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Research article

Motivational factors for dietary intake behavior in gestational diabetes mellitus: A cross-sectional study

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ABSTRACT

Context: Decision-making behavior pertains to the cognitive process where a patient evaluates the advantages and disadvantages of health-related decisions, taking into account their personal preferences, values, and cognitive factors. This behavior is central to the successful implementation of clinical care. Effective decision-making enhances an individual's or organization's response to challenges and opportunities, improves problem-solving capabilities, reduces risks and uncertainties, and facilitates the attainment of desired outcomes.
Objective: The goal of this study was to investigate the current status of dietary choice decision-making in gestational diabetes mellitus and to analyze its influencing factors, and then to find the determining factors and give targeted nursing interventions in order to improve the dietary decision-making ability of gestational diabetes mellitus patients and further standardize their dietary patterns.
Methods: A cross-sectional research design was employed in this study. Convenience sampling was utilized to survey 539 GDM patients attending the obstetrics outpatient clinic and obstetrics ward of a tertiary hospital in Wuxi City, China, from March 2023 to July 2023. The survey instruments used were the General Information Questionnaire, the Motivation to Protect Pregnant Women with Gestational Diabetes Mellitus Dietary Intake Questionnaire, and the Conflict in Decision-Making Scale.
Results: The findings were derived from data collected from 539 GDM cases. The participants' ages ranged from 19 to 52 years, with a mean age of 31.53 ± 4.37 years. The scores for GDM disease perceived susceptibility were 15.200 ± 3.481, disease perceived severity 18.455 ± 4.670, internal reward 13.226 ± 4.275, external reward 8.278 ± 2.923, response efficacy 15.078 ± 3.889, self-efficacy 18.952 ± 4.800, cost of response 14.540 ± 5.227, and decision conflict questionnaire score 70.96 ± 11.78.
Conclusions: The study revealed that GDM patients exhibited a moderate level of decision-making dilemma. Notably, the patients' perceived susceptibility and severity of the disease, along with their response efficacy and self-efficacy, positively influenced their dietary decision-making abilities. Specifically, enhancing patients' awareness of their condition and boosting their self-efficacy significantly improved their decision-making capabilities. Conversely, internal and external rewards, as well as the cost of response, exerted a negative impact on GDM patients' decision-making abilities. Therefore, it is imperative to mitigate potential barriers in GDM

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patients' dietary intake behaviors, thereby enhancing their decision-making skills related to dietary intake.

1. Introduction

1.1. Background

Gestational diabetes mellitus (GDM) is a metabolic disorder characterized by the initial diagnosis of diabetes mellitus during pregnancy or the detection of glucose tolerance abnormalities unrecognized before conception [1]. The precise pathogenesis in GDM patients remains elusive but may stem from inadequate insulin secretion due to progressive β-cell death or dysfunction in the pancreas. This prevents the effective regulation of elevated blood glucose levels during pregnancy. Alternatively, a significant increase in hormone levels can lead to impeded binding of blood glucose to the insulin receptor [2]. Recent investigations have demonstrated that women exposed to arsenic during early pregnancy face a significantly elevated risk of GDM. This association is likely attributed to arsenic's deleterious effects on glucose tolerance and its capacity to delay peak insulin secretion following glucose stimulation [3,4]. Furthermore, the reduction in skeletal muscle mass associated with arsenic exposure may contribute to the development of insulin resistance and hyperglycemia, warranting broader investigation [5]. These findings underscore the significant correlation between clean water, food, and the environment with the occurrence of diseases, emphasizing the need for safeguarding these resources to mitigate health risks.

Estimating and comparing GDM prevalence globally is challenging due to disparities in screening methodologies and diagnostic criteria across nations. Data indicates that the standardized global prevalence of GDM stands at 14.0 %, with China's prevalence hovering at approximately 14.8 %, exceeding the global norm [6,7].

GDM often results in numerous adverse outcomes, including spontaneous abortion, fetal anomalies, macrosomia, neonatal hypoglycemia, and neonatal respiratory distress syndrome [8]. Although clinical studies suggest that GDM's negative health impact is often temporary, there is evidence that prenatal hyperglycemia and fetal overgrowth prior to GDM diagnosis at 24 weeks gestation can have lasting metabolic effects on children and adolescents [9,10]. Notably, women with a history of GDM have a nearly tenfold increased risk of developing type 2 diabetes mellitus (T2DM) compared to those with uncomplicated pregnancies, and their children face a significantly higher likelihood of metabolic disorders such as obesity and T2DM in adulthood [11–14]. Longer follow-up studies further reveal that the risk of T2DM is particularly elevated in women with a history of GDM, with cumulative incidence estimates ranging from 8 % in studies with 1–5 years of follow-up to 19 % in studies extending beyond five years [15]. These findings underscore the critical need for enhanced GDM management and preventive strategies. Beyond prompt diagnosis and treatment to mitigate mother-child complications, long-term monitoring and care for women with a prior GDM history and their offspring is paramount. Consequently, governments, healthcare systems, and public health authorities worldwide must prioritize the long-term consequences of GDM and implement measures to reduce its incidence and mitigate its impact on future generations.

