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Abstract

The aim of this study was to clarify the factors influencing the dietary behavior of patients with diabetic nephropathy. One hundred twenty-two patients with type 2 diabetes were recruited from the outpatients of Okayama University Hospital in Okayama, Japan. We performed a cross-sectional study using a questionnaire including 206 items among 18 categories as follows:background factors, coping behavior (coping scale), degree of uncertainty in illness (uncertainty scale), and dietary behavior. The data were analyzed by correlation analysis, t-test, one-way analysis of variance, Pearson correlation analysis, and multiple regression analysis. We found that those patients with microalbuminuria alone tended to recognize more mild about their kidney status than those with macroalbuminuria and chronic renal failure. We also found that common factors influencing the dietary behavior of diabetic patients with and without nephropathy are as follows:1. coping with the problem (beta0.342, p0.01);2. anxiety about prognosis (beta0.344, p0.01);3. sex (beta0.234, p0.05);4. uncertainty regarding treatment (beta0.377, p0.01);5. negative coping (beta0.354, p0.01);and 6. employment status (beta0.367, p0.01). Coping and uncertainty in illness had a significant relation to positive support and lack of support. To maintain appropriate dietary behavior in diabetic patients, medical staff need to determine what the social supports are important for the patient, and also to ensure good communication among healthcare personnel as well as positive support for patients and families.

KEYWORDS: diabetic nephropathy, dietary behavior, coping, uncertainty in illness, social support

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Original Article

Influencing Factors for Dietary Behaviors of Patients with Diabetic Nephropathy

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The aim of this study was to clarify the factors influencing the dietary behavior of patients with diabetic nephropathy. One hundred twenty-two patients with type 2 diabetes were recruited from the outpatients of Okayama University Hospital in Okayama, Japan. We performed a cross-sectional study using a questionnaire including 206 items among 18 categories as follows: background factors, coping behavior (coping scale), degree of uncertainty in illness (uncertainty scale), and dietary behavior. The data were analyzed by correlation analysis, *t*-test, one-way analysis of variance, Pearson correlation analysis, and multiple regression analysis. We found that those patients with microalbuminuria alone tended to recognize more mild about their kidney status than those with macroalbuminuria and chronic renal failure. We also found that common factors influencing the dietary behavior of diabetic patients with and without nephropathy are as follows: 1. coping with the problem ($\beta = 0.342$, $p < 0.01$); 2. anxiety about prognosis ($\beta = -0.344$, $p < 0.01$); 3. sex ($\beta = -0.234$, $p < 0.05$); 4. uncertainty regarding treatment ($\beta = 0.377$, $p < 0.01$); 5. negative coping ($\beta = -0.354$, $p < 0.01$); and 6. employment status ($\beta = 0.367$, $p < 0.01$). Coping and uncertainty in illness had a significant relation to positive support and lack of support. To maintain appropriate dietary behavior in diabetic patients, medical staff need to determine what the social supports are important for the patient, and also to ensure good communication among healthcare personnel as well as positive support for patients and families.

Key words: diabetic nephropathy, dietary behavior, coping, uncertainty in illness, social support

Diabetic nephropathy is the leading cause of end-stage renal failure in developed countries. The clinical stages of diabetic nephropathy are classified as follows: stage 1, normoalbuminuria (urinary albumin/creatinine ratio (ACR) < 30 mg/g creatinene); stage 2, microalbuminuria (30 ≦ ACR < 300 mg/g creatinine); stage 3, macroalbuminuria (ACR ≧ 300 mg/g creatinine and/or persistent proteinuria with serum concentrations of creatinine < 1.2 mg/dl); stage 4, chronic renal failure (serum concentration of creatinine ≧ 1.2 mg/dl with proteinuria); and stage 5, under chronic dialysis therapy [1].

It has been considered that the progression of disease is irreversible at the stage of macroalbuminuria, but recent papers have suggested that remission or regression of diabetic nephropathy is possible at this

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stage in response to appropriate treatment [2, 3]. Although the primary treatment for diabetic nephropathy varies according to the stage of the disease, the basic treatment involves strict control of blood glucose levels and blood pressure.

