Original Article

Analysis of Nursing Intervention of Health Knowledge Education under an Information-motivation-behavioral Model for Patients with Early Diabetic Nephropathy

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Abstract

Background: The information-motivation-behavioral (IMB) model has been applied to clinical nursing for a various diseases. However, research has explored the effectiveness of the clinical nursing interventions using health knowledge education (HKE) based on the IMB model in early diabetic nephropathy (DN) cases. Methods: Eighty patients with early diabetes diagnosed at Navy Anqing Hospital between July 2020 to July 2022 were recruited and randomly assigned to two groups. The experimental group (Exp group, N=40 cases) received IMB model-based HKE, and the control group (Ctrl group, N=40 cases) received routine HKE. The biochemical indexes, DN knowledge scores, and self-management ability (SMA) scores of both groups were compared before and after the intervention. Results: After HKE, the fasting blood glucose level, blood glucose two hours after meals, triglycerides, glycosylated hemoglobin, and urinary microalbumin levels in the Exp group were 7.39 ±0.78 mmol/L, 10.61±1.09 mmol/L, and 1.91±0.34 mmol/L, respectively, which were significantly lower than those in the Ctrl group (P<0.05). After HKE, the total score of DN knowledge and SMA in the Exp group were significantly higher compared to those in the Ctrl group (P<0.05). Conclusion: For patients with early diabetes, IMB model-based HKE nursing intervention can effectively improve patients' blood glucose levels and SMA, which is worthy of further promotion.

Keywords: IMB model; health knowledge education; early diabetes; nursing intervention.

INTRODUCTION

The progression of diabetes is categorized into three stages. The first stage is reffered to as "high-risk groups", the second stage as "early diabetes", or "prediabetes", and the third stage as "diabetes".[1] Early diabetes is a state in which the blood glucose level fall between normal blood glucose and diabetic hyperglycemia.[2] Compared to those with normal blood glucose, patients with prediabetes have a grsignificantly higher risk of developing diabetes. According to the timing of abnormal blood glucose, early diabetes is classified into impaired fasting glucose and impaired glucose tolerance, as well as the mixed state of the two.[3,4] These three states suggest different risks for a patient to progress to diabetes. If the first two states are not combined with some risk factors for diabetes (such as hyperlipidemia and obesity), then this population has a lower risk of diabetes compared with the third state. If the risk factors for diabetes are combined, the risk of diabetes will be increased.[5] The population in the mixed state of impaired fasting glucose and impaired glucose tolerance can be considered the population with a higher risk of diabetes.[6]

Nephropathy in diabetes mellitus can generally be detected through urine tests. If the urine trace protein test is positive, it indicates early diabetic nephropathy (DN). The main symptoms include fatigue, pale face, foamy urine, increased frequency of urination, higher urine volume, hypertension, renal anemia, and pitting edema of the lower limbs.[7,8]

Due to the complex metabolic disorders associated with DN, the treatment of end-stage renal disease is often more difficult than that of other renal diseases, so timely prevention and treatment are of great significance for delaying DN.[9] The current approach to treating patients with early diabetes is mainly restoring blood sugar to normal through intervention,

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maintaining the disease at least in the prediabetes stage, and preventing or delaying its conversion to diabetes.[10] For patients without high-risk factors, lifestyle intervention can be considered first. For patients with high-risk factors, drug intervention may be initiated along with lifestyle intervention.[11] To prevent the further deterioration of early DN patients, effective self-behavior management and health model education are often necessary.[12] Health education models commonly used in clinics in recent years include the health belief model, motivational interview, empowerment education, cross-theoretical model health knowledge education (HKE), and information-motivation-behavioral (IMB) model-based HKE.[13,14] Among these, the IMB model is a theoretical model of behavior change frequently used in clinical practice in recent years. It consists of three branches, namely, information, motivation, and behavior skills. It also explores the relationship between these three and their impact on behavior change. The IMB model has been applied to the behavioral intervention process for patients with various diseases.[15]

However, there are limited studies on HKE and IMB model-based nursing intervention in the treatment of early DN patients. Therefore, in the treatment process of early DN patients, this study aimed to compare the changes in patients' biochemical indicators, self-management ability (SMA), and DN knowledge score under the conventional HKE nursing intervention and the HKE and IMB model-based nursing intervention and comprehensively evaluate the application effect of HKE and IMB model-based nursing intervention in the treatment of DN. It was hoped to provide some reference value for the improvement of SMA in patients with early DN.

