

# Development of a Resilience Scale for adult-onset type 2 diabetes patients - Evaluation of reliability and validity

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## Abstract

The objective of this study was to develop a Resilience Scale (RS) associated with treatment in adult-onset type 2 diabetes patients, and to examine its reliability and validity. Before developing the RS, an RS draft was prepared, and then 65 items were carefully selected to develop an original version. To complete the RS, a survey using the 65-item original RS was administered to 162 type 2 diabetes patients in an outpatient setting. To examine criterion-related validity, the Sense of Coherence (SOC) scale and General Self-Efficacy Scale (GSES) were also administered. The results confirmed construct validity and criterion-related validity.

Next, items with a floor or ceiling effect in the 65-item original RS were eliminated, items with low communality were also eliminated, and factor analysis was performed using maximum likelihood-promax rotation. This yielded six factors and 27 items. The cumulative contribution (proportion of variance explained) for these six factors and 27 items was 55.31%. The six factors were: "feeling that people close to me can be entrusted with my treatment," "pride in effectively learning," "exercise," "pride in making daily effort in treatment," "resolve not to remain in a bad situation," and "the importance of keeping feet tidy." Cronbach's  $\alpha$  coefficient for the 27-item RS was 0.898, and these were moderate to high ( $\alpha = 0.706$  to  $0.885$ ) among all subscales, thus showing high internal consistency. The 27-item RS was significantly positively correlated with the SOC and GSES, thus establishing criterion-related validity. However, no significant correlation between the 27-item RS and HbA1c (NGSP) was observed. This completed the 27-item RS.

## Key words

resilience, type 2 diabetes mellitus, self-care, sense of coherence, diabetes education

## Introduction

The goal of diabetes education is to prevent complications and motivate patients to take an active role in self-care. The three mainstays of diabetes therapy, namely diet, exercise, and drug therapy, are an intricate part of the patient's daily life. This has an impact on family members and others close to the patient. Moreover, maintaining self-care can create an emotional burden<sup>1-4)</sup> associated with various hardships<sup>5)</sup>. To cope, diabetic patients must improve their self-management ability and exert effort on their

own behalf in an active and positive manner<sup>6)</sup>. Self-management is the ability to face issues and actively solve problems. However, coping with various hardships involves not only constructive positive behavior, but also the ability to minimize negative influences and deal flexibly with problems. The concept of resilience comes close to explaining this ability.

Resilience means the ability to endure and flexibly deal with problems without becoming discouraged. Resilience refers to the "process of, capacity for, and

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outcome of successful adaptation despite challenging or threatening circumstances"<sup>7)</sup>. In the field of psychiatry, Rutter<sup>8)</sup> refers to resilience as "persons having a defense mechanism against psychiatric disorders in the face of adversity". Resilience is "not part of an individual's personality, but rather an individual trait that changes with influence and proper support from others"<sup>9)</sup>. Therefore, this can be adapted for use in diabetes education.

Moreover, as an approach to reducing the emotional burden associated with self-care behavior in diabetic patients, diabetes education has focused on resilience, which may have promise for reducing this emotional burden.

Research on resilience in diabetes education has included the efficacy of diabetes education programs incorporating the concept of resilience<sup>10)</sup>, the relationship between resilience and diabetes outcomes<sup>11)</sup>, and resilience resources and coping in diabetic patients<sup>12)</sup>. However, none of these studies have measured the effects of resilience in diabetes. Outside the field of diabetes, resilience scales have been developed in psychology and education<sup>13-15)</sup>.

Resilience of type 2 diabetes patients undergoing diet, exercise, and drug therapies has not been clarified. Meanwhile, type 1 diabetes is largely juvenile-onset. As such it must be examined from two perspectives; namely, the achievement of development tasks and resilience development. In this study, we focused on adult-onset type 2 diabetes patients.

We conducted this study based on the thinking that adult-onset type 2 diabetes patient resilience influenced previous diabetes education, and patient involvement in his/her treatment as his/her ability. The patient's perspective of blood glucose control outcome influences the correlation between control of blood glucose and resilience, such as the patient's consideration of the reasons for insufficient blood glucose control as external (inappropriate medication or lack of cooperation from others) or internal (importance of self-care and self-confidence). The progression of complications from diabetes causes internal struggle in patients requiring self-care, which may influence resilience. For this reason we selected patients without serious complications as subjects for this study.

In evaluating diabetes education, healthcare professionals feel and have reported that patients who receive such education develop the ability to follow treatment regimens<sup>16-17)</sup>. However, objective demonstration of these effects has been difficult. Therefore, this study aimed to develop a Resilience Scale (hereinafter referred to as RS) for adult-onset type 2 diabetes patients using the concept of resilience.

### **Study objective**

The objective of this study is to develop a RS in association with treatment in adult-onset type 2 diabetes patients, and to evaluate the reliability and validity of this RS.

