Effects of a Self-Management Skills-Acquisition Program on Pre-Dialysis Patients with Diabetic Nephropathy

CNE Continuing Nursing Education

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In Japan, diabetic nephropathy is found in 35.1% of total patients on dialysis as an underlying disease, a proportion that is expected to increase in the future, considering the increase in the number of patients with type 2 diabetes (Japanese Society of Nephrology, 2009). Similarly, the number of patients with diabetic nephropathy is dramatically increasing globally (National Kidney Foundation [NKF], 2007; Zimmet, Alberti, & Shaw, 2001). To improve the quality of life (QOL) of these patients and reduce their medical expenditures, it is important to prevent the progression of the disease and to delay the introduction of dialysis or avoid it altogether. Therefore, strict management of blood glucose and blood pressure, whether by the patients themselves or their healthcare professionals, is required for controlling the progression of diabetic nephropathy (NKF, 2007). Self-management education with content and structure based on theoretical frameworks and evidence can help improve patient outcomes (Funnell et al., 2011).

In addition, early referral to a nephrologist helps inhibit the deterioration of renal function and prevents associated complications (Inaguma et al., 2006). However, many patients with diabetic nephropathy are not referred to nephrologists when they are in the early stages of renal failure, so these patients are not aware of the need for self-management skills. Further, no structured self-management programs have currently been introduced into healthcare facilities in Japanese society. Therefore, an urgent task is the development and propagation of effective learning programs, which are structured to support early detection of diabetic nephropathy and facilitate switches to appropriate treatment.

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Authors' Note: *As a disclaimer, the authors state that no risk was assumed because the program mainly consisted of education using textbooks with content based on clinical practice guidelines and study materials already on the market, the safety of which has been confirmed. The project was commissioned and funded by Kure City, Hiroshima Prefecture, Japan.*

Acknowledgements: *This study was funded by Kure City. The authors would like to sincerely thank all the people in the relevant institutions that cooperated with this study.*

Statement of Disclosure: *The authors reported no actual or potential conflict of interest in relation to this continuing nursing education activity. Additional statements of disclosure and instructions for CNE evaluation can be found on page 149.*

Kazawa, K., & Moriyama, M. (2013). Effects of a self-management skills-acquisition program on pre-dialysis patients with diabetic nephropathy. *Nephrology Nursing Journal, 40*(2), 141-148.

The study was to examine the effects of a six-month educational program aiming acquisition of self-management skills on patients with diabetic nephropathy. One-group, pre- and post-test design was performed. Face-to-face and telephone interviews were conducted by nurses. Thirty participants completed the program. As a result of the program, self-efficacy, self-management ability, and HbA_{1c} improved, and renal function was maintained.

Key Words: **Predialysis, diabetic nephropathy, patient education, self-management.**

Goal

To provide an overview of the effects of a six-month educational program aiming acquisition of self-management skills on patients with diabetic nephropathy.

Objectives

1. Discuss the impact of diabetes on the population of Japan in comparison with global statistics.
2. Review the application of self-management education with content and structure based on theoretical frameworks.
3. Explain the educational techniques integrated that provided evidence to improve patient outcomes.

This offering for 1.3 contact hours is provided by the American Nephrology Nurses' Association (ANNA).

American Nephrology Nurses' Association is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center Commission on Accreditation.

ANNA is a provider approved by the California Board of Registered Nursing, provider number CEP 00910.

Accreditation status does not imply endorsement by ANNA or ANCC of any commercial product.

This CNE article meets the Nephrology Nursing Certification Commission's (NNCC's) continuing nursing education requirements for certification and recertification.

We reviewed the literature for educational or support programs for patients with type 2 diabetes and diabetic nephropathy. The reviewed studies reported that clinical indicators were improved by comprehensive therapy that involved lifestyle interventions, such as those dealing with diet, exercise, and smoking cessation, in addition to drug therapy (Gaede, 2009; Joss et al., 2004; Shikata et al., 2010). However, in their evaluation criteria, these reports did not include programs that were structured to motivate patients to engage in behavior modification or any of its process indicators, such as self-efficacy and self-management behaviors.

Therefore, in this study, we investigated the effects of an educational intervention using a self-management skills-acquisition program for patients with diabetic nephropathy. The goal of this study was to use this intervention to teach patients the knowledge and techniques concerning self-management of their disease, which could lead to delaying the introduction of dialysis and avoiding emergency dialysis.

