ORIGINAL RESEARCH

Mediating Role of Depression Between Diabetes Management Self-Efficacy and Diabetes Self-Care Behavior Among Elderly Type 2 Diabetes Mellitus Patients in China

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Objective: To investigate the current status of diabetes self-care behavior and the association between depression, self-efficacy and self-care in a sample of Chinese elderly type 2 diabetes mellitus (T2DM) patients.

Methods: A cross-sectional study with a convenient sample including 240 elderly T2DM patients collected the data of demographic characteristics, diabetes self-care behavior, self-efficacy and depression status. The difference of self-care behavior in different sample characteristics was compared by independent t-test. The Personal correlation analysis was employed to examine the correlation of study variables. The method of bootstrap was used to analyze mediating role of depression.

Results: Only 22.5% of patients reported better diabetes self-care behavior and depression partly mediated the association between self-efficacy and self-care behavior. The significant coefficient of path a (B = −0.052, p < 0.001) and path b (B = −0.423, p < 0.05) indicated negative associations of self-efficacy on depression, and depression on self-care behavior. The indirect effect (Path a × b) between self-efficacy and self-care behavior through depression was significant (B = 0.022, p < 0.05), the 95% bias-corrected bootstrap confidence interval was 0.004 to 0.006. Meanwhile, the mediating role of depression was not found significant among the participants reported 60–74 years old (B = 0.104, p < 0.001). But depression completely mediated this association among the participants reported 75–89 years old (B = 0.034, p > 0.05).

Conclusion: The level of diabetes self-care behavior among the elderly T2DM patients in Dahu community of Anqing city was hardly optimistic. The self-efficacy focused intervention could be encouraged for community and clinicians to improve diabetes self-care behavior. Moreover, the prevalence of depression and T2DM is increasing in younger population. More work is needed to confirm these findings, especially conducting cohort studies on different populations.

Keywords: diabetes self-care behavior, the elderly, type 2 diabetes mellitus, diabetes management self-efficacy, depression

Introduction

International Diabetes Federation (IDF) Diabetes Atlas (Ninth edition) revealed a fact that 463 million people are suffering diabetes worldwide, of which, 116.4 million in China on the top of the ranking.[1] With the acceleration of ageing of the population processing in China and the changes in people's lifestyle and diet, the incidence of diabetes in the elderly shows a trend of rapid growth.[2] A nationally representative cross-sectional survey has been used in China. From

Chinese Geriatrics Society demonstrated the prevalence of diabetes in the elderly was more than 20% (90–95% elderly diabetes is T2DM), and this data will continue increase in the future, and the older patients have the higher incidence of diabetes complications and mortality.[3] It not only has impact on physical and mental health of people but also incurs more serious public health problems, increasing the burden on people's families and decreasing socioeconomic level.[4,5]

For T2DM patients, diabetes self-care is the cornerstone of diabetes management, and is identified as daily behaviors that patients perform to care their T2DM such as self-testing blood glucose, diet and exercise.[6] Importantly, a large number of researches demonstrated that good diabetes self-care behavior independently predicted a better glycemic control, reducing or postponing complication and improving the quality of life.[7–9] Although more and more studies focused on self-care behavior, in Chinese diabetes population especially in aged diabetes patients in community, there are limited studies concentrating on this issue and its influencing factors.[6]

An important factor accounting for poor diabetes self-care behavior is probably poor diabetes management self-efficacy.[6] The concept of self-efficacy originated from the social cognitive theory which considered individual's behaviors can be determined and influenced by their belief.[10] Employed in the field of diabetes, self-efficacy, as a strong predictor of diabetes self-care behavior,[11,12] is the belief of diabetics in the ability to achieve self-care activities. This relationship between them has been shown stable across racial/ethnic groups and across varying levels of health literacy.[13] In addition, some of experimental studies documented that self-efficacy focused intervention programs are beneficial to improve diabetes self-care behavior.[14,15] However, not all patients with good self-efficacy have good diabetes self-care behavior,[16,17] which indicated some adverse factors may hinder the process from the belief of self-efficacy to achievement of self-care behavior.