Materials and Methods

Object of study

Eighty patients diagnosed with early DN at Navy Anqing between July 2020 to July 2022 were included as research subjects. Patients ranged in age from 44 to 68 years old, with a mean age of 54.25±5.13 years old.

The inclusion criteria were i) patients who met the clinical diagnostic criteria of early DN; ii) patients who were older than 18 years old; iii) patients who had a junior high school education or above; iv) patients who had certain cognitive and communication abilities; and v) patients who had signed the informed consent form.

The exclusion criteria for patients were i) patients without SMA; ii) patients with proteinuria caused by abnormal renal function due to other reasons; iii) patients with abnormal urine protein content caused by hypertensive nephropathy, various primary renal diseases, lupus nephropathy, and other types of nephropathies; and iv) incomplete medical records or incomplete informed consent.

All procedures of this study were approved by the Ethics Committee of Navy Anqing Hospital, and all subjects included in the study signed informed consent forms.

Grouping of subjects

In this study, 80 patients with early DN were randomly assigned into two groups, with 40 patients in each group. The experimental group received HKE based on the IMB model (Exp group, N=40 cases), and the control group received routine HKE (Ctrl group, N=40 cases). The structure diagram of the IMB model is shown in Figure 1.

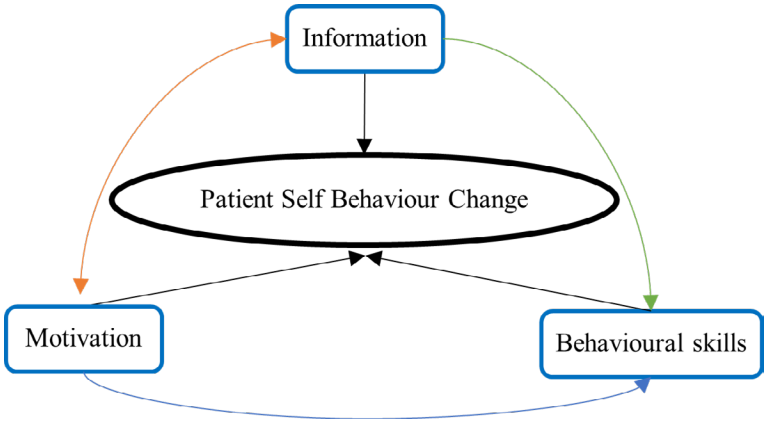


Figure. 1 Structure diagram of the IMB model.

HKE process and contents of the two groups of patients

Before the two groups of patients were treated with HKE, 15 patients were randomly selected for the preexperiment of the HKE regimen, and then the HKE regimen was further improved according to the results of the preexperiment.

In the Exp group, there were three HKE nursing interventions based on the IMB model, and each HKE would adopt different education methods according to the different treatment stages of patients. Among them, the focus of the first IMB model-based HKE nursing intervention was teaching the Exp group about the diet and exercise knowledge of DN patients, such as how to control the capacity intake during the diet, how to calculate the daily energy intake, and how to perform appropriate exercise. The second IMB model-based HKE nursing intervention focused on teaching about DN itself and how to self-monitor related knowledge. The third IMB model-based HKE nursing intervention focused on teaching DN medication and mental health management-related knowledge. Table 1 presents the specific content and schedule of the HKE nursing intervention in the Exp group.

