($\beta = 0.824$, $p = 0.001$), and motivational readiness ($\beta = 0.987$, $p = 0.001$) as significant predictors, explaining 81.8% ($R = 0.818$) of the variance in mHealth readiness (Refer Table V). CFA was not conducted for KAP assessment, as it was only applied to validate the mHealth readiness model.

Table I: Cronbach Alpha Value for 5 Factors

Factor	Technological	People	Motivational	Engagement	MHealth apps
Cronbach's Alpha	0.866	0.964	0.968	0.928	0.956

Table II: Knowledge of CKD among Early-Stages of CKD Patients

Category	Number	%
Good	120	71.0%
Poor	49	28.9%

Table III: Attitude of CKD among Early-Stages of CKD Patients

Category	Number	%
Good	142	84.0%
Poor	27	15.9%

Table IV: Practice of CKD among Early-Stages of CKD Patients

Category	Number	%
Good	39	23.0%
Poor	130	76.9%

Table V: Factors associated with mHealth apps Readiness by Using Multiple Linear Regression(MLR)

Variables	adjusted β	(95% CI)	t-stat	p-value
People Readiness	0.171	(0.075-0.267)	3.517	0.001
Engagement Readiness	0.824	(0.115-0.399)	3.578	0.001
Motivational Readiness	0.987	(0.280-0.582)	5.638	0.001

R²: 0.818.

(a) Multiple Linear Regression.

(b) Crude Regression Coefficient.

(c) Adjusted Regression Coefficient.

Stepwise, backward and forward multiple linear regression methods were applied. Model assumptions are fulfilled.

DISCUSSION

This study validated the Malay version of the RMHA questionnaire for assessing mHealth readiness among early-stage CKD patients. Confirmatory factor analysis (CFA) confirmed model validity, with Cronbach's alpha values exceeding 0.70, ensuring reliability. In validating the RMHA questionnaire for assessing mHealth readiness in CKD populations, this study aligns with prior research that supports the reliability and applicability of this tool. For example, Handayani et al. (2020) (10) also validated the RMHA instrument for evaluating technological, people, motivational, and engagement readiness. Their findings, which demonstrated high internal validity and reliability (Cronbach's alpha > 0.70), are consistent with this results, strengthening the case for the RMHA questionnaire's effectiveness in assessing mHealth readiness among CKD patients. Additionally, this study parallels other international research on the adoption of mHealth apps in CKD management, including (5) and (7). These studies highlighted the influence of factors such as user trust, perceived usefulness, and intention to use, with similar conclusions about the role of psychosocial factors—like people readiness, engagement readiness, and motivational readiness—as significant predictors of mHealth apps adoption.

Regarding KAP on CKD prevention, 71% of respondents had good knowledge, 84% had a positive attitude, but only 23% reported good practice, highlighting a knowledge-practice gap. Similar trends were observed in studies from Lebanon (16) and Jordan (4), where high knowledge did not translate into preventive behaviors. Barriers included financial constraints, adherence issues, and difficulty incorporating CKD management

into daily life.

For mHealth readiness, people, engagement, and motivational readiness were key predictors of app adoption. Ease of use and affordability influenced technological readiness, consistent with (10). Trust, intention, and perceived usefulness also played significant roles (5) and (7). Gender and knowledge significantly impacted readiness, while financial concerns and digital literacy levels influenced adoption. Improving digital health literacy, addressing financial barriers, and enhancing user engagement strategies can boost mHealth adoption among CKD patients, supporting future healthcare digitization efforts.

CONCLUSION

This study successfully achieved its objectives by validating the Malay version of the RMHA questionnaire, assessing mHealth readiness, evaluating KAP on CKD prevention, and determining the associations between sociodemographic characteristics, KAP, and mHealth readiness. For objective 1, Confirmatory Factor Analysis (CFA) validated the reliability and internal consistency of the questionnaire, supporting its applicability for assessing mHealth readiness among early-stage CKD patients. For objective 2, the findings demonstrated that people readiness, engagement readiness, and motivational readiness were significant predictors of mHealth adoption. Technological readiness was influenced by ease of use and affordability, while trust, intention, and perceived usefulness also played key roles in determining mHealth readiness. These results highlight the importance of patients' confidence and accessibility in adopting digital health solutions.

For objective 3, in terms of KAP on CKD prevention, knowledge (71%) and attitude (84%) were generally positive, but only 23% of respondents exhibited good practice, revealing a significant knowledge-practice gap. This aligns with previous studies from Lebanon, Jordan, and Indonesia, where knowledge did not always translate into preventive behaviors. Barriers such as financial constraints and difficulties incorporating CKD management into daily life contributed to poor practice. For objective 4, sociodemographic factors, particularly gender and knowledge, significantly influenced mHealth readiness ($p < 0.05$). Multiple regression analysis identified people readiness, engagement readiness, and motivational readiness as key predictors, explaining 81.8% ($R^2 = 0.818$) of the variance in mHealth readiness. These findings emphasize the need to improve digital health literacy and address barriers to enhance mHealth adoption among CKD patients. Future research should explore strategies to bridge the knowledge-practice gap and improve engagement with mHealth solutions for better CKD management.

ACKNOWLEDGEMENTS

The authors would like to commend the Nursing Director of Island Hospital for granting permission to conduct the research within the hospital unit. Special thanks are extended to all the patients at Island Hospital who participated in the study; their cooperation and willingness to contribute are sincerely acknowledged and greatly valued.

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