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Original Research

Understanding Self-Management in Gestational Diabetes Mellitus: The Role of Diabetes-Related Distress, Self-Efficacy, and Family Support

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Abstract

Background: Gestational diabetes mellitus (GDM) is a common pregnancy complication associated with adverse maternal and neonatal outcomes. Self-management (e.g., dietary control, physical activity, blood glucose monitoring) is critical for glycemic control in GDM pregnancies, as it mitigates short- and long-term health risks for both mothers and offspring. However, data on self-management status and its contributing factors, particularly diabetes-related distress, remain limited in border ethnic minority areas of China, and regional medical disparities may exacerbate management challenges. This study aimed to investigate GDM self-management levels and key influencing factors in these areas and to provide evidence for targeted interventions. **Methods:** This hospital-based cross-sectional study recruited 330 patients with GDM from a tertiary hospital in Jilin Province (February–December 2022). Data on demographics, self-management behaviors, diabetes-related distress, family support, and self-efficacy were collected. Multiple linear regression was used to identify factors associated with self-management. **Results:** The total self-management score indicated a poor level of self-management. Self-management was negatively correlated with diabetes-related distress and positively correlated with self-efficacy and family support. Multiple linear regression identified conception via assisted reproductive technology (ART), multiple comorbidities, family history of diabetes, lower diabetes-related distress, and higher self-efficacy as significant independent factors influencing self-management. **Conclusions:** The self-management level among GDM patients in Jilin Province was poor. Interventions that target modifiable factors, particularly reduction of diabetes-related distress and enhancement of self-efficacy, are warranted to improve outcomes.

Keywords: diabetes-related distress; gestational diabetes mellitus; self-efficacy; self-management

1. Introduction

Gestational diabetes mellitus (GDM) is one of the most common endocrine and metabolic disorders during pregnancy, with its global prevalence reaching 16.7%. In China, its incidence has shown a significant upward trend in recent years, going from 7% to 17.5% [1,2]. As an important public health issue affecting maternal and infant health, GDM not only increases the risk of adverse pregnancy outcomes such as gestational hypertension, cesarean section, and macrosomia [3,4], but also carries profound long-term health implications for the mother. GDM is associated with a high risk of recurrence in future pregnancies and a tenfold increase in the incidence of type 2 diabetes [5,6], for offspring GDM can cause, including cognitive decline and hyperactive/impulsive behavior [7,8]. Neuroimaging studies suggest that it may be related to structural changes in the brain, such as thinning of the cortex, shrinking of deep gray matter, and abnormal white matter connectivity. These findings highlight the urgency of prevention and control and precise management of GDM systems [9,10].

In order to address the challenges posed by GDM, China has established a systematic and full cycle prevention and control system, transitioning from the two-step screening method recommended by the World Health Organization to a one-step universal screening policy centered around 75 g oral glucose tolerance test (OGTT) at 24–28 weeks of pregnancy [11]. Despite the widespread implementation of GDM screening policies in China, early screening among high-risk pregnant women remains insufficient. A nationwide survey of 16,286 pregnant women found that 64.3% had at least one risk factor for GDM, but only 16.1% underwent an early glucose challenge test before 24 weeks of gestation. GDM cases detected through early screening accounted for only 11.9% of all GDM cases among high-risk women [12]. Coupled with the implementation of the three-child policy and the increasing number of advanced-maternal-age pregnancies, which lead to a rising trend in GDM incidence, the prevention and control system faces tremendous pressure.

Self-management is central to the control of GDM, encompassing dietary control, physical exercise, blood-glucose monitoring, and medication adherence [13]. However, studies have indicated that the current participation of GDM patients in self-management is generally low, only about 52% [14]. Among the main challenges faced by patients are poor exercise adherence, insufficient understand-

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ing of blood-glucose monitoring, fear of finger pricks, and medication non-adherence [15]. Although socioeconomic factors such as education level, income, and access to health education influence self-management [16], it is important to note that relevant research in China has primarily focused on developed urban areas. A Study targeting GDM patients in border ethnic-minority regions are relatively limited, and data on self-management remain scarce [17], making it difficult to support the optimization and implementation of regionalized prevention and control strategies.