Table 1 The specific content and schedule of the HKE nursing intervention in Exp group

Total intervention time	1st 50~60 min	2nd 50~60 min	3rd 30~40 min
Information aspect	Distribute and explain diet and exercise-related health manuals	Distribute diabetes knowledge and self-monitoring-related knowledge manuals, and explain them	Distribute and explain health manuals on drug therapy and mental health management
Motivation aspect	Establish a trusting relationship and understand the patient's motivation level	Help patients establish the initial motivation for self-management behavior	Review patients' motivation to change reinforcement self-behavior management during the intervention
Behavioral skills	Patients were trained to control food calories and exercise skills	Conduct self-glucose monitoring and insulin injection technical guidance training	Demonstrate the first two behavioral techniques and reinforce them

The Ctrl group received conventional HKE. Upon admission, the responsible nurse educated the patients about their knowledge of diabetes and nephropathy, and regularly issued relevant HKE brochures to answer the patients' questions about diabetes during hospitalization.

Observed indicators

The two groups of patients were observed for observation indicators, including general patient information, the Audit of Diabetes Knowledge, Summary of Diabetes Self-Care Activities, and DN-related indicators.

The general information included variables such as sex, age, type of diabetes, course of disease, family history, occupation, and education level. The DN Knowledge scale included nine dimensions, namely, treatment, DN, duration of illness, diet, influence of physical exercise, hypoglycemia, reduction of complications, foot care, and influence of drinking or smoking, involving 33 influencing factors and 132 items. The scoring rule of this scale is 1 point for correct answers and 0 points for wrong answers. The higher the total score is, the better the cognition of DN knowledge. The SDSCA scale comprised six dimensions, namely, blood glucose monitoring behavior, medication behavior, special eating behavior, general eating behavior, foot care behavior, and exercise behavior, with 11 items below.

In addition, the observational indicators of DN included in this study were fasting blood glucose (FBG), systolic pressure (SP), diastolic pressure (DP) triglyceride (TG), hemoglobin A1c (HbA1c), 2-hour plasma glucose (2hPG), and urinary microalbumin. These indicators were measured before and after the HKE intervention.

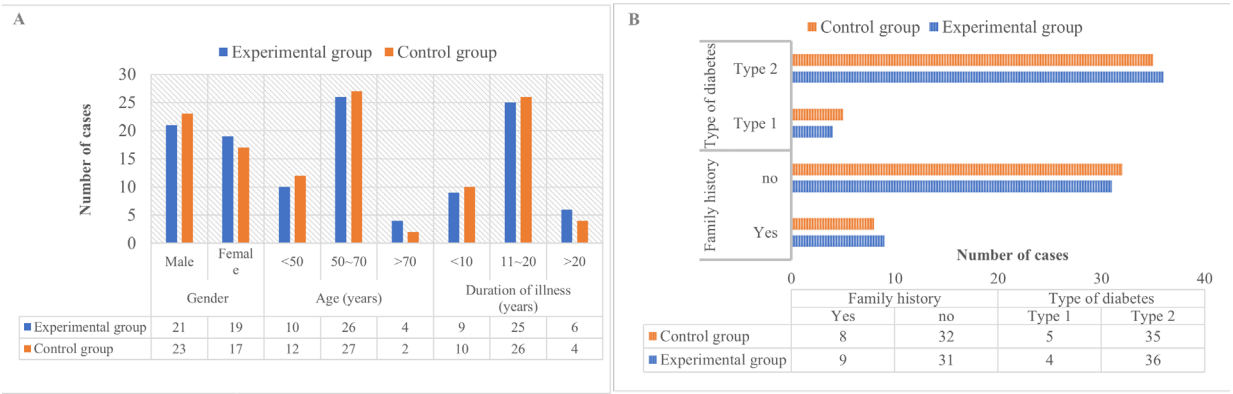
Method of Statistics

The test data were analyzed by SPSS 19.0. The mean plus or minus standard deviation (±s) of measurement data was expressed, and the mean comparison among groups was performed by t-test. The count data were denoted as a percentage (%), and the χ^2 test was performed. The difference was statistically significant at $P<0.05$.

Results

Comparison of general data between the two groups

Figure 2 shows the comparison of general information between groups. The figure indicates that there were no notable difference was indicated between groups in terms of mean age, sex ratio, course distribution, family history of diabetes, or diabetes type ($P>0.05$).



