

A Study of the Effectiveness of Mobile Health Application in A Self-management Intervention for Kidney Transplant Patients

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Introduction. With the development of information technology in medical treatment, mobile medical treatment has become a new way to seek treatment, follow-up, extended care, popular science, disease prevention and access to disease expertise. The application of mobile medical treatment is relatively mature in the management of chronic diseases. Currently, mobile medical intervention is also introduced in the self-management of patients after Renal Transplantation. Compared with traditional intervention methods, mobile medical treatment has the advantages of convenience, speed, low cost and no geographical restriction, and it is easy to be used by KT recipients in self-management and has good feasibility. Therefore, we conducted self-management intervention for patients after Renal Transplantation based on mobile medical procedures, so as to improve patients' satisfaction, medication compliance, follow-up rate, and ease patients' anxiety about the disease.

Methods. A total of 160 discharged patients with stable recovery of transplanted Renal function who underwent renal transplantation surgery in our hospital from January 2021 to January 2023 were selected for retrospective analysis. According to the different intervention plan, the patients were divided into the intervention group and the comparison group, 80 cases each. Among them, the intervention group used the mobile medical application self-management behavior intervention, and the comparison group used the conventional self-management behavior intervention. The differences of self-management behavior score, quality of life score, Basel score and anxiety score between the two groups of patients after Renal Transplantation were analyzed and compared. **Results.** After intervention, there were statistically significant differences in the scores of self-management behavior scale, Quality of life related rating scale, Basel Assessment scale and Self-rating Anxiety Scale between the intervention group and the control group ($P < .05$).

Conclusion. Mobile health intervention tools can provide efficient, comprehensive and accurate remote health intervention and professional support for patients, optimize the medical service system, and meet the social medical needs of high-quality nursing services.

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INTRODUCTION

Chronic kidney disease has become a common threat to human health as a result of economic and lifestyle changes.¹ Patients with stage 5 of chronic kidney disease, require hemodialysis, peritoneal dialysis, or renal transplantation to survive.²⁻³ Therefore, the current takes Transplantation (RT) surgery has become an effective method for treatment of kidney failure, that takes the short-term prognosis of patients with Transplantation have improved a lot, but takes Transplantation of patients with long-term survival rate significantly reduced.⁴

Disease self-management is more maturely applied abroad and has been developed to cover a variety of chronic diseases.⁵ Chronic disease self-management program was developed under the support of the Patient Education Research Center at Stanford University in the United States, that includes a variety of diseases such as arthritis, AIDS, and back pain.⁶ Health self-management is a core component of chronic disease management in the community and has been widely used and achieved good results in many chronic diseases such as arthritis and diabetes mellitus.⁷ With the development of information technology in healthcare, mobile health has become a new way to access medical consultation, follow-up, extended care, popularization, disease prevention, and access to disease expertise.⁸ However, with the shift of the medical model to a biopsychosocial model and changes in social life and the increase in human lifespan, the evaluation of the effectiveness of disease treatment has expanded from a purely biological perspective to a holistic evaluation of the physiological, psychological, and social functions of patients undergoing renal transplantation.^{9,10} However, patients with a renal transplant encounter post-discharge complications and side effects from immunosuppression, that seriously affect their prognosis and quality of life.¹¹ Especially after discharge from hospital, renal transplant patients receive less professional guidance from medical and nursing staff. In addition, lack of knowledge regarding their condition and poor self-management ability, coupled with the economic burden and other factors lead to a low quality of life and high rate of complications.¹²

Studies have shown that renal transplant patients need long-term postoperative medication, and

face heavy financial burden, and limited mobility after discharge from hospital.¹³⁻¹⁵ Compared with traditional interventions, mobile health has the advantages of convenience, speed, low cost, and no geographical restrictions, and is easily used by patients with various diseases for better feasibility in self-management. However, there are few reports of mobile health interventions in the self-management of renal transplant patients in China, which deserve further study.

