



Coping styles associated with glucose control in individuals with type 2 diabetes mellitus

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Keywords

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ABSTRACT

Aims/Objectives: Glycemic control varies according to stress level and the efficacy of control measures, affecting the outcomes of diabetes. Although detailed coping styles have not been well studied in patients with type 2 diabetes mellitus, problem-focused coping strategies are believed to be related to better control of blood glucose. Associations between coping profiles/dimensions and blood glucose control were examined in individuals with type 2 diabetes.

Materials and Methods: The participants included 503 Japanese patients (mean age 63.9 ± 12.6 years) with type 2 diabetes. The average glycated hemoglobin A1c (HbA1c) levels were calculated from HbA1c levels measured more than four times within the 12 months before the assessment. Coping profiles were assessed using the Brief Scale for Coping Profile. Lifestyle factors were also included in the analyses.

Results: Factors other than age were not associated with HbA1c levels in patients who used insulin. Conversely, habitual alcohol consumption, single status, the adaptive emotion-focused coping dimension, and changing mood and changing one's point of view profiles were associated with HbA1c levels.

Conclusions: These findings suggest that adaptive emotion-focused coping supports glycemic control in type 2 diabetes patients who do not use insulin. Additional studies using a longitudinal design are required to further examine the relationships between psychological factors and glycemic control.

INTRODUCTION

Type 2 diabetes mellitus is a worldwide epidemic¹. The high prevalence of type 2 diabetes, which is a lifestyle-related disease, has resulted in a substantial socioeconomic burden, and type 2 diabetes can increase the risks of serious physical and mental health issues². It has been shown that glycemic control improves the health of type 2 diabetes patients³, and associations between multiple factors, such as self-efficacy or stress, and diabetes outcomes, such as body mass index and metabolic control, have been examined intensively⁴. Self-management in patients with type 2 diabetes is known to be burdensome, because it requires self-discipline and perseverance to adapt everyday activities (exercise, diet, rest) to the requirements of medication use and the control of glucose levels⁵. In particular,

insulin therapy might be related to increased psychological distress⁶. Thus, the coping strategies used to manage diabetes play important roles in the maintenance and psychosocial adjustment to diabetes^{7–9}.

Traditionally, two primary concepts of coping dimensions have been considered, including a problem-focused coping dimension (making a plan of action) and an emotion-focused coping dimension (seeking emotional support)^{10,11}. Problem-focused coping is related to better metabolic control, emotional status and overall adjustment in patients with diabetes¹², whereas emotion-focused coping is related to poor adjustment and adherence to health regimens in chronically ill patients¹³.

In addition, emotion-focused coping has recently been divided into two dimensions¹⁴. Approach-oriented emotion-focused coping might be considered as an attempt to strategize or energize oneself as a result of a stressful environment,

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whereas traditional emotion-focused coping represents an attempt to ignore the problem altogether; the former consists of adaptive emotion-focused coping strategies, and the latter of maladaptive emotion-focused coping strategies. Both emotion-focused coping approaches alleviate the negative effects of stressors, but only adaptive emotion-focused coping techniques lead to better adjustment to the stressful situation. Thus, there are three types of coping strategies, namely, problem-focused, adaptive emotion-focused and maladaptive emotion-focused coping strategies. In several studies of patients with diabetes, problem-reducing actions have been shown to be positively associated with health-related quality of life and metabolic control¹⁵. Indeed, this coping strategy is central to many diabetes self-management programs¹⁶. The use of approach- and problem-focused coping has been associated with better overall adjustment (effect size 0.13), although adjustment was found to not be associated with adaptive emotion-focused (effect size 0.10) and maladaptive emotion-focused (effect size -0.07) coping strategies¹⁵. Consistently, it is reported that glycated hemoglobin A1c (HbA1c) is not associated with problem-focused (effect size 0.002), adaptive emotion-focused (effect size 0.13) and maladaptive emotion-focused (effect size 0.01) coping strategies¹⁵. Nevertheless, few studies have examined the potential links between the three coping dimensions and glycemic control among Japanese individuals with type 2 diabetes.