Self-Management Skills-Acquisition Program

Program Content

The structure and content of the program were based on:

- Educational themes in previous studies that have been regarded as effective for patients with chronic kidney disease (CKD), including diabetic nephropathy (Gaede, 2009; Inaguma et al., 2006; Joss et al., 2004; Wu et al., 2009).
- Evidence-based clinical practice guidelines and expert opinions from diabetologists and nephrologists.
- A qualitative study (mini-ethnography) with observation and interviews from home visits.
- Discussion among advanced practice nurses in chronic care, registered dietitians, and patients with CKD.

Table 1
The Goals and Structure of the Self-Management Skills-Acquisition Program

Goals: Improvement of self-efficacy and quality of life (QOL); maintenance and improvement of clinical indicators.	
The content of the program: Improvement and maintenance of self-management ability.	
Content in 1st to 4th Sessions	**Content Throughout the Program**
• Establish a partnership with the participants. • Identify supporters (such as family) and discuss how supporters can contribute. **(Analyze current data and lifestyle, establish diet/exercise targets.)** • *Establish long-term (life purpose) and short-term (6 months) goals.* • *Analyze clinical indicators (lab test results, blood pressure) and lifestyle.* **(Acquire self-monitoring methods.)** • Explain how to use textbooks, daily journal, and study materials. • Explain self-monitoring methods (blood pressure and body weight; blood glucose, if appropriate).	• Learning support: nurses, as partners of the participants, discuss and teach the content of the textbooks. • *Set short-term targets achievable by individual participants (diet and exercise).* • Periodically analyze daily self-monitoring results with participants • *Analyze the reported results monthly with the participants.* ⇨ *Positively evaluate the execution of target behaviors.* ⇨ Consider resetting failed targets. • Encourage participants to express their emotions, such as feelings of anxiety and a sense of burden. • *Confirm participants' emotional and physical changes resulting from their target behaviors.* • Share with participants experiences of other patients.
Improvement of monthly frequencies of target behaviors.	
Improvement of self-efficacy and occurrence of behavior modification.	
Improvement of QOL, maintenance and improvement of clinical indicators.	

Note: Approaches to improved self-efficacy are italicized in the table.

In addition, based on work by Bandura (1977), the following were included in the program:

- Approaches for improving self-efficacy.
- Knowledge so that the patient could evaluate his or her condition and talk with his or her physicians when it deteriorated.

Nurses served as advisors to patients and their primary physicians to foster good communication between the two.

Goals and Structure

The goals and structure of the program used in this study are shown in Table 1. Approaches to improved self-efficacy are italicized in the table. First, participants sought to recognize the state of their bodies and diseases by linking their laboratory and self-monitoring data (weight, blood pressure, and blood glucose) to their lifestyle. Second, participants and nurses set achievable, systematic daily goals to improve their lifestyle, as well as long-term (life purpose) and short-

term (6 months) goals. When participants experienced success, nurses gave them positive feedback. When a participant was unable to achieve his or her goal, the nurse evaluated whether that goal was achievable and did not blame the patient for the failure. Moreover, nurses did not evaluate only numerical values of blood glucose, weight, and blood pressure because this could have had a negative impact on patients' mental states; instead, nurses made patients more aware of changes in their bodies and feelings.

Duration and Operation

The duration of the program was set at six months, a period in which the maintenance of behavior modification most often occurs (Prochaska & Velicer, 1997). The first to fourth sessions were face-to-face meetings conducted by nurses for approximately one hour once every two weeks at participants' homes or at the outpatient clinic. The fifth and sixth sessions were conducted for approximately 30 minutes once a month by the method (telephone or e-mail) chosen by the participant. Thereafter, telephone follow ups were performed every month. Education was provided through textbooks, a daily journal, and study materials with themes on diabetes, nephropathy (complications), diet therapy, exercise therapy, stress management, foot care, and drug therapy. Dietary and exercise target behaviors were set during and after the second session.

Learning Supporters (Nurses)

Five nurses with clinical experience in internal medicine conducted the intervention according to a protocol designed by the authors. Before the intervention, lectures by a clinical nurse specialist in chronic care, a registered dietitian, and an expert patient with CKD were provided, and role-play interventions were performed for the participating nurses. Team conferences were held periodically during the intervention to ensure its quality. Each participant's desired goals for the diet and exercise therapy were confirmed with his or her primary physician before the intervention, and reports on education and changes in the participants were submitted to physicians every month during the intervention period. When data deviated from standard values, nurses immediately discussed the case with the physicians. Dietary composition was appropriately advised by registered dietitians, and participants received nutrition counseling from these dietitians when they requested it.

