FACTORS INFLUENCING BLOOD GLUCOSE CONTROL BEHAVIOR AMONG PREGNANT WOMEN WITH CLASS A1 GESTATIONAL DIABETES MELLITUS IN WENZHOU, CHINA

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR MASTER DEGREE OF NURSING SCIENCE
(INTERNATIONAL PROGRAM)
IN MATERNITY NURSING AND MIDWIFERY PATHWAY
FACULTY OF NURSING
BURAPHA UNIVERSITY
2024

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LEIXI WANG : FACTORS INFLUENCING BLOOD GLUCOSE CONTROL BEHAVIOR AMONG PREGNANT WOMEN WITH CLASS A1 GESTATIONAL DIABETES MELLITUS IN WENZHOU, CHINA. ADVISORY COMMITTEE: JINJUTHA CHAISENA DALLAS, Ph.D. CHINTANA WACHARASIN, Ph.D. 2024.

Gestational diabetes mellitus (GDM) is one of the most common complications of pregnancy. It can lead to a number of serious maternal and infant complications. This study aimed to investigate blood glucose control behavior among pregnant women with GDM and its influencing factors in Wenzhou, China. A total of 131 participants were recruited using simple random sampling in the clinic at the second affiliated hospital of Wenzhou Medical University. The data was collected using online questionnaires via WeChat mobile application. The questionnaires included general information questionnaire, GDM-related perceived susceptibility questionnaire, GDM-related perceived barrier questionnaire, diabetes self-efficacy scale, diabetes social support scale and GDM blood glucose control behavior questionnaire. Descriptive statistics and standard multiple linear regression were used to analyze data.

The study results revealed that the blood glucose control behavior among pregnant women with class A1 GDM is at a moderate level. Age, perceived susceptibitity, perceived barrier, self-efficacy,and social support explained 45% of the variance in blood glucose control behavior. Self-efficacy ($\beta = .47$, $p < .001$), age ($\beta = .22$, $p < .001$), perceived barrier ($\beta = .-15$, $p < .05$), and perceived susceptibitity ($\beta = .14$, $p < .05$) were effective predictors of blood glucose control behavior. However, social support ($\beta = .11$, $p > .05$) did not significantly predict blood glucose control behavior.

The results of this study provide preliminary information on blood glucose control behavior and its predictive factors in pregnant women with class A1 GDM. Important influencing factors, including self-efficacy, perceived susceptibitity, perceived barriers and age should be taken into account when developing nursing intervention to improve blood glucose control behavior among pregnant women.

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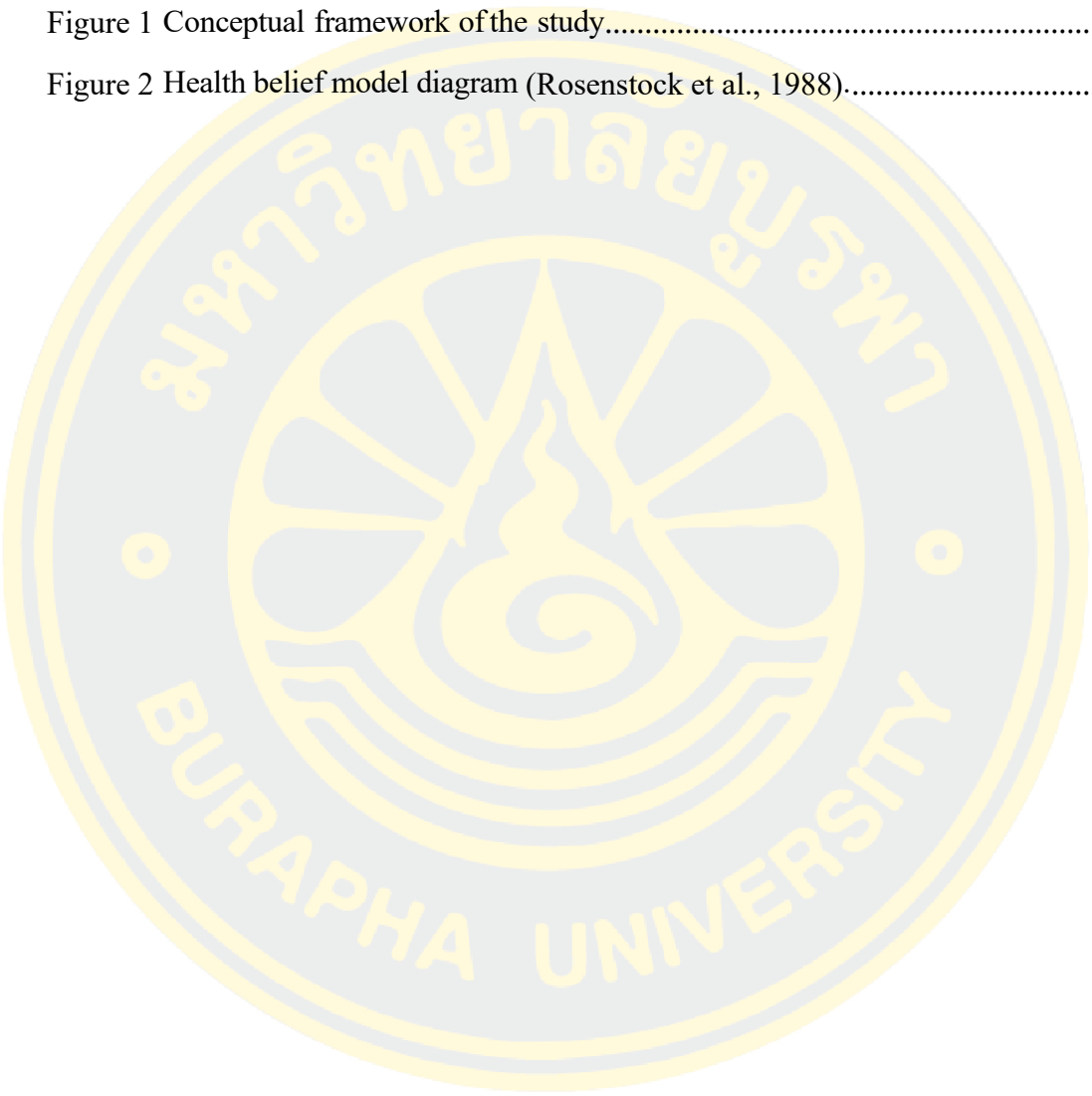

CHAPTER 1
INTRODUCTION

Background and significance of the study

Gestational Diabetes Mellitus (GDM) is the most common complication of pregnancy. The World Health Organization (WHO) defined GDM ‘as any degree of glucose intolerance first detected during pregnancy’. Throughout the pregnancy, the body needs larger insulin quantities to support mother's and child's needs. Unfortunately, hormonal such as placental lactogen, adrenal glucocorticoid, prolactin and progesterone can block insulin's ability to control blood glucose levels. Therefore, women with GDM are insulin resistant (Behboudi-Gandevani et al., 2019; Chiefari et al., 2017).

Prevalence of GDM is increased overtime worldwide. In western countries, the pooled global standardized prevalence of GDM was 14.0% in 2019-2021, ranging from 9% in Africa, 12.6% in North America and 21% in Asia. The standardized prevalence of GDM in low-income, middle-income and high-income countries were 12.7%, 9.2% and 14.2%, respectively (Wang et al., 2021).

In China, with the constant adjustment of fertility policy, the prevalence of high-risk pregnant women, including elder age, overweight or obesity, has been risen dramatically, giving rise to a tremendous burden on the healthcare system. In 2008, the incidence of GDM in China was 1% - 5% (Liu & Liu, 2008). The latest systematic review and meta-analysis showed that the pooled prevalence of GDM in mainland China according to International Association of Diabetes and Pregnancy Study Group (IADPSG) criteria was 14.8% in 2019 (Gao et al., 2019).

GDM can be classified as class A1 GDM and class A2 GDM (CMA, 2022). Class A1 GDM is a gestational diabetes managed without medication and responsive to nutritional therapy or diet control. Class A2 GDM is a gestational diabetes managed with medication to achieve adequate blood glucose control (American College of Obstetricians and Gynecologists, 2018). Studies have shown that the most of pregnant women with GDM have GDMA1. In China, the prevalence of class A1 GDM has reached 70%-85% (Zhou, 2019). Some even reported that the proportion of class A1

GDM reached 92% (Yang, 2022). Therefore, class A1 GDM should be more focused in order to reach broaden knowledge in China.

According to previous research, it has been found that pregnant women with GDM have poor blood glucose control behavior will impact mothers, children, family and society (Li, 2016; Cheng et al., 2017; Huo et al., 2019). For mothers, studies have shown that poor blood glucose control can lead to adverse pregnancy outcomes, leading to complications during pregnancy, while also affecting the woman's own health. It has both physical and psychological consequences (Lowe et al., 2019). For physical effects, it is associated with increased risk of perineal trauma, cesarean delivery rate, postpartum hemorrhage, macrosomia, complications during delivery; also, it is more likely to lead to long-term complications such as cardiovascular disease, chronic kidney disease, cancer, type 2 diabetes and hypertension (Daly et al., 2018; Franzago et al., 2019; Yarandi et al., 2021). For psychological effects, pregnant women with poor blood glucose control behavior are prone to produce anxiety, depression, and other negative emotions, thus increasing the production of glucagon and norepinephrine and leading to elevated blood glucose levels (OuYang et al., 2021; Yarandi et al., 2021).

Regarding child, poor blood glucose control can lead to adverse pregnancy outcomes for babies, resulting in stunted growth of the newborn. In the short-term, it will causes perinatal mortality, neonatal malformation, neonatal hypoglycemia, macrosomia, and respiratory distress syndrome (Franzago et al., 2019; Kawasaki et al., 2018). In the long-term, it will causes childhood obesity and childhood diabetes (Filardi et al., 2018; Shashikadze et al., 2021).

Also, poor blood glucose control will cause a huge societal economic and healthy burden, leading to a major public health challenge. It may increase the financial burden on family and society, becoming a serious social public problem. This includes reducing capacity on work, increase costs for treatment, leading to negative economic impact (Natamba et al., 2019; Shrestha et al., 2020). In China, due to additional expenses during both the pregnancy and delivery, on average, the cost of pregnancy with GDM was ¥6677.37 more than a pregnant woman without GDM (Xu, Dainelli, et al., 2017). Therefore, it is important for pregnant women with GDM to adopt appropriate blood glucose control behavior to mitigate the negative effects of disease.

The International Diabetes Federation (IDF, 2017) points out that the key to managing diabetes is good blood glucose control awareness and behavior. Blood glucose control behaviors that stabilize blood sugar levels through diet and exercise are effective for most pregnant women with GDM. When diet and exercise adjustments fail and blood sugar levels remain high, pregnant women will need drug treatment to adjust blood sugar levels (American Diabetes Association, 2018). Compared with class A1GDM, class A2 GDM will lead to more severe pregnancy outcomes (Billionnet et al., 2017). Therefore, it is of great significance to explore the status and influencing factors of blood glucose control behavior in pregnant women with class A1 GDM. By practicing reasonable blood glucose control behaviors, they can maintain blood glucose levels in a stable state, and they are also able to control the progression of the disease, thereby avoiding complications that worsen their condition and reduce insulin resistance (Wah et al., 2019).

This study applies positive health belief model (HBM) concept and literature reviewed as a research framework. This model is the most widely used theory regarding individual behavior change. Rosenstock et al. (1988) explains that health behavior is based on beliefs about health and disease. The health belief is the core of changing health behavior. This model consists of four components, these are modifying factors (age, gender, geographic location, education, ethnicity, health knowledge, income, etc.), individual beliefs (perceived susceptibility, perceived severity, perceived barriers, perceived benefits and self-efficacy), cues to action (media campaigns, physician reminders, friend/family member's illness, etc.) and action. The core is individual beliefs about health and disease, emphasizing the decisive role of health beliefs in the formation and maintenance of health behaviors. Individual beliefs are the basis and motivation for people to accept persuasion, change bad behaviors, and adopt healthy behaviors.

For this study, all the indicator framework components with some related variables will be examined. Modifying factors (i.e., age), individual beliefs (i.e., perceived susceptibility, perceived barriers, and self-efficacy), and cue to action (i.e., social support) are selected for this study based on supporting evidence.

Age is associated with health behavior. Some researchers find that women older than 35 with GDM are more likely to follow dietary controls (Li, 2016). However,

some show that pregnant women younger than 30 years of age perform better on eating behavior (Zhang et al., 2020).

Perceived susceptibility is related to health behavior. Previous studies have found that perceived susceptibility is positively correlated with blood glucose control behavior (Li, 2016; Ma et al., 2019). It is reported that individuals who perceive that they are susceptible to disease will engage in behaviors that would help reduce the risk of developing the disease (Champion & Skinner, 2008). The level of knowledge is the key to measure perceived susceptibility. It indicates that with the improvement of receiving health knowledge, the patients' perceived susceptibility and blood glucose control ability are enhanced (Cheng et al., 2017).

Perceived barriers are correlated with health behavior. Studies have found that the barriers perceived by pregnant women with GDM can affect their diet, exercise, and other blood glucose control behaviors (Khoramabadi et al., 2016). Some indicate that perceived barriers are positively correlated with blood glucose control behavior (Li, 2016), while some have shown that perceived barriers are negatively correlated with blood glucose control behavior (Ma et al., 2019; Zhang et al., 2016).

Self-efficacy is associated with health behavior. Some find that women with higher self-efficacy have better blood glucose control behavior (Jiang, 2018). Self-efficacy can be influenced by direct experience, vicarious experience, evaluation and persuasion of others, as well as emotional and physiological states. Through the intervention of self-efficacy, clients with GDM can improve their cognitive ability and healthy behavior compliance. This helps them establish a good lifestyle consciously for which they can control blood glucose behavior and reduce GDM complications effectively (Yao et al., 2019).

Social support is indirectly or directly correlated with health behavior. Some find that the level of social support affects blood glucose behavior of pregnant women with GDM (Parsons et al., 2019). The higher social support, the better self-management behavior is. Social support during pregnancy mainly includes support mainly from family and and significant others support (Nielsen et al., 2020). These factors can exert their influence indirectly when they affect the confidence of women with gestational diabetes that will motivate them to follow good behavior (Schiøtz et al., 2012).

For GDM clients' health behavior studies, many studies focus on only one aspect. Some researchers study only diet control behavior (Hui et al., 2014; Kusinski et al., 2020). Some examines exercise behavior (Harrison et al., 2018). Some investigates self-monitoring of abnormal blood glucose condition (Guo et al., 2020). Few studies (Cheng et al., 2017; Hu et al., 2021; Huo & Ding, 2019) explore all aspects of blood control behavior (i.e., diet control, regularly appropriate exercise, blood glucose self-monitor, and emotional management). Also, there is few research (Li, 2016) using HBM as a framework for inspecting correlations between selected variables from HBM and blood glucose control behavior among pregnant women with GDM. In addition, in Wenzhou, China, there is few research in pregnant women with class A1 GDM. Therefore, this study will explore the predictive factors (i.e., age, perceived susceptibility, perceived barriers, self-efficacy, and social support) of blood glucose control behavior among pregnant women with class A1 GDM.

Results of this study might be used as a guide for improving blood glucose control behavior more appropriately and to prevent severe and/or long-term complications in pregnant women with class A1 GDM. Also, the results from this study might be useful for providing more body of knowledge about blood glucose control behavior among pregnant women which can contribute to widen nursing education and research.

Research objectives

1. To describe blood glucose control behavior of pregnant women with class A1 GDM in Wenzhou, China.

2. To examine the influencing factors of blood glucose control behavior among pregnant women with class A1 GDM including age, perceived susceptibility, perceived barriers, self-efficacy, and social support.

Research hypothesis

Age, perceived susceptibility, perceived barriers, self-efficacy, and social support could jointly predict blood glucose control behavior among pregnant women with class A1 GDM in Wenzhou, China.

Conceptual framework

This study was guided by health belief model (HBM) and literature review (Rosenstock et al., 1988). The HBM has several constructs that explain or predict why people will take action to prevent, to control, or to screen for a disease. These constructs include modifying factors, individual beliefs (perceived susceptibility, perceived severity, perceived barriers, perceived benefits, and self-efficacy), cues to action, and action. For this study, the research would examine some variables of each HBM component based on literature review and evidence supported. These included age (from modifying factor component), perceived susceptibility, perceived barriers, self-efficacy (from health belief component), social support (from action cues), and blood glucose control behavior (from action component).