### **Definition of terms**

Patient resilience in diabetes treatment is the capacity to minimize negative influence and flexibly deal with various problems and hardships in diabetes control and treatment. Resilience is an individual trait which may change as a result of diabetes education, and develop through proper education.

### **Study Methods**

#### 1. Creation of an original RS

##### 1) Creation of a RS draft

To develop an original RS for adult-onset type 2 diabetes patients, the content validity of 77 items on a RS draft was examined. These 77 items included factors and characteristics identified using a qualitative descriptive method based on an assessment sheet compiled from semi-structured interviews with 80 diabetic patients who were hospitalized for diabetes education.

The subjects were 80 patients aged between 21 and 78 ( $56.8 \pm 14.2$  years of age), including individuals with nephropathy and vision impairment hospitalized for diabetes education. Semi-structured interviews were conducted to assess patient problems and goals, and ability and strength after one week of hospitalization for diabetes education. Questionnaire items consisted of treatment behaviors, attitude about and acceptance of being diabetic, and treatment knowledge and skill. Interview duration was one to two hours. The results of the assessment were shared with diabetes treatment team members.

##### 2) Creation of an original RS

To ensure content validity, a survey was conducted

by mail of 12 specialists in diabetes nursing who were asked to what degree they agreed with, or reasons they did not agree with, each item on the RS draft. The 12 specialists were all Certified Diabetes Educators of Japan (CDEJ) of the Certification Board for Diabetes Educators in Japan and 8 of them were also Certified Nurses the Nursing Association. All 12 specialists in diabetes nursing responded to the survey sent by mail concerning the 77-item RS draft for use in adult-onset type 2 diabetes patients (effective response rate: 100%). Based on the comments by the specialists, 12 items for which agreement was not obtained were deleted, and the specific wording of items thought to be difficult to understand was revised. To further examine content validity, the now 65-item RS was administered to six patients who were hospitalized for diabetes education, and based on their comments, the wording was revised. Finally, content validity was examined by three researchers in diabetes nursing to finish the 65-item original RS for adult-onset type 2 diabetes patients (Table 1). The RS consists of 65 items under six concepts, which are "support from people around the patient", "favorable states of treatment", "strong pride in behavior and continuity of treatment behavior", "treatment behavior and intention for diabetes control", "experience of past and successful improvement", "state of hopefulness". A 5-point Likert scale was used for responses, ranging from "1" (does not apply) to "5" (strongly agree). The scale scores were calculated, and a higher score indicated better resilience.

### 3) Creation of a complete version

#### (1) Subjects

Questionnaires were distributed to 177 patients and 170 valid responses were collected (response rate: 96.0%). Eight patients were excluded from analysis due to incomplete questionnaire forms (effective response rate: 91.5%). The time required to complete the questionnaire ranged from 20 to 90 minutes per person.

Patients were referred, based on the criteria described below, by physicians at outpatient diabetes clinics from two facilities (one university hospital and one public hospital). The investigators (researchers in this study) discussed study participation with and obtained consent from these patients. Inclusion criteria

were: type 2 diabetes and aged from 20 to 75 years. Exclusion criteria were: severe diabetes including triopathy or atherosclerosis, markedly decreased visual acuity, physical pain, emotional lability, or any patient whom the physician felt might be adversely affected by responding to the survey. Because greater patient reliance on others as visual acuity deteriorates may significantly decrease self-esteem, patients with visual complications were excluded as subjects. Patients with nephropathy of stage IV onward were also excluded as subjects because physical changes, difficulty in accepting dialysis therapy, and burden might have increased.

Patients visited the outpatient diabetes clinic every 1 to 2 months. Before or after medical examination, investigators sought patient consent for participation, and distributed a questionnaire survey to those who expressed consent. The questionnaire survey was self-administered. If requested, however, an inquiry survey was performed. Patients who did not have sufficient time for the survey at the clinic were asked to complete it at home and return it by mail to the investigators.

#### (2) Data collection

The questionnaire was a self-administered survey that included the RS (original) for adult-onset type 2 diabetes patients, the short-form Sense of Coherence (SOC) scale, the General Self-Efficacy Scale (GSES), and demographic data. Using a descriptive survey completed by the patient the demographic data collected included age, work, duration of diabetes, type of complications, treatment regimen, and hospitalization.

