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The relationship between hope level and self-management behaviors in Chinese patients with type 2 diabetes mellitus: a chain-mediated role of social support and disease perception

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Abstract

Background Type 2 diabetes mellitus is a chronic disease and one of the fastest-growing global health emergencies of the 21st century. The relationships between hope level, social support, disease perception, and self-management behaviors are still unclear. Therefore, this study aimed to create a structural equation model to investigate the underlying mechanisms of self-management behaviors in patients with type 2 diabetes mellitus and provide a theoretical basis for future interventions.

Methods By using cross-sectional studies and convenience sampling methods. A survey was conducted from June 2023 to April 2024 on 404 patients with type 2 diabetes mellitus at the First and Third Hospitals of Jinzhou Medical University. Data were collected using scales, including the General Information Questionnaire, the Herth Hope Scale, the Social Support Rating Scale, the Brief Disease Perception Questionnaire, and the Diabetes Self-Management Behavior Scale. Data were analyzed using descriptive analysis, Harman's one-way analysis of variance, Pearson's correlation test, structural equation modeling, and the bootstrap method to verify mediating effects.

Results Correlation analyses showed that all four variables were significantly correlated with each other ($p < 0.01$). Social support had the strongest correlation with self-management behavior ($\beta = 0.554, p < 0.01$), followed by hope level ($\beta = 0.543, p < 0.01$), and disease perception ($\beta = -0.505, p < 0.01$). The structural equation model indicated a strong overall fit ($\chi^2/df = 3.378, GFI = 0.926, CFI = 0.924, IFI = 0.925, TLI = 0.903, RMSEA = 0.077$).

Conclusion Overall, the chain mediation of social support and disease perception was significant. In developing targeted intervention strategies, future research should prioritize enhancing hope, optimizing social support, and reducing negative perceptions of disease by patients as key areas of focus. At the same time, strengthening self-management abilities and health behaviors in patients with type 2 diabetes should not be neglected.

Keywords Type 2 diabetes, Hope level, Social support, Disease perception, Self-management behaviors

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Introduction

Diabetes mellitus (DM) is one of the global public health problems [1]. The International Diabetes Federation (IDF) reports in 2021 that [2] there are 537 million adults with diabetes and the absolute number of people with diabetes will increase by 46% by 2045. Of these, China has the largest number of people with diabetes [3]. Type 2 diabetes mellitus (T2DM) is increasing at an alarming rate due to rapid urbanization, aging of the population, and lifestyle changes [4]. T2DM is long and difficult to cure, often resulting in irreversible complications such as retinopathy, nephropathy, and cardiovascular disease that occur 5–10 years after diabetes is diagnosed [5]. Not only does it harm the patient's health and diminish their quality of life. It can even be life-threatening in severe cases. Therefore, patients with type 2 diabetes must follow a daily self-management program to maintain good blood glucose control and prevent complications.

However, faced with the challenging task of self-management and the fear of future complications, patients often find themselves in a psychological dilemma [6]. Therefore, effective psychological counseling is crucial for them. And studies have shown that [7], there is a significant link between attitudes and health behavior; a positive attitude towards a behavior leads to a greater willingness to do that behavior, and people with type 2 diabetes who have a positive attitude toward the treatment of their disease have greater self-management skills.

Hope is a dynamic force that transcends the status quo and creates a sustained positive contribution to life [8]. Hope level as a positive attitude plays a key role in promoting self-management behavior [9]. Effective patient self-management behavior is essential for successful diabetes control, which helps reduce risk factors associated with type 2 diabetes, prevent complications, and slow the progression of type 2 diabetes [10]. However, most surveys indicate that [11], many people with diabetes struggle with self-management deficits, and some suffer from depression, blindness, and foot ulcers, which have a severe impact on their quality of life and well-being. It is rumored that [12], An important reason for patients with type 2 diabetes mellitus to have lower self-management abilities is a lack of awareness of the importance of self-management, limited access to health information, limited education, and a lack of knowledge of the disease. In terms of understanding the disease, the perception of the disease is low, coupled with a negative attitude towards it and a lack of compliance, which results in inappropriate glycemic control and hinders the treatment and recovery of type 2 diabetes mellitus [13]. Disease perception, also known as disease cognition, refers to a patient's cognitive assessment and understanding of a medical condition and its potential consequences [14]. Some studies have confirmed that [15], disease perception is one of the

factors that affect self-management and psychological distress in diabetic patients. The perception of patients of their disease is closely related to their mental health, quality of life, and behavioral patterns of health. These indicators are crucial predictors of physical and mental health and play a crucial role in the management of chronic disease [16]. Social support refers to the various types of help and resources required from others that people receive from the social relationship network, which is an important factor in determining health behavior and psychological stress, and can help patients build confidence in coping with the disease and increase motivation to participate in self-health management [17]. Adequate social support helps promote the recovery of patients' physical and mental health. In contrast, a lack of social support can reduce the psychological adaptation of patients to the disease and impact their acceptance of it [18]. Family members, in particular, provide a major source of social support, not only providing emotional support to patients, but also helping them adapt to an effective lifestyle [19]. Living with family members allows patients to receive more supervision and help, to be more effective and confident in self-management, and to reduce negative perceptions of the disease [20]. It has been noted that [21] Diabetes Self-Management Support (DSMS) is effective in improving blood glucose levels and quality of life, reducing healthcare costs, and maintaining self-management behavior, and is a crucial strategy to improve patients' long-term autonomy and well-being. Providing adequate social support to patients with negative attitudes towards the disease or low motivation will increase their hope and confidence in treatment, reduce negative perceptions of the disease, reduce negative emotions caused by the disease, and encourage them to understand and learn to improve their knowledge of the disease, including self-management practices such as diet, exercise, medication, and blood glucose monitoring. This will help them achieve their goal of delaying the onset of disease complications and effectively managing the disease. To prevent disease complications and manage the disease, the patient should follow an appropriate self-management program [10, 12]. Therefore, it is crucial to provide social support and a positive perception of the disease to help patients with negative attitudes develop confidence and good self-management skills to control blood glucose levels and reduce complications.

