



# Construction and reliability and validity tests of the dietary self-management ability scale for kidney transplant recipients

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**Background:** To establish a dietary self-management evaluation indicators scale for kidney transplant recipients and to test the reliability and validity of the scale.

**Methods:** Based on the knowledge attitude practice model (KAP model) of health-related behavior changes, an evaluation indicators scale of dietary self-management ability of kidney transplant recipients was constructed through a literature review, expert consultation and group discussion. A questionnaire survey was carried out with 102 kidney transplant recipients from a large tertiary hospital to test the reliability and validity of the constructed scale.

**Results:** The dietary self-management ability scale for kidney transplant recipients had 29 items in 3 dimensions. The content validity at the scale level was 0.969, and the content validity at the item level was 0.778–1.000. Exploratory factor analysis extracted 3 common factors, and the cumulative variance contribution rate was 68.610%; the correlation coefficient between each dimension was 0.467–0.629, and the correlation coefficient between each dimension and the total score of the scale was 0.648–0.845. Cronbach's for the scale was 0.831, and the test-retest reliability of the scale was 0.910.

**Conclusions:** The constructed dietary self-management ability scale for kidney transplant recipients has good reliability and validity and can be used as a tool to evaluate the dietary self-management ability of kidney transplant recipients.

**Keywords:** Kidney transplantation; diet; self-management; reliability; validity

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## Introduction

Many physiological characteristics of the kidney affect the body's nutritional metabolism, excretion and electrolyte balance. After kidney transplantation, protein-energy malnutrition and weight loss in recipients are closely associated with increased post-transplant mortality (1,2). To date, one-fifth of kidney transplant recipients suffer

from malnutrition to varying degrees (3). On the one hand, many patients lack proper dietary knowledge and self-management abilities and maintain the preoperative low potassium and phosphorus diet after transplantation; on the other hand, because patients must take immunosuppressive agents for life, they have an increased risk of developing chronic diseases, such as new-onset diabetes mellitus,

hypertension, diabetes mellitus and hyperlipidemia, after transplantation (4). Therefore, to prevent posttransplant malnutrition and various chronic metabolic diseases, patients need to establish healthy eating habits for long-term dietary control and nutrition management (5,6). Good self-management abilities are important for the long-term survival of kidney transplant patients (7). Dietary self-management abilities are relatively important abilities for kidney transplant recipients. Based on the knowledge attitude practice model (KAP model) of health-related behavior changes, this study established appropriate evaluation indicators of self-management abilities suitable for kidney transplant recipients to provide a measurement tool for subsequent behavioral nutrition interventions in kidney transplant recipients.

## Methods

### *Establishing the research group*

The research group had 5 members, including 1 master of nursing, 1 advanced practice nurse (APN), 1 head nurse, 1 professor in the kidney transplantation department and 1 dietitian. The main tasks of the research team included reviewing the relevant literature, constructing a preliminary pool of evaluation indicators, selecting experts, distributing and collecting questionnaires, and revising the questionnaire based on expert opinion.

### *Constructing a pool of indicators*

In this study, based on KAP model of health-related behavior changes, through reviewing related Chinese and international literature, we analyzed the relevant outcomes of the nutritional guides of kidney transplantation recipients. Combined with the opinions of experts in relevant fields, we constructed evaluation indicators for dietary self-management abilities of kidney transplant recipients. The initial version of the evaluation indicators included the rational dietary knowledge dimension, the rational dietary attitude dimension and the rational dietary behavior dimension.

### *Developing the questionnaire and implementing expert consultation*

A questionnaire suitable for expert consultation was developed based on the preliminarily constructed

evaluation indices of the dietary self-management abilities of kidney transplant recipients. The content of the questionnaire covered research background, instructional terms, an evaluation index of the dietary self-management abilities of kidney transplant recipients, general information of the experts, the evaluation criteria used by the experts and the degree of familiarity with the indicators of the experts. Experts evaluated the importance of and their familiarity with evaluation indicators based on their own theoretical and practical experience. The level of importance was assessed using a 5-level scale, including very important, important, somewhat important, less important and not important. The degree of familiarity was also assessed using a 5-level scale, including very familiar with, familiar with, somewhat familiar with, less familiar with and unfamiliar with. From the 4 perspectives of theoretical knowledge, practical experience, peer consultation and intuition, the experts also scored their evaluation criteria using a 4-level scale, including large, moderate, small and none. In addition, “modification comments” and “additional indicator” columns were included so that the experts could propose ideas for revising, adding and deleting evaluation indicators. The members of the research group distributed the questionnaires to experts in the form of in-person distribution and online consultation. After 2 rounds of expert consultation and group discussions, a tentative version of the dietary self-management ability scale for kidney transplant recipients was formed, which included 29 items in 3 dimensions (dietary knowledge, dietary attitude and dietary behavior). This step also included an assessment of the content validity of the evaluation index.