SOC: SOC is the ability to deal with stress. This is a salutogenic model proposed by Antonovsky<sup>18)</sup>. A short-form 13-item SOC (SOC-13) was created by Antonovsky, and a Japanese version was translated by Yamazaki<sup>19)</sup>. SOC has three subscales: sense of comprehensibility, sense of manageability, and meaningfulness. The reliability and validity of the SOC-13 have been confirmed<sup>20)</sup>. SOC includes the confidence of individuals in their past and future that enables them to exist with people and in the environment surrounding them. Resilience originally emphasized the internal ability of individual patients only. However, because resilience in diabetes

Table 1. Original Resilience Scale for adult-onset type 2 diabetes patients (65 items)

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1	I want to know about my physical condition.
2	Learning is a challenge, and that challenge is enjoyable.
3	Once I make up my mind, I am self-confident that I can do something.
4	I am able to acquire knowledge.
5	I have sufficient general practical knowledge about diabetes.
6	I have been hospitalized to learn about diabetes.
7	I excel in how I learned about diabetes and in the amount I learned about it (books, internet, asking others).
8	I am aware of diabetes complications and can learn about them.
9	I can imagine my physical condition.
10	When I don't feel well, I see my doctor to find out what is wrong.
11	I make ideal self-care behavior a habit.
12	I don't feel burdened by my treatment (including diet and exercise).
13	I comply with my treatment (diet, exercise, and drugs).
14	I am knowledgeable about my drug treatment.
15	I have valuable experience with hypoglycemia.
16	I know how to prevent and manage hypoglycemia.
17	I can deal with hypoglycemia if it happens.
18	I can inject myself and take medications.
19	I am able to make adjustments, including diet and exercise, based on my blood glucose levels.
20	I try to follow my diet as instructed.
21	I recognize when I have done something wrong (drank too much, ate too much, or snacked between meals).
22	I can tell others that I have given up drinking alcohol.
23	I put into effect my salt intake restrictions.
24	I weigh myself regularly.
25	I'm in an environment where I can adjust my own meals.
26	I have successfully improved my diet.
27	I have taken steps to improve my diet and am proud of this.
28	I can rely on someone to prepare my meals.
29	I make it a habit to exercise.
30	I know how many steps I take and how long I exercise from an objective perspective, for example, by using a pedometer.
31	I am keenly aware of my physical condition.
32	I exercise on a regular basis.
33	I have the experience of feeling the benefits of exercising.
34	I have hobbies and do volunteer activities that don't bore me even after a long time.
35	I am confident that I exercise within the limits of my ability.
36	I know what severe athlete's foot and foot gangrene are.
37	My feet are in good condition.
38	I pay attention to my feet.
39	I'm concerned about changes in my blood glucose levels.
40	I have a target level for blood glucose control.
41	I know how to monitor my blood sugar (for example, self-monitoring of blood glucose, being aware of symptoms).
42	I want to make good use of my blood glucose levels in my treatment.
43	I am interested in testing.
44	I am interested in my body.
45	I am able to understand the test results.
46	I can perform self-monitoring of blood glucose.
47	My family is concerned about me.
48	I can discuss anything with my family.
49	A family member always prepares my meals.
50	I feel like "I can entrust everything to my family".
51	My whole family put into effect my salt intake restrictions.
52	My family is involved in my treatment.
53	My family has learned about diabetes related to my treatment.
54	My family helps whenever necessary.
55	My family knows how to prevent and deal with hypoglycemia.
56	I tell others about my treatment.
57	People around me help me with treatment.
58	I feel that I have carried out the best treatment possible.
59	When in a powerless condition, I want to improve things.
60	I understand explanations from medical staff.
61	I try to keep my mood upbeat.
62	I can reflect on bad situations (when a test result such as my blood glucose level was bad, when I did not feel physically well, or when I ate too much).
63	I would like to achieve my ideal weight so that my results improve.
64	I would like to learn about my current status and how to improve things.
65	I hope to live a long time and fulfill my role in the family.

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treatment is closely associated with patient confidence in their living environment, we applied SOC to examine criterion-related validity.

The GSES: GSES is a sense of self-efficacy based on a social learning theory proposed by Bandura<sup>21)</sup>. The GSES was developed by Sakano and Tojo, and its reliability and validity have been confirmed<sup>22)</sup>. GSES consists of three factors, "positive action," "anxiety toward failure," and "ability of evaluating on society." It determines the effort to accomplish tasks and long-term tolerance to difficult situations. Therefore, we considered GSES similar to resilience, and applied it to the examination of criterion-related validity.

Glycemic control: Glycemic control based on HbA1c levels (National Glycohemoglobin Standardization Program: NGSP) was reviewed from electronic medical records after obtaining patient consent. Glycemic control status over the previous 6 months, including the survey time, was assessed. Because resilience was unlikely to change within a 6-month period, and a 6-month HbA1c level shows the control of blood glucose level in each subject, HbA1c over the above period was assessed.

### (3) Analysis method

#### <1> Reliability

To examine factor analysis and factor structure of the RS for adult-onset type 2 diabetes patients, exploratory factor analysis was performed. Reliability was examined with Cronbach's  $\alpha$  coefficient for internal consistency.

#### <2> Validity

To examine criterion-related validity, Pearson's correlation coefficient was calculated between the RS and the SOC-13 scale and the GSES scale.