	Gender		Age (years)			Duration of illness (years)		
Experimental group	21	19	10	26	4	9	25	6
Control group	23	17	12	27	2	10	26	4

	Family history		Type of diabetes	
	Yes	no	Type 1	Type 2
Control group	8	32	5	35
Experimental group	9	31	4	36

Figure. 2 Contrast of general information between the two groups of patients.
(Note: A is the distribution map of sex, age, and course of disease of the two groups; B is the diabetes type and family history distribution map of the two groups)

Comparison of biochemical indexes between the two groups before and after HKE

Figure 3 shows the results of FPG, 2hPG, and TG outcome indexes in the two groups before and after HKE. Before HKE treatment, no considerable differences were revealed in FPG, 2hPG, or TG levels between groups ($P>0.05$). After HKE treatment, the FPG, 2hPG, and TG values of the Exp group were 7.39 ±0.78 mmol/L, 10.61±1.09 mmol/L, and 1.91±0.34 mmol/L, respectively. These values were drastically inferior to those of the Ctrl group, whose FPG, 2hPG, and TG values were 8.03±1.03 mmol/L, 11.62±1.51 mmol/L, and 2.22±0.61 mmol/L, respectively ($P<0.05$).

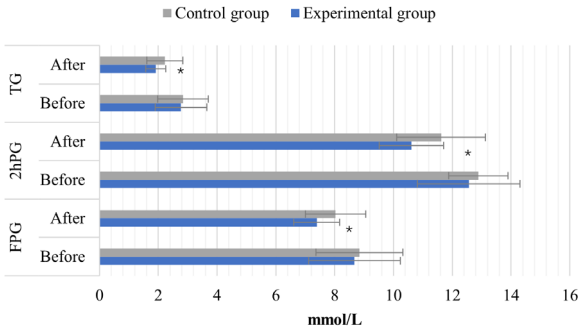


Figure. 3 The results of echocardiographic indexes of patients with acute myocardial infarction in the two groups.
(Note: * *P< 0.05* vs. Ctrl group.)

Figure 4 displays the results of blood pressure outcome indexes in the two groups before and after HKE treatment. Before and after HKE treatment, no considerable differences were revealed in SP and DP levels between the groups (*P*> 0.05).

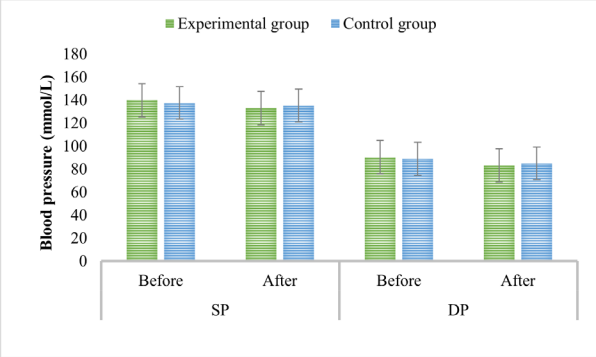


Figure. 4 Blood pressure outcome indexes of the two groups before and after HKE.

Figure 5 illustrates the results of HbA1c and urinary microalbumin before and after HKE treatment. Before HKE treatment, no considerable differences were revealed in HbA1c and urinary microalbumin levels between the groups (*P*>0.05). After HKE treatment, HbA1c and urinary microalbumin contents in the Exp group were 7.27±0.58% and 35.89±9.72 mg/24 h, respectively. These values were significantly lower than those of the Ctrl group (HbA1c and urinary microalbumin contents were 7.73±0.75% and 52.03±11.85 mg/24 h, respectively) (*P*<0.05).

