Effects of Early Blood Glucose Management on Newborns Born by Cesarean Section: A Case-control Trial

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Objective: This paper aims at assessing the impact of early blood glucose management on the newborn during cesarean section, especially on the pregnancy outcome and newborn status of diabetes patients during pregnancy or diabetes patients before pregnancy.

Methods: This study conducted a controlled trial design on pregnant and postpartum women in a maternal and child health hospital in North China. The experimental group received early intensified blood glucose management, while the control group received conventional blood glucose management. Enhanced management includes the use of dynamic blood glucose monitoring and standardized blood glucose control objectives, while conventional management relies on fingertip or venous blood glucose monitoring. Data on the incidence of complications, newborn weight, length, and complications were collected and compared between two groups of pregnant women.

Results: Maternal complications' incidence in the strengthened management group was 52.4%, lower than the conventional management group's 77.8%, with a t-value of 8.940 and a *P*-value of 0.003. Especially in terms of postpartum hemorrhage, the incidence rate in the strengthened management group was only 7.9%, much lower than the 47.6% in the conventional management group, with a t-value of 24.725 and a *P*-value of 0.000. The pre-pregnancy body mass index was positively correlated with the weight and length of newborns ($P<0.05$). However, low birth weight infants' incidence in the strengthened management group was 20.6%, significantly higher than the 7.9% in the conventional management group, with a t-value of 4.148 and a *P*-value of 0.042. Two groups had no obvious differences in fetal malformations, macrosomia, and neonatal admission rates.

Conclusion: Early strengthening of blood glucose management can effectively reduce the complications of cesarean section in pregnant women, especially postpartum hemorrhage, but its impact on newborn weight and length is limited.

Keywords: Blood glucose management; BMI; Newborns; Pregnancy and childbirth complications; Gestational diabetes mellitus

INTRODUCTION

The global obesity problem is becoming increasingly severe. The incidence rate of Gestational Diabetes Mellitus (GDM) and Pre-Gestational Diabetes Mellitus (PGDM) is rising. They become public health issues that affect the health of pregnant women and newborns [1-2]. These metabolic disorders not only increase complications during pregnancy and childbirth, but may also have long-term adverse effects on newborns' growth [3]. Body Mass Index (BMI) before pregnancy is an important indicator for evaluating women's nutritional status and lifestyle, which has a significant impact on Blood Glucose (BG) control during pregnancy and maternal and infant health [4]. The traditional BG management strategy mainly relies on fingertip BG monitoring, but this method has certain limitations [5]. Firstly, the frequency of fingertip BG monitoring is limited and cannot provide all-weather BG fluctuation information, which may result in inaccurate BG control [6-7]. Secondly, traditional research mostly focuses on evaluating the short-term effects of gestational BG control on mothers and infants, while understanding the long-term effects is still limited, especially in the long-term health of newborns [8-9]. Therefore, how to optimize the growth and development of newborns by improving BG management before and during pregnancy is still urgent to be solved [10-11]. In response to the shortcomings of traditional research, the study innovatively introduces Continuous Glucose Monitoring (CGM) technology to achieve continuous and comprehensive monitoring of BG in pregnant women. This paper aims at assessing early BG management's impact on newborns and their mothers undergoing cesarean section by comparing the effects of strengthened and conventional BG management. This study focuses on the impact of pre-pregnancy BMI on newborn weight and length, as well as the preventive effect of BG control on complications during pregnancy and childbirth. In addition, this study will also explore the potential impact of pre-pregnancy BMI on the long-term health of newborns, providing a scientific basis for weight management before and during pregnancy. This paper expects to provide more effective BG management strategies for clinical practice, improve maternal and infant health during pregnancy and childbirth, and provide reference for future pre-pregnancy and pregnancy care guidelines.