It had been found that age might positively or negatively correlate with blood glucose behavior (Li, 2016; Zhang et al., 2020). Perceived susceptibility was positively associated with blood glucose control behavior (Li, 2016). Perceived barriers to blood glucose control behavior compliance might be positively or negatively correlated with blood glucose control behavior (Li, 2016; Ma et al., 2019; Zhang et al., 2016). Finally, self-efficacy and social support were positively associated with blood glucose control behavior (Ferranti et al., 2014; Parsons et al., 2019). Thus, age and perceived barriers are still suspicious factor in term of affecting to blood glucose control behavior and should be has more testing. This study would confirm the association of selected factors with blood glucose control behavior among pregnant women with class A1 GDM in Wenzhou, China. Diagram of the study framework as shown in Figure 1.

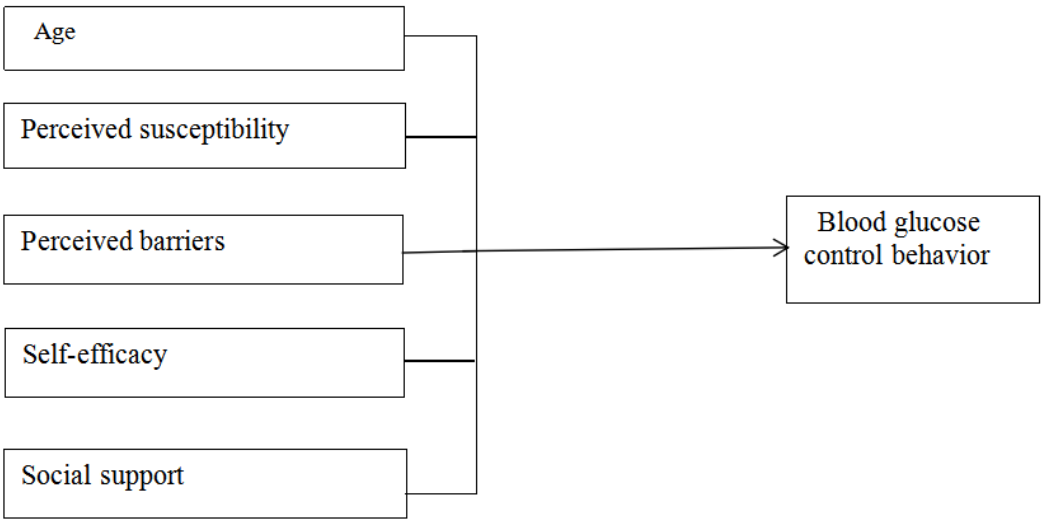

Figure 1 Conceptual framework of the study

Scope of the study

This study was conducted in pregnant women with class A1 GDM who receive service from an obstetrical clinic at the second affiliated hospital of Wenzhou Medical University, Wenzhou, China. Data was collected from June to December 2022. The independent variables were age, perceived susceptibility, perceived barriers, self-efficacy, and social support and dependent variable is blood glucose control behavior.

Definition of terms

Class A1 GDM is defined as a gestational diabetes managed without medication and responsive to nutritional therapy or diet control and diagnosed by the physician.

Age is defined as number of years lived. Age will be measured by a general information questionnaire developed by the researcher.

Perceived susceptibility is defined the beliefs, perceptions, and knowledges about how likely a person is to get a disease or a condition. It was measured by GDM-related perceived susceptibility questionnaire which is the first part of self-management ability questionnaire for gestational diabetes mellitus patients (SMQGDM) developed by Qi (2018). It consists of three dimensions as 1) risk factors, 2) complications in the mother, 3) complications in infants.

Perceived barriers are defined as difficulties of complying with appropriate blood glucose control behavior. It consists of four dimensions as 1) lack of knowledge regarding diet control, 2) waste, 3) inconvenience, and 4) harm. It was measured by the GDM-related perceived barrier questionnaire, which is the fourth part of GDM-related health belief questionnaire developed by Li (2016).

Self-efficacy refers to confidence in one's ability to successfully implement blood glucose control behaviors. It has three subscales of confidence in 1) diet control, 2) exercise, 3) complication management. It was measured by diabetes self-efficacy scale and translated into Chinese by Sun and Li (2010) which developed by Lorig et al. (1996) and translated into Chinese version .

Social support is defined as help provided by family members and/or friends. It consists of two subscales: affirmative and emotional support. It was measured by the diabetes social support scale (part 5 of the Diabetes Care Profile (DCP)) by Li et al. (2015) which developed by Fitzgerald et al. (1996) and translated into Chinese.

Blood glucose control behavior refers to activities of keeping blood glucose in a level not harmful to one's health. It has four subscales: diet control compliance, exercise compliance, blood glucose monitoring, and high and low blood glucose management. It was measured by GDM blood glucose control behavior questionnaire by Li (2016) which originally developed by Wang et al. (1998) and modified .

CHAPTER 2
LITERATURE REVIEW

The study of correlations between selected factors and blood glucose control behavior among pregnant women with gestational diabetes mellitus in Wenzhou, China is based on literature review. Contents of the review are as follow:

1. Concept of gestational diabetes mellitus
   1.1 Definition of gestational diabetes mellitus
   1.2 Diagnostic criteria of gestational diabetes mellitus
   1.3 Effects of gestational diabetes mellitus
   1.4 Class A1/A2 gestational diabetes mellitus in China
2. Concept of blood glucose control behavior
   2.1 Definition of blood glucose control behaviors
   2.2 Significance of blood glucose control behavior
   2.3 Current situation of blood glucose control behavior
   2.4. Management of blood glucose control behavior
3. Concept of health belief model
4. Factors influencing blood glucose control behavior
5. Summary

Concept of gestational diabetes mellitus

1. Definition of gestational diabetes mellitus

Diabetes can occur before or during pregnancy. Pregnancy with diabetes includes pregestational diabetes mellitus (PGDM), pre-diabetes and gestational diabetes mellitus (GDM) according to guidelines for hyperglycemia during pregnancy developed by Chinese Medical Association (CMA) in January 2022. PGDM includes Type 1 diabetes mellitus (T1DM) and Type 2 diabetes mellitus (T2DM). If diabetes is not diagnosed before pregnancy but blood glucose is elevated during pregnancy, PGDM should be diagnosed if blood glucose meets any of the following criteria: 1) Fasting plasma glucose (FPG) $\geqslant$ 7.0mmol/L; 2) Accompanied by typical hyperglycemic or hyperglycemic crisis symptoms, and arbitrary blood glucose $\geqslant$

11.1mmol/L; 3) HbA1c ⩾6.5%. Pre-diabetes includes impaired fasting glucose (IFG) and impaired glucose tolerance (IGT). The CMA (2022) recommend FPG screening for all pregnant women at their first prenatal visit. FPG ⩾5.6mmol/L can be diagnosed as IFG. If FPG ranges from 5.1~5.6mmol/L during early pregnancy, GDM is not directly diagnosed, it is recommended that pregnant women should do oral glucose tolerance test (OGTT) during 24~28 weeks of gestation or reexamine FPG, FPG⩾5.1 mmol/L, it can be diagnosed as GDM; FPG＜5.1mmol/L, OGTT was performed. GDM is defined as any degree of abnormal glucose tolerance that first appears during pregnancy (Juan et al., 2019). It can be classified as class A1 GDM and class A2 GDM (CMA, 2022). Class A1 GDM is a gestational diabetes managed without medication and responsive to nutritional therapy or diet control. On the other side, class A2 GDM is a gestational diabetes managed with medication to achieve adequate blood glucose control (American College of Obstetricians and Gynecologists, 2018).

2. Diagnostic criteria of gestational diabetes mellitus

The diagnostic methods and criteria for GDM have been controversial for many years. The new more rigorous criteria have been elaborated by the International Association Diabetes Pregnancy Study Groups (IADPSG) in 2010 (Diabetes & Panel, 2010). The American Diabetes Association (ADA) updated the diagnostic criteria for GDM in 2011 (Wysham & Kirkman, 2011) and the World Health Organization (WHO) also developed the diagnostic criteria for pregnancy hyperglycemia in 2013 (WHO, 2013). In China, (IADPSG) criteria is used to diagnose GDM. GDM diagnostic methods and/or criteria as follows (IADPSG):

2.1 Seventy-five-gram oral glucose tolerance test (75g OGTT) is typically recommended for pregnant women without PGDM at 24 to 28 weeks of gestation.

Methods of 75g OGTT can be done by pregnant women have regular diet for 3 days straight before the trial. Fasting for at least eight hours before OGTT. During the examination, 300ml of liquid containing 75g glucose was taken orally within 5 minutes, venous blood is extracted before and after glucose consumption for 1 hour (hr) and 2 hr.

Diagnostic criteria of 75g OGTT including fasting, 1-hr, and 2-hr glucose levels should be lower than 5.1, 10.0, and 8.5 mmol/L (or 92, 180, 153 mg/dL),

respectively. If any glucose levels reach or exceed the above criteria, GDM will be diagnosed.

2.2 Pregnant women in areas with a high risk of GDM or lack of medical resources are recommended to be examined for fasting plasma glucose (FPG) at 24 to 28 weeks of gestation. If FPG equal or greater than 5.1 mmol/L (92.7 mg/dL) can be directly diagnosed as GDM, do not need to perform 75g OGTT. If FPG values between 4.4 mmol/L (80 mg/dL) and less than 5.1 mmol/L, OGTT should be performed as soon as possible. In contrast, if FPG values less than 4.4 mmol/L, it has extremely less possibility of GDM. Therefore, there is no need to performing OGTT either.

2.3 Pregnant women who are at high risk for GDM and have the first OGTT results as normal should have repeated OGTT in the third trimester.

2.4 FPG levels gradually decrease with weekly pregnancy, especially in early pregnancy. Therefore, FPG levels in early pregnancy cannot be used as the diagnostic basis of GDM.

2.5 OGTT or FPG is recommended as early as possible for pregnant women who do not have regular prenatal visits if the first visit is after 28 weeks of gestation.

3. Effects of gestational diabetes mellitus

GDM adversely affects pregnant women, fetus, family and society.

3.1 Effects of GDM on pregnant women

GDM affects both physical and mental health of pregnant women (Marchetti et al., 2017). For physical aspect, women with gestational diabetes had an increased risk of developing type 2 diabetes compared with those who had a normal blood sugar in pregnancy, and the risk size increased with the number of pregnancies (Kim et al., 2019; Zhu & Zhang 2016). It has been noted that women with a history of GDM have a nearly 10-fold increased risk of developing T2DM (Vounzoulaki et al., 2020). Twenty-eight studies including 34,627 incident cases of T2DM and 170,139 women with GDM were identified. The pooled incidence of T2DM after GDM was 26.20 per 1000 person-years (95% CI, 23.31 to 29.10).. Women from Asia and those with older age and higher body mass index seem to experience higher risk of developing T2DM (Li et al., 2020). Also, Some researchers pointed that women with GDM have a significantly higher rate of obesity, hypertension, and metabolic syndrome, together

with altered levels of circulating inflammatory markers; all are risk factors for cardiovascular disease (Bianco & Josefson, 2019; Franzago et al., 2019).

According to mental health, women with GDM are more prone to prenatal depression, anxiety, and stress when they are aware that uncontrolled diabetes can lead to pregnancy-related complications and adverse neonatal outcomes. Anxiety, depression, and negative emotions can stimulate sympathetic nerves to release glucagon, then further increase blood sugar. Thus, even make it much more difficult to control blood sugar (OuYang et al., 2021).

3.2 Effects of GDM on the fetus.

GDM can also lead to a series of adverse pregnancy outcomes. Kamana et al. (2015) indicates that about 15 to 45% of babies born by diabetic mothers have macrosomia (birthweight > 4,000 g) 3-fold higher rate comparing to normoglycemic controls. Some studies point out that incidence of neonatal hypoglycemia and respiratory distress syndrome are significantly increased compared to normal pregnant women. For long-term consequence, children of GDM women often have overweight or obese, high blood pressure, be at increased risk of developing type 2 diabetes, and have cardiovascular disease in later life (Bianco & Josefson, 2019; Cerychova et al., 2018).

3.3 The impact of gestational diabetes on the family and society

For families, GDM increases medical costs; for the society, GDM will cause huge social and economic burden and waste of social resources, which is a serious social public problem. In China, GDM has brought huge economic burden. In 2015, the additional cost of pregnancy with GDM was ¥6677.37: Expense for GDM diagnosis and treatment was ¥4421.49, expense for the mother's complications was ¥1340.94 and expense for neonatal complications was ¥914.94. Therefore, the annual economic burden of GDM in that year was ¥19.36 billion (equal to $5.59 billion) (Xu, Dainelli, et al., 2017).

4. Class A1/A2 gestational diabetes mellitus in China

The ADA (2022) recommend that a healthy lifestyle is an important component of GDM management. A number of randomized controlled trials (RCTS) have suggested that diet, exercise intervention and lifestyle management can reduce the risk of GDM from the first and second trimester. A dozen years ago, the incidence of

GDM in China was 1% - 5%, about 80% were class A1 GDM (Liu & Liu, 2008). The latest systematic review and meta-analysis showed that the pooled prevalence of GDM in mainland was 14.8% in 2019 according to IADPSG criteria (Gao et al., 2019). Some studies have shown that 70% to 85% of pregnant women with GDM are class A1 GDM and can achieve target glycemic control through a healthy lifestyle alone according to Carpenter-Coustan criteria, and the percentage would be even higher if the IADPSG criteria for GDM were used (Yang, 2022). Zhou (2019) reported that 92% of pregnant women with GDM are class A1 GDM, could control their blood glucose within the normal range through a healthy lifestyle. Therefore, the vast majority of pregnant women with GDM do not require drug therapy. After 3-7 days of diet control, if the blood glucose of pregnant women is still poorly controlled, then insulin should be added, thus the pregnant woman will develop to class A2 GDM. Compared with class A1 GDM, class A2 GDM has more maternal and fetal complications and an increased incidence of fetal malformations (Billionnet et al., 2017). Therefore, how to adopt a reasonable lifestyle to control blood glucose in the normal range and avoid drug treatment will be of great significance.

Concept of blood glucose control behavior

1. Definition of blood glucose control behavior

Blood glucose control behavior is considerable as a self-care ability. It is the ability to actively participate in self-care to achieve the desired goals as healthy well-being (Denney & Quinn, 2018). It is recommended that pregnant women with GDM generally have the following four aspects: reasonable diet, regular exercise, self-monitoring of blood sugar, and the correct treatment of hyperglycemia and hypoglycemia (Li, 2016).

2. Its significance of blood glucose control behavior

Appropriate blood glucose control behavior can solve the problem of both short-term and long-term negative effects. Blood glucose control behavior can effectively reduce pregnancy complications and improve pregnancy outcomes. Also, it can significantly reduce the occurrence of GDM comorbidities in mothers and infants as a long-term consequence (Billionnet et al., 2017; Eberle & Stichling, 2021).

3. Current status of blood glucose control behavior in women with GDM

At present, most domestic studies believe that the blood glucose control behavior of pregnant women with GDM is not optimistic, which is at a medium or poor level. Cheng et al. (2017) investigating this behavior in 950 GDM clients find that clients have poor in weight control, diet control, and regular exercise as 76.0%, 57.0%, and 44.0%, respectively. Li (2016) finds that only 13.5% of clients have good self-management in GDM for which rates of good self-management regarding diet control, exercise, blood glucose monitoring and management of high and low blood glucose are 6.4%, 6.0%, 5.7%, 16.67% respectively. Huo and Ding (2019) finds out that rates of GDM clients with good, moderate, and poor self-management level are 31.0%, 29.0%, 40.0%, respectively. Highest and lowest of self-management behavior level are exercise management and medicine treatment.

4. Management of blood glucose control behavior

GDM can be managed by nutritional therapy, exercise intervention, blood glucose monitoring, medicine treatment, and psychological intervention (ADA, 2018; CMA, 2022).