### *Pilot experiment*

From September 2018 to March 2019, a convenience sampling method was adopted to select 102 kidney transplant recipients from a large, tertiary hospital in Guangzhou for a pilot experiment using the preliminary questionnaire. The inclusion criteria were as follows: age  $\geq 18$  years old; normal diet on the third day after kidney transplantation; and clear consciousness. The exclusion criteria were as follows: unstable disease conditions or complicated with other serious diseases; unconsciousness, cognitive dysfunction or mental disorders; and serious language dysfunction or hearing impairment. All selected patients signed informed consent forms and voluntarily

participated in this study.

The content of the pilot experiment included a general demographic information questionnaire, instructions related to filling out the questionnaire, and the dietary self-management abilities of kidney transplant recipients questionnaire. The questionnaire adopted a 5-point Likert scale; the knowledge dimension included very familiar with, familiar with, somewhat familiar with, less familiar with and unfamiliar with; the attitude dimension included totally agree, agree, somewhat agree, less agree and disagree; and the behavior dimension included always, often, sometimes, occasionally and never. The score range for each item was 1–5 points. The total score for the self-management ability scale for kidney transplant recipients was 145 points. The higher the score is, the higher the dietary self-management ability. The members of the research group fully explained to the participants the content and purpose of the study and the method for completing the questionnaire and clearly stated to the participants that the survey was conducted anonymously and that all information and data were only used for the improvement of the quality of medical care and for scientific research.

### *Statistical methods*

Epidata3.0 software was used for data entry, and SPSS25.0 software was used for data analysis. The content validity of the scale was assessed using the content validity index at the scale level and the content validity index for each item. Exploratory factor analysis and Pearson correlation analysis were used to assess the structural validity of the scale, and Cronbach's  $\alpha$  coefficient and test-retest reliability were used to assess the reliability of the scale.

## **Results**

### *General information of experts*

Nine experts participated in this study. There were 2 males and 7 females, aged 32–54 ( $42.56 \pm 8.57$ ) years, with 9–23 ( $16.89 \pm 5.06$ ) working years. Four experts had BS degrees, 3 had MS degrees and 2 had PhD degrees. Two experts had intermediate job titles, and 7 had associate or higher titles. Four transplant specialists had more than 10 years of working experience, and 3 nurses in the transplant department had more than 18 years of experience; nurse specialized in organ transplantation, and there was 1

nutritionist.

### *General information of the participants in the pilot experiment*

A total of 120 questionnaires were distributed, and 102 valid questionnaires were collected. The effective recovery rate was 85%. There were 72 males (70.59%) and 28 females (27.45%), aged 18–63 ( $42.2 \pm 10.32$ ) years. Twelve graduated from elementary school (11.75%), 50 from junior high school or high school (49.02%), and 40 from college and above (39.22%).

### *Positive coefficient and authoritative coefficient of the experts*

This study used the effective recovery rate of the expert consultation questionnaire as the basis for calculation. Two rounds of questionnaires were distributed, and the effective recovery rate was 100%. In the first round, 9 (100%) experts proposed 33 amendments. In the second round, 2 (22.2%) experts proposed 4 amendments. The authoritative coefficients for the 2 rounds of expert consultation were 0.88 and 0.91, respectively.

### *Expert consultation result*

Based on the experts' recommendations collected from the first round of consultation, 5 additional items were added to the scale. The experts believed that it was necessary to determine the patient's persistence in having rational diet. The item "If I have a rational diet after kidney transplantation, I am willing to stick to the diet" was added to the attitude dimension. Experts believed that it was necessary to evaluate changes in dietary behaviors after kidney transplantation. Two items, "I still follow the diet for chronic kidney disease after kidney transplantation" and "I follow the new dietary principles after kidney transplantation", were added to the behavior dimension. "I know how to implement a rational diet after kidney transplantation" and "I understand the principle of a rational diet after kidney transplantation" were considered duplicates, and therefore, the former was deleted. Three items were revised. For example, "I know my body mass index (BMI) value" was changed to "I know what my standard body weight is" in the knowledge dimension.

One item was revised based on the experts' opinion provided in the second round of consultation. "I am willing

to learn how to implement a rational diet after kidney transplantation” was revised to “I am willing to learn to implement a better diet after kidney transplantation” in the attitude dimension. After 2 rounds of expert consultation and group discussions, the preliminary version of the dietary self-management ability scale for kidney transplant recipients was formed and included 3 dimensions (knowledge, attitude, and behavior) and 29 items.