Recently, the studies of psychological factors among T2DM patients are emerging.[18,19] Depression, as a negative psychological factor, often co-occurs with diabetes. A meta-analysis identifying 42 studies revealed individuals with diabetes to be more than twice as likely to develop comorbid depression.[20] In China, the prevalence of depression among T2DM patients was close to 50%, influencing their and family's life severely.[21] Some of studies suggested that depression has a direct impact on the index of diabetes self-care behavior,[22,23] especially diet, exercise and glucose self-testing. A cross-sectional indicated that increased daily intake of vitamin B3 can reduce the risk of depression.[24] Another study found that a high intake of other vegetables and fruits was a significant contributor to the reduced prevalence of T2DM.[25] Diet has been shown to improve depressive symptoms and T2DM.[26] Moreover, diabetes self-efficacy was demonstrated negatively associated with depression and the improvement of self-efficacy may reduce the depressive symptoms of patients.[27] Nonetheless, there are no researches determining if depression mediated the relationship between self-efficacy and self-care behavior.

Taken together, this study will investigate the current status of diabetes self-care behavior and the mediating role of depression on the association between self-efficacy and self-care in a community sample of Chinese elderly T2DM patients. The following hypotheses are made.1. Self-efficacy was negatively correlated to depression. 2. Self-efficacy was positively correlated to self-care behavior. 3. The mediation effect of depression existed between self-efficacy and self-care behavior. It will be helpful to guide old patients to acquire perfect self-care behavior to achieve the goal of glycemic control and provide a valuable road for general practitioners to improve management and intervention efficiency.

Participants and Methods
Research Design
A cross-sectional study using face-to-face questionnaire was conducted in a community service center in Anqing City of Anhui province, China. Anqing is located in southeast China, Longitude: 117.054, Latitude: 30.5248. After preliminary investigation, the community has a sufficient sample population that meets the criteria and the community has good cooperation with this research group, which can ensure that the research is rigorous and smooth.

Participants
This study complies with the Declaration of Helsinki. Ethical approval was obtained from the institutional Ethics Committee at Anhui Medical University (ID:20190289) prior to the collection of data. All participants provided their

written informed consent prior to responding to the survey. Two hundred and forty elderly T2DM patients managed by Dahu community service center in Anqing city of Anhui province were recruited into this study. The criteria of all participants includes: (1) age ≥60 years; (2) diabetes duration ≥1 years; (3) able to reading and writing Chinese and communicating effectively in Chinese; (4) meets WHO 1999 diagnostic criteria for diabetes. Participants were excluded when investigators found patients had severe psychotic illness, cognitive impairment and major complications that might influence their confidence and performance of diabetes self-care activities.

Data Collection

Data were collected from May to November, 2019 in Dahu community service center of Anqing city. The investigators are graduate students with some specialized knowledge. Before the survey, all investigators received training to ensure they absolutely understand the ideal of this survey and acquired investigation skill. After getting informed consent from participants, investigators released the questionnaire to participants who met the inclusion and exclusion criteria. Each person fills out the questionnaire in a separate room to ensure that they are not influenced by others. Any questions during the filling process will be explained by the researchers. Finally, 240 valid questionnaires were obtained.

Measurements

As a measuring tool, the questionnaire initially included general demographic questions such as age, gender (males and females), social economical status and so on. Age was divided into 60–74 years (young-old) and 75–89 years (old-old) groups.[28] Otherwise, diabetes-related questions such as diabetes duration (continuous variable), personal monthly expenditure on diabetes and three major scales which measured diabetes self-care behaviors, diabetes management self-efficacy and depression were followed.

Diabetes Self-Care Behavior

The Summary of Diabetes of Self-care Activities (SDSCA) was developed by Toobert et al[29] for diabetics over 60 years old. It was widely employed to assess diabetes self-care behavior in community-based old diabetics both in China and in the other countries.[30–32] In this study, the Chinese version of scale consists of 11 items, measuring, respectively, 6 subdomains such as general diet (2 items), special diet (2 items), exercise (2 items), blood sugar testing (2 items), foot care (2 item), and medication taking (1 item). The score of every item ranging from 0 to 7 represents the number or average of days in a week for completing these activities. The possible total score was 0–77, with higher total score showing better level of self-care behaviors. According to scoring index = (actual score/highest possible score) × 100%, scoring index ≥60% is defined as better self-care behavior. Wan et al[33] tested the reliability and validity of the scale, the overall Cronbach's α was 0.84, the Cronbach's α of 5 subscales was 0.71~0.93.