Current research on the relationship between levels of hope and self-management behavior focuses on cancer patients [22, 23], and studies have shown that well-designed interventions can increase levels of social support and hope, which can help improve patients' self-management behaviors. Fewer studies have been conducted in patients with chronic diseases, but it has been found [24] that the level of hope affects self-management

behaviors in COPD and that by increasing patients' hope and belief in the treatment of their disease, their lifestyle, and self-management, their treatment can be effectively improved.

Theoretical foundation

Studies such as Alexander's [25] rethink the biopsychosocial (BPS-P) model of Karunamuni et al. [26] and point to the need to view biological, psychological, and social influences on health as an integrated whole, whereas the links between these influences are dynamic and interdependent, and to view human beings as social beings, and that we are all situated in an environment of social change. Furthermore, the social cognitive theory proposed by Bandura [27] emphasizes the concept of human agency and the concept of triadic reciprocal determinism. Human agency refers to the human ability to direct themselves through their thoughts, motivation, and self-action. In the binary model, reciprocal determinism explores the reasons why behavioral, cognitive, and other personal factors and environmental influences interact to produce mutual consequences. In this study, the person's level of hope and illness perception is considered subjective factors that influence behavior, with social support as an external environmental factor, and the individual's self-management behavior is governed by their level of hope and illness perception, as well as real-world conditions such as social support. After controlling for sociodemographic and work-related factors, patients with type 2 diabetes mellitus have a direct impact on their self-management behaviors. Similarly, the level of knowledge of the disease by the patients directly affects their self-care behaviors. Furthermore, social support and perception of disease can indirectly influence their self-management behaviors by influencing their level of hope. The psychological aspects of patients with type 2 diabetes can be broadly categorized as follows: knowledge of diabetes, attitudes toward treatment, self-efficacy, and level of hope and confidence in the treatment of the disease. Social cognitive theory can be a useful framework for understanding the occurrence of target behaviors. However, there is a lack of research on how the individual and their environment interact with each other in the "triadic interaction model" to influence behavior.

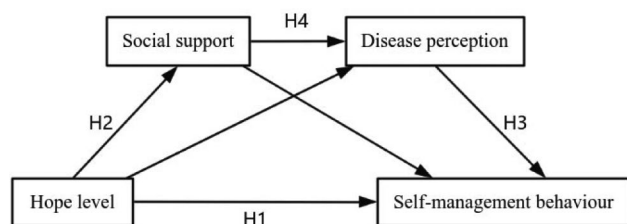


Fig. 1 Chain mediation model and assumptions

Research Methodology and Hypotheses

Based on the literature review and social cognitive theory. We adopted a cross-sectional study design and quantitative survey methods are used for research. We used a chain mediation model to test the mediating roles of social support and disease perception on the level of hope and self-management behavior in patients with type 2 diabetes. Based on a literature review, we created a chain mediation model and proposed the following hypotheses, as shown in Fig. 1. To investigate this association, we used structural equation modeling (SEM) to identify the mediating effect and construct the SEM hypothesis model. The aim is to provide a theoretical basis for clinical staff to improve self-management behaviors in patients with type 2 diabetes.

Hypothesis 1 The hope level is positively associated with self-management behaviors in patients with type 2 diabetes mellitus.

Hypothesis 2 The hope level can indirectly influence self-management behavior in people with type 2 diabetes through the mediation of social support.

Hypothesis 3 Hope level can indirectly predict self-management behavior in patients with type 2 diabetes through the mediating role of disease perception.

Hypothesis 4 Hope level can indirectly predict self-management behavior in patients with type 2 diabetes through chain-mediated effects of social support and disease perception.

Materials and methods

Participants

In this study, a cross-sectional study and convenient sampling were used to collect data at the First Affiliated Hospital and the Third Affiliated Hospital of Jinzhou Medical University. First, communicate with the director of the nursing department at the hospital to explain the purpose of this investigation. Two nurses were recruited as investigators for two hospitals. And then contact the head nurse of the endocrinology department for approval. Second, the investigators were trained in the endocrinology departments of the two hospitals, giving them sufficient professional skills. Clarify the grading standards and communication skills. Finally, after obtaining informed consent from the researchers, hospitalized patients with type 2 diabetes were asked to complete the survey on their own. For the calculation of the sample size, according to Kendall M's rough sampling criterion, the sample size should be 5 to 10 times the sum of all dimensions of the scale. After considering a sample loss rate of 20%, 425 questionnaires were distributed in the study, and 404

questionnaires were finally valid after excluding invalid questionnaires. The patients had to meet the following criteria: (1) patients who met the diagnosis of type 2 diabetes according to the 2020 Chinese guidelines for the prevention and treatment of type 2 diabetes and the diagnostic and classification criteria of the World Health Organization [28]. (2) aged ≥ 18 years; (3) conscious, capable of communicating, and those who gave their informed consent to the study. Exclusion criteria: (1) those who have suffered from severe acute complications of diabetes mellitus and other serious organic pathologies; (2) patients with psychiatric and psychological disorders; (3) those who have participated in other studies.