Previous studies suggested that demographic characteristics and psychosocial factors (such as disease knowledge, self-efficacy, and family support) play key roles in the self-management of GDM patients [9,10]. However, the influence of psychological factors, especially the impact of diabetes-related distress, has not been sufficiently explored in the GDM population. Diabetes-related distress refers to the emotional burden associated with diagnosis, treatment demands, and fear of complications [18,19]. According to multinational data, its prevalence is as high as 40% among GDM patients [20], and it is significantly associated with reduced treatment adherence and decreased quality of life [21]. Given that diabetes-related distress may diminish psychological resources and thereby reduce self-management capacity [18,19], this study incorporated diabetes-related distress as a core variable, filling this gap and clarifying its specific association with self-management among Chinese pregnant women with GDM.

Building upon existing literature on GDM self-management, which has yet to fully elucidate the specific roles of psychosocial factors, particularly the unique influence of diabetes-related distress, this study investigated the current status of self-management among GDM patients at a tertiary hospital in Jilin Province. It systematically explored influencing factors, with a focused examination of diabetes-related distress, self-efficacy, and family support. The findings were intended to provide an evidence-based foundation for developing regionally targeted psychosocial interventions, ultimately aiming to improve maternal and infant health outcomes.

2. Materials and Methods

2.1 Participants

This hospital-based cross-sectional study, which followed STROBE guidelines, was conducted among women with GDM who were receiving prenatal care at a tertiary-level hospital situated in the province of Jilin. Patients (n = 330) were recruited by the convenience sampling method from February to December 2022.

2.2 Sample-Size Calculation

The required sample size was estimated based on the principle for multiple regression analysis, which recommends a minimum of 5 to 10 participants per predictor variable to ensure adequate statistical power and model stability [22]. In this study, 33 independent variables were considered for inclusion in the multivariate analysis: 20 items from sociodemographic and clinical characteristics; 7 domains from the Gestational Diabetes Mellitus Self-Management Behavior Scale; 1 dimension from the diabetes distress scale; 1 dimension from the Family Support Scale; and 4 dimensions from the Self-Efficacy Scale.

Considering the Kendall sample-size requirement and potential attrition or incomplete responses, an additional 20% buffer was added to the sample size in this study. The specific calculation is as follows: 33 × (5 to 10) × 1.2, resulting in a sample size range of 198 to 396. In the actual study, 343 responses were collected; after screening for incomplete questionnaires and responses with patterned or contradictory answers (n = 13), 330 were finally included in the analysis, with an effective response rate of 96%.

2.3 Inclusion Criteria

(a) Diagnosed with GDM according to the 2014 guidelines for the diagnosis and treatment of GDM [23]; (b) diagnosis was confirmed by a 75 g OGTT performed at any time during pregnancy, meeting any of the following criteria: fasting blood glucose ≥5.1 mmol/L and <7.0 mmol/L; 1-hour blood glucose ≥10.0 mmol/L; 2-hour blood glucose ≥8.5 mmol/L and <11.1 mmol/L; (c) individuals provided informed consent and participated voluntarily.

2.4 Exclusion Criteria

(a) Presence of mental or cognitive disorders that would impair the ability to complete the questionnaire; (b) employment in a healthcare-related profession (to minimize potential bias from specialized medical knowledge on self-management behaviors and to ensure the sample represented the general patient population); (c) women with pre-existing diabetes mellitus (type 1 or type 2) diagnosed before the current pregnancy.