In preventing and managing GDM, vitamin D, probiotics, and inositol supplementation have emerged as promising primary prevention strategies, collectively constituting a comprehensive approach [16–18]. Therapeutic management of GDM focuses on personalized dietary guidance, regular physical activity, comprehensive health education, and effective weight management, all crucial to optimizing treatment outcomes and enhancing quality of life [19–21]. Medication also plays a vital role. Traditionally, insulin injection has been the first-line treatment due to concerns about the safety of oral medications [22]. However, with medical advancements, increasing evidence suggests that oral medications are comparable to insulin in terms of glycemic control, safety, and efficacy [23]. Oral drugs offer several advantages, including ease of use, storage, and the potential to enhance patient compliance and reduce treatment costs [23]. Consequently, oral drugs have increasingly been studied and adopted in GDM treatment, providing more options and hope for patients.

Medical nutrition therapy stands as the cornerstone of treatment for GDM patients, effectively optimizing glucose metabolism and enhancing pregnancy outcomes through personalized diet plans and optimized dietary structures. A balanced diet is pivotal in managing diabetes and safeguarding the well-being of both mother and child, thus emphasizing its widespread importance and application [24]. However, numerous studies have highlighted concerns regarding dietary intake in GDM patients, such as inappropriate dietary structures, limited knowledge regarding food types and quantities, and low adherence to healthy dietary habits [25,26]. Furthermore, the majority of women view dietary modifications as a temporary measure, seldom intending to sustain them in the long run [27]. This persistent issue significantly elevates the risk of adverse pregnancy outcomes in GDM patients and heightens the financial burden on their families. To tackle this problem effectively, it is imperative to delve into the factors that influence dietary intake behaviors in GDM patients. This understanding can aid healthcare professionals in pinpointing the root causes and tailoring patient-centered care.

Decision-making behavior, referring to the logical and judgmental processes involved in choosing among different options, plays a critical role in enhancing autonomy and self-regulation in GDM patients, especially when it comes to dietary intake choices [28]. Efficient decision-making behavior is important for enhancing autonomy and self-regulation in GDM and is crucial for their dietary intake choices.Individual preferences, values, and perceptions significantly shape health behavior decisions. Whether it's deciding on rehabilitation referrals, engaging in shared decision-making, or navigating bi-directional referrals, individuals' behavioral decision-making is influenced by internal factors that may vary depending on their unique characteristics [29,30]. These studies not only focus on the decision-making processes themselves but also explore the facilitating and hindering factors that affect these decisions.

In the healthcare context, patients' behavioral decision-making is influenced by various factors, including the availability and comprehension of health information, the accessibility of healthcare services, as well as personal beliefs and attitudes. Understanding these factors is crucial for developing targeted interventions and providing more personalized healthcare that caters to patients' unique needs. In summary, understanding the determinants of dietary intake behaviors in GDM patients is a vital step towards enhancing their health outcomes. By exploring the factors that influence their decision-making processes, healthcare professionals can develop more effective strategies to promote healthy dietary habits and improve the overall quality of care for GDM patients.

Currently, the bulk of research surrounding GDM patients focuses primarily on their current dietary intake patterns, often neglecting a crucial aspect: the behavioral decision-making process involved in selecting and adhering to healthful dietary options, as well as the diverse factors that shape these decisions. It is imperative to recognize that healthy dietary habits are inherently linked to the behavioral decisions made by GDM patients themselves. These choices not only impact their own well-being but also have far-reaching consequences for the health of their unborn child.

Optimizing dietary intake behaviors is paramount in preventing potential complications associated with GDM, such as macrosomia, fetal distress, and neonatal hypoglycemia. As such, a deeper understanding of the decision-making processes underlying dietary choices in GDM patients is necessary to develop targeted and effective intervention strategies.

Exploring the factors that influence these dietary behavioral decisions is essential for several reasons. Firstly, it allows healthcare professionals to gain a deeper insight into the dietary habits and preferences of GDM patients. Secondly, this understanding can facilitate the development of more personalized dietary plans that are tailored to the unique needs and challenges of each patient. By addressing the root causes and motivating factors that drive dietary choices, we can empower GDM patients to make healthier decisions that ultimately lead to improved pregnancy outcomes. In summary, a thorough exploration of the factors that influence the dietary behavioral decisions of GDM patients is vital for promoting healthier dietary habits and improving overall health outcomes. This knowledge provides both theoretical and practical insights that can guide the development of personalized dietary plans and interventions, ultimately contributing to the well-being of both mother and child.