Table 1 Characteristics of the demographic sample ($N=404$)

Characteristics	Categories	N	Percentage (%)
Age	18–44	67	16.6
	45–59	241	59.7
	≥ 60	96	23.8
Gender	Male	286	70.8
	Female	118	29.2
Marriage status	Unmarried	57	14.1
	Married	274	67.8
	Divorced	38	9.4
	Widowed	35	8.7
Educational level	Primary and lower	101	25.0
	Middle school	220	54.5
	University and above	83	20.5
Occupational status	Incumbency	297	73.5
	Retired/Unemployed	93	23.0
	Other	14	3.5
Average monthly family income	<3000 yuan	110	27.2
	3000–5000 yuan	216	53.5
	>5000 yuan	78	19.3
Type of medical insurance coverage	Urban workers' medical care	183	45.3
	Urban and rural residents' medical care	128	31.7
	Self-financed	93	23.0
Duration of diabetes mellitus	Less than five years old	150	37.1
	5–10 years	174	43.1
	More than 10 years	80	19.8
Complication	No	243	60.1
	Yes	161	39.9
Current treatment programmes	Diet control alone	14	3.5
	Oral hypoglycemic agent	173	42.8
	Insulin	166	41.1
	Insulin and hypoglycaemic drug therapy	51	12.6
Educated about diabetes	No	224	55.4
	Yes	180	44.6
Ways to find out that you have diabetes	Proactive diagnosis	121	30.0
	Passive diagnosis	283	70.0

Measures

Demographic characteristics

The general characteristics questionnaire included age, gender, marital status, education, occupational status, average monthly household income, and type of health insurance. Disease-related information included the duration of diabetes, comorbidities, current treatment regimen, diabetes-related education, and ways to detect diabetes. Table 1 provides comprehensive demographic information.

Herth hope scale (HHI)

Compiled by the American scholar Herth [29] in 1992, it is primarily used to measure the level of hope in patients with cancer or chronic diseases. In this study, we used the HHI, which was translated by Hai-Ping Zhao et al. [30]. The scale consists of 12 entries divided into 3 dimensions, each of which consists of 4 entries, that is, positive attitudes toward reality and the future (entries 1, 2, 6, and 11), taking positive actions (entries 4, 7, 10, and 12), and maintaining close ties with others (entries 3, 5, 8, and 9), with a Cronbach alpha coefficient of Each entry consisted of four options, namely 'strongly disagree', 'disagree', 'agree', 'strongly agree', and 'strongly agree', which were scored as 1 respectively. Each entry consisted of four options: 'strongly disagree', 'disagree', 'agree', and 'strongly agree', which were scored as 1, 2, 3, and 4 respectively. The scoring was done using a Likert 4-point scale, with entries 3 and 6 reversed scored. Patients were divided into three groups based on their hope level scores: 12 to 23 points indicated a low hope level, 24 to 35 points indicated a moderate hope level, and 36 to 48 points indicated a high hope level. The Cronbach's α coefficient for this study was 0.906.

Social support rate scale (SSRS)

The scale was developed by Shaw Shui Yuen [31] in 1994 and consists of 10 entries. It is divided into three dimensions: subjective support (Topics 1, 3–5), objective support (Topics 2, 6, 7) and utilization of support (Topics 8–10). Topics 1 to 4 and 8 to 10 were single-choice questions, with ①, ②, ③, and ④ scoring 1, 2, 3, and 4 points respectively, and topic 5 was divided into five sources of support, A, B, C, D, and E, each of which was scored 1 to 4 points, respectively, for each of the sources, ranging from 'no' to 'complete support'. Each source is rated from "none" to "full support" with a score of 1 to 4 points. Topics 6 and 7 were evaluated band several sources scored with higher scores, ased on actual situations, with no source scored as 0, representing higher levels of social support. A score of ≤ 22 represents a low level, 23–44 represents a medium level, and 45–66 represents a high level. The higher the score, the higher the level of social

support, and Cronbach's alpha coefficient for this scale in this study was 0.860.

Brief illness perception questionnaire (BIPQ)

Developed by Broadbent et al. [32] in 2006 and translated by Chinese scholars Sun Weiming et al. [33]. There are nine entries, including five entries (entries 1–5) for the perception dimension, two entries (entries 6 and 8) for the comprehension dimension, and one entry (entry 7) for the emotion dimension, for a total of three dimensions. Entry 9 was an open response item that asked participants to list the three most important self-perceived causal factors of the disease and was not included in the overall score. The first eight items on the scale are scored on a scale of 0–10, and the questionnaire's total score is calculated by summing the scores for each item, with items 3, 4, and 7 being reversed, and higher scores representing more negative perceptions of the patient's illness. The Cronbach's alpha coefficient for this scale in this study was 0.855.

Summary of diabetes self-care activities (SDSCA)

The Diabetes Self-Management Behavior Scale compiled by foreign scholar Toobert [34] and translated by Chinese scholar Wan Qiaoqin [35] and others in Chinese was used. The scale consists of five dimensions: diet (4 items), exercise (2 items), blood glucose monitoring (2 items), foot care (2 items), and medication (1 item), with a total of 11 items, of which 10 items are positively scored and 1 item is negatively scored, and each item is scored on a scale of 8 points, ranging from 0 to 7 points, and the total score and the score of each dimension were calculated as follows: the sum of each item was divided by the number of items, with ≤ 4.1 points as poor, $4.2 \sim 5.5$ points as moderate and ≥ 5.5 points as moderate. 5.5 as moderate, and ≥ 5.6 as good. The Cronbach's alpha coefficient for this scale in this study was 0.880.

Ethical approval

The research was authorized by the Ethics Committee of Jinzhou Medical University (JZMULL2023075), followed by the 1964 Proclamation of Helsinki and its subsequent

amendments, and informed consent was obtained from each study participant before the study.

Data analysis

Statistical analyses were performed with SPSS 26.0 and Amos 24.0 statistical software. Common-method bias was assessed using the Harman one-way test. Descriptive analysis of demographic samples was performed, followed by a Pearson correlation analysis to analyze the correlation between the four variables. SEM was calculated using Amos 24.0 and the mediation effects model was validated using the Bootstrap method. $p < 0.05$ was considered statistically significant. The 95% confidence interval (CI) for the mediating effect was estimated by extracting 5,000 bootstrap samples. The significance of the effects is tested by whether the CI contains 0. The non-inclusion of zero in the CI indicates a significant effect [36].