4.1 Nutritional therapy

Nutritional therapy is an important component of GDM treatment. diabetes prevention, treatment, blood glucose control, and education. Studies have shown that nutritional treatment can delay the occurrence of abnormal glucose metabolism and lipid metabolism disorders in GDM patients during pregnancy and significantly control the blood sugar and hemoglobin levels in patients (Lende & Rijhsinghani, 2020). The International Federation of Gynecology and Obstetrics (FIGO) also recommends that all patients diagnosed with GDM must receive regular medical nutrition education and consultation throughout pregnancy and adopt an individualized diet according to the basic BMI, gestational week, fetus, number and type of patients to control the quantity and quality of food at the appropriate level (Hod et al., 2015).

Some people found that GDM patients will have more problems with insufficient dietary intake, overdose intake and nutritional imbalance during pregnancy compared with the average pregnant woman (Gou et al., 2019). Some showed that individualized nutritional intervention in GDM patients could effectively control patient weight and reduce the incidence of adverse pregnancy outcomes (Simmons et

al., 2017). Some reported that excessive dietary control makes the patient feel hunger, which causes ketone body production, which and then affects the intellectual development and behavioral development of the fetus (Hernandez et al., 2018). Medical nutritional therapy for GDM patients should ensure the optimal nutritional status of mother and baby, adequate energy intake to ensure proper weight gain during pregnancy, achieve and maintain blood sugar levels, and avoid the occurrence of ketosis (CMA, 2022). The Clinical Practice Guidelines for Pregnancy and Diabetes points out that nutrition treatment should be carried out reasonably according to the actual situation of patients, such as for overweight and obese patients should limit energy intake, and lightweight or weak patients should ensure enough energy supply (Denney & Quinn, 2018). Medical staff should take individualized nutritional treatment to the patient according to his actual situation (Xu, He, et al., 2017).

ACOG (2018) suggested that carbohydrates should be limited to 33% ~ 40% of total energy, protein (20%) and fat (40%). However, the CMA recommends consuming at least 175 grams of carbohydrates per day, with 50% to 60% of total energy. Insufficient carbohydrate intake may lead to ketosis (CMA, 2022). Carbohydrate intake is mainly divided into three main meals and two to three extra meals to help allocate carbohydrate intake and reduce postprandial blood glucose fluctuations (ADA, 2018; CMA, 2022). The energy of breakfast, lunch and evening meals should be controlled at 10% to 15%, 30% and 30% of the total daily energy intake respectively, and the energy of each extra meal can account for 5% to 10%. Food should be multifaceted and it is better to choose foods with low glycemic index (GI). A single carbohydrate can easily lead to high blood sugar after a meal, so a mix of carbohydrates is recommended. Increasing dietary fiber intake is beneficial to health. A daily dietary fiber intake of 10-14g / 1000kcal and a daily salt intake limit of 6g are recommended for pregnant women with GDM (Yang & Wang, 2021). The CMA recommends 25 to 30 grams of dietary fiber per day. Patients with GDM are prone to deficiency of vitamin B, vitamin C, vitamin D and other micronutrients, which can be supplemented according to the results of nutritional assessment (CMA, 2022). Professionals should design an individual diet structure based on patients' metabolic goals and personal preferences (such as customs, culture, religion, health concepts, economic status, etc.) (Randel, 2014).

4.2 Exercise control intervention

Both ADA (2018) and CMA (2022) recommend that GDM patients who exclude medical or obstetric contraindicate should adhere to exercise therapy throughout pregnancy. Safe and appropriate exercise can reduce the serum insulin level in patients, improve the utilization rate of carbohydrates in people to a certain extent, enhance the sensitivity of external human tissues to insulin, improve the abnormal sugar metabolism status of patients and achieve the ultimate goal of reducing patients' blood sugar (CMA,2022). Patients with GDM should have 30 minutes of moderate-intensity exercise per day for at least 5 days per week, or at least 150 minutes of cumulative exercise per week, the best time to exercise is 1-2 hours after meal (ACOG, 2018). Pregnant women who do not exercise regularly before pregnancy should start from low intensity and step by step (CMA, 2022). Aerobic exercise and resistance exercise are acceptable forms of exercise during pregnancy (CMA, 2022). A combination of aerobic and resistance exercise during pregnancy improved pregnancy outcomes more than aerobic exercise alone (Singh et al., 2020). Walking for 10 to 15 minutes after each meal is generally recommended to improve blood glucose control (Randel, 2014). Moreover, some proposed that pregnant women can do exercise like yoga, dancing, stretching, flexibility exercise, spa or water aerobics (Gilbert et al., 2019). Don't do sports that can cause falls, injuries or collisions during pregnancy, such as contact sports (ice hockey, boxing, soccer, basketball, etc.) and high-risk sports (skiing, surfing, cross-country biking, horseback riding, etc.). During pregnancy, especially in the first trimester, exercise (such as bikram yoga, pilates, scuba diving, skydiving) that causes maternal hyperthermia should also be avoided (CMA, 2022).

If pregnant women feel dizziness, nausea or discomfort during lying down exercise, they should adjust their position and avoid supine position. During exercise, pregnant women should have an adequate water supply, wear loose clothing and avoid exercising in high heat and humidity. For pregnant women who need to use insulin treatment, it is necessary to be alert to the occurrence of hypoglycemia caused by exercise and avoid fasting exercise in the morning. Pregnant women with blood glucose level < 3.3 mmol / L or > 13.9 mmol / L should stop exercise and detect urinary ketone body (CMA, 2022). It also recommends you should stop exercising when you experience the following warning signs: Vaginal bleeding, ruptures membranes,

abdominal pain, regular uterine contractions, amniotic fluid outflow, difficulty breathing, dizziness, headache, chest pain, muscle weakness etc. (Padayachee & Coombes, 2015).

4.3 Blood glucose monitoring

Blood glucose monitoring is an important part of GDM management, and it is an important basis to reflect the effect of dietary and exercise control and drug treatment in GDM patients during pregnancy and to evaluate and adjust the treatment regimen (Juan & Yang, 2020). The most basic and common way of blood glucose monitoring in GDM patients during pregnancy is patient self-blood glucose monitoring. Blood glucose control behavior refers to the peripheral blood glucose measurement by patients, which is conducive to patients to understand their self-blood glucose situation in time (Tian et al., 2020). CMA recommends that after 3-7 days of dietary treatment, pregnant women with gestational hyperglycemia should undergo 24 h blood glucose profile test (peripheral blood glucose), including night blood glucose, blood glucose 30 min before three meals, blood glucose 2 hr after three meals (CMA, 2022). ACOG recommends that all patients with GDM self-monitor their blood glucose 4 times a day: That is, fasting blood glucose once a day and blood glucose 3 times 2 hours after meals. If conditions are limited, blood glucose should be measured at least once a day (Zhou et al., 2021). Both ADA and ACOG recommend fasting blood glucose levels below 95 mg/dL (5.3 mmol/L) ,1 hour postprandial blood glucose levels below 140mg/dL (7.8mmol/L) and 2 hour postprandial blood glucose levels below 120mg/dL (6.7mmol/L) (category B evidence) (ADA, 2018). It is recommended to regulate blood glucose multidisciplinary (Such as nutrition clinic, endocrine clinic, obstetrics clinic), and the above blood glucose values are checked weekly. However, if abnormal blood glucose monitoring is high, the frequency of blood glucose monitoring is increased. If blood glucose is stable and fluctuates in the normal range, the blood glucose monitoring frequency can be reduced. Once patients with GDM can control blood glucose levels well through diet, the frequency of blood glucose testing can be adjusted according to gestational age and compliance (Tian et al., 2020).

4.4 Medicine treatment

Patients diagnosed with GDM should be treated with diet and exercise, and if blood glucose cannot be controlled, medications that are beneficial to the mother and

the fetus should be used. Patients diagnosed with GDM should be treated with diet and exercise, and if blood sugar is not controlled, with maternal-fetal medications. ADA and ACOG emphasize that insulin is the first choice for the treatment of hyperglycemia in women with gestational diabetes mellitus, and advocate individual choice of insulin type and regimen, but fail to recommend any specific insulin regimen for the treatment of GDM (ACOG, 2018). Insulin is a macromolecular protein, and it is not easy to pass through the placenta. The use of insulin in GDM patients during pregnancy will not cause adverse effects on the fetus, which is the only recognized safe drug used at home and abroad to control blood sugar in GDM patients during pregnancy at home and abroad (Bao et al., 2021). Metformin can be used to control blood glucose in pregnant women who cannot use insulin due to subjective and objective conditions (refuse to use insulin and cannot safely inject insulin or cannot afford insulin) (CMA, 2022).

4.5 Psychological intervention

Psychological care is also one of components of blood glucose control behavior. Women with GDM should be strengthened their psychological health along with given them GDM knowledge. This will help them have confidence in performing their behavior to stabilize or decrease their GDM condition (OuYang et al., 2021). It is important to establish a good communication mechanism with patients, encourage patients to express their inner tension and anxiety, and comfort and encourage patients. Explain in detail the occurrence and development of the disease, relieve the patient's tension and anxiety, so that the patient can actively cooperate with clinical treatment and nursing work. At the same time, tell them the examples of those successful childbirth, build their confidence to face the disease, communicate with their husbands and tell them at appropriate time to encourage and understand the patients, so that the patients feel safe and reduce their negative emotions.

Concept of health belief model (HBM)

Healthy behavior is affected by many factors such as psychology, physiology, and society. The Health Belief Model (HBM) is a psychological model that attempts to explain and predict health behaviors. HBM was proposed by Hochbaum (1958) and gradually perfected by Rosenstock et al. (1988). This model explains health behaviors based on person’s beliefs about health and disease. It has been used to explore patient

motivations for adapting a health-related behavior and in assessing health-behavior interventions. It emphasizes the subjective perception in accepting persuasion, having motivation to change bad behaviors, adopting healthy behaviors, and forming and maintaining healthy behaviors (Azadi et al., 2021; Khiyali et al., 2017).

HBM is an important theoretical model that can make reasonable explanations for people's adoption of healthy behavior. It analyzes the factors that affect behavior in psychological terms. This pattern focuses on the psychological changes of the patient, and believes that if the patient has the belief in health and disease, and actively changes the dangerous behavior, the act of taking the health and health of the disease is the guarantee of the improvement of the disease. The health belief model explains the factors of behavior change from the form of faith and attitude, and emphasizes the importance of subjective attitude and psychological belief in action, namely, subjective attitude and psychological belief that determines whether it will take some kind of health behavior. HBM is one of the most widely used conceptual frameworks. It can serve both as a guidance framework for health behaviour interventions and as an explanation for the change and maintenance of health-related behaviours (Champion & Skinner, 2008).

Since its development, the health belief model has been used in many populations to explore many different health-related topics, such as hypertension compliance, health education of patients with type II diabetes, health education for cancer patients (Khorsandi et al., 2017; Lau et al., 2020; Mohammadi et al., 2018). It has been found to be a reliable and valid tool to use as a framework while conducting research pertaining to health behaviors and health educational programs. Therefore, to study the blood glucose control behavior of pregnant women with GDM, the concept of HBM is used as a methodological tool to explain.

The HBM has several constructs that explain or predict why people will take action to prevent, to control, or to screen for a disease. These constructs include individual beliefs, cues to action , action and modifying factors (Champion & Skinner, 2008).

The core concept of HBM is individual beliefs. Individual beliefs refer to perceived threat (perceived susceptibility and perceived severity) of related diseases. The higher the individual's awareness of a disease threat or health problem, the more

likely they are to take health behavior. Also, evaluation to counteract threat includes judgment of whether adoption of such activity can lead to good health (perceived benefits) and personal understanding of difficulties in behavior change (perceived barriers) affect health behavior adoption. Only when a person has perceived benefits over perceived barriers, that person tends to take initiative health behavior (Rosenstock et al., 1988).

In addition, self-efficacy is also a part of individual beliefs. Self-efficacy means that a person has a correct evaluation and judgment of his own behavior ability and believes that he can successfully take an action leading to the desired result through efforts. The important role of self-efficacy is that when you recognize that there will be obstacles to taking an action, you need the confidence and the will to overcome those obstacles in order to complete the action (Rosenstock et al., 1988).

Another component that affects personal health behavior is cues to action. Behavioral cues refer to stimulation and suggestion of an individual to take action and are the promoting factors for an individual to make healthy behavior. It includes the propaganda of mass media, suggestions of medical staff, and disease experience of relatives, friends, or oneself. If one has sufficient preparation in thought and strategy, one's action will be more consolidated and lasting (Rosenstock et al., 1988).

The knowledge, attitude, belief, and practice (KAP) model was compared with HBM. The KAP model hold that knowledge and information are the basis for establishing positive and correct beliefs and attitudes, thus promoting health-related behaviors. Beliefs and attitudes are the driving forces for behavior change.

Both frameworks encourage the promotion of human health through positive feedback. However, compared with HPM, the health belief model (HBM) is more suitable for this study. The KAP model believes that there is a strong link between knowledge, belief and behavior, and only when people have the right knowledge and beliefs of health can lead them to adopt appropriate health behaviors. However, the health belief model is more concerned with the psychological and attitude factors of people, and believes that health behavior is a perception and response to health risks and disease threats, including awareness of disease, assessment of risk, the intention of behavior and the execution of behavior. Therefore, the HBM is more focused on the relationship between attitudes and actions. In this study, several factors (perceived

susceptibility, perceived barriers, and self-efficacy) were more consistent with changing one's health behavior.

This study focuses on blood glucose control behavior. The dependent variable is regarded as the outcome, and independent variable as the factors in the health belief model framework. In the study risk factors link to age, perceived susceptibility, perceived barriers, self-efficacy, and social support. Explore the risk factors of blood glucose control behavior and to reduce the occurrence of maternal and infant complications by controlling the risk factors.

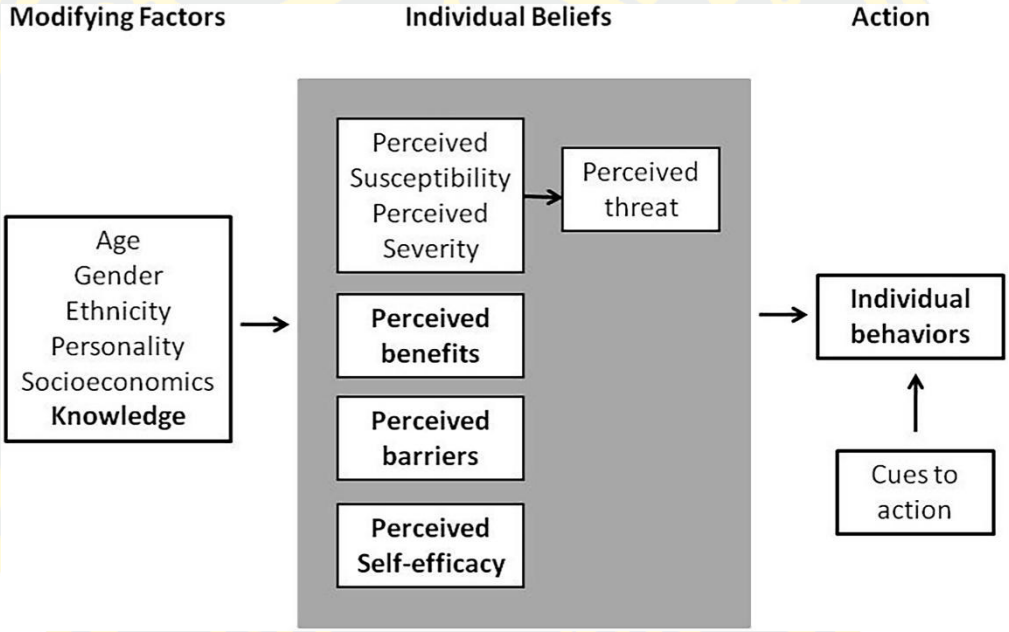

Figure 2 Health belief model diagram (Rosenstock et al., 1988).

Factors influencing blood glucose control behavior

From the literature review and evidence support, it has been found that some variables from HBM components are associated with blood glucose behavior.