#### <3> Correlation with glycemic control

Mean HbA1c levels (NGSP) over the 6-month period prior to and including the survey were calculated. Pearson's correlation was calculated between mean HbA1c levels and each factor on the RS for adult-onset type 2 diabetes patients.

Statistical analysis was performed using SPSS ver.21, and  $p > 0.05$  was regarded as being statistically significant in all tests.

#### (4) Survey period

February to July 2012.

#### (5) Ethical considerations

The voluntary nature of participation in the survey, protection of privacy, and confidentiality of data were explained verbally and in writing to each patient. Written informed consent was obtained from each patient. This study was approved by the Ethics Committee of the Kanazawa University Graduate School of Medical Science (approval number 320).

## Results

### 1. Patient characteristics

Patient age ranged from 36 to 75 years, with a mean age of  $62.3 \pm 9.04$  years. Duration of diabetes ranged from 3 months to 40 years, with a mean duration of  $11.8 \pm 8.9$  years. Approximately half of the subjects were working (53.1%), twenty-nine percent had complications. Seventy-two percent of the subjects used oral glucose lowering medications, twenty-nine percent were treated with insulin therapy with overlapping responses. Sixty-eight percent were hospitalized for education (Table 2). Investigation required 20 to 90 minutes per subject.

### 2. Evaluation of factor structure by factor analysis

Before factor analysis, 13 of the 65 items with ceiling or floor effects were excluded. Six items for which, depending on the patient, there might be no applicable response choice were excluded beforehand. For example, "experience of hypoglycemia" in patients not taking drug therapy and "I can rely on someone to prepare my meals" in patients who prepared meals themselves were excluded. Factor analysis was performed for the remaining 46 items. Six factors were extracted based on the slope of the scree plot, and while excluding 19 items with communality  $< 0.35$  and pattern matrix  $< 0.35$ , factor analysis proceeded. Factor analysis by maximum likelihood solution-promax rotation was performed with these items, resulting in six factors and 27 items.

The cumulative contribution (proportion of variance explained) of the six factors extracted by factor analysis was 55.31% (Table 3).

### 3. Factor names after factor analysis and explanation of factor content

Factor I is "feeling that people close to me can be entrusted with my treatment". This factor signifies that a patient receiving diabetes treatment feels that their family and others close to them; think about

Table 2. Patient characteristics		(n=162)	
		n	%
Age (years)	<39	5	3.0
	40 ~ 49	11	6.6
	50 ~ 59	30	18.7
	60 ~ 69	84	51.9
	70 ~ 75	32	19.8
Gender	Male	102	62.3
	Female	61	37.7
Working	Yes	87	53.1
	No	76	46.9
Diabetes duration (years)	<5	40	24.6
	5 - <10	34	21.2
	10 - <15	31	19.2
	15 - <20	16	9.8
	>20	40	24.6
	Unknown	1	0.6
Complications	Yes	48	29.6
	No	112	69.1
	Unknown	2	1.2
Type of complications*	Retinopathy	19	11.7
	Nephropathy	5	3.1
	Neuropathy	26	16.0
	Angina pectoris	15	9.3
	Atherosclerosis	16	9.9
Self monitoring of blood glucose	Yes	83	51.2
	No	79	48.8
Hypoglycemia	Yes	83	51.2
	No	79	48.8
Treatment regimen*	No drugs for diabetes	10	6.2
	Oral glucose lowering drug	117	72.0
	Insulin	48	29.2
	Incretin-related drug	35	21.7
Household	Live with others	148	91.4
	Live alone	14	8.6
Meal preparation*	For oneself	80	49.4
	Spouse	86	53.1
	Children	9	5.6
	Parent	11	6.8
	Son or daughter-in-law	2	1.2
Hospitalized for education	Yes	111	68.5
	No	51	31.5
History of hospitalization	No. of times		
	1	79	71.2
	2	22	19.8
	3	7	6.3
	>4	2	1.8
	Unknown	1	0.9

\* Overlapping responses: n = 162 is 100%

Table 3. Factor analysis with promax rotation, maximum likelihood solution of the Resilience Scale for adult-onset type 2 diabetes patients (27 items) (n=162)

