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Factors influencing diabetes self-management among adults with type 2 diabetes mellitus in China

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Abstract

Background: In China, the prevalence of Type 2 Diabetes Mellitus (T2DM) continues to rise, and Diabetes Self-Management (DSM) is generally suboptimal. Thus, identifying the factors influencing DSM in adults with T2DM is crucial for healthcare providers.

Objectives: This study aimed to 1) describe DSM among adults with T2DM in Wenzhou, China, 2) examine the correlations between diabetes knowledge, perceived self-efficacy, fatalism, social support, and DSM, and 3) determine how much power of the correlated independent variables could predict DSM.

Methods: This study adopted the cross-sectional design and included 108 adults with T2DM who were randomly selected from the outpatient clinic of a hospital in Wenzhou, China. Data were recruited using a demographic questionnaire, and standardized tools were utilized to determine the correlation between DSM, diabetes knowledge, perceived self-efficacy, fatalism, and social support. Data were analyzed using descriptive statistics, Pearson correlation, and multiple regression analysis.

Results: 62% of participants had poor blood glucose control (HbA1c $\geq 8.0\%$) and suboptimal DSM. Significant factors related to DSM were diabetes knowledge ($r = 0.594$, $p < 0.001$), perceived self-efficacy ($r = 0.447$, $p < 0.001$), and social support ($r = 0.312$, $p = 0.001$). The regression analysis revealed that all variables significantly explained 38.2% of the variance in DSM among adults with T2DM. However, only diabetes knowledge and perceived self-efficacy significantly predicted DSM ($\beta = 0.468$, $p < 0.001$; $\beta = 0.184$, $p = < 0.05$, respectively).

Conclusion: The findings indicated that increasing diabetes knowledge and perceived self-efficacy could help improve DSM in T2DM to ascertain the ultimate treatment outcomes. Nurses and healthcare providers should improve the ability of patients and their families to think critically and act autonomously.

Keywords

self-management; diabetes mellitus type 2; adult; self-efficacy; fatalism; social support; China

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Background

Diabetes mellitus (DM) has become one of the most prevalent health issues in the 21st century (International Diabetes Federation [IDF], 2021). China has been reported to have the highest number of people with DM (140.9 million) (IDF, 2021). In the survey conducted in Zhejiang Province from 2007 to 2017, the incidence rate of DM increased by an average of 4.01% per year (especially for those aged 20–39 years), indicating a trend toward a younger incidence of T2DM (Wang et al., 2020). In addition, DM-related complications, such as microvascular and macrovascular diseases, increase the risk of mental problems, disability, and mortality, as well as require more medical costs and lower the quality of life (Hu, 2011; IDF, 2021).

As the cornerstone of diabetes care, nurses should assess diabetes self-management (DSM) as part of routine clinical

nursing, including its influence on therapeutic outcomes, health state, quality of life, and psychosocial aspects that affect DSM (American Diabetes Association [ADA], 2019). DSM includes dietary control, glucose monitoring, medication adherence, physical activity, and physician contact as recommended behavioral activities for adults with T2DM (Li et al., 2018). However, much evidence suggests that DSM is suboptimal among Chinese adults with T2DM (Cui et al., 2020; Ji et al., 2020; Yao et al., 2019). Previous studies have established that the reasons for the poor adherence to DSM are still unclear and that the factors related to DSM need to be urgently identified (Luo et al., 2015). In traditional Chinese culture, strong family bonds are highly valued, which has profound implications for DSM in addition to the individual (Liu, 2012). Based on the Individual and Family Self-Management Theory (IFSMT) of Ryan and Sawin (2009), various factors under three dimensions may influence the outcomes of DSM,

including family and individual characteristics, perspective, self-efficacy, knowledge, and social support.