1. Age

Age is defined as the number of years lived. Age was included as a predictor in this study. People of different ages have different abilities to control their behavior. Li (2016) found statistically significant differences in self-management behavior among patients of different ages ($P < 0.05$), women older than 35 years had better

compliance with diet control, exercise compliance, glucose monitoring, abnormal glucose management. Ansarzadeh et al. (2020) showed that age is one of the influencing factors of patient motor blood glucose control; that is, the older the patient, the better the motor blood glucose control. This may be related to the gradual increase of self-awareness of care in patients with age. However, Zhang et al. (2020) showed that pregnant women younger than 30 years of age scored higher on eating behavior. It may be that pregnant women younger than 30 are more likely to actively receive messages about healthy eating and adopt healthy eating behaviors. Thus, this study aimed to test associate of age and blood glucose control behavior.

2. Perceived susceptibility

Perceived susceptibility is defined as an individual's judgment of the likelihood of developing a disease or a health problem. Existing studies have shown that perceived susceptibility can positively affect blood glucose control behaviors. The more likely people feel that they are to develop a disease, the more likely they are to take action to avoid it (Li, 2016; Ma et al., 2019). For example, gestational diabetes is associated with the development of type 2 diabetes, but people tend not to pay much attention to things that are far away and have not happened. How to make them evaluate the facts, make subjective judgments, and form beliefs about disease susceptibility is the important to success in health education and health promotion. Lack of knowledge is the main factor limiting the perceived susceptibility. Increasing disease-related knowledge is key to improving perceived susceptibility. The patient identifies if he is at risk of getting some disease, then, he acquires information and understanding on how serious the disease is (Louis II, 2016). By informing the harm of the disease to the health, the possible complications and other serious consequences, and explaining the related knowledge of the disease, such as the definition, etiology, prevalence, treatment, prognosis, risk factors and high risk factors of the disease, as well as the importance of scientific lifestyle and diet style for the prevention and treatment of gestational diabetes mellitus, patients' awareness of disease susceptibility can be improved. These perceptions combined will determine the level of threat he is facing (Li, 2016).

According to previous researches, Cheng et al. (2017) found that education is one of the main factors affecting blood glucose control during pregnancy in GDM patients; the more the knowledge, more willing to accept various medical information,

easier to understand relevant knowledge, can fully realize the importance of blood glucose control, thus show good compliance. Huo and Ding (2019) reported that patient self-management is based on the knowledge of disease. Therefore, scientific and reasonable health education can promote patients to fully and correctly understand the disease, apply knowledge to practice, and consciously form good self-management behavior. Shen et al. (2018) showed that patients with better knowledge of GDM had better self-management of diet, blood glucose monitoring, body weight monitoring and medication as prescribed by doctors. Javalkar et al. (2016) also proved that patients' disease knowledge was positively correlated with self-management. Fan and Guo. (2015) showed that strengthening health education for patients and their families can increase patients' disease knowledge and change their health behaviors. Therefore, in this study, perceived susceptibility was tested as a factor influencing blood glucose control behaviors.

3. Perceived barriers

Perceived Barriers are defined as the subjective judgment of individuals on the difficulties they may face in adopting behavior, including physical, psychological, economic and time cost barriers. People recognize that difficulties are essential for health promotion activities to be consolidated and sustained (Ma 2019). If there are some precautions that are costly, painful, and not effective, they should be pointed out in real time and help people to take them. To improve the cognitive level of a patient's health beliefs, the medical staff must make a comprehensive evaluation of the patients' health beliefs and give specific interventions according to the particularity of the patients' health beliefs to improve their blood sugar self-monitoring behavior (Lu, 2016). For example, although some pregnant women with GDM believe that exercise can help with glycemic control, but exercise cost time and they may be concerned about risk for fetal injury.

Existing studies have shown that perceived barriers can positively or negatively affect blood glucose control behaviors. Zhang et al. (2016) found that perceived diabetes treatment difficulties inpatient health beliefs were inversely associated with blood glucose monitoring ($P < 0.05$). Ma et al. (2019) reported that perceived barriers had negative effects on self-management behavior (the influence coefficient was-0.243, respectively). However, Li (2016) found that perceived barriers

was positively correlated with self-management behavior. Lu (2016) discovered that perceived barriers had an indirect impact on self-management behavior in type 2 diabetes. Tsai et al. (2021) investigated the relationship between health beliefs and foot self-care behaviors, among people with type II diabetes. The results showed that the diabetic foot self-care behavior was significantly and positively correlated with diabetic foot ulcer health beliefs of perceived barriers. Song et al. (2016) showed that conscious action disorder is positively correlated with blood glucose self-monitoring behavior ($r= 0.354$, $P <0.05$). Only when patients have enough understanding of the difficulties encountered in long-term self-monitoring of blood glucose can this healthy behavior be maintained for the long term. Thus, this study aimed to test the influencing of perceived barriers to blood glucose control behaviors in pregnant women with GDMA1.

4. Self-efficacy

Self-efficacy is defined as an individual's evaluation and judgment of their own ability, that is, whether they believe that they have the ability to control internal and external factors to successfully adopt health behaviors and achieve desired results (Bandura & Walters, 1977). Self-efficacy is an important driver of individual behavior, which directly affects the growth and development of individuals. Methods to improve self-efficacy include positive evaluation of their abilities, seeking support and recognition from others, increasing successful experience, and mastering necessary knowledge and skills (Mohammadi et al., 2018). We should actively improve our sense of self-efficacy, so as to better play to our potential. Studies have shown that women with more self-efficacy have better blood glucose control behavior (Karimy et al., 2018).

Lorig et al. (1996) believes that the internal mechanism of self-management is self-efficacy. Yao et al. (2019) analyzed the relationship between self-efficacy and self-management behaviors (diet control, physical exercise, regular medication and blood glucose self-monitoring) of diabetic patient in a total of 2166 T2DM patients. The results showed that self-efficacy and self-management behaviors of diabetic patients were positively correlated. Karimy et al. (2018) explored the relationship between self-efficacy and diabetes self-care behavior compliance. In this cross-sectional study conducted in 2017, 403 patients with diabetes were enrolled. The results showed that patients with high self-care scores had better self-efficacy. Jiang (2018) found that the higher the level of self-efficacy of gestational diabetes patients,

the higher the level of self-management and the self-efficacy and self-management interact. Shen et al. (2018) investigated 158 patients with GDM in obstetrics department of 5 public hospitals in Beijing, China， she found that patients with higher self-efficacy had better self-management of diet. Hu et al. (2021) showed that GDM patients with higher self-efficacy had significantly higher self-management level, which may be related to the effective control and regulation of individual behavior by self-efficacy. The higher the self-efficacy is, the patients will make efforts to overcome the difficulties encountered in the process of self-care behaviors, so as to ensure the implementation of self-management health behaviors. Therefore, self-efficacy can be an influencing factor to blood glucose control behavior in this study.

5. Social Support : Family and significant others support

Social support is defined as the spiritual and material help from outside sources, including family, community, and society. In this study, social support was also a predictor of blood glucose control behavior. Studies have shown that family and significant others support has an important impact on their self-management during pregnancy (Huo & Ding, 2019). Studies have shown that most social support of pregnant women with GDM comes from family and significant others support (Nielsen et al., 2020). A good family support system can promote GDM pregnant women to better cooperate with the treatment and improve the blood glucose control behavior of patients (Hu et al., 2021). Family support mainly includes emotional support, encouragement and compliance monitoring. Pregnant women with GDM may encounter various difficulties and face certain mental pressure in the process of controlling blood glucose, which may cause anxiety and depression and other problems (Parsons et al., 2019)**.** The listening, understanding and companionship of family members can reduce the emotional burden of patients and provide emotional support (Wah et al., 2019). Encouragement and motivation from family members can increase patients' confidence that glycemic control can be accomplished and encourage them to adhere to a good lifestyle. What's more, families can urge pregnant women with GDM to have regular prenatal examination and nutrition outpatient consultations to ensure that they are following the guidance of doctors and nutritionists for diet control, exercise, and activities. However, some studies also pointed out that family support should not be excessive. Some family members pay too much attention to patients,

which will cause patients to be bored after a long time, and make patients think that they are involved in the family and depressed. In addition, family members should learn GDM related knowledge simultaneously to provide scientific help for patients (Ma et al., 2019).

Schiøtz et al. (2012) studied the relationship between family support and self-management behavior in people with type 2 diabetes. Self-completed questionnaires were collected from 2572 patients with type 2 diabetes. It is found that good family support is significantly correlated with health promotion behavior and well-being. Lee et al. (2019) examined the relationship between a patient's primary health supporter (family member or friend) and glucose self-monitoring and medication adherence. 326 veterans with type 2 diabetes were surveyed. The study found that support from health advocates was significantly associated with better diabetes-related attitudes, self-care, and glucose control. Hu et al. (2021) showed that the self-management level of GDM patients with high social support especially family support was significantly higher than that of GDM patients with low social support, which may be related to the fact that more social support can improve patients' confidence in treatment. Higher social support can play a more urging role in the diet, exercise and blood glucose monitoring and management of patients with GDM, and at the same time, it can provide better help for patients to control their condition and improve bad behaviors. Shen et al. (2018) showed that the level of social support affected the blood glucose monitoring and exercise self-management of GDM patients, and the higher the score of social support was, the better the patients' self-management behavior was. Economic support is also an important part. Family economic and social health insurance policies can significantly affect blood glucose control behavior (Cheng et al., 2017). In conclusion, social support, especially, family and significant others support may be one of the important factors influencing GDM patients' self-management during pregnancy.

Summary

In conclusion, GDM is a more common metabolic disease in women during pregnancy, and it has become a serious public problem because GDM harms maternal and child health. It is still very important to manage the disease effectively. At present, the management rate of gestational diabetic diabetes patients in China is relatively low,

and it is difficult for the treatment rate and control rate to improve. A good job of blood glucose control is of positive significance to control the blood sugar level and reduce the incidence of complications. By consulting the literature, it was found that GDM patients' blood glucose control and their influencing factors involve less research at home and abroad. In China, GDM patients are still in the initial stage.

Most of the research focused on the patients' demographic data, clinically relevant data and other factors on blood glucose control and lack the discussion of health belief factors. Therefore, further research will be carried out in this study. Drawing on the concept of HBM system intervention, medical staff establish a scientific, feasible and effective self-management model for GDM patients so as to improve their blood glucose control level, improve maternal and infant outcomes and quality of the popular.

So, this study aimed to study the influencing factors of blood glucose control behavior in Wenzhou, China, which has guiding significance for the future nursing work. The results of the study on the impact of age, perceived susceptibility, perceived barrier, self-efficacy, social support on blood glucose control behavior were also worth discussing. In order to solve these gaps in Wenzhou, China, our study has certain significance.

CHAPTER 3
RESEARCH METHODOLOGY

This chapter presented research methodology including research design, research setting, population and sample, research instruments, quality of instruments, ethical consideration, data collection procedures, and data analysis.

Research design

The design of this study was cross-sectional and correlational predictive design.

Research setting

The study was conducted at the obstetric clinic of the second affiliated hospital of Wenzhou Medical University (WMU) located in Wenzhou, China. This hospital is located in Wenzhou, China. It is the class A hospital (the highest rank of hospital in Wenzhou). At present, it has 14 disciplines (departments), 89 departments (teaching and research sections), 186 subspecialties, more than 130 specialized clinics, and 2,667 beds. Among them, obstetrics is a key construction discipline of colleges and universities in Zhejiang Province, which has rich sources of research objects and research basis. This obstetric clinic provides care for pregnant women including women with both low risk and high risk including general physical and mental health, maternal abdominal exam, fetal health exam and order them for fetal monitoring, blood drawing, or B-mode ultrasound service. The clinic provides care for about 100 GDM clients each month.

Population and sample

1. Population

The target population of this study was pregnant women with class A1 gestational diabetes mellitus who visit an obstetrical ward at the second affiliated hospital of WMU, Wenzhou, China.

2. Sample

Participants were pregnant women with class A1 GDM. Inclusion criteria of participants include:

1) Age 18 years or above

2) Have been diagnosed with class A1GDM

3) Have singleton fetus

4) Do not use insulin therapy

5) No other severe obstetrical complication or problem of medical conditions until cannot provide information

6) Can communicate in Chinese and use WeChat fluently

Exclusion criteria of participants include:

1) Damage to vital organ function or co-occurrence with other serious chronic conditions, such as malignant tumors, severe liver and kidney dysfunction, etc.

2) Severe audio-visual impairment, unable to cooperate with this study.

3) Combined with severe neuropsychiatric symptoms or personality disorders.

3. Sample size

The sample size in this study was calculated by using Tabachnick and Fidell's formula (2007) as follows:

$N \geq 104 + m$ (where m is a number of independent variables)

Based on this formula, the sample size for this study should be least 109. In this study, add more 22 case from 20% incomplete rate. Therefore, 131 participants were recruited.

4. Sampling technique

1. After entering the clinic, the researchers searched doctors' outpatient records for eligible women. After getting permission, the women who met the inclusion criteria were selected for questionnaire survey by scanning the questionnaire star two-dimensional code on the spot.

2. The sample random sampling method was used to select 131 eligible participants who met the inclusion criteria.

3. Participants who was numbered one by one and the participants code as the odd number was selected as the sample.

Research instruments

Data was collected by seven questionnaires. They were described as follows:

1. General information questionnaire

Demographic and obstetrical data was measured by a general information questionnaire developed by the researcher. Demographic information includes age, education, residence, marital status, family type, occupation, and family financial status.

2. Obstetrical information questionnaire

Obstetrical information recovered by the researchers includes planned pregnancy, conception method, gravida, parity, abortion, alive child, gestational age, time period from GDM diagnosed till data collection date, pre-pregnant body mass index (BMI), and appropriate weight gain according to each BMI group criteria.

3. GDM-related perceived susceptibility questionnaire

GDM-related perceived susceptibility questionnaire was used to test for perceived susceptibility. This tool was measured by the first part of self-management ability questionnaire for gestational diabetes mellitus patients (SMQGDM) developed by Qi (2018). It has 9 items with 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5) with the statements. It has 9 items with 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5) with the statements. It consists of three subscales: risk factors (item1, 2,3), complications in the mother (4,5,6), complications in infants (7,8,9). Its possible total score ranges from 9-45. The higher the score, the greater women get perceived susceptibility. From previous study (Qi, 2018), it has content validity index (CVI) as .98 and Cronbach's alpha coefficient as .893.

4. GDM-related perceived barrier questionnaire

Perceived barriers of blood glucose control behavior were measured by the fourth part of GDM-related health belief questionnaire of GDM developed by Li (2016). It has 9 items with 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5) with the statements. It has four subscales: lack of knowledge regarding diet control (item 1, 2), waste (item 3, 8), inconvenience (item 4, 9), and harm (item 5, 6,

7). Its possible total score ranges from 9-45. The higher the score, the greater the barriers women perceive about perform blood glucose control behavior. From previous study (Li, 2016), it has content validity index (CVI) as .8 and Cronbach's alpha coefficient as .82.

5. Diabetes self-efficacy scale

Self-efficacy in blood glucose control behavior was measured by diabetes self-efficacy scale developed by Lorig et al. (1996), then translated into Chinese by Sun and Li (2010). It consists of 9 items with 5-point Likert scale ranging from no confidence at all (1) to have very strong confidence (5) in performing such activities related to blood glucose control. It has three subscales: diet control (item 1, 2, 3), exercise (item 4, 5), and complication management (item 6, 7, 8, 9). Possible total scores range from 9-45. High score indicates high self-efficacy in blood glucose control behavior. It has CVI as 1.0 and Cronbach's alpha coefficient as .90 (Jiang, 2018).

6. Diabetes social support scale

Social support for blood glucose control behavior was measured by diabetes social support scale that is the fifth part of the Diabetes Care Profile (DCP) which focus on family and significant others support that developed by Fitzgerald et al. (1996), then translated into Chinese by Li et al. (2015). It has 10 items with 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). There are two subscales: affirmative support (item 1, 2, 3, 6, 8, 9), and emotional support (item 4, 5, 7, 10). The possible total score ranges from 5-50. High score means high social support for blood glucose control behavior. It has CVI as .89 and Cronbach's alpha coefficient as .73.