1.2. Influences

Throughout an individual's life journey, behavioral patterns and decision-making tendencies undergo unique and dynamic changes. Kray et al.'s study revealed a gradual shift in risk-taking behaviors, with adolescents tending to be more adventurous in early adolescence and gradually becoming more prudent towards mid- and late adolescence. This shift reflects the increasing maturity of the cognitive control process, which has a profound impact on decision-making [31]. Concurrently, the theory of socioemotional selectivity suggests that older and younger people adopt different attitudes towards social relationships and access to information, highlighting the challenges and opportunities faced by different age groups and their adaptive responses [32,33].

However, this dynamic equilibrium is particularly evident during specific life stages, such as pregnancy. Pregnancy, as a distinct phase in a woman's life, is not only demanding on maternal health but also crucial for the fetus's healthy development. Despite varying research conclusions regarding the relationship between glycemic management decisions and gestational weeks, they all converge on a central question: how to effectively manage glycemia, considering individual differences at various gestational week stages. Although Huang Na et al.'s study concluded that gestational weeks do not directly affect glycemic management decisions, it underscores the need to consider individual patient characteristics and specific contextual factors in analyzing glycemic management behaviors during pregnancy [34,35].

Of particular note is the complexity of pregnancy management in patients with GDM. These patients not only face higher healthcare costs but may also demonstrate significant variations in dietary intake decisions, depending on their family's economic conditions [36,37]. Higher-income families are often able to provide better financial support and nutritional guidance to GDM patients, whereas lower-income families may face greater economic and social pressures, leading to unhealthy dietary choices [38].

Moreover, literacy levels significantly influence GDM patients' dietary intake decisions. Individuals with higher educational attainment are generally more receptive to the concept of a healthy diet and are more likely to adopt it in their daily lives. However, even among these patients, a prior history of GDM increases the risk of recurrence, posing a significant threat to both the mother's and the fetus's health [39,40].

A history of prior GDM is strongly associated with a heightened risk of GDM recurrence in subsequent pregnancies [41]. This elevated risk not only compromises the mother's health but may also have deleterious effects on future pregnancies and neonatal outcomes. Therefore, understanding and managing this recurrence risk is paramount. Fritsche et al. observed that the magnitude of positive decision bias increases when the interval between perception and decision-making is prolonged. This suggests that decision-making processes may be integrated over longer time periods to form stable representations [42]. This phenomenon is particularly relevant in GDM management, as prolonged behavioral decision-making can impact the mother's health management strategies and lifestyle modifications.

Excessive weight gain during pregnancy is not merely a physiological phenomenon; it can be associated with changes in body metabolism, hormone secretion, and placental function, which may, in turn, influence a pregnant woman's ability to make informed dietary decisions [43]. Excessive weight gain often reflects irrational eating habits and may exacerbate food cravings and appetite, leading to unhealthy dietary choices, such as the consumption of high-energy, high-fat foods.

Clinically, we have observed that GDM patients often overlook minor elevations in fasting blood glucose levels. Studies have demonstrated that fasting blood glucose is closely linked to insulin resistance and β-cell function, and neglecting minor elevations can delay timely intervention [2]. Conversely, when 2-h glucose levels are elevated after an oral glucose tolerance test, this often signals a more significant elevation in fasting glucose, prompting increased patient concern.

Insulin therapy, along with a strict dietary plan, is essential for maintaining stable blood glucose levels in GDM patients. This approach necessitates significant dietary adjustments, including considerations for meal timing, composition, and intake, which can have a psychological impact on patients. Strict dietary control and frequent glucose monitoring can increase patients' anxiety and make them more cautious in their food choices. Therefore, insulin therapy is not just a medication-based intervention; it involves comprehensive lifestyle modifications that profoundly affect patients' daily lives.

Providing GDM patients with health-promoting lifestyle education programs has been shown to significantly enhance healthy lifestyle behaviors and improve their quality of life [44]. These programs, through systematic dietary education, empower patients to modify their eating habits and achieve better health outcomes. Dietary education is crucial for GDM patients as it not only educates them about healthy dietary practices but also provides them with practical skills for dietary planning and management.

Dietary diaries, as a tool for self-management, can be an invaluable resource for GDM patients. By documenting their daily dietary intake, patients can gain a deeper understanding of how their eating habits affect their blood glucose levels, thereby enhancing their disease management and self-care abilities. Improved self-management skills often lead to increased compliance with dietary recording and treatment follow-up, creating a virtuous cycle of healthier behaviors and outcomes.

