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Research on the Application Effect of Health Intervention Based on Planned Behavior Theory in Insulin Treatment for Patients with Type 2 Diabetes

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Abstract: Objective To explore the impact of health education programs based on the theory of planned behavior on insulin injection knowledge, behavior, blood glucose control and quality of life in patients with type 2 diabetes. Methods: Type 2 diabetes patients who needed insulin treatment and were admitted to the endocrinology department of a hospital were selected as the research subjects and randomly divided into the observation group and the control group using the random number table method. The control group received routine clinical health education, while the observation group implemented a 6-month systematic intervention program based on the theory of planned behavior on the basis of routine education, which was constructed and implemented from four dimensions: behavioral attitude, subjective norms, perceived behavioral control, and behavioral intention. The scores of each dimension of planned behavior theory, self-management behavior scores, fasting blood glucose, 2-hour postprandial blood glucose levels and intervention satisfaction were compared between the two groups of patients before and after intervention. Results After the intervention, the observation group was significantly higher than the control group in terms of scores in the dimensions of behavioral attitude, subjective norms, perceived behavioral control, behavioral intention, and total score of self-management behavior. At the same time, the fasting blood glucose and 2-hour postprandial blood glucose levels in the observation group were significantly lower than those in the control group, and the overall satisfaction with health education was also higher. Conclusion Health education based on the theory of planned behavior can effectively improve the knowledge, attitude and belief of insulin treatment for type 2 diabetes patients regarding standard injection, enhance their self-management ability, thereby better controlling blood sugar and improving patient satisfaction, and has clinical promotion value.

Keywords: Theory of Planned Behavior; Type 2 diabetes; Insulin injection; Health education; Self-management

1. Preface

Diabetes has become a major public health problem worldwide, with type 2 diabetes accounting for more than 90 percent of all diabetes cases []1. Insulin therapy is an important way to control blood sugar in patients with type 2 diabetes, especially those with a long course of the disease or those who do not respond well to oral hypoglycemic drugs. But the effectiveness of insulin therapy is not only dependent on the drug itself, but also on whether the patient can perform the injection procedure properly [2]. Many patients in clinical practice have poor blood sugar control and an increased risk of complications due to lack of knowledge about insulin injection, improper operation, fear or resistance to injection, lack of effective social support and insufficient self-management ability.

The traditional model of health education mainly focuses on one-way knowledge indoctrination by nurses, with emphasis on demonstrations of the operation steps, often neglecting the internal psychological and behavioral transformation process of patients. Although this educational approach can increase patients' knowledge reserves in the short term, it is difficult to promote their long-term, stable and standardized injection behavior, and the educational effect is not easy to consolidate. Therefore, it is particularly necessary to explore an intervention model that can deeply influence patients' cognition and beliefs and ultimately promote behavioral change.

Planned behavior theory is a psychological social theory framework that is widely used in health behavior research. The theory holds that an individual's behavioral intention is the most direct factor

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in predicting behavior, and behavioral intention is influenced by three dimensions: behavioral attitude, subjective norms, and perceived behavioral control. Applying the theory of planned behavior to the intervention of insulin injection behavior is to teach patients how to inject while systematically changing their attitude towards standardized injection, creating a supportive social norm environment, enhancing their confidence and sense of control in performing self-management, and promoting the establishment and maintenance of behavior from the source. At present, there are few studies in China on systematizing and structuring insulin injection behavior based on this theory. Therefore, the aim of this study is to establish and implement a health education program based on the theory of planned behavior, evaluate its effect on insulin treatment in patients with type 2 diabetes, and provide a more scientific and effective approach to patient education in clinical practice.

2. Data and Methods

2.1 General Information

Patients with type 2 diabetes mellitus who were hospitalized in the endocrinology department of our hospital between June 2023 and June 2024 were selected as the study subjects. Inclusion criteria: Meeting the diagnostic criteria for type 2 diabetes established by the World Health Organization [3]; Between 18 and 70 years of age; Doctor's order to start or have already started insulin injection treatment, with an expected treatment duration of more than 6 months; Conscious, with basic communication and reading skills; Informed consent and voluntary participation in this study. Exclusion criteria: Severe dysfunction of vital organs such as heart, liver, and kidney; Have cognitive impairments or mental disorders; Those with severe diabetic complications such as blindness or amputation that affect self-care ability; It is expected that follow-up will not be completed. Patients who met the criteria were divided into the observation group and the control group using the random number table method [4]. A total of 96 patients were selected, with 48 in each group. There was no statistically significant difference in general information such as age, gender, disease duration and educational attainment between the two groups of patients, and they were comparable.