7. GDM blood glucose control behavior questionnaire

Blood glucose control behavior was measured by GDM blood glucose control behavior questionnaire evolved from diabetes self-management behavior scale proposed by Wang et al. (1998), then modified by Li (2016). It consists of 18 items with 5-point Likert scale ranging from not did at all (1) to always did (5). Also, it has the option of nonapplicable for participants who have never exposed with that situation. There are four subscales: dietary control compliance (items 1-6), exercise compliance (item 7-10), blood glucose monitoring (items 11-14), and high and low blood glucose management (item 15-18).

Possible total scores range from 18 to 90. High score means having appropriate blood glucose control behavior. For some participants choosing the NA option, their total score will be calculated by the rule of three in arithmetic based on the total score as 90.

Blood glucose control behavior is divided into 3 levels by trisection:

Low (18-41 scores),

Moderate (42-65 scores),

High (66-90 scores) (Li, 2016).

It has CVI as .81 and Cronbach's alpha coefficient as .91 (Li, 2016).

Quality of instruments

All instruments are already tested for their validity, thus, its validity will not be examined.

The reliability of instruments was tested in 30 pregant women who had same characteristics as participants. Cronbach's alpha coefficients of the questionnaires related to perceived susceptibility, perceived barriers, self-efficacy, social support, and blood glucose control behavior were .89, .79, .93, .71, .93, respectively. Cronbach's alpha coefficient should be at least .70 (Qi, 2018). The validity and reliablity of each table were shown in Table 1.

Table 1 Validity and reliability of the scales

	Validity	Reliablity
GDM-related perceived susceptibility questionnaire	.98 (Qi, 2018)	.89
GDM-related perceived barrier questionnaire	.84 (Li, 2016)	.79
Diabetes self-efficacy scale	1.0 (Sun and Li, 2010)	.93
Diabetes social support scale	.89 (Li et al. 2015)	.71
GDM blood glucose control behavior questionnaire	.81(Li, 2016)	.93

Protection of human rights for subjects

The thesis proposal had been submitted to Burapha University Ethics Committee on Human Research (BUU EC) in Thailand and the Institution Review Board (IRB) of the second affiliated hospital of WMU, Wenzhou, China. After the approval, during data collection, clients meeting inclusion criteria had been informed about the brief study, its benefits, confidentiality, and voluntary nature of the study by both written document and telling. If they participated in the study, they had the right to withdraw from the study at any time. They were assured that their refusal to participate were not affect the healthcare service they would receive. The consent form was signed by participants before data collection. All data was kept in a secure place. Study results were presented as comprehensive data, not link to any individual identify. Data were only be utilized for the research purpose. It was destroyed after study results are published.

Data collection procedures

Data collection procedures in this study were conducted by the researcher as follows:

1. Thesis proposal was submitted to Burapha University Ethics Committee on Human Research (BUU EC).

2. After the approval from BUU, the letter from Faculty of Nursing, BUU was sent to the director and the Institution Review Board (IRB) of the second affiliated hospital of WMU.

3. After the approval from hospital, the researcher contacted all administrators of the research setting to introduce herself, explain brief details of the study, and ask for their cooperation.

4. At the setting, the researcher followed the registration records to find clients meeting inclusion criteria. Then, the researcher used a simple random sampling technique to recruit participants.

5. The researcher met the selected clients to introduce herself, inform them about the study, participants' roles, and their human right protection. Then, the

researcher asked them to participate in the study voluntarily. If they agreed, they would sign the consent forms for signature verification.

6. Participants answered the self-report questionnaires via the WeChat application during their waiting for the service. It took about 20 minutes for them to complete questionnaires. A total of 135 questionnaires were issued. 4 invalid questionnaires were excluded and a total of 131 participants were included in the sample.

7. The researcher checked for data completeness.

Data analysis

Data was analyzed by statistical software. The level of significance was set as .05. Data analysis was performed by below statistical methods.

1. Descriptive data of general information was analyzed by descriptive statistics.

2. Description of variables (both independents and dependent) were analyzed by descriptive statistics.

3. The predictors of blood glucose control behavior which include age, perceived susceptibility, perceived barriers, self-efficacy, social support among pregnant women with class A1 GDM were analyzed by standard multiple linear regression. The data was tested for assumptions using standard multiple regression including normality of variables, linearity, homoscedasticity, no autocorrelation and no multi-collinearity. The histogram and the Normal P -P plot showed the variables (age, perceived susceptibility, perceived barrier, self-efficacy, social support) were distributed normally. Scatterplots of the residual and partial regression plots showed the independent variables had a linear relationship with dependent variable and the data were homoscedastic. There was no multi-collinearity as the tolerance value of the model were >.1 and VIF values were < 10. The Durbin-Watson value was 1.586 indicating that there is no autocorrelation. When all assumptions were met, standard multiple linear regression analysis was performed.

CHAPTER 4
RESEARCH RESULTS

This chapter presents the results of study including 1) demographic characteristics of patients, 2) obstetrical information of patients, 3) descriptive data of dependent variable as blood glucose control behavior, 4) descriptive data of independent variable, 5) correlations among the study variables, and 6) predicting factors of blood glucose control behavior among pregnancy women.

Demographic characteristics of patients

For demographic characteristics, the patients had a mean age of (32.01±4.38) years. The majority of them were less than 35 years old (74.80 %), Junior college education or above (77.80%), employed (82.40%), no debt (68.00%), and living in urban areas (89.30%). See (Table 2).

Table 2 Demographic characteristics of patients（n = 131）

Characteristics	**Group**	**Frequency (n)**	**Percent (%)**
Age *(M* = 32.01; *SD* = 4.38;	≤30 years	40	30.50
Range = 22-44)	31-35 years	58	44.30
	36-40 years	29	22.10
	40-45 years	4	3.10
Education	Primary school	2	1.50
	Junior middle school	12	9.20
	High school (including technical secondary school)	15	11.50
	Junior college	37	28.20
	Undergraduate	58	44.30
	Other (identify)	7	5.30
Place of residence	City	76	58.00
	Town	41	31.30
	Countryside	14	10.70
Marital status	Married	130	99.20
	Single	1	0.80
Occupation	Worker	50	38.20
	Teacher	13	9.90
	Merchant	23	17.60
	Civil servant	7	5.30
	Unemployed	23	17.60
	Other (identify)	15	11.50

Table 2 (Continued)

Characteristics	Group	Frequency (n)	Percent (%)
Family financial status	Have deposit without debt	66	50.40
	Have deposit more than debt	23	17.60
	Have deposit less than debt	7	5.30
	Have deposit equal to debt	13	9.90
	Other (identify)	22	16.80
	Total	131	100

Obstetrical information of patients

For obstetrical information of patients, most of them were natural pregnancy (91.60%), planned pregnancy (68.70%), and had a reasonable weight gain based on BMI (70.20%). See (Table 3).

Table 3 Obstetrical information of patients (n = 131)

Characteristics	Group	Frequency (n)	Percent (%)
Planned pregnancy	Yes	90	68.70
	No	41	31.30
Appropriate weight gain according to the criteria of each BMI group	Yes	92	70.20
	No	39	29.80
Method of conception	Natural	120	91.60
	Artificial assisted	11	8.40
	Total	131	100

Descriptive data of dependent variable as blood glucose control behavior

Blood glucose control behavior as the dependent variable and its subscales were analyzed by descriptive statistics. Possible total scores range from 18 to 90, the higher score, the better blood glucose control behavior women have. The score of blood glucose control behavior in three levels (low [18-41], moderate [42-65], high [66-90]) as shown in table 4. In this study, blood glucose control behavior with mean score 60.68 (SD = 13.47), it was moderate from range of 42-65 as shown in table 5, accounting for 54.20% as shown in table 4. It has four dimension as dietary control compliance with mean score of 21.23 (SD=4.26) with range of 12-30 shows moderate level, exercise compliance with mean score of 13.13 (SD=4.09) with range of 4-20 shows moderate level , blood glucose monitoring with mean score of 12.70 (SD=4.09) with range of 4-20 shows moderate level and high and low blood glucose management with mean score of 13.86 (SD=3.08) with range of 5-20 shows moderate level as shown in table 5.

Table 4 Description of the level of blood glucose control behavior (n = 131)

Blood glucose control behavior	**Score range**	**N**	**%**
Low	18-41	5	3.82
Moderate	42-65	71	54.20
High	66-90	55	41.98

Table 5 Description of blood glucose control behavior (n = 131)

Variable	Actual score	Possible score	M	SD
Blood glucose control behavior	29-85	18-90	60.68	13.47
Dietary control compliance	12-30	6-30	21.23	4.26
Exercise compliance	4-20	4-20	13.13	4.09
Blood glucose monitoring	4-20	4-20	12.70	4.09
High and low blood glucose management	5-20	4-20	13.86	3.08

Descriptive data of independent variables

Variables of this study, age, perceived susceptibility, perceived barrier, self-efficacy, social support and blood glucose control behavior were analyzed by descriptive statistics. The findings from the study showed the mother's age had a mean score of 32.01 (SD=4.38), perceived susceptibility with mean score 31.92 (SD=3.72), perceived barrier with mean score 27.33 (SD = 4.66), self-efficacy with mean score 30.04 (SD = 7.36), and social support with mean score 36.48 (SD = 5.64). See (Table 6).

Table 6 Descriptive data analysis results of independent variables (factors) (n = 131)

Variable	Actual score	Possible score	M	SD
Age	22-44	≥18	32.01	4.38
Perceived susceptibility	22-40	9-45	31.92	3.72
Perceived barrier	17-43	9-45	27.33	4.66
Self-efficacy	17-45	9-45	30.04	7.36
Social support	21-50	5-50	36.48	5.64

Correlation among variables

The correlations among the study variables demonstrated in table 7. The result showed significant positive correlation between age, perceived susceptibility, self-efficacy, and social support with blood glucose control behavior (r=. 371, p<. 01; r=. 289, p<. 01; r=. 587, p<. 01; r=. 213, p<. 01) respectively. The result also showed significant negative correlation between perceived barrier with blood glucose control behavior (r=-. 248, p<. 01). There was no coefficient score to show correlation among independent factors more than .8. That means there is no multicollinearity in this study.

Table 7 Correlation matrix between influencing factors and blood glucose control behavior(n=131)

Variables	1	2	3	4	5	6
Age	1.00					
Perceived susceptibility	0.091	1.00				
Perceived barrier	-0.101	-.238**	1.00			
Self-efficacy	.223*	0.168	-0.054	1.00		
Social support	.219*	0.171	-.210*	.371**	1.00	
Blood glucose control behavior	.371**	.289**	-.248**	.587**	.213**	1.00

*p < .05, ** p < .01

Standard multiple linear regression analysis

To examine selected factors (age, perceived susceptibility, perceived barrier, self-efficacy, social support) influencing blood glucose control behavior, standard multiple linear regression was used for analysis. This statistical method had several assumptions that had to be met as mentioned in chapter 3. When all assumptions were met, standard multiple linear regression analysis was performed.

From table 8, standard multiple regression analysis showed that factors include age, perceived susceptibility, perceived barrier, self-efficacy and social support explained 45 % of the variance in blood glucose control behavior (Adj R2 = .450, F (5, 125) = 22.299, p < .001). Age, perceived susceptibility, perceived barrier, and self-efficacy were effective predictors of blood glucose control behavior. The best predictor is self-efficacy (β=. 47, p<. 001), followed by age (β=. 22, p<. 001), perceived barrier (β=. -15， p < .05), and perceived susceptibility (β=. 14， p < .05). Social support (β= .11, p >. 05) is not a significant predictor of blood glucose control behavior. See (Table 8).

Table 8 Standard multiple linear regression analysis predicting factors of blood glucose control behavior(n=131)

Predicting factors	B	SE	β	t	p-value
Age	0.66	0.21	0.22	3.19	.002
Perceived susceptibility	0.50	0.25	0.14	2.02	.045
Perceived barrier	-0.42	0.20	-0.15	-2.12	.036
Self-efficacy	0.86	0.13	0.47	6.54	.000
Social support	0.26	0.17	0.11	1.51	.135

Constant = -0.176, R^2 = .471, Adjust R^2 = .45, F (5, 125) = 22.299, p <.001

CHAPTER 5
CONCLUSION AND DISCUSSION

This chapter presents the summary and discussion of the study findings. The implication of the findings for nursing, limitation of the study, and recommendation for future research are addressed.

Summary of the research

This study was a cross-sectional and correlational predictive design that aimed to describe blood glucose control behavior among pregnancy women having class A1 GDM in Wenzhou, China, and to predict the related factors (age, perceived susceptibility, perceived barrier, self-efficacy, and social support) affecting blood glucose control behavior. Conceptual framework of this study based on health belief model (HBM) (Rosenstock et al., 1988) and the literature review. Simple random sampling method was used to recruit the sample of 131 pregnant women with gestational diabetes mellitus who visit an obstetrical ward at the second affiliated hospital of WMU, Wenzhou, China.

The results showed that the patients had a mean age of 32.01(SD = 4.38, range = 22-44) years. The majority of them were less than 35 years old (74.80 %) and had Junior college education or above (77.80%). Most of them were employed (82.40%) and lived in urban areas (89.30%). Most of patients had no debt (68.00%) and were planned pregnancy (68.70%). The majority of them were natural pregnancy (91.60%) and had a reasonable weight gain based on BMI (70.20%).

The average score of blood glucose control behavior was 60.68 (SD=13.47), and the results showed that the blood glucose control behavior of most participants was at the moderate level. The average scores of the factors influencing blood glucose control behavior, including age, perceived susceptibility, perceived barrier, self-efficacy, and social support were 32.01 (SD=4.38), 31.92 (SD=3.72), 27.33 (SD=4.66), 30.04 (SD=7.36), and 36.48(SD=5.64) respectively.

The results showed that age, perceived susceptibility, perceived barrier, and self-efficacy and social support together explained 45% of the variance in blood

glucose control behavior (F (5, 125) =22.299, p<. 001). The strongest predictor was self-efficacy（β =.47, p<. 001), followed by age（β =. 22, p<. 001), perceived barrier（β =-.15, p=0.036) and perceived susceptibility（β =. 14, p=. 045). While social support（β =. 11, p=. 135) was not significant in predicting blood glucose control behavior.

Discussions

Blood glucose control behavior

The results showed that the score of blood glucose control behavior among pregnancy women having class A1 GDM in Wenzhou, China was at moderate level. This is similar to the results reported in previous studies (Cheng et al., 2017; Li, 2016).

In this study, through the analysis, the compliance of patients with high and low blood glucose management and dietary control compliance is relatively good, and the blood glucose monitoring and exercise compliance are relatively poor. This may be related to the fact that patients usually pay more attention to high and low blood glucose changes, which will lead to serious complications of the fetus (Li, 2016). However, many pregnant women do not know the harm of high and low blood glucose to themselves and the fetus, and do not take the correct prevention and treatment measures.

In addition, studies have shown that income can influence blood glucose control behavior (Cheng et al., 2017). This study was conducted in an area with good economic development in China, and the hospitals that carried out this study were all well-known local hospitals. The population entering the hospital was financially well off, as blood glucose control behavior caused by financial stress could be effectively managed.

Another reason to show the moderate level of blood glucose control behavior in this study, recently, in Wenzhou, more and more hospitals and communities have begun to publicize the importance of diet for blood glucose control. So more and more pregnant women have accepted the concept of diet control so that pregnant women think that diet is an important treatment method. However, there is still a lot of room for improvement in the diet control of pregnant women with GDM, such as diet

control is difficult to adhere to, food matching is not scientific enough (Huo & Ding, 2019).

Influencing factors of blood glucose control behavior

Understanding the influencing factors of blood glucose control behavior is an important public health issue, because poor blood glucose control behavior causes great health risks for mothers and infants and increase the occurrence of complications (Yarandi et al., 2021). This study discusses the relationship between various factors and blood glucose control behavior, and the results are as follows:

Self-efficacy: The data analysis of this study showed that self-efficacy was the strongest predictor of blood glucose control behavior (β =. 47, p<. 001). The results are consistent with previous studies (Jiang, 2018). Multiple studies have shown that people with higher self-efficacy are more likely to have good glucose control behaviors. The explanation for this strong relationship may be due to the higher self-efficacy of women, the higher self-confidence, and the more confident pregnant women are, the more likely they are to overcome difficulties in performing certain self-care behaviors and ensure the implementation of self-management health behaviors (Karimy et al., 2018; Yao et al., 2019).