2.5 Measurements

2.5.1 Sociodemographic Characteristics

A total of 20 variables were collected, including age; ethnicity; place of residence; educational level; occupational status; monthly household income per capita; medical payment methods; living arrangements; mode of conception; gravidity; parity; number of abortions; gestational age (weeks); pre-pregnancy body mass index (BMI); family history of diabetes; multiple comorbidities; history of diabetic complications; fasting blood glucose; 2-h postprandial blood glucose; and participation in diabetes health education. All laboratory data were acquired from maternal medical records.

"Multiple comorbidities" referred to other diseases that were clinically diagnosed and coexisted during the current pregnancy, excluding GDM.

"History of diabetic complications" referred specifically to any signs or symptoms that were assessed or com-

plained of during the current pregnancy that suggested that they may be associated with hyperglycemia, such as significant polyuria, polydipsia, recurrent infections, or blurred vision.

2.5.2 Self-Management Behavior Scale for Patients With Gestational Diabetes Mellitus

This scale comprises 37 items categorized into seven dimensions: dietary management, exercise management, weight management, medication use, glucose monitoring, risk assessment, and psychosocial adaptation management. The scale has been previously validated in a Chinese sample, demonstrating strong internal consistency (Cronbach's $\alpha = 0.890$) and construct validity [24]. In the present study, the scale maintained good reliability, with a Cronbach's $\alpha = 0.869$.

All items are rated on a five-point Likert scale based on the frequency or agreement of specific self-management behaviors, with most items referencing the participant's experience over the previous week. For example, in the dietary-management dimension, items assess behaviors such as meal regularity and dietary composition during the previous week. The total score ranges from 37 to 185. To facilitate interpretation, a score rate was calculated for both the total scale and each dimension using the following formula: (actual score/highest possible score) × 100%; a higher score rate indicated better self-management of patients. Based on established criteria, a score rate above 80% is classified as "good", 60%–80% as "moderate", and below 60% as "poor".

2.5.3 Chinese Version of the Problem Areas in Diabetes (PAID-C)

This instrument consists of 20 items and uses a 5-point Likert scale to measure the overall emotional burden and distress associated with living with and managing diabetes. The scale measures the level of diabetes-related emotional distress experienced in a recent period (typically the previous few weeks). The Cronbach's α coefficient in this study = 0.902. The total scores spanned from 0 to 80; elevated scores signified a greater intensity of emotional distress endured by the patient. A score of 50 or below is regarded as mild distress, whereas a score exceeding 50 indicates severe distress [25].

2.5.4 Family Support Scale (FSS)

This instrument consists of 15 items and uses a dichotomous scale. The items evaluate the perceived availability of practical and emotional support from family members during the pregnancy. The Cronbach's α coefficient in this study = 0.718. The total scores ranged from 0 to 15; a higher score corresponds to a greater level of family support. In the original study, the scale had a Cronbach's α coefficient of 0.90, confirming good internal consistency [26].

2.5.5 Self-Efficacy Scale

This questionnaire consists of 9 items, which are categorized into 4 dimensions: diet, exercise, blood glucose, and disease control. The scale assesses the individual's confidence in performing GDM self-management tasks at the present time. It uses a five-point Likert scale. The total scores span from 0 to 45; higher scores signify greater self-efficacy [27]. The scale has been widely used in the diabetic population, and a study in China measured its Cronbach's α coefficient of 0.89, which is reliable and valid [28]. The Cronbach's α coefficient in this study was 0.747.

2.5.6 Pilot Testing

Prior to formal data collection, a pilot study was conducted to assess the feasibility, clarity, acceptability, and time required to complete the questionnaire battery. A convenience sample of 30 pregnant women with GDM, who met the study eligibility criteria but were not included in the main study, was recruited from the same hospital. Participants were asked to complete all questionnaires and subsequently provide verbal feedback regarding the comprehensibility of the items, the logical flow, and any potential ambiguities or sensitivities. The average completion time was recorded. Based on the feedback, minor linguistic adjustments were made to enhance clarity (e.g., simplifying complex medical terms in the instructions), and the layout was optimized for readability. No items were removed or added. The pilot study confirmed that the survey instruments were well-understood, culturally appropriate, and could be completed within a reasonable timeframe (approximately 20 min), thus ensuring the validity and smooth implementation of the formal survey.

