Maternal and Perinatal Outcomes in Pregnancies Complicated by Gestational Diabetes Mellitus: A Hospital-Based Cross-Sectional Study

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Abstract

Background: Gestational diabetes mellitus (GDM) is among the commonest medical disorders complicating pregnancy and is associated with a spectrum of adverse maternal and perinatal outcomes. The burden of GDM is rising rapidly in South Asia, yet contemporary hospital-based profiles from tertiary care settings in South India remain limited.

Objectives: To describe the sociodemographic and clinical characteristics, glycaemic profile, treatment modalities, and maternal and perinatal outcomes among women with GDM managed at a tertiary care teaching hospital.

Methods: This was a hospital-based, cross-sectional, STROBE-compliant study of 260 pregnant women diagnosed with GDM at SLIMS, Pondicherry. Sociodemographic, glycaemic, treatment, and outcome variables were recorded using a structured proforma. Data were summarised using descriptive statistics; continuous variables are expressed as mean ± standard deviation and categorical variables as frequencies and percentages.

Results: The mean maternal age was 29.5 ± 6.2 years and mean pre-pregnancy body mass index (BMI) was 28.1 ± 4.6 kg/m². A family history of diabetes was present in 74 (28.5%) and previous GDM in 29 (11.2%). Medical nutrition therapy (MNT) alone controlled 109 (41.9%) women, while 83 (31.9%) required insulin. Good glycaemic control at term was achieved in 153 (58.8%). The total caesarean rate was 137 (52.7%). Gestational hypertension complicated 34 (13.1%) pregnancies. Neonatal outcomes included preterm birth in 36 (13.8%), neonatal hypoglycaemia in 32 (12.3%), macrosomia in 11 (4.2%), and NICU admission in 58 (22.3%). Perinatal mortality was 8 (3.1%).

Conclusion: In this cohort, GDM was associated with a high caesarean rate and appreciable maternal and neonatal morbidity, underscoring the value of early diagnosis, structured glycaemic management, and neonatal surveillance.

Keywords: Gestational diabetes mellitus; pregnancy outcome; perinatal outcome; caesarean section; glycaemic control; South India

Introduction

Gestational diabetes mellitus (GDM), defined as carbohydrate intolerance of variable severity with onset or first recognition during pregnancy, has emerged as one of the most frequent metabolic complications of pregnancy worldwide. Its prevalence has risen in parallel with the global epidemic of obesity, sedentary lifestyle, and delayed childbearing, and the increase has

been especially steep across South and Southeast Asia. Indian women appear to carry a disproportionately high risk of GDM relative to Western populations, attributable to a distinct "thin–fat" phenotype, greater central adiposity at any given body mass index (BMI), and a strong familial predisposition to type 2 diabetes. In tertiary care centres across India, reported prevalence has frequently exceeded 10–15%, placing a substantial burden on obstetric and neonatal services[1].

The clinical importance of GDM lies in its well-documented association with a broad spectrum of adverse maternal and perinatal outcomes. A large systematic review and meta-analysis confirmed that GDM independently increases the risk of caesarean delivery, hypertensive disorders of pregnancy, preterm birth, macrosomia, neonatal hypoglycaemia, and admission to neonatal intensive care. These risks are mediated principally by maternal hyperglycaemia, which drives fetal hyperinsulinaemia, accelerated fetal growth, and disordered neonatal metabolic adaptation. Pre-pregnancy overweight and excessive gestational weight gain act as important effect modifiers, compounding the metabolic risk conferred by hyperglycaemia alone. Early-onset GDM, recognised before the conventional window of 24–28 weeks, has been linked to a more adverse metabolic milieu and less favourable neonatal outcomes, suggesting that both the severity and the timing of glucose intolerance matter[2].

Beyond the immediate perinatal period, GDM signals lasting risk. Affected women face a markedly elevated lifetime probability of type 2 diabetes and cardiovascular disease, while their offspring are predisposed to childhood obesity and glucose intolerance, perpetuating an intergenerational cycle of metabolic disease. Coexisting endocrine disturbances, including thyroid dysfunction and autoimmunity, are more prevalent among pregnant women with diabetes and may further modulate maternal and fetal risk. This constellation of short- and long-term consequences makes GDM a priority for antenatal screening, timely diagnosis, and structured management[3].