Pregnant women with higher self-efficacy are more interested in participating in blood glucose control behavior and have a stronger sense of responsibility for blood glucose control, and are able to recover quickly from setbacks and failures. Patients' self-efficacy is affected by direct experience, surrogate experience, evaluation and persuasion of others, as well as emotional and physiological states (Karimy et al., 2018). Therefore, blood glucose control behaviors can be improved by improving the self-confidence and problem-solving skills of pregnant women (Karavasileiadou et al., 2022).

Age: Age is the second factor to predict blood glucose control behavior (β=. 22, p<. 001). This is consistent with the conclusion of (Li, 2016). With the increase of age, pregnant women showed a better trend in all aspects of blood glucose control behavior. The reason is that older pregnant women pay more attention to the condition of pregnancy and worry more about the outcome of pregnancy (Li, 2016). However, younger patients have poor self-control, and are taken care of by family members due to pregnancy, so they have incorrect cognition of diet and exercise. Family members

pay wrong attention to the wrong focus, such as only paying attention to the adequate nutrition of diet and do not know the harm of overnutrition, which may lead to serious adverse pregnancy outcomes. Education should be emphasized in such patients (Hu et al., 2021) .

Perceived barrier: Perceived barrier is the third factor to predict blood glucose control behavior (β=. -15， p＜.05). The data analysis of this study showed that perceived barrier was negatively correlated with blood glucose control behavior (r=-.248, p<.01), and the higher the level of perceived barrier, the worse the blood glucose control behavior of the study subjects, which was consistent with the theoretical hypothesis of the health belief model (HBM) (Rosenstock et al., 1988). The main reason may be that patients have insufficient understanding of the importance of blood glucose control behavior and cannot predict the difficulties in the process of blood glucose control behavior. In addition, excessive costs, potential pain, lack of transportation, and conflicts with daily life arrangements may hinder blood glucose control (Li, 2016; Ma et al., 2019).

Perceived susceptibility: Standard multiple linear regression showed perceived susceptibility is also the factor to predict blood glucose control behavior (β=. 14， p＜.05). It was positively correlated with blood glucose control behavior. The better the perceived susceptibility of gestational diabetes mellitus, the better the blood glucose control behavior of patients. The reason that women with higher level of perceived susceptibility have better blood glucose control behavior is that disease perceived susceptibility is the basis of effective self-management, and perceived susceptibility can be improved by understanding disease-related knowledge (Huang et al., 2022). On the one hand, people with more disease knowledge tend to pay more attention to their own disease and health, and will take the initiative to learn and implement self-management. On the other hand, patients with rich disease knowledge often receive more health education, which makes patients have a more accurate and comprehensive understanding of the disease and self-management, promotes the transformation of knowledge into behavior, and actively implements self-management, thus promoting the change of blood glucose control behavior (Hu et al., 2021; Zhang et al., 2020).

Social support: In this study, the factor that did not significantly predict blood glucose control behavior was social support (β=. 11, p>. 05). Although Pearson correlation statistics showed the relationship between this factor and the result (r=. 383, p<. 01), there was a positive correlation between social support and blood glucose control behavior, but it did not significantly predict glucose control behavior. This is different from the study of (Cheng et al., 2017; Huo & Ding, 2019; Li, 2016). This may be due to the high educational level of the maternal surveyed in this study, who can learn GDM knowledge by themselves or through doctor's education, and rely less on their families. In addition, it may be because of the complexity of dietary calorie calculation and nutritional balance matching for GDM patients, which is difficult for the non-professional population of the patient's family members, and the family members cannot provide professional support (Ma et al., 2019). What's more, the formation of exercise habits needs a long-term process, and the patient's family or friends may only play a role in reminding or urging, and more need to rely on the patient's own efforts. Moreover, sometimes excessive family intervention can cause stress and distress to pregnant women (Ma et al., 2019).

Implications of the study

The findings from this study would be useful for nursing practice, nursing education, and nursing research. Having better understanding towards blood glucose control behaviors and its influencing factors would help nurses provide better care and effective nursing intervention to promote health among pregnant women with GDM. The results obtained from this study can also serve as an important baseline data for further nursing research in developing nursing intervention to enhance blood glucose control behaviors among pregnant women with GDM. Following are the implications:

Nursing practice:

Through this study, the current status of blood glucose control behavior of pregnant women with gestational diabetes in Wenzhou can be understood, such as which aspects of patients do better, which aspects are worse, and need to be paid attention to by diabetic patients, as well as some influencing factors of blood glucose control behavior. It will enable nursing staff to implement effective nursing intervention, provide patients with individualized nursing and educational guidance, and promote patients to actively participate in the management of the disease, which

will continuously increase the awareness of self-management and master more self-management methods and skills.

Self-efficacy: It is suggested that medical staff should provide timely education and guidance for pregnant women with GDM from diet, exercise and blood glucose monitoring in clinical work, establish a good nurse-patient relationship with patients, improve the treatment cooperation of patients, enhance the self-management confidence and ability of patients, and improve the level of blood glucose control. At the same time, medical staff should give positive guidance and evaluation on the correct blood glucose control behavior of patients, which is conducive to the establishment of a good sense of self-efficacy of patients. In the process of health education, we should focus on helping patients with high self-efficacy to cultivate scientific and reasonable blood glucose control behaviors. For patients with low self-efficacy, we should first help them improve their self-efficacy level and then train their blood glucose control behaviors. We can organize communication among patients and inspire patients with the successful experience of others.

Perceived susceptibility: It is suggested that health education should be given to patients to improve their awareness and blood glucose control level. Therefore, the obstetrics clinic and ward should carry out various health education work according to local conditions, carry out purposeful health promotion activities according to the situation of pregnant women in our hospital, and strengthen the promotion of knowledge about gestational diabetes mellitus. It mainly enhanced health promotion work related to reasonable nutrition food sources, simple calculation of energy, food exchange, exercise time, exercise amount, blood glucose monitoring and so on.

Perceived barrier: This suggests that in the future research and intervention, nurses can strengthen the correct understanding of behavioral barriers and provide coping strategies to overcome difficulties and obstacles, such as covering more costs in medical insurance, providing sanitary points for patients to measure blood glucose, providing parking facilities, etc.

Nursing education:

Knowing which factors contributed to better blood glucose control behavior, nurse educators could use this study findings for teaching nursing students. Understanding how these factors lead to blood glucose control behavior would help

them to provide appropriate care and guidance to pregnancy women to improve blood glucose control behavior when nursing students enter clinical work.

Limitations of the study

One limitation is the setting of data collection. This study was conducted from only one hospital. It may limit generalization of the study. Another limitation is the reliability of the research instrument for the perceived susceptibility and perceived barrier is less than 0.8, it is relatively low, and there is still room for improvement, indicating that these two questionnaires may need further research and improvement.

Recommendations for future study

The results of the study can also serve as the baseline data for future nurses who wish to research on blood glucose control behavior of pregnant women with GDM.

When collecting data, researchers can expand the scope of data collection beyond one hospital or one region, the experiment should be extended to primary hospitals, which can ensure that the data cover the population more comprehensively.

At present, there are few studies based on the health beliefs of pregnant women with GDM, and there are few questionnaires on perceived susceptibility and perceived barriers. It is suggested that in the future, the reliability and validity of the questionnaire can be evaluated again, the questionnaire can be improved and revised, and a more complete questionnaire on health beliefs can be developed.

Conclusion

The study examined the influencing factors of blood glucose control behavior in the second affiliated hospital of Wenzhou medical university, China. The study involved pregnancy women having class A1 GDM. The blood glucose control behavior among pregnancy women having class A1 GDM in Wenzhou, China is at moderate level. Among the factors, self-efficacy, age, perceived barrier, and perceived susceptibility could significantly predict blood glucose control behavior, which are all consistent with the findings of other researches in the past. In addition to that, this

study also revealed findings that were different from other researches. Knowing these factors are important because it will help us to develop better nursing interventions. Nursing staff should assist pregnant women with GDM to enhance their self-efficacy, improve their diabetes knowledge, overcome perceived barriers, and improve their blood glucose control level.

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APPENDICES

APPENDIX A

Instruments (English version)

Questionnaire number: ____

Dear mother,

I am a graduate student from Burapha University. In order to better carry out health education of GDM, I will investigate the relationship between selected factors and blood glucose control behavior among pregnant women having class A1 GDM. There are 6 questionnaires with 62 items in total. These questionnaires include:

1. General information questionnaire (7 items)
2. GDM-related perceived susceptibility questionnaire (9 items)
3. GDM-related perceived barriers questionnaire (9 items)
4. Diabetes self-efficacy scale (9 items)
5. Diabetes social support scale (10 items)
6. GDM blood glucose control behavior questionnaire (18 items)

It will take time about 20 minutes for you to answer these questionnaires.

Thank you for your cooperation,

Leixi Wang

Master's degree nursing student, Faculty of Nursing, Burapha University, Thailand in collaboration with School of Nursing, Wenzhou Medical University, Wenzhou, China

GENERAL INFORMATION

General information questionnaire

Demographic questionnaire

Instruction: Please fill in the blank provided or select the options by marking ∨ in the box matching with your information.

1. Age ..... years
2. Education:
   - ☐ Primary school ☐ Junior middle school
   - ☐ High school (including technical secondary school)
   - ☐ Junior college ☐ Undergraduate
   - ☐ Other (identify).....
3. Place of residence: ☐ City ☐ Town ☐ Countryside
4. Marital status: ☐ Married ☐ Single ☐ Other (identify).....
5. Family members (*Can select more than one option):
   - ☐ Husband ☐ Your own child(ren) ☐ Your parents
   - ☐ Parents-in-law ☐ Other (identify) .....
6. Occupation:
   - ☐ Worker ☐ Teacher ☐ Merchant
   - ☐ Civil servant ☐ Unemployed ☐ Other (identify) .....
7. Family financial status:
   - ☐ Have deposit without debt ☐ Have deposit more than debt
   - ☐ Have deposit less than debt ☐ Have deposit equal to debt
   - ☐ Other (identify).....

Obstetrical data recorded by the researcher

For the researcher

8. Planned pregnancy: ☐ Yes ☐ No
9. Method of conception: ☐ Natural ☐ Artificial assisted
10. Gravida ..... time(s)
11. Parity ..... time(s)
12. Abortion ..... time(s)
13. Living child(ren) ..... person(s)
14. Gestational age ..... weeks
15. Period from knowing about having GDM condition till today ..... days
16. Pre-pregnant body mass index (BMI) ..... kg/m^2
17. Appropriate weight gain according to the criteria of each BMI group: ☐ Yes ☐ No

KNOWLEDGE RELATED TO GESTATIONAL DIABETES MELLITUS

GDM-related perceived susceptibility questionnaire

Instruction: This section concerns knowledge and complications of GDM. Please, mark √ in the option most congruent with your thoughts. Each option has the meanings as:

Strongly disagree	=	Completely disagree with that statement
Disagree	=	Somewhat disagree with that statement
Not sure	=	Neither agree or disagree with that statement
Agree	=	Somewhat agree with that statement
Strongly agree	=	Completely agree with that statement

	Strongly disagree (1)	Disagree (2)	Not sure (3)	Agree (4)	Strongly agree (5)
1. I know that people who are overweight, obese or physically inactive are more likely to develop GDM.					
2. I know that an unhealthy lifestyle is one of the risk factors for GDM.					
3. I know that people who are inactive are more likely to get GDM.					
4. I know that women with GDM are more likely to have preterm birth or miscarriage.					
5. I know that women with GDM are more likely to experience postpartum hemorrhage and infections.					
6. I know that women with GDM are more likely to have a hypoglycemic or hyperglycemic response					
7. I know that gestational diabetes is more likely to lead to macrosomia or low birth weight.					
8. I know that gestational diabetes is more prone to neonatal hypoglycemic responses.					
9. I know that gestational diabetes is more likely to cause neonatal dyspnea.					

Notes: Three subscales: risk factors (item1, 2,3), complications in the mother (4,5,6), complications in infants (7,8,9)

PERCEIVED BARRIERS OF PERFORMING BLOOD GLUCOSE CONTROL BEHAVIOR

GDM-related perceived barrier questionnaire

Instruction: This section concerns your view of health. Please, mark √ in the option most congruent with your thoughts. Each option has the meanings as:

Strongly disagree	=	Completely disagree with that statement
Disagree	=	Somewhat disagree with that statement
Not sure	=	Neither agree or disagree with that statement
Agree	=	Somewhat agree with that statement
Strongly agree	=	Completely agree with that statement

	Strongly disagree (1)	Disagree (2)	Not sure (3)	Agree (4)	Strongly agree (5)
1. I have no idea how to control my diet.					
2. Once my blood sugar has dropped to normal level, I do not need to continue diet control.					
3. It is a waste of time to receive health education on GDM.					
4. Long-term diet control is inconvenient for me and my family.					
5. I am worried that long-term diet control will cause the fetus to be malnourished.					
6. Exercise makes me feel tired and uncomfortable.					
7. Monitoring blood sugar causes pain and discomfort.					
8. It costs too much to see doctors regularly.					
9. Having trips to the hospital regularly are inconvenient.					

Notes: Four subscales: Lack of knowledge regarding diet control (item 1, 2), waste (item 3, 8), inconvenience (item 4, 9), harm (item 5, 6, 7).

SELF-EFFICACY IN BLOOD GLUCOSE CONTROL BEHAVIOR

Diabetes self-efficacy scale

Instructions: The following items ask you about your confidence in such activities. Choose option most corresponding to your opinion by marking √. Each option has the meanings as:

No confidence at all	=	Absolutely uncertain to do that activity
Lack of some confidence	=	Somewhat uncertain to do that activity
Have some confidence	=	Somewhat certain to do that activity
Have strong confidence	=	Very certain to do that activity
Have very strong confidence	=	Absolutely certain to do that activity

	No confidence at all (1)	Lack of some confidence (2)	Have some confidence (3)	Have strong confidence (4)	Have very strong confidence (5)
1. I can have three main meals (breakfast, lunch, dinner) with a fixed amount at a fixed time every day.					
2. When I have meal with a non-diabetic person(s), I can still stick to an appropriate amount and type of my diet.					
3. When I am very hungry, I can pick out an appropriate amount of snack.					
4. I can exercise about 30 minutes a day at least 3 days a week.					
5. When I exercise, I can do mild to moderate intensity exercise suitable to me, such as walking, doing yoga, for pregnant women stretching to avoid having hypoglycemia.					
6. I can treat myself correctly when my blood sugar rises or drops.					
7. I can detect my abnormal physical condition, then seek medical attention.					
8. I can control my diabetes condition so it does not affect my life.					
9. I can prevent and control GDM complications by following the doctor's advice.					

Notes: Three subscales: Diet control (item 1, 2, 3), exercise (item 4, 5), complication management (item 6, 7, 8, 9).

SOCIAL SUPPORT RELATED TO BLOOD GLUCOSE CONTROL BEHAVIOR

Diabetes social support scale

Instructions: The following items are about your family (and/or friends) support. Please select the option best describe your received support by marking √. Each option has meanings as:

Strongly disagree	=	Completely disagree with that statement
Disagree	=	Somewhat disagree with that statement
Not sure	=	Neither agree or disagree with that statement
Agree	=	Somewhat agree with that statement
Strongly agree	=	Completely agree with that statement

	Strongly disagree (1)	Disagree (2)	Not sure (3)	Agree (4)	Strongly agree (5)
1. My family (and/or friends) gave me a support related to my diabetic diet.					
2. My family (and/or friends) gave me a support related to my exercise.					
3. My family (and/or friends) gave me a support related to my blood sugar test.					
4. My family (and/or friends) gave me a support related to and my illness acceptance.					
5. My family (and/or friends) gave me a support related to listening to me when I need.					
6. My family (and/or friends) gave me a support related to discussing with me about blood glucose control.					
7. My family (and/or friends) gave me a support related to encouraging my spirit and eliminating my fear regarding diabetes.					
8. My family (and/or friends) had a positive impact on my diabetes condition.					
9. My family (and/or friends) feel comfortable with my diabetes.					
10. My family (and/or friends) had never complained about my illness.					

Notes: Two subscales: Affirmative support (item 1, 2, 3, 6, 8, 9), emotional support (item 4, 5, 7, 10).