Diabetes Management Self-Efficacy

To evaluate diabetes management self-efficacy, this study used Chinese version of the Diabetes Management Self-efficacy Scale (C-DMSES) which translated from the 20-items Australia/English version DMSES by Shu-Fang Vivienne Wu (Cronbach's alpha = 0.77 to 0.93).[34] This measurement asks participants to recall their confidence in managing their blood glucose level, foot care, medication, diet, and level of physical activities. The possible total score is around 0–200 and a high score represents a high level of self-efficacy. According to scoring index = (actual score/highest possible score) × 100%, scoring index ≤40% is defined as low level of self-care behaviors, 40–80% is medium level, and ≥80% is high level. In this study, this scale exhibited high reliability (Cronbach's alpha = 0.936).

Depression

The Patient Health Questionnaire-9 (PHQ-9) was widely employed to determine depression status by evaluating the frequency of occurrence of 8 symptoms in emotion and 1 symptom in suicide ideation among diabetics in China and in the other countries.[35,36] It is a 9-items scale and the score of each item is 0–3. Therefore, the total score ranges from 0 to 27. The total score among 0–4 indicates no depression. The total score over 4 indicates having depressive symptoms. The Cronbach's alpha is 0.783 in the present study.

Statistical Analysis

SPSS 23.0 (Statistical Product and Service Solutions, SPSS) was used to manage and analyze data. Firstly, each variable was described by mean (standard deviation) or number of cases (percentage). Secondly, the differences of self-care behavior in different demographic characteristics, diabetes-related information, diabetes management self-efficacy, depression were, respectively, compared by independent *t*-test. Then, the Pearson correlations analysis was employed to analyze the correlation among diabetes management self-efficacy, depression and diabetes self-care behavior. Finally, the method of Bootstrap using PROCESS macro in SPSS 23.0 recommended by Hayes[37] was applied to test the mediation effect of depression between diabetes management self-efficacy and self-care behavior by using Model 4 in the way that the bias-corrected 95% confidence interval (CI) was calculated with 5000 bootstrapping re-samples. The Bootstrap 95% CI of indirect effect (Path a×b) without "0" indicted a significant mediation effect. Moreover, the mediating effect of depression also was tested respectively in different age groups. The study considered statistical significance at p-value <0.05 (two-tailed).

Results

The Characteristics of Participant

The demographic characteristics, diabetes-related characteristics, self-care behavior, self-efficacy, and depression of 240 older adults with T2DM are shown in Table 1. The mean age of participants was 73.76 years, ranged from 60 to 88 years old, with 108 (45.0%) male. Most participants were married (76.7%) and with having junior high school or above educational level (65.4%). There are 36 (15.0%) patients had a household monthly income <2000 yuan and 87 (36.3%) spend more than 400 yuan on diabetes monthly. The mean diabetes duration of the participants was 12.47 years and the mean BMI was 23.73. There are 54 (22.5%) patients had better self-care behavior and 89 (37.1%) had high level of self-efficacy. Nearly half of participants suffered from depression (46.7%).

Table 1 Participants' Demographic Characteristics, Diabetes-Related Characteristics, Self-Care Behavior, Self-Efficacy, and Depression (n = 240)

Variable	Mean (SD)	N(%)
Age (years)	73.76 (7.01)	
60–74		128 (53.3)
75–89		112 (46.7)
Gender		
Male		108 (45.0)
Female		132 (55.0)
Marriage		
Married		184 (76.7)
No married		56 (23.3)
Education		
Primary school or below		83 (34.6)
Junior high school		85 (35.4)
Senior high school		41 (17.1)
College or above		31 (12.9)
Household monthly income (CNY)		
<2000		36 (15.0)
2000–4000		91 (37.9)
>4000		113 (47.1)
Diabetes duration (years)	12.47 (8.08)	
1–10		129 (53.8)
>10		111 (46.2)

(*Continued*)

Table 1 (Continued).