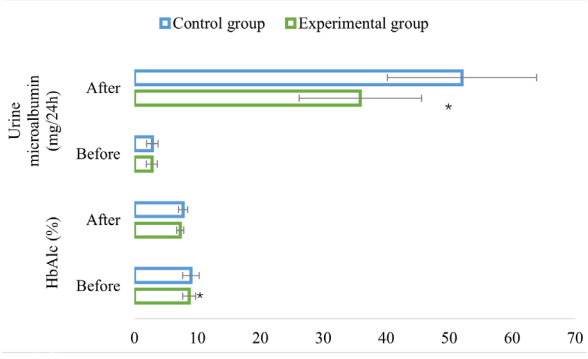
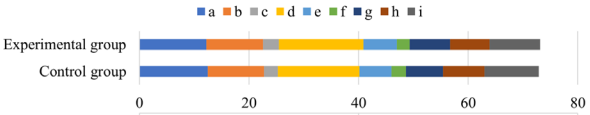


Figure. 5 Results of HbA1c and urinary microalbumin before and after HKE in the two groups.
(Note: * *P< 0.05* vs. Ctrl group.)

Comparison of the knowledge level of DN before and after HKE between the two groups

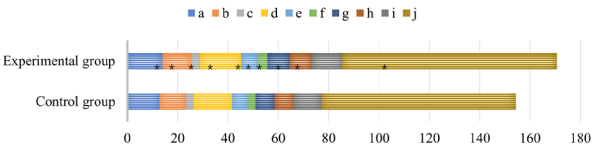
Figure 6 presents the comparison of the knowledge level of DN between the two groups before HKE treatment. Before HKE treatment, no notable differences were indicated between the groups in the knowledge scores of the dimensions of treatment, DN, duration of illness, influence of diet, physical exercise, hypoglycemia, reduction of complications, foot care, and drinking or smoking (*P*>0.05).



	Control group	Experimental group
a	12.45	12.22
b	10.26	10.34
c	2.56	2.89
d	14.89	15.46
e	5.85	6.07
f	2.61	2.35
g	6.75	7.34
h	7.57	7.19
i	9.94	9.25

Figure. 6 Contrast of the knowledge level of DN between groups before HKE.
(Note: a, b, c, d, e, f, g, h, and i represent the knowledge level scores of treatment, DN, duration of illness, diet, influence of physical exercise, hypoglycemia, reduction of complications, foot care, and drinking or smoking influence, respectively.)

The knowledge level of DN between the two groups after HKE is shown in Figure 7. After HKE treatment, the knowledge scores of the Exp group were markedly superior to those of the Ctrl group in the dimensions of treatment, DN, duration of illness, influence of diet, physical exercise, hypoglycemia, reduction of complications, foot care, and drinking or smoking (*P*<0.05). In addition, after the IMB model-based HKE nursing intervention, the total score of DN knowledge level in the Exp group was significantly improved compared with the Ctrl group (*P*<0.05).



	Control group	Experimental group
a	12.78	14.04
b	10.54	11.35
c	3.02	3.64
d	15.36	16.26
e	6.34	6.72
f	2.98	3.61
g	7.43	8.99
h	7.78	8.72
i	10.93	12.02
j	77.16	85.35

Figure. 7 Contrast of the knowledge level of DN between groups after HKE.
(Note: a, b, c, d, e, f, g, h, and i represent the scores of the knowledge level of the dimensions of treatment, DN, duration of illness, diet, influence of physical exercise, hypoglycemia, reduction of complications, foot care, and drinking or smoking, respectively, and j represents the total score. * *P<0.05* vs. Ctrl group.)

Contrast of SMA between the two groups before and after HKE

Figure 8 shows the comparison of SMA between the two groups before and after HKE treatment. Before HKE, the scores of SMA for patients in the Exp group and Ctrl group were 34.08±3.26 points and 33.74±4.11 points, respectively. After HKE treatment, the SMA scores of the Exp group and Ctrl group were 46.11±6.53 points and 38.39±4.16 points, respectively. It was found that there was no notable difference in the scores of SMA between groups before HKE (P>0.05). However, after HKE treatment, the SMA of the Exp group was markedly superior to that of the Ctrl group (P<0.05).

