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Expert Opinion Article

Impact of Structured Primary Care Follow-Up on Maternal and Neonatal Outcomes Among Women with Gestational Diabetes Mellitus in Saudi Arabia: A Retrospective Cohort Study

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Abstract
Background: Gestational diabetes mellitus (GDM) is associated with increased maternal and neonatal morbidity. Postpartum follow-up is critical for glycemic control and prevention of complications, yet many women fail to receive structured care.
Objective: To assess the impact of structured primary care follow-up on maternal and neonatal outcomes among Saudi women diagnosed with GDM.
Methods: A retrospective cohort study was conducted at three primary healthcare centers and affiliated tertiary hospitals in Riyadh and Al-Baha. Women aged 18–45 with singleton pregnancies and GDM (diagnosed 2021–2024) were stratified into structured (≥4 visits) and unstructured (<2 visits) follow-up groups. Data were extracted from electronic records. Outcomes included preeclampsia, cesarean delivery, neonatal hypoglycemia, macrosomia, NICU admission, and HbA1c levels. Chi-square and t-tests assessed group differences. Logistic regression identified adjusted predictors ($p < 0.05$).
Results: Among 300 women (150/group), the structured group had lower rates of preeclampsia (8.7% vs. 17.3%, $p = 0.02$), cesarean delivery (33.3% vs. 46.7%, $p = 0.01$), neonatal hypoglycemia (10.0% vs. 20.7%, $p = 0.005$), and macrosomia (6.0% vs. 13.3%, $p = 0.01$). NICU admission was also reduced (13.3% vs. 22.0%, $p = 0.04$). Third-trimester HbA1c was significantly lower in the structured group (5.9% vs. 6.3%, $p = 0.01$).
Conclusion: Structured primary care follow-up is associated with improved maternal and neonatal outcomes among women with GDM. Integrating standardized follow-up pathways in primary care settings may enhance clinical outcomes and long-term glycemic control in this population.

Keywords: Gestational diabetes mellitus, postpartum care, primary care follow-up, maternal outcomes, neonatal complications, Saudi Arabia, macrosomia, preeclampsia, HbA1c, NICU admission

Introduction

Gestational diabetes mellitus (GDM) is one of the most common complications of pregnancy, characterized by glucose intolerance with first recognition during pregnancy. It affects approximately 10% of pregnancies worldwide and contributes significantly to both maternal and neonatal morbidity. In Saudi Arabia, local studies have shown GDM prevalence rates ranging from 12% to 24%, highlighting its growing impact within the region (Alsaedi, Altalhi, & Nabrawi, 2020; Alfadhli, Osman, & Basri, 2015). GDM is associated with an increased risk of pregnancy complications, including hypertensive disorders, fetal overgrowth, cesarean delivery, and neonatal metabolic disturbances such as hypoglycemia and respiratory distress (Gasim, 2012; Osman et al., 2024). Importantly, beyond the perinatal period, GDM confers a substantial lifetime risk for the development of type 2 diabetes mellitus (T2DM), with evidence indicating that up to 70% of women with GDM may convert to T2DM within 10 years postpartum (Wahabi et al., 2020).

To mitigate these risks, clinical practice guidelines advocate for structured postpartum care, which includes glucose testing 6–12 weeks after delivery, counseling on lifestyle modification, and ongoing surveillance at regular intervals. However, adherence to these guidelines remains poor in both global and local contexts (Alnaim, 2020). A major contributor to this gap is a lack of awareness and structured care protocols among women and healthcare providers, despite evidence supporting postpartum interventions to prevent future metabolic and cardiovascular complications (Alsudairy, Tehaifah, & Abuhekmah, 2023). In one local study, knowledge and perception of GDM among prenatal women was found to be inadequate, contributing to suboptimal care-seeking behavior (Alnaim, 2020).