2.6 Data Collection

Data were collected from February to December 2022. Eligible participants completed the self-administered questionnaire in the obstetrics outpatient clinic, with the assistance of trained researchers if needed. The questionnaire included sociodemographic characteristics, self-management behaviors, diabetes-related distress, family support, and self-efficacy. The average completion time was approximately 20 minutes per participant. After collection, questionnaires were screened for completeness and validity: incomplete questionnaires or responses with patterned/contradictory answers were excluded (n = 13), resulting in a final sample of 330 participants (effective response rate: 96%). Laboratory data (e.g., fasting blood glucose, 2-h postprandial blood glucose) were extracted from maternal medical records.

2.7 Statistical Analysis

The data analysis was conducted using IBM SPSS Statistics (version 26.0, Armonk, NY, USA), using descriptive statistics, *t*-tests, and one-way ANOVA to evaluate demographic variations in self-management. For one-way

ANOVA comparisons involving multiple groups, Least Significant Difference (LSD) post-hoc pairwise comparisons were performed to identify the specific sources of difference. The Pearson correlation and multiple linear regression analyses were used to identify the primary factors influencing self-management behavior. To identify independent influencing factors of self-management, we first included variables with a $p < 0.10$ in all univariate analyses, and variables considered important based on the literature were used in the initial multiple linear-regression model. In addition, the core psychosocial variables of interest, diabetes-related distress, family support, and self-efficacy, were included *a priori* based on the study's theoretical framework. Model assumptions, including linearity, homoscedasticity, normality of residuals, and absence of multicollinearity (all variance inflation factors <5), were checked and met. A $p \leq 0.05$ was considered statistically significant. Prior to conducting the multiple linear-regression analysis, key assumptions were assessed. Multicollinearity was evaluated using variance inflation factors (VIF), with all VIF values below 5, indicating no severe multicollinearity. Normality of residuals was examined through visual inspection of Quantile–Quantile (Q-Q) plots, suggesting that there was no significant deviation from normality. Homoscedasticity was assessed by plotting standardized residuals against predicted values, revealing a random scatter pattern consistent with constant variance. Linearity was confirmed through partial regression plots. These diagnostic tests confirmed that the regression model assumptions were reasonably met.

Covariates for the multiple linear-regression model were selected based on a combination of literature review, theoretical relevance, and statistical criteria from univariate analyses. This approach controlled for known potential confounders. The final model included education level, monthly household income per capita, mode of conception, gestational age, family history of diabetes, multiple comorbidities, 2-h postprandial blood glucose level, diabetes-related distress, self-efficacy, and family support.

3. Results

A total of 330 patients with GDM were included in this study. The mean age of the participants was 31.88 years (SD = 4.95; range = 22–48). Most patients, 69.4% (n = 229), identified as national minorities. Additionally, 70.6% (n = 233) of the participants resided in urban areas, approximately 43.9% (n = 145) had received college-level education or above, and 73.6% (n = 243) were employed. There were significant differences in the self-management noted for education level, monthly household income per capita, mode of conception, gestational age, family history of diabetes, multiple comorbidities, and 2-h postprandial blood glucose level (Tables 1,2).

The overall self-management score was 109.60 ± 17.70, the scoring rate was 59.2%. To enable direct comparison across self-management dimensions with varying score ranges, subscale scores were standardized. As shown in Table 3, medication adherence exhibited the highest standardized performance (z = 1.43), followed by blood glucose monitoring (z = 0.51). In contrast, exercise management showed the lowest performance (z = –0.22). When comparing relative standing within the sample, participants demonstrated the strongest self-management in medication adherence and the weakest in exercise management, with other dimensions clustering around the sample average.