### *Item analysis*

The critical ratio analysis comparing the 29 items between the high value group and the low value group indicated statistical significance ( $P < 0.01$ ), with no deletions or modifications. Pearson correlation analysis indicated that the scores for each item were positively correlated with the total score, with a correlation coefficient of 0.452–0.783; the difference was statistically significant ( $P < 0.01$ ), and there were no deletions or modifications to the items.

### *Validation*

#### **Structural validity**

##### *Exploratory factor analysis*

Exploratory factor analysis showed that the Kaiser-Meyer-Olkin (KMO) value was 0.755, and the Bartlett test result was 2,235.493,  $P < 0.001$ , indicating suitability for factor analysis. Using principal component analysis, 3 common factors were extracted, and the cumulative contribution rate was 68.610%. *Table 1* lists the load of various factors after rotation.

##### *Correlation among dimensions and correlation between each dimension and the total score of the dietary self-management ability scale for kidney transplant recipients*

The statistical results showed that the correlation coefficients between each dimension of the rational dietary self-management ability scale for kidney transplant recipients ranged from 0.467 to 0.629 and that the correlation coefficients between each dimension and the total score for the scale ranged from 0.648 to 0.845, showing moderate to high correlations. Therefore, no items were deleted.

#### **Content validity**

The results of the expert consultation showed that the CVI, S-CVI and mean S-CVI for the 29 items of the dietary self-management ability scale for kidney transplantation

recipients were 0.778–1.000, 0.862 and 0.969, respectively.

### *Analysis of reliability*

Cronbach's  $\alpha$  coefficient for the scale was 0.831, and Cronbach's  $\alpha$  coefficients for each dimension (knowledge, attitude, and behavior) were 0.798, 0.840, and 0.852, respectively ( $P < 0.01$ ). The test-retest reliability of the scale was 0.910, and the test-retest reliability values for each dimension (knowledge, attitude, and behavior) were 0.827, 0.818, and 0.847, respectively ( $P < 0.01$ ).

## **Discussion**

### *The importance of the scale*

Knowledge, attitude, and practice (KAP) model divides people's behavior change into the processes of acquiring knowledge, developing beliefs and forming behaviors. In this model, the establishment of health beliefs and changes in attitudes are particularly important (8). After kidney transplantation, patients must take immunosuppressive agents for life, which has a negative impact on the body's nutrition and metabolism and can induce chronic diseases such as new-onset diabetes mellitus, obesity, hypertension, hyperlipidemia and osteoporosis (5). With the continuous improvement in the average life expectancy and survival rate of kidney transplant recipients, these nonimmune chronic diseases have an increasingly prominent influence on the long-term survival of patients (9). Therefore, while taking immunosuppressive agents, patients require long-term dietary control and specialized nutritional management to prevent obesity, hypertension, diabetes, hyperlipidemia and osteoporosis. According to KAP, a classic theory of health behavior change, patients need to have sufficient knowledge of diets and good self-management practices to develop healthy dietary management behaviors. Improving the self-management abilities of patients is the most important task in nutritional interventions. Therefore, this study designed a dietary self-management ability scale for kidney transplant recipients to provide an evaluation tool for subsequent nutritional interventions.

### *Quality assurance of the scale*

At the early stage of scale construction, the research team thoroughly consulted and referenced the literature and guidelines related to kidney transplant nutritional

**Table 1** Factor loading and commonality of the items in the dietary self-management ability scale for kidney transplantation recipients