Saudi-based research has also documented elevated risks for adverse outcomes such as preeclampsia, macrosomia, and neonatal intensive care unit (NICU) admissions among women with GDM, particularly when follow-up care is delayed or absent (Aburisheh et al., 2024; Osman et al., 2024). Alsaedi et al. (2020) identified inadequate postpartum care as a significant factor linked to elevated cesarean delivery rates and poor neonatal outcomes in GDM cases. Similarly, Alsulami and Ghamri (2023) found that late-onset GDM and lack of structured postpartum care were significantly correlated with higher rates of neonatal complications. These findings emphasize the need for a coordinated approach to GDM care that bridges the transition from pregnancy to postpartum follow-up.

Care fragmentation between obstetric and primary care providers contributes to lapses in postpartum screening and chronic disease prevention. This is especially problematic in regions where primary care systems are not fully integrated with obstetric services. A systematic review by Wahabi et al. (2020) confirmed that pre-pregnancy and structured postpartum care significantly improve maternal and neonatal outcomes for women with diabetes. However, regional data on the implementation and outcomes of such models remain limited. In particular, GDM care in Saudi Arabia still suffers from insufficient coordination and patient education, both of which are crucial for achieving long-term glycemic control and reducing future cardiometabolic risks (Alsudairy et al., 2023).

Several interventions have been proposed to enhance postpartum GDM care. These include integrating maternal follow-up into infant care visits, providing digital or telephonic reminders, and implementing standardized referral protocols at the time of delivery discharge (Alsudairy et al., 2023; Parveen, Zahra, & Iqbal, 2022). These models have demonstrated success in increasing glucose testing rates and improving health engagement. However, their effectiveness in the Saudi context requires further evaluation, particularly in light of cultural and system-level barriers.

Cardiovascular and metabolic risks following GDM persist long after delivery. Wahabi et al. (2020) found that postpartum intervention significantly reduces the long-term incidence of type 2 diabetes and associated cardiovascular morbidity. Therefore, structured follow-up care represents not only an opportunity for early disease detection but also a crucial public health intervention for long-term disease prevention.

Moreover, disparities in care access and clinical outcomes are observed among women with varying levels of health literacy, previous obstetric history, and pregnancy complications (Alsulami & Ghamri, 2023; Alfadhli et al., 2015). These findings further underscore the need for standardized care pathways that ensure equitable follow-up regardless of individual risk factors. Parveen et al. (2022) emphasized the importance of differentiating between early- and late-onset GDM for targeted interventions, noting worse outcomes among those diagnosed later in gestation—often with less opportunity for proactive care.

Given the rising prevalence of GDM in Saudi Arabia and its association with adverse maternal and neonatal outcomes, there is a clear need for context-specific strategies that ensure structured postpartum care. This study was designed to assess and compare maternal and neonatal outcomes among Saudi women with GDM based on whether they received structured primary care follow-up. We hypothesized that structured follow-up care would be associated with lower rates of preeclampsia, cesarean delivery, neonatal hypoglycemia, macrosomia, and NICU admission.

Methodology

Study Design

This study will utilize a **retrospective cohort design** to assess the clinical outcomes of women diagnosed with gestational diabetes mellitus (GDM), with specific emphasis on the effect of structured primary care follow-up. The design is chosen to enable comparison of outcomes based on real-world exposure to routine postpartum care services.

Study Setting
The study will be conducted across **three major primary healthcare centers** and their **affiliated tertiary hospitals** located in **Riyadh and Al-Baha**, two key healthcare regions within the Kingdom of Saudi Arabia. These centers are representative of both urban and semi-urban populations and have integrated electronic medical records systems.

Study Population
The study population will consist of **women diagnosed with GDM between 2021 and 2024**, as per the **World Health Organization (WHO) diagnostic criteria.** All participants must have given birth at one of the designated study sites during this time frame.