MATERIALS AND METHODS

Study Participants

Choose our hospital in January 2021 to January 2023 were takes Transplantation of surgical treatment of stable graft function of 160 cases of discharged patients' data were retrospectively analyzed. According to the different intervention plan, the patients were divided into the intervention group and the comparison group, 80 cases each. According to the results of the prediction experiment, the mean and standard deviation of the comparison group were 20.4 and 9.71, respectively. The mean and standard deviation of comparison group and intervention group were 25.0 and 5.15, respectively. Assume that the Class I error α of the hypothesis test is 0.05, the two-sided test is adopted, and the Class II error β is 0.1. The sample size ratio between the intervention group and the comparison group was 1:1. According to the sample size Calculation formula:

$$n_1 = n_2 = 2 \left[\frac{(t_\alpha + t_\beta) s}{\delta} \right]^2$$

The minimum sample size required for each group was calculated by PASS 11.0 software as $n_1 = n_2 = 64$ people. Considering the missing sample and increasing the sample size by 10%, the minimum required sample size of the intervention group and the comparison group was 71 people, and the sample size of our study was higher than the minimum required sample size in line with the requirements.

Inclusion Criteria

1: Patients who met the legal requirements of the Regulations on Human Organ Donation were hospitalized and received their first allogeneic kidney transplantation; 2: those who were clear about their condition and agreed to participate

in this study and had elementary school or above education level; and 3: patients with certain communication and reading comprehension ability: age ≥ 18 years and ≤ 60 years.

Exclusion Criteria

1: Patients with current cognitive impairment, concurrent or combined with other serious life-threatening diseases; 2: patients with hearing or visual impairment or severe psycho-cognitive disorders who could not cooperate with this study, patients with Renal Transplantation who could not take care of themselves; and 3: patients with serious infectious diseases such as severe hepatitis, those with complications such as post-discharge complications, those with malignant tumors, serious illness or with acute illness.

Methods

The intervention group used a mobile application (Huawei Sports band, manufactured by Huawei of China) to implement self-management behavioral interventions for patients after renal transplantation, as follows:

(1) Information support: Information support: contains 11 categories of health knowledge related to each stage of Renal Transplantation. Patients can read according to their own needs, and provide favorites function, easy to consult at any time. Psychological and social support guidance such as sexual life and fertility, how to adjust the mentality, and return to work has been strengthened. Establish the personal file of the patient in Renal Transplantation, including the general information of the patient, medication, exercise, etc. The full-time follow-up nurses and attending physicians of Renal Transplantation will give multimedia lectures 2 to 3 times within one week before discharge, and each time they take 30 to 40 minutes. The course covers how to self-monitor, self-care, diet management, medication management, exercise management, complications prevention and regular review. At the same time, the self-management health education manual and CD-ROM were issued to guide and check the patients to fill in the Renal Transplantation Patient Self-Monitoring Log correctly. For patients with low education level and questions, one-to-one guidance and answers were given. Finally, the self-made evaluation form was used to assess the

degree of patients' mastery of disease rehabilitation and health care knowledge.

(2) Skills guidance: Provide intelligent self-monitoring forms to facilitate patients in recording important data such as daily blood pressure, body weight, and intake and output volume, and provide automatic conversion of water content of each food, intake and output volume statistics, medicine and food, and other fuzzy search functions to make self-monitoring more convenient, fast, and accurate; automatically take medication and visit reminders according to patients' medical prescription settings and post-operative hours. Ten patients who had a kidney transplant 5 to 8 years ago, willing to contribute, and had good communication were selected to present themselves to other patients before discharge and became their companions to establish QQ or WeChat group contact with the patients after discharge; each companion was responsible for five patients regarding simple psychological guidance, sharing experience and providing support during the intervention. Patients were willing to receive online follow-up visits in person at least once a month by phone, or QQ, or WeChat, in order to ensure that they received follow-up visits in person. The follow-up nurse can increase the number of follow-up visits on a case-by-case basis. Each follow-up visit takes 15 to 30 minutes, and the patient is promptly addressed for problems that arise during the intervention, and counseled for possible psychological problems, so that the patient can build up confidence and cooperate with the treatment.