BLOOD GLUCOSE CONTROL BEHAVIOR

GDM blood glucose control behavior questionnaire

Instruction: The following items are statements about your blood glucose control behavior. Please tick an option ∨ maching with your actual action. Each option has meanings as:

Not at all = Did not do it at all in a week
Rarely did = Did it 1-2 days a week
Did a bit = Did it 3-4 days a week
Often did = Did it 5-6 days a week
Always did = Did it every day in a week
NA (not applicable) = Never be in or had that situation

	Not at all (1)	Rarely did (2)	Did a bit (3)	Often did (4)	Always did (5)	NA
1. I had three main meals with 2-4 snack meals a day.						
2. I ate snack meals 2-3 hours after the main meals.						
3. I followed my doctor's advice about diet control.						
4. I took some whole grains (such as, whole wheat bread, oats, corn) per day.						
5. I recorded the types and weights of food that I take everyday						
6. I ate vegetables every day.						
7. I did exercise at least 30 minutes a day.						
8. I still did exercise when I was busy.						
9. I had exercise by walking, jogging, swimming, or maternity yoga.						
10. I started to exercise about an hour after meal.						
11. I measured my blood glucose.						
12. I also monitored my blood glucose when I was out.						
13. After I monitored my blood sugar, I recorded its results.						
14. When I didn't feel well, I checked my blood glucose more often than usual.						
15. When my blood sugar value was not good, I found out its causes.						
16. When my blood sugar was too low or had						

	Not at all (1)	Rarely did (2)	Did a bit (3)	Often did (4)	Always did (5)	NA
symptoms as cold sweat, weakness, dizziness; I immediately took self-treatment measures (such as, drinking sugar water, eating candy or cooky).						
17. When the blood sugar was higher than usual or had symptoms as feeling thirsty, polyuria, nausea; I immediately took self-treatment measures (e. g., drinking more water, go to the hospital).						
18. When doing exercise, I prevented low blood sugar condition by taking some measures (e.g., candy or cooky).						

Notes: Four subscales: Dietary control compliance (items 1-6), exercise compliance (item 7-10), blood glucose monitoring (items 11-14), & high and low blood glucose management (item 15-18).

APPENDIX B

Instruments (Chinese version)

亲爱的准妈妈们，你们好！

我是布拉帕大学的研究生。为了更好地开展 GDM 产妇的健康教育，我将调查非胰岛素管理的 GDM 孕妇的血糖控制行为的影响因素。这里共有 6 份问卷，共 62 个条目。这些问卷包括:

1. 一般信息问卷(7 个条目)
2. 妊娠期糖尿病感知易感性问卷(9 个条目)
3. 妊娠期糖尿病感知障碍问卷(9 个条目)
4. 妊娠期糖尿病自我效能量表(9 个条目)
5. 妊娠期糖尿病社会支持量表(10 个条目)
6. 妊娠期糖尿病血糖控制行为问卷(18 个条目)

所有问卷其信度和效度都经过专家验证。回答这些问卷大约需要 20 分钟的时间。

谢谢您的配合！

王蕾茜

泰国布拉帕大学与温州医科大学合作——护理学院护理系硕士研究生

一般信息问卷

说明:请在空白处填写信息或在符合您的信息的方框中打√选择。

1. 年龄 .....岁
2. 学历:
   - ☐ 小学
   - ☐ 初中
   - ☐ 高中(含中专)
   - ☐ 大专
   - ☐ 本科
   - ☐ 其他(具体说明).....
3. 居住地: ☐ 城市 ☐ 乡镇 ☐ 农村
4. 婚姻情况: ☐ 已婚 ☐ 未婚 ☐ 其他 (具体说明).....
5. 家庭成员 (*可以多选):
   - ☐ 丈夫 ☐ 自己的孩子(们) ☐ 父母
   - ☐ 公婆 ☐其他 (具体说明) .....
6. 职业:
   - ☐ 职员 ☐ 教师 ☐ 个体户
   - ☐ 公务员 ☐ 无业 ☐ 其他 (具体说明) .....
7. 家庭经济状况:
   - ☐ 有存款而无债务 ☐ 存款比债务多
   - ☐ 存款比债务少 ☐ 存款等于债务
   - ☐ 其他 (具体说明).....

产科资料由研究人员记录

研究者填写

8. 计划妊娠: ☐ 是 ☐ 否

9. 怀孕方式: ☐ 自然 ☐ 试管婴儿

10. 怀孕次数 ..... 次

11. 分娩次数 .....次

12. 流产 ..... 次

13. 现存子女 ..... 个

14. 孕周 ..... 周

15. 诊断为妊娠期糖尿病的时间..... 天

16. 孕前体重指数(BMI) ..... kg/m^2

17. 按各BMI标准适当增重: ☐ 是 ☐ 否

妊娠糖尿病感知易感性问卷

说明:本节涉及您对GDM的知识及并发症的了解情况。请在最符合你的想法的选项上打 √ 。

每个选项的含义如下:

(1) 非常不同意 = 完全不同意这种说法

(2) 不同意 = 不太同意这种说法

(3) 不一定 = 不认可也不否认

(4) 同意 = 比较同意这种说法

(5) 非常同意 = 完全同意这种说法

	非常不同意 (1)	不同意 (2)	不一定 (3)	同意 (4)	非常同意 (5)
1.我知道超重、肥胖或缺乏运动的人更容易患妊娠期糖尿病。					
2.我知道不健康的生活方式是妊娠期糖尿病的危险因素之一。					
3.我知道缺乏运动的人更容易患妊娠期糖尿病。					
4.我知道妊娠期糖尿病患者更容易发生早产或流产。					
5.我知道妊娠期糖尿病患者更容易发生产后出血及感染。					
6.我知道妊娠期糖尿病患者更容易发生低血糖或高血糖反应。					
7.我知道妊娠期糖尿病更容易发生巨大儿或低体重儿。					
8.我知道妊娠期糖尿病更容易发生新生儿低血糖反应。					
9.我知道妊娠期糖尿病更容易发生新生儿呼吸困难。					

注:三个分量表:风险因素(第 1、2、3 项),母亲并发症(4、5、6 项),新生儿并发症(7、8、9 项)

妊娠期糖尿病感知障碍问卷

说明:本节关注的是你对健康的看法。请在最符合你的想法的选项上打√。每个选项的含义如下:

(1) 非常不同意 = 完全不同意这种说法

(2) 不同意 = 不太同意这种说法

(3) 不一定 = 不认可也不否认

(4) 同意 = 比较同意这种说法

(5) 非常同意 = 完全同意这种说法

	非常不同意 (1)	不同意 (2)	不确定 (3)	同意 (4)	非常同意 (5)
1. 我不知道如何控制饮食。					
2. 既然糖尿病是血糖高，一旦血糖降至正常后，就没有必要再继续控制饮食。					
3. 接受妊娠期糖尿病健康教育浪费时间。					
4. 长期控制饮食给我和家人的生活带来不便。					
5. 长期控制饮食，我担心胎儿营养不够。					
6. 运动会让我感觉疲劳，不舒服。					
7. 监测血糖增加疼痛不适。					
8. 定期看医生费用太高。					
9. 定期去医院交通不便。					

注释:四个分量表:缺乏关于饮食控制的知识(条目 1、2)，浪费(条目 3、8)，不便(条目 4、9)，危害(条目 5、6、7)。

妊娠期糖尿病自我效能量表

说明：下面的问题是想了解您在进行如下活动时的信心，请您依次阅读如下条目，请根据您的实际情况选择并在相应的方框内打“√”

(1) 完全没有信心=完全没有信心做到

(2) 缺乏信心=对完成这件事信心不足

(3) 有点信心=有点信心完成这件事

(4) 很有信心=有信心完成这件事

(5) 完全有信心=绝对有信心完成这件事

项目	完全没信心(1)	缺乏信心(2)	有点信心(3)	很有信心(4)	完全有信心(5)
1.您有信心做到每天早、中、晚三餐都在固定时间，以固定的饭量吃饭吗？					
2.您在跟非糖尿病人同时进餐时，对仍坚持自己的饮食的量和种类(原来吃什么还是吃什么，原来吃多少，还是吃多少)，您有信心做到吗？					
3.当您饥饿时，您有信心挑选出合适的食物(如零食等)吗？					
4.您有信心做到每周运动4-5次，每次坚持15-30分钟吗？					
5.当您在运动时，有信心避免低血糖的发生吗？					
6.当您的血糖升高或降低时，您对于作出正确的处理有信心吗？					
7.当您的身体发生变化时,您有信心对身体状况做出判断并及时就医吗？					
8.对于控制您自身的糖尿病病情从而使它不影响到生活，您有信心做到吗？					
9.若遵从医嘱，您有信心预防并控制糖尿病引发的并发症吗？					

注:三个分量表:饮食控制(条目 1、2、3)，锻炼(条目 4、5)，并发症管理(条目 6、7、8、9)。

妊娠期糖尿病社会支持量表

说明：下面的问题是了解您的家庭支持情况，请您依次阅读如下条目，请根据您的实际情况选择并在相应的方框内打“ √ ” 。

(1) 非常不同意 = 完全不同意这种说法

(2) 不同意 = 不太同意这种说法

(3) 不一定 = 不认可也不否认

(4) 同意 = 比较同意这种说法

(5) 非常同意 = 完全同意这种说法

项目	非常不同意(1)	不同意(2)	不确定(3)	同意(4)	非常同意(5)
1.在遵照糖尿病饮食方面，我的家人和朋友给了我很多支持。					
2.在进行足够的运动锻炼方面，我的家人和朋友给了我很多支持					
3.在检测血糖方面，我的家人和朋友给了我很多支持。					
4.我的家人或朋友接受我以及我的病情。					
5.当我需要的时候我的家人或朋友能够倾听与我病情有关的事情					
6.我的家人(和/或朋友)给予我支持，与我讨论如何控制血糖。					
7.我的家人或朋友鼓励并消除我对糖尿病的恐惧。					
8.我的家人或朋友对于我的糖尿病病情起到了积极的影响。					
9.我的家人或朋友没有因为我得了糖尿病而感到不舒服。					
10.我的家人或朋友从不抱怨我的病情。					

注:两个分量表:肯定支持(条目 1，2，3，6，8，9)，情感支持(条目 4，5，7，10)。

妊娠期糖尿病血糖控制行为问卷

说明:以下项目是关于您的血糖控制行为的陈述。请在最符合你的行为的选项上打 √，每个选项的含义如下:

(6) 完全没有做到= 一周内都没做到过

(7) 很少做到 = 一周内有1-2天做到

(8) 有时做到 = 一周内有3-4天做到

(9) 经常做到 = 一周内有5-6天做到

(10) 总是做到 = 一周内每天都能做到

(11) 不适用 = 从来没有过这种情况

	完全没有做到(1)	很少做到(2)	有时做到(3)	经常做到(4)	总是做到(5)	不适用(6)
1. 我一天有三顿正餐和两到四顿点心。						
2. 我在主餐后 2-3 小时吃点心。						
3. 我听从了医生关于饮食控制的建议。						
4. 我每天吃一些全谷物(比如，全麦面包，燕麦，玉米)。						
5. 我记录了我每天吃的食物的种类和重量。						
6. 我每天都吃蔬菜。						
7. 我每天至少锻炼 30 分钟。						
8. 在繁忙时我仍可以做到坚持锻炼。						
9. 我通过散步、慢跑、游泳或产妇瑜伽来锻炼身体。						
10. 我在饭后一小时左右开始锻炼。						
11. 我平时可以做到定期检测血糖。						
12. 我出门在外时，仍可以做到定期检测血糖。						
13. 我可以做到记录每次血糖值。						
14. 当我感觉不舒服时，我可以做到增加血糖的测量次数。						
15. 当我的血糖值不好时，我会积极寻找原						

	完全没有做到(1)	很少做到(2)	有时做到(3)	经常做到(4)	总是做到(5)	不适用(6)
因。						
16. 血糖过低或出现出冷汗、乏力、头晕等症状时;我立即采取了自我治疗措施(如喝糖水，吃糖果或饼干)。						
17. 血糖高于平时或有口渴、多尿、恶心等症状时;我立即采取正确的自我处理措施(如多喝水，去医院)。						
18. 在做运动的时候，我采取了一些措施(如吃糖或饼干)来预防低血糖。						

注:四个分量表:饮食控制依从性(第 1-6 项)、运动依从性(第 7-10 项)、血糖监测(第 11-14 项)、高血糖和低血糖管理(第 15-18 项)。

APPENDIX C

The Institutional Review Board (IRB) Approval

IRB of Burapha University

สำเนา

ที่ IRB3-067/2565

เอกสารรับรองผลการพิจารณาจริยธรรมการวิจัยในมนุษย์

มหาวิทยาลัยบูรพา

คณะกรรมการพิจารณาจริยธรรมการวิจัยในมนุษย์ มหาวิทยาลัยบูรพา ได้พิจารณาโครงการวิจัย

รหัสโครงการวิจัย : G-HS033/2565

โครงการวิจัยเรื่อง : Factors influencing blood glucose control behavior among pregnant women having first-time gestational diabetes mellitus with non- insulin management in Wenzhou, China.

หัวหน้าโครงการวิจัย : MRS.LEIXI WANG

หน่วยงานที่สังกัด : คณะพยาบาลศาสตร์

BUU Ethics Committee for Human Research has considered the following research protocol according to the ethical principles of human research in which the researchers respect human's right and honor, do not violate right and safety, and do no harms to the research participants.

Therefore, the research protocol is approved (See attached)

1. Form of Human Research Protocol Submission Version 2 : 1 July 2022
2. Research Protocol Version 1 : 19 May 2022
3. Participant Information Sheet Version 2 : 1 July 2022
4. Informed Consent Form Version 2 : 1 July 2022
5. Research Instruments Version 2 : 1 July 2022
6. Others (if any) Version - : -

วันที่รับรอง : วันที่ 9 เดือน สิงหาคม พ.ศ. 2565

วันที่หมดอายุ : วันที่ 9 เดือน สิงหาคม พ.ศ. 2566

ลงนาม *นางสาวรมร แย้มประทุม*

(นางสาวรมร แย้มประทุม)

ประธานคณะกรรมการพิจารณาจริยธรรมการวิจัยในมนุษย์ มหาวิทยาลัยบูรพา

ชุดที่ 3 (กลุ่มคลินิก/ วิทยาศาสตร์สุขภาพ/ วิทยาศาสตร์และเทคโนโลยี)

IRB of the Second Affiliated Hospital of Wenzhou Medical University

温州医科大学附属第二医院 温州医科大学附属育英儿童医院

伦理委员会审查批件

批件号：伦审（2022-K-48-02）

科室：产科	主要研究者：王蕾蕾		职称：主管护师
项目名称	温州地区首次诊断妊娠期糖尿病非胰岛素治疗孕妇血糖控制行为的影响因素分析		
项目来源	自选课题		
审查类别	复审	审查方式	简易审查
审查日期	2022 年 6 月 20 日	审查地点	/
审查委员	王爱霞		
审查材料	1. 临床课题研究复审申请 2. 试验方案（版本号：1.0 ；版本日期：2022.4.14） 3. 知情同意书（版本号：1.0 ；版本日期：2022.4.14） 4. 调查问卷		
审查意见	经过我院医学伦理委员会审查，审查结果为：同意		
年度/定期跟踪审查	审查频率为该研究批准之日起每 12 月一次，首次请于 2023 年 6 月 19 日前 1 个月递交“定期/年度研究进展报告”。 本伦理委员会有根据实际进展情况改变跟踪审查频率的权利。		
批件有效期	2022 年 6 月 20 日——2023 年 6 月 19 日（逾期未实施，自行废止）		
主任委员签字： 日 期：2022 年 6 月 20 日 温州医科大学附属第二医院 温州医科大学附属育英儿童医院 医学伦理委员会（盖章）			

声明：

本伦理委员会的职责、人员组成和工作程序均遵循 ICH-GCP、NMPA-GCP、中国相关法律和法规。

地址：浙江省温州市龙湾区温州大道东段 1111 号 电话：0577-85676879 邮编：325000

注意事项：

1）修改试验方案、知情同意书、招募广告及其他提供给受试者的相关材料，请及时提交“修正案审查申请”。

2）本中心发生的医疗器械严重不良事件或药物可疑且非预期严重不良反应及研发期间安全性更新报告须按照 NMPA/GCP 最新要求及时递交我院伦理委员会，国内外其他中心发生的严重不良事件或药物可疑且非预期严重不良反应需定期汇总后递交伦理委员会，伦理委员会有权对其评估做出新的决定。

3）研究纳入了不符合纳入标准或符合排除标准的受试者，符合中止试验规定而未让受试者退出研究，给予错误治疗剂量，给予方案禁止的合并用药等没有遵从方案的情况；或可能对受试者的权益\健康以及研究的科学造成不良影响等偏离 GCP 原则的情况，请发现者及时提交“不依从或违背方案报告”。

4）自批件签发之日起，请研究者在规定的跟踪审查截止日期前 1 个月提交“定期/年度研究进展报告”，本伦理委员会有根据实际进展情况改变跟踪审查频率的权利。

5）暂停或提前终止临床研究，请及时提交书面申请。

6）完成试验请及时提交“结题报告”。

7）凡涉及中国人类遗传资源采集标本、收集数据等研究项目，必须获得中国人类遗传资源管理办公室批准后方可在本中心开展研究。

8）凡经我院伦理委员会批准的研究项目在实施前，申请人应按相关规定在国家卫健委、药审中心等的临床试验登记备案信息系统平台登记研究项目相关信息。

APPENDIX D

Permission for data collection

MHESI 8137/1238

Graduate School, Burapha University
169 Longhaad Bangsaen Rd.
Saensuk, Muang, Chonburi
Thailand, 20131

August 31st, 2022

To The president of the Second Affiliated Hospital of Wenzhou Medical University,

Enclosure: 1. Certificate ethics document of Burapha University
2. Research Instruments (Try out)

On behalf of the Graduate School, Burapha University, I would like to request permission for Mrs. Leixi Wang to collect data for testing the reliability of the research instruments.