The therapeutic landscape of GDM has evolved considerably. Medical nutrition therapy (MNT) and physical activity remain the cornerstone of initial management, achieving adequate glycaemic control in a substantial proportion of women.[2] When lifestyle measures are insufficient, pharmacotherapy is indicated. Insulin has traditionally been the gold standard because it does not cross the placenta, but metformin has gained acceptance as a convenient oral alternative with comparable glycaemic and obstetric outcomes in several randomised trials. The randomised evidence on early initiation of metformin and on head-to-head comparison of metformin with insulin has helped refine treatment algorithms, although questions regarding long-term offspring outcomes persist. Selection of treatment modality in routine practice is influenced by the degree of hyperglycaemia, gestational age at diagnosis, patient preference, and local resources, and the distribution of modalities and their associated outcomes vary across settings[4].

Despite a growing literature, contemporary, granular descriptions of the maternal and perinatal outcome profile of GDM from tertiary teaching hospitals in South India remain relatively sparse, and outcomes reported across regional and international cohorts are heterogeneous. Recurrent GDM, in particular, has been associated with distinct maternal and neonatal risk trajectories that merit local characterisation. Macrosomia, one of the most clinically consequential fetal outcomes of maternal diabetes, shows wide variation in reported frequency and predictors between populations, reflecting differences in glycaemic control, obstetric practice, and background

nutrition. Documenting the local outcome profile is therefore essential to benchmark quality of care, inform counselling, and guide service planning[5].

Against this background, the present hospital-based cross-sectional study was undertaken to describe the sociodemographic and clinical characteristics, glycaemic profile, treatment modalities, and maternal and perinatal outcomes among women with GDM managed at a tertiary care teaching hospital in South India.

Methods

Study design and setting

This was a hospital-based, cross-sectional study conducted in the Department of Obstetrics and Gynaecology, SLIMS, Pondicherry. The study was designed and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations for cross-sectional studies[6].

Study population and eligibility

The study population comprised 260 pregnant women diagnosed with GDM. Eligible participants were pregnant women with a confirmed diagnosis of GDM according to standard diagnostic criteria, receiving antenatal care and delivering at the study institution. Women with pre-gestational (overt) diabetes mellitus diagnosed before pregnancy, multiple gestation, and those with incomplete outcome data would be excluded[7].

Diagnosis and clinical management

GDM was defined as carbohydrate intolerance first recognised during pregnancy on the basis of an oral glucose tolerance test, consistent with contemporary diagnostic standards. Following diagnosis, women were managed according to institutional protocol, beginning with medical nutrition therapy (MNT) and physical activity counselling. Pharmacotherapy with metformin, insulin, or their combination was initiated when glycaemic targets were not achieved with lifestyle measures alone, guided by the degree of hyperglycaemia, gestational age, and clinical judgement. Antenatal surveillance, timing, and mode of delivery followed standard obstetric practice[8].

Data collection and variables

Data were captured using a structured proforma. Recorded variables included sociodemographic characteristics (maternal age, urban or rural residence, booking status), obstetric and clinical history (previous GDM, family history of diabetes, pre-pregnancy BMI, gestational age at GDM diagnosis), the glycaemic profile (fasting plasma glucose, 2-hour postprandial glucose, and glycated haemoglobin [HbA1c]), treatment modality, and the adequacy of glycaemic control at term. Maternal outcomes comprised antenatal complications (gestational hypertension, polyhydramnios), mode of delivery, maternal complications during treatment and delivery, and maternal intensive care unit (ICU) admission. Neonatal and perinatal outcomes comprised birth weight, macrosomia (birth weight ≥4000 g), preterm birth (<37 completed weeks), neonatal hypoglycaemia, neonatal intensive care unit (NICU) admission, and the composite perinatal

outcome (live birth without major morbidity, live birth with morbidity, stillbirth, and early neonatal death).

Statistical analysis

Data were analysed using descriptive statistics. Continuous variables are presented as mean ± standard deviation, and categorical variables as frequencies and percentages. Composite indicators, including the total caesarean rate (emergency plus elective) and perinatal mortality (stillbirth plus early neonatal death), were derived by summation of their component categories.