Pearson's correlation coefficient was used to assess the association between self-management behaviors and various key psychosocial variables (diabetes-related distress, family support, and self-efficacy). Self-management was negatively correlated with diabetes-related distress (r = –0.389, $p < 0.001$), and positively correlated with family support (r = 0.171, $p = 0.002$) and self-efficacy (r = 0.379, $p < 0.001$).

For exploratory purposes and to identify potential predictors as much as possible, univariate analyses were conducted. Variables of $p < 0.05$, together with theoretically important core psychosocial variables (diabetes-related distress, self-efficacy, family support), were included in multiple linear-regression models as candidate predictors.

Multiple linear regression determined that mode of conception, the presence of multiple comorbidities, family history of diabetes, diabetes-related distress, and self-efficacy were the primary factors influencing self-management of patients with GDM [F = 13.931; $p < 0.01$; $R^2 = 0.364$] (Table 4).

4. Discussion

The present study evaluated the self-management capabilities of pregnant women with GDM and identified several influencing factors, including general characteristics, diabetes-related distress, family support, and self-efficacy. The results indicated that overall self-management proficiency remained suboptimal (score rate: 59.2%), with considerable room for improvement. To enable direct comparison across self-management dimensions with varying score ranges, standardized z-scores (mean = 0, SD = 1) were computed for each subscale. Analysis revealed distinct patterns of relative strength and weakness. Notably, exercise management demonstrated the lowest z-score (z = –0.22), indicating performance below the sample average. This was consistent with reports of generally low levels of physical activity among pregnant women in China. According to a systematic review and meta-analysis [29], the prevalence of achieving the internationally recommended level of physical activity among pregnant women in China was only 21.0% (95% confidence interval: 12.5%–29.5%). In contrast, medication adherence showed the highest z-score (z = 1.43), representing the strongest area of self-management, followed by blood glucose monitoring (z = 0.51). Other dimensions, including weight management (z = 0.02), diet

Table 1. Sociodemographic characteristics of the study population and their univariate associations with self-management scores.

Variable	Frequency	Percentage	Score	*t*/F	*p*	LSD
Age (years)						
18–34	232	70.3	109.08 ± 17.51	–0.813	0.417	
≥35	98	29.7	110.82 ± 18.17			
Ethnicity						
Han ethnic group	101	30.6	109.38 ± 17.52	–0.150	0.881	
National minority	229	69.4	109.69 ± 17.81			
Place of residence						
Urban	233	70.6	109.44 ± 16.36	–0.230	0.818	
Rural	97	29.4	109.98 ± 20.64			
Education level						
①Primary school	35	10.6	111.14 ± 22.81	4.166	0.008	④>②
②High school	150	45.5	106.88 ± 16.19			
③Three-year college	77	23.3	108.68 ± 16.49			
④University and above	68	20.6	115.84 ± 18.01			
Occupational status						
Employed	243	73.6	110.72 ± 17.28	–1.942	0.053	
Unemployed	87	26.4	106.45 ± 18.56			
Monthly household income per capita						
①<3000 CNY	90	27.3	110.24 ± 20.89	3.833	0.025	③>②
②3000~5000 CNY	202	61.2	107.88 ± 15.21			
③>5000 CNY	38	11.5	117.18 ± 20.08			
Medical payment methods						
Urban resident basic medical insurance	106	32.1	108.23 ± 18.86	1.332	0.265	
Rural resident basic medical insurance	177	53.6	111.05 ± 17.18			
None	47	14.2	107.23 ± 16.77			
Living arrangements						
Spouse	249	75.5	108.50 ± 16.87	2.424	0.066	
Parents	26	7.9	108.23 ± 16.92			
Parents-in-law	50	15.2	115.76 ± 21.00			
None	5	1.5	109.80 ± 19.07			
Mode of conception						
Naturally	292	88.5	108.27 ± 17.20	–3.853	<0.001	
Assisted reproductive technology	38	11.5	119.79 ± 18.38			
Gravidity						
1	93	28.2	109.16 ± 16.23	–0.280	0.780	
>1	237	71.8	109.77 ± 18.27			
Parity						
0	187	56.7	109.55 ± 16.97	–0.060	0.952	
≥1	143	43.3	109.66 ± 18.67			
Number of abortions						
0	147	44.5	109.75 ± 18.07	0.021	0.980	
1~2	174	52.7	109.43 ± 17.69			
>2	9	2.7	110.33 ± 12.59			