(3) Communication: Real-time online communication, self-monitoring data and medical side sharing, convenient for nurses and patients at any time to exchange disease changes, seek help, and share disease-related monitoring data. Telephone follow-up was conducted as required according to the situation of Renal Transplantation patients. Telephone follow-up was conducted to understand the dynamic changes of the current physical health status and mental and emotional health of patients with Renal Transplantation, and timely personalized guidance was given. After Renal Transplantation patients leave the hospital, nurses should inform Renal Transplantation patients that they should not relax their vigilance and monitor their body temperature and urine volume regularly through telephone follow-up. Patients who are relaxed

in Renal Transplantation should be reminded of the importance of keeping close contact with the hospital, so that the transplant doctors can keep abreast of the patients' general condition and the function of the transplanted kidney, and find problems in time. According to the specific conditions of the patients in Renal Transplantation, especially the patients with serious negative emotions such as depression and anxiety, we can make an appointment by telephone first. Then we can further gain the trust of Renal Transplantation patients through detailed self-introduction face to face. To understand the problems of Renal Transplantation patients through chat and inquiry, and then provide specific knowledge, information and psychological support related to symptoms.

The control group received the conventional renal transplant postoperative patient self-management behavioral intervention after conventional renal transplantation such as diet, treatment, physical activity and psychosocial management. The intervention specifically included providing health knowledge, guidance on self-monitoring methods, medication and follow-up reminders, psychological support and other behavioral interventions through outpatient and telephone follow-up.

Observation Index

Chronic kidney disease self-management behavior scale, with good reliability and validity, is one of the commonly used tools to assess self-management behavior of chronic kidney disease in China, which includes three dimensions and 100 entries. The scale was evaluated on a 5-point basis, (five = very good, four = good, three = fair, two = poor, and one = poor) with the total score of 500. The levels of daily life, treatment, and psychological management behaviors of the two groups of patients after renal transplantation were evaluated according to the total score of the scale and the scores of each dimension. The higher the score, the better the self-management behavior. Quality of Life of Renal Transplant Recipients (QOL-RT): This scale was developed by Fan Zhongzhen *et al.* to measure the quality of life of patients with Renal Transplantation, including four dimensions of physical, psychological, social, and disease treatment and one independent item of overall quality of life, with a total of 34 items. The Likert 5-point scale was used, with 1 = "never"

and 5 = "always", and the total score ranged from 34 to 170, and the quality of life could be classified into three levels according to the total score, with good score being > 136 and general score being 102 to 136, The higher the score, the better the quality of life of Renal Transplantation patients.

Statistical Analysis

All statistical data in this study were entered into excel, and SPSS 28 was used for statistical calculation. Measurement data conforming to the normal distribution were expressed as mean \pm SD, independent samples t-test was used, count data were compared by chi-square test, and rank data were compared by rank sum test. $P < .05$ was considered statistically significant.

RESULTS

Comparison of Self-management Behaviors

The results of two independent sample tests showed that after intervention, the scores of diet, treatment, repulsive body activity and psychosocial management of renal transplant patients in both groups were significantly better than those without intervention, while all scores were significantly higher in intervention group than the control group ($P < .05$). (Figure 1)

Comparison of Quality of Life

The results of the two independent sample tests showed that before and after the intervention, the physical, psychological, and social function scores, and disease treatment score of the intervention and comparison groups differed significantly, with statistical significance ($P < .05$) (Figure 2).

Comparison of Self-efficacy Scores

The self-efficacy and each dimension scores of renal transplant patients in the intervention group after the intervention were significantly higher than those before the intervention. ($P < .05$). The scores of symptoms of self-efficacy dimension and disease co-management self-efficacy dimension in the control group before and after the intervention were statistically analyzed and were significant ($P < .05$) (Figure 3).