Variable	Mean (SD)	N(%)
Personal monthly expenditure on diabetes (CNY)		
<200		87 (36.3)
200–400		105 (43.7)
>400		48 (20.0)
BMI	23.73 (2.93)	
≥24		104 (35.8)
Self-care behavior (SDSCA total)	37.84 (12.27)	
Better self-care behavior		54 (22.5)
General diet	9.76 (4.28)	
Specific diet	7.32 (2.63)	
Exercise	5.83 (4.09)	
Blood sugar testing	4.74 (4.59)	
Foot care	4.17 (5.08)	
Medication taking	6.02 (2.12)	
Self-efficacy	139.12 (40.18)	
High level		89 (37.1)
Depression	5.03 (4.30)	
Depressed		112 (46.7)
No depressed		128 (53.3)

Note: SDSCA was used to evaluate the level of self-care behavior.
Abbreviation: SDSCA, the Summary of Diabetes Self-Care Activities.

Comparison of Participants' Characteristics with Self-Care Behavior

As shown in Table 2, the significant differences were found among SDSCA total score such as marriage ($p<0.05$), education ($p<0.01$), personal monthly expenditure on diabetes ($p<0.05$), BMI ($p<0.05$), self-efficacy ($p<0.001$) and depression ($p<0.001$). Individuals who were married, had junior high school education or above, the BMI <24 and spend

Table 2 Comparison of Participants' Demographic and Diabetes-Related Characteristics with Self-Care Behavior

Self-Care Behavior	Group	Mean (SD)	t	p value
SDSCA total	**Marriage**		1.979	0.049*
	Married	38.70 (12.49)		
	Unmarried	35.01 (11.14)		
	Education		−3.048	0.003**
	Primary school or below	34.58 (10.19)		
	Junior high school or above	39.57 (12.93)		
	Personal monthly expenditure on diabetes (CNY)		−2.288	0.023*
	≤200	35.46 (12.09)		
	>200	39.20 (12.20)		
	BMI		2.265	0.024*
	<24	39.40 (12.24)		
	≥24	35.81 (12.07)		
	Self-efficacy		−6.116	0.000***
	Medium and below level	34.38 (11.57)		
	High level	43.71 (11.19)		
	Depression		4.050	0.000***
	Depressed	40.75 (13.38)		
	Non-depressed	34.52 (9.92)		

(Continued)

Table 2 (Continued).

Self-Care Behavior	Group	Mean (SD)	t	p value
General diet	**Age (years)**		−3.528	0.001**
	60–74	8.87 (4.54)		
	75–89	10.78 (3.73)		
	Diabetes duration (years)		−2.752	0.006**
	1–10	9.06 (4.53)		
	>10	10.57 (3.84)		
	BMI			
	<24	10.63 (4.03)	3.711	0.000***
	≥24	8.62 (4.36)		
	Self-efficacy		−6.151	0.000***
	Medium and below level	8.54 (4.36)		
	High level	11.82 (3.26)		
	Depression		3.144	0.002**
	Depressed	8.85 (4.12)		
	Non-depressed	10.55 (4.28)		
Specific diet	**Household monthly income (CNY)**		−2.247	0.026*
	≤4000	6.97 (2.65)		
	>4000	7.73 (2.56)		
Exercise	**Gender**		2.011	0.045*
	Male	6.42 (4.07)		
	Female	5.36 (4.06)		
	Marriage		3.340	0.001**
	Married	6.31 (3.94)		
	Unmarried	4.27 (4.21)		
	Education		−3.827	0.000***
	Primary school or below	4.48 (3.93)		
	Junior high school or above	6.54 (4.00)		
	Self-efficacy		−5.381	0.000***
	Medium and below level	4.80 (4.04)		
	High level	7.58 (3.57)		
	Depression		6.324	0.000***
	Depressed	4.18 (3.96)		
	Non-depressed	7.28 (3.64)		
Blood sugar testing	**Personal monthly expenditure on diabetes (CNY)**		−2.155	0.032*
	≤200	3.90 (4.12)		
	>200	5.22 (4.79)		
Foot care	**Marriage**		2.443	0.015*
	Married	4.61 (5.30)		
	Unmarried	2.73 (4.00)		
	Education		−3.501	0.001**
	Primary school or below	2.63 (3.87)		
	Junior high school or above	4.99 (5.46)		
	Household monthly income (CNY)		−2.249	0.025*
	≤4000	3.48 (4.77)		
	>4000	4.95 (5.33)		
	Personal monthly expenditure on diabetes (CNY)		−2.533	0.012*
	≤200	3.08 (4.63)		
	>200	4.79 (5.24)		
	Self-efficacy		−5.478	0.000***
	Medium and below level	2.87 (4.18)		
	High level	6.38 (5.71)		
	Depression		3.247	0.001**
	Depressed	5.15 (5.80)		
	Non-depressed	3.05 (3.85)		