Item	Load	Commonality
Knowledge dimension		
6. I understand the principle of diet after kidney transplantation	0.787	0.757
7. I know how to adjust my daily water intake after kidney transplantation	0.753	0.698
10. I know what my standard body weight is	0.721	0.658
2. I know which fruits affect drug concentrations	0.685	0.645
8. I know what "abnormal 3+1" is after kidney transplantation	0.645	0.617
9. I know the threshold blood sugar level for diagnosing post-transplant diabetes	0.638	0.608
5. I know which foods contain high level of purine	0.635	0.598
1. I know what foods are contraindicated after kidney transplantation	0.545	0.578
3. I know which foods contain high levels of potassium	0.525	0.618
4. I know which foods contain high levels of calcium	0.503	0.558
Attitude dimension		
17. I am willing to implement a better diet	0.821	0.798
11. I think a rational diet after kidney transplantation has a major effect on the recovery of body functions	0.819	0.778
19. If I have a rational diet after kidney transplantation, I am willing to stick to that diet	0.785	0.725
18. I am willing to establish a rational diet by changing my own behaviors	0.778	0.654
13. I think that a rational diet has a major impact on the concentration of anti-rejection drugs after kidney transplantation	0.721	0.751
15. I think a rational diet after kidney transplantation has a major impact on the prevention of rejection	0.719	0.627
16. I always fear that eating the wrong foods might affect kidney function after kidney transplantation	0.698	0.618
14. I think that a rational diet has a major impact on the prevention of postoperative infection	0.664	0.675
12. I think that a rational diet after kidney transplantation has a major impact on maintaining the nutritional status of the body	0.498	0.611
Behavioral dimension		
21. I can implement a rational diet after kidney transplantation and follows the principles of the new diet	0.789	0.721
20. I still stick to the diet for chronic kidney disease after kidney transplantation	0.745	0.639
23. I have the right amount of good quality protein at every meal	0.725	0.748
24. I will adjust my diet according to the biochemical indicator results from laboratory tests	0.673	0.683
25. I will avoid eating foods that improve immunity (such as ginseng and royal jelly)	0.613	0.598
28. I exercise at least 5 times a week	0.602	0.511
22. I adjust my daily water intake based on urine output and body weight	0.584	0.624
29. I will rationally control my diet and manage my body weight	0.582	0.601
26. I will avoid eating foods that affect drug concentrations (such as grapefruit and star fruit)	0.555	0.598
27. I control my daily intake of sugar	0.549	0.564



interventions and dietary management, analyzed all aspects of rational diets for kidney transplant recipients, and studied the KAP model of health-related behavior change. The work at this stage ensured the scientificity of the theoretical framework of evaluation indices for the dietary self-management ability scale for kidney transplant recipients. Through expert consultation and group discussions, dietary self-management evaluation indicators for kidney transplant recipients were established. The indicators were then modified and revised by experts engaged in kidney transplantation, nursing, nutrition and other fields. These experts all have rich clinical management experience and teaching experience. The effective recovery rate for the 2 rounds of expert consultation was 100%, and a total of 37 questions were raised during the consultation, indicating high enthusiasm and attention by the experts.

#### *Validation of the scale*

Validity reflects the degree to which an assessment tool can accurately measure an object (10). In this study, structural validity and content validity were used to evaluate the validity of the evaluation indices of the dietary self-management ability scale for kidney transplant recipients. Exploratory factor analysis was performed to test the structural validity of the scale. The factor load for each of the 29 items ranged from 0.498 to 0.821; a total of 3 factors were extracted, and the cumulative contribution rate of the variance was 68.610%. The factor load for each item was consistent with the design expectation, indicating good validity of the scale. The correlation coefficients among the 3 dimensions of the dietary self-management ability scale for kidney transplant recipients ranged from 0.467 to 0.629, which were lower than the correlation coefficients between each dimension and the total score of the scale, which ranged from 0.648 to 0.845. This result indicates that the 3 dimensions of the scale do not overlap each other and that the scale has good structural validity. The average content validity of the 2 rounds of consultation at the item level was >0.75, and the content validity of the scale level was >0.85, indicating good structural validity.

#### *Reliability evaluation of the scale*

Reliability reflects the consistency and stability of measurement results (10). Cronbach's  $\alpha$  coefficient for the scale was 0.831, and Cronbach's  $\alpha$  coefficients for each dimension (knowledge, attitude, and behavior) were 0.798,

0.840, and 0.852, respectively ( $P < 0.01$ ), indicating good internal consistency of the scale. The test-retest reliability of the scale was 0.910, and the test-retest reliability values for each dimension (knowledge, attitude, and behavior) were 0.827, 0.818 and 0.847, respectively ( $P < 0.01$ ), indicating good stability of the scale.

#### **Conclusions**

This study constructed a dietary self-management ability scale for kidney transplant recipients (29 items in 3 dimensions) based on the KAP model. The content of the scale was designed by referencing nutritional guidelines for kidney transplantation patients (4,11). The scale covered various aspects of dietary self-management after transplantation, such as dietary principles, dietary contraindications, and dietary control for preventing common complications. Reliability and validity tests showed that the scale had good reliability and validity and could be used as a tool to evaluate the dietary self-management abilities of kidney transplant recipients. The number of experts that participated in this study was relatively small, which affects the comprehensiveness of the evaluation indicators to some extent. The next step is to expand the sample size for confirmatory factor analysis to provide a scientific, accurate and comprehensive tool for assessing the dietary self-management abilities of kidney transplant recipients. This tool can also be used in subsequent nutritional interventions for kidney transplant recipients.

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#### **Footnote**

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was approved by the Ethics Committee of Clinical Research and Application, Second Affiliated Hospital of Guangzhou

Medical University (ID: 2018-QCC-ks-01). All selected patients signed informed consent forms and voluntarily participated in this study.

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