1.3. Theoretical framework

The present study delves deeper into the complex dietary behavioral decision-making processes of individuals with GDM, drawing insights from the theory of protective motivation, a pivotal framework in social psychology [45]. This theory offers a comprehensive understanding of individuals' willingness to engage in health behaviors, emphasizing the intricate interplay between cognitive, affective, and external rewards in shaping and influencing their health choices. Within the context of GDM, individuals' behavioral decisions around dietary intake are influenced by a range of factors. Their level of motivation to adhere to a particular diet is shaped by their expectations and values associated with success. For instance, a GDM patient may choose a low-sugar, high-fiber diet because they believe it will effectively reduce the risk of GDM-related complications, reflecting a positive appraisal of the expected outcomes. Additionally, the fear of adverse effects, such as poor glycemic control on their health and the fetus's welfare, might further enhance their motivation to avoid failure and choose foods accordingly.

The theory of protective motivation comprises three key components: information sources, cognitive mediators, and coping patterns. Among these, cognitive mediation, encompassing threat appraisal and coping appraisal, plays a central role in understanding an individual's decision-making process. Threat appraisal involves assessing factors such as perceived susceptibility to GDM and its severity, as well as the internal and external rewards associated with adopting healthy dietary behaviors. Coping appraisal, on the other hand, relates to an individual's assessment of the effectiveness and feasibility of their dietary choices, including their self-efficacy and the costs involved.

Previous studies have highlighted the significance of perceived susceptibility and perceived severity in influencing health behaviors. GDM patients' knowledge about the disease and their perceived risk of developing future diabetes, for instance, may jointly influence their behavioral intentions towards breastfeeding [46]. Similarly, the perception of disease severity has been shown to motivate individuals to engage in protective health behaviors, emphasizing the need to increase patients' awareness of the potential consequences of unhealthy dietary choices [47].

Individuals' dietary preferences and eating habits often serve as barriers to healthy behaviors [48]. External factors, despite being often overlooked, can significantly impact food intake [49]. Cultural influences, for example, may dissuade pregnant women from consuming nutrient-rich foods, highlighting the need to consider such contextual factors in designing dietary interventions [50].

Individuals' confidence in their ability to successfully complete a health behavior and their beliefs about whether the behavior will have the desired effect are crucial in the formation of willingness to engage in health behaviors.This is supported by the studies of Huy et al. and Ansari-Moghaddam et al. [51,52]. On the other hand, the findings of Chamroonsawasdi et al. showed that self-efficacy, as a mediating effect of response efficacy, has an indirect effect on behavioral intentions [53]. This suggests the possibility that individuals' confidence in their ability to successfully implement a health behavior may indirectly influence their behavioral intentions by influencing their beliefs about whether the behavior will have the desired effect. The presence of this indirect effect highlights the complex relationship between an individual's intrinsic confidence and the influence of the external environment.

Moreover, the physical consequences of dietary choices often serve as a feedback loop, influencing future behavioral decisions. As Sullivan et al. observed, individuals tend to prioritize healthy foods when their bodies start to show negative effects from unhealthy diets [54]. This underscores the importance of providing timely and relevant feedback to GDM patients, allowing them to make informed and healthier dietary choices. Lastly, the cost of healthy eating is a significant consideration, especially for those who may find it unaffordable. Studies have shown that higher dietary costs can positively correlate with the quality of healthy eating, but this may not be feasible for all [55]. The discrepancy in health outcomes between socioeconomic groups, with lower-income groups suffering disproportionately, highlights the need for policies and interventions that address these disparities and promote equitable access to healthy foods [56]. Therefore, in addition to focusing on the negative effects of unhealthy behaviors, we need to consider the ability of individuals to bear the costs of healthy behaviors. Healthy behaviors occur and are reinforced only when individuals are able to properly understand and bear these costs and respond positively to them [57].

2. Methods

2.1. Participants

In this study, 539 GDMs attending outpatient clinics and obstetrics wards of a tertiary hospital in Wuxi, China, were invited to participate from March 2023 to July 2023.

Inclusion criteria: ① Diagnosis of GDM was confirmed in accordance with the diagnostic criteria recommended by the International Association of Diabetes and Pregnancy Research Groups (24–28 weeks of pregnancy, fasting blood glucose $\geq$5.10 mmol/L by oral 75g glucose tolerance test, 1h $\geq$ 10.0 mmol/L and 2h $\geq$ 8.5 mmol/L after glucose consumption, with 1 or more of them abnormal); ② Establishment of a card in the obstetrics outpatient clinic and regular labor and delivery examination; ③ Informed consent and voluntary participation in this study.

Exclusion criteria: ① Severe pregnancy complications or comorbidities; ② Pre-pregnancy type 1 or type 2 diabetes mellitus; ③ Cognitive or psychiatric disorders that prevent cooperation.

2.2. Sampling technique

2.2.1. General questionnaire

A total of 15 factors were included as components of the general information questionnaire, including age, week of gestation, mode of conception, per capita monthly household income, literacy level, history of gestational diabetes, whether or not they worked, rate of weight gain, mode of payment for medical care, fasting glucose value, 2-h post-glucose glucose value at glucose tolerance, experience of hospitalization for glycemic control, whether or not they were on insulin therapy, and whether or not they had received dietary education, Whether or not they kept a diet diary.