1. MATERIALS AND METHODS

1.1 General information of research subjects

For the study of the impact of early pregnancy BG management on newborns undergoing cesarean section, inclusion criteria: (1) Natural conception, single pregnancy. (2) Pregnant women aged 18 and above. (3) Unconscious disorder, able to understand and answer the questions raised. One maternal and child health hospital in North China was selected to establish an outpatient card and regular prenatal examinations were conducted. Full term pregnant women who were followed up until delivery were selected as the research subjects. Exclusion criteria: (1) Participants should not have a history of severe damage to their heart or liver or kidney function before pregnancy. (2) Participants who have a past history of chronic diseases such as diabetes and hypertension before and at the beginning of pregnancy, or who have records of hereditary diseases in their families. (3) Individuals who experience severe nausea and vomiting during pregnancy. (4) Participants whose medical records during pregnancy are incomplete or missing key information. (5) Participants in natural childbirth. Participants were required to voluntarily participate and sign an informed consent form. 684 pregnant women participated. The age distribution is between 18-43 years old, with an average age of 28.7 years and a standard deviation of 4.4 years. Among all age groups, the pregnant women aged 25 to 29 are the largest, with 292 people, accounting for 42.6% of the total population. Following closely behind is the age group of 30 to 34, with 221 pregnant women participating, accounting for 32.3%. 110 young pregnant individuals aged 18 to 24 participated, accounting for 16.1%. The older age group aged 35 to 43 have 61 participants, accounting for approximately 9.0%. Figure 1 shows the BMI grouping information of these study subjects.

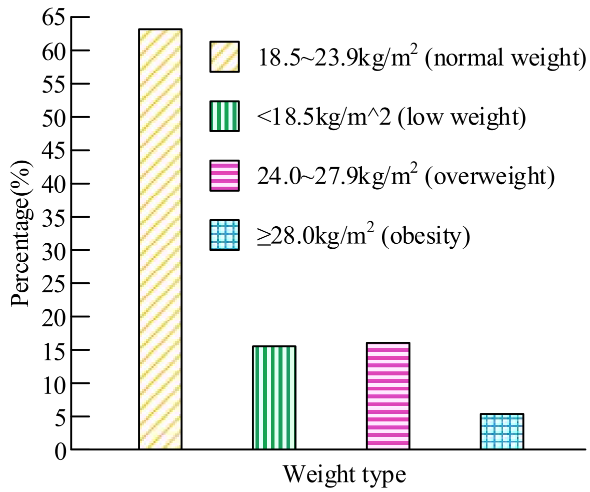

Fig. 1 BMI information of study subjects

1.2 Classification and diagnostic criteria for gestational hyperglycemia

There is a clear definition of the classification and diagnostic criteria for high BG during pregnancy. PGDM refers to women who have been diagnosed with types 1, 2, or special type of diabetes before pregnancy. Overt Diabetes in Pregnancy (ODM), also known as diabetes during pregnancy, refers to diabetes diagnosed at any point in pregnancy according to the diagnostic criteria of diabetes for non pregnant people. Diagnostic criteria: (1) Fasting Plasma Glucose (FPG) equal to or exceeding 7.0mmol/L, BG greater than 11.1mmol/L 2 hours after glucose loading, or random BG equal to or exceeding 11.1mmol/L. (2) Pre-diabetes includes Impaired Fasting Glucose (IFG) and Impaired Glucose Tolerance (IGT). In the first prenatal examination in early pregnancy, a FPG between 5.6 and 6.9mmol/L can be diagnosed as pregnancy with IFG. IGT refers to FPG below 7.0mmol/L and BG between 7.8 and 11.1mmol/L 2 hours after glucose loading (2hPG). (3) The diagnosis of GDM is determined through the 75 gram Oral Glucose Tolerance Test (OGTT) conducted at 24 to 28 weeks of pregnancy. The BG thresholds at 1 hour and 2 hours after fasting and oral glucose administration are 5.1, 10.0, and 8.5mmol/L, respectively. If the BG at any time point meets or exceeds these criteria, it can be diagnosed as GDM. (4) If the FPG is between 5.1mmol/L and 5.6mmol/L in early pregnancy, and the FPG is greater than 5.1mmol/L during follow-up at 24 to 28 weeks of pregnancy, it can also be diagnosed as GDM. Figure 2 shows the classification and diagnostic criteria for high BG during pregnancy.