Results

Common method bias test

All data were based on self-reports in the questionnaire, and we performed an unrotated exploratory factor analysis of all measures using the Harman one-way test [37], which showed that a total of 12 common factors with eigenvalues greater than 1 were present and the first common factor explained 29.894% of the total variation, which is less than the 40% criterion [38]. Therefore, there was no significant bias from the common method in this study.

Characterization of demographic samples

A total of 425 data was collected, with 21 samples that had too short a response time and identical answers deleted, a total of 404 valid samples were retained, with a sample validity rate of 95.1%. The characteristics of the information of the sample are listed in Table 1.

Table 2 shows the mean, standard deviation and correlation of the variables. Correlation analysis showed that social support was significantly positively correlated with self-management behavior in patients with type 2 diabetes mellitus patients ($r = 0.554$, $P < 0.01$), disease perception was significantly negatively correlated with self-management behavior ($r = -0.505$, $P < 0.01$), and hope level was significantly positively correlated with self-management behavior ($r = 0.543$, $P < 0.01$); and social support was a significantly negative correlation ($r = -0.421$, $P < 0.01$), a significant negative correlation between hope level and disease perception ($r = -0.425$, $P < 0.01$); and a significant positive correlation between hope level and social support ($r = 0.501$, $P < 0.01$).

Table 2 Descriptive and correlation analysis of variables (N = 404)

	M	SD	social support	Disease perception	Hope level
Social support	34.13	8.40			
Disease perception	39.13	10.84	-0.421**		
Hope level	36.67	4.55	0.501**	-0.425**	
Self-management behavior	39.62	13.70	0.554**	-0.505**	0.543**

** $P < 0.01$

Table 3 The chain-mediating regression equation (N=404)

Regression equation		Overall fit indices			Significance of regression coefficients		
Result Variables	Predictive variables	R	R ²	F	β	95%CI	t
Self-management behavior	Hope level	0.66	0.44	43.78	0.40	[0.97,1.46]	9.78***
Social support	Hope level	0.60	0.36	32.40	0.36	[0.51,0.83]	8.29***
Disease perception	Hope level	0.55	0.30	21.20	-0.26	[-0.86,-0.39]	-5.25***
	Social support				-0.20	[-0.39,-0.12]	-3.77***
Self-management behavior	Hope level	0.71	0.50	44.50	0.26	[0.53,1.04]	5.97***
	Social support				0.22	[0.21,0.51]	4.86***
	Disease perception				-0.19	[-0.35,-0.14]	-4.49***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Age, gender, educational level, average monthly family income, combined complications, and diabetes-related education were included as control variables. The study variables were standardized

Table 4 Results of the model fit indicators

Classify	Absolute Fitting Indicator		Value-added fit indicators			Simple Fit Indicator	
	χ^2/df	RMSEA	IFI	TLI	CFI	PGFI	PNFI
Sort							
Standard of judgement	< 5	< 0.08	> 0.9	> 0.9	> 0.9	> 0.5	> 0.5
Fit result	3.378	0.077	0.925	0.903	0.924	0.626	0.700

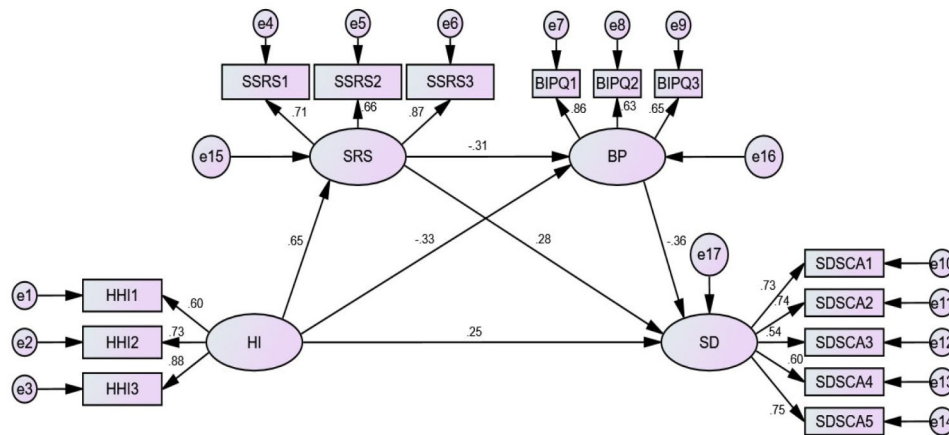


Fig. 2 The chain mediation model diagram of hope level, social support, disease perception, and self-management behavior in patients with type 2 diabetes mellitus. Abbreviations SRS, Social Support Rate Scale; HI, Herth Hope Scale; BP, Brief Illness Perception Questionnaire; SD, Summary of Diabetes Self-Care Activities

The chain mediating regression analysis

The results of Table 3 show that hope level had a significant positive effect on self-management behavior ($\beta = 0.26, P < 0.001$), social support had significant positive effects on self-management behavior ($\beta = 0.22, P < 0.001$), and disease perception on self-management behavior ($\beta = -0.19, P < 0.001$).

The construction of a structural equation model

A structural model for chain mediation was constructed with the hope level as the independent variable, self-management behavior as the dependent variable, and social support and perception of disease as the mediating variables. The model fit well and the specific results are shown in Table 4. The diagram of the chain-mediated effect model of hope level, social support, disease

perception, and self-management behavior for Type 2 diabetes is shown in Fig. 2.

As can be seen in the path analysis table in Table 5, the path coefficient of hope level in social support was significantly positive ($\beta = 0.649, P < 0.001$), the path coefficient of social support on perceived illness was significantly negative ($\beta = -0.310, P < 0.001$), the path coefficient of hope level in perceived illness was significantly negative ($\beta = -0.333, P < 0.001$) and the path coefficient of perceived illness on self-management behavior, the path coefficient of social support on self-management behavior was significantly negative ($\beta = -0.361, P < 0.001$), the path coefficient of hope level in self-management behavior was significantly positive ($\beta = 0.276, P < 0.001$), and the path coefficient of hope level on self-management behavior was significantly positive ($\beta = 0.249, P < 0.001$), so the hypothesis is valid.