LSD, Least Significant Difference.

Income categories were reported in CNY; 1 USD was approximately equivalent to 7.1 CNY based on the average exchange rate over the past year.

management (z = 0.10), risk assessment (z = 0.22), and psychosocial adaptation (z = 0.16), clustered near the sample mean (z ≈ 0). Other dimensions, including medication adherence, blood-glucose monitoring, and psychosocial adaptation, scored moderately well. This pattern suggested that although structured, externally guided behaviors (medication, monitoring) were more readily maintained, lifestyle modifications requiring sustained self-discipline (exercise)

Table 2. Clinical characteristics of the study population and their univariate associations with self-management scores.

Variable	Frequency	Percentage	Score	*t*/F	*p*
Gestational age (weeks)					
14–27	130	39.4	105.72 ± 10.40	–3.704	<0.001
28–40	200	60.6	112.12 ± 20.77		
Pre-pregnancy body mass index (BMI, kg/m^2)					
Thin (<18.5)	8	2.4	116.00 ± 34.16	0.263	0.852
Normal (18.5–23.9)	249	75.5	109.40 ± 16.33		
Overweight (24.0–27.9)	55	16.7	110.53 ± 20.15		
Obese (≥28)	18	5.5	106.67 ± 19.20		
Family history of diabetes					
No	237	71.8	107.50 ± 16.46	–3.240	<0.001
Yes	93	28.2	114.95 ± 19.62		
Multiple comorbidities					
No	264	80.0	107.25 ± 15.94	–4.215	<0.001
Yes	66	20.0	118.97 ± 21.13		
History of diabetic complications					
No	317	96.1	109.33 ± 17.51	–1.365	0.173
Yes	13	3.9	116.15 ± 21.48		
Fasting blood glucose					
Elevated	294	89.1	108.86 ± 17.05	–1.796	0.080
Within normal range	36	10.9	115.58 ± 21.64		
2-hour postprandial blood glucose					
Elevated	51	15.5	114.16 ± 19.81	2.010	0.045
Within normal range	279	84.5	108.76 ± 17.19		
Participation in diabetes health education					
No	127	38.5	108.60 ± 20.16	–0.769	0.443
Yes	203	61.5	110.22 ± 15.98		

Table 3. Scores of self-management, diabetes-related distress, family support, and self-efficacy in women with GDM (mean ± SD).

Variable	Range	Score	Score rate/percentage	Standardized z-score (Mean ± SD)
Self-management	37~185	109.60 ± 17.70	59.2%	
Diet management	9~45	27.01 ± 5.82	60.0%	0.10 ± 1.00
Exercise management	5~25	14.73 ± 3.97	58.9%	–0.22 ± 1.00
Weight management	4~20	9.77 ± 2.21	48.9%	0.02 ± 1.00
Medication adherence*	4~20	6.65 ± 4.82	33.2%	1.43 ± 1.00
Blood glucose monitoring	4~20	13.15 ± 2.69	65.8%	0.51 ± 1.00
Risk assessment	6~30	20.49 ± 4.04	68.3%	0.22 ± 1.00
Psychosocial adaptation	5~25	17.79 ± 3.38	71.2%	0.16 ± 1.00
Diabetes distress	0~80	32.85 ± 11.80		
Mild diabetes distress	0~50	30.67 ± 8.95	93.0%	
Severe diabetes distress	51~80	59.83 ± 5.89	7.0%	
Family support	0~15	10.34 ± 1.62		
Self-efficacy	0~45	24.81 ± 5.52		

*Indicates that only patients receiving medication treatment needed to complete this item. GDM, gestational diabetes mellitus.

presented greater challenges for women with GDM.