In the present study, we aimed to investigate the relationship between coping profiles and glycemic control among individuals with type 2 diabetes. We hypothesized that a problem-focused and adaptive emotion-focused coping strategy would be associated with better glycemic control.

METHODS

Participants

The protocol of this study was approved by the ethics committee of the Graduate School of Medicine, Hirosaki University, and we obtained written informed consent from all participants before entering the present study. This study included 728 of 945 individuals with type 2 diabetes who received treatment for at least 1 year at the Department of Endocrinology and Metabolism at the Hirosaki University Hospital and agreed to participate in the survey. The remaining 217 patients were excluded due to moderate-to-severe dementia (85 patients), blindness (23 patients), severe mental illness (such as bipolar disorder and schizophrenia [68 patients]) and withdrawal (41 patients). The severity of dementia was assessed by the doctors overseeing each patient.

In total, 611 of the 728 patients returned the questionnaires, and 503 (67.4%) had complete questionnaires. Blood samples were collected routinely from these patients four times per year and were analyzed for the HbA1c level. A total of 408 patients were taking oral hypoglycemic drugs, and 267 were using insulin; both oral hypoglycemic drugs and insulin were used by 211 patients. A total of 39 patients did use not any medication. We obtained demographic data, such as age, sex, smoking, alcohol

consumption, exercise habits, marital status, solitary living and medical histories, of the patients using questionnaires and medical records (Table 1).

We used the Japanese version of the Center for Epidemiologic Studies Depression Scale to evaluate the severity of depressive symptoms in all patients^{17,18}. The Center for Epidemiologic Studies Depression Scale is a 20-item self-reported measure that focuses on the depressive symptoms the patient experienced during the week before completing the questionnaire. The maximum score is 60, with higher scores indicating more severe depressive symptoms.

Table 1 | Participant characteristics

Variables	
Sex	
Male, <i>n</i> (%)	304 (60)
Female, <i>n</i> (%)	209 (40)
Age (years)	63.9 ± 12.5
Body mass index (kg/m ²)	25.1 ± 4.2
HbA1c (%)	7.1 ± 0.9
Smoking habit	
Yes, <i>n</i> (%)	79 (15.7)
No, <i>n</i> (%)	425 (84.3)
Habitual alcohol consumption	
Yes, <i>n</i> (%)	160 (32)
No, <i>n</i> (%)	343 (68)
Exercise frequency	
None, <i>n</i> (%)	253 (50)
Once a week, <i>n</i> (%)	30 (6)
2–3 times a week, <i>n</i> (%)	79 (16)
4–5 times a week, <i>n</i> (%)	45 (9)
Almost every day, <i>n</i> (%)	95 (19)
Single	
Yes, <i>n</i> (%)	149 (30)
No, <i>n</i> (%)	354 (70)
Living alone	
Yes, <i>n</i> (%)	64 (13)
No, <i>n</i> (%)	439 (87)
Insulin use (<i>n</i> = 504)	
Yes, <i>n</i> (%)	267 (53)
No, <i>n</i> (%)	236 (47)
CES-D	13.3 ± 7.6
Coping dimensions	
Problem-focused	14.4 ± 4.8
Adaptive emotion-focused	15.8 ± 4.4
Maladaptive emotion-focused	20.6 ± 3.1
Coping profiles	
Active solution	6.3 ± 2.6
Seeking help for a solution	8.1 ± 2.8
Changing mood	8.1 ± 2.6
Emotional expression involving others	11.1 ± 1.6
Avoidance and suppression	9.5 ± 2.1
Changing one's point of view	7.6 ± 2.4

Values show the mean ± standard deviation. CES-D, Center for Epidemiologic Studies Depression Scale; HbA1c, glycated hemoglobin A1c.