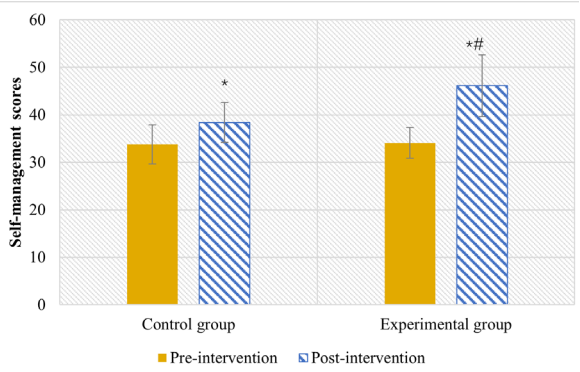


Figure. 8 Contrast of SMA between groups before and after HKE.
(Note: * *P<0.05* vs. before intervention; # P<0.05 vs. Ctrl group.)

Discussion

Diabetic nephropathy is a common chronic microvascular complication of both type 1 and type 2 diabetes, and it exhibits a certain level of inheritance. Chronic hyperglycemia is an important cause of DN in diabetic patients.[16] Numerous studies have indicated that DN has a familial aggregation (the incidence within a family is higher than that in the population), suggesting heredity potential genetic link.[17,18] Among them, abnormalities in SOD-Mn, ELMO1, AGT, and other genes may increase the risk of developing the disease. Diabetic nephropathy involves renal damage caused by chronic hyperglycemia, leading to lesions that can affect the entire kidney, including the glomerulus, renal tubules, renal interstitium, and renal vessels.[19] The current research emphasizes the importance of actively preventing diabetic nephropathy (DN) before it develops. Patients with microalbuminuria in the early stage should be actively treated. Although DN cannot be reversed, early interventions can significantly mitigate its progression.[20] Notably, patients with DN may have no symptoms in the initial stage (stages 1–3) but might experience frequent micturition. For patients with early DN, timely and effective HKE, spreading disease-related knowledge, and teaching self-monitoring methods can alleviate the development of DN to a certain extent. Additionally, these measures can help in improving liver and kidney function as well as the blood glucose index of patients.[21]

HKE is one of the socio-educational activities in the general sense, characterized by planning, organization, and systematic implementation. HKE cultivates people's thinking mode of pursuing health through knowledge dissemination and training demonstration. It helps people to consciously identify and adopt a healthier lifestyle and behaviors., Moreover, HKE can to some extent alleviate the injuries to the human body by risk factors affecting health. As a result, it plays a crucial role in disease prevention, establishing a healthy lifestyle, and ultimately improving the overall quality of life.[22] The core of HKE lies in improving health awareness, changing or adjusting unhealthy lifestyles and behaviors, and trying to avoid the appearance of health risk factors in daily life. Relying on HKE and dissemination of relevant knowledge, individuals can effectively promote awareness of unhealthy behaviors and their hazards to the human body and help the public understand how to promote physical and mental well-being through their behavioral changes.[23]

In this study, an IMB model was employed in the HKE nursing intervention for early DN patients. By introducing three aspects of IMB skills into patients' HKE, the impact of this method on their biochemical indexes, DN knowledge score, and SMA score was explored. The results revealed that before HKE, there were no considerable differences in FPG, 2hPG, TG, systolic blood pressure, diastolic blood pressure, HbA1c, or urinary microalbumin levels between the two groups (P>0.05). After HKE treatment, the FPG, 2hPG, TG, HbA1c, and urinary microalbumin content of patients in Exp group were 7.39±0.78 mmol/L, 10.61±1.09 mmol/L, 1.91±0.34 mmol/L, 7.27±0.58%, and 35.89±9.72 mg/24 h, respectively. These values were significantly lower than those of the Ctrl group (P<0.05). However, no remarkable difference in systolic and diastolic blood pressure was found between the two groups (P>0.05). This suggests that HKE based on the IMB model can effectively improve the blood glucose level of patients with early DN, reduce the contents of HBA1c and triglycerides in the blood, and greatly reduce the content of trace albumin in the urine, thus improving the clinical symptoms of the patients.