Various studies, including a Diabetes Control and Complications Trial (DCCT), have shown that glycemic control is related to the development of nephropathy in patients with type 1 diabetes [4]. Furthermore, the UK Prospective Diabetes Study (UKPDS) [5] and Kumamoto study have shown that HbA1c values are related to the development of nephropathy in patients with type 2 diabetes. The Kumamoto study suggests that no progression of nephropathy takes place in patients whose HbA1c is below 6.5%. Diet therapy and exercise are fundamental lifestyle modifications that allow patients to adequately control their diabetes mellitus [6].

In order to prevent aggravation of nephropathy, the patients need to have a good understanding of their disease. Diabetic patients in an advanced stage of nephropathy need strict diet therapy, though it is well known that adopting an appropriate protein-restricted diet can be difficult. Recent studies of diabetic nephropathy cover a broad range of topics, including the effects of a protein-restricted diet [7–9] and the effects of drug treatment [10–21]. However, there have been few studies designed to examine how patients understand or cope with their clinical condition [22]. In order to prevent the progression of nephropathy, it is necessary to apply the appropriate support for cognitive features and coping behaviors of patients according to the stage of nephropathy.

The aim of this study was to clarify the factors related to the ability of patients to self-manage their disease condition. This study also aimed to identify whether patients accurately perceive their own stage of diabetic nephropathy and to clarify the factors that influence the dietary behavior of patients with diabetic nephropathy.

Materials and Methods

Patients. This cross-sectional study analyzed the data from 122 patients with type 2 diabetes mellitus. They were recruited from the diabetes outpatient clinic at Okayama University Hospital from August 2004 to March 2005. There were approximately 600 eligible patients that were referred by their physicians. We selected 200 patients aged 18 years or older who were capable of understanding the questionnaire content. Of the 200 patients selected, 166 agreed to participate. After excluding the patients with type 1 diabetes and drug-induced diabetes, 122 patients with type 2 diabetes were analyzed.

Methods. Patients were administered a 206-item questionnaire during their waiting time at visits. The estimated administration time for the questionnaire was 40 to 60 min. When patients found the surveys difficult to complete on their own, they were assisted by research staff members.

This study was approved by the Ethics Committee of the Okayama University Hospital. The subjects were informed verbally as well as in writing about the purpose of the study and its methods, the voluntary nature of their participation in the study, and the obligation of the researchers to maintain secrecy and not reveal any information that would identify any individuals. All patients were asked to sign a consent form that fulfilled the requirements of the Ethics Committee. Both the physicians and patients provided consent allowing us to obtain information from the patients' clinical records to confirm examination data and the presence of complications.

Clinical parameters. The following parameters were examined: sex, age, schooling history, family size, employment status, symptoms, duration of diabetes, hemoglobinA1c (HbA1c) levels, regimen of therapy, attendance at hospital education programs, clinical stage of nephropathy, awareness of microalbuminuria or macroalbuminuria, recognition of renal status, social support, symptom, knowledge of nephropathy, coping behavior (coping), degree of uncertainty in illness and dietary behavior.

We used the Jalowiec's coping scale (Japanese version) for chronic disease [23] and the MUIS-A scale created by Mishel [24] to measure the patients' feelings of uncertainty related to illness, dietary behavior, the symptoms scale, and the social support scale [25] (see Table 1).

Coping is defined as constantly changing cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person [26]. The dietary behavior scale was factor analyzed, and 6 items were extracted from the data. A higher score

Table 1 Scales used

scales		factors	items	Cronbach's alpha	range	mean ± S.D
coping (Jalowiec's coping scale Japanese version)	4	coping with the problem	5	0.78	0～20	11.7 ± 4.2
		expectations of treatment	3	0.51	0～12	5.3 ± 2.7
		negative coping	3	0.59	0～12	2.6 ± 2.7
		positive attitude	2	0.74	0～10	4.7 ± 2.1
uncertainty (MUIS-A scale)	4	difficulty in grasping physical condition	5	0.64	0～20	5.5 ± 3.6
		uncertainty regarding the treatment	3	0.67	0～12	4.1 ± 2.8
		anxiety about prognosis	3	0.67	0～12	4.8 ± 2.8
		difficulty in understanding clinical condition	5	0.56	0～20	5.1 ± 2.8
dietary behavior	1	balanced diet eats well, maintains adequate calorie intake, uses light seasoning, does not use dressing, restricts protein, eats vegetables at every meal	6	0.78	0～24	17.4 ± 4.6
symptom	1	constipation, fatigue, aches, decreased vision, foot pain, edema, decreased concentration, palpitations while walking	8	0.7	0～16	4.3 ± 3.1
social support	3	supportive healthcare staff	4	0.75	0～16	12.3 ± 2.8
		lack of support	4	0.73	0～16	1.9 ± 2.5
		positive support	10	0.92	0～40	23.0 ± 9.8
knowledge of nephropathy	1	≪A factor to aggravate nephropathy≫ diabetic control is bad, long medical history of diabetes, genetic factor, Hypertension, cigarette, therapeutic interruption, lack of dietary energy, ≪about diabetic nephropathy≫ stage of diabetic nephropathy, remisssion, regresion	10	0.74	0～10	5.2 ± 2.3