Based on the literature review, studies have obtained contradictory findings about diabetes knowledge, perceived self-efficacy, fatalism, and social support. Diabetes knowledge is a patient's comprehension of information related to the physiology of diabetes and the principles of treatment (Yin et al., 2008). Lack of diabetes knowledge can partially hinder DSM, especially in diet and physical exercise (Adu et al., 2019). Studies of diabetes knowledge and DSM have yielded inconsistent results (Bezo et al., 2020; Hu et al., 2013). Perceived self-efficacy is a person's level of confidence in their ability to cope with normal and stressful situations (Ryan & Sawin, 2009). A good level of perceived self-efficacy affects positive evaluations in DSM. It can also help patients remove obstacles in the DSM process and adhere to long-term health improvements (Adu et al., 2019). However, research results indicated that much uncertainty still exists regarding the association between DSM and perceived self-efficacy (Kurnia et al., 2017; Lin et al., 2017).

Fatalism is described as the belief that every situation and occurrence is predetermined and is beyond one's power to change the course of the event (Keeley et al., 2009; Sukkarieh-Haraty et al., 2018). It includes the concepts of predestination, luck, and pessimism (Shen et al., 2009). As a psychosocial factor, fatalism contributes to low blood glucose levels, poor medication adherence, and reduced quality of life (Walker et al., 2012). So far, however, studies about the association between fatalism and DSM are scarce (Suo et al., 2019). Social support is an individual's perception that if one needs assistance, they can provide assistance at any time (Ryan & Sawin, 2009). It is relevant to barriers encountered, DSM level, and blood glucose control (Gonzalez-Zacarias et al., 2016). To date, the correlation between DSM and social support research has not yet been determined (Ji et al., 2020; Zhang et al., 2017).

There are many studies on the influence of the factors mentioned above on DSM that can be searched, but gaps still exist in such studies. Furthermore, studies exploring the factors influencing DSM, particularly in Zhejiang, China, are scarce. Compared with other countries, China has unique cultures and beliefs that are valued and need to be taken into consideration (Liu, 2012; Luo et al., 2015). Therefore, this study aimed to 1) describe DSM among adults with T2DM in Wenzhou, China; 2) examine the correlations between diabetes knowledge, perceived self-efficacy, fatalism, social support, and DSM; and 3) determine how much power of the correlated independent variables could predict DSM among this population.

Methods

Study Design

This study used a predictive correlational cross-sectional design.

Participants

A simple random sampling method was employed to recruit 108 participants with T2DM who visited the diabetes outpatient department (OPD) at the tertiary care hospital of Wenzhou Medical University in Wenzhou, China. The inclusion criteria

were as follows: 1) aged 18–60 years; 2) T2DM diagnosis within six months; 3) can write and speak Chinese; 4) having a good place and temporal orientation, absence of mental illness; 5) no significant physical impairment such as limited physical mobility requiring assistance; and 6) having stable conditions such as no limitation of physical activity caused by complications or comorbidities.

The sample size was calculated using the formula $N \geq 104 + m$, where N denotes the total number of participants, and m is the total number of independent variables (Tabachnick & Fidell, 2007). The determined sample size with four independent variables was 108 adults with T2DM.

Instruments

The researchers developed the demographic questionnaire, which consisted of two parts: 1) general information provided by the participants (gender, age, weight, height, BMI, educational level, marital status, living condition, working status, and income level); and 2) health information obtained from the participant's medical record (duration of T2DM diagnosis, glycemic control status, T2DM-related complications, and any comorbidities).

The Chinese version of the Diabetes Self-Management Questionnaire (DSMQ) (Li et al., 2018) was used to assess DSM, which was modified from the DSMQ developed by Schmitt et al. (2013). The questionnaire contained 16 items, five dimensions (dietary control, glucose monitoring, medication adherence, physical activity, and physician contact), and a sum scale about the overall evaluation. Four-point Likert scale was used, ranging from 0, indicating "does not apply to me" to 3 indicating "applies to me very much." Of the 16 items, nine were reverse-scored due to their negative phrasing. The overall score was the sum of the dimensions. A higher sum score indicated that the individual had a higher level of DSM behavior. In this study, the instrument showed reliability with Cronbach's alpha value of 0.774.

