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Continuity of Care and Delivery Outcomes in Pregnant Women with Gestational Diabetes Mellitus: A Retrospective Controlled Study at a Tertiary Hospital in China

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ABSTRACT

Objective: *To evaluate the impact of continuity of care on delivery outcomes in pregnant women diagnosed with gestational diabetes mellitus (GDM).*
Methods: *This retrospective controlled study was conducted at a tertiary general hospital in Hubei Province, China. The control group consisted of 60 GDM patients who received standard prenatal care between September 2020 and September 2021. The intervention group included 200 GDM patients who received continuity of care between October 2021 and June 2023. The continuity of care model encompassed health education, dietary and exercise counseling, psychological support, and online follow-up from the time of diagnosis until one week postpartum. Delivery outcomes—including rates of vaginal delivery, pelvic adhesions, premature rupture of membranes, postpartum hemorrhage, dystocia, and manual placental removal—were compared between groups.*
Results: *The intervention group had a significantly higher rate of vaginal delivery compared to the control group (44.5% vs. 28.3%, P = 0.02). Rates of pelvic adhesions (5.5% vs. 28.3%), premature rupture of membranes (2.0% vs. 11.7%), postpartum hemorrhage (1.5% vs. 8.3%), and dystocia (3.5% vs. 18.3%) were significantly lower in the intervention group (P < 0.05). There was no statistically significant difference in the rate of manual placental removal (5.5% vs. 13.3%, P = 0.07).*
Conclusion: *Continuity of care is associated with improved delivery outcomes in pregnant women with GDM and demonstrates strong potential for clinical application in perinatal management.*

1. Introduction

Gestational diabetes mellitus (GDM) is a common metabolic disorder that arises during pregnancy and, if inadequately managed, can pose significant risks to both maternal and neonatal health [1–4]. Uncontrolled GDM has been linked to complications such as dystocia, postpartum hemorrhage, preterm labor, macrosomia, and long-term metabolic disorders in both mothers and offspring. In current clinical practice, standard care for patients with GDM primarily emphasizes in-hospital monitoring and education during routine antenatal visits. However, this conventional model often lacks continuity and does not adequately address the comprehensive needs of GDM patients beyond the hospital setting.

Continuity of care is an emerging, patient-centered approach that integrates hospital-based services with community-based support throughout the entire perinatal period. This model includes extended monitoring, personalized education, and interdisciplinary collaboration beyond hospital discharge. While continuity of care has been well established in the management of chronic conditions such

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as hypertension and type 2 diabetes, its application in GDM care remains underexplored—particularly in real-world clinical settings. This study aims to assess the effect of continuity of care on maternal delivery outcomes in patients with GDM using a non-concurrent controlled design.

2. The first page

2.1. Study Design and Participants

This study adopted a non-concurrent controlled design and was conducted in the obstetrics and endocrinology outpatient departments of a tertiary general hospital in Hubei Province, China. A total of 260 pregnant women diagnosed with gestational diabetes mellitus (GDM) were enrolled and assigned to two groups based on their time of admission. The control group (n = 60) consisted of patients who received routine prenatal care between September 2020 and September 2021, while the intervention group (n = 200) included patients who received continuity of care between October 2021 and June 2023.

The inclusion criteria were as follows: (1) diagnosis of GDM confirmed by an oral glucose tolerance test (OGTT), based on the criteria established by the International Association of Diabetes and Pregnancy Study Groups (IADPSG); (2) singleton pregnancy; (3) gestational age between 24 and 31 weeks at the time of enrollment to ensure a minimum six-week intervention period; (4) capacity for self-care and participation in follow-up visits; and (5) absence of major psychiatric disorders or infectious diseases. Exclusion criteria included a history of in vitro fertilization, coexisting pregnancy-induced hypertension, or severe hepatic or renal impairment.

Baseline demographic and clinical characteristics—such as maternal age, educational level, and parity—were collected at enrollment. As shown in Table 1, no statistically significant differences were observed between the two groups ($P > 0.05$), indicating baseline comparability.

2.2. Intervention Measures

The intervention group received a comprehensive continuity of care program designed and implemented by a multidisciplinary team [5–12], comprising obstetricians, endocrinologists, nurses, nutritionists, and psychological counselors. The intervention was delivered from the time of GDM diagnosis through one week postpartum, incorporating both in-person and digital components [13–16].