means that the patient's uncertainty is higher. Items for symptoms caused by diabetes and complications were reviewed; 8 items dealing with symptoms were extracted to determine symptom progression. A higher score means that the patient's symptoms were severe. The social support scale consisted of 14 items and was based on Starr's social support questionnaire with the addition of 4 items dealing with medical staff support. A higher score reflects greater support. The knowledge of nephropathy consisted of 10 items; a correct answer was counted as one point and a perfect score was 10 points.

Statistical analysis. For all scales, an exploratory factor analysis was subsequently performed, and the structure was checked using confirmatory factor analysis. Cronbach's alpha statistic was determined to assess internal consistency for all scales. The statistical analysis used the Student's *t*-test, one-way analysis of variance, and Pearson correlation' analysis of the background factors of the patients as well as the measures coping scale score, uncertainty scale scores, and scores of dietary behavior.

Multiple regression analysis was used to identify which factors affected the patients' dietary behavior. The independent variables were age, sex, coping, uncertainty in illness, social support, whether a physician pointed out the albuminuria (proteinuria), knowledge of nephropathy, family size, and employment status; and the dependent variable was dietary behavior.

Results

Background factors. Table 2 shows the patients characteristics. The patients included 57 men and 65 women. The mean age was 60.2 ± 12.5 years, and the mean duration of diabetes was 11.7 ± 9.9 years (1–40 years). The mean HbA1c was 7.16 ± 1.3%. Fifty-two of the subjects (42.6%) were employed. Educational background showed that 56 patients (45.9%) had attended vocational college or obtained higher education. Regarding family size, 19 patients (15.6%) lived alone, 41 (33.6%) lived with 1 person, and 62 (50.8%) lived with 3 or more persons. The patients were classified according to the nephropathy stage, as indicated in the clinical records; 72 (59.0%) had normoalbuminuria, 35 (28.7%) had microalbuminuria, 8 (6.6%) had macroalbuminuria, and 7 (5.7%) had chronic renal failure. The data regarding the participants' (patients) diabetic regimens at the time of the survey were obtained from the patients' charts. Twelve patients (9.8%) received dietary treatment; 60 (49.2%) oral medication; 31 (25.4%) insulin treatment; and 19 (15.6%) oral medication and insulin treatment. Seventy-one patients (58.2%) participated in hospital educational programs, 37 (30.3%) had not participated, and 14 patients (11.5%) didn't answer the question (see Table 2).

Recognition of kidney status of clinical nephropathy. Table 3 indicates how patients understood their clinical stage of nephropathy. An accurate understanding of the patients' disease condition was considered to be as follows; patients with normoalbu-

Table 2 Background factors (n = 122)

		number of patients	(%)
sex	male	57	(46.7)
	female	65	(53.3)
age	mean ± S.D.	60.2 ± 12.5 years	
schooling history	high school or lower education	65	(53.3)
	vocational college or higher education	56	(45.9)
	missing	1	(0.8)
family size	alone	19	(15.6)
	two	41	(33.6)
	more than three	62	(50.8)
emopoyment status	working	52	(42.6)
	not working	69	(56.6)
	missing	1	(0.8)
duration of diabetes	mean ± S.D.	11.7 ± 9.9 years	
HbA1c	mean ± S.D.	7.16 ± 1.3%	
treatment of regimen	diet therapy	12	(9.8)
	oral drug therapy	60	(49.2)
	insulin therapy	31	(25.4)
	oral drug+insulin therapy	19	(15.6)
attendance at hospital education programs	attend	71	(58.2)
	not attend	37	(30.3)
	unclear	14	(11.5)
complications	neuropathy	26	(21.3)
	diabetic retinopathy	39	(32.0)
	nephropathy	13	(10.7)
clinical stage of nephropathy	normoalbuminuria	72	(59.0)
	microalbuminuria	35	(28.7)
	overt proteinuria	8	(6.6)
	chronic renal failure	7	(5.7)