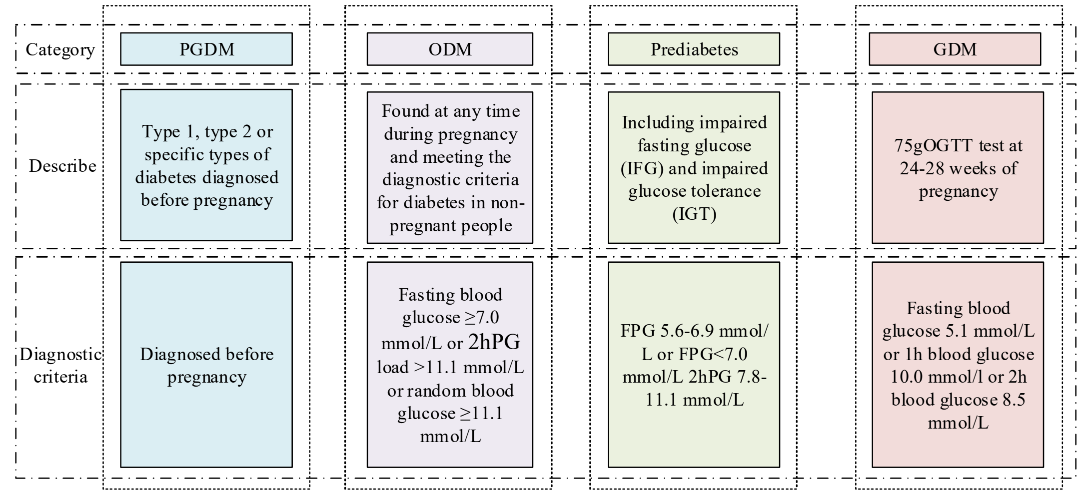

Fig. 2 Classifying and diagnosing criteria of hyperglycemia

1.3 Objectives of dietary control management during pregnancy

After completing communication with pregnant women, a series of comprehensive risk factor screening and evaluation were conducted, and personalized BG control and weight management goals were established for pregnant women. For pregnant women with GDM or PGDM, the BG control target should be set as: FPG below 5.3mmol/L, BG below 7.8mmol/L 1 hour after meals, or BG below 6.7mmol/L 2 hours after meals. Night BG levels below 3.3mmol/L should be avoided to ensure maternal and infant safety and effectively control BG. These control objectives are formulated based on the B-level recommendation level. For PGDM patients, while ensuring no increase in low BG risk, BG control goals can be adjusted appropriately based on clinical experience and individual circumstances of pregnant women to meet the specific needs of different pregnant women. This personalized management method aims to optimize the overall health status of pregnant women and ensure the healthy development of the fetus. Table 1 presents the recommended pregnancy weight gain goals for pregnant women with pre-pregnancy BMI.

Table 1 Recommended pregnancy weight gain goals

Pre-pregnancy BMI classification	Early pregnancy weight gain standards	Weight gain rate in the 2th and 3th trimester of pregnancy (kg/w)	Recommended range of total weight gain during pregnancy (kg)
Underweight (BMI<18.5)	0.00-2.00kg	0.51(0.44-0.58)	12.50-18.00
Normal weight (18.5~23.9)	0.00-2.00kg	0.42(0.35-0.50)	11.50-16.00
Overweight (24.0~27.9)	0.00-2.00kg	0.28(0.23-0.33)	7.00-11.50
Obesity (BMI>28.0)	0.00-2.00kg	0.22(0.17-0.27)	5.00-9.00

1.4 Pregnancy blood glucose management methods

To effectively manage high BG during pregnancy, this study was divided into two groups. The experimental group adopted an early strengthening management approach. First of all, through online courses or face-to-face teaching, pregnant women were regularly informed about pregnancy with diabetes. This includes proper understanding of the disease, pre-pregnancy preparation, reasonable diet, exercise therapy, BG self-monitoring technology, medication treatment, delivery care, postpartum recovery, and psychological adjustment during the epidemic. Secondly, a professional team consisting of endocrinologists, nutritionists, and nurses was formed to strengthen the tracking and management of pregnant women wearing CGM devices for 14 days. Through the Internet community platform, monitor the daily diet, exercise, BG, weight and psychological and emotional status of pregnant women to ensure that they can correctly follow the treatment plan. Meanwhile, promptly respond to pregnant women's inquiries, develop personalized and gradually advancing dietary and exercise management plans, and provide psychological counseling. In terms of medical nutrition and exercise therapy, personalized dietary plans were developed based on the pre-pregnancy BMI, BG, and weight gain rate of pregnant women. The goal is to maintain an appropriate weight, correct metabolic disorders, and reduce the burden of pancreatic B cells. Based on the taste preferences of pregnant women, guide them to adjust their nutrient intake ratio and meal schedule, and ensure sufficient intake of vitamins and minerals. In addition, through physical model education, help pregnant women to learn dietary weighing and food exchange methods, so that they can plan their daily diet on their own. In terms of disease monitoring and medication treatment, use Continuous Glucose Monitoring System (CGMS) or Self-Monitoring of Blood Glucose (SMBG) to guide pregnant women in monitoring BG and adjusting treatment plans with the help of doctors. For pregnant women with stable BG control, comprehensive BG contour monitoring should be conducted at least once a week. For newly diagnosed or poorly controlled PGDM or GDM pregnant women, BG monitoring should be conducted 7 times a day. Meanwhile, pregnant women should undergo regular prenatal examinations and use medication such as metformin or insulin as needed, as well as drugs targeting thyroid dysfunction, to ensure that pregnancy BG and thyroid function are within the ideal range.