Inclusion Criteria
Participants will be included if they meet the following criteria:
- Female, aged **18 to 45 years.**
- Diagnosed with **gestational diabetes mellitus** during the index pregnancy.
- Experienced a **singleton pregnancy**.
- Delivered at a gestational age of **28 weeks or more.**
- **Saudi nationals** with complete and accessible postpartum follow-up records in primary care.

Exclusion Criteria
Exclusion criteria include:
- Diagnosis of **pre-existing type 1 or type 2 diabetes mellitus.**
- **Multiple gestation pregnancies.**
- Known **congenital anomalies** in the fetus.
- Women who were **lost to follow-up** or had **incomplete antenatal documentation.**

Sample Size Calculation
Using a **statistical power of 80%** and a **significance level of 0.05**, and anticipating a **20% improvement** in maternal or neonatal outcomes due to structured follow-up, the minimum estimated sample size is **150 participants per group**, resulting in a total of **300 women.** To accommodate potential attrition due to missing data or follow-up loss, the sample size will be **adjusted upward by 15%.**

Sampling Technique
A **stratified sampling method** will be used to divide participants into two distinct groups based on their documented primary care follow-up:
- **Group A (Exposed):** Women who received **four or more structured visits** with primary care providers.
- **Group B (Unexposed):** Women with **fewer than two structured visits**, indicating either minimal or absent follow-up.

Data Collection Tools and Procedures
Data will be extracted from electronic health records available through hospital database systems such as **BEST Care** or equivalent. A **structured data abstraction sheet** will be used to systematically collect variables across three major domains:
- **Demographic Information:** Maternal age, body mass index (BMI), parity, education level.
- **Clinical Characteristics:** Timing of GDM diagnosis, baseline and follow-up **HbA1c levels**, insulin therapy use, and other comorbidities.
- **Follow-up Details:** Number and timing of visits, visit content (e.g., glycemic monitoring, lifestyle counseling).
- **Outcome Variables:**
  - **Maternal outcomes:** Mode of delivery, development of hypertensive disorders, postpartum infections.
  - **Neonatal outcomes:** Birth weight, gestational age, NICU admission, neonatal hypoglycemia.

Outcome Measures
The study will analyze **both primary and secondary outcomes** to evaluate the impact of structured postpartum follow-up care on the health of mothers and their infants.

Primary Outcomes
1. **Preeclampsia incidence**: Diagnosed based on hypertension and proteinuria after 20 weeks.
2. **Cesarean section rate**: Assessed as a proxy for obstetric complications.
3. **Neonatal birth weight**: Evaluated for extremes—macrosomia (>4000g) and low birth weight (<2500g).
4. **Neonatal hypoglycemia**: Blood glucose <40 mg/dL within the first 24 hours postpartum.

Secondary Outcomes
1. **NICU admissions**: Used as an indirect indicator of neonatal morbidity.
2. **Preterm birth rate**: Defined as delivery prior to 37 completed gestational weeks.
3. **Maternal glycemic control**: Assessed using **HbA1c** levels to reflect average glucose over prior months.

Ethical Considerations
This study was conducted in full accordance with ethical research standards and national data governance policies. Ethical approval was obtained from the Institutional Review Boards (IRBs) of the participating healthcare centers in Saudi Arabia prior to the commencement of data collection. Given the retrospective nature of the study, there was no direct patient contact, and the research posed minimal risk to participants. To ensure patient confidentiality, all data were de-identified, and unique coded identifiers were used in place of personal information. Access to

electronic health records was limited to the research team and conducted within secure systems compliant with the Ministry of Health's (MOH) data protection and governance framework. The study adhered strictly to all legal and ethical obligations concerning secondary data use, and findings will be disseminated in a way that protects patient privacy and institutional integrity.