DISCUSSION

Management in the first year after renal transplantation focuses on the use of

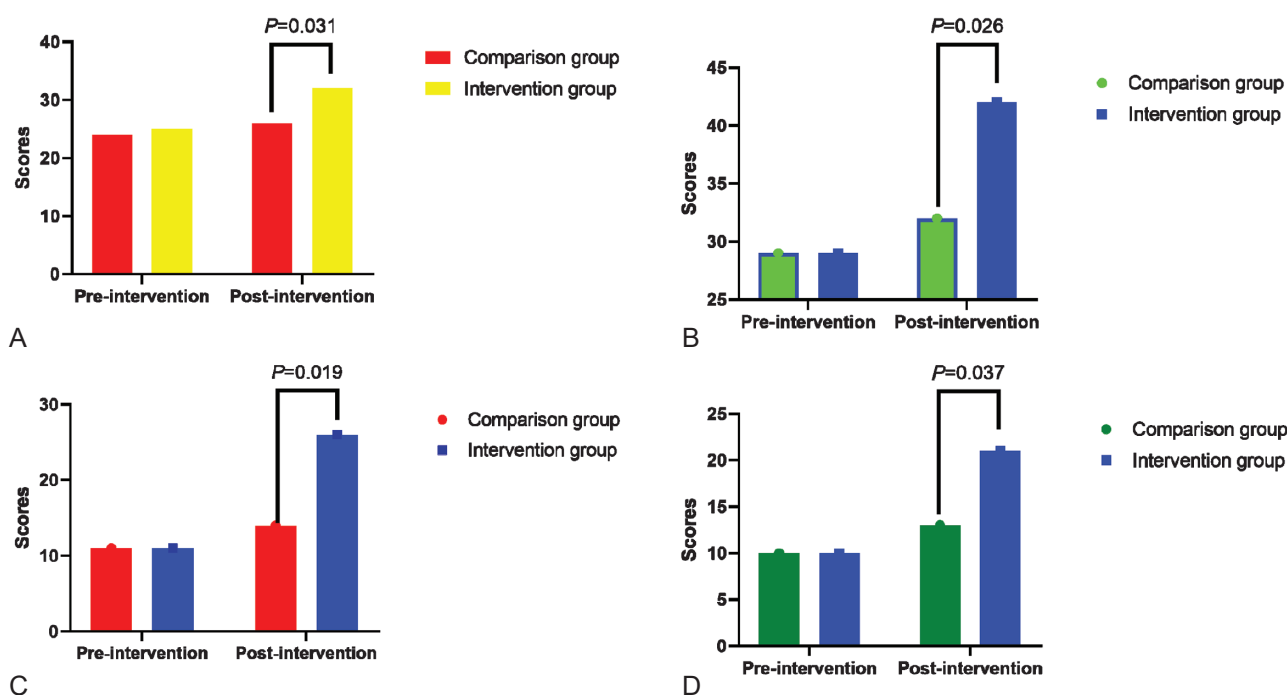


Figure 1. Comparison of self-management behaviors (All statistical data in this study were entered into excel). Measurement data conforming to the normal distribution were expressed as mean ± SD, independent samples t-test was used, and it was found that after the intervention, the diet management score (A), treatment management score (B), repulsive body activity management score (C) and psychosocial management score (D) of Renal Transplantation patients in both groups were significantly better than before the intervention, and the intervention group was higher than the comparison group. The differences were statistically significant ($P < .05$).