2.2.2. Motivational questionnaire

On the basis of the protective motivation theory, 7 dimensions were set up for the protective motivation of GDM dietary intake behavior, i.e., the 7 influential aspects of the theory, including disease susceptibility, disease severity, internal reward, external reward, response efficacy, self-efficacy, and cost of response, and finally formed the 31-entry questionnaire of protective motivation of pregnant women with gestational diabetes mellitus in terms of dietary intake behavior. In addition, reference was made to other protective motivation questionnaires to standardize the language setting of the entries to make it more scientific. A 5-point Liket scale was used, with the options "strongly disagree-strongly agree" assigned a score of 1–5, respectively. Among them, Dimension 3 (internal reward), Dimension 4 (external reward) and Dimension 7 (cost of response) were reverse scored, and the higher the total score, the stronger the willingness of GDM to be motivated to protect.

2.2.3. Decision Conflict Scale [58]

The scale is commonly used to diagnose patient decision-making conflicts, identify patient decision support needs, determine the quality of the decision-making process, and evaluate the effectiveness of decision support interventions. The scale consists of 5 dimensions (information, value clarity, support, uncertainty, and decision effectiveness) with 16 entries. The scale was scored on a 5-point Likert scale, with the options "strongly disagree - strongly agree" scored on a 0–4 scale, calculated as follows: total score = sum of scores for each entry/16*25, with a higher total score indicating a smaller decision-making dilemma for the patient. The total Cronbach's alpha coefficient of the scale was 0.921, and the retest reliability was 0.813. The scale was simple and easy to understand, and could be completed in 5 min.

2.3. Sample size

According to the statistical Kendall sample estimation method: the sample content is at least 5–10 times the number of variables [59]. In this study, including age, gestational week, mode of conception, per capita monthly household income, literacy level, history of gestational diabetes mellitus, whether or not working, rate of weight gain, mode of payment for medical care, fasting blood glucose value at the time of glycemic tolerance, blood glucose value at the time of glycemic tolerance at 2 h after glucose administration, experience of hospitalization to control glycemic control, whether or not insulin therapy, whether or not dietary education was received, whether or not a dietary diary was kept, in a questionnaire for general information. A total of 15 variables, as well as 7 dimensions of the Protective Motivation Questionnaire and 5 dimensions of the Decision Conflict Scale, for a total of 27 dimensions, taking into account 20 % of invalid questionnaires. Calculated sample size: N=(27*5–10)+(1 + 20 %) = 162–324 cases.

2.4. Data collection procedure

In this study, the questionnaires were dispensed on site by the researchers, utilizing standardized instructional language that elucidated the survey's objective, outlined the process for answering the questionnaires, and guaranteed confidentiality. The questionnaires were completed independently by the patients themselves. For those patients with limited literacy or reading challenges, the questionnaires were administered via face-to-face interviews conducted by the investigators. A total of 541 questionnaires were distributed, excluding those completed in a short duration, incomplete questionnaires, or those containing data entry errors. Consequently, 539 valid questionnaires were retrieved, resulting in an effective recovery rate of 99.63 %.

2.5. Data analysis

Excel 2019 was used for data entry and SPSS 26.0 was used for statistical analysis and processing of statistics as follows.

① In the general demographic data, the mean ± standard deviation was used as a statistical indicator for the measurement data, and the frequency and composition ratio (%) were used as statistical indicators for the count data;
② Independent sample *t*-test and ANOVA test were taken to analyze the influencing factors of dietary intake behavioral decision-making;
③ Multiple linear regression was used to analyze the influential factors that were significant in the single factor analysis;
④ Means ± standard deviation were used to describe the dimension scores and total scores of the Motivation for Dietary Intake Protection Questionnaire and Decision Conflict Scale for pregnant women with gestational diabetes mellitus, respectively;
⑤ Pearson correlation was used to analyze the correlation between perceived severity of illness, perceived susceptibility to illness, self-efficacy, response efficacy, internal rewards, external rewards, cost of response, and behavioral decision-making in GDM.

3. Results

3.1. Socio-demographic characteristics of participants

A total of 539 cases of GDM were investigated in this study with age of (31.53 ± 4.37) years; gestational week of (36.82 ± 3.74) weeks; weight gain rate of (0.39 ± 0.44) kg/week; fasting blood glucose at oral glucose tolerance of (5.002 ± 0.755) mmHg; and 2-h blood glucose value of (8.561 ± 2.130) mmHg after glucose intake; There were 496 cases of natural conception (92.02 %) and 43 cases of unnatural conception (7.98 %).