(Continued)

Table 2 (Continued).

Self-Care Behavior	Group	Mean (SD)	t	p value
Medication taking	**Diabetes duration (years)**		−2.069	0.040*
	1–10	5.75 (2.37)		
	>10	6.32 (1.75)		
	Self-efficacy		2.342	0.020*
	Medium and below level	6.26 (1.76)		
	High level	5.60 (2.59)		

Notes: SDSCA was used to evaluate the level of self-care behavior. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.
Abbreviation: SDSCA, the Summary of Diabetes Self-Care Activities.

more than 200 yuan on diabetes monthly were more likely to have higher score of SDSCA total. In terms of the subscales of SDSCA, the participants among 75–89 years old presented higher score of general diet compared with the age of 60~74 ($p<0.01$). The male elderly participants reported higher score of exercise ($p<0.05$). The married participants reported higher score of exercise ($p<0.01$) and foot care ($p<0.05$). The household monthly income of participants >400 yuan was significantly relating to higher score of specific diet ($p<0.05$) and foot care ($p<0.05$). The participants who had a junior high school education or above were more likely to have higher score of exercise ($p<0.001$) and foot care ($p<0.01$). The participants who spend more than 200 yuan on diabetes monthly reported higher blood sugar testing score ($p<0.05$). The diabetes duration of participants >10 years was significantly relating to higher score of general diet ($p<0.01$) and medication taking ($p<0.05$). The participants who had a BMI <24 were more likely to have higher score of general diet ($p<0.001$). Moreover, the participants who reported high level of self-efficacy were more likely to have higher score of SDSCA total ($p<0.001$), general diet ($p<0.001$), exercise ($p<0.001$), foot care ($p<0.001$) and medication taking ($p<0.001$). The participants without depressive symptoms reported higher score of SDSCA total ($p<0.001$), general diet ($p<0.01$), exercise ($p<0.001$), and foot care ($p<0.01$).

Correlation Between Self-Efficacy, Depression and Self-Care Behavior

Table 3 provides the correlation between self-efficacy, depression and self-care behavior. Self-efficacy was negatively correlated to depression (p < 0.01), and correlation coefficient is −0.486. Self-efficacy was positively correlated to self-care behavior (r = 0.311, p < 0.01). Depression had a significantly negative relation to self-care behavior (r = −0.264, p < 0.01).

The Mediation Effect of Depression Between Self-Efficacy and Self-Care Behavior

Table 4 shows the results of the mediation analysis. In the total participants, the total effect (path c) of self-efficacy on self-care behavior was significant (B = 0.095, $p<0.001$). The significant coefficient of path a (B = −0.052, $p < 0.001$) and path b (B = −0.423, $p < 0.05$) indicated negative associations of self-efficacy on depression, and depression on self-care behavior. The indirect effect (Path a×b) between self-efficacy and self-care behavior through depression was significant (B = 0.022, $p < 0.05$), and the 95% bias-corrected bootstrap confidence interval was 0.004 to 0.006. The path c' was significant (B = 0.073, $p < 0.001$), which indicated that depression partly mediate the relationship between self-efficacy and self-care behavior. The significant coefficients are shown in Figure 1. However, the indirect effect was not significant

Table 3 Correlation Between Self-Efficacy, Depression and Self-Care Behavior

Outcome Variables	1	2	3
1. Self-care behavior	1.00	–	–
2. Self-efficacy	0.311**	1.00	–
3. Depression	−0.264**	−0.486**	1.00

Note: **$p < 0.01$.