We evaluated coping behaviors using The Brief Scale for Coping Profile (BSCP). The BSCP consists of 18 items rated on a 4-point Likert scale^{19–22}. We asked patients to check a box indicating the frequency with which they used the strategy in an item in stressful situations using a scale from 1 (almost never) to 4 (very often). The original study validated the BSCP and determined that the Cronbach's reliability coefficients in workers ranged from 0.66 to 0.75¹⁹. We confirmed that the Cronbach's reliability coefficient for our participants was 0.835, suggesting sufficiently high internal consistency. The scale evaluates the ability to cope with stressful daily environments using six subscales: "Active solution," "Seeking help for a solution," "Changing mood," "Changing one's point of view," "Avoidance and suppression" and "Emotional expression involving others." These six subscales reflect three coping dimensions: problem-focused coping dimensions ("Active solution" and "Seeking help for a solution"), adaptive emotion-focused coping dimensions ("Changing mood" and "Changing one's point of view") and maladaptive emotion-focused ("Avoidance and suppression" and "Emotional expression involving others") coping dimensions. A high score on a certain subscale indicates that the respondent frequently selected that coping method.

Statistical analysis

In the present study, comparisons of several factors among three groups based on HbA1c levels were carried out using ANOVA and χ^2 -tests. The data are presented as the mean \pm standard deviation. Univariate linear regression analyses with forced entry were carried out to examine the correlations between glycemic control (average HbA1c level) and several factors, such as age, sex, body mass index, smoking habits, alcohol consumption habits, presence of other people in the household, exercise habits and scores for the six coping profiles or three coping dimensions.

We used the following dummy variables: male = 0, female = 1; absence of spouse = 0, presence of spouse = 1; living alone = 0, living with family = 1; absence of smoking = 0, presence of smoking = 1; absence of alcohol consumption = 0, presence of alcohol consumption = 1; no exercise = 1, exercise once a week = 2, exercise 2–3 days per week = 3, exercise 4–5 days per week = 4, and exercise almost every day = 5; and insulin non-use = 0, insulin use = 1. A *P*-value < 0.05 indicated statistical significance. SPSS software for Windows, version 25.0 (IBM Corporation, Armonk, NY, USA), was used for all analyses. A *P*-value < 0.05 was regarded as significant. Bonferroni's corrections were applied for multiple testing for the six coping profiles or three coping dimensions. A *P*-value < 0.0167 and < 0.0083 was regarded as significant for the six coping profiles and three coping dimensions, respectively.

RESULTS

The HbA1c level was correlated with age, body mass index, habitual alcohol consumption and insulin use in univariate linear regression analyses (Table 2). Because insulin use had

strong effects on this association, we stratified the data based on insulin use or non-use. There were no differences in factors other than HbA1c between patients who used insulin and those who did not use insulin (Table 3). Factors other than age were not associated with HbA1c levels in patients who used insulin. In contrast, habitual alcohol consumption, single status, the adaptive emotion-focused coping dimension, and changing mood and changing one's point of view profiles were associated with HbA1c levels (Table 4).

DISCUSSION

The results of the present study show for the first time that the adaptive emotion-focused coping dimension is inversely associated with HbA1c levels in type 2 diabetes patients, but only in those who did not use insulin. Therefore, psychological therapy focusing on stress management using adaptive emotion-focused coping, such as cognitive-behavioral therapy, might improve glycemic control.

Problem-reducing actions have been shown to be positively related to health-related quality of life and metabolic control in several studies of diabetes patients¹⁵. Problem-focused coping is associated with adjustment, anxiety and depression, but not with glycemic control¹⁵. This coping strategy is central to many diabetes self-management programs.¹⁶ We failed to find a strong association between the problem-focused

Table 2 | Univariate linear regression results for factors including coping dimensions and profiles associated with glycemic control among type 2 diabetes patients

	<i>r</i>	Significance
Sex	0.034	0.450
Age	-0.134	0.002*
BMI	0.090	0.042*
Smoking	-0.007	0.876
Alcohol	0.106	0.018*
Exercise frequency	-0.056	0.212
Single	0.052	0.244
Living alone	-0.004	0.924
CES-D	-0.001	0.976
Insulin use	0.329	<0.000*
Coping dimensions		
Problem-focused	-0.027	0.550
Adaptive emotion-focused	-0.083	0.062
Maladaptive emotion-focused	-0.025	0.572
Coping profiles		
Active solution	0.018	0.684
Seeking help for a solution	-0.062	0.164
Changing mood	-0.044	0.330
Emotional expression involving others	-0.016	0.726
Avoidance and suppression	-0.026	0.566
Changing one's point of view	-0.085	0.058

*Statistically significant. BMI, body mass index; CES-D, Center for Epidemiologic Studies Depression Scale.

