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Factors Affecting Self-management Behavior among Patients with Type 2 Diabetes in a Border Area of Southwest China

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Purpose: This study aimed to investigate the status and factors associated with self-management behavior (SMB) of patients with type 2 diabetes (T2DM) in a border area of southwest China. **Methods:** A cross-sectional study was conducted with T2DM patients in Dali, China. The participants filled in the questionnaires including demographic and disease-related characteristics, psychosocial status, resources of DM knowledge, knowledge of DM care, competency in DM care skills, the Chinese Diabetes Management Self-Efficacy Scale (C-DMSES), and the Chinese Summary of Diabetes Self-Care Activities (C-SDSCA). All the data were analyzed with SPSS version 26. Multiple linear regression analysis examined associations between predictors and SMB. **Results:** A total of 470 valid questionnaires have been collected. The score for overall SMB was 50.71 ± 11.99; 19.6% of patients were at a good level, 48.3% were moderate, and 32.1% were poor. The significant factors that influenced SMB included self-efficacy (β = 0.37; $p < .001$), competency in DM care skills (β = 0.22; $p < .001$) and lacked in the treatment confidence (β = -0.09; $p = .023$). **Conclusion:** The level of self-management among T2DM patients in this area was medium-low state. For future studies, our findings suggest that self-efficacy, competency in DM care skills, and treatment confidence should be considered essential factors in improving the self-management behavior of T2DM patients in the border area of southwest China.

Key Words: *Type 2 diabetes mellitus; Self-management; National minority; China*

INTRODUCTION

Diabetes mellitus (DM) is a significant public health problem worldwide and is still increasing uncontrollably. Especially in China, the prevalence rate over 18 years old of diabetes is 11.2% [1], and it is estimated to have 150.7 million patients in 2040 [2]. More than 95.0% of DM patients suffer from type 2 diabetes mellitus (T2DM) [3] and the prevalence of T2DM in adults is 9.7-11.6% [4]. Nevertheless, the awareness rate of DM in China is only 36.5%, and the treatment rate is 32.2%, all at a low level [1]., Most patients face problems with delayed treatment; unauthorized withdrawal or change of medication; and neglect of diet, exercise, and blood glucose monitoring. These patients indicate a high incidence, early onset, and severe development of complications [5], and 78.0% of diabetic patients in China suffer from more than one complication [6]. T2DM and its associated complications threaten the national health status and lead to a heavy economic burden on individuals and society [7].

It is well known that good self-management behavior (SMB) improves the symptoms of chronic diseases and the quality of life, reducing the incidence of complications, medical costs and utilizing health resources [8]. Diabetes self-management comprises the daily activities undergone by patients to regulate their blood glucose and reduce the effects of diabetes on their health scientifically and rationally. Hence, self-management is crucial in treating and managing diabetes. Studies reported that the self-management level performed by diabetic patients determines their prognosis and quality of life, and the level of self-management positively correlated with the quality of life of patients [9-11].

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Self-management behavior is influenced by various factors. Of them, an important factor is self-efficacy, which is positively correlated with and even can predict diabetes SMB [12]. Due to long-term treatment and the risk of complications, diabetics are prone to psychological problems that make patients reluctant to engage in self-management related activities [12]. Social support, however, especially by the family members, can encourage patients to cooperate better with treatment and improve their self-management level [13]. Patients with high levels of specific knowledge and skills are more likely to perform self-management activities [14,15].

A community-based primary care system has a positive effect on improving the knowledge penetration rate and the self-management ability of diabetic patients [13]. However, in China, community health resources are scarce, with 80.0% of urban health resources concentrated in large hospitals and only 20.0% in communities [14]. Chronic disease patients primarily learn simple disease management methods from the hospital medical staff. The information obtained is not systematic and mainly aims at guiding patients to perform basic self care [15]. Therefore, self-management of chronic diseases is far from being universally accepted and widely disseminated [16]. Although Dali is located in border area of southwest China, and development economy in this area is relatively backward, the prevalence of diabetes has similar to the average level of China in recent years. As early as 2015, the prevalence rate of DM in this area attained 11.3%, including 12.2% of males and 11.1% of females. It is associated with the rapid development of the local economy, changes in the lifestyle of the population and the arrival of an aging society [17].