Table 4 The Mediation Effect of Depression Between Self-Efficacy and Self-Care Behaviors

Participants	Variable	Path c		Path c' and b		Path a		Path a×b			
		B	SE	B	SE	B	SE	B	SE	LLCI	ULCI
Total	Self-efficacy	0.095***	0.019	0.073***	0.021	−0.052***	0.006				
	Depression	–	–	−0.423*	0.120	–	–	0.022*	0.011	0.004	0.046
	R^2_{adj}	0.097		0.113		0.237					
	F	25.420		15.137		73.738					
Age:60–74	Self-efficacy	0.094***	0.025	0.104***	0.029	−0.049***	0.009				
	Depression	–	–	0.203	0.266			−0.010	0.013	−0.036	0.015
	R^2_{adj}	0.098		0.103		0.212					
	F	13.751		7.144		33.795					
Age:75–89	Self-efficacy	0.091**	0.028	0.034	0.031	−0.054***	0.009				
	Depression	–	–	−1.061***	0.288	–	–	0.058**	0.020	0.027	0.104
	R^2_{adj}	0.088		0.188		0.258					
	F	10.558		12.655		38.174					

Notes: ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$.

among the participants reported 60–74 years old, the 95% bias-corrected bootstrap confidence interval was −0.036 to 0.015. Among the participants reported 75–89 years old, the path c' was significant (B = 0.034, $p > 0.05$), which indicated that depression completely mediate the relationship between self-efficacy and self-care behavior.

Discussion

This study evaluated the current status of diabetes self-care behavior and examined the mediating role of depression between diabetes management self-efficacy and self-care behavior among the elderly community T2DM patients in China.

The results revealed the level of diabetes self-care behavior was dissatisfied in this community. Only 22.5% of patients possessed better diabetes self-care behavior in this sample that included 240 elderly with T2DM. It is similar with the result of another recent study that 20.1% of diabetics reported having better diabetes self-care behavior in other communities in China.[31] As bodily and social functions are increasingly decline, a lot of important factors have impact on diabetes self-care behavior.[6] This study indicated individuals who are married, had junior high school education or above, had the BMI <24 and spend more than 200 yuan on diabetes monthly were more likely to have better diabetes self-care behavior. Moreover, this study found that the participants aged 75–89 had better general diet. The participants who have the diabetes duration >10 years was related to better general diet and medication taking. The reason may be related to the fact that the patients with the older age or longer diabetes duration had more knowledge and accumulated more experience about diabetes, which could promote self-care ability. Beyond that, we can see that the male elderly
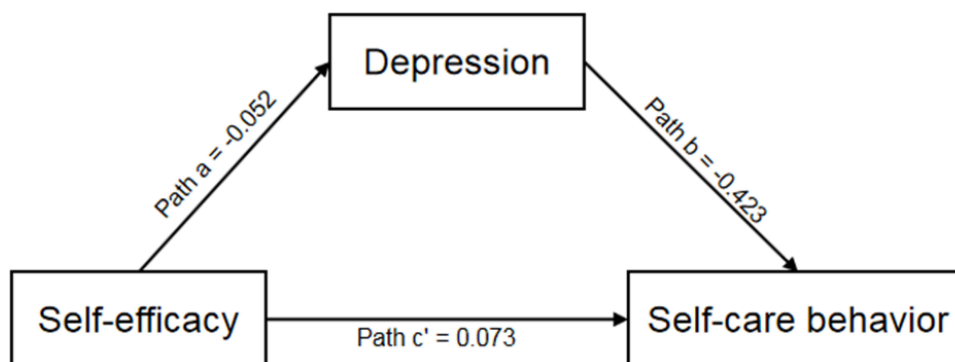

Figure 1 Schematic model of depression as the mediator between self-efficacy and self-care behaviors.

participants reported higher score of exercise and the higher household monthly income of participants was related to higher score of specific diet and foot care. Because the higher level of income indicated that greater capacity to obtain expensive food (such as milk and vegetables) and more time to manage daily life.