Table 3 | Characteristics of participants who used insulin and did not use insulin

Variables	Insulin users	Insulin non-users	Significance
Sex			
Male, <i>n</i> (%)	150 (56)	144 (61)	0.261
Female, <i>n</i> (%)	117 (44)	92 (39)	
Age (years)	63.9 ± 12.1	63.8 ± 13.0	0.98
Body mass index (kg/m ²)	24.9 ± 4.0	25.3 ± 4.5	0.236
HbA1c (%)	7.3 ± 0.9	6.8 ± 0.7	0.000*
Smoking habit			
Yes, <i>n</i> (%)	35 (13)	44 (19)	0.085
No, <i>n</i> (%)	232 (87)	192 (81)	
Habitual alcohol consumption			
Yes, <i>n</i> (%)	78 (29)	82 (35)	0.218
No, <i>n</i> (%)	189 (71)	154 (65)	
Exercise frequency			
None, <i>n</i> (%)	139 (52)	114 (48)	0.056
Once a week, <i>n</i> (%)	18 (7)	12 (6)	
2–3 times a week, <i>n</i> (%)	39 (15)	40 (17)	
4–5 times a week, <i>n</i> (%)	25 (9)	20 (8)	
Almost every day, <i>n</i> (%)	46 (17)	49 (21)	
Single			
Yes, <i>n</i> (%)	77 (29)	72 (31)	0.730
No, <i>n</i> (%)	190 (71)	164 (69)	
Living alone			
Yes, <i>n</i> (%)	34 (13)	30 (13)	0.938
No, <i>n</i> (%)	233 (87)	206 (87)	
CES-D	13.3 ± 7.0	13.2 ± 8.3	0.897
Coping dimensions			
Problem-focused	14.6 ± 5.0	14.1 ± 4.6	0.209
Adaptive emotion-focused	15.7 ± 4.2	15.9 ± 4.6	0.800
Maladaptive emotion-focused	20.5 ± 3.0	20.7 ± 3.1	0.663
Coping profiles			
Active solution	6.4 ± 2.7	6.1 ± 2.4	0.065
Seeking help for a solution	8.1 ± 2.9	8.0 ± 2.7	0.830
Changing mood	8.1 ± 2.7	8.0 ± 2.5	0.621
Emotional expression involving others	11.1 ± 1.6	11.2 ± 1.5	0.396
Avoidance and suppression	9.4 ± 2.1	9.5 ± 2.1	0.611
Changing one's point of view	7.6 ± 2.4	7.7 ± 2.4	0.589

Values show the mean ± standard deviation. *Statistically significant. CES-D, Center for Epidemiologic Studies Depression Scale; HbA1c, glycated hemoglobin A1c.

coping dimension and glycemic control. Univariate linear regression showed a significant correlation between the problem-focused coping dimension and glycemic control in patients who did not use insulin, but not in insulin users, although Bonferroni's correction showed no correlation between the problem-focused coping dimension and glycemic control regardless of insulin use. In addition, the seeking help for a solution profile correlated positively with glycemic control, which is opposite to the direction shown in a previous study^{23,24}. We have no clear explanation for this discrepancy. First, the sample size might not have been large enough to allow detection of the association. Second, the mentality of the participants might have been different

between former studies and this study, because Japanese people traditionally do not prefer active coping strategies.