2.2 Methods

The control group adopted the current clinical routine health education methods. During hospitalization, the responsible nurse provided health education on insulin injection to the patients according to medical orders, including the function of insulin, storage methods, principles of rotation of injection sites, key points of injection techniques, prevention and management of hypoglycemia. The education was conducted one-on-one at the bedside, with relevant practical operation videos provided for patients to watch and learn on their own. Health education is limited to the patient themselves and does not involve family members or other significant others. When the patient is discharged, regular discharge guidance is given to the patient, and they are advised to return to the hospital for regular follow-up visits.

In addition to the routine health education in the control group, the observation group implemented a 6-month systematic health education program based on the theory of planned behavior. The specific implementation steps are as follows: The first step is to establish a special health education group. The group consists of four members, including one head nurse with years of experience in diabetes specialty, who is responsible for coordinating, quality supervision and process control of the entire intervention program; Three key clinical nurses, all trained uniformly, are responsible for implementing health education, delivering online content, conducting out-of-hospital follow-ups, and collecting and conducting preliminary analysis of research data. Secondly, standardized training was provided to the team members. The training covered the core content and application methods of the theory of planned behavior, the latest guidelines and practical techniques for standardized insulin injection, communication skills and precautions for out-of-hospital follow-up, and the standardized distribution and retrieval interpretation methods of various scales used in the study. All members will undergo a unified assessment after the training, out of 100, and a score of 90 or above is considered

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qualified to participate in the study intervention, ensuring the homogeneity and standardization of the intervention.

The core content of the intervention program is designed based on the four construct dimensions of the theory of planned behavior. During the behavioral attitude intervention phase, a 30-minute one-on-one intervention is carried out at the bedside on the day the patient is admitted. The focus is on helping patients develop a positive attitude towards regular insulin injections. The specific content includes a comprehensive assessment of the patient's basic situation and weak points in knowledge and skills; Deepen patients' awareness of the serious consequences of improper injections by showing pictures of complications and real cases; Use open-ended questions to guide patients to self-analyze obstacles in their injection behavior, such as knowledge misconceptions, fears, or lack of support, and summarize together with the patients to internalize the necessity of proper injection.

Two to four days after admission, there will be about 30 minutes of combined individual and family intervention for patients and their families in the ward. The aim is to create a standardized and supportive environment for the patient. Specific measures include organizing patients and at least one major family member to watch a video of standardized insulin injection and error case analysis together, using injection molds to guide patients and family members to practice standardized injection steps, and conducting risk education throughout the process [5]. Strengthen the support of medical staff and family members, actively care about the patient's injection situation during daily ward rounds and promptly correct errors, mobilize family members to participate in the patient's daily injection management, and make the patient feel the positive pressure and support from the external environment. Instruct patients to learn to self-examine the injection site, identify and record subcutaneous fat hyperplasia, and encourage them to record changes in blood sugar after standardized injection, so that they can intuitively feel the benefits of standardized behavior and thereby stimulate internal self-management awareness.

The perceptual behavior control intervention stage mainly uses out-of-hospital phone follow-ups for reinforcement, conducted once at 1, 2, and 4 weeks after the patient's discharge for 5 to 10 minutes each time. The aim is to enhance patients' sense of self-management efficacy. On the day of discharge, patients are given a illustrated manual on insulin Injection behavior management, which explains the content of self-monitoring and management in detail, making patients believe that the management behavior is concrete and feasible, thereby building confidence. During the follow-up, personalized guidance was provided for problems that were fed back through the mobile platform or self-reported by the patients. For patients who did not perform well in self-management programs, increase the frequency of follow-up to once a week, jointly analyze the influencing factors, assist in formulating practical personal management programs, and improve the self-control ability of patients.

During the behavioral intention intervention stage, the intervention effect was maintained through patient management wechat groups and telephone follow-ups. The intervention was conducted every 15 days from the 2nd to the 4th month after discharge, and once a month from the 5th to the 6th month, each session lasting 5 to 10 minutes. Turn positive behavioral intentions into stable actions. Regularly push knowledge to the group, invite self-managed patients to share their experiences, and reinforce behavioral intentions through peer education. Researchers will ask patients in the group or on the phone from time to time to understand their mastery of knowledge and implementation of behavior, give positive summaries and feedback, and praise and encourage their progress to consolidate their behavior.