	I	II	III	IV	V	VI	communality
<b>Factor I : Feeling that people close to me can be entrusted with my treatment</b>							
My family is involved in my treatment.	.859	-.128	-.007	.099	.022	.014	.767
My family has learned about diabetes related to my treatment.	.804	.092	.040	-.056	.038	-.122	.645
People around me help me with treatment.	.791	-.032	-.146	.105	-.034	.061	.660
I feel like "I can entrust everything to my family".	.741	-.193	-.017	.012	-.042	.119	.537
My family knows how to prevent and deal with hypoglycemia.	.685	.313	.078	-.166	-.082	-.078	.554
My family is concerned about me.	.643	-.046	.069	.118	.074	-.010	.528
<b>Factor II : Pride in effectively learning</b>							
I excelled in how I learned about diabetes and in the amount I learned about it.	-.176	.767	.070	.052	.046	-.081	.580
I am knowledgeable about my drug treatment.	-.005	.733	-.032	-.126	.025	.041	.477
I am aware of diabetes complications and can learn about them.	.037	.696	-.029	.173	-.080	-.001	.609
I can image my physical condition.	-.072	.642	.013	.106	-.034	.110	.517
I have sufficient general practical knowledge about diabetes.	-.000	.593	-.030	.143	.021	.116	.526
I know how to prevent hypoglycemia.	.289	.576	.041	-.270	.119	-.074	.405
I want to make good use of my blood glucose levels in my treatment.	-.053	.430	-.213	.232	.177	.029	.378
<b>Factor III : Exercise</b>							
I exercise on a regular basis.	.003	.068	.903	-.057	-.083	-.045	.765
I make it a habit to exercise.	-.065	-.031	.747	.089	.000	.085	.644
I know how many steps I take and how long I exercise from an objective perspective, for example, by using a pedometer.	-.048	-.112	.670	.098	.146	-.024	.510
I am confident that I exercise within the limits of my ability.	.098	-.008	.604	.013	-.010	.085	.450
<b>Factor IV : Pride in making daily effort in treatment</b>							
I have taken steps to improve my diet and am proud of this.	-.009	-.022	.005	.878	-.098	.023	.709
I have successfully improved my diet.	-.017	.026	.035	.613	.247	-.195	.484
I put into effect my salt intake restrictions.	.068	-.025	.050	.530	.186	-.122	.381
I make ideal self-care behavior a habit.	.017	.277	.067	.526	-.160	.070	.531
I am able to make adjustments, including diet and exercise, based on my blood glucose levels.	.107	.133	.041	.522	-.127	.008	.397
<b>Factor V : Resolve not to remain in a bad situation</b>							
I can reflect on bad situations	-.099	.079	.026	-.081	.953	.018	.861
When in a powerless condition, I want to improve things.	.194	-.016	-.046	.054	.434	.120	.357
I feel that I have carried out the best treatment possible.	.118	-.015	.050	.228	.386	.067	.388
<b>Factor VI : Importance of keeping feet tidy</b>							
I pay attention to my feet.	.011	.009	.055	-.052	.161	.776	.717
My feet are in good condition.	-.002	.091	.027	-.103	-.030	.736	.529
	variance explained <sup>a)</sup>	7.13	2.44	1.48	2.06	1.02	0.81
	proportion of variance explained <sup>a)</sup>	26.40	9.04	5.48	7.62	3.79	2.98
	cumulative proportion of variance explained <sup>a)</sup>	26.40	35.44	40.92	48.54	52.33	55.31
Factor correlation	I	II	III	IV	V	VI	
	I						
	II	.312					
	III	.204	.233				
	IV	.378	.496	.433			
	V	.309	.248	.162	.391		
	VI	.317	.332	.345	.432	.336	

a) variance explained, proportion of variance explained, and cumulative proportion of variance explained values indicate before rotation.

the patient's treatment, are willing to learn about diabetes, and show concern for the patient. More so than specific "support" for treatment, this signifies a heartfelt belief that family members and other close people involved in the treatment, in whom trust has been placed, share in the feelings of the diabetic patient receiving treatment. It is also a feeling that those who are close are supportive in the processes and experiences involved in the patient's treatment.

Factor II is "pride in effectively learning ". This factor signifies a willingness to learn about treatment to control diabetes, namely, glycemic control and prevention of the onset or worsening of complications; and the feeling that what has been learned can be applied reliably to controlling diabetes. What this second factor reflects is not only practical knowledge acquired during daily treatment, but also acquiring new knowledge about diabetes necessary for treatment, including drug therapy and how to prevent hypoglycemia. The practical and medical knowledge acquired by application in daily life is integrated, and through learning becomes understood. This status of "being able to image one's physical condition" comes from a firm belief in oneself, namely, a sense of pride as a result of having learned about treatment.

Factor III is "exercise". This factor reflects the habit of exercising and being active. This does not include self-confidence about exercise therapy, but only to actually exercising and being active.

Factor IV is "pride in making daily effort towards treatment". Daily treatment includes self-care behavior with regard to diet, exercise, and salt restriction. This signifies pride in continuing these efforts as daily habits and being capable of making adjustments.

Factor V is "resolve not to remain in a bad

situation". This included the items "I can reflect on bad situations", "when in a powerless condition, I want to improve things", and "I feel that I have received the best treatment possible". A bad situation may refer to when a test result such as blood glucose is high, when one is not feeling physically well, or when eating too much. This factor signifies an ability to reflect on bad situations, trying to have a more positive frame of mind, and resolving to do what is necessary not to remain in a poor physical or emotional condition.

