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Original Article

Correlation between blood glucose level and self-management level in patients with type II diabetes mellitus

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Abstract: Objective: To explore the correlation of blood glucose level with self-management level in patients with type II diabetes mellitus (T2DM) and the nursing of the patients. Methods: One hundred patients with T2DM were selected and randomized into a control group and a study group (n=50) according to random number table. Patients in the control group received routine nursing, while patients in the study group received routine nursing combined with comprehensive nursing on self-management behaviors. Patients in the two groups were compared in terms of the effects on blood glucose control and self-management level before and after nursing. According to the self-management scores after nursing, patients in the study group were divided into a low self-management score group (<75 points) and a high self-management score group with a score (≥75 points). The effects on blood glucose control were compared between the two groups. Pearson correlation and logistic regression were used to analyze the diagnostic values of indexes and the correlation of blood glucose level with self-management level. Results: After nursing, the scores for each dimension of self-management behaviors in the study group were significantly higher than those in the control group (all P<0.001). After nursing, the levels of serum fasting plasma glucose (FPG), 2-hour postprandial blood glucose (2hPBG) and glycosylated hemoglobin (HbA_1c) in the study group were significantly lower than those in the control group (all P<0.001), and the levels in the high self-management score group were significantly lower than those in the low self-management score group (all P<0.001). Pearson correlation analysis showed that the scores for each dimension and the total score of self-management behaviors were negatively correlated with blood glucose level in patients with T2DM (all P<0.05). Logistic regression analysis showed that the scores for each dimension and the total score were negatively correlated with blood glucose level in T2DM patients (all P<0.05). Conclusion: The blood glucose control is significantly correlated with the self-management level of patients with T2DM. Comprehensive nursing on self-management behaviors significantly improves the patients' self-management level and blood glucose control, so it is worthy of clinical promotion.

Keywords: Type II diabetes mellitus, blood glucose level, self-management level, correlation, nursing

Introduction

Diabetes mellitus (DM) is an endocrine and metabolic disease characterized by the chronic increase of blood glucose level. Type I DM is extremely rare and more than 90% of DM is Type II DM (T2DM) [1]. Occurring frequently in the middle-aged and elderly population, T2DM is featured by relative insulin deficiency due to the poor effect of insulin for a long time [2]. The disease has insidious onset and a long course, and its pathogenesis is affected by various risk factors, most of which are hyperglycemia, hypercholesterolemia and hyperlipemia. Advanced age and obesity also affect the pathogenesis. T2DM, which clinically manifests as polydipsia, polyphagia, polyuria, and weight loss, is accompanied by many complications. Vascular complications with the closest relationship to glycometabolism are the most common, and acute coronary syndrome and arteriosclerosis with high risks are the most severe. When suffering from the complications, patients with T2DM go to the hospital consciously. The complications cause great damage to the patients' quality of life. The higher the blood glucose concentration is, the poorer the quality of life is [3]. As modern lifestyle changes and population aging aggravates, the incidence of DM in China had been 11.6% in 2010; meanwhile, patients with DM around the world are expected to reach 592 million by 2035. The high incidence of the

disease has been globally recognized [4]. Therefore, it is urgent to improve the therapeutic efficacy for T2DM, and blood glucose control is critical to the treatment of this disease.

At present, hypoglycemic agents are usually used for blood glucose control in patients with T2DM. However, a study shows that drugs alone cannot solve the problem of blood glucose control, because the effects on the control are influenced by a variety of subjective and objective factors. Among the factors, self-management ability is the most relevant, and Pearson correlation analysis shows that the r is about -0.45 [5]. With a long treatment cycle and high treatment expenses, it brings physical and mental pressure to the patients during treatment and seriously affects the development, control and outcomes of the disease. Accordingly, drug intervention assisted by nursing intervention, which aims to improve patients' self-management levels in diet, exercise and other aspects, is vital to preventing the complications of DM and improving the blood glucose control of the patients [6]. Therefore, the correlation of blood glucose control with self-management in patients with T2DM and the nursing of the patients were analyzed in this study, to provide a new nursing direction for clinical practice.