The control group adopts conventional management methods. Pregnant women's goals in BG and weight control were consistent with those of the strengthened management group. They received the same diabetes education courses as the strengthened management group, including diet and exercise guidance. In addition, both groups followed the same standards for monitoring before pregnancy and medication treatment during pregnancy. Pregnant women in the conventional management group also received CGMS monitoring and subsequent SMBG monitoring, and underwent regular prenatal examinations. However, unlike the strengthened management group, pregnant women in the conventional management group did not participate in the 14 day strengthened BG tracking management plan. This means that the management team is unable to continuously track, provide feedback, and adjust their daily behavior and BG status. Pregnant women in the conventional management group mainly received follow-up medical management through regular hospital visits. Although this management approach provides basic medical support, there may be certain limitations in adjusting treatment plans in a timely manner and providing personalized feedback compared to a strengthened management group. Through this comparison, this paper aims at assessing different management strategies' impact on pregnant women with high BG. Figure 3 shows the management method of pregnancy BG.

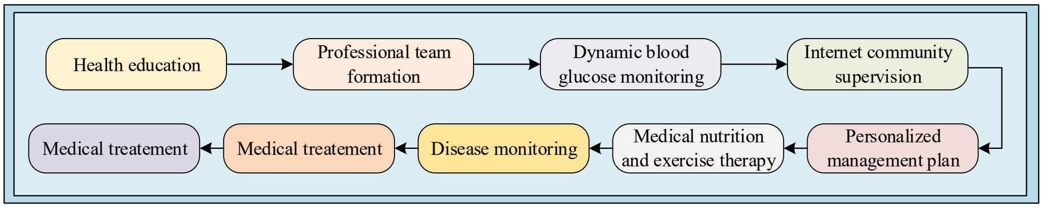

Fig. 3 Blood glucose management methods during pregnancy

1.5 Statistical methods

In the statistical analysis stage, propensity score matching method was used to pair participants to ensure similarity between the two groups in key variables such as age, pre-pregnancy BMI, reproductive assistance, thyroid drug treatment during pregnancy, insulin treatment, and OGTT test results at 24-28 weeks. Use a caliper value of 0.1 to optimize the matching quality during matching. After completing the matching, perform a covariate balance test on the sample. For continuous variables, first perform Shapiro Wilk normality test and Levene homogeneity of variance test. If these data satisfied a normal distribution and had homogeneous variances, they were represented by mean±standard deviation and compared using two independent sample t-tests. If these data did not follow a normal distribution or had uneven variances, they were represented as median and interquartile range [M (P25, P75)] and compared using Mann Whitney U test. For categorical variables, chi square test or Fisher's exact probability test was used for unordered categorical data, while Wilcoxon rank sum test was utilized for comparing ordered categorical data. In all comparisons, if P<0.05, it is considered that the difference is statistically significant.

2. RESULTS

2.1 The impact of early blood glucose management on pregnant women

Two statistical models were used in the analysis of different BMI before pregnancy and the occurrence of GDM. The analysis of Model 1 did not adjust for potential confounding factors. Model 2 considered and controlled for confounding elements, like maternal age, parity, and Gestational Weight Gain (GWG) in the analysis in Table 2.