We failed to find an association between the maladaptive emotion-focused coping dimension and poor glycemic control. One possible explanation for this discrepancy is that the present study included participants who were older, and had more severe type 2 diabetes and longer illness durations. Some studies have suggested that avoidant coping strategies are related to perceived well-being in situations that are difficult to control²⁵, and that avoidance is positively related to adjustment in the short-term (i.e., immediately after diagnosis)²⁶. In addition, the discrepancy might be attributable to cultural differences. In the Aomori region of Japan, where the present study was carried

Table 4 | Univariate linear regression results for factors including coping dimensions and profiles associated with glycemic control among type 2 diabetes patients who did not use insulin and who used insulin

	Insulin non-users (n = 236)		Insulin users (n = 267)	
	r	Significance	r	Significance
Sex	0.047	0.472	0.000	1.000
Age	-0.112	0.088	-0.169	0.006*
BMI	0.140	0.032	0.099	0.106
Smoking	0.010	0.878	-0.071	0.244
Alcohol	0.208	0.002***	0.012	0.846
Exercise frequency	0.016	0.806	-0.063	0.308
Single	0.172	0.008***	-0.015	0.812
Living alone	-0.010	0.878	-0.002	0.970
CES-D	0.001	0.982	-0.008	0.894
Coping dimensions				
Problem-focused*	-0.142	0.030	0.014	0.822
Adaptive emotion-focused*	-0.216	0.000***	0.018	0.774
Maladaptive emotion-focused*	-0.083	0.202	0.033	0.596
Coping profiles				
Active solution**	-0.085	0.192	0.035	0.564
Seeking help for a solution**	-0.161	0.014	-0.010	0.872
Changing mood**	-0.202	0.002***	0.041	0.508
Emotional expression involving others**	-0.053	0.414	0.029	0.640
Avoidance and suppression**	-0.086	0.188	0.025	0.676
Changing one's point of view**	-0.181	0.006***	-0.015	0.812

†* $P < 0.0167$ is regarded as significant due to three multiple tests. †** $P < 0.0083$ is regarded as significant due to six multiple tests. †***Statistically significant. BMI, body mass index; CES-D, Center for Epidemiologic Studies Depression Scale.

out, there are shaman called *kamisama* or *itako* who make predictions, tell fortunes and provide medical care through their spiritual or religious power²⁷. Several studies with various patient groups suggested that an increase in spiritual or religious coping in type 2 diabetes patients decreases anxiety, hopelessness or depression, and stimulates psychological functions or quality of life^{28–30}.

The present study had several notable limitations. First, the assessment of coping profiles was based on the BSCP, which includes just 18 items, and was developed for Japanese workers and not for people with chronic diseases, such as type 2 diabetes. Several studies have tested different dimensions^{7–15,31–36}. Even for three dimensions, the detailed factors have not yet been integrated. We have shown that: (i) task-oriented coping (problem-focused coping); (ii) emotion-oriented coping (adaptive emotion-focused coping); and (iii) avoidance-oriented coping (maladaptive emotion-focused coping) dimensions are useful based on our clinical experience and previous Japanese research³⁷. In addition, there are several questionnaires that have a validated Japanese version, such as the BSCP and the Coping Inventory for Stressful Situations-2nd Edition^{34,35}, both of which include the three dimensions mentioned above. Because the BSCP was developed in Japan, it was available in Japan, whereas the Japanese version of the Coping Inventory for Stressful Situations-2nd Edition has only recently been

validated³⁸. At the time our research plan was formulated, only the BSCP was available for the assessment of these three dimensions in Japan. Therefore, we could not compare the results between previous studies and the present study. The second limitation of this study was the recruitment strategy, which involved the recruitment of individuals with type 2 diabetes from the clinical setting of only one institution and excluded patients with severe mental illness, including major depressive disorders. Third, some patients with anemia were included in the study. Because HbA1c is influenced by iron-deficiency anemia³⁹ or renal anemia⁴⁰, HbA1c cannot be regarded as an accurate biomarker for glucose control in the present study. Further studies with several biomarkers of glucose control in addition to HbA1c, such as fasting blood levels, are required. Finally, the present study design was cross-sectional; thus, we could not determine a causal relationship between coping behaviors and glucose control among the patients in our study population. A follow-up survey is required to investigate these associations.