Materials and methods

General information

This study was approved by the Medical Ethics Committee of Qingdao Municipal Hospital (Group). Altogether 100 patients with T2DM admitted to Qingdao Municipal Hospital (Group) from February 2017 to February 2018 were selected and randomized into the control and study groups (n=50). According to the self-management scores after nursing, patients in the study group were divided into the low self-management score group with a score lower than 75 points and the high self-management score group with a score higher than or equal to 75 points. Patients and their families agreed with this study and signed an informed consent form.

Inclusion criteria [7]: Patients met the diagnostic criteria for T2DM from WHO in 1999 [8]; patients were diagnosed with T2DM for more than 6 months; patients had acceptable language competence; patients were in good mental condition; patients had acceptable cognitive function; patients had no alcohol and drug dependence.

Exclusion criteria: Patients complicated with other thromboembolic diseases; patients complicated with severe organic diseases of basic organs, which included trunk and brain diseases; patients complicated with mental or cognitive disorders; lactating or pregnant women.

Methods

Patients in the control group received routine nursing, and they were instructed on diet, exercise, medication and other aspects. The patients were instructed to eat more food containing high fiber and high vitamin but less food containing high protein, high fat and high sugar. However, they were not guided and supervised during the process. The patients were educated on the importance of exercise and advised to get out of bed and walk more. However, their exercise was not supervised. The patients and their families were specifically informed of the dosage, types and time of medication, but the medication continuity was not checked. The patients' blood glucose was monitored on time and measured by nursing staff before breakfast, lunch and falling asleep at night. On the basis of the control group, patients in the study group received comprehensive nursing on self-management behaviors. Specific steps were as follows.

(1) Dietary management. Self-management guidance was conducted on the patients' diet. First, correct instruction manuals on diet were issued, which included the reasonable proportion of sugar, fat and protein in diet intake, and the intake of inorganic salts and vitamins. Besides, reasonable dietary choices and prohibited food containing absorbable sugar were specifically recorded. Second, the patients' diet for each meal was recorded on time and checked by themselves and their families. If the diet was unhealthy, they should improve it by themselves. In addition, the patients should have many meals but little food for each meal, and their diet was checked every night to improve their self-management ability on diet.

(2) Exercise management. Self-management guidance was conducted on the patients' exercise. First, professional nursing practitioners systematically educated the patients on the importance of aerobic exercises such as walking, jogging and yoga, and guided them to do

exercises. The amount of exercise and exercise intensity were gradually increased. Secondly, the patients should review their exercise contents, amount of exercise and self-perception every day. Before exercise, their blood glucose was detected by themselves, and they could do exercises only when their blood glucose level was 3.6 to 16 mmol/L. At the same time, their exercise conditions were monitored every day to improve their self-management ability on exercise.

(3) Medication management. Self-management guidance was conducted on the patients' medication. First, professional physicians instructed the patients and their families on the types, dosage, methods and frequency of medication, and educated them on the necessity and effectiveness of medication. Second, special cards for getting and taking the medicines were made for the patients, including the types, time and methods of the medication. At the same time, the patients' medication was recorded, monitored and checked every day to improve their self-management ability on medication.

(4) Blood glucose management. Self-management guidance was conducted on the patients' self-blood glucose monitoring. First, health education on the importance and necessity of self-blood glucose monitoring was carried out for the patients. Second, professional doctors patiently instructed the patients and their families how to use portable blood glucose meters until at least one person was skilled in using them. At the same time, spot checks were conducted on the self-blood glucose monitoring and the correctness of the steps was evaluated.