Methods

Participants

Participants were patients with type 2 diabetic nephropathy who were insured by national health insurance in Kure City, Hiroshima Prefecture, Japan, and attending any of the 20 hospitals or clinics in Kure city and Hiroshima city. The inclusion criteria were an eGFR between 15 to 59 mL/min/1.73m^2, a urinary albumin/creatinine ratio of 300 mg/gCr or higher, and being between 20 to 74 years of age. The exclusion criteria were having received renal replacement therapy, having a cognitive impairment or mental disorder, or being pregnant.

Design

A one group pre- and post-test design was used.

Period of Study

This study was conducted from March 24 to December 31, 2010.

Evaluation Indicators

Evaluation indicators were set as follows based on clinical practice guidelines and specialist opinions. The following indicators were collected before the intervention and every three months after, up to six months.

Psychological indicators. We used the self-efficacy scale for health behaviors in patients with chronic diseases created by Kim, Shimada, and Sakano (1996), and the World Health Organization (WHO) Quality of Life (WHO-QOL26) instrument published by WHO in 1997, the Japanese version of which was created by Tazaki and Nakane (2007).

Process indicators. We collected the proportion of days in a month that participants performed the following self-management behaviors: engaging in the dietary and exercise target behaviors set by each participant; self-monitoring blood pressure, body weight, and blood glucose levels; and oral intake and injection of prescribed drugs.

Physiological indicators. We collected the following: Hb_{A1c} (Japan Diabetes Society [JDS] value), serum creatinine (Scr), eGFR, blood urea nitrogen (BUN), hemoglobin (Hb), total protein (TP), albumin (Alb), potassium (K), inorganic phosphate (P), serum triglycerides (TG), low density lipoprotein cholesterol (LDL-cho), and high density lipoprotein cholesterol (HDL-cho) in blood tests; blood pressure; and body mass index (BMI). We calculated eGFR from the following predictive equations: eGFR (mL/min/1.73 m^2) = $194 \times Scr^{-1.094} \times age^{-0.287}$(× 0.739, for females) (issued by the Japanese Society of Nephrology [JSN]).

Data Collection

Nurses collected data on self-monitoring and execution rate (frequency) of target behaviors every month by telephone or mail. Data from the self-efficacy and QOL scales were mailed to the researchers after participants had answered the scales. Laboratory data were collected from the participants or their medical records.

Recruitment and Registration Procedures

Kure City, as a medical insurer, selected all insured persons whose medical fee receipts (claim data) listed diabetic nephropathy as their current diagnosis, and consent of their primary physicians for participation was obtained. Each patient was asked to participate in this study after permission was obtained.

Table 2
Changes in Self-Efficacy, Quality-of-Life, and Self-Management Behaviors

	N	Sequential Comparison				Comparison at Each Evaluation Time		
		Baseline (BL)	Post 3-Month (P3M)	Post 6-Month (P6M)	*p*-Value[a]	BL-P3M	BL-P6M	P3M-P6M
Self-efficacy scale score (mean ± SD point)	28	77.8 ± 9.2	80.6 ± 8.2	80.9 ± 9.0	0.008**	0.012* [b]	0.011* [b]	0.526
WHO-QOL26 score (mean ± SD point)	28	3.39 ± 0.43	3.51 ± 0.49	3.41 ± 0.45	0.701			
Frequency of dietary target behaviors (mean ± SD%)	30		67.5 ± 26.0	75.2 ± 24.7	0.095			
Frequency of exercise target behaviors (mean ± SD%)	30		48.7 ± 39.8	65.0 ± 35.1	0.043*			
Frequency of self-monitoring (mean ± SD%)	30	31.3 ± 38.6	75.2 ± 28.4	73.0 ± 30.7	0.000***	0.000*** [b]	0.000*** [b]	0.607
Frequency of drug intake and injection (mean ± SD%)	30	92.8 ± 19.8	99.7 ± 1.3	99.7 ± 1.8	0.001**	0.017*[b]	0.011* [b]	1.000