In conclusion, the findings of the present study suggest that an adaptive emotion-focused coping profile is a supportive factor for successful glycemic control in type 2 diabetes patients who do not use insulin. Other coping profiles did not have a major impact on glycemic control. Psychological therapy focusing on the coping profile might improve glycemic control.

Additional studies using a longitudinal study design are required to examine the relationships between psychological factors and glycemic control.

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REFERENCES

- Lam DW, LeRoith D. The worldwide diabetes epidemic. *Curr Opin Endocrinol Diabetes Obes* 2012; 19: 93–96.
- UKPDS Group. Cost effectiveness analysis of improved blood pressure control in hypertensive patients with type 2 diabetes: UKPDS 40. UK Prospective Diabetes Study Group. *BMJ* 1998; 317: 720–726.
- Hirsch IB, Bode BW, Childs BP, *et al.* Self-Monitoring of Blood Glucose (SMBG) in insulin- and non-insulin-using adults with diabetes: consensus recommendations for improving SMBG accuracy, utilization, and research. *Diabetes Technol Ther* 2008; 10: 419–439.
- Massey CN, Feig EH, Duque-Serrano L, *et al.* Well-being interventions for individuals with diabetes: a systematic review. *Diabetes Res Clin Pract* 2018; 147: 118–133.
- Sullivan PW, Morimoto EH, Ghushchyan V, *et al.* Obesity, inactivity, and the prevalence of diabetes and diabetes-related cardiovascular comorbidities in the U.S., 2000–2002. *Diabetes Care* 2005; 28: 1599–1603.
- Delahanty LM, Grant RW, Wittenberg E, *et al.* Association of diabetes-related emotional distress with diabetes treatment in primary care patients with Type 2 diabetes. *Diabet Med* 2007; 24: 48–54.
- Aldwin CM. *Stress, Coping and Development: An Integrative Perspective*. New York, NY: Guilford Press, 1994.
- Reid GJ, Dubow EF, Carey TC, *et al.* Contribution of coping to medical adjustment and treatment responsibility among children and adolescents with diabetes. *J Dev Behav Pediatr* 1994; 15: 327–335.
- Graue M, Wentzel-Larsen T, Bru E, *et al.* The coping styles of adolescents with type 1 diabetes are associated with degree of metabolic control. *Diabetes Care* 2004; 27: 1313–1317.
- Folkman S, Lazarus RS. An analysis of coping in a middle-aged community sample. *J Health Soc Behav* 1980; 21: 219–239.
- Folkman S, Lazarus RS. If it changes it must be a process: Study of emotion and coping during three stages of a college examination. *J Pers Soc Psychol* 1985; 48: 150–170.
- Lundman B, Norberg A. Coping strategies in people with insulin-dependent diabetes mellitus. *Diabetic Educ* 1993; 19: 198–204.
- Bombardier CH, D'Amico C, Jordan JS. The relationship of appraisal and coping to chronic illness adjustment. *Behav Res Ther* 1990; 28: 297–304.
- Hagger MS, Koch S, Chatzisarantis NLD, *et al.* The common sense model of self-regulation: meta-analysis and test of a process model. *Psychol Bull* 2017; 143: 1117–1154.
- Duangdao KM, Roesch SC. Coping with diabetes in adulthood: a meta-analysis. *J Behav Med* 2008; 31: 291–300.
- Hill-Briggs F, Gemmell L, Kulkarni B, *et al.* Associations of patient health-related problem solving with disease control, emergency department visits, and hospitalizations in HIV and diabetes clinic samples. *J Gen Intern Med* 2007; 22: 649–654.
- Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychol Meas* 1977; 1: 385–401.
- Sugawara N, Yasui-Furukori N, Takahashi I, *et al.* Age and gender differences in the factor structure of the Center for Epidemiological Studies Depression Scale among Japanese working individuals. *Compr Psychiatry* 2015; 56: 272–278.
- Kageyama T, Kobayashi T, Kawashima M, Kanamaru Y. Development of the Brief Scales for Coping Profile (BSCP) for Workers: basic Information about its Reliability and Validity. *Sangyo Eiseigaku Zasshi* 2004; 46: 103–114.
- Tomotsune Y, Sasahara S, Umeda T, *et al.* The association of sense of coherence and coping profile with stress among research park city workers in Japan. *Ind Health* 2009; 47: 664–672.
- Sugawara N, Sato K, Takahashi I, *et al.* Depressive Symptoms and Coping Behaviors among Individuals with Irritable Bowel Syndrome in Japan. *Intern Med* 2017; 56: 493–498.
- Yoshida K, Yoshida K, Otaka H, *et al.* Association between insomnia and coping style in Japanese patients with type 2 diabetes mellitus. *Neuropsychiatr Dis Treat* 2018; 14: 1803–1809.
- Anderson PL, Zimand E, Hodges LF, *et al.* Cognitive behavioral therapy for public-speaking anxiety using virtual reality for exposure. *Depress Anxiety* 2005; 22: 156–158.