Social cognitive theory considered that individual's belief of self-efficacy determines whether coping behavior will be initiated, how much effort will be expended, and how long it will be sustained in the face of obstacles and aversive experiences.[11] Consistent with this assumption, the participants with higher self-efficacy also performed better self-care behavior, especially performing better general diet, exercise, foot care and medication taking in the present study, which was similar with the former research in China.[38] Meanwhile, the Personal correlation analyses confirmed again that self-efficacy of the elderly T2DM patients is positively associated with diabetes self-care behavior.

Depression and diabetes are all serious chronic diseases and often co-occur, especially among the elderly. Diabetes-related depression is also a major complication of diabetes. However, the pathogenesis remains to be revealed. Recently, studies have revealed that hippocampal neuronal apoptosis, triggered by mitophagy via the abnormal Glu-GluR2-Parkin pathway, may be involved in the pathogenesis of diabetes-related depression.[39] The elderly with DM experience always have greater risk for subsequent development or recurrence of depression, and conversely, the history of depression increases the risk for new onset DM.[40] There is a two-way effect between diabetes and depression. Moreover, compared to T2DM patients without depression symptoms, the patients suffering depression indicated increasing risk of severe disease, more complications, treatment resistance and higher mortality.[31] Meanwhile, those patients with depression performed poor self-care behavior.[40] Consistent with previous articles,[41,42] this study found that nearly half of participants suffered from depression and depression had negatively associated with diabetes management self-efficacy and self-care behavior.

In the context of diabetes self-care behavior, self-efficacy was mainly originated from positive emotion response.[43] However, there are no researches to investigate the role of negative emotion symptoms on the relationship between diabetes management self-efficacy and diabetes self-care behavior. The result that mediation role of depression added evidence to demonstrate our hypothesis that depression may mediate the association between diabetes management self-efficacy and diabetes self-care behavior among the elderly T2DM patients. However, the mediating role of depression was not found significant among the participants reported 60–74 years old. Depression exclusively mediated this association among the participants aged 75–89.

This study, applying it to the elderly T2DM patients, is considering the role of depression on relationship between diabetes self-care behavior and self-efficacy. There are some limitations that should be emphasized in this study. Firstly, our sample came from one community which cannot represent the overall elderly population in China. The sample size is relatively small. An investigation with large sample size should be carrying out to better speculate the current situation of diabetes self-care behavior and understand the relationship among depression self-efficacy and self-care behavior. For example, communities in different areas are sampled for surveys. Study representativeness was increased on the basis of expanding sample sizes. Secondly, compared to longitudinal designs, this cross-sectional design cannot clearly draw the causal conclusions. We will continue to carry out longitudinal and intervention studies in the future. Finally, this study did not control all the confounding factors such as family history of diabetes, complications, family history of T2DM, or chemical exposure, age, gender, comorbidities, drug use and so on. In later studies, we should attach the importance of controlling of confounding factors and consider them as the covariates during investigation.

With the acceleration of ageing of the population process and the rapid development of primary health care in China, community is becoming a critical site that managing and intervening chronic disease for older adults.[44] Therefore, it is of significant importance for the improvement of management and intervention focused on the elderly T2DM patients to investigate the current situation of diabetes self-care behavior and its influencing factors in community of China. Moreover, these findings can be helpful for community and clinicians to realize that strengthening diabetes management self-efficacy and controlling and relieving depressive symptom could improve self-care behavior among the elderly T2DM patients directly and indirectly, especially among adults aged 75–89. Community service center should both pay attention to the health outcome of the elderly T2DM patients and care their mental health.

Acknowledgments

Disclosure

The authors report no conflicts of interest in this work.

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