The results of the study showed that age, per capita monthly family income, education level, 2-h post-glucose glucose value at the time of glucose tolerance, previous history of gestational diabetes mellitus, whether or not they were working, whether or not they had been hospitalized for glycemic control, whether or not they had received dietary education, and whether or not they had kept a dietary diary were all factors influencing the decision-making behaviors for dietary intake in GDM, and the differences were statistically significant ($P < 0.05$), and the specific information is shown in Table 1.

3.2. Motivations for dietary intake behavior

The results of Pearson correlation analysis showed that the correlation coefficients between the total score of the Decision Conflict Scale and the scores of the four dimensions of perceived susceptibility, perceived severity, response efficacy, and self-efficacy were 0.271, 0.244, 0.266, and 0.306, respectively; and the correlation coefficients with the scores of the three dimensions of internal rewards, external rewards, and cost of response were −0.118, −0.088, - 0.171, the difference is statistically significant ($P < 0.05$), s ee Table 2.

3.3. Motivation and decision-making scores (Insertion of Table 3)

3.3.1. Factors influencing dietary intake decisions

Using the Decision Conflict Scale score as the dependent variable, and age, per capita monthly household income, literacy, 2-h postsugar glucose value at the time of glucose tolerance, previous history of gestational diabetes mellitus, whether or not they worked, whether or not they were hospitalized to control their blood glucose, whether or not they received dietary education, whether or not they kept a dietary diary, susceptibility, severity, internal rewards, external rewards, response efficacy, self-efficacy, and the cost of response scores, as the independent variables. Multiple linear regression analyses were performed.

The independent variables were assigned in the following manner. Age: 18–25 years old = 1, 26–35 years old = 2, >35 years old = 3; Per capita monthly household income: <3000 yuan = 1, 3000–5000 yuan = 2, >5000 yuan = 3; Educational attainment: high school and below = 1, junior college = 2, undergraduate degree = 3, graduate school and above = 4; Glucose value 2 h after glucose intake during glucose tolerance: $<8.5 = 1$, ≥ 8.5 and $\leq 10 = 2$ and $> 10 = 3$; all other variables were entered as actual values.

The results showed that literacy, 2-h post-glucose value at the time of glucose tolerance, whether or not they had been hospitalized for glycemic control, whether or not they had received health education on diet, perceived severity, self-efficacy, and cost of response were the factors influencing deci sion-making behaviors for dietary intake in GDM ($P < 0.05$), as shown in Table 4.

4. Discussion

This study aimed to assess the factors that influence GDM dietary intake behaviors and motivational situations.

The results revealed that the GDM Decision Conflict Scale had a score of 70.960 ± 11.783, indicating a moderate level of conflict. This finding suggests that the sustained attention of clinical caregivers towards GDM patients has enabled most of them to adhere to caregiver instructions and consume healthy foods, thereby maintaining stable and normal blood glucose levels. This observation is consistent with previous studies [60]. The analysis further indicated that the reduced decision conflict might stem from the clinical caregivers' heightened focus on GDM and the establishment of a robust clinical practice system. This system ensures professional staff are involved from outpatient consultation to follow-up one year after delivery. Additionally, GDM's close association with diet and nutrition underscores the importance of strict dietary control to minimize adverse pregnancy outcomes and treatment costs. The active participation of pregnant women and their partners significantly boosts their self-confidence in managing the disease.

It was also noteworthy that GDM patients who had not received comprehensive dietary education and those with lower literacy levels faced greater challenges in decision-making. This underscores the need for clinical staff to enhance public awareness and disseminate GDM diet-related knowledge. During subsequent management and follow-up, special attention should be paid to patients with lower literacy, regularly assessing their dietary behaviors and correcting any erroneous intakes.

Interestingly, despite the low number of patients hospitalized for glycemic control issues in this study, their dietary intake decision-making scores were significantly higher than those of non-hospitalized patients. Furthermore, the perceived severity of illness and cost of response emerged as significant factors in the Motivation to Protect Questionnaire. This suggests that GDM patients become more attuned to dietary management after considering the increased costs associated with childbirth and anticipating potential treatment expenses from outpatient visits. This heightened awareness appears to boost their self-confidence and motivate them to adopt healthier eating habits.

In scientific research, potential sources of bias can significantly compromise the accuracy and reliability of the results. To tackle these issues, researchers employ a range of strategies aimed at minimizing the influence of selection bias and information bias. Firstly, with regards to selection bias, the researcher meticulously considers various factors during the research design stage. This involves defining, with clarity, the inclusion and exclusion criteria for the study population to ensure that the sample selected is truly representative of the overall population characteristics. In cases where selection bias is inevitable, the researcher mitigates its impact by increasing the sample size, thereby enhancing the stability and reliability of the findings. Secondly, the control of information bias is equally crucial. During the data collection process, the researcher employs standardized and objective methods to minimize subjective interpretations and misjudgments. Furthermore, the researcher respects the right to informed consent of the research subjects, safeguards their privacy, rights, and interests, and avoids conflicts of interest. These measures collectively ensure the impartiality and credibility of the study, thus reducing the potential impact of bias. By adhering to these rigorous practices, researchers can greatly enhance the quality of their studies, ensuring that the results are both accurate and reliable.