Table 2 Analysis of labor conditions among pregnant women in different pre-pregnancy BMI groups

Labor situation		Model 1 gestational diabetes	Model 1 fetal abnormalities	Model 2 gestational diabetes	Model 2 fetal abnormalities
<18.5kg/m^2	*OR*(95%*CI*)	0.993(0.485-2.046)	0.985(0.710-1.368)	1.006(0.487-2.072)	0.997(0.716-1.386)
	P-value	0.994	0.932	0.993	0.995
<18.5-23.9kg/m^2	*OR*(95%*CI*)	1.000	1.000	1.000	1.000
⩾ 24.0kg/m^2	*OR*(95%*CI*)	1.823(1.020～3.249)	0.812(0.585～1.116)	1.820(1.010～3.274)	0.801(0.576～1.108)
	P-value	0.045	0.195	0.047	0.798

Note: Fetal abnormalities are limited to umbilical cord abnormalities, including phenomena such as umbilical cord wrapping around the neck, shoulder, and body.

In Table 2, compared to pregnant women with normal pre-pregnancy weight, those who were overweight or obese before pregnancy had a higher risk of developing GDM, with an unadjusted Odds Ratio (OR) of 1.821 and a Confidence Interval (CI) of 1.020 to 3.249. Even after considering potential confounding elements, like maternal age, parity, and GWG, pregnant individuals who were overweight or obese before pregnancy still showed a higher risk of GDM, with an adjusted OR of 1.818 and a 95%CI of 1.010 to 3.274. However, in terms of fetal abnormalities, pre-pregnancy BMI did not show a significant correlation with it before or after adjusting for confounding factors, with *P*-values greater than 0.05. This finding suggested that pre-pregnancy BMI was not fetal abnormalities' obvious predictor. Table 3 shows the pregnancy outcomes of pregnant women in both conventional and CGM monitoring groups.

Table 3 Pregnancy outcomes of pregnant women in the conventional monitoring group and CGM monitoring group

Project	Conventional monitoring (%)	CGM monitoring (%)	χ^2 (t)-value	*P*-value
Total maternal complications	77.800	52.400	8.940	0.003#
Premature rupture of membranes	14.300	17.500	0.238	0.626
Preeclampsia	9.500	15.900	1.145	0.285
Postpartum hemorrhage	47.600	7.900	24.725	0.000#
Postpartum follow-up examination showed diabetes	23.100	2.400	5.205	0.023*
Postpartum follow-up examination showed impaired fasting blood glucose	0.000	1.000	/	1.000
Postpartum review showed abnormal glucose tolerance	15.400	46.300	5.460	0.019*

Note: * indicates *P*<0.05, # indicates *P*<0.01.

In Table 3, the CGM monitoring group had the lower total incidence of maternal complications (with at least one complication) than the conventional monitoring group (*P*<0.05). This group had the lower incidences of postpartum hemorrhage and diabetes than the conventional monitoring group (*P*<0.05), and the incidence of other complications was similar (*P*>0.05). Table 4 presents the strengthened treatment's effectiveness.

Table 4 Comparison of pregnancy outcomes of people whether they received early strengthened management or not

Project	Conventional management group (%)	Strengthened management group (%)	χ^2 (t)-value	*P*-value
Total maternal complications	59.100	55.900	0.056	0.813
Weight gain during pregnancy reaches target	40.900	47.100	0.204	0.651
Premature rupture of membranes	27.300	17.600	0.275	0.600
Preeclampsia	13.600	14.700	0.000	1.000
Postpartum hemorrhage	22.700	2.900	5.466	0.019*

Note: * indicates *P*<0.05, # indicates *P*<0.01.

Postpartum hemorrhage's incidence in the strengthened management group was significantly reduced to 2.9%, while the incidence in the conventional management group was 22.9%, with a comparison showing $P<0.05$. In terms of other complications, the comparison between these two groups, including premature rupture of membranes, pre-eclampsia, and abnormal amniotic fluid, showed $P>0.05$.

In summary, when classifying pre-pregnancy BMI, the overall weight achievement rate of the strengthened management group was slightly higher than the conventional management group's in low weight, normal weight, overweight, and obese populations ($P>0.05$). For these low weight and overweight individuals, the compliance rate of the strengthened management group was higher, while the compliance rate of the normal weight and obese population was similar between these two groups.

2.2 The influence of early blood glucose management on newborns

The influence of pre-pregnancy BMI on newborn height and weight was analyzed in Table 3.