(5) Psychological nursing. Self-management guidance was conducted on the patients' negative emotions. First, the negative emotions were channeled on time. The nursing staff told the patients their illness and the significance of treatment, in order to enhance their confidence in treatment and relieve their anxiety and depression. Second, the patients were informed of the importance of good emotions to recovery, and were guided to self-channel negative emotions. Depressed patients could relieve their depression through getting support from their relatives and friends, going out to relax, bathing and listening to music. They could also seek enlightenment from professional doctors when necessary.

(6) Sleep management. Self-management guidance was conducted on the patients' sleep. First, the patients were informed that sleep disorder was a common symptom of patients with diabetes, and there was no need to fear their existing sleep disorders, so as to prevent them from the exacerbation of panic and anxiety. Second, various methods of sleep improvement were provided for the patients to help self-regulate their sleep, including appropriate exercise, bathing and listening to soothing music before sleep.

Outcome measures and evaluation criteria

Main outcome measures: Effects on blood glucose control included the levels of fasting plasma glucose (FPG), 2-hour postprandial blood glucose (2hPBG) and glycosylated hemoglobin (HbA_1c) before and after nursing. FPG referred to the blood glucose level detected before breakfast, after the patients fasted overnight (at least 8-10 hours). 2hPBG referred to blood glucose 2 hours after lunch and dinner. HbA_1c referred to the proportion of hemoglobin binding to glucose in total hemoglobin. Self-management level consisted of the self-management level scores before and after nursing. Likert scoring [9] was used to score the patients' self-management behaviors such as diet, exercise, medication, blood glucose monitoring, body massage, and high and low blood sugar prevention and treatment. The total score was 130 points, which consisted of 30 points for diet, 20 points for exercise, 15 points for medication, 20 points for blood glucose monitoring, 25 points for body massage, and 20 points for high and low blood sugar prevention and treatment. Each subunit was divided into multiples of 5 points. Five points indicated full completion according to the doctor's instructions. Four points indicated frequent completion. Three points indicated occasional completion. Two points indicated rare completion. One point indicated no completion. Finally, the total score of each subunit was calculated.

Secondary outcome measures: Effects on blood glucose control in the high and low self-management score groups. According to the self-management scores after nursing, patients in the study group were divided into the high and low self-management score groups, and the mean levels of serum FPG, 2hPBG and HbA_1c were compared between the two groups. Correlation: Pearson correlation and logistic regression were used to analyze the correlation

Table 1. Comparison of general information (n, %) ($\bar{x}$ ± sd)

Group	Control group (n=50)	Study group (n=50)	χ^2/t	P
Gender (male/female)	26/24	27/23	0.040	0.841
Average age	44.9±13.80	45.20±14.10	0.108	0.915
Average duration (year)	1.34±0.65	1.31±0.36	0.285	0.776
BMI (kg/m^2)	24.43±2.34	24.35±2.31	0.172	0.864
Smoking (n, %)	27 (54.00)	26 (52.00)	0.140	0.841
Drinking (n, %)	25 (50.00)	26 (52.00)	0.040	0.841
Per capita household income (ten thousand yuan)	3.32±0.45	3.33±0.44	0.112	0.911
Treatment time (year)	0.57±0.15	0.58±0.14	0.731	0.345
Oral sulfonylureas/combined insulin	35/15	34/16	0.047	0.829
Educational level (n, %)			0.099	0.952
Primary school	21 (42.00)	21 (42.00)		
Secondary school	22 (44.00)	23 (46.00)		
College	7 (14.00)	6 (12.00)		
Self-management score	60.12±9.03	61.01±9.31	0.485	0.629

Table 2. Comparison of effects on blood glucose control before and after nursing ($\bar{x}$ ± sd)

Group	Control group (n=50)	Study group (n=50)	t	P
FPG (mmol/L)				
Before nursing	10.19±4.44	10.17±4.43	0.079	0.937
After nursing	8.64±3.12#	6.12±2.17#	4.731	0.000
2hPBG (mmol/L)				
Before nursing	14.72±3.21	14.94±3.13	0.347	0.729
After nursing	12.85±3.12#	10.12±2.41#	4.843	0.000
HbA_1c (mmol/L)				
Before nursing	27.38±3.46	27.23±3.34	0.119	0.905
After nursing	25.23±2.48#	20.19±2.05#	11.266	0.000

Note: FPG, fasting plasma glucose; 2hPBG, 2-hour postprandial blood glucose; HbA_1c, glycosylated hemoglobin. Compared with before nuring, #P<0.05.

of blood glucose level with self-management level.