The core components of the intervention included:

- **Dietary Intervention:** Individualized dietary plans were developed based on each patient's body mass index (BMI), gestational age, and glycemic profile. Educational materials and food models were used to enhance understanding of nutritional balance, glycemic control, and gestational weight management.
- **Medical Exercise Therapy:** Moderate-intensity aerobic exercises—such as walking and prenatal yoga—were recommended. Instruction was provided through group classes and video demonstrations, with exercise regimens tailored to each patient's physical condition and gestational stage.
- **Psychological Support:** Mental health status was monitored using validated psychological scales. Health educators provided counseling, stress-reduction techniques, and peer support via group chats to enhance emotional resilience and address patient concerns.
- **Online Education and Communication:** Weekly health information and disease-related updates were disseminated via WeChat public accounts. Dedicated group chats facilitated real-time communication, question-and-answer sessions, and peer interaction.
- **Antenatal Education:** Weekly in-person sessions at the hospital's "maternity school" covered topics including pregnancy nutrition, labor preparation, breastfeeding, and newborn care.
- **Self-Management Training:** Patients received instruction on self-monitoring of blood glucose and insulin administration. Individualized management plans were developed to improve treatment adherence and self-efficacy.
- **Follow-up Mechanism:** Follow-up contacts were conducted bi-weekly through phone calls, text messages, or home visits. Continuity of care was maintained by ensuring consistent engagement with the same healthcare team.

In contrast, patients in the control group received standard care according to hospital protocols, which included in-hospital nutritional counseling, routine blood glucose monitoring, and general antenatal education.

Details of the intervention schedule and content modules are presented in Supplementary Tables 1.1 and 1.2.

2.3. Outcome Measures

The primary measures were maternal delivery indicators, including:

- Vaginal delivery rate
- Incidence of pelvic adhesions
- Premature rupture of membranes
- Postpartum hemorrhage
- Dystocia
- Manual removal of the placenta

All outcome data were retrospectively extracted from hospital medical records and verified by trained research staff to ensure consistency and accuracy.

2.4. Statistical Analysis

Data entry was performed using Microsoft Excel 2016, and statistical analyses were conducted using STATA version 18.0. Categorical variables were presented as frequencies and percentages, and group differences were assessed using the Chi-square (χ^2) test. Continuous variables were first evaluated for normality. Variables with a normal distribution were expressed as mean ± standard deviation (SD) and compared using independent sample *t*-tests. Non-normally distributed variables were reported as median (P25, P75) and analyzed using the Wilcoxon rank-sum test. A two-sided *P*-value < 0.05 was considered statistically significant.

3. Results

3.1. Baseline Characteristics

Baseline demographic and obstetric characteristics of participants in the control and intervention groups are summarized in Table 1. No statistically significant differences were observed between the two groups in maternal age (30.32 ± 3.86 vs. 30.76 ± 4.16 years, P = 0.259), educational level (P = 0.44), or parity (P = 0.14). Specifically, the proportion of women with a college education or higher was slightly greater in the intervention group (59.0%) compared to the control group (53.33%). Conversely, the proportion of primiparous women was slightly lower in the intervention group (52.5% vs. 63.33%). However, these differences did not reach statistical significance.

These findings suggest that the two groups were comparable at baseline, thereby minimizing potential confounding effects from demographic or obstetric variables. This comparability strengthens the internal validity of the study and supports the attribution of observed differences in delivery outcomes to the continuity of care intervention.

3.2. Maternal Delivery Outcomes

As shown in Table 2, the intervention group demonstrated significantly better delivery outcomes compared to the control group. The vaginal delivery rate was notably higher in the intervention group (44.5%) than in the control group (28.3%) ($P = 0.02$). The incidence of pelvic adhesions was significantly lower in the intervention group (5.5%) compared to the control group (28.3%) ($P < 0.001$). Similarly, the intervention group showed reduced rates of premature rupture of membranes (2.0% vs. 11.7%, $P < 0.001$), postpartum hemorrhage (1.5% vs. 8.3%, $P = 0.018$), and dystocia (3.5% vs. 18.3%, $P < 0.001$).

Although the rate of manual removal of the placenta was lower in the intervention group (5.5%) than in the control group (13.3%), this difference did not reach statistical significance ($P = 0.070$).

Additionally, as presented in Table 3, the median volume of postpartum blood loss was significantly lower in the intervention group [150 mL (P25, P75: 50, 600)] than in the control group [200 mL (P25, P75: 50, 1000)] ($P = 0.015$).

These findings indicate that the continuity of care intervention is effective in reducing adverse delivery outcomes and enhancing maternal safety in patients with GDM.

4. Discussion

This study demonstrates that implementing a structured continuity of care model significantly improves maternal delivery outcomes among women diagnosed with gestational diabetes mellitus (GDM). Compared with routine care, the intervention was associated with a notably higher rate of vaginal delivery and a lower incidence of key obstetric complications, including pelvic adhesions, premature rupture of membranes, postpartum hemorrhage, and dystocia. These findings are consistent with previous studies suggesting that comprehensive prenatal care interventions can positively influence maternal health outcomes.