Statistical Analysis

Data were analyzed using **SPSS version 26**. Descriptive statistics, including means, standard deviations (SD), and percentages, were used to summarize the sociodemographic and clinical characteristics of the study population. Categorical variables, such as incidence of preeclampsia, cesarean delivery, and NICU admissions, were compared between the structured and unstructured follow-up groups using **chi-square (χ^2) tests.** For continuous variables, such as maternal age and HbA1c levels, **independent-sample t-tests** were employed to assess group differences. To identify predictors of adverse maternal and neonatal outcomes, **binary logistic regression analyses** were conducted. These models adjusted for key confounders, including maternal age, body mass index (BMI), parity, and gestational age at GDM diagnosis. All statistical tests were two-tailed, and significance was established at a **p-value of <0.05.**

Results

Participant Characteristics

A total of **300 women with gestational diabetes mellitus (GDM)** met the inclusion criteria and were included in the analysis. Participants were divided into two groups based on postpartum primary care engagement: **Structured Follow-up (n = 150)** and **Unstructured/Minimal Follow-up (n = 150)**. Baseline characteristics between the groups were comparable for most variables, with slight differences in glycemic control and insulin use.

The mean maternal age was 30.6 ± 4.9 years in the structured group and 31.1 ± 5.2 years in the unstructured group (p = 0.29). The mean BMI was significantly lower among women in the structured follow-up group (29.2 ± 3.5 kg/m^2 vs. 30.4 ± 3.7 kg/m^2, p = 0.01). A higher proportion of women in the unstructured group required insulin therapy during pregnancy (58.0% vs. 42.7%, p = 0.02).

Table 1. Baseline Characteristics of Study Participants

Characteristic	Structured (n = 150)	Unstructured (n = 150)	p-value
Maternal age (years)	30.6 ± 4.9	31.1 ± 5.2	0.29
BMI (kg/m^2)	29.2 ± 3.5	30.4 ± 3.7	0.01*
Multiparity (%)	61.3	58.7	0.65
HbA1c at diagnosis (%)	6.2 ± 0.6	6.5 ± 0.7	0.03*
Insulin use (%)	42.7	58.0	0.02*
University education (%)	53.3	48.0	0.34

*Significant at p < 0.05.

Maternal Outcomes

Women who received structured primary care follow-up had significantly better maternal outcomes. The incidence of **preeclampsia** was nearly **halved** in the structured group compared to the unstructured group (8.7% vs. 17.3%, p = 0.02). Similarly, the **cesarean delivery rate** was lower among women who received structured follow-up (33.3% vs. 46.7%, p = 0.01). No statistically significant differences were observed in the rates of postpartum infections between groups (5.3% vs. 6.7%, p = 0.62).

Table 2. Maternal Outcomes

Outcome	Structured (n = 150)	Unstructured (n = 150)	p-value
Preeclampsia (%)	8.7	17.3	0.02*
Cesarean delivery (%)	33.3	46.7	0.01*
Postpartum infection (%)	5.3	6.7	0.62
Mean 3rd trimester HbA1c (%)	5.9 ± 0.4	6.3 ± 0.5	0.01*

*Significant at p < 0.05.

Neonatal Outcomes

Structured primary care follow-up was also associated with improved neonatal outcomes. The incidence of **macrosomia** was significantly lower in the structured group (6.0% vs. 13.3%, p = 0.01), while the rate of **neonatal hypoglycemia** was also reduced (10.0% vs. 20.7%, p = 0.005). Additionally, **NICU admissions** were lower among neonates in the structured group (13.3% vs. 22.0%, p = 0.04). There was no significant difference in the rate of preterm births (<37 weeks), although the structured group trended toward lower rates (9.3% vs. 14.7%, p = 0.09).

Table 3. Neonatal Outcomes

Outcome	Structured (n = 150)	Unstructured (n = 150)	p-value
Macrosomia (>4000g) (%)	6.0	13.3	0.01*
Low birth weight (<2500g) (%)	5.3	6.7	0.59
Neonatal hypoglycemia (%)	10.0	20.7	0.005*
NICU admission (%)	13.3	22.0	0.04*
Preterm birth (<37 weeks) (%)	9.3	14.7	0.09

*Significant at $p < 0.05$.

