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The Effect of Digital Health Management Tools in Combination with Self-management Activities on Quality of Life in a Chronic Kidney Disease Population: A Cross-Sectional Survey in China

運用數字醫療管理工具並聯合自我管理行為對慢性腎病人群生活質量的影響：一項來自中國的橫斷面研究

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Abstract

Digital tools have significantly impacted almost every aspect of daily life, ranging from fast growing e-commerce, digital banking, online education, and electronic processing for most transactions. The healthcare industry has adopted digital tools, such as smart wearable devices (SWDs) coupled with mobile applications to monitor individual health indicators, particularly for chronic disease management. The adoption of these tools has been largely driven by increasingly prevalent and costly global health challenges, such as chronic kidney disease (CKD). CKD affects approximately 10–15% of the global population and places a large healthcare budget burden on numerous countries. Self-management has become a focus of chronic management and care. This includes preventive activities for healthy individuals and enabling individuals who are in a sub-health condition or have a chronic disease to monitor symptoms, conduct self-treatment, track effects, and implement lifestyle changes, particularly for chronic conditions. Previous studies have categorized these activities as self-integration, problem-solving, seeking social support (SSS), and adherence to medication regimens.

However, there is currently no evidence whether using digital health management tools ("digital tools" for short) can improve the quality of life (QoL) of CKD patients. This study aimed to investigate whether digital tools can help CKD patients when used in conjunction with self-management activities. To achieve this, we needed to create a research model that could identify any correlations between the variables. The model was initially designed based on a well-established chronic care model that integrated a further three elements (digital tools, self-management activities, and QoL) to identify the relationships between these variables and CKD-associated QoL. The model was designed to answer several questions: (1) what is the current adoption state of digital tools among CKD patients in China?; (2) what is the state of CKD self-management activities in China?; (3) are there any correlations between digital tool use and QoL among CKD patients?; (4) what is the impact of different combinations of digital tools and self-management activities on the QoL of CKD patients?; and (5) what are the demographic variables that influence CKD-associated QoL?

A mixed methods research design was used in combination with a cross-sectional survey design to test 25 research hypotheses, which included five hypotheses regarding positive correlations between digital tools and CKD-associated QoL, and twenty hypotheses regarding positive correlations between digital tools used in conjunction with self-management activities and CKD-associated QoL. The process began with in-depth interviews with six healthcare professionals to gain insight into three aspects that would be incorporated into the questionnaire design. The first aspect was related to the demographic

factors that influence CKD-associated QoL, such as age, gender, education, working status, family support, income, reimbursement, and disease progression. The second aspect was about self-management activities for CKD care and how they are assessed. The third aspect was about the benefits of using digital health solutions for CKD management, such as mobile apps, SWDs, online education programs which have rapidly increased in usage in recent years, as well as the internet hospital model that has widely adopted by large hospitals in China. The interviews highlighted the importance of using specific classifications for digital health tools. Therefore, five digital tools categories were adopted based on previous research: smartphone application, health management program, social media, online health education, and SWD.

The questionnaire consisted of four parts: demographic information, assessment of self-management activities, digital tool use, and self-rated QoL. The survey was conducted in 19 hospitals across eight provinces in China from January to February 2022. The included hospitals ranged from large teaching hospitals to county hospitals. Overall, 1193 completed questionnaires were collected.

The demographic section of the survey assessed eight key variables: age, gender, education level, working status, number of family members in household, household income, medical reimbursement coverage, and CKD severity. The average participant age was 51.6±16.0 and approximately two thirds were above the age of 45. Of the participants, 80% practiced self-management activities daily to manage their QoL and 56.2% used digital tools. QoL was measured using the self-rated EQ-5D-5L health questionnaire.

Twenty-five hypotheses were developed at the beginning of this study. They aimed to prove the existence of positive correlations between digital tools, health self-management activities, and CKD-associated QoL. The hypotheses fell into two categories: five for the dual-variable correlation between digital tools and QoL and twenty for tri-variable correlation between digital tools in combination with self-management activities and QoL. For the former category, only one hypothesis was confirmed (i.e., a positive correlation existed), while no correlations were found for the other hypothesis. For the latter category, six hypotheses were associated with significant correlations (three positive, three negative). Therefore, four hypotheses were verified overall.

Digital health solution adoption is in its nascent stage in China; however, adoption has increased post-COVID-19. The CKD patients in this study demonstrated active self-management activity practice, with over half using digital tools. The use of SWDs was found to benefit QoL. Furthermore, three digital tool and self-management activity combinations exerted beneficial effects on QoL: 1) social media use combined with SSS, 2) online health education use combined with adherence to medication regimens,

and 3) SWD use combined with adherence to medication regimes. Three harmful combinations were also identified: 1) smartphone application use combined with adherence to medication regimens, 2) health management program use combined with SSS, and 3) SWD use combined with self-integration. This study identified that the current challenges in managing CKD-associated QoL are likely driven by a lack of medical knowledge, unreliable digital tools, and conflict between professional medical advice and individual lifestyle. Further efforts are needed to improve digital tools and self-management programs to better support the QoL of CKD patients.

This study is the first large-scale nationwide survey to assess the impact of the combined use of digital tools and self-management activities on the QoL of CKD patients in China, with over 1,000 participants included. Due to its cross-sectional nature, future prospective research will be valuable to further validate the findings of this study, which will benefit CKD patients.