Since there has never been a report before, we investigated and analyzed the status of SMB in T2DM patients in the typical border area in China. Therefore, this study can be referred to developing self-management methods of T2DM that could be suitable for the area.

METHODS

1. Study design

This study used a cross-sectional design and convenience sampling.

2. Participants

We enrolled 470 T2DM patients who were being treated in outpatient clinics of two general hospitals in Dali, a border region in southwest China, from 2016 to 2017. One of the authors and three nurses who were working in the hospitals and trained in data collection conducted survey. The subjects had been above 18 years, met the Chinese diagnostic criteria for T2DM [18], were diagnosed with T2DM, and had more than one year of treatment experience. People with mental illness, impaired consciousness, communication problems, and inability to care for themselves were excluded from the study.

3. Measurement

1) General and disease characteristics

Patient demographics were collected, including age, gender, ethnicity, height and weight, body mass index (BMI), marital status, educational level, occupation, monthly income, economic burden, medical payment methods, disease duration, family history of DM, and the treatment method.

2) Self-management behavior

Self-management behavior (SMB) of patients was determined using the Chinese version of the Summary of Diabetes Self-Care Activities (C-SDSCA) [19], which had Cronbach's alpha of 0.83. Total 11 items divided into six dimensions (ordinary diet, special diet, exercise, blood glucose monitoring, foot care, and medication) and the status of the self-management activities in the past seven days. Each item was scored from 0 to 7, a total of 77 points, and a higher score indicated improved SMB. The standard score was used as the analysis index for the SMB level (standard score = total score/the highest possible score × 100). It was categorized into three levels, ≤ 60 is considered a poor level, 60–80s a moderate level, and ≥ 80 is a good level [20].

3) Psychosocial status

The psychosocial status involved in treatment confidence, anxiety, family concern, and psychological support. A total of 4 closed questions were set. For the single-choice question, the answer is none/never, moderate/sometimes, and strong/frequent, with a score of 0, 1, and 2, respectively. Except for anxiety, this scored in reverse, the higher the score, the better the condition of the patient.

4) Resources of DM knowledge

The sources of DM knowledge included self-learning, peer communication, medical staffs, lectures provided by hospitals, and a staff who visited home and the answer comprise never, occasional, and frequent, with the score of 0, 1, and 2, respectively. The higher the score, the more

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knowledge patients acquire from this source.

5) Knowledge of DM care and competency in DM care skills

The knowledge and competency in DM care were measured using total 7 closed questions on diet, exercise, blood sugar control, medication, foot care, distress management, and smoking cessation, respectively [24]. For the knowledge of DM care, if the participants knew all 7 items, they were considered to have the knowledge; however, if they did not know any of them, they were considered to have lacked knowledge. For the competency in DM care skills, if the participants could conduct all 7 skills, they were considered competent; however, if they couldn't not conduct any of them, they were considered incompetent.

6) Self-efficacy

Self-efficacy was measured using the Chinese version of the Diabetes Management Self-Efficacy Scale (C-DMSES) [25], which had Cronbach's alpha of 0.94. The total 20 items were divided into four dimensions to reflect diet, medical treatment, exercise, and diabetic foot prevention of patients. Each item was scored from 0 to 10 points, totaling 200 points. A higher score depicted a higher self-efficacy of the patient to undergo SMB. The standard score was used as the analysis index for the self-efficacy level (standard score = total score/the highest possible score × 100). Moreover, categorized into three levels, ≤ 40 considered poor, 40–80 is moderate, and ≥ 80 is good [26].