Table 3 Recognition of renal status based on of clinical stage

number of patinets (%) n=122

recognition of renal status	clinical stage of nephropathy			total
	normo aluminuria	micro albuminuria	macro proteinuria & chronic renal failure	
normal	67(93.0%)	25(73.5%)	7(46.7%)	99
return normally	3(4.2%)	4(11.8%)	1(6.7%)	8
not become worse by ones' effort	1(1.4%)	4(11.8%)	4(26.6%)	9
not avoid dialysis	0	0	3(20.0%)	3
need dialysis soon	1(1.4%)	0	0	1
does not understand	0	1(2.9%)	0	1
total	72(100%)	34(100%) 1 did not form	15(100%)	122

correct recognition

minuria thought that their kidneys were still good; patients with microalbuminuria believed that their kidneys could be restored; patients with macroalbuminuria knew that complications could be avoided; patients with chronic renal failure knew that dialysis could be avoided. Sixty-seven (93.0%) of 72 with normoalbuminuria, 8 (22.8%) of 35 with microalbuminuria, and 8 (53.3%) of 15 with macroalbuminuria and chronic renal failure had a good understanding of their clinical stage of nephropathy. Compared to the patients with macroalbuminuria and chronic renal failure, the patients with microalbuminuria believed their kidney stage was better than it really was ($p=0.053$).

Factors influencing dietary behavior. We found the following common factors influenced the dietary behavior of diabetic and diabetic nephropathy patients: 1. coping with the problem (diabetic patients/diabetic nephropathy: $\beta=0.478$, $p<0.001$/$\beta=0.342$, $p<0.01$), 2. anxiety about prognosis (diabetic patients/diabetic nephropathy: $\beta=-0.248$, $p<0.01$/$\beta=-0.344$, $p<0.01$); 3. male (diabetic patients/diabetic nephropathy: $\beta=-0.254$, $p<0.01$/$\beta=-0.234$, $p<0.05$) ($R^2=0.395$) (Figs. 1 and 2). Furthermore, we found that specific factors affecting the dietary behavior of diabetes nephropathy patients were 1. uncertainty regarding treatment ($\beta=0.377$, $p<0.01$); 2. negative coping ($\beta=-0.354$, $p<0.01$); 3. employment status ($\beta=0.367$, $p<0.01$), ($R^2=0.632$) (Fig. 2).

Relationship between background factors and the patient's coping, uncertainty in illness. 'Coping with the problem' had a significant relation to age ($r=0.36$, $p<0.001$), HbA1c ($r=-0.26$, $p<0.05$), and positive support ($r=0.21$, $p<0.05$), 'Negative coping' was significantly associated with 'lack of support' ($r=0.35$, $p<0.001$) and symptom ($r=0.32$, $p<0.001$) (Table 4).

'Uncertainty regarding the treatment' had a significant relation to family size (alone 5.5 ± 3.4/two 3.6 ± 2.6, $p<0.05$), 'lack of support' ($r=0.26$, $p<0.01$), 'positive support' ($r=-0.22$, $p<0.05$), and symptoms ($r=0.19$, $p<0.05$). 'Anxiety about prognosis' had a significant relation to attendance at the hospital education program (attend 4.3 ± 2.7/nonattendance 5.8 ± 2.6, $p<0.01$), clinical stage of nephropathy (normoalbuminuria 5.3 ± 2.7/microalbuminuria 3.9 ± 2.5, $p<0.05$), awareness of microaluminuria or macroalbuminuria (pointed/not pointed 4.0 ± 2.9/5.2 ± 2.7, $p<0.05$), recognition of renal status (normal 5.0 ± 2.7/abnormal 3.7 ± 3.0, $p<0.05$), and 'lack of support' ($r=0.33$, $p<0.001$) (Table 4).