Table 5 Intermediary path analysis (N = 404)

Path			Estimate	S.E.	C.R.	P
Social support	<---	Hope level	0.649	0.117	8.512	***
Disease perception	<---	Social support	-0.31	0.186	-3.902	***
Disease perception	<---	Hope level	-0.333	0.291	-4.088	***
Self-management behavior	<---	Disease perception	-0.361	0.063	-5.35	***
Self-management behavior	<---	Social support	0.276	0.16	3.75	***
Self-management behavior	<---	Hope level	0.249	0.249	3.342	***

*** $P < 0.001$ **Table 6** Mediated effects test

	Estimate	Lower	Upper	P
Total effect	0.621	0.535	0.696	0.000
Direct effect	0.249	0.087	0.404	0.003
Hope Level → Social Support → Self-Management Behavior	0.179	0.074	0.307	0.002
Hope level → Disease perception → Self-management behavior	0.12	0.042	0.232	0.005
Hope level → Social support → Disease perception → Self-management behavior	0.073	0.027	0.158	0.001

To accurately measure the mediating effect, the Bootstrap method was used to test the mediating effect of social support and disease perception in the relationship between hope level and self-management behavior, the number of Bootstrap repetitive samples was 5,000, the level of confidence interval was set at 95%, and the sampling method was the bias-corrected nonparametric percentile method. As can be seen from the table, none of the confidence intervals contain a zero, indicating that total, direct, and mediated effects are present. The specific results are displayed in Table 6.

Discussion

In this study, the relationship between hope level, social support, disease perception, and self-management behavior was explored, and a mediation model was developed for type 2 diabetic patients as research subjects. The study results showed that there was a positive correlation between hope level and self-management behavior and that hope level can influence self-management behavior in three ways: social support, disease perception, and social support → disease perception, supporting the four hypotheses. Although potential confounders such as self-efficacy [39] and health literacy [40] were not validated in this study, the findings could deepen our understanding of the mechanisms underlying these four variables and provide meaningful ideas for caregivers to take steps to improve self-management behavior in patients with type 2 diabetes.

Participants in this study had good general health, fewer patients with comorbidities, a moderately high level of hope for the treatment of the disease, and a low

level of self-management behavior, which implies that despite their positive attitudes toward the disease, they had a low level of knowledge about the disease and a high level of negative perceptions of the disease. According to the results of some surveys, the general health of the patient, perceived physical and mental health, and knowledge of the disease are the most important factors in determining whether or not a person will adhere to the rational use of medication, as well as a healthy lifestyle [39, 41, 42]. For example, demographic factors such as age, economic status, comorbidities, and the receipt of health education [43], can influence how well a person performs self-management behavior. These current findings suggest that it is important for healthcare professionals to measure the patient's knowledge of the disease, as well as the patient's ability to manage his health, and provide appropriate education and counseling on diabetes management. This will help improve patients' ability to self-manage and change unhealthy lifestyles, thus further improving quality of life and well-being [21].

The results of this study showed that the results hope level was positively correlated with self-management behaviors, indicating that the level of hope significantly predicts self-management behaviors in type 2 diabetes mellitus, which is consistent with the results of previous studies [22, 44, 45]. Patients with hope take the initiative to communicate with others and seek help, which enriches their lives and promotes their mental health [46]. Therefore, hopeful individuals tend to expect help from others to learn more about the disease and reduce negative emotions associated with the disease, thus stimulating belief in the treatment of the disease and enhancing self-management of the disease [47]. Therefore, nurses and clinical nurses should take into account the importance of hope levels in self-management behavior, and further research should specifically develop and conduct educational counseling programs to validate the role of hope levels in self-management of type 2 diabetes. For example, an educational intervention study based on the PRECEDE model [48] included knowledge, attitudes, self-efficacy, social support, health-promoting behavior, patient hope, and mental health aspects. The study was shown to be effective after the intervention.

The present study verified the mediating role of social support between levels of hope and self-management behavior, which is consistent with the results of a previous study [49] in which there was a significant positive correlation between self-management behavior, hope, and social support, and social support was the best predictor of self-management behavior and hope. People with type 2 diabetes perceive higher levels of social support and may have greater hope in treating their disease and adopt more effective self-management behavioral approaches. Social support theory suggests [17] that human survival requires cooperation with others and dependence on their help, and the stronger the social support network a person has, the better able they are to cope with a variety of challenges in their environment. People with type 2 diabetes mellitus hope and social support can support their attitudes and beliefs in treating the disease [7] and act as an internal driver in the process of the self-management plan and the developed glycemic control plan. Therefore, social support can act as a mediator between hope levels and self-management behavior in patients with type 2 diabetes.

This study also validated the mediating effect of illness perception on hope level and self-management behavior. This result supports the idea that disease perception is a predictor of self-management behavior [50, 51]. The mediating effect of disease perception suggests that if patients with type 2 diabetes have higher levels of hope, they may have less negative perceptions of the disease, have better attitudes and confidence in the treatment of the disease, gain more knowledge related to the treatment of the disease, and adopt better self-management behavior to cope with the disease [52]. This suggests that we should pay attention to the knowledge of patients with type 2 diabetes about their disease-related treatments in our future clinical work, and instruct patients with type 2 diabetes to do a good job of identifying symptoms and complications related to type 2 diabetes, affirming the patient's ability to control his personal control and therapeutic control, and mobilizing the patient's motivation to treat their disease to continuously improve their self-management ability.