Statistical methods

SPSS21.0 was used to analyze the statistical data. Measurement data were expressed as mean ± standard deviation, tested by independent samples t and represented by t. Ranked variables were tested by rank sum and represented by H. Count data were expressed by incidence (rate) (n%), tested by χ^2 and Fisher exact probability, and represented by χ^2. Logistic regression and Pearson correlation were used to analyze correlation, which included the correlation of blood glucose level with the scores for each dimension (diet, exercise, medication, blood glucose monitoring, body massage, and high and low blood sugar prevention and treatment), and the total score of self-management behaviors. When P<0.05, the difference is statistically significant.

Results

Comparison of general information

There was no significant difference in general information between the study and control groups (P>0.05). More details are shown in **Table 1**.

Comparison of effects on blood glucose control before and after nursing

Before nursing, there was no significant difference between the study and control groups in serum FPG, 2hPBG or HbA_1c level (P>0.05). After nursing, the three levels in the two groups were significantly lower than those before nursing (P<0.05), and the levels in the study group were significantly lower than those in the control group (P<0.001). More details are shown in **Table 2** and **Figure 1**.

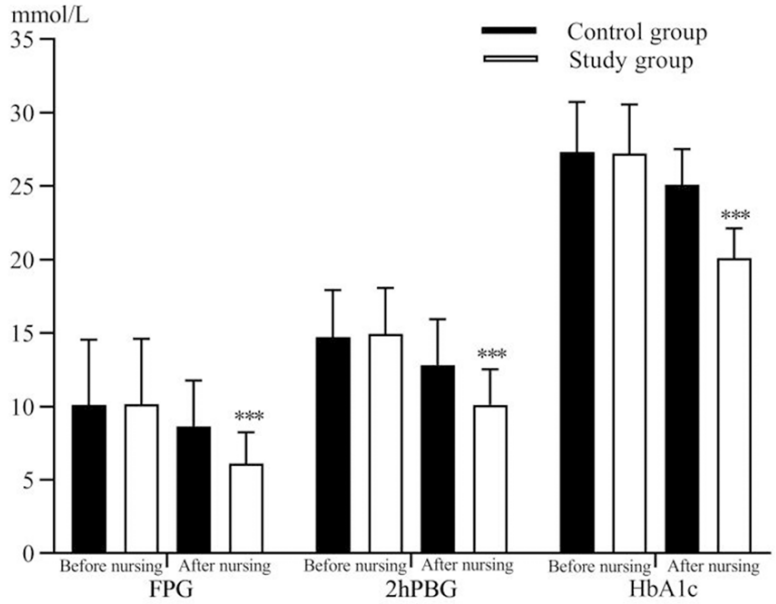

Figure 1. Comparison of effects on blood glucose control before and after nursing. Compared with the control group, ***P<0.001.

Comparison of self-management scores before and after nursing

Before nursing, there was no significant difference between the study and control groups in self-management scores (P>0.05). After nursing, the scores in the study group were significantly higher than those in the control group (P<0.001). More details are shown in **Table 3** and **Figure 2**.

Comparison of effects on blood glucose control between high and low self-management score groups

According to the self-management scores after nursing, patients in the study group were divided into the low self-management score group (n=20) and the high self-management score group (n=30). After nursing, the levels of serum FPG, 2hPBG and HbA_1c in the high self-management score group were significantly lower than those in the low self-management score group (P<0.001). More details are shown in **Table 4** and **Figure 3**.