Note: BL: at the time of registration; P3M: 3 months after intervention; P6M: 6 months after intervention.
[a] Friedman test
[b] Wilcoxon signed rank test
*$p < 0.05$
**$p < 0.01$
***$p < 0.001$

Method of Analysis

Scr, eGFR, and Hb_{A1c} were compared at four separate time points: six months before the intervention, at the time of registration, and then three and six months after the intervention. The indicators except for Scr, eGFR, and Hb_{A1c} were compared at either three times (at the time of registration, and three and six months after the intervention) or two times (three and six months after the intervention). For indicators being compared at three and four time points, tests of normality were performed followed by the Friedman test, and data showing significant differences were analyzed using multiple comparisons. Indicators comparing two time points were analyzed using tests of normality. In addition, participants' and physicians' evaluations of the program were in percentages. For the statistical analyses, SPSS v. 17.0 was used and the significance level was set at $p < 0.05$.

Ethical Considerations

Approval was obtained from the ethics committees of Hiroshima University Hospital and the participating medical institutions. All participants received an explanation of the purpose of the study, program content, data collection methods, confidentiality, how the results would be published, the voluntary nature of their participation, and that they would be at no disadvantage even if they refused to cooperate. Written consent was obtained for all participants.

Results

Overview of the Participants

Of the 32 individuals who were eligible and consented to participate, we analyzed 30 who had completed the program. The mean age was 67.0 ± 4.3 years, 20 (66.70%) were men, and the duration of their diabetes was 15.1 ± 9.2 (2–30) years.

Evaluation of Program Effects

The sequential changes in each evaluation criterion six months before the intervention, at the time of registration, and three and six months after the intervention, excluding missing values, are shown in Tables 2 and 3.

For psychological indicators, sequential changes in self-efficacy showed statistical significance, and significant differences were confirmed between the time of registration, three months, and six months after the intervention. QOL showed a slight increase with time but was not statistically significant.

For self-management behaviors, the frequency of dietary target behavior increased, but the difference between times was not statistically significant. The frequency of exercise target behaviors increased significantly between three and six months after the intervention, but there were large inter-individual differences, as shown by the standard deviations. The frequency of self-monitoring increased immediately after the intervention,

Table 3
Changes in Clinical Indicators

Indicator	*N*	Sequential Comparison				
		6 Months before the Intervention (Pre)	At the Time of Registration (BL)	3 Months after the Intervention (P3M)	6 Months after the Intervention (P6M)	*p*-Value[a]
Scr (mean ± SD mg/dL)	25	1.67 ± 0.57	1.67 ± 0.53	1.70 ± 0.52	1.67 ± 0.57	0.367
eGFR (mean ± SD mL/min/1.73 m^2)	25	33.2 ± 11.6	33.9 ± 13.0	33.1 ± 13.3	34.8 ± 15.0	0.401
BUN (mean ± SD mg/dL)	30		30.7 ± 13.1	32.2 ± 14.3	30.8 ± 13.2	0.619
Hb (mean ± SD mg/dL)	26		12.3 ± 2.0	12.3 ± 1.8	12.6 ± 2.1	0.559
HbA1c (mean ± SD%)	26	6.6 ± 1.1	6.8 ± 1.5	6.3 ± 0.9	6.3 ± 0.9	0.044*
TP (mean ± SD g/dL)	22		7.2 ± 0.7	7.1 ± 0.7	7.2 ± 0.6	0.247
Alb (mean ± SD g/dL)	22		4.2 ± 0.3	4.2 ± 0.4	4.3 ± 0.4	0.294
K (mean ± SD mEq/L)	21		4.4 ± 1.1	4.6 ± 0.7	4.7 ± 0.6	0.132
P (mean ± SD mg/dL)	16		3.2 ± 1.1	3.4 ± 0.7	3.4 ± 0.6	0.849
TG (mean ± SD mg/dL)	16		113.2 ± 47.0	104.0 ± 48.2	105.5 ± 43.6	0.717
HDL cholesterol (mean ± SD mg/dL)	29		56.1 ± 25.7	51.7 ± 18.7	54.6 ± 22.3	0.561
LDL cholesterol (mean ± SD mg/dL)	29		97.7 ± 30.0	91.2 ± 28.7	96.4 ± 30.6	0.343
Systolic blood pressure (mean ± SD mmHg)	30		134.1 ± 18.4	128.4 ± 16.7	130.0 ± 14.4	0.588
Diastolic blood pressure (mean ± SD mmHg)	30		72.2 ± 11.5	69.2 ± 9.5	69.6 ± 10.0	0.442
BMI (mean ± SD)	30		25.5 ± 4.3	25.1 ± 4.6	25.4 ± 4.4	0.869