Furthermore, these studies support the claim that the chain relationship between social support and illness perception mediates the relationship between levels of hope and self-management behavior. Higher levels of hope held by patients for the treatment of their illness lead to higher levels of social support [23], while higher levels of social support can reduce negative perceptions of illness [53], and lower negative perceptions of illness can further motivate and inspire patients to be more positive and motivated, which better strengthens patients' resolve to overcome difficulties and solve problems and helps patients better manage their illness. Although

some studies have demonstrated the impact of interventions such as telemedicine-assisted management programs [54] and interventions based on the development of structured self-management plans [55] on the self-management behavior of patients with type 2 diabetes mellitus, our findings in this study provide a theoretical basis for the development and implementation of multifaceted interventions to improve the self-management aspect of patients with type 2 diabetes mellitus. Furthermore, more attention should be paid to interdisciplinary collaborations, such as positive psychology and nursing education, which can help nursing professionals explore new perspectives and methods for researching intervention programs.

This study sheds light on the pathways of hope level, disease perception, social support, and self-management behavior by using a structural equation model, which provides a novel perspective in the field of individual psychology and society to improve the self-management behavior of patients with type 2 diabetes mellitus. With the advancement of the biopsychosocial medicine model, the negative psychological impact of type 2 diabetes on the disease has become a widely discussed issue. The early intervention of patients with type 2 diabetes has significant practical significance. Healthcare professionals should cultivate critical thinking and comprehensive abilities, while emphasizing operational ability and specialist knowledge, to gain a keen understanding of patients' psychological, physiological, social, and other aspects of health needs and provide a theoretical foundation for clinical healthcare professionals to improve patients' self-management ability.

Limitations and further studies

There are several limitations to this study. Initially, there was no cross-sectional design with a longitudinal approach to examine changes in psychological variables over time, which may limit the ability to make temporal and causal inferences. Therefore, scholars should focus on exploring changes in these variables' trajectories in further studies, especially the variability of these psychological characteristics, and strongly advocate for interventions in diabetes health education. Second, the study population was selected from two tertiary hospitals in northeast China, which may limit the universality to all Chinese patients with type 2 diabetes. The results of the study may be affected by differences in different regions due to perceived environmental and human factors. Therefore, we should examine possible influencing factors and consider mediating factors other than social support and disease perception that should be further studied. Convenience sampling can lead to selection bias. Therefore, probability sampling methods such as random stratified sampling could be used to recruit patients

with type 2 diabetes. Finally, since all instruments were self-reported, the true feelings of these patients with type 2 diabetes were not captured or tracked. Therefore, research designs such as mixed methods research and qualitative research should be explored to deepen our understanding of the psychological mechanisms influencing behavior in people with type 2 diabetes.

Conclusions

This study found that the level of hope in patients with type 2 diabetes affects their self-management behavior. Social support and perception of the disease partially and continuously mediated this effect. This study sheds light on the mechanisms behind the relationship between hope levels and self-management behavior and provides theoretical guidance for intervention programs aimed at increasing patients' hope levels, increasing social support, and improving patients' negative disease perceptions and self-management behavior.

Abbreviations

DM	Diabetes mellitus
IDF	The International Diabetes Federation
DSMS	Diabetes Self-Management Support
SEM	structural equation modeling
HHI	Herth Hope Scale
SSRS	Social Support Rate Scale
BIPQ	Brief Illness Perception Questionnaire
SDSCA	Summary of Diabetes Self-Care Activities
RMSEA	Root mean square error of approximation
IFI	Incremental Fit Index
TLI	Tucker–Lewis index
CFI	Comparative fit index
PGFI	Parsimony goodness-of-fit index
PNFI	Parsimony-adjusted normed fit index

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Author contributions

QZ: Writing-original manuscript, writing-review or editing, conceptualization, data management, methodology, formal analysis, Validation. JXS, HLB, TL: Writing-Reviewing or editing, conceptualization, data management, methodology, supervision. XW: writing-review or editing. CYZ, KRD, CLS: data management. All authors read and approved the manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

The research was authorized by the Ethics Committee of Jinzhou Medical University (JZMULL2023075), followed by the 1964 Proclamation of Helsinki and its subsequent amendments, and informed consent was obtained from each study participant before the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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References

- Rachmawati U et al. Aug. The association of diabetes literacy with self-management among older people with type 2 diabetes mellitus: a cross-sectional study. *BMC nursing* vol. 18, Suppl 1 34. 16 2019, <https://doi.org/10.1186/s12912-019-0354-y>
- Facts & figures [EB/OL]. /International Diabetes Federation. <https://idf.org/about-diabetes/diabetes-facts-figures/>
- IDF Diabetes Atlas. Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Res Clin Pract.* 2022;183:109119. [10.1016/j.diabres.2021.109119](https://doi.org/10.1016/j.diabres.2021.109119).
- Li J et al. Spatiotemporal trends and influence factors of global diabetes prevalence in recent years. *Social science & medicine* (1982) vol. 256 (2020): 113062. <https://doi.org/10.1016/j.socscimed.2020.113062>
- Parviniannasab AM et al. Feb. The effect of social support, diabetes management self-efficacy, and diabetes distress on resilience among patients with type 2 diabetes: a moderated mediation analysis. *BMC public health* vol. 24, 1 477. 15 2024, <https://doi.org/10.1186/s12889-024-18022-x>
- Wang R-H, et al. Associations of changes in psychosocial factors and their interactions with diabetes distress in patients with type 2 diabetes: a longitudinal study. *J Adv Nurs* vol. 2017;73(5):1137–46. <https://doi.org/10.1111/jan.13201>.
- Karimy M et al. Nov. The association between attitude, self-efficacy, and social support and adherence to diabetes self-care behavior. *Diabetology & metabolic syndrome* vol. 10 86. 27 2018, <https://doi.org/10.1186/s13098-018-0386-6>
- Sartore AC, Grossi SAA. Escala de Esperança de Herth—instrumento adaptado e validado para a língua portuguesa [Herth Hope Index—instrument adapted and validated to Portuguese]. *Revista da Escola de Enfermagem da U S P* vol. 42,2 (2008): 227–32. <https://doi.org/10.1590/s0080-62342008000200003>
- Calkins-Smith, Alison K, et al. Hope and mealtime insulin boluses are associated with depressive symptoms and glycemic control in youth with type 1 diabetes mellitus. *Pediatr Diabetes* vol. 2018;19(7):1309–14. <https://doi.org/10.1111/peci.12695>.
- Ji M, et al. Self-management behaviors, Glycemic Control, and metabolic syndrome in type 2 diabetes. *Nurs Res* vol. 2020;69(2):E9–17. <https://doi.org/10.1097/NNR.0000000000000401>.
- Zimbudzi E, et al. Self-management in patients with diabetes and chronic kidney disease is associated with incremental benefit in HRQL. *J Diabetes its Complications* vol. 2017;31(2):427–32. <https://doi.org/10.1016/j.jdiacomp.2016.10.027>.
- Schinckus L, et al. When knowing is not enough: emotional distress and depression reduce the positive effects of health literacy on diabetes self-management. *Patient Educ Couns* vol. 2018;101(2):324–30. <https://doi.org/10.1016/j.pec.2017.08.006>.
- Saad AMJ, et al. Self-efficacy, self-care and glycemic control in Saudi Arabian patients with type 2 diabetes mellitus: a cross-sectional survey. *Diabetes Res Clin Pract.* 2018;137:28–36. <https://doi.org/10.1016/j.diabres.2017.12.014>.
- Leventhal H, et al. The common-sense model of self-regulation (CSM): a dynamic framework for understanding illness self-management. *J Behav Med* vol. 2016;39:935–46. <https://doi.org/10.1007/s10865-016-9782-2>.
- Masmoudi R, et al. Diabetes distress and illness perceptions in Tunisian type 2 diabetes patients. *Diabetes, metabolic syndrome and obesity: targets and therapy.* 6 Nov. 2023;16:3547–56. <https://doi.org/10.2147/DMSO.S430001>.