Discussion

Of the 122 patients included in this study, 50 (41%) had nephropathy that ranged from microalbuminuria to chronic renal failure. In a previous study of 8,817 Japanese patients with diabetes mellitus, a similar proportion (42%) had diabetic nephropathy

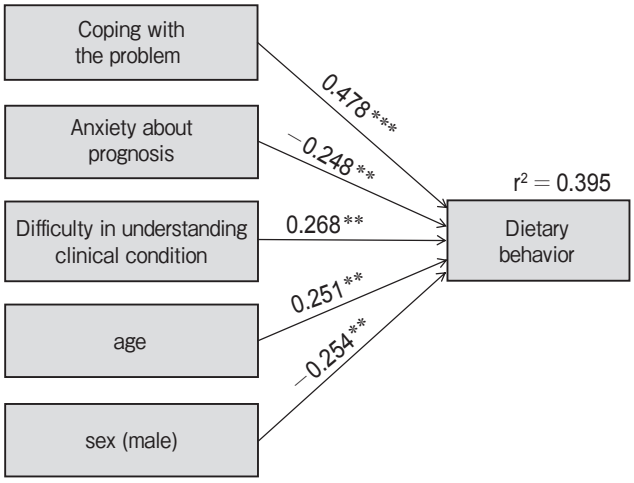

Fig. 1 Relationship among the patient's background factors, uncertainty, coping and dietary behavior patients of diabetes mellitus. n=122. $^{**}p<0.01$, $^{***}p<0.001$.

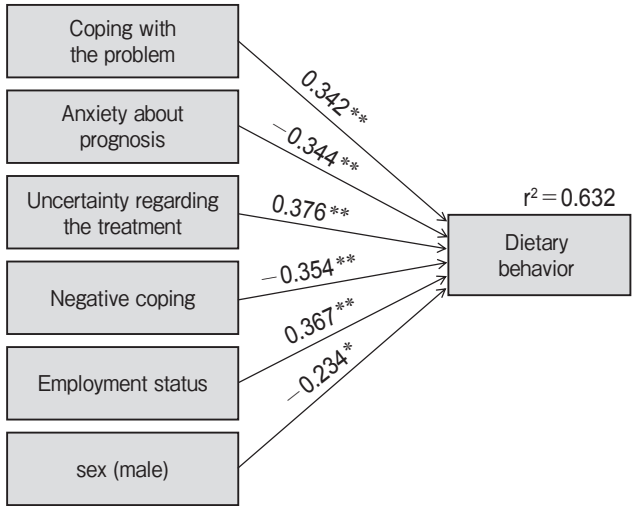

Fig. 2 Relationship among the patient's background factors, uncertainty, coping and dietary behavior patients of diabetic nephropathy. n=50. $^{*}p<0.05$, $^{**}p<0.01$.

Table 4 The relationship among background factors, coping scale, unceratinty scale and dietary behavior

		coping scale			
		coping with the problem	expectations of treatment	negative coping	positive attitude
sex (n=122)	male (n=58)	11.9±4.1	5.9±2.7*	2.4±2.7	4.5±2.1
	female (n=64)	11.5±4.4	4.9±2.6	2.7±2.7	4.8±2.2
age (n=122)		r=0.36***	r=0.23*	r=−0.02	r=0.18*
schooling history (n=121)	high school or lower education (n=65)	11.5±4.0	5.5±2.7	2.7±2.7	4.9±2.1
	vocational college or higher education (n=56)	11.9±4.5	5.2±2.8	2.5±2.7	4.4±2.1
famiry size (n=122)	alone (n=19)	11.0±4.4	5.8±2.8	3.8±2.6	4.3±2.6
	two (n=41)	12.4±4.6	5.2±2.8	2.1±2.8	4.8±2.1
	more than three (n=62)	11.4±4.0	5.3±2.6	2.5±2.6	4.7±2.0
employment status (n=121)	working (n=52)	10.9±4.2	5.2±2.4	2.3±2.3	4.3±2.2
	not working (n=69)	12.2±4.2	5.5±2.9	2.8±2.9	4.9±2.1
duration of diabetes		r=0.17	r=−0.03	r=−0.002	r=−0.006
HbA1c (n=122)		r=−0.26*	r=−0.21*	r=−0.12	r=−0.16
treatment of regimen (n=122)	diet/oral (n=72)	11.7±4.3	5.4±2.7	2.3±2.4	4.6±2.1
	insulin (n=50)	11.7±4.2	5.2±2.8	3.0±3.0	4.7±2.2
attendance at hospital education programs (n=108)	attend (n=71)	11.5±4.4	5.1±2.9	2.6±2.7	4.8±2.0
	not attend (n=37)	11.8±4.0	5.7±2.6	2.9±2.9	4.4±2.5
clinical stage of nephropathy (n=122)	normoalbumiuria (n=72)	11.7±4.6	5.2±2.6	2.9±2.9	4.5±2.3
	microalbuminuria (n=35)	11.6±4.0	5.8±2.9	2.3±2.5	4.7±1.7
	overt proteinuria/chronic renal failure (n=15)	11.7±3.4	4.7±2.8	1.7±1.5	5.1±2.4
awareness of microalbuminuria or macroalbuminuria (n=121)	pointed (n=47)	11.7±4.5	5.3±3.0	2.3±2.8	4.8±2.3
	not pointed (n=74)	11.7±4.1	5.4±2.6	2.7±2.6	4.6±2.0
recgnition of renal status (n=120)	normal (n=99)	11.6±4.3	5.3±2.6	2.7±2.8	4.5±2.1
	abnormal (n=21)	11.7±4.0	5.6±3.2	2.0±1.9	5.2±2.0
social support (n=122)	supportive healthcare staff	r=0.12	r=0.09	r=0.08	r=0.22*
	lack of support	r=−0.002	r=−0.17	r=0.35***	r=0.05
	positive support	r=0.21*	r=0.19*	r=−0.12	r=0.22
symptom (n=122)		r=−0.05	r=−0.30**	r=0.32***	r=0.01
knowledge of nephropathy (n=122)		r=0.1	r=0.09	r=−0.02	r=0.25**