4. Data collection

Patient information was collected using a structured questionnaire. One of the authors and three trained nurses conducted the survey; following the guidance of nurses, the patients filled in the questionnaires. Then, questionnaires were checked and confirmed. This study was approved by the Medical Ethics Committee of D University (201503–14), China. The informed written consent was obtained before completing the questionnaires; their data were used only in this study and protected.

5. Statistical analysis

All the data were analyzed with SPSS version 26.0. Descriptive statistics were determined to describe the characteristics of the measured variables. The mean with standard deviation and percentages were utilized to present the descriptive statistics. Bivariate analyses were performed with an independent sample's t-test and analysis of variance (ANOVA). Pearson's Correlation was computed to explore the bivariate Correlation between the variables. Stepwise Multiple Linear Regression Analysis was utilized to estimate the contributions of the different independent variables to SMB levels. Significant variables within the previous analysis were entered into the regression model. These variables included the patients' gender, current occupation, economic burden, treatment confidence, anxiety, psychological support, family concern; acquire DM knowledge by self-learning and communicate with peers; understanding DM well and perform DM care skills properly; and self-efficacy level. The values were considered statistically significant in all statistical analyses at $p < .05$.

RESULTS

The mean age of the 470 T2DM patients was 56.59 years, and the majority were above 60 years (n = 193, 41.1%). The average duration of T2DM was 7.32 years (Table 1).

The average score for SMB was 4.61 ± 11.99 and Table 1 shows the average scores of each dimension of SMB. Among the participants, 19.6% (n = 92) were in good level, 48.3% (n = 227) were moderate, and 32.1% (n = 151) were poor. The average score for self-efficacy was 6.92 ± 34.69, and 18.4% (n = 146) were in good level, 62.0% (n = 291) were moderate, and 7.0% (n = 33) were poor.

Table 2 indicates the differences in SMB scores according to the participants' general and T2DM-related characteristics. Compared with the female T2DM patients, male patients showed lower SMB level (t = –2.02, $p = .044$). Current occupation (F = 2.24, $p = .018$), economic burden (F = 5.45, $p = .005$), confidence in treatment (F = 16.31, $p < .001$), anxiety

Table 1. The Scores of Self-Management Behavior and Self-Efficacy, and T2DM-related Characteristics of Participants (N = 470)

Variables	Average score (M ± SD)
Self-management behavior	4.61 ± 11.99
Ordinary diet	4.24 ± 4.92
Special diet	4.29 ± 2.45
Exercise	4.42 ± 4.40
Blood-glucose testing	4.54 ± 4.11
Foot care	5.05 ± 4.61
Medications	5.67 ± 1.97
Self-efficacy	6.92 ± 34.69
Diet	6.62 ± 24.37
Exercise	6.92 ± 6.32
Treatment	7.57 ± 6.91
Prevention of diabetic foot	8.03 ± 2.34
T2DM duration	7.32 ± 5.63

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Table 2. Differences in Self-Management Behavior Scores according to the Participants' General and T2DM-related Characteristics (N = 470)