Results

Sociodemographic and clinical characteristics

A total of 260 women with GDM constituted the study cohort. The mean maternal age was 29.5 ± 6.2 years. Slightly more than half of the women resided in urban areas (142; 54.6%), while 118 (45.4%) were from rural areas. Most women were booked cases (195; 75.0%), whereas 65 (25.0%) were unbooked. A previous history of GDM was documented in 29 women (11.2%), and 74 women (28.5%) reported a family history of diabetes. The mean pre-pregnancy BMI was 28.1 ± 4.6 kg/m², indicating a cohort that was, on average, in the overweight range. The mean gestational age at diagnosis of GDM was 28.9 weeks, consistent with detection around the conventional screening window. These characteristics are summarised in Table 1.

Glycaemic profile and treatment modalities

The glycaemic profile of the cohort at diagnosis showed a mean fasting plasma glucose of 104.2 mg/dL, a mean 2-hour postprandial glucose of 165.6 mg/dL, and a mean HbA1c of 5.91%. With respect to treatment, MNT alone was sufficient to manage 109 women (41.9%). Pharmacotherapy was required in the remainder: insulin was used in 83 women (31.9%), metformin in 51 women (19.6%), and combined metformin plus insulin in 17 women (6.5%). The distribution of treatment modalities is depicted in Figure 1. By term, good glycaemic control was achieved in 153 women (58.8%), whereas 107 women (41.2%) had suboptimal control. The glycaemic profile and treatment details are presented in Table 2.

Maternal outcomes

Antenatal complications included gestational hypertension in 34 women (13.1%) and polyhydramnios in 24 women (9.2%). The mean gestational age at delivery was 38.5 weeks. Regarding mode of delivery, 108 women (41.5%) had a vaginal delivery and 15 (5.8%) had an instrumental vaginal delivery, while 81 (31.2%) underwent emergency lower-segment caesarean section (LSCS) and 56 (21.5%) underwent elective LSCS. The overall caesarean rate, combining emergency and elective procedures, was therefore 137 (52.7%).

Maternal complications encountered during treatment and delivery included hypoglycaemia during treatment in 18 women (6.9%), postpartum haemorrhage in 17 (6.5%), wound infection in 11 (4.2%), birth canal trauma in 8 (3.1%), and other complications in 18 (6.9%). Maternal ICU admission was required in 10 women (3.8%). The full profile of maternal outcomes is provided in Table 3, and key outcome proportions in Figure 2.

Neonatal and perinatal outcomes

The mean neonatal birth weight was 3060 g. Macrosomia (birth weight ≥4000 g) was observed in 11 neonates (4.2%). Preterm birth before 37 completed weeks occurred in 36 pregnancies (13.8%). Neonatal hypoglycaemia was documented in 32 neonates (12.3%), and NICU admission was required for 58 neonates (22.3%).

With respect to the composite perinatal outcome, 180 pregnancies (69.2%) resulted in a live birth without major morbidity, and 72 (27.7%) in a live birth with morbidity. There were 6 stillbirths (2.3%) and 2 early neonatal deaths (0.8%), yielding a perinatal mortality of 8 (3.1%). Neonatal and perinatal outcomes are detailed in Table 4, and the principal maternal and neonatal outcome proportions are summarised graphically in Figure 2.

Table 1. Sociodemographic and clinical characteristics of the study cohort (N = 260)

Characteristic	Value
Maternal age (years), mean ± SD	29.5 ± 6.2
Residence — Urban, n (%)	142 (54.6)
Residence — Rural, n (%)	118 (45.4)
Booked, n (%)	195 (75.0)
Unbooked, n (%)	65 (25.0)
Previous GDM, n (%)	29 (11.2)
Family history of diabetes, n (%)	74 (28.5)
Pre-pregnancy BMI (kg/m²), mean ± SD	28.1 ± 4.6
Gestational age at GDM diagnosis (weeks), mean	28.9

SD, standard deviation; GDM, gestational diabetes mellitus; BMI, body mass index.

Table 2. Glycaemic profile and treatment modalities (N = 260)

Variable	Value
Fasting plasma glucose (mg/dL), mean	104.2
2-hour postprandial glucose (mg/dL), mean	165.6
HbA1c (%), mean	5.91
Treatment — MNT only, n (%)	109 (41.9)
Treatment — Insulin, n (%)	83 (31.9)
Treatment — Metformin, n (%)	51 (19.6)
Treatment — Metformin plus insulin, n (%)	17 (6.5)
Good glycaemic control at term, n (%)	153 (58.8)
Suboptimal glycaemic control at term, n (%)	107 (41.2)

HbA1c, glycated haemoglobin; MNT, medical nutrition therapy.