$^{*}p<0.05$ $^{**}p<0.01$ $^{***}p<0.001$

[27].

Recognition of kidney status. The patients with microalbuminuria thought that the condition of their kidneys was better than it really was. It was difficult for the patients to recognize the factors relating to their renal state or to note and understand its relation to albuminuria. One of the reasons is the lack of somatic experiences or symptoms in almost all patients with microalbuminuria [28]. Another reason is that patients with microalbuminuria did not require a strict restriction of dietary protein intake, and it was difficult to understand the seriousness of their condition even if the patient received an explanation of their kidney status.

Coping. Our investigation showed 'coping with the problem' had a positive effect and 'negative coping' had a negative effect on dietary behavior. Similar to previous studies, our results show that glycemic control is better for patients who use active rather than emotional coping behaviors [29].

Uncertainty in illness. 'Uncertainty regarding the treatment' had a positive effect and 'anxiety about prognosis' had a negative effect on dietary behavior. In other words, when the level of "anxiety about prognosis" is high, patients feel that self-management does not lead to better health. Therefore, they are less likely to attempt dietary behavior.

There have been some reports that patients with a poor prognosis can maintain hope for improvement when there is uncertainty about the therapies for the disease[22]. Uncertainty in illness may make the patients more adherent to their therapies because they have a hope for improvement. Our results are similar to those reported previously.

When patients have uncertainty, they eventually associate uncertainty with "risk" or with "opportunity." When patients are faced with a risk, they take actions to control negative emotions, gather information, and exercise caution to alleviate uncertainty in illness [24]. Mishel insists that even if uncertainty in illness leads to an increase in chronic anxiety, there can also be positive effects [30]. Mishel reports that when a person is faced with an uncertain situation, his or her coping behaviors become limited, and that the recognition of uncertainly has marked effects on human behaviors [31]. Although excessive amounts of information contribute to stress and lead to uncertainty in illness, it is necessary to give information at the appropriate times to facilitate self-care and to prevent the progress of the disease [32, 33]. Medical staff should assess their patients' perceptions of uncertainty in illness before they offer knowledge of nephropathy to patients. Interventions provided by medical staff are effective in helping patients to modify their behavior, as reported in the Diabetes Prevention Program (DPP) research program [34].

Social support. 'Coping with the problem' had a significant correlation with positive support, and 'negative coping' had a significant correlation with lack