Characteristics	Categories	N (%)	Self-management behavior	
			M ± SD	t/F(*p*)
General and disease-related characteristics				
Age (yr)	< 60	277 (58.9)	65.61 ± 16.16	-0.40 (.629)
	≥ 60	193 (41.1)	66.19 ± 14.72	
Gender	Male	248 (52.8)	64.48 ± 15.37	-2.02 (.044)
	Female	222 (47.2)	67.38 ± 15.68	
BMI	< 18.5	16 (3.4)	65.50 ± 17.71	0.23 (.793)
	18.5-24.9	262 (55.7)	66.29 ± 14.75	
	> 24.9	192 (40.9)	65.29 ± 16.52	
Spouse	Yes	415 (88.3)	65.82 ± 15.74	0.03 (.969)
	No	14 (3.0)	65.31 ± 16.87	
	Bereaved	41 (8.7)	66.36 ± 13.62	
Current occupation	Retire[a]	135 (28.7)	67.62 ± 14.56	2.24 (.018)[a>c]
	Professionals[b]	27 (5.7)	65.94 ± 13.67	
	Farmer[c]	132 (28.1)	62.32 ± 17.17	
	Service work[d]	46 (9.8)	61.52 ± 14.47	
	Public servant[e]	28 (6.0)	68.97 ± 15.86	
	Unemployed[f]	47 (10.0)	68.50 ± 15.35	
	Others[g]	55 (11.7)	69.73 ± 13.87	
Educational level	≤ Primary school	157 (33.4)	64.20 ± 15.55	2.39 (.068)
	Junior high school	164 (34.9)	65.05 ± 15.46	
	High school	104 (22.1)	67.78 ± 15.45	
	≥ University	45 (9.6)	70.07 ± 15.62	
Monthly household income (CNY)	< 2,000	155 (33.0)	63.70 ± 15.64	1.82 (.142)
	2,000-5,000	237 (50.4)	67.41 ± 14.80	
	5,000-10,000	54 (11.5)	65.61 ± 16.09	
	> 10,000	24 (5.1)	64.88 ± 20.11	
Medical expenses	Full insurance Support	36 (7.7)	69.08 ± 9.43	2.07 (.127)
	Partial insurance Support	405 (86.2)	65.90 ± 16.01	
	Own expense	29 (6.2)	61.22 ± 14.77	
Family history of DM	Parent or child	71 (15.1)	62.05 ± 14.04	2.86 (.058)
	Siblings	83 (17.7)	65.28 ± 16.05	
	None	316 (67.2)	66.86 ± 15.68	
Treatment methods	Oral medication	105 (22.3)	64.91 ± 15.44	2.30 (.077)
	Insulin injection	240 (51.1)	67.43 ± 15.34	
	Oral meds and Insulin injection	108 (23.0)	64.27 ± 15.70	
	None	17 (3.6)	59.43 ± 17.08	
Economic burden	Heavy[a]	136 (28.9)	62.69 ± 15.71	5.45 (.005)[c>a]
	Ordinary[b]	217 (46.2)	66.09 ± 15.25	
	None[c]	117 (24.9)	69.09 ± 15.40	
Psychosocial status				
Treatment confidence	Strong[a]	364 (77.4)	67.86 ± 16.02	16.31 (< .001)[a>c]
	Moderate[b]	73 (15.5)	60.93 ± 10.47	
	None[c]	33 (7.0)	54.58 ± 12.82	
Anxiety	Frequent[a]	99 (21.1)	63.66 ± 13.31	4.56 (.011)[c>a]
	Sometimes[b]	276 (58.7)	65.23 ± 15.61	
	Never[c]	95 (20.2)	69.95 ± 17.00	
Psychological support	Frequent[a]	116 (24.7)	68.58 ± 13.87	3.99 (.019)[a>c]
	Sometimes[b]	192 (40.9)	66.30 ± 16.11	
	Never[c]	162 (34.5)	63.36 ± 15.78	
Family concern	Frequent[a]	389 (82.8)	66.94 ± 15.73	5.94 (.003)[a>b]
	Sometimes[b]	69 (14.7)	61.23 ± 14.34	
	Never[c]	12 (2.6)	57.25 ± 9.12	

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Table 2. Continued

Characteristics	Categories	N (%)	Self-management behavior	
			M ± SD	t/F(*p*)
Knowledge resources				
Self-learning	Frequent[a]	177 (37.7)	67.97 ± 15.95	3.38 (.035)[a>c]
	Occasional[b]	195 (41.5)	65.34 ± 14.93	
	Never[c]	98 (20.9)	63.04 ± 15.77	
Peer communication	Frequent[a]	176 (37.4)	68.54 ± 15.16	4.98 (.007)[a>c]
	Occasional[b]	199 (42.3)	64.98 ± 15.02	
	Never[c]	95 (20.2)	62.69 ± 16.79	
Medical staff	Frequent	276 (58.7)	67.32 ± 14.79	3.01 (.050)
	Occasional	148 (31.5)	63.93 ± 16.68	
	Never	46 (9.8)	63.24 ± 15.77	
Lectures from hospitals	Frequent	119 (25.3)	67.47 ± 15.32	2.08 (.126)
	Occasional	169 (36.0)	66.65 ± 14.89	
	Never	182 (38.7)	64.06 ± 16.25	
Staff visit	Frequent	153 (32.6)	66.64 ± 14.07	0.29 (.747)
	Occasional	82 (17.4)	65.55 ± 14.72	
	Never	235 (50.0)	65.44 ± 16.79	
Knowledge of DM care	Yes	131 (27.9)	70.80 ± 16.13	4.37 (< .001)
	No	339 (72.1)	63.94 ± 14.94	
Competency in DM care skills	Yes	116 (24.7)	74.27 ± 14.19	7.05 (< .001)
	No	354 (75.3)	63.09 ± 15.02	