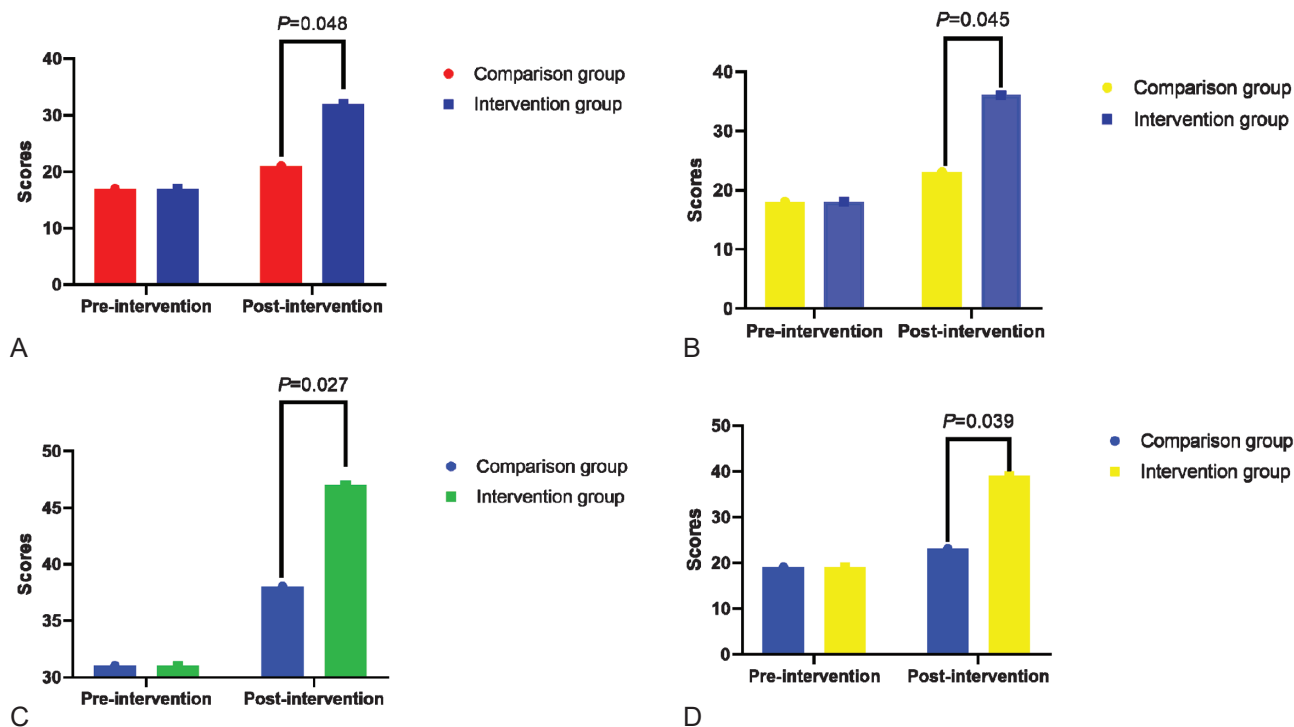


Figure 2. Comparison of quality of life (All statistical data in this study were entered into excel). Measurement data conforming to the normal distribution were expressed as mean ± SD, independent samples t-test was used, it was found that before and after the intervention, the physical function score (A), psychological function score (B), social function score (C) and disease treatment score (D) were significantly different between the intervention and comparison groups, and statistical analysis revealed that all were significant ($P < .05$).

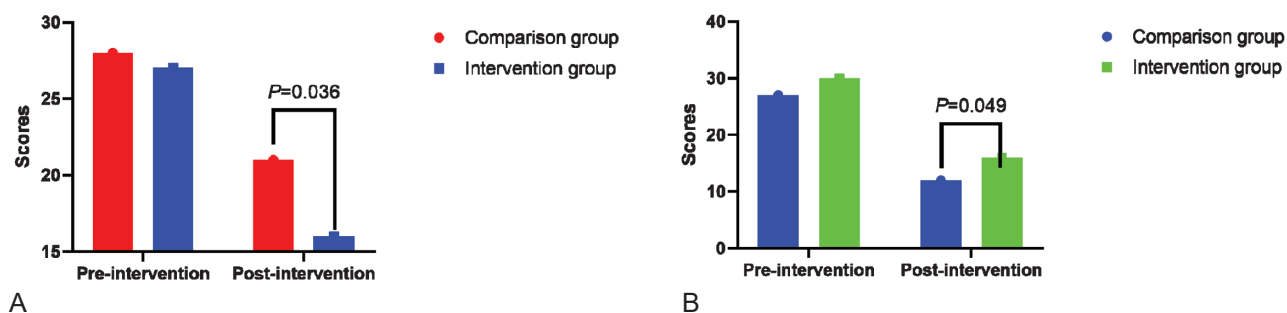


Figure 3. Comparison of self-efficacy scores (All statistical data in this study were entered into excel). Measurement data conforming to the normal distribution were expressed as mean \pm SD, independent samples t-test was used, and it was found that the self-efficacy and all dimensions scores of Renal Transplantation patients in the intervention group were higher after the intervention than before the intervention, and statistical analysis revealed that all were significant ($P < .05$). The scores of symptoms self-management and disease co-management efficacy dimensions in the comparison group of Renal Transplantation patients before and after the intervention were statistically analyzed and found to be significant ($P < .05$).