16. Broadbent E et al. The brief illness perception questionnaire. *Journal of psychosomatic research* vol. 60,6 (2006): 631–7. <https://doi.org/10.1016/j.jpsychores.2005.10.020>
17. Bekiros S, et al. A new buffering theory of social support and psychological stress. *PloS one* 17,10 e0275364. 12 Oct. 2022. <https://doi.org/10.1371/journal.pone.0275364>.
18. Al-Dwaikat, Tariq N, et al. Social Support, Self-Efficacy, and psychological well-being of adults with type 2 diabetes. *Western J Nurs Res* Vol. 2021;43(4):288–97. <https://doi.org/10.1177/0193945920921101>.
19. Hunt CW et al. Relationships among self-efficacy, social support, social problem solving, and self-management in a rural sample living with type 2 diabetes mellitus. *Research and theory for nursing practice* vol. 26,2 (2012): 126–41. <https://doi.org/10.1891/1541-6577.26.2.126>
20. Strom JL, Leonard E, Egede. The impact of social support on outcomes in adult patients with type 2 diabetes: a systematic review. *Curr Diabetes Rep* vol. 2012;12(6):769–81. <https://doi.org/10.1007/s11892-012-0317-0>.
21. Gao J et al. May. Effects of self-care, self-efficacy, social support on glycemic control in adults with type 2 diabetes. *BMC family practice* vol. 14 66. 24 2013, <https://doi.org/10.1186/1471-2296-14-66>
22. Zhang D, et al. Mediating role of Hope between Social Support and Self-Management among Chinese Liver Transplant recipients: a multi-center cross-sectional study. *Clin Nurs Res* Vol. 2023;32(4):776–84. <https://doi.org/10.1177/10547738221078897>.
23. Parviniannasab AM et al. Apr. The mediating role of hope in the relation between uncertainty and social support with self-management among patients with ESKD undergoing hemodialysis. *BMC nephrology* vol. 25,1 129. 12 2024, <https://doi.org/10.1186/s12882-024-03558-2>
24. Ma L-C et al. Nov. Factors Influencing Self-Management Behaviors among Hemodialysis Patients. *Journal of personalized medicine* vol. 12,11 1816. 2 2022, <https://doi.org/10.3390/jpm12111816>
25. Haslam SA et al. Rethinking the nature of the person at the heart of the biopsychosocial model: Exploring social changeways not just personal pathways. *Social science & medicine* (1982) vol. 272 (2021): 113566. <https://doi.org/10.1016/j.socscimed.2020.113566>
26. Karunamuni N et al. Pathways to well-being: Untangling the causal relationships among biopsychosocial variables. *Social science & medicine* (1982) vol. 272 (2021): 112846. <https://doi.org/10.1016/j.socscimed.2020.112846>
27. Jeng B, et al. Social Cognitive Theory variables as correlates of physical activity in fatigued persons with multiple sclerosis. *Multiple Scler Relat Disorders*. 2022;57:103312. <https://doi.org/10.1016/j.msard.2021.103312>.
28. The Chinese Guidelines for the prevention and treatment of type 2 diabetes mellitus. (2020 edition) (above). *Chinese Journal of Practical Internal Medicine*, 2021 41 (08): 668–695. 10.19538/j.cnki.nk2021080106
29. Herth K. Abbreviated instrument to measure hope: development and psychometric evaluation. *J Adv Nurs* vol. 1992;17:1251–9. <https://doi.org/10.1111/j.1365-2648.1992.tb01843.x>.
30. Smith MD, et al. Does social support determine the treatment setting for hemodialysis patients? *Am J Kidney Diseases: Official J Natl Kidney Foundation* vol. 1985;5(1):27–31. [https://doi.org/10.1016/s0272-6386\(85\)80131-1](https://doi.org/10.1016/s0272-6386(85)80131-1).
31. Xiao Shuiyuan. The theoretical basis and research application of the Social Support rating scale [J]. *J Clin Psychiatry*, 1994(2): 98–100.
32. Broadbent E et al. A systematic review and meta-analysis of the brief illness perception Questionnaire. *Psychol Health* 30,11 (2015): 1361–85. <https://doi.org/10.1080/08870446.2015.1070851>
33. Sun, Weiming, et al. Application of the Chinese version of the simplified Disease Perception Questionnaire in patients with somatization disorder. *Chongqing Med Univ J*. 2015;40(8):1138–42. 10.13406/j.cnki.cyxb.000482.
34. Pan W, et al. Cross-validating a structural model of factors influencing diabetes self-management in Chinese americans with type 2 diabetes. *J Transcultural Nursing: Official J Transcultural Nurs Soc* vol. 2019;30(2):163–72. <https://doi.org/10.1177/1043659618790085>.
35. Schmitt A, et al. Measurement of psychological adjustment to diabetes with the diabetes acceptance scale. *J Diabetes its Complications* vol. 2018;32(4):384–92. <https://doi.org/10.1016/j.jdiacomp.2018.01.005>.
36. Liu X et al. Mar. The mediation role of sleep quality in the relationship between cognitive decline and depression. *BMC geriatrics* vol. 22,1 178. 3 2022, <https://doi.org/10.1186/s12877-022-02855-5>