This study found that women who conceived through assisted reproductive techniques showed better levels of self-management. This observed association can be explained by a number of non-mutually exclusive mechanisms. First, the most intuitive explanation is that women undergoing assisted reproductive technology are often subjected to more intensive prenatal monitoring and structured lifestyle interventions, which may directly improve their self-management skills and adherence [30,31]. Another

Table 4. Multiple linear regression analysis of factors associated with self-management behaviors in patients with GDM.

Factor	B	SE	β	*t*	*p*
Constant	92.723	9.726		9.534	<0.001
Education level (Ref: primary school)					
High School	–0.875	2.988	–0.025	–0.293	0.770
Three-year college	0.751	3.217	0.018	0.234	0.816
University and above	5.889	3.426	0.135	1.719	0.087
Monthly household income per capita (Ref: <3000 CNY)					
3000~5000 CNY	–3.450	2.098	–0.095	–1.644	0.101
>5000 CNY	3.394	3.101	0.061	1.095	0.275
Mode of conception (Ref: natural conception)	8.178	2.629	0.148	3.111	0.002
Gestational age (weeks)	–1.458	1.855	–0.040	–0.786	0.433
Family history of diabetes (Ref: no)	5.609	2.083	0.143	2.693	0.007
Multiple comorbidities	7.861	2.266	0.178	3.469	<0.001
2-hour postprandial blood glucose (Ref: within normal range)	0.365	2.346	0.007	0.156	0.876
Family support score	0.643	0.517	0.059	1.243	0.215
Diabetes distress score	–0.405	0.075	–0.270	–5.380	<0.001
Self-efficacy score	0.880	0.161	0.275	5.455	<0.001

$R = 0.604$, $R^2 = 0.364$, adjusted $R^2 = 0.338$, Model diagnostics: All variance inflation factors (VIF) <5, indicating no multicollinearity concerns. Residual analysis supported normality and homoscedasticity assumptions. Income categories were reported in CNY; 1 USD was approximately equivalent to 7.1 CNY based on the average exchange rate over the past year.

plausible explanation is that people seeking and receiving assisted reproductive technologies may inherently possess certain characteristics, such as higher health awareness, stronger motivation to have a successful pregnancy after experiencing fertility challenges, or better socioeconomic and educational backgrounds, all of which have been shown to be independently associated with improved health management behaviors [32]. Our cross-sectional study design did not distinguish the relative contributions of these potential pathways. Therefore, future longitudinal studies or mixed-methods studies combined with qualitative interviews are needed to clarify whether this better self-management is primarily driven by the intensive care regimen that accompanies the pregnancy with assisted reproductive technology or is determined by the pre-treatment characteristics of the group of women who choose the technique.

A family history of diabetes also positively influenced self-management practices, likely due to increased disease familiarity and prior exposure to self-care strategies through affected family members [33]. Maternal and sibling history, in particular, have been indicated as significant predictors [34], suggesting that familial health context plays a formative role in shaping self-management capabilities.

Central to our findings were the robust roles of self-efficacy and diabetes-related distress—two core psychosocial determinants. Self-efficacy consistently promoted better self-management across multiple domains, reinforcing its established importance in sustained health-behavior change [35]. In contrast, diabetes distress, comprising emotional burden, treatment-related concerns, and social-support deficits, significantly impaired self-management capacity. This pointed to the need to address GDM not only as a metabolic condition but also as a psychological challenge [36,37]. Although self-efficacy may modestly buffer the effects of distress [18], both factors exerted independent effects, supporting the need for dual-focused interventions that integrate skill-building and emotional support.