The Chinese version of the Diabetes Knowledge Assessment (DKN) scales (Yin et al., 2008) was used to measure diabetes knowledge, which was modified from the DKN scales developed by Beeney et al. (2003) and contained 14 items. For each item, the participants were scored 1 score for a correct response and 0 for an incorrect response. The overall score ranged from 0 to 14, with the higher total score indicating that the participant has a greater understanding of diabetes. For this study, Cronbach's alpha value was 0.776.

The Self-Efficacy Scale for patients with Type 2 DM (SE-Type 2 scale) was developed by Bijl et al. (1999), and it was translated and modified into the Chinese version (Yin et al., 2008). The scale contained seven items and used a five-point Likert scale ranging from 1 indicating "no" to 5 indicating "yes." A higher score indicated a stronger sense of self-efficacy. For this study, Cronbach's alpha value was 0.776.

The Chinese version of the fatalism scale (Zhang et al., 2018) was used to assess fatalism, which was modified from the fatalism scale developed by Shen and colleagues (Shen et al., 2009). It contained 16 items and was divided into three dimensions: predetermination, luck, and pessimism. This scaled used five-point Likert scale (1 = "totally disagree," 2 = "disagree," 3 = "uncertain," 4 = "agree," and 5 = "totally agree"). The degree of fatalism increases as the individual's score

increases, which means that the individual has less self-control. In this study, Cronbach's alpha value was 0.855.

The Chinese version of the Perceived Social Support Scale (PSSS) was modified from the PSSS developed by Zimet et al. (1990) (Jiang, 1996). The scale contained 12 items consisting of two subscales: family support and support outside the family. It used a seven-point Likert scale ranging from 1 indicating "very strongly disagree" to 7 indicating "very strongly agree." The sum score ranged from 12 to 84, with the higher score indicating an individual's perceived high social support. In this study, Cronbach's alpha value was 0.827.

Data Collection

Data were collected from June to July 2021 at the tertiary care hospital of Wenzhou Medical University in Wenzhou, China. The application program picked the queue number of individuals who met the criteria to collect 5–10 samples per day, five days per week, for a period of half a month. On a voluntary basis, each participant was provided with a private room and sufficient time to fill out the questionnaire. In an average of 15–20 minutes, the participant could complete the questionnaire. All information was obtained from the participants and their medical records.

Data Analysis

SPSS version 26.0 was used for the data analysis, with statistical significance set to <0.05 . In this study, no data were missing. Demographic and relevant study factors were summarized using descriptive statistics. Pearson correlation analysis was used to test the correlation between the study variables, while multiple regression analysis was employed to determine the factors influencing DSM. All assumptions testing for multiple regression analysis were met.

Ethical Considerations

Ethical approvals were obtained from the ethics committee of Burapha University, Thailand (BUU No. G-HS 111/2563) and of the First Affiliated Hospital of Wenzhou Medical University,

China (No. 2021-093). In addition, a consent form was obtained from all the participants prior to data collection.

Results

Characteristics of the Participants

This study included 108 individuals (men = 65 [60.2%], women = 43 [39.8%]). The participants' age ranged from 18 to 60 years, with the mean age being 47.7 years; 75.9% of the participants aged between 40 and 60 years. Regarding educational level, 50% of the participants completed secondary school, and 26.9% completed primary school. Most participants lived with family members (90.7%). None of the samples needed assistance carrying out daily activities at home. Interestingly, 37.9% of participants were overweight, and 6.5% were obese (class I and II). More than half of the participants (58.3%) only used oral medication for T2DM, and 19 (17.6%) used combined therapy. Approximately half of the participants had a co-morbidity (47.2%). Based on the data, only 16.7% of the participants had controlled blood glucose ($\text{HbA1c} < 7.0\%$), whereas 62% had high levels of poor blood glucose control ($\text{HbA1c} \geq 8.0\%$).

Descriptive Characteristics of the Study Variables

The overall DSM score among the participants ranged from 2.1 to 8.8, and the mean score was 4.85 out of 10 (standard deviation [SD] = 1.42). In terms of subscales scores, medication adherence was the highest (mean [M] = 6.31, SD = 2.85), followed by physician contact (M = 6.20, SD = 1.66), dietary control (M = 5.32, SD = 2.09), and physical activity (M = 4.50, SD = 2.88). The glucose monitoring subscale had the lowest mean score (M = 2.40, SD = 1.95), as presented in Table 1.