immunosuppressive medications and monitoring of various biochemical markers of allograft function, while long-term management focuses on the prevention of cardiovascular and cerebrovascular diseases, post-transplant diabetes mellitus, hyperlipidemia, bone disease, malignancies, and other diseases.¹⁶ Related literature shows that Renal Transplantation patients have poor self-management effects due to differences in living environment, cultural knowledge, education, and access to self-management information. The incidence of unplanned readmission was increased due to complications such as decreased medication compliance, weight gain, infection, and increased muscular drunkenness.¹⁷ With the development of information technology in medical care, mobile medical has become a new way of medical treatment, follow-up, continuous care, disease prevention, and access to disease expertise.¹⁸ Mobile health care is more sensibly applied in the management of chronic diseases, and mobile health care interventions have been introduced in patients' self-management. Compared with traditional interventions, mobile health-care applications have the advantages of convenience, speed, low cost, and no geographical restrictions, and are easily used by patients for self-management with good feasibility.¹⁹

We found that the differences in the total scores of self-managements, diet, treatment, repulsive body activity, and psychosocial management dimensions between the two groups of renal transplant patients before the intervention were not statistically significant. This indicates that after the self-management model intervention, patients

were able to master more proficiently the knowledge related to disease rehabilitation guidance, diet, treatment, medication, and exercise, complications prevention, and self-care improvement through centralized instruction and intensive training and learning.²⁰ As a result of online follow-up, patients were able to gain a better understanding of their psychological status, answer questions timely, and supervise their own self-monitoring more effectively.²¹ The peer mentorship model uses one-to-one peer-to-peer listening and discussion as the primary method of providing self-management support.²² With the help of QQ or WeChat groups, peers can communicate with patients and share experience with each other, so that patients can get support and reduce their loneliness²³ At the same time, under the care of family members or relatives and friends, help patients correct bad living habits, reasonable diet and regular exercise.²⁴ Self-management is a health behavior by which the patient maintains and promotes health through his or her own behavior, monitors and manages the signs and symptoms of illness, reduces the impact of illness on his or her social functioning, emotions and interpersonal relationships, and continues to treat his or her illness.²⁵ By empowering patients, the self-management model aims to develop disease, role, and emotion management skills.²⁶ It has been suggested that the self-management model can improve patients' dysphoria when applied to patients with PICCs (A central venous catheter placed in a peripheral vein) inserted into their chests.²⁷ Research in the literature showed that patients discharged from hospital after kidney transplantation can significantly improve their

self-management.²⁸

In our study, we found statistically significant differences in total scores of quality of life, physical, psychological, social, disease treatment, and overall quality of life dimensions between the pre-intervention and control groups. The reason for this may be that establishing long-term contact with renal transplant patients through weekly telephone follow-up, not only provides health education for these patients on a continuous basis, but also gives appropriate patient care, which has a contributory effect on improving their quality of life.²⁹ Our scholars pointed out that although the telephone follow-up is only a simple inquiry and greeting, it makes renal transplant patients feel the care and warmth of relatives, so that they can feel the humanistic care and humane “after-sales service” of the hospital even after discharge, which is worth promoting.³⁰

In summary, mobile health applications provide remote health interventions and professional support to patients in an efficient, comprehensive, and accurate manner, overcoming the spatial and temporal limitations of traditional interventions. It is expected that this study would verify the better practical application of the application, which will help to meet the needs of patients and promote positive disease regression under the reality of limited medical resources and has important practical implications for improving the efficiency of medical resource utilization, optimizing the medical service system, and meeting the social and medical needs for high-quality care services.

AUTHORS' CONTRIBUTIONS

Xiuyuan Xie, Xuejing Wang and Zheng Lin designed the study and performed the experiments, Anqi Li and Yanhong Yan collected the data, Ting Lu and Yue Wu analyzed the data, Xiuyuan Xie, Xuejing Wang and Zheng Lin prepared the manuscript. All authors read and approved the final manuscript.

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CONFLICT OF INTERESTS

The authors declared no conflict of interest.

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