The disparity between current self-management performance and ideal clinical targets indicated an urgent need for more personalized and proactive care models. In particular, exercise and weight management represented critical areas for preventing complications and improving gestational outcomes. Future interventions should be patient-centered, theory-informed, and family-inclusive where appropriate. Moreover, longitudinal and interventional studies are needed to clarify causal pathways and evaluate the efficacy of tailored support programs aimed at enhancing self-efficacy and mitigating diabetes-related distress.

At present, the frequency of routine prenatal check-ups for GDM in China is 7 to 11, and the follow-up is increased after diagnosis, adopting the management model of "doctor diagnosis + nurse-led health education". Based on this, the present study has both theoretical innovation and practical guidance value. First, at the theoretical level, the study incorporated diabetes distress, self-efficacy, and family support into the integrated model, systematically revealing the comprehensive influence path of multiple psychosocial factors on the self-management behavior of GDM patients, making up for the lack of attention paid to diabetes distress and the discussion of multifactorial synergy mechanisms in existing studies. Second, in terms of sample representativeness, the study focused on GDM patients in hos-

pitals in ethnic minority areas in China's border areas, and its conclusions have direct extrapolation and reference significance for regions with similar medical resource allocation and similar cultural backgrounds. Finally, in terms of application orientation, the study not only clarified the influencing factors, but also further clarified the key intervention points, such as alleviating diabetes-related distress and improving self-efficacy, providing an evidence-based basis for the clinical formulation of precise and structured psychosocial intervention programs, which helps to improve intervention efficiency and improve patient outcomes.

Limitations

This study had several limitations. First, the cross-sectional design precluded the establishment of causal relationships. Future studies should employ longitudinal or experimental designs to further examine the temporal and causal nature of the identified associations. Second, the use of convenience sampling at a single center may have introduced selection bias and limited the generalizability of the findings to broader populations. Nevertheless, this study contributed to the literature by focusing on an underdeveloped border region with a substantial ethnic minority population in China, thereby addressing a research gap in these specific demographic and geographic contexts. Future research should seek to validate these findings across multiple centers and more diverse populations.

5. Conclusions

The level of self-management among pregnant women diagnosed with GDM in this regional sample was suboptimal. Key factors influencing self-management included non-modifiable factors (mode of conception via assisted reproductive technology, presence of multiple comorbidities, and family history of diabetes) and modifiable psychosocial factors (lower diabetes-related distress and higher self-efficacy). Clinical practice and future interventions should prioritize modifiable factors such as enhancing self-efficacy through skill-building and providing psychological support to alleviate diabetes-related distress. Tailored interventions focusing on weight management and exercise management are needed, while medication-related self-management among women receiving pharmacological treatment also warrants further attention.

Availability of Data and Materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Author Contributions

Conceptualization, JSui and LJ; methodology, JSui and LJ; validation, JSun and JZ; investigation, JSui and JD; data curation and formal analysis, ZL; interpretation of data, JSui, LJ, JD and ZL; writing—original draft preparation, JSui, JD and ZL; writing—review and editing, JSui, LJ and ZL; supervision, LJ. All authors contributed to critical revision of the manuscript for important intellectual content. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Yanbian University Medical College (Approval No: 20230410). The written informed consent was obtained from the participants or their guardians.

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Conflicts of Interest

The authors declare no conflicts of interest.

Declaration of AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used DeepL for translation, Grammarly for spelling and grammar checks, and ChatGPT-5.2 for auxiliary optimization of sentence structure and expression logic. After using these tools, the authors thoroughly reviewed, edited, and verified all content to ensure accuracy, scientific rigor, and consistency with the study's actual findings. The authors take full responsibility for the final content of the publication.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.31083/CEOG48573.

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