Four independent variables were investigated in this study. It was found that diabetes knowledge was 7.87 (SD = 2.69), perceived self-efficacy was 24.19 (SD = 4.50), fatalism was 33.65 (SD = 8.47), and social support was 57.32 (SD = 8.60) (Table 1).

Table 1 Descriptive characteristics of the study variables ($n = 108$)

Study variables	Range		M	SD
	Possible range	Actual range		
Diabetes self-management	0–10	2.1–8.8	4.85	1.42
Dietary control	0–10	0.8–10	5.32	2.09
Glucose monitoring	0–10	0–8.9	2.40	1.95
Medication adherence	0–10	0–10	6.31	2.85
Physical activity	0–10	0–10	4.50	2.88
Physician contact	0–10	1.1–10	6.20	1.66
Diabetes knowledge	0–14	2–13	7.87	2.69
Perceived self-efficacy	7–35	15–33	24.19	4.50
Fatalism	16–80	16–57	33.65	8.47
Social support	12–84	40–78	57.32	8.60

Factors Influencing Diabetes Self-Management

Table 2 presents the results of the correlation test. DSM was significantly related with diabetes knowledge ($r = 0.594$, $p < 0.001$), perceived self-efficacy ($r = 0.447$, $p < 0.001$) and social support ($r = 0.312$, $p = 0.001$). However, there was no significant association between DSM and fatalism ($r = -0.152$, $p = 0.117$).

As presented in Table 3, all predictors of DSM among adults with T2DM were able to explain 38.2% of the variance in DSM according to the regression analysis ($F_{3, 104} = 23.021$, $p < 0.001$). DSM among adults with T2DM was only predicted by diabetes knowledge ($\beta = 0.468$, $p < 0.001$) and perceived self-efficacy ($\beta = 0.184$, $p = 0.039$). Of the two significant predictors, diabetes knowledge better explained the variance in DSM followed by perceived self-efficacy.

Table 2 The correlation between the study variables ($n = 108$)

	Diabetes self-management	Diabetes knowledge	Perceived self-efficacy	Fatalism	Social support
Diabetes self-management	1.000				
Diabetes knowledge	0.594**	1.000			
Perceived self-efficacy	0.447**	0.487**	1.000		
Fatalism	-0.152	-0.429**	-0.081	1.000	
Social support	0.312**	0.292**	0.281**	-0.106	1.000

** $p < .01$; * $p < .05$ **Table 3** Regression analysis of the correlated factors of DSM ($n = 108$)

Correlated factors	B	S.E.	β	t	p-value
Diabetes knowledge	0.247	0.047	0.468	5.290	<0.001
Perceived self-efficacy	0.058	0.028	0.184	2.086	0.039
Social support	0.020	0.013	0.123	1.531	0.129
Constant = 0.334, $R^2 = 0.399$, $Adj R^2 = 0.382$, $F_{(3, 104)} = 23.021$, $p < 0.001$					

Discussion

In this study, the total mean score and the score per dimension indicated suboptimal DSM among adults with T2DM, which was consistent with the result of some other investigations in China (Cui et al., 2020; Ji et al., 2020; Yao et al., 2019). This finding was also in line with the study by Al-Qahtani (2020) in Saudi Arabia, which used the Arabic version of the DSMQ and reported that the mean score was 5.04 out of 10. Medication adherence had the highest score overall, whereas glucose monitoring had the lowest, consistent with the finding in China (Chen et al., 2018; Han et al., 2013). A wide variation in the dimensions of DSM in China was evident, which might be the reason for the low level of DSM overall.