BMI = body mass index; DM = diabetes mellitus.

(F = 4.56, p = .011), psychological support (F = 3.99, p = .019), and family concern (F = 5.94, p = .003) showed significant differences in SMB level. Patients often acquire DM knowledge by self-learning (F = 3.38, p = .035) or communication with peers (F = 4.98, p = .007) have higher SMB levels. Patients who know DM care skills (t = 4.37, p < .001) and have competency in DM care skills (t = 7.05, p < .001) have higher SMB level.

Moreover, there was a strong positive correlation between self-efficacy level and SMB level (r = 0.44, p < .001), as shown in Table 3.

Table 3. Correlation between Age, T2DM Duration, Self-efficacy, and Self-management Behavior (N = 470)

Items	Age	T2DM duration	Self-efficacy
	r (*p*)	r (*p*)	r (*p*)
T2DM duration	.35 (< .001)	1	
Self-efficacy	-.15 (.001)	-.04 (.351)	1
Self-management	.04 (.343)	.02 (.726)	.44 (< .001)

T2DM = type 2 diabetes mellitus.

As shown in Table 4, the stepwise multiple linear regressions indicate that the following were independent factors of SMB. The tolerance range was greater than .10 and the variance inflation factor (VIF) was less than 2.0, which indicated no problem of multicollinearity. Self-efficacy (β = 0.37; p < .001), competency in DM care skills (β = 0.22; p < .001), lack of treatment confidence (β = –0.09; p = .023), and these variables explained 24.5% of the variation in SMB level (F = 51.81; p < .001).

DISCUSSION

Our study shows more elderly patients over 60 years and most of them are retirees and farmers among the participants. Elderly patients with chronic diseases are a special group, and there are many problems, such as low educational level, low income, and living alone due to chil-

Table 4. Factors Influencing Self-management Behavior of T2DM Patients (N = 470)

Variable	B	SE	β	t	*p*	95% CI
Self-efficacy	0.33	0.04	0.37	8.83	< .001	0.26~0.41
Competency in DM care skills (Yes)*	8.02	1.48	0.22	5.41	< .001	5.10~10.93
Treatment confidence (None)†	-5.72	2.51	-0.09	-2.28	.023	-10.66~-0.79
R^2_{adj} = .25; F = 51.81; p < .001						

*Reference = No; †Reference = Strong.
SE = standard error; CI = confidence interval; T2DM = type 2 diabetes mellitus; DM = diabetes mellitus.

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dren working outside [27]. In addition, most of the rural areas in this border area are located in mountainous areas, and the economy is underdeveloped. Therefore, in addition to improving social security and regional medical services, the self-health management of the population should also be paid attention. It is meaningful to improve the SMB level of T2DM patients in this region for the management of the disease.

Currently, the T2DM patients in this study indicated unsatisfactory SMB, as only 19.6% of T2DM patients had good SMB levels. The level of each dimension of SMB was different, where the diet had the worst self-management performance compared to other dimensions of SMB, which was similar to the results of a study by Storm [28]. Studies revealed that people in this area prefer salted products (cured meat and pickled vegetables), high-fat food, and a high-salt diet as independent risk factors for prediabetes and diabetes in the region [17,24]. The medication score was the highest, partly matching the results of recent studies on populations from other areas of China [29]. The results indicate that attention should be paid to the ability of patients in various dimensions of self-management and focus on improving the ability of self-management in lower-scoring dimensions, including diet and exercise.