Pearson correlation analysis of correlation of blood glucose level with self-management level

Pearson correlation analysis showed that the scores for each dimension and the total score of self-management behaviors were negatively correlated with blood glucose level in patients with T2DM (P<0.05). More details are shown in **Table 5**.

Logistic regression analysis of correlation of blood glucose level with self-management level

Logistic regression analysis showed that the scores for each dimension and the total score of self-management behaviors were negatively correlated with blood glucose level in patients with T2DM (P<0.05). More details are shown in **Table 6**.

Discussion

To control blood glucose level is efficient because the most fundamental change of T2DM is hyperglycemia caused by metabolic imbalance [10, 11]. Clinically, poor medication continuity and unhealthy living habits lead to the outcome [12]. Therefore, effective nursing intervention based on medication is very important to the treatment of T2DM [13]. Routine nursing, which includes medication, diet, exercise and other general guidance, provides treatment directions for patients, but its effect is unsatisfactory because of the patients' poor self-management [14].

T2DM is a chronic and lifelong disease and the patients' self-management level is significantly correlated with the effects on blood glucose control, so comprehensive nursing on self-management behaviors was used in patients with T2DM in this study. In Zhang's study, comprehensive health education containing improvement in self-management significantly improves the effects on blood glucose control and relieves complications of T2DM [15]. Comprehensive nursing on self-management behaviors aims at improving effects on blood glucose control, including diet, exercise, medication and sleep management, and psychological nursing [16, 17]. The most important one is medication nursing because medication continuity is critical to blood glucose control in T2DM. Patients who receive medication nursing fully understand the disease and the signifi-

Table 3. Comparison of self-management scores before and after nursing ($\bar{x}$ ± sd, n=50)

Group	Before nursing				After nursing			
	Control group	Study group	t	P	Control group	Study group	t	P
Diet	14.10±3.44	14.17±3.43	0.102	0.919	16.72±4.91	21.94±5.83	4.843	0.000
Exercise	7.81±1.01	7.77±1.02	0.197	0.844	8.12±1.03	11.34±1.21	14.329	0.000
Medication	8.56±0.78	8.57±0.76	0.065	0.948	10.45±1.23	13.41±1.93	9.145	0.000
Blood glucose monitoring	8.53±1.03	8.54±1.04	0.048	0.962	9.01±1.87	11.31±2.11	5.768	0.000
Body massage	14.43±1.98	14.34±1.97	0.228	0.820	16.43±2.01	19.21±2.31	6.420	0.000
High and low blood sugar prevention and treatment	8.42±2.01	8.43±2.03	0.025	0.980	10.56±3.01	13.34±3.13	4.527	0.000
Total score	60.12±9.03	61.01±9.31	0.485	0.629	73.31±13.41	87.21±17.21	4.505	0.000