Factor VI is the "importance of keeping feet tidy". This factor signifies that diabetic patients care for their feet as a part of their body and recognize that keeping them in good condition is important.

#### 4. Evaluation of reliability

##### 1) Internal consistency

Cronbach's  $\alpha$  coefficient was calculated for the subscales of the RS (27 items) for adult-onset type 2 diabetes patients. Internal consistency was moderate to high ( $\alpha = 0.706$  to  $0.885$ ), Cronbach's  $\alpha$  coefficient for all 27 items was  $0.898$  (Table 4).

##### 5. Evaluation of criterion-related validity

##### 1) Correlation with SOC

Pearson's correlation coefficient was calculated between the total RS (27 items) and the total SOC score. There was a significant positive correlation ( $r = 0.420$ ,  $p < 0.01$ ). Pearson's correlation coefficients were also calculated between the RS factors and total SOC. Except for factor III "exercise," there were significant positive correlations with each factor ( $r = 0.252$ - $0.412$ ,  $p < 0.01$ ) (Table 5).

##### 2) Correlation with GSES

There was weak positive correlation ( $r = 0.245$ ,  $p < 0.01$ ) between the total RS (27 items) and the GSES. Pearson's correlation coefficients were calculated

Resilience Scale	$\alpha$ coefficient
I Feeling that people close to me can be entrusted with my treatment (six items)	.885
II Pride in effectively learning (seven items)	.843
III Exercise (four items)	.832
IV Pride in making daily effort in treatment (five items)	.797
V Resolve not to remain in a bad situation (three items)	.706
VI Importance of keeping feet tidy (two items)	.753
Resilience Scale (27 items)	.898

Table 5. Pearson's correlation coefficient between Resilience Scale (27 items) and SOC, GSES (n=162)

Resilience Scale	SOC	GSES
I Feeling that people close to me can be entrusted with my treatment	.412**	.221**
II Pride in effectively learning	.252**	.187
III Exercise	.128	.126
IV Pride in making daily effort in treatment	.310**	.151
V Resolve not to remain in a bad situation	.290**	.099
VI Importance of keeping feet tidy	.292**	.136
Resilience Scale (27 items)	.420**	.245**

\*\* p < 0.01

between the RS subscales and GSES. There was significant positive correlation ( $r = 0.221$ ,  $p < 0.01$ ) with RS factor I "feeling that people close to me can be entrusted with my treatment". No other significant correlations with other factors were observed (Table 5).

### 3) Correlation with glycemic control (HbA1c)

The 27-item RS was not significantly correlated with HbA1c. In addition, there were no significant correlations between the RS subscales and HbA1c. Among the scale items, there was low, but significant negative correlation ( $r = -0.225$ ,  $p < 0.05$ ) with "when in a powerless condition, I want to improve things".

## Discussion

This study focused on resilience as a concept, including adaptation, self-esteem, self-efficacy, and appropriate interpersonal relations, which is related to treatment and self-care in diabetic patients. We developed a RS associated with diabetes education in adult-onset type 2 diabetes patients, and the reliability and validity of this RS were examined.

### 1. Factor structure of the RS for adult-onset type 2 diabetes patients and significance of each factor and resilience

Factor I of the RS, a "feeling that people close to me can be entrusted with my treatment," comprised the factor items "my family is involved in my treatment," "my family has learned about diabetes related to my treatment," "people around me help me with treatment.," "I feel like" I can entrust everything to my family," "my family knows how to prevent and deal with hypoglycemia," and "my family is concerned about me." This factor is similar to "patients are aware of support from others," as

described in resilience studies to date. The content of this factor is similar to environmental factors ("I Have" factor) that promote the development of resilience, as reported by Grotberg<sup>26)</sup>. Although resilience in these subscale items did not include instrumental cooperation such as meal preparation, it did signify that family and other close persons entrusted with treatment were closely involved in treatment, had a deep understanding of the patient's treatment, supported the patient's autonomy, and accompanied patients along their treatment journey.

Factor II, "pride in effectively learning", comprised the subscale items "I excel in how I learn about diabetes and in the amount I learned about it." "I am knowledgeable about my drug treatment", "I am aware of diabetes complications and can learn about them", "I can image my physical condition", "I have sufficient general practical knowledge about diabetes", "I know how to prevent hypoglycemia", and "I want to make good use of my blood glucose levels for my treatment". These items reflect self-confidence and self-assurance, the attitude about learning, and the patient's experience in having received inpatient education. This is influenced by diabetes education received at a medical institution. Rutter<sup>8)</sup> mentions the ability to act positively as a condition for resilience to function. This ability is related to degree of problem solving skills, self-esteem, and self-efficacy. This is similar to Factor II "pride in effectively learning" as shown in our study. Therefore, learning about diabetes treatment increases resilience.