5. Conclusion

GDM dietary intake decision-making behavior is still at a moderate level, which suggests that the personalized management system has some shortcomings. In order to improve this situation, we urgently need to strengthen the accountability of clinical caregivers and call for a preventive approach. We should provide health education to pregnant women with high-risk factors in advance and do a good job in follow-up visits to raise their awareness of the seriousness of the disease, the dangers of glycemic instability, and the importance of adhering to a healthy diet and exercise. We should also provide pregnant women with adequate information about dietary intake and decision support to increase their confidence and ability to change adverse behaviors. In addition, we should assist pregnant women in obtaining social support to reduce barriers to their dietary choices and to facilitate the transition from motivation to action, so that they can improve their glycemic management and sustain healthy dietary intake behaviors.

5.1. Limitations

- The use of researcher-developed research tools may create methodological bias.
- Cross-sectional study designs collect data that represent a single point in time and do not capture change or development over a longer period of time.

5.2. Implications for practice

Lack of motivational inquiry makes management by clinical caregivers ineffective and hinders GDM self-dietary management. Exploring the influencing factors of GDM 's dietary intake decision-making behaviors based on the theory of protective motivation provides theoretical and practical references to promote GDM to make healthful dietary choices, improve patient-centered care, and carry out relevant clinical intervention studies.

Data availability statement

Data included in study/supplementary material/referenced in study.

Ethical statement

Research ethics approval for this study was obtained from the Ethics Committee of Wuxi Medical College of Jiangnan University under approval number JNU20230301IRB18. Informed consent was obtained from each subject prior to enrollment. All women who agreed to participate in the study provided their data voluntarily and could withdraw from the study at any time.

CRediT authorship contribution statement

Jiajin Di: Writing – original draft, Software, Methodology, Funding acquisition, Data curation, Conceptualization. **Minjie Jia:**

Visualization, Investigation. **Yunxu Zhou:** Writing – original draft, Visualization, Methodology, Data curation, Conceptualization. **Qingxian Zhu:** Writing – review & editing, Supervision. **Lei Wu:** Validation, Investigation. **Jun Liu:** Writing – review & editing, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Annex.

Table 1
Comparison of different demographic characteristics (n = 539, $\bar{X} \pm s$) **with total decision conflict scores**

sports event		**Number of cases (n, %)**	**Decision Conflict Scale Score (points, $\bar{X} \pm s$)**	***t/F***	***p***
Age (years)	18–35	41 (7.61)	69.09 ± 11.50	3.270[1])	0.039*
	36–45	408 (75.70)	71.69 ± 11.52		
	≥46	90 (16.70)	68.51 ± 12.77		
Week of pregnancy (w)	<28	16 (2.97)	70.41 ± 7.60	0.028[1])	0.973
	≥28 and ≤ 37	163 (30.24)	70.87 ± 13.04		
	>37	360 (66.79)	71.03 ± 11.35		
Monthly per capita household income (¥)	≤3000	19 (3.53)	66.86 ± 12.67	5.260[1])	0.005**
	3000–5000	141 (26.16)	68.72 ± 12.50		
	≥5000	379 (70.32)	72.00 ± 11.33		
educational attainment	High school and below	122 (22.63)	67.12 ± 13.64	7.885[1])	0.000**
	three-year college	165 (30.61)	70.36 ± 9.52		
	undergraduate	230 (42.67)	73.32 ± 11.46		
	Graduate students and above	22 (4.08)	72.02 ± 13.94		
Rate of weight gain (kg/week)	<0.5	415 (76.99)	70.75 ± 11.59	0.302[1])	0.740
	≥0.5 and ≤ 1	112 (20.78)	71.57 ± 11.97		
	>1	12 (2.23)	72.40 ± 16.81		
Fasting blood glucose value at glucose tolerance (mmol/L)	<5.1	305 (56.59)	70.34 ± 11.78	2.646[1])	0.072
	≥5.1 and ≤ 6	196 (36.36)	72.39 ± 11.91		
	>6	38 (7.05)	68.59 ± 10.56		
2-h post-glucose blood glucose value at glucose tolerance (mmol/L)	<8.5	220 (40.82)	72.71 ± 11.80	4.279[1])	0.014*
	≥8.5 and ≤ 10	222 (41.19)	69.55 ± 11.37		
	>10	97 (18.00)	70.22 ± 12.28		
Methods of conception	natural conception	496 (92.02)	71.11 ± 11.78	1.007[1])	0.314
	Unnatural conception	43 (7.98)	69.22 ± 11.79		
Previous gestational diabetes	Yes	137 (25.42)	73.14 ± 9.73	2.522[2])	0.012*
	No	402 (74.58)	70.22 ± 12.33		
Is it working	Yes	400 (74.21)	71.80 ± 11.59	2.832[2])	0.005**
	No	139 (25.79)	68.54 ± 12.04		
Methods of payment of medical expenses	medical insurance	481 (89.24)	71.11 ± 11.75	0.829[2])	0.407
	non-medical insurance	58 (10.76)	69.75 ± 12.08		
Have you been hospitalized for blood sugar control	Yes	65 (12.06)	74.91 ± 12.34	2.898[2])	0.004**
	No	474 (87.94)	70.42 ± 11.61		
Whether insulin therapy	Yes	40 (7.42)	71.88 ± 12.96	0.511[2])	0.610
	No	499 (92.58)	70.89 ± 11.69		
Whether they have received health education on diet	Yes	495 (91.84)	71.64 ± 11.26	3.656[2])	0.001**
	No	44 (8.16)	63.35 ± 14.65		
Whether or not you keep a food diary	Yes	410 (76.07)	72.24 ± 11.35	4.586[2])	0.000**
	No	129 (23.93)	66.89 ± 12.24		