2.3 Observation Indicators

Compare the changes in indicators before the intervention and 6 months after the intervention in both groups of patients. The primary indicator of observation was the insulin use Knowledge and Behavior score, which was evaluated using the Insulin Use Knowledge and Behavior Questionnaire covering aspects such as insulin storage, injection techniques, dose adjustment, and adverse reaction management. The higher the total score, the better the knowledge and behavior compliance. The secondary observations included the following. My Views on Insulin Scale was used to assess

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patients' attitudes and beliefs towards insulin treatment, with higher scores indicating a more positive attitude. Fasting blood glucose and 2-hour postprandial blood glucose levels of patients were measured to assess short-term blood glucose control. The quality of life changes in patients were evaluated using the Quality of Life Specific Scale for Diabetic patients. At the end of the intervention, a self-designed satisfaction questionnaire was used to assess patients' satisfaction with the health education content, with a total score of 100. Very satisfied was rated as above 90, satisfied as 80 to 89, average as 60 to 79, and dissatisfied as below 60.

2.4 Statistical Methods

Data analysis was performed using SPSS 26.0 statistical software. The measurement data were normally distributed and expressed as mean plus or minus standard deviation. Paired sample t-tests were used for intra-group comparisons and independent sample t-tests for inter-group comparisons. Count data were expressed as cases or percentages and compared using the chi-square test. A difference was considered statistically significant when the P value was less than 0.05.

3. Results

3.1 Comparison of Scores in Each Dimension of the Theory of Planned Behavior before and after the Intervention between the Two Groups

Before the intervention, there were no statistically significant differences in the scores of the four dimensions of behavioral attitude, subjective norms, perceived behavioral control, and behavioral intention between the two groups of patients. After 6 months of intervention, both groups had improved scores in each dimension compared to before the intervention, but the improvement in the observation group was significantly greater than that in the control group, and the difference between the two groups was statistically significant.

Table 1 Comparison of scores in each dimension of the Theory of Planned Behavior before and after the intervention between the two groups

Dimensions	Group	Number of cases	Before intervention (points)	Post-intervention (points)	t values (within the group)	P value (within the group)	t value (between groups)	P value (between groups)
Behavior attitude	Observation Group	48	18.5±3.2	28.7±2.1	15.324	<0.001	8.765	<0.001
	Control Group	48	18.8±3.0	23.6±2.8	8.912	<0.001		
Subjective norms	Observation Group	48	20.1±2.8	31.5±1.9	18.642	<0.001	10.231	<0.001
	Control Group	48	20.3±2.5	25.4±2.5	9.874	<0.001		
Perceptual behavioral control	Observation Group	48	16.9±3.5	27.8±2.4	16.587	<0.001	9.452	<0.001

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Dimensions	Group	Number of cases	Before intervention (points)	Post-intervention (points)	t values (within the group)	P value (within the group)	t value (between groups)	P value (between groups)
	Control Group	48	17.2±3.3	22.1±3.0	7.659	<0.001		
Behavioral intent	Observation Group	48	19.4±2.9	30.2±2.0	17.895	<0.001	11.023	<0.001
	Control Group	48	19.1±3.1	24.0±2.7	8.124	<0.001		

3.2 Comparison of Self-Management Behavior Scores before and after Intervention between the Two Groups

Before the intervention, there was no statistically significant difference in the scores of the Insulin Use Knowledge Behavior Questionnaire and the Diabetes Patient Quality of Life Specific Scale between the two groups of patients. After 6 months of intervention, the improvement in the knowledge behavior score and quality of life score in the observation group was significantly better than that in the control group.

Table 2 Comparison of self-management behavior scores before and after intervention between the two groups

Indicators	Group	Number of cases	Before intervention (points)	Post-intervention (points)	t values (within the group)	P value (within the group)	t values (between groups)	P value (between groups)
Knowledge-behavior score	Observation Group	48	65.3±8.5	88.7±6.2	13.245	<0.001	7.892	<0.001
	Control Group	48	66.1±7.9	76.4±7.8	6.784	<0.001		
Quality of life score	Observation Group	48	58.2±9.1	72.5±7.3	9.876	<0.001	4.562	<0.001
	Control Group	48	57.8±8.7	65.3±8.1	5.432	<0.001		

3.3 Comparison of Blood Glucose Control Indicators before and after Intervention in the Two Groups

There was no statistically significant difference in fasting blood glucose and 2-hour postprandial blood glucose levels between the two groups before the intervention. After 6 months of intervention, blood glucose levels in both groups decreased compared to before the intervention, but the decrease

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was greater in the observation group, and the difference between the groups was statistically significant.