Our study identified three crucial factors: self-efficacy, competency in DM care skills , lack of treatment confidence strongly associated with SMB of T2DM patients. A high level of self-efficacy is key to changing individual behavior and maintaining a healthy lifestyle; it helps patients cope with pressure [30]. However, the self-efficacy of T2DM patients in this region was mainly concentrated at a moderate level, which still needs to be improved. Finding ways to increase the self-efficacy of patients in their ability to manage their disease could increase their likelihood of using technology for self-management [31]. Self-efficacy is influenced by direct and indirect experience, evaluation of others, persuasion, as well as emotional and physiological states [32]. We should focus on these priority factors and improve the self-efficacy of T2DM patients in the region to enhance the transformation and implementation of effective self-management.

The current study also revealed a significant negative correlation between the lack of treatment confidence and the SMB level of T2DM. Previous studies have indicated that perceived self-confidence and social support are essential in metabolic control, self-management, and psychosocial adjustment results in T2DM [33]. Therefore, self-confidence-promoting interventions, including goal setting, alternative experiences, peer support groups, stress management, and psychological support strategies, should be implemented among patients. Some special methods can also be applied. For instance, structured self-monitoring of blood glucose positively impacts patient confidence and attitudes toward diabetes [34].

Self-management of chronic disease indicates that patients learn the skills necessary to take on an active role in caring for their own chronic conditions and assume some medical and preventive tasks with the support of health professionals [35]. Patients with diabetes with higher skills usually have higher perceived self-management [32,33]. Our study also fully demonstrated a positive impact on SMB of competency in DM care skills. These skills included proper diet, regular exercise, regular blood glucose monitoring, medically prescribed medication, mood management, foot care, and smoking cessation [24]. Therefore, in improving the SMB ability of T2DM patients, in addition to mastering DM knowledge, it is essential to enhance the skills that patients should have and undergo supervision measures to improve the practice and execution of patients.

This study mainly provides basic data for the intervention strategies of self-management behaviors of T2DM patients in a border area of China. Health behavior theories are attempts to describe why individuals do or do not engage in particular health behaviors and how individuals go about changing their unhealthy to healthy behaviors [36]. Therefore, in the intervention strategy: 1) an appropriate health behavior theory can be selected as the theoretical framework, taking the regional characteristics of border areas as the perspective; 2) The intervention measures should focus on the intervention of the patient's self-efficacy, treatment confidence, and the competency in DM care skills, thus influencing the improvement of the patient's self-management behavior to the greatest extent possible; 3) In the intervention target, focus on improving the low-level dimensions such as diet management behavior and exercise management behavior, and strengthen the relevant measures of these contents.

Several limitations of the study should be noted. First, inferences about causality between each factor and SMB could not be made due to a cross-sectional study. Second, the tools to measure "psychosocial status" "knowledge resources" and "Knowledge of DM care and competency in DM care skills" have not undergone the tool development process. Third, some potential influencing factors were not determined in this study, such as the lack of consideration of the multicultural characteristics of border areas. Therefore, this could limit the interpretation of our

findings.

CONCLUSION

The SMB level of T2DM patients in this border area is medium-low. SMB is primarily affected by multiple factors. When future research or intervention is provided, self-efficacy, treatment confidence, and competency in DM care skills should be considered as important factors to improve SMB among patients in the border area of southwest China.

CONFLICT OF INTEREST

The authors declared no conflict of interest.

AUTHORSHIP

YY contributed to the conception and design of this study; YY collected data; YY and SJ performed the statistical analysis and interpretation; YY and SJ drafted the manuscript; YY and SJ critically revised the manuscript; YY and SJ supervised the whole study process. All authors read and approved the final manuscript.

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