37. Podsakoff PM, et al. Common method biases in behavioral research: a critical review of the literature and recommended remedies. *J Appl Psychol* vol. 2003;88:879–903. <https://doi.org/10.1037/0021-9010.88.5.879>.
38. Duong CD. Psychological distress related to Covid-19 in healthy public (CORPD): a statistical method for assessing the validation of scale. *MethodsX* 9 (2022): 101645. <https://doi.org/10.1016/j.mex.2022.101645>
39. Liu Y et al. May. The mediating effects of self-efficacy and study engagement on the relationship between specialty identity and career maturity of Chinese nursing students: a cross-sectional study. *BMC nursing* vol. 23,1 339. 21 2024, <https://doi.org/10.1186/s12912-024-02002-y>
40. Dinh TT, Ha, Bonner A. Exploring the relationships between health literacy, social support, self-efficacy and self-management in adults with multiple chronic diseases. *BMC health services research* vol. 23,1 923. 30 Aug. 2023, <https://doi.org/10.1186/s12913-023-09907-5>
41. Zhang L et al. Jul. The effect of health literacy, self-efficacy, social support and fear of disease progression on the health-related quality of life of patients with cancer in China: a structural equation model. *Health and quality of life outcomes* vol. 21,1 75. 18 2023, <https://doi.org/10.1186/s12955-023-02159-1>
42. Jo A, et al. The roles of health literacy and social support in improving adherence to self-care behaviors among older adults with heart failure. *Nurs open* vol. Aug. 2020;7:6 2039–46. <https://doi.org/10.1002/nop2.599>.
43. Lambrinou E, et al. Lifestyle factors, self-management and patient empowerment in diabetes care. *Eur J Prev Cardiol* vol. 2019;26:55–63. <https://doi.org/10.1177/2047487319885455>.
44. Chen Y, Behaviors S-M, Quality of Life Among Chinese Preoperative Patient With Symptomatic Valvular Heart Diseases. *J Transcultural Nursing: Official J Transcultural Nurs Soc* vol. 2020;31(3):284–93. <https://doi.org/10.1177/1043659619864157>.
45. Liu T, et al. Zhongguo Yi Xue Ke Xue yu xue bao. *Acta Academiae Mediciniae Sinicae* vol. 2019;41(3):367–72. <https://doi.org/10.3881/j.issn.1000-503X.10680>.
46. McCarthy J, et al. Family members' perspectives of hope when supporting a relative experiencing mental health problems. *Int J Mental Health Nurs* vol. 2023;32(5):1405–15. <https://doi.org/10.1111/inm.13185>.
47. Khan MM, et al. Hope and healthy lifestyle behaviors in older adulthood. *Aging Mental Health* vol. 2023;27(7):1436–42. <https://doi.org/10.1080/13607863.2023.2188171>.
48. Gholampour Y, et al. The Effect of Educational intervention based on PRECEDE Model on Health Promotion behaviors, Hope Enhancement, and Mental Health in Cancer patients. *Clin Nurs Res* Vol. 2022;31(6):1050–62. <https://doi.org/10.1177/10547738211051011>.
49. Wang L-Y et al. Self-care behavior, hope, and social support in Taiwanese patients awaiting heart transplantation. *J Psychosom Res* 61,4 (2006): 485–91. <https://doi.org/10.1016/j.jpsychores.2004.11.013>
50. Chen Q, et al. The mediating role of coping styles in illness perception and self-management in patients with obstructive sleep apnea. *Sleep Med*. 2024;113:349–56. <https://doi.org/10.1016/j.sleep.2023.12.003>.
51. Guo Z, et al. Illness perceptions in relation to self-management behavior among elderly patients with COPD: a cross-sectional study. *Int J Nurs Pract* e13264 15 May. 2024. <https://doi.org/10.1111/jin.13264>.
52. Kim S, et al. Type D personality, cognitive illness perception, depression, approach coping, and self-management among older adults in long-term care hospitals. *Structural equation modeling. Geriatric nursing*. Volume 48. New York, N.Y.; 2022. pp. 150–7. <https://doi.org/10.1016/j.gerinurse.2022.09.011>.
53. Heinze JE, et al. Relationships among Disease, Social Support, and Perceived Health: a Lifespan Approach. *Am J Community Psychol* vol. 2015;56:3–4. <https://doi.org/10.1007/s10464-015-9758-3>.
54. von Storch K, et al. Telemedicine-assisted self-management program for type 2 diabetes patients. *Diabetes Technol Ther* vol. 2019;21:514–21. <https://doi.org/10.1089/dia.2019.0056>.
55. Chatterjee S, et al. Diabetes structured self-management education programmes: a narrative review and current innovations. *The lancet. Diabetes Endocrinol* vol. 2018;6(2):130–42. [https://doi.org/10.1016/S2213-8587\(17\)30239-5](https://doi.org/10.1016/S2213-8587(17)30239-5).

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