From the IFSMT, the physical and individual factors affected DSM in this study, including age, educational level, income, BMI, and comorbidities (Ryan & Sawin, 2009). For individual factors in demographic information, one possible reason might be that the participants' mean age was 47.7 years, and most of them were of working age, engaged in careers, and had less time to take care of themselves. Compared with the elderly, the working-age population spent less time managing their disease regularly because they were busy with their careers and social interactions (Bezo et al., 2020; Yamashita et al., 2012). Compared to those with lower educational levels, highly educated adults had a greater understanding of diabetes and related complications (Ryan & Sawin, 2009). Income was assumed to be related to adjustments in diet, medication, and glucose regulation (Luo et al., 2015).

Furthermore, abnormal BMI, perceived as the negative factor influencing DSM, was the barrier to achieving optimal DSM (Clark, 2004; Zhang et al., 2017). An explanation for this was that the problem of insulin resistance and metabolic syndrome might exacerbate the complexity of the condition and affect the DSM outcomes (Clark, 2004). Moreover, living with one or more co-morbidities like hypertension, individuals are forced to manage multiple illnesses and prioritize the most severe symptoms or conditions they have ever encountered (Ryan & Sawin, 2009). Notably, the HbA1c values obtained in

this study, as the indicator, also rationalized the result that Chinese adults with T2DM had poor DSM, which must be taken into account.

Diabetes knowledge could significantly predict DSM ($\beta = 0.468$, $p < 0.001$), indicating that adults with diabetes and better diabetes knowledge had higher scores on DSM. Consistently, some previous studies also affirmed that diabetes knowledge, being a strong predictor, could influence DSM in different areas (Bezo et al., 2020; Hou et al., 2020). According to the IFSMT, engaging in knowledge-based self-regulatory behavior encourages participation in behavior and outcomes of self-management (Ryan & Sawin, 2009). However, a low level of diabetes knowledge was observed in this study, which led to suboptimal DSM.

DSM was also significantly predicted by perceived self-efficacy ($\beta = 0.184$, $p = 0.039$), indicating that participants with a higher level of perceived self-efficacy would frequently perform the DSM activities. Similar to previous studies, perceived self-efficacy was found to significantly predict DSM (Kurnia et al., 2017; Liu & Wei, 2021). As Ryan and Sawin (2009) pointed out, self-efficacy is an individual's confidence in their ability to engage in activities successfully, which is required in these behavioral adjustments and changes. A low level of self-efficacy in DSM leads to less frequent blood glucose monitoring. Adults with T2DM may be concerned about the side effects of medications or doses and may feel overburdened with some things, such as exercising and administering medication (Schmidt-Busby et al., 2018), all of which may lead to poor DSM adherence and outcomes. The results further validate the theory proposed by Ryan and Sawin (2009) that DSM outcomes can be improved when individuals and their families gain knowledge about diabetes, which eventually leads to self-efficacy. The correlation matrix showed a strong link between diabetes knowledge and perceived self-efficacy ($r = 0.487$, $p < 0.001$), indicating that inadequate diabetes knowledge may impact perceived self-efficacy, resulting in a low DSM score.

Surprisingly, fatalism could not predict DSM, nor was it correlated with DSM ($r = -0.152$, $p = 0.117$). The result of this study contradicted those from previous studies showing that fatalism was associated with DSM (Lange & Piette, 2006; Osborn et al., 2010) and even predicted it significantly (Walker et al., 2012). However, the result of this study was corroborated by some previous studies (Asuzu et al., 2017; Egede & Osborn, 2010). One possible explanation was that, concerning educational level, the participants' poor understanding of the scales resulted in low mean scores. Moreover, due to traditional Chinese culture, the participants might have hesitated to think about or answer questions about death freely.

On the other hand, fatalism was considered in the context of this study, but it was often described as a contextual

structure that manifests itself primarily during difficulties and sudden outbreaks of illness or symptoms (Keeley et al., 2009). It was not visible in the participants with a stable state of illness, as indicated by the low mean fatalism score. Based on the IFSMT, factors in the context dimension are interrelated with those in the process dimension, directly or indirectly influencing the outcomes (Ryan & Sawin, 2009). Likewise, fatalism was significantly related to diabetes knowledge ($r = -0.429$, $p < 0.001$), indicating that fatalism might be indirectly related to DSM, as Asuzu et al. (2017) found in their study. In addition, other confounding factors might influence this relationship, such as health literacy and multiple comorbidities (Walker et al., 2012).