Table 5 Single factor analysis of catheter related variables

Pre-pregnancy BMI	Newborn weight (kg)	Newborn length (cm)
<18.5kg/m^2	3146.21±425.3^a	49.13±2.0
<18.5-23.9kg/m^2	3258.72±446.5	49.50±1.8
⩾24.0kg/m^2	3342.33±491.1^b	49.72±1.9^b
F	8.263	4.872
P-value	＜0.001	0.008

Note: When comparing between groups, if there is a significant difference ($P<0.05$) compared to the pre-pregnancy normal weight or appropriate GWG group, it is marked as a. If the difference is significant ($P<0.05$) compared to the pre-pregnancy low weight or GWG deficiency group, it is marked as b.

In Table 3, the average weight of newborns was 3.254.8 kilograms, with an average body length of 49.5 centimeters and standard deviations of 455.3 grams and 1.8 centimeters, respectively. The different pre-pregnancy BMI had an obvious influence on newborns' weight and length ($P<0.05$). This indicated that as the mother's pre-pregnancy BMI increased, the birth weight and length of newborns also showed an upward trend. Figure 4 shows the effects of regular monitoring and CGM monitoring on newborns.

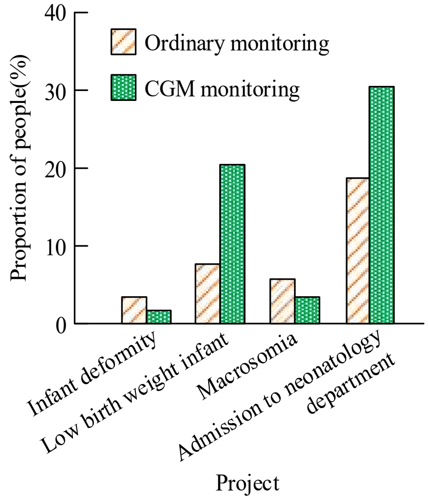

Fig.4 Comparison of the effects of conventional monitoring and CGM monitoring on newborns

In Figure 4, the comparison of fetal malformations between the normal and CGM monitoring groups shows P>0.05. The comparison of low weight newborns showed P<0.05. The comparison between the normal and CGM monitoring groups for macrosomia showed P>0.05. The comparison of admitted neonatology between the conventional and CGM monitoring groups showed P>0.05. Table 7 shows the impact of early reinforcement management on newborns.

Table 6 Comparison of neonates between two groups whether they receive early strengthened management or not

Project	Conventional management group (%)	Strengthened management team (%)	χ^2 (t)-value	P-value
Infant deformity	3.800	16.300	4.011	0.243
Total neonatal complications	40.900	41.200	0.000	0.984
Low birth weight infant	9.000	8.800	0.000	1.000
Macrosomia	18.200	23.500	0.020	0.886
Admission to neonatology department	40.900	41.200	0.000	0.984

Note: * indicates P<0.05, # indicates P<0.01.

The comparison of the overall incidence of neonatal complications, fetal malformations, low weight newborns, macrosomia, and neonatal admission rates showed P>0.05. In terms of fetal malformations, a total of 8 cases were found, including 2 cases of neurological malformations, 4 cases of chromosomal abnormalities related malformations, 1 case of cleft lip and palate, and 1 case of persistent left superior vena cava in the fetus. Among these deformities, 5 cases ended in miscarriage, while 1 case had a live birth.

3. DISCUSSION

With the adjustment of national policies and the implementation of the "comprehensive three child policy", more and more families are paying attention to how to achieve healthy and high-quality pregnancy, as well as how to reduce health risks during pregnancy and discomfort during childbirth [12]. Pre-pregnancy BMI is an important indicator for evaluating women's nutritional status and lifestyle [13-14]. According to research survey data, the majority of women preparing to conceive have a normal weight range, accounting for 63.3%. However, 15.1% of women are still underweight, which may affect their fertility and pregnancy process [15-16]. Meanwhile, 21.6% of women weigh more than the normal range, which may increase their risk of complications during pregnancy. These data indicate that maintaining a healthy weight is crucial for women preparing to conceive, both for their own health and for the health of future babies [17-18]. Therefore, pre-pregnancy weight management should be an important component of pre-pregnancy counseling and preparation to help women achieve a healthy weight state before pregnancy [19]. BG management plays a crucial role in pregnancy health, especially when dealing with GDM and PGDM [20-21]. With the increasing prevalence of diabetes in the world, more pregnant women suffer from high BG, which not only poses a threat to mother's health, but also poses a potential risk to the developing fetus [22]. Under high BG conditions, pregnant women may face a higher risk of pregnancy complications, like hypertension, premature birth, fetal malformations, and difficulties during delivery [23]. In addition, high BG may also lead to problems, like macrosomia, low BG, et al. in newborns [24].