Note: Scr = serum creatinine, eGFR = estimated glomerular filtration, BUN = blood urea nitrogen, Hb = hemoglobin, TP = total protein, Alb = albumin, K = potassium, P = inorganic phosphate, TG = triglyceride, HDL = high density lipoprotein, LDL = low density lipoprotein, BMI = body mass index.
[a] Friedman test
* $p < 0.05$

and there were significant differences between the time of registration, three months, and six months after the intervention. The frequency of drug intake and injection showed significant differences in the sequential comparisons, but in the multiple comparisons, showed only an increasing tendency between the time of registration and six months after the intervention.

Regarding changes in clinical indicators, renal function showed no changes according to Scr, eGFR, and BUN levels across all four measurement times, indicating that renal function was maintained. Hb_{A1c} decreased significantly three and six months after the intervention compared with the time of registration. TP, Alb, K, P, TG, LDL-cho, and HDL-cho were maintained within the normal range and showed no significant changes. Blood pressure decreased after the intervention. No sequential change was found in BMI.

Evaluation of the Program

Participants' evaluations of the program are shown in Table 4; 95% of participants rated the program as "very good" or "good." Some participants said: "It is good to participate in this program because I tend to stay indoors when I am alone," and "It was very significant because I was able to reconfirm...my kidney function, the meaning of the numerical values on my test results, and the necessity of a healthy daily life." Regarding the face-to-face education sessions conducted by nurses, 95% of participants rated them "very good" or "good," and telephone education sessions and continued contact by nurses were rated "very good" or "good" by 85% of participants. However, 15% answered "hard to say" or "not good" and described that "the face-to-face education was better" and "it was difficult to have conversations by telephone due to hearing difficulties." While only three participants asked nurses to contact them by e-mail, they all answered "very good" or "good." Regarding the organization ability of the nurse in charge, 90% answered "very good" or "good." Finally, regarding the program's duration, 70% answered "hard to say," and 30% answered "long," "short," or "very short."

In the open-answer questions,

Table 4
Participants' Evaluations of the Program

Question items	Very Good *n* (%)	Good *n* (%)	Hard to Say *n* (%)	No Good *n* (%)	No Good at All *n* (%)
Participation in the program	8 (40)	11 (55)	1 (5)	0 (0)	0 (0)
Face-to-face education sessions conducted by nurses	11 (50)	8 (40)	1 (5)	0 (0)	0 (0)
Telephone education sessions and contact with nurses	6 (30)	11 (55)	2 (10)	1 (5)	0 (0)
E-mail contact with nurses (if chosen; $n = 3$)	2	1			
The system that there were nurse in charge	14 (70)	4 (20)	2 (10)	0 (0)	0 (0)
Program duration	Very long 0 (0)	Long 1 (5)	Hard to say 14 (70)	Short 4 (20)	Very short 1 (5)

Table 5
Primary Physicians' Evaluations of the Program

Question Items	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Necessity of the program for patients	Very necessary 2 (16.7)	Necessary 8 (66.6)	Hard to say 2 (16.7)	Not very necessary 0 (0)	Not necessary 0 (0)
Contributions to medical care	Very useful 2 (16.7)	Useful 7 (58.3)	Hard to say 2 (16.7)	Not very useful 1 (8.3)	Not useful 0(0)
Benefits patients	Yes, very much 6(50.0)	Yes 4 (33.4)	Hard to say 1 (8.3)	No, not very much 1 (8.3)	No 0 (0)
Patient education by nurses in charge	Very good 6 (50.0)	Good 4 (33.4)	Hard to say 2 (16.6)	Not very good 0 (0)	Not good 0 (0)
Cooperation with nurses in charge	Very good 3 (24.9)	Good 4 (33.4)	Hard to say 4 (33.4)	Not very good 1 (8.3)	Not good 0 (0)

participants described: "I was encouraged by the nurse setting the achievable goal for me together," and "Even if my data did not readily improve, the nurses thought patiently about how I improved it." These descriptions revealed that the relationships they had established with the nurses and the education allowed them to positively engage in self-management. Further, this suggested that nurses and participants cooperated in the development of the direction of the course and the methods of self-management, and such an approach benefitted participants by making them feel supported.