The improvement in vaginal delivery rates observed in the intervention group may be largely attributable to improved glycemic control achieved through individualized dietary and exercise guidance [7,8]. Numerous studies have established that maintaining maternal blood glucose within target ranges reduces the risk of macrosomia and associated complications, which frequently necessitate cesarean section. Additionally, the structured physical activity plans and self-monitoring strategies likely enhanced patients' engagement in consistent health behaviors, contributing to greater metabolic stability throughout pregnancy.

The incorporation of psychological support—via counseling, emotional reassurance, and peer group interactions—may have also contributed to the observed reduction in dystocia rates [11]. Psychological distress during pregnancy and labor is a known risk factor for uterine inertia and dysfunctional labor. By addressing maternal emotional well-being, the intervention may have supported a more physiologically favorable labor process.

Interestingly, the rate of manual removal of the placenta did not differ significantly between the two groups. This finding suggests that while continuity of care effectively addresses functional obstetric complications, its influence on anatomical or structural abnormalities—such as placenta accreta or adhesions from previous uterine interventions—may be limited. Future iterations of continuity care programs could benefit from incorporating early risk stratification tools, including ultrasound-based assessments for abnormal placentation, into prenatal care planning [17].

In summary, the favorable outcomes observed in this study underscore the value of integrated, multidisciplinary approaches in the management of GDM. A proactive care model that extends beyond the hospital setting and into patients' daily lives can yield meaningful improvements in delivery safety and maternal health.

5. Limitations

Despite the encouraging findings, this study has several limitations that warrant consideration. First, the non-concurrent design and single-center setting in a tertiary hospital may limit the generalizability of the results, particularly to rural or resource-limited healthcare environments. Although standardized protocols and consistent staff structures were maintained across time periods, unmeasured confounding variables—such as provider–patient communication quality or seasonal variations in healthcare access—may have influenced outcomes.

Second, the study evaluated only short-term maternal outcomes up to one week postpartum [4]. Long-term maternal indicators—such as postpartum glucose tolerance, risk of progression to type 2 diabetes, and weight retention—as well as neonatal outcomes, including early growth trajectories and metabolic profiles, were not assessed. Future longitudinal studies are needed to explore the sustained impact of continuity of care beyond the immediate postpartum period.

Third, although the continuity of care model was comprehensive and implemented in a real-world clinical context, no cost-effectiveness analysis was conducted. In light of growing demands on healthcare resources, future research should incorporate economic evaluations to assess the scalability and feasibility of broader implementation [10].

6. Conclusion

In conclusion, the integration of continuity of care into the management of gestational diabetes mellitus significantly improves maternal delivery outcomes, including higher rates of vaginal delivery and lower incidences of obstetric complications. These benefits are likely attributable to improved self-management, enhanced emotional support, and effective interdisciplinary collaboration enabled by the structured intervention.

Given its patient-centered design, systematic implementation, and potential adaptability across diverse healthcare settings, continuity of care represents a valuable addition to existing GDM management protocols. Its incorporation may be particularly impactful in maternal health systems striving to reduce perinatal morbidity and enhance the quality of prenatal care.

Future multicenter studies with extended follow-up durations and formal cost-effectiveness analyses are warranted to validate these findings and inform evidence-based recommendations for broader policy and clinical adoption.

Author Contribution

Feifei Chen is the first and corresponding author of this manuscript and was responsible for the conceptualization, literature review, manuscript drafting, and final approval of the article.

Chengwen Song, a doctoral candidate in Public Administration at Kookmin University, South Korea, contributed primarily to data analysis and interpretation.

Compliance with Ethical Standards

Ethical Approval: This study was reviewed and approved by the Institutional Ethics Committee of a tertiary hospital in Hubei Province, China (Approval No. KY-2023091604). All procedures were performed in accordance with the ethical standards of the institutional and national research committees and with the principles of the Declaration of Helsinki (as revised in 2013).

Informed Consent: The requirement for written informed consent was waived by the ethics committee due to the retrospective design and the use of anonymized patient data.

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Competing Interest declaration

The authors declare that they have no conflict of interest.