Table 4 Continued from opposite page

uncertainty scale				
difficulty in grasping physical condition	uncertainty regarding the treatment	anxiety about prognosis	difficulty in understanding clinical condition	dietary behavior
5.6 ± 2.8	4.2 ± 2.5	5.1 ± 2.8	5.3 ± 2.6	16.9 ± 4.4
5.4 ± 4.3	4.0 ± 3.0	4.6 ± 2.7	4.8 ± 2.9	18.0 ± 4.7
r = −0.08	r = 0.01	r = −0.01	r = 0.27**	r = 0.22*
5.9 ± 3.8	4.4 ± 3.0	4.8 ± 2.7	5.1 ± 2.7	17.3 ± 4.9
5.1 ± 3.4	3.8 ± 2.5	4.8 ± 2.8	4.8 ± 2.7	17.6 ± 4.2
8.4 ± 4.5**	5.5 ± 3.4*	5.5 ± 2.5	4.6 ± 3.3	14.7 ± 6.1**
4.3 ± 3.0 *	3.6 ± 2.6	4.1 ± 2.7	5.2 ± 2.6	19.0 ± 4.0
5.4 ± 3.3	4.0 ± 2.6	5.1 ± 2.8	5.1 ± 2.7	17.2 ± 4.1
5.7 ± 3.5	4.1 ± 2.9	4.8 ± 2.8	4.7 ± 2.8	16.5 ± 4.9*
5.3 ± 3.7	4.1 ± 2.7	4.7 ± 2.7	5.2 ± 2.5	18.2 ± 4.3
r = 0.14	r = 0.15	r = 0.09	r = −0.02	r = −0.04
r = 0.17	r = 0.09	r = 0.045	r = −0.11	r = −0.19*
4.5 ± 3.4***	4.1 ± 2.7	4.6 ± 2.8	5.2 ± 2.8	17.6 ± 4.5
7.0 ± 3.4	4.1 ± 2.9	5.1 ± 2.7	4.8 ± 2.7	17.2 ± 4.7
5.5 ± 3.6	3.9 ± 2.7	4.3 ± 2.7**	4.6 ± 2.5	17.8 ± 5.0
5.6 ± 4.0	4.6 ± 3.1	5.8 ± 2.6	5.5 ± 2.5	17.8 ± 3.9
5.5 ± 3.7	4.2 ± 2.8	5.3 ± 2.7*	3.6 ± 2.1	17.4 ± 4.8
5.6 ± 3.7	4.1 ± 2.9	3.9 ± 2.5	3.0 ± 2.2	17.5 ± 4.8
5.2 ± 3.5	3.7 ± 2.3	4.8 ± 3.1	3.0 ± 2.1	17.5 ± 3.3
5.4 ± 4.2	4.1 ± 3.3	4.0 ± 2.9*	4.7 ± 2.8	17.5 ± 5.5
5.6 ± 3.2	4.1 ± 2.4	5.2 ± 2.7	3.4 ± 2.1	17.4 ± 4.0
5.3 ± 3.4	4.1 ± 2.7	5.0 ± 2.7*	5.1 ± 2.8	17.2 ± 4.7
5.6 ± 4.2	4.0 ± 3.4	3.7 ± 3.0	4.8 ± 2.7	18.7 ± 4.1
r = 0.09	r = −0.09	r = −0.09	r = −0.33**	r = 0.05
r = 0.42***	r = 0.26**	r = 0.33***	r = 0.07	r = −0.19
r = −0.2*	r = −0.22*	r = −0.04	r = −0.09	r = 0.12
r = 0.44***	r = 0.19*	r = 0.15	r = 0.04	r = −0.04
r = −0.06	r = −0.17	r = −0.15	r = −0.12	r = 0.2*

*$p < 0.05$ **$p < 0.01$ ***$p < 0.001$

of support. Positive support had a significant negative correlation with 'uncertainty regarding the treatment,' and lack of support had a significant correlation with 'uncertainty regarding the treatment' and 'anxiety about prognosis.' In other words, social support did not have a direct influence on dietary behavior, but it had an influence on coping and uncertainty in illness.

In a prospective study of type 2 diabetic adults, it was found that a decrease in social support is predictive of a worsening of blood glucose control over time [35, 36]. Support from one's spouse has been found to be the most important source of support during illness episodes, although disruptions in the marital relationship often occur when a partner has a chronic illness [37]. To maintain appropriate dietary behavior of diabetic patients, the medical staff must be aware of the social supports available to the patient, and it is necessary to offer support for family members as well.

Conclusions. The present findings indicate that information regarding the stage of nephropathy is important in getting patients to alter their lifestyle. Uncertainty has direct negative and positive effects on dietary behaviors; These effects appear to be largely dependent on how patients perceive uncertainty. It is particularly important to moderate anxiety for patients with diabetic nephropathy. To improve uncertainty in illness, 'negative coping', and 'coping with the problem', the medical staff need to be aware of the social supports available to the patient, and it is necessary to ensure good communication among healthcare personnel and positive support for patients and families.

Limitations. In order to verify the present model and to establish more concrete assistance measures, it will be necessary to conduct a prospective interventional study.

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