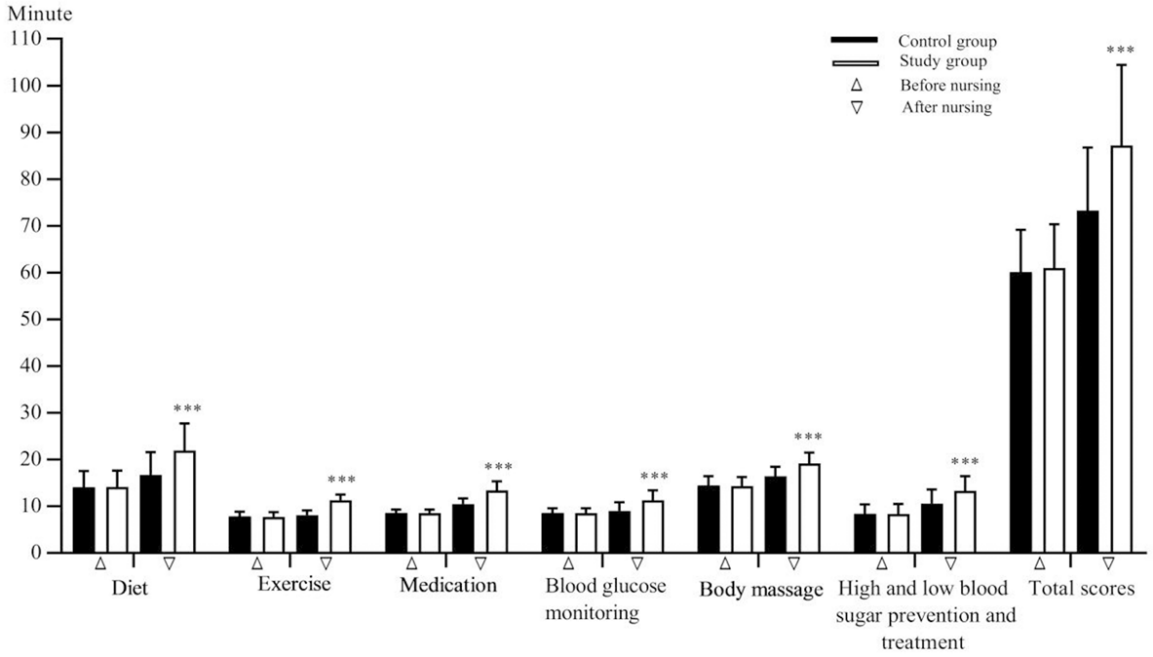

Figure 2. Comparison of self-management scores before and after nursing. Compared with the control group, ***P<0.001.

cance of treatment, which increases their medication initiative. They also master medication knowledge, which maximizes the efficacy of medication and avoids wrong medication. The whole medication is carried out through the patients' self-management, so the effect is remarkable. Meanwhile, diet, exercise and sleep management are conducted. The importance of the three management and their corresponding methods are informed, which enhances the patients' management initiative and enables them to master the management methods. As a result, the patients develop healthy living habits, which is conducive to reaching the standards of blood glucose control. The results of this study showed that the self-management scores in the study group were significantly higher than those in the control group, which indicates that self-blood glucose management is of great significance. Moreover, informing the patients of the significance of self-monitoring and the correct steps is helpful for blood glucose control. Psychological nursing is indispensable, because negative emotions are common symptoms of patients with T2DM and they negatively affect the patients' management initiative and effects on blood glucose control. In this study, psychological nursing was carried out during the whole process. The nursing staff not only psychologically channeled the patients, but also guided them to manage and channel their negative

Table 4. Comparison of effects on blood glucose control between high and low self-management score groups ($\bar{x}$ ± sd)

Group	FPG (mmol/L)	2hPBG (mmol/L)	HbA_1c (mmol/L)
Low self-management score group (n=20)	8.91±3.11	13.01±1.91	25.81±2.38
High self-management score group (n=30)	5.97±2.03	9.75±1.83	19.77±2.09
t	3.371	6.065	9.470
P	0.000	0.000	0.000

Note: FPG, fasting plasma glucose; 2hPBG, 2-hour postprandial blood glucose; HbA_1c, glycosylated hemoglobin.