The evaluation of the program by primary physicians is shown in Table 5. Participants in this study were selected from 13 medical institutions that had agreed to participate out of the total 20 institutions. A questionnaire was distributed to the 17 primary physicians of the participants in this study, and answers were obtained and analyzed from 12 of them (response rate = 70.6%).

In describing the necessity of the program for patients, 83.3% of physicians answered "very necessary" or "necessary." Regarding its contribution to medical care, 75% answered "very useful" or "useful." On whether it benefitted patients, 83.4% answered "yes, very much" or "yes," and one physician stated: "I think that the program was useful for blood pressure and blood glucose control through weight loss and salt and protein restriction." In assessing how education sessions were conducted by the nurses in charge, 10 physicians (83.4%) answered that the nurses' performance was "very good" or "good." As for each physician's own cooperation with the nurses in charge, seven (58.3%) answered that it was "very good" or "good." Similarly, in the open-answer questions, physicians gave high evaluations of the reports detailing participants' educational and self-management statuses, general condition during the program period, and how nurses explained detailed test results to patients after their medical examinations. We talked with physicians who had not answered the questionnaire, and all had positive opinions about the program.

Discussion

Program Effects

In this study, self-efficacy and self-management behaviors improved due to educational intervention. Therefore, we considered our hypothesis to be supported in that self-management behaviors can be strengthened by improving patients' self-efficacy using

this intervention. Further, the processes that brought about this behavior modification are described as follows. First, the intervention helped motivate participants to manage their own treatment by linking renal function and laboratory test results with the subjective symptoms of decreased renal function, so participants could better understand what it felt like, and thus, avoid it. However, some participants were unable to manage their treatment at first due to other reasons, such as economic status and interpersonal stress, in addition to their lack of knowledge about decreased renal function. Nevertheless, even those participants were able to confront treatment in the subsequent sessions when these problems were identified and solved together with nurses. Second, the intervention helped participants achieve a smooth transition from a diabetic diet to a renal disease diet. The significance of protein and salt restriction in the protection of renal function was explained to the participants, and they were then taught methods for evaluating these effects and specific cooking methods. Further, we encouraged the utilization of peer support, such as learning how to cook renal diet-friendly foods in monthly cooking classes and exchanging information with other participants.

Changes in Clinical Indicators

No changes in renal function were observed in the participants. The American Diabetes Association (ADA) (2003) has reported that renal function decreases annually from 2 to 20 mL/min/1.73 m^2 for those at the stage of disease of our participants. As such, this is a limitation of our study because the data collection period only covered six months after registration in the program. However, the aims of this program – to improve self-management ability and lifestyle to minimize negative influences on renal function – were successfully achieved. Further, HbA_{1c} levels were reduced after the intervention. We considered the following as the likely causes of these effects: 1) participants' acquisition of self-management ability and improvements in their lifestyle, 2) the appeal to participants to reflect on their self-monitoring in the management of their disease, and 3) nurses' accurate feedback on the data of the participants to their physicians.

Evaluation of the Overall Program

As for participants' evaluation of the program, 95% felt very good or good about participating. In addition, it appeared from the open-answer descriptions that participants had established partnerships with the nurses in charge. However, some had hearing impairments or wished to receive face-to-face education sessions rather than telephone sessions, and thus, it is necessary to investigate more effective intervention methods in the future. In addition, many participants did not know about their own condition until participating in this program, suggesting the necessity of recruiting patients early in the stages of their disease for these interventions. Further, participants' primary physicians also felt the program was necessary for patients and gave high evaluations for the cooperation with nurses, which further indicates the usefulness of the program.

Limitations and Future Research

In this study, participants were selected from a limited number of areas and medical institutions, and their ages were high because they were insured under the Japanese national health insurance scheme. In addition, a power analysis revealed that the number of participants in this study was insufficient. The reasons for this small sample were that only 20 medical institutions agreed to participate in "a project for preventing the progression of diabetic nephropathy to more severe stages" proposed by Kure City; similarly, in these institutions, few patients had diabetic nephropathy, and it took time to negotiate with physicians about the registration of their patients. However, the positive results of this study suggest that future research investigating the effects of a self-management skills-acquisition program on patients with diabetic nephropathy will yield significant results when a sufficient sample size is used; similarly, a randomly assigned control group must be included in future studies.

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Additional Readings

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