Note: 1) F-value; 2) t-value.
* $P < 0.05$.
** $P < 0.01$.

Table 2
Correlation analysis of GDM dietary intake decisions with protective motivational factors

sports event	Decision Conflict Scale Total Score	susceptibility	Perceived severity	Internal incentives	External incentives	Reaction Efficiency	self-efficacy	Reaction costs
Decision Conflict Scale Total Score	1							
susceptibility	0.271**	1						
Perceived severity	0.244**	0.349**	1					
Internal incentives	−0.118**	−0.054	−0.064	1				
External incentives	−0.088*	−0.176**	−0.158**	0.229**	1			
Reaction Efficiency	0.266**	0.687**	0.362**	−0.031	−0.173**	1		
self-efficacy	0.306**	0.545**	0.416**	−0.243**	−0.374**	0.537**	1	
Reaction costs	−0.171**	−0.178**	−0.075	0.391**	0.441**	−0.152**	−0.340**	1

Note.
* $p < 0.05$.
** $p < 0.01$.

Table 3
Scores of patients with gestational diabetes mellitus on the Behavioral Protection of Dietary Intake Motivation Questionnaire and Decision Conflict Scale (n = 539)

sports event	Score (X ± s)
susceptibility	15.200 ± 3.481
Perceived severity	18.455 ± 4.670
Internal incentives	13.226 ± 4.275
External incentives	8.278 ± 2.923
Reaction efficacy	15.078 ± 3.889
self-efficacy	18.952 ± 4.800
Reaction costs	14.540 ± 5.227
Total score of the questionnaire on motivation for behavioral protection of dietary intake in pregnant women with gestational diabetes mellitus	103.729 ± 13.856
text	14.061 ± 2.162
clarity of value	13.913 ± 2.559
be in favor of	13.007 ± 2.677
uncertainties	13.224 ± 2.675
Decision effectiveness	16.751 ± 4.042
Decision Conflict Scale Total Score	70.960 ± 11.783

Table 4
Multiple linear regression analysis of factors influencing dietary intake decision-making behavior

	Non-standardized coefficient		Standardized coefficient	t	p
	B	Standard Error	Beta		
a constant (math.)	71.666	6.848	–	10.466	0.000**
Age (years)	−0.850	0.952	−0.035	−0.894	0.372
Monthly per capita household income	1.696	0.901	0.078	1.883	0.060
educational attainment	1.565	0.594	0.114	2.636	0.009**
Previous gestational diabetes	−1.844	1.072	−0.068	−1.721	0.086
Is it working	−1.342	1.100	−0.050	−1.220	0.223
Glucose 2 h after glucose intake during glucose tolerance	−1.622	0.631	−0.101	−2.570	0.010*
Have you been hospitalized for blood sugar control	−3.484	1.454	−0.096	−2.397	0.017*
Whether or not they have received health education on diet	−3.954	1.907	−0.092	−2.073	0.039*
Whether or not you keep a food diary	−2.414	1.239	−0.087	−1.948	0.052
susceptibility	0.225	0.190	0.066	1.183	0.237
Perceived severity	0.266	0.111	0.105	2.394	0.017*
Internal incentives	−0.094	0.119	−0.034	−0.795	0.427
External incentives	0.238	0.182	0.059	1.312	0.190
Reaction Efficiency	0.180	0.170	0.059	1.054	0.292
self-efficacy	0.324	0.133	0.132	2.443	0.015*
Reaction costs	−0.229	0.106	−0.102	−2.174	0.030*

$R^2 = 0.221$; adjusted $R^2 = 0.197$; F (16,522) = 9.243, $p = 0.000$.

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