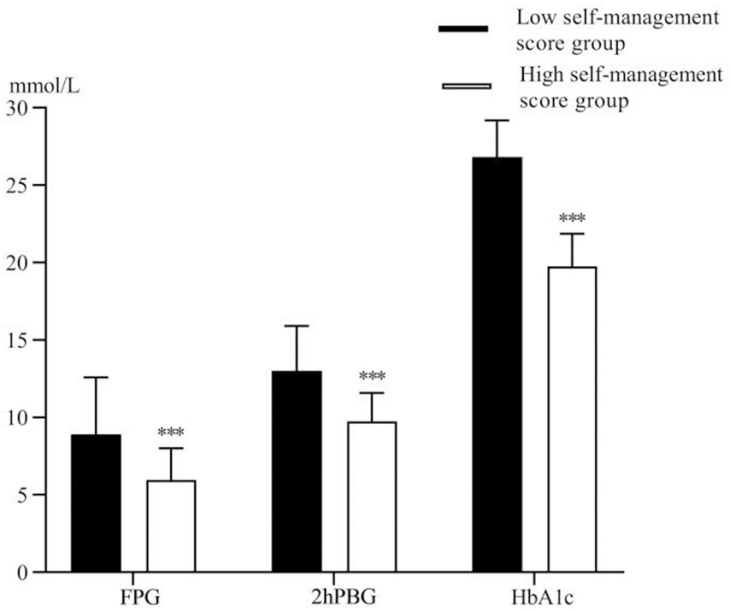

Figure 3. Comparison of effects on blood glucose control between high and low self-management score groups. Compared with the control group, ***P<0.001.

Table 5. Pearson correlation analysis of correlation of blood glucose level with self-management level (%)

Indicator	r	P
Diet	-0.575	0.01
Exercise	-0.351	0.00
Medication	-0.314	0.01
Blood glucose monitoring	-0.256	0.00
Body massage	-0.412	0.00
High and low blood sugar prevention and treatment	-0.345	0.00
Total score	-0.456	0.01

emotions by themselves, which could enhance their confidence in rehabilitation [18]. The results of this study also showed that the levels of serum FPG, 2hPBG and HbA_1c in the study group were significantly lower than those in the control group, which is consistent with the results of the above studies [19, 20]. This proves that comprehensive nursing on self-management behaviors in this study is beneficial to improve the patients' self-management level and control their blood glucose level.

According to studies, effects on blood glucose control are closely related to self-management level. The higher the self-management level is, the better the medication continuity and the effects of healthy living habits are. Therefore, effective control of blood glucose level is of great significance to avoid or delay complications caused by glucose metabolic disorders [21, 22]. Self-management includes the self-management of diet, exercise, blood glucose monitoring, medication and other aspects. The management of diet avoids the intake of high-sugar and high-calorie food as much as possible. The management of exercise accelerates the consumption of sugar. The management of medication facilitates the enhancement of medication continuity. All of them are conducive to blood glucose control [23, 24]. Therefore, improvement in self-management based on medication is critical to blood glucose control and treatment of patients with T2DM. The results of this study showed that after nursing, the levels of serum FPG, 2hPBG and HbA_1c in the high self-management score group were significantly lower than those in the low self-management score group, which indicates that

Table 6. Logistic regression analysis of correlation of blood glucose level with self-management level

Indicator	Regression coefficient	SE	Wald χ^2	Degree of freedom	P	Relative risk
Diet	0.217	0.083	21.902	1	0.000	1.038
Exercise	0.250	0.084	9.164	1	0.001	1.307
Medication	0.229	0.116	17.385	1	0.000	1.813
Blood glucose monitoring	0.228	0.113	9.211	1	0.000	1.312
Body massage	0.241	0.083	16.311	1	0.000	1.214
High and low blood sugar prevention and treatment	0.251	0.016	20.031	1	0.000	1.235
Total score	0.241	0.084	19.421	1	0.000	1.841

self-management level is an important influencing factor for improving blood glucose control. Pearson correlation analysis showed that the scores for each dimension and the total score of self-management behaviors were negatively correlated with blood glucose level in patients with T2DM, which further proves that self-management level is critical to the treatment of T2DM and it indicates the exact direction for the nursing of DM [25].

In this study, the sample size is small and there is no comparison of basic diseases between the research objects, which may affect the results. Therefore, the sample size should be enlarged in future studies to explore the nursing of T2DM.

In summary, metabolic control is significantly correlated with the self-management level of patients with T2DM. Comprehensive nursing on self-management behaviors significantly improves the patients' self-management level and blood glucose control, so it is worthy of clinical promotion.

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Disclosure of conflict of interest

None.

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