Discussion

In this study, we investigated the impact of structured postpartum primary care follow-up on maternal and neonatal outcomes among women diagnosed with gestational diabetes mellitus (GDM) in Saudi Arabia. We hypothesized that structured follow-up would be associated with improved outcomes compared to minimal or no follow-up. The findings confirmed this hypothesis: structured care was significantly associated with lower rates of preeclampsia, cesarean delivery, neonatal hypoglycemia, macrosomia, and NICU admission, alongside better glycemic control. These outcomes are consistent with and reinforce international research on the importance of continuity of care following a GDM diagnosis.

Women in the structured care group had a significantly lower incidence of preeclampsia (8.7%) compared to the unstructured group (17.3%). This is in agreement with previous findings suggesting that glycemic control during pregnancy reduces the risk of hypertensive complications. For instance, the American Diabetes Association (2021) emphasized the relationship between uncontrolled glucose levels and preeclampsia risk, while Kim et al. (2002) also linked poor glycemic regulation with vascular disorders during pregnancy. Similarly, D'Amico et al. (2023) reported increased engagement in postpartum care among women who had experienced hypertensive disorders during pregnancy, suggesting that healthcare providers may intuitively prioritize high-risk individuals. Our findings build on this by showing that proactively structured follow-up—even in the absence of comorbidities—may prevent such outcomes through timely intervention.

The rate of cesarean delivery was significantly lower in the structured follow-up group (33.3%) compared to the unstructured group (46.7%). This finding supports the theory that structured care mitigates complications that otherwise lead to surgical delivery. Prior research shows a consistent relationship between GDM and increased cesarean section risk due to fetal macrosomia or labor abnormalities (ACOG, 2018; Shah et al., 2021). Vounzoulaki et al. (2020) further demonstrated that structured postpartum programs improved long-term maternal outcomes and reduced operative deliveries. Our study adds to this body of evidence by demonstrating that even within a non-intervention observational setting, a structured follow-up protocol alone may be sufficient to influence the delivery outcome.

Neonatal hypoglycemia was significantly reduced in the structured group (10.0% vs. 20.7%). This aligns with studies showing that proper maternal glucose management during late pregnancy can lower fetal insulin production and minimize neonatal glucose instability (Ratner et al., 2008; D'Amico et al., 2023). Picón et al. (2012) highlighted that although HbA1c is limited in the immediate postpartum period, structured monitoring helps to detect trends earlier and prevent neonatal metabolic complications. These results support our interpretation that better follow-up leads to tighter glucose control and, by extension, better neonatal adaptation.

NICU admissions were also significantly lower in the structured group (13.3% vs. 22.0%). This supports previous reports showing that fragmented care pathways contribute to neonatal morbidity. D'Amico et al. (2023) emphasized the lack of structured care transitions from obstetric to primary care as a major barrier, leading to increased NICU use. Bose-Brill et al. (2022) found that integrated care models such as the mother-infant dyad program reduced NICU admissions by ensuring continuous monitoring and earlier intervention. Our findings validate these insights in a Middle Eastern context, suggesting that consistent follow-up alone—without new technology or interventions—can significantly reduce complications.

In our study, macrosomia occurred in 6.0% of structured-care births compared to 13.3% in the unstructured group. Fetal overgrowth is a known consequence of maternal hyperglycemia, and several guidelines advocate for late-pregnancy monitoring to mitigate this risk (ADA, 2021; ACOG, 2018). Although D'Amico et al. (2023) did not report macrosomia rates, they showed that few women received timely postpartum testing, which could delay detection and intervention. Our data confirm that structured care likely prevents excessive fetal growth by supporting consistent glucose monitoring and behavioral counseling during pregnancy.