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Appendix Table

Table 1. Comparison of Baseline Characteristics of Pregnant Women in the Two Groups (n = 260)

Characteristic	Control Group (n = 60)	Intervention Group (n = 200)	t/χ^2	P value
Age (years, mean ± SD)	30.32 ± 3.86	30.76 ± 4.16	0.518	0.259
Educational Level			0.61	0.44
College and above	32 (53.33%)	118 (59.00%)		
High school or below	28 (46.67%)	82 (41.00%)		
Parity			2.19	0.14
Primipara	38 (63.33%)	105 (52.50%)		
Multipara	22 (36.67%)	95 (47.50%)		

Table 2. Comparison of Maternal Delivery Outcomes Between the Two Groups (n = 260)

Outcome	Control Group (n = 60)	Intervention Group (n = 200)	χ^2	P value
Vaginal delivery			4.99	0.020
Yes	17 (28.3%)	89 (44.5%)		
No	43 (71.7%)	111 (55.5%)		
Pelvic adhesions			25.04	<0.001
Yes	17 (28.3%)	11 (5.5%)		
No	43 (71.7%)	189 (94.5%)		
Premature rupture of membranes			8.39	<0.001
Yes	7 (11.7%)	4 (2.0%)		
No	53 (88.3%)	196 (98.0%)		
Postpartum hemorrhage			5.15	0.018
Yes	5 (8.3%)	3 (1.5%)		
No	55 (91.7%)	197 (98.5%)		
Dystocia			13.54	<0.001
Yes	11 (18.3%)	7 (3.5%)		
No	49 (81.7%)	193 (96.5%)		
Manual removal of placenta			3.11	0.070
Yes	8 (13.3%)	11 (5.5%)		

Outcome	Control Group (n = 60)	Intervention Group (n = 200)	χ^2	P value
No	52 (86.7%)	189 (94.5%)		

Table 3. Comparison of Postpartum Blood Loss Between the Two Groups (Median [M (P25, P75)])

Variable	Control Group (n = 60)	Intervention Group (n = 200)	Z value	P value
Postpartum blood loss (mL) Median (P25, P75)	200 (50, 1000)	150 (50, 600)	-1.45	0.015

Supplementary Table 1.1. Frequency and Modes of Intervention in the Continuity of Care Program

Intervention Type	Delivery Mode	Description	Frequency	Minimum Sessions
Online	WeChat Public Account	Weekly posts of two health education tips	Once per week	≥10
	Dietary Counseling	Personalized meal plans and food diary review	Once per week	
	WeChat Groups	Q&A and peer experience sharing	Twice per week	
	Follow-up	SMS, email, and phone consultations	Every two weeks	≥4
Offline	Maternity School	In-person group classes on prenatal topics	Once per week	≥6
	Medical Exercise	Aerobic exercise sessions (e.g., walking, yoga)	Twice per week	≥12

Supplementary Table 1.2. Components of the Continuity of Care Intervention Program

Module	Description
Dietary Intervention	Personalized meal plans were developed based on blood glucose levels and BMI, guided by registered dietitians and diabetes nurses. Patients received dietary handbooks and food models demonstrating the food exchange method. Nutritional targets followed ADA guidelines: 50–60% carbs, 15–20% protein, 25–30% fat. Energy intake was set at 24–30 kcal/kg/day, with three meals and three snacks. Adjustments were made based on food diaries and glucose fluctuations.
Medical Exercise Therapy	(1) Pre-pregnancy activity levels were assessed; patients received exercise manuals and group instruction led by sports medicine experts. (2) Recommended exercises included aerobic (e.g., walking, swimming) and resistance training (e.g., yoga, dumbbells). (3) Patients were educated to monitor exertion levels and recognize warning signs. (4) Exercise plans were customized based on prior activity habits and pregnancy risk status.
Psychological Support	Support was delivered via videos, group chats, and counseling. Content included GDM education, cognitive restructuring, peer sharing, and guided emotional expression. Patients were encouraged to use music therapy, mindfulness, and receive family support. Weekly messages were sent via WeChat to reinforce education and correct misconceptions.
Online Care	A WeChat public account was established to deliver weekly health updates (e.g., GDM knowledge, cooking videos, insulin injection techniques). Patients could engage at any time. Feedback was collected biweekly to update content. WeChat groups facilitated Q&A, experience sharing, and daily self-care discussions.
Offline Follow-up	Follow-ups were conducted via phone calls and through "Internet + Nursing" platforms. Calls allowed individualized feedback, while app-based systems enabled real-time tracking. Community-based follow-up was also piloted, though infrastructure remains under development in local clinics.
Maternity School	Weekly in-hospital group classes (Tues/Thurs, 1 hour) were led by senior obstetricians and head nurses. Topics included prenatal care, nutrition, postpartum recovery, breastfeeding, and newborn care. Multimedia tools (video, audio, text, images) were used. Participation was voluntary, and patients could select sessions based on their gestational stage and availability.
Self-Management Guidance	Skills training included use of glucometers and insulin injection. Patients were guided to set achievable goals, maintain blood glucose diaries, and analyze results with the care team. Personalized plans were developed for diet, exercise, and monitoring routines. Progress was reinforced through positive feedback to enhance confidence and adherence.