In addition, knowledge of DN in the two groups was evaluated from nine dimensions, namely, treatment, DN, duration of disease, diet, influence of physical exercise, hypoglycemia, reduced incidence of complications, foot care, and influence of alcohol or smoking. The results showed that before HKE, no considerable differences were revealed in knowledge scores between the Exp group and the Ctrl group on the dimensions of treatment, DN, duration of illness, diet, influence of physical exercise, hypoglycemia, reduced incidence of complications, foot care, and influence of alcohol or smoking (P>0.05). However, after HKE, the scores of knowledge level and total score of knowledge about DN in treatment, DN, duration of illness, diet, the effect of exercise, hypoglycemia, reducing the incidence of complications, foot care, and drinking or smoking dimensions of patients

in Exp group were markedly improved to those in the Ctrl group (P<0.05). This indicates that HKE intervention based on the IMB model had a remarkable effect, effectively improving the degree of health knowledge mastery among patients. It demonstrated a better educational effect than conventional HKE mehods, and was more worthy of clinical promotion.

The SMA scores of the two groups of patients before and after the HKE nursing intervention were also compared, with the aim of evaluating the influence of different HKE methods on the SMA in patients with early DN. The results showed that before HKE, the SMA scores of the experimental and Ctrl groups were 34.08±3.26 and 33.74±4.11 points, respectively. After HKE, the SMA scores of the Exp group and the Ctrl group were 46.11±6.53 points and 38.39±4.16 points, respectively. No remarkable difference was found in the scores of SMA between the two groups before HKE (P>0.05). After HKE, the SMA of the Exp group was significantly improved to that of the Ctrl group (P<0.05). This indicates that HKE based on the IMB model can effectively improve the SMA of patients with early DN. This may be because when this model is used to carry out HKE, relevant knowledge of how to accelerate the treatment process and improve the quality of life of patients with early DN through behavior change is taught. It can effectively improve patients' sense of participation and self-efficacy in treatment and guide patients to initiate corresponding behavioral changes conducive to treatment. Through the relevant HKE sessions, the patients learned the relevant knowledge of DN, enhanced their motivation to make the corresponding behavioral changes, mastered the relevant behavioral skills, and finally promoted the patients' SMA to greatly improve. Therefore, HKE based on the IMB model has shown promising results in improving patients' SMA, which is consistent with the findings of Floss *et al.*[24]. However, the study on the HKE intervention effect of the IMB model for patients with different types and different periods of DN is more complex and needs further in-depth research in the future.

Conclusion

In this study, the changes in biochemical indexes, SMA, and knowledge scores of DN were compared between routine HKE nursing intervention and IMB model-based HKE nursing intervention. The findings demostrated that HKE based on the IMB model could effectively improve the biochemical index levels of patients with early DN, enhance their knowledge of DN, and improve their SMA. However, important it is important to acknowledge some shortcomings in this study. Firstly, the number of subjects included in this study was small, the source is of participants was limited, Additionally there is no comparative analysis of HKE effects in different types and stages of DN, which needs to be further optimized in the future. In conclusion, HKE and IMB model-based nursing intervention can effectively improve the symptoms of patients with early DN, ienhancing their understanding of disease-related knowledge, and improving their SMA, which provides a certain reference value for the clinical diagnosis and treatment of patients with early DN.

Abbreviations

Abbreviation	Full name
IMB	Information-motivation-behavioral
HKE	Health knowledge education
DN	Diabetic nephropathy
SMA	Self-management ability
Exp group	Experimental group
Ctrl group	Control group
FBG	Fasting blood glucose
SP	Systolic pressure
DP	Diastolic pressure
TG	Triglyceride
HbA1c	Hemoglobin A1c
2hPG	2-hour plasma glucose

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Author contributions

Lingmei Chen carried out the research experiment, compiled data, and evaluated outcomes. Mingzhu Gan drafted the manuscript, and QY supervised the research investigation.

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Availability of data and materials

The supporting evidence for this investigation can be provided upon request

Ethics approval and consent to participate

All processes of this study have been approved by the Ethics Committee of Navy Anqing Hospital and the subjects included in the study have signed an informed consent form.

Competing interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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