Mrs. Leixi Wang, ID 63910136, a graduate student of the Master of Nursing Science program (International Program) in Maternity Nursing and Midwifery Pathway, Faculty of Nursing, Burapha University, Thailand, was approved her dissertation proposal entitled: "Factors influencing blood glucose control behavior among pregnant women having first-time gestational diabetes mellitus with non-insulin management in Wenzhou, China" under supervision of Assist. Prof. Dr. Jinjutha Chaisena Dallas as the principle advisor. She proposes to collect data from 30 women having first-time gestational diabetes mellitus with non-insulin management who come to the obstetrical clinic for checking-up at the Second Affiliated Hospital of Wenzhou Medical University.

The data collection will be carried out from September 1 - 22, 2022. In this regard, you can contact Mrs. Leixi Wang via mobile phone +86-1506-7813-390 or E-mail: 836502058@qq.com

Please do not hesitate to contact me if you need further relevant queries.

Sincerely yours,

(Assoc. Prof. Dr. Nujjaree Chaimongkol)
Dean of Graduate School, Burapha University

Graduate School Office
Tel: +66 3810 2700 ext. 701, 705, 707
E-mail: grd.buu@go.buu.ac.th
http://grd.buu.ac.th

MHESI 8137/1239

Graduate School, Burapha University
169 Longhaad Bangsaen Rd.
Saensuk, Muang, Chonburi
Thailand, 20131

August 31st, 2022

To The president of the Second Affiliated Hospital of Wenzhou Medical University,

Enclosure: 1. Certificate ethics document of Burapha University
2. Research Instruments

On behalf of the Graduate School, Burapha University, I would like to request permission for Mrs. Leixi Wang to collect data for conducting research.

Mrs. Leixi Wang, ID 63910136, a graduate student of the Master of Nursing Science program (International Program) in Maternity Nursing and Midwifery Pathway, Faculty of Nursing, Burapha University, Thailand, was approved her dissertation proposal entitled: "Factors influencing blood glucose control behavior among pregnant women having first-time gestational diabetes mellitus with non-insulin management in Wenzhou, China" under supervision of Assist. Prof. Dr. Jinjutha Chaisena Dallas as the principle advisor. She proposes to collect data from 131 pregnant women with gestational diabetes mellitus who visit an Obstetrical Ward at the Second Affiliated Hospital of Wenzhou Medical University.

The data collection will be carried out from September 20 to November 30, 2022. In this regard, you can contact Mrs. Leixi Wang via mobile phone +86-1506-7813-390 or E-mail: 836502058@qq.com

Please do not hesitate to contact me if you need further relevant queries.

Sincerely yours,

(Assoc. Prof. Dr. Nujjaree Chaimongkol)
Dean of Graduate School, Burapha University

Graduate School Office
Tel: +66 3810 2700 ext. 701, 705, 707
E-mail: grd.buu@go.buu.ac.th
http://grd.buu.ac.th

Please type or write with readable hand writing

GRD-109 (Eng)
(Try out)

Graduate School Burapha University

Request form for issuing a requesting letter for data collection (Try out)

To Dean of Graduate School

I am (Mr./Mrs./Ms.) Mrs Leixi Wang Student ID .....63910136.....

❑ Doctoral degree ☑ Master degree - plan ☑ A ❍ B Study type ☑ Full-time ❍ Part-time

Program Master of Nursing Science (International program) Major/Pathway.....Maternity Nursing & Midwifery...

Faculty of Nursing Telephone 15067813390 E-mail 836502058@qq.com

Doctoral dissertation/ Master thesis/ IS **Title**: Factors influencing blood glucose control behavior among pregnant women having first-time gestational diabetes mellitus with non-insulin management in Wenzhou, China.

Principal advisor' name.....Assistant Professor Dr. Jinjutha Chaisena Dallas

I would like to request for issuing **a requesting letter for data collection (Try out)**:

By issuing to (name of the director of Institute/ University/ Organization)

.....The Second Affiliated Hospital of Wenzhou Medical University.....

Institute/ University/ Organization/ Department/ Division .....Obstetrics Clinic.....

To collect data from (details of participants and sample size)...Women having first-time gestational diabetes mellitus with non-insulin management who come to the obstetrical clinic for a check-up at the Second Affiliated Hospital of Wenzhou Medical University for 30 cases.

Duration of data collection: from date.....September 1, 2022.....to...September 10, 2022.....

My contact information: # cellphone and E-mail .....15067813390, ...836502058@qq.com

With this request, I have enclosed documents...1...copies

1) A copy of proof of ethical approval from Burapha university, and
2) Research instruments

Please be informed accordingly,

Student's name .....Leixi Wang.....

(.....Leixi Wang .....)

Date.....25 Month.....8.....Year...2022.....

Principal advisor acknowledged	Dean of Faculty/College acknowledged	Dean of Graduate School approved
Jinjutha (Signed)..... Date..... 26 AUG 2022	(Signed) Pomelai ..... Date..... 26 AUG 2022	(Assoc.Prof.Dr.Nujjaree Chaimongkol) (Signed) Dean of Graduate School Date..... 31 August 2022 .....

Please type or write with readable hand writing

GRD-109 (Eng)
(Main Study)

Graduate School Burapha University

Request form for issuing a requesting letter for data collection (Main Study)

To Dean of Graduate School

I am (Mr./Mrs./Ms.) Mrs Leixi Wang Student ID .....63910136.....

❑ Doctoral degree ☑ Master degree - plan ☑ A ○ B Study type ☑ Full-time ○ Part-time

Program Master of Nursing Science (International program) Major/Pathway.....Maternity Nursing & Midwifery...

Faculty of Nursing Telephone 15067813390 E-mail 836502058@qq.com

Doctoral dissertation/ Master thesis/ IS **Title**: Factors influencing blood glucose control behavior among pregnant women having first-time gestational diabetes mellitus with non-insulin management in Wenzhou, China.

Principal advisor' name.....Assistant Professor Dr. Jinjutha Chaisena Dallas

I would like to request for issuing **a requesting letter for data collection (Main Study)**:

By issuing to (name of the director of Institute/ University/ Organization)

...The Second Affiliated Hospital of Wenzhou Medical University.....

Institute/ University/ Organization/ Department/ Division ...Obstetrics Clinic.....

To collect data from (details of participants and sample size) .....

① The target population of this study is pregnant women with gestational diabetes mellitus who visit an obstetrical ward at the second affiliated hospital of WMU, Wenzhou, China.....

② The sample size in this study was calculated by using Tabachnick and Fidell's formula (2007) as follows: $N \geq 104 + m$ (where m is a number of independent variables) Based on this formula, the sample size for this study should be least 109. In this study, add more 22 case from 20% incomplete rate. Therefore, 131 participants will be recruited.

Duration of data collection: from date.....September 20, 2022.....to..... November 30, 2022.....

My contact information: # cellphone and Email .....15067813390, ...836502058@qq.com

With this request, I have enclosed documents.....copies

1) A copy of proof of ethical approval from Burapha university, and
2) Research instruments

Please be informed accordingly,

Student's name .....Leixi Wang.....

(.....Leixi Wang .....)

Date.....25 Month.....8.....Year...2022.....

Principal advisor acknowledged	Dean of Faculty/College acknowledged	Dean of Graduate School approved
Jinjutha (Signed)..... Date..... 26 AUG 2022	Pornchai (Signed)..... Date..... 26 AUG 2022	(Assoc.Prof.Dr.Nujjaree Chaimongkol) Dean of Graduate School (Signed)..... Date..... 31 August 2022

APPENDIX E

The acceptance permission for using the instruments

Permission to use the Diabetes Care Profile's Social Support Scale

Ms. LeiXi Wang,

You have our permission

n to use the Diabetes Care Profile's Social Support Scale. If you have any questions, please contact me. Good luck with your study.

James T. Fitzgerald, Ph.D.

Emeritus Professor

Department of Learning Health Sciences

University of Michigan

From: LeiXi Wang <yiyu3@qq.com>
Sent: Monday, April 25, 2022 1:13 PM
To: tfitz <tfitz@umich.edu>
Subject: The Diabetes Care Profile (DCP)

Dear Fitzgerald professor:

Hello! My name is Leixi Wang, I'm sorry to bother you! I am a stutent studying nursing science for master degree in Burapha university. I am so interested in the fifth part of the Diabetes Care Profile (DCP), the social support scale which was made by you in 1996. The scale is very useful for my study. I want to get your permission to use it. Is it ok? I am looking forward to your reply. Thank you very much! Best wishes!

Permission to use the Diabetes Self-efficacy Scale

This scale is in the public domain which means it is free to use by anyone so you have my permission. If you publish, please cite the scale and if you translate, please send us a copy of the translation along with the English so we may share with others.

Kate Lorig

From: LeiXi Wang <yiyu3@qq.com>
Sent: Monday, April 25, 2022 9:20 AM
To: Kate R Lorig <lorig@stanford.edu>
Subject: Self-efficacy scale

Dear Lorig professor:

Hello! My name is Leixi Wang, I'm sorry to bother you! I am a stutent studying nursing science for master degree in Burapha university. I am so interested in diabetes self-efficacy scale which was made by you in 1996. The scale is very useful for my study. I want to get your permission to use it. Is it ok? I am looking forward to your reply. Thank you very much! Best wishes!

Permission to use Gestational diabetes knowledge (regarding perceived susceptibility) questionnaire

祁梦君回复：不好意思，最近比较忙忘记回复您，希望我的研究可以帮到您。

祁梦君

Reply by Mengjun Qi: I am sorry that I have been busy recently and forgot to reply you. I hope my research can help you.

Mengjun Qi

---------- **Original mail** ----------

发件人: "LeiXi Wang" <yiyu3@qq.com>;
From: "LeiXi Wang" <yiyu3@qq.com>;
发送时间: 2022 年 4 月 24 日(星期天) 晚上 11:43
Sent: 11:43 PM, Sunday, April 24, 2022
收件人: "紫色风铃"<2226599027@qq.com>;
To: "Purple Wind Chimes"<2226599027@qq.com>
主题: 妊娠糖尿病患者自我管理能力问卷
Theme: Permission to use gestational diabetes knowledge (regarding perceived susceptibility) questionnaire

亲爱的祁梦君老师，您好！我是来自温州医科大学附属第二医院产科病房的护士，我叫王蕾茜。抱歉打扰您了！我现在正在攻读研究生，目前在做关于妊娠期糖尿病的课题，需要用到一份关于妊娠期糖尿病血糖管理方面的问卷(关于妊娠期糖尿病相关知识的部分)，我查阅文献，发现您有做过相关的课题，您编制的妊娠糖尿病患者自我管理能力问卷信效度都很好，很有科研意义，我想使用您这份问卷用于临床研究可以吗，希望得到您的同意！祝您工作顺利！盼回复!

Dear Teacher Mengjun Qi , hello! I am a nurse from the maternity ward of the Second Affiliated Hospital of Wenzhou Medical University. My name is Leixi Wang. Sorry to bother you! I am now studying for a postgraduate degree, and I am currently doing a project on gestational diabetes, which requires a questionnaire on blood glucose management of gestational diabetes (part about knowledge and perceived susceptibility related to gestational diabetes). I have consulted literature and found that you have done related projects, and the questionnaire on self-management ability of gestational diabetes patients compiled by you has good reliability and validity, which is of great scientific significance. Can I use your questionnaire for clinical research? I hope to get your consent! Wish you success in your work! Looking forward to your reply!

Permission to use GDM-related perceived barrier questionnaire and GDM blood glucose control behavior questionnaire

李雪回复：不好意思刚看到，同意您使用。

李雪

Reply by Xue Li: I'm sorry I just saw it. I agree you to use it.

Xue Li

---------- **Original mail** ----------

From: LeiXi Wang <Tel: 15067813390>
Sent: Tuesday, April 26, 2022 21:34 PM
To: Xue Li <Tel: 18678769538>
Subject: Permission to use GDM-related perceived barrier questionnaire and GDM blood glucose control behavior questionnaire

尊敬的李雪老师你好！不好意思这么晚打扰您！我是来自温州医科大学附属第二医院产科病房的护士王蕾茜。我这次联系您是有个量表要使用，需要跟您说明一下。我现在在读泰国东方大学举办的护理研究生，我做的研究需要用到您发表的硕论里的《妊娠期糖尿病自我管理健康信念问卷》和《妊娠期糖尿病自我管理行为量表》，学校让我们跟您报备一下，您是否同意我使用您制作的问卷用于研究？学校着急审核，盼回复！祝您工作顺利，生活愉快！

Dear teacher Xue Li, Hello! Sorry to bother you so late! I am Leixi Wang, a nurse from the maternity ward of the Second Affiliated Hospital of Wenzhou Medical University. I contact you this time is to use a scale, I need to explain to you. I am now studying as a nursing graduate in Oriental University of Thailand. My research needs to use the “GDM-related perceived barrier questionnaire” and “GDM blood glucose control behavior questionnaire” in your published master thesis. The school let us to ask you, do you agree that I use the questionnaire you made for research? Looking forward to your reply! I wish you a smooth work and happy life!

BIOGRAPHY

NAME	Leixi Wang
DATE OF BIRTH	10 September 1990
PLACE OF BIRTH	Wenzhou, China
PRESENT ADDRESS	Room 312, Building 1, Nanya City Garden, Shibajia Branch Road, Lucheng District, Wenzhou, Zhejiang, China
POSITION HELD	Supervisor nurse, maternal-infant specialist nurse
EDUCATION	2008.9-2012.5 Wenzhou Medical University Nursing and Midwifery major undergraduate
AWARDS OR GRANTS	1.The first prize of health Education Speech Contest of Wenzhou Nursing Society in 2018, Wenzhou Nursing Society 2.Second prize in 2018 "Be a Warm Nurse" essay contest, Nursing Department, The Second Affiliated Hospital of Wenzhou Medical University 3.2018 Outstanding Student of Maternal and infant Specialized nurse in Zhejiang Province, Nursing Department of Obstetrics and Gynecology Hospital Affiliated to Zhejiang University School of Medicine 4.Second prize of the first Zhejiang Perinatal Nursing Health Education Teacher Speech Contest in 2019, Zhejiang Maternal and Child Health Association 5.2020 Nursing Research activist, Nursing Department, The Second Affiliated Hospital of Wenzhou Medical University 6.2021 Third prize in nursing Innovation Competition of the Second Affiliated Hospital of Wenzhou Medical University, Nursing Department of the Second Affiliated Hospital of Wenzhou Medical University