Table 3 Comparison of blood glucose control indicators before and after intervention between the two groups

Indicators	Group	Number of cases	Before intervention (mmol/L)	Post-intervention (mmol/L)	t values (within the group)	P value (within the group)	t values (between groups)	P value (between groups)
Fasting blood glucose	Observation group	48	9.8±1.5	6.9±0.8	12.347	<0.001	5.678	<0.001
	Control Group	48	9.6±1.6	7.8±1.1	7.891	<0.001		
2-hour postprandial blood glucose	Observation Group	48	13.5±2.1	9.2±1.3	11.569	<0.001	4.987	<0.001
	Control Group	48	13.7±2.3	10.5±1.7	8.124	<0.001		

3.4 Comparison of Intervention Satisfaction between the two Groups

A health education satisfaction survey was conducted for both groups of patients at the end of the intervention. The proportion of patients in the observation group at the very satisfied and satisfied levels was significantly higher than that in the control group, and the overall satisfaction was better than that in the control group, which was statistically significant.

Table 4 Comparison of health education satisfaction between the two groups of patients

Groups	Number of cases	Very satisfied (n,%)	Satisfied (n,%)	Average (n,%)	Dissatisfied (n,%)	Overall satisfaction rate (%)	χ^2 value	P value
Observation group	48	22 (45.8)	20 (41.7)	6 (12.5)	0 (0.0)	87.5	8.921	0.012
Control group	48	12 (25.0)	18 (37.5)	14 (29.2)	4 (8.3)	62.5		

4. Discussion

This study systematically applied the theory of planned behavior to the health education of insulin treatment for patients with type 2 diabetes. The results showed that the intervention measures designed based on this theory were better than the traditional health education model in terms of enhancing patients' cognitive beliefs, improving self-management behaviors, optimizing blood

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glucose control, and increasing patient satisfaction. This result validates the superiority and necessity of structured interventions guided by the theory of behavioral change in chronic disease management.

The study found that the improvement in scores of the observation group was significantly better than that of the control group in four dimensions: behavioral attitude, subjective norms, perceived behavioral control, and behavioral intention. This validates the effectiveness of the intervention pathway designed in this study. The behavioral attitude dimension improved significantly, thanks to the use of crisis education, obstacle analysis and other means at the beginning of the intervention, which enabled patients to change their negative or indifferent attitude towards insulin injection from the very beginning and truly recognize the positive significance and necessity of standardized injection. The improvement in the subjective normative dimension was due to the intervention's inclusion of family members in the education system, enhanced continuous attention and feedback from medical staff, and the establishment of a strong social support system for patients, making patients feel social expectations and support from others, thereby increasing their willingness to comply. The improvement in the perceived behavioral control dimension mainly relied on the intervention providing detailed instruction manuals, continuous personalized problem-solving, and program adjustments, which truly reduced the difficulty for patients to perform self-management and increased their confidence in doing what they could do. Ultimately, these positive changes worked together to form stronger and more persistent behavioral intentions in the observation group, laying the foundation for the long-term maintenance of the behavior.

Secondly, the observation group was also significantly better than the control group in terms of self-management behavior and blood glucose control. The improvement in knowledge-behavior scores indicates that the intervention based on the theory of planned behavior not only conveys knowledge but also promotes the transformation of knowledge into actual behavior. The simultaneous improvement in quality of life indicates that the stable blood sugar brought about by standardized treatment reduces the disease burden and psychological stress of patients. More direct evidence is that fasting blood glucose and 2-hour postprandial blood glucose control levels in the observation group were significantly better than those in the control group. The improvement in blood glucose levels is a physiological result of a series of positive changes in patients' cognition, attitude, behavior, etc., and is the most powerful proof of the effectiveness of the intervention. This indicates that health education guided by the theory of planned behavior is ultimately aimed at achieving practical results in clinical practice.

In addition, the overall satisfaction with health education in the observation group was significantly better than that in the control group. Conventional education models are relatively monotonous and passive, while the intervention provided in this study is continuous, interactive and personalized. From in-depth one-on-one communication within the hospital to regular phone follow-ups outside the hospital and interactive support in online groups, the entire intervention process was patient-centered, addressing both skill issues and emotional and supportive needs of the patients. The all-round, companion-like educational experience gives patients a strong sense of participation, gain and respect, which leads to higher evaluations.

Therefore, health education programs based on the theory of planned behavior, by systematically intervening in patients' attitudes, subjective norms, perceived behavioral control, and behavioral intentions, can effectively promote the formation and maintenance of standardized injection behavior in patients treated with insulin for type 2 diabetes, thereby achieving better glycemic control and improving patient satisfaction. To promote such structured theory-driven intervention models in clinical nursing, the focus of education will shift from mere knowledge and skills training to long-term behavioral support that promotes intrinsic motivation and self-efficacy in patients. The follow-up period of this study was only six months. Further observation is needed for the maintenance of effects over a longer period of time, and future multi-center, large-sample studies can be conducted for verification.

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