Factor III, "exercise", comprised the subscale items "I exercise on a regular basis", "I make it a habit to exercise", "I know how many steps I take and how long I exercise from an objective perspective, for example, by using a pedometer", and "I am confident

that I exercise within the limits of my ability". The content relates to exercise therapy and indicates the habit of regularly exercising. Self-confidence and self-assurance of diabetic patients related to exercise therapy were not included, and the relationship between exercise and glucose monitoring was not expressed. Glycemic control is greatly influenced by diet and drug therapy; however, a sense of glycemic control through exercise therapy was difficult to acquire. Among subscales, this factor was not significantly correlated with either SOC or GSES. Regardless of glycemic control status, exercise is thought to contribute to a sense of stability in diabetic patients.

Factor IV, "pride in making daily effort in treatment," comprised the subscale items "I have taken steps to improve my diet and am proud of this," "I have successfully improved my diet," "I put into effect salt intake restrictions", "I make ideal self-care behavior a habit", and "I am able to make adjustments, including diet and exercise, based on my blood glucose levels." This factor is associated with the results of ideal self-care behavior, including diet, exercise, and drug therapy. Integrated self-assessment of treatment by patients is a characteristic. This subscale was significantly correlated with SOC, including significant correlations with each SOC subscale: sense of comprehensibility, sense of manageability, and meaningfulness. This factor indicates that patients feel they can comprehend and manage their behavior regarding diet, exercise, and drug therapy, and that they believe this is meaningful for treatment. These are all integrated as an aspect of resilience.

Factor V, "resolve not to remain in a bad situation", comprised the subscale items "I can reflect on bad situations", "when in a powerless condition I want to improve things", and "I feel that I have carried out the best treatment possible". In contrast to other factors expressing positive self-care behavior and thoughts, this factor indicates the resolve to no longer remain in a bad situation and to overcome feelings of discouragement. Rutter<sup>8)</sup> mentioned proper management of adverse circumstances as a condition for resilience to function. Rather than from coping with a specific stressor, he described this as

being learned through coping with many stresses. Adverse consequences in diabetes treatment include poor glycemic control and the development of complications. Factor V signifies being prepared to cope and not remain in a bad situation despite facing adversity. This is explained by Rutter's definition.

Factor VI, "importance of keeping feet tidy" comprised the subscale items "I pay attention to my feet", and "my feet are in good condition". This resilience is related to foot care. The feet are the only aspect of diabetes that the patient can visualize externally and gauge the results of self care from. Because diabetes is an internal disorder, the patient may have difficulty understanding and establishing an image of what is happening internally. This factor reflects patients perceiving their body through their feet. Sherrington expresses this as a sensation of oneself; namely, proprioception of the self<sup>27)</sup>. Proprioception is a feeling of what is comfortable through the body<sup>28-29)</sup>. This resilience relates to awareness of body sensation through the feet.

## 2. Reliability of the RS

Cronbach's  $\alpha$  coefficient for the RS (27 items) for adult-onset type 2 diabetes patients was 0.898, and the  $\alpha$  coefficients for the six factors domains extracted by factor analysis were 0.706 to 0.885. These results confirmed high internal consistency of the RS (27 items).

## 3. Validity of the RS

To examine criterion-related validity, Pearson's correlation coefficient was calculated between the RS (27 items) for adult-onset type 2 diabetes patients and total SOC. This showed significant positive correlation ( $r = 0.420$ ,  $p < 0.01$ ). Resilience in adult-onset type 2 diabetes patients includes the capability, resources, and strengths utilized in treatment. Resilience was significantly positively correlated with a sense of coherence (coherence) measured by the SOC scale; namely, higher resilience regarding treatment was associated with a higher sense of coherence (stress coping ability), thus confirming validity.

In addition, to examining criterion-related validity, correlation between the total RS (27 items) and the GSES was analyzed. This showed weak positive correlation ( $r = 0.245$ ,  $p < 0.01$ ). Increased self-

efficacy is said to promote appropriate changes in behavior and improve the ability to cope<sup>23-24</sup>). Based on the positive correlation between the total RS and GSES score, validity was also confirmed.

Meanwhile, regarding the RS subscales, factor I "feeling that people close to me can be entrusted with my treatment" was significantly positively correlated with the total GSES ( $r = 0.221, p < 0.01$ ); however, there were no significant correlations with other factors. The existing study shows that substantial social support improves self-efficacy<sup>25</sup>). Factor I "feeling that people close to me can be entrusted with my treatment" is similar to social support, so that factor I was related to GSES.