The findings from this study indicated that social support could not predict DSM among adults with T2DM ($\beta = 0.123$, $p = 0.129$), although social support was correlated with DSM ($r = 0.312$, $p = 0.001$). This finding was similar to some previous studies (Ji et al., 2020; Kurnia et al., 2017). Social support was considered to contribute to enhanced knowledge, improved self-regulation skills, and higher levels of self-efficacy, leading to better DSM (Ryan & Sawin, 2009). In the findings, the low level of social support could be explained by the fact that none of the participants required assistance to carry out daily activities at home, which affected the DSM outcomes. Only two types of social support, family support and support outside the family were assessed in this study, but other sources of support might have also been received by individuals (Ryan & Sawin, 2009). The inconsistency of these two parts could explain why social support cannot predict DSM. Close family ties and relationships are highly valued in traditional Chinese culture (Liu, 2012). The statistics also confirmed that 90.7% of the participants lived with their families. Yet, the family support score was not as high as expected. The researchers attributed this to ineffective family support, possibly due to a lack of diabetes knowledge and insufficient time. Except for family support, the score of the other type was lower, indicating that the individuals received less support from outside the home. The majority of the participants were of working age and might be under employment-related pressure (Bezo et al., 2020). Healthcare workers might also be overworked and limited in time to provide support, especially in light of the Covid-19 pandemic.

Strengths and Limitations

The study was initially designed to improve understanding of the factors influencing DSM in China, although the nature of the cross-sectional design renders the determination of causality impossible. In particular, the correlation between fatalism and social support with DSM warrants further research. In China, fatalism is still relatively new, and information about it is limited. To the best of our knowledge, this is the first study to describe the relationship between fatalism and DSM in China. It also provides additional information and understanding for future research. The variables could explain only 38.2% of the variation of DSM, indicating that other factors should be investigated further. Another limitation was the only Chinese version of the fatalism scale. Despite the small sample size, the findings are applicable for ongoing research and development and the implementation of individual-specific interventions.

Implications and Recommendations

Based on the findings, nurses and healthcare providers need to focus more on increasing individuals' knowledge, self-efficacy, and DSM skills. In the nursing process, nurses are expected to improve patients' abilities to think critically and act autonomously and those of their families, which would facilitate the effective practice of DSM. Medical and nursing staff should develop related interventions promptly to achieve HbA1c treatment goals, and the awareness of adults with diabetes of the significance of HbA1c values should be raised—also, the program should be aimed at increasing diabetes knowledge. Perceived self-efficacy can assist adults living with patients with T2DM in optimizing their lifestyle, minimizing the potential risk of diabetes-related complications, and developing desirable DSM outcomes. As the study results are limited in generalization, similar studies should be conducted elsewhere in China, and other potential variables affecting DSM should be investigated further, such as health literacy and multiple comorbidities. Furthermore, the Chinese version of the diabetes fatalism scale needs to be developed further so that it can be applied to adults with T2DM in the Chinese context.

Conclusion

In conclusion, DSM was suboptimal among adults with T2DM in Wenzhou, China. The second major finding was that diabetes knowledge and perceived self-efficacy could significantly predict DSM, whereas fatalism and social support could not. In addition, all independent variables were found to influence each other, thus influencing diabetes knowledge and perceived self-efficacy. Based on the IFSMT, reducing fatalism by increasing diabetes knowledge could help improve DSM. Taken together, the findings indicate that improving diabetes knowledge and perceived self-efficacy, reducing fatalism, and enhancing effective social support could improve the DSM.

Declaration of Conflicting Interest

All authors declared no potential conflict of interest to report.

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Authors' Contributions

All authors provided substantial contributions to the conception and design, acquisition of data, or analysis and interpretation of data. In addition, all drafted the manuscript or revised it critically for important intellectual content and provided approval of the final version.

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Data Availability

The dataset generated during and analyzed during the current study is available from the corresponding author upon reasonable request.

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