24. Thorpe CT, Fahey LE, Johnson H, *et al.* Facilitating healthy coping in patients with diabetes: a systematic review. *Diabetes Educ* 2013; 39: 33–52.
25. Folkman S, Moskowitz JT. Coping: pitfalls and promise. *Annu Rev Psychol* 2004; 55: 745–774.
26. Suls J, Fletcher B. The relative efficacy of avoidant and nonavoidant coping strategies: a meta-analysis. *Health Psychol* 1985; 4: 249–288.
27. Fujii H, Yamamoto H, Ohzeki N, *et al.* Shamanism and mental health in Aomori. *J Aomori Univ Health Welf* 2002; 4: 79–87. (In Japanese).
28. Peyrot MF, Mcmurry JF. Stress buffering and glycemic control - the Role of coping styles. *Diabetes Care* 1992; 15: 842–846.
29. Rubin RR, Payrot M. Psychological issues and treatments for people with diabetes. *J Clin Psycho* 2001; 57: 457.
30. Rowe MM, Allen RG. Spirituality as a means of coping. *Am J Health Studies* 2004; 19: 62–67.
31. Nomura M, Fujimoto K, Higashino A, *et al.* Stress and coping behavior in patients with diabetes mellitus. *Acta Diabetol* 2000; 37: 61–64.
32. Skočić M, Rudan V, Brajković L, Marčinko D. Relationship among psychopathological dimensions, coping mechanisms, and glycemic control in a Croatian sample of adolescents with diabetes mellitus type 1. *Eur Child Adolesc Psychiatry* 2010; 19: 525–533.
33. Persson LO, Erichsen M, Wändell P, *et al.* Psychometric evaluation of a coping questionnaire in two independent samples of people with diabetes. *Stress Health* 2013; 29: 286–296.
34. Sobol-Pacyniak AB, Szymczak W, Kwarta P, *et al.* Selected factors determining a way of coping with stress in type 2 diabetic patients. *Biomed Res Int* 2014; 2014: 587823.
35. Moryś JM, Bellwon J, Jeżewska M, *et al.* The evaluation of stress coping styles and type D personality in patients with coronary artery disease. *Kardiol Pol* 2015; 73: 557–566.
36. Basinger ED. Testing a dimensional versus a typological approach to the communal coping model in the context of type 2 diabetes. *Health Commun* 2019; 34: 1–12.
37. Suzuki S. The validity of the three dimensional model to classify coping behavior. *Shinrigaku Kenkyu* 2004; 74: 504–511. (In Japanese).
38. Watanabe K, Yokoyama K, Furukawa TA. Reliability and validity of the Japanese version of the coping inventory for adults for stressful situations in healthy people. *Psychol Rep* 2015; 116: 447–469.
39. Coban E, Ozdogan M, Timuragaoglu A. Effect of iron deficiency anemia on the levels of hemoglobin A1c in nondiabetic patients. *Acta Haematol.* 2004; 112: 126–128.
40. Shima K, Chujo K, Yamada M, *et al.* Lower value of glycated haemoglobin relative to glycaemic control in diabetic patients with end-stage renal disease not on haemodialysis. *Ann Clin Biochem* 2012; 49: 68–74.