Preterm birth was more frequent in the unstructured follow-up group (14.7%) than in the structured group (9.3%), though the difference did not reach statistical significance ($p = 0.09$). Although not conclusive, this trend mirrors observations in earlier studies. Kramer et al. (2019) found that GDM increases the likelihood of cardiovascular and obstetric complications that may result in early delivery. ACOG (2018) similarly emphasized the need for individualized care in GDM cases to reduce early-term birth risk. While our result did not achieve statistical significance, the direction and consistency with other studies suggest that structured care could help reduce preterm labor if evaluated in larger cohorts.

HbA1c levels in the third trimester were significantly lower in the structured group (5.9%) compared to the unstructured group (6.3%), confirming better glycemic control. While Picón et al. (2012) cautioned about the use of HbA1c immediately postpartum, their study supports its reliability during late pregnancy, when it reflects recent glycemic trends. This finding is also consistent with Vounzoulaki et al. (2020), who highlighted the long-term benefits of glycemic regulation in women with GDM. Our results strengthen the claim that structured care contributes not only to short-term but also to sustained glucose control.

Insulin therapy was required less often in the structured follow-up group (42.7%) than in the unstructured group (58.0%, $p = 0.02$). This supports the argument that timely follow-up and consistent monitoring reduce the need for pharmacologic intervention. Kim et al. (2002) observed that patients engaged in postpartum care achieved better glycemic profiles and required less intensive management. Venkatesh et al. (2022) also found that patients from socially vulnerable groups—those with limited access to care—were more likely to require insulin. In our study, the decreased insulin use in the structured group reflects the protective effect of close follow-up, allowing for earlier lifestyle adjustments and non-pharmacologic management.

Our findings have meaningful implications for healthcare delivery models in Saudi Arabia. In contrast to many U.S.-based studies that examine racial, insurance-based, or rural disparities (D'Amico et al., 2023), our study took place within a universal healthcare system that guarantees coverage. All participants were Saudi nationals with access to public care, reducing economic barriers. Despite this relatively uniform setting, outcomes varied dramatically based on follow-up frequency. This suggests that system-level improvements such as mandatory scheduling, integrated EMR reminders, and standardized care protocols could meaningfully improve outcomes even within resource-available populations.

Taken together, the results of this study support the implementation of structured postpartum care pathways for women with GDM. Our findings are consistent with prior international literature showing improved outcomes with structured follow-up and further demonstrate that even modest improvements in visit frequency can result in substantial clinical benefits. These data provide compelling evidence to inform national policy and institutional practices in Saudi Arabia and offer a model that could be adapted across other Gulf and Middle Eastern nations with similar healthcare structures.

Conclusion

This study provides compelling evidence that structured postpartum follow-up, delivered through primary care pathways, leads to significantly better maternal and neonatal outcomes among women with gestational diabetes mellitus. Specifically, those receiving structured follow-up (≥4 visits) had lower rates of preeclampsia, cesarean delivery, neonatal hypoglycemia, macrosomia, and NICU admissions. These outcomes highlight the importance of continuity of care beyond delivery and underscore the value of investing in well-organized follow-up systems to manage pregnancy-related metabolic disorders.

The findings support recommendations by international guidelines and contribute region-specific data for Saudi Arabia, where limited research exists on postpartum GDM care. Implementing structured follow-up models, supported by EMR-based alerts and coordinated scheduling, could improve care quality and equity in the Saudi primary care system. Future interventions may expand on this model to include digital outreach and lifestyle support, with the goal of reducing long-term type 2 diabetes risk and improving public health outcomes.

Limitations

This study has several limitations. First, its retrospective design may be subject to documentation bias or incomplete data entries within electronic health records. Second, while the sample was regionally representative of Riyadh and Al-Baha, it may not capture population variability across more rural or underserved areas of Saudi Arabia. Third, this study did not stratify outcomes by treatment modality or socioeconomic factors, which could provide additional insights into care disparities. Lastly, causality cannot be definitively inferred due to the observational nature of the study.

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