The study explored the impact of early BG management on newborns undergoing cesarean section and compared the differences between the strengthened and conventional management groups in terms of maternal complications, newborn condition, and BG control. Through data analysis of 684 pregnant women, the strengthened management group had lower overall incidence of maternal complications than the conventional management group. The strengthened management group's overall maternal complications incidence was 52.4%. The conventional management group had a score of 77.8%, with a t of 8.940 and a *P* of 0.003. This indicated that strengthened BG management had a significant effect in reducing maternal complications, which is consistent with the study by Egan AM et al. [25]. By comparing the application effects of strengthened and conventional BG management in newborns and their mothers undergoing cesarean section, this study provided important insights into the impact of gestational BG control on maternal and infant health. Among pregnant women receiving enhanced BG management, the incidence of overall complications significantly decreased, especially the incidence of postpartum hemorrhage, from 22.7% in the conventional management group to 2.9% in the enhanced management group. This significant difference emphasized the strengthened BG control was important in reducing the complications during pregnancy and childbirth. Compared to the study by Tong J N et al., the overall results show consistency [26]. In the study, CGM technology was used to control BG in women with fertility needs, and the effectiveness of BG control was evaluated based on the standardized reports generated. For patients with high gestational BG, whether it was gestational ODM or GDM, only one continuous CGM lasting more than 7 days might have a positive impact on the pregnancy outcomes and long-term health of the pregnant woman. The overall incidence of complications and postpartum hemorrhage in these pregnant women were significantly lower than those managed solely through traditional fingertip or venous BG monitoring. Therefore, by improving BG control, the pregnancy outcomes of patients with high BG during pregnancy could be effectively improved. In terms of GWG compliance rate, the weight compliance rate of the strengthened management group was 40.9%. The conventional management group had 47.1%, t was 0.204, and *P* was 0.651, indicating that there was no significant difference in weight gain compliance between the two groups. This meant that GWG was influenced by multiple factors, and a single BG management strategy was difficult to fully control GWG.

In terms of the impact of pre-pregnancy BMI on the weight and length of newborns, the average weight of newborns was 3.254.8 kilograms and the average length was 49.5 centimeters. Through univariate analysis, pre-pregnancy BMI and neonatal weight had a significant correlation (F=8.263, P<0.001) and body length (F=4.872, P=0.008). The average weight of newborns with pre-pregnancy low body weight (BMI<18.5kg/m²) is 3146.21±425.3 kilograms. The normal weight group (BMI 18.5-23.9kg/m²) was 3258.72 ± 446.5 kilograms. The overweight and obese group (BMI≥24.0kg/m²) had a weight of 3342.33 ± 491.1 kilograms. This indicated that different pre-pregnancy BMI affected newborns' weight and length obviously. Mothers who were overweight or obese before pregnancy were more likely to give birth to newborns with larger weight and length. The incidence of low birth weight infants in the strengthened management group was significantly higher than that in the regular monitoring group. The strengthened management group accounted for 20.6%, while the conventional monitoring group accounted for 7.9%, with a t of 4.148 and a P of 0.042. This suggested that in strengthened BG management, the weight gain of some pregnant women might not meet the recommended standards, thereby affecting the normal growth of the fetus. In terms of neonatal complications, these two groups had no obvious difference in fetal malformations, macrosomia, and neonatal admission rates. Yamamoto J M et al. confirmed that target BG control and neonatal admission had no obvious association, consistent with this research findings [27]. Early BG management has limited effectiveness in preventing these specific neonatal complications. However, these data provide a foundation for future research, suggesting the need for more comprehensive management measures in preventing neonatal complications, rather than just BG control.

In summary, early BG management plays a positive role in reducing maternal complications, especially in reducing the risk of postpartum hemorrhage. However, early BG management has limited effectiveness in improving newborn weight and preventing fetal malformations. Future research should further explore more comprehensive management strategies in order to achieve better maternal and child health outcomes. For pregnant individuals with different pre-pregnancy BMI classifications, more personalized management plans should be developed to ensure maternal and child safety and health.

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