#### 4. The comparison of the 27-item RS and the 65-item original RS

The 65-item original RS consists of "support from people around the patient", "favorable state of treatment", "strong pride in behavior and continuity of treatment behavior", "treatment behavior and intention for diabetes control", "experience of past and successful improvement", and "state of hopefulness". The 27-item RS extracted similar concepts within theoretical assumptions, such as "feeling that people close to me can be entrusted with my treatment", "pride in effectively learning", "exercise", "pride in making daily effort in treatment", "resolve not to remain in a bad situation", and "importance of keeping feet tidy". On the 27-item RS, "Factor II: pride in effectively learning" was correlated with "Factor IV: pride in making daily effort in treatment". These two factors had pride in common; therefore, it was possible for these two factors to be included as one. However, learning is different from behavior in daily treatment; therefore, we emphasized clinical meaning and separated them. Compared with the construct of the 65-item original RS, these were distinguished at the behavioral level; however, the construct of the 27-item RS united behavior on treatment, intention, and emphasis on treatment. The construct of the 27-item RS integrated the ability to endure and to flexibly deal with problems without becoming discouraged by resilience.

#### 5. RS and HbA1c levels, a diabetes control index

Although the RS factors were not significantly correlated with HbA1c levels, and the subscale item

"when in a powerless condition, I want to improve things" showed significant, negative correlation ( $r = -0.225, p < 0.05$ ). Resilience includes abilities separate from the positive active behavior signified by the factor "resolve not to remain in a bad situation". Therefore, although self-care behavior demonstrating positive action is related to glycemic control<sup>30</sup>), resilience was not significantly related to glycemic control. However, negative correlation with one subscale item does suggest that resilience may influence glycemic control.

#### 6. Application in nursing practice

The cumulative contribution (proportion of variance explained) of the six factors extracted by factor analysis was 55.31%, the six factors reflect diabetes education, and can be used for education with focus placed on these six factors. In addition, nursing intervention is possible using the six factors considering duration and acceptance of being diabetic. Diabetic patient responses to the RS indicate how strengths and abilities related to treatment are perceived. Understanding the levels of responses to each item on the RS enables nurses to intervene in care.

#### 7. Study limitations and future outlook

The subject composition is biased because of the use of two facilities in a limited area.

In diabetes education to date, there have been no objective indicators that include coping with negative situations. With the RS, however, the effects of diabetes education may be objectively assessed, and the RS captures changes in patients. It is desirable to increase the number of subjects in the study, as well as the reliability and practicality of the scale utilizing the cross-validation for confirming between different group and test-retest method for confirming of stability.

### **Conclusions**

1. Factor analysis of the RS for adult-onset type 2 diabetes patients identified six factors and 27 items. These factors were: "feeling that people close to me can be entrusted with my treatment," "pride in effectively learning," "exercise," "pride in making daily effort in treatment," "resolve not to remain in a bad situation," and "importance of keeping feet tidy."

Cronbach's  $\alpha$  coefficient for the RS (27 items) was 0.898, thus showing high internal consistency.

2. The total RS was significantly positively correlated with SOC ( $r = 0.420$ ,  $p < 0.01$ ) and positively correlated with GSES ( $r = 0.245$ ,  $p < 0.01$ ). This established criterion-related validity.

This completes development of the 27-item RS for adult-onset type 2 diabetes patients.

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## 成人発症2型糖尿病患者の療養に伴うレジリエンス尺度の開発と信頼性・妥当性の検討

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### 要 旨

本研究の目的は、成人発症2型糖尿病患者の療養に伴うレジリエンス尺度を作成し、信頼性・妥当性を検討することである。尺度作成に先立ち、成人2型糖尿病患者のレジリエンス尺度試案を作成し、次いで原案となる65項目を精選した。

レジリエンス尺度完成には外来通院中の2型糖尿病患者162名を対象にレジリエンス尺度原案65項目調査を行った。基準関連妥当性の検討のため、Sense of coherence(SOC)およびGeneral Self-Efficacy Scale (GSES)を調査した。その結果、構成概念妥当性、基準関連妥当性が確認された。レジリエンス尺度原案65項目の床効果と天井効果が認められた項目を削除し、さらに共通性が低い項目を削除しながら最尤法プロマックス回転による因子分析を行った結果、6因子27項目となった。因子分析で抽出した6因子27項目の累積寄与率は55.31%であった。6因子は信頼して療養を任せることができる身近な人を感じる、有効な学習をしていることへの自負、運動をしている、日々の療養に努力していることへの誇らしさ、よくない状態にとどまらない構え、大事な足をきれいに保っている、であった。レジリエンス尺度(27項目)のCronbach's  $\alpha$  係数は0.898であり、それぞれのサブスケールにおいても高い内的整合性が確認された ( $\alpha = 0.706 \sim 0.885$ )。レジリエンス尺度 (27項目) と SOC および GSES は有意な正の相関を示し、基準関連妥当性が得られた。一方、レジリエンス尺度 (27項目) と HbA1c 値は有意な相関は示されなかった。27項目のレジリエンス尺度が完成した。