Table 3. Maternal outcomes: delivery mode, antenatal and maternal complications (N = 260)

Outcome	n (%)
Gestational age at delivery (weeks), mean	38.5
Vaginal delivery	108 (41.5)
Instrumental vaginal delivery	15 (5.8)
Emergency LSCS	81 (31.2)
Elective LSCS	56 (21.5)
Total caesarean (emergency + elective)	137 (52.7)
Gestational hypertension	34 (13.1)
Polyhydramnios	24 (9.2)
Hypoglycaemia during treatment	18 (6.9)
Postpartum haemorrhage	17 (6.5)
Wound infection	11 (4.2)
Birth canal trauma	8 (3.1)
Other maternal complications	18 (6.9)
Maternal ICU admission	10 (3.8)

LSCS, lower-segment caesarean section; ICU, intensive care unit.

Table 4. Neonatal and perinatal outcomes (N = 260)

Outcome	Value
Birth weight (g), mean	3060
Macrosomia (≥4000 g), n (%)	11 (4.2)
Preterm birth (<37 weeks), n (%)	36 (13.8)
Neonatal hypoglycaemia, n (%)	32 (12.3)
NICU admission, n (%)	58 (22.3)
Live birth without major morbidity, n (%)	180 (69.2)
Live birth with morbidity, n (%)	72 (27.7)
Stillbirth, n (%)	6 (2.3)
Early neonatal death, n (%)	2 (0.8)
Perinatal mortality (stillbirth + early neonatal death), n (%)	8 (3.1)

NICU, neonatal intensive care unit.

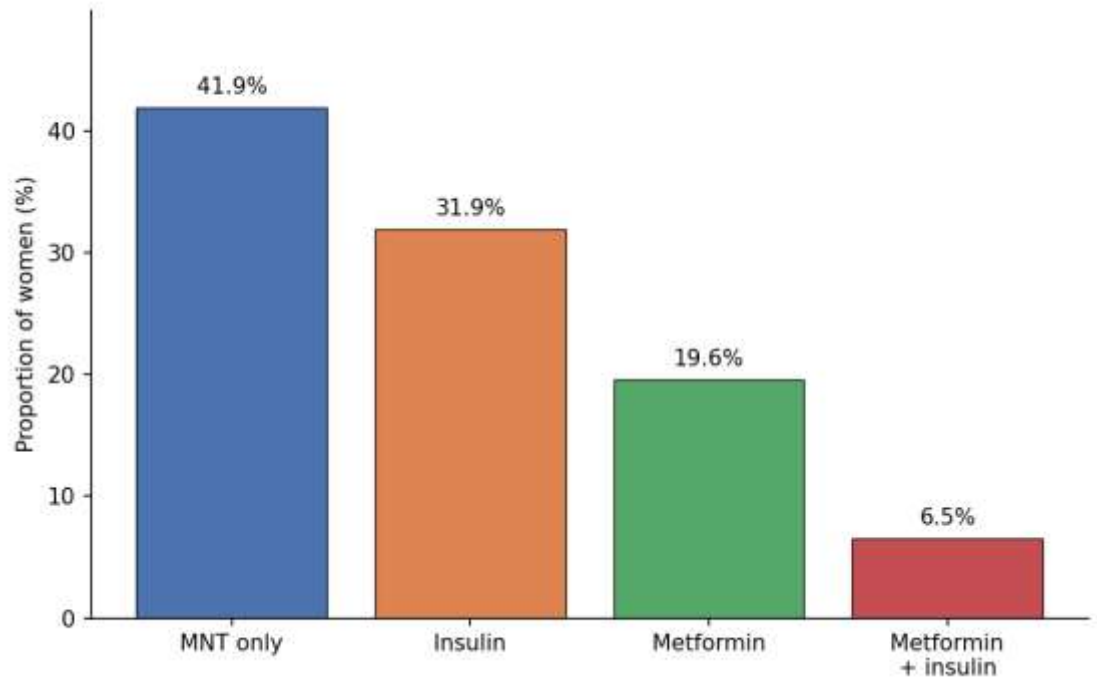

Figure 1. Distribution of treatment modalities among women with gestational diabetes mellitus (N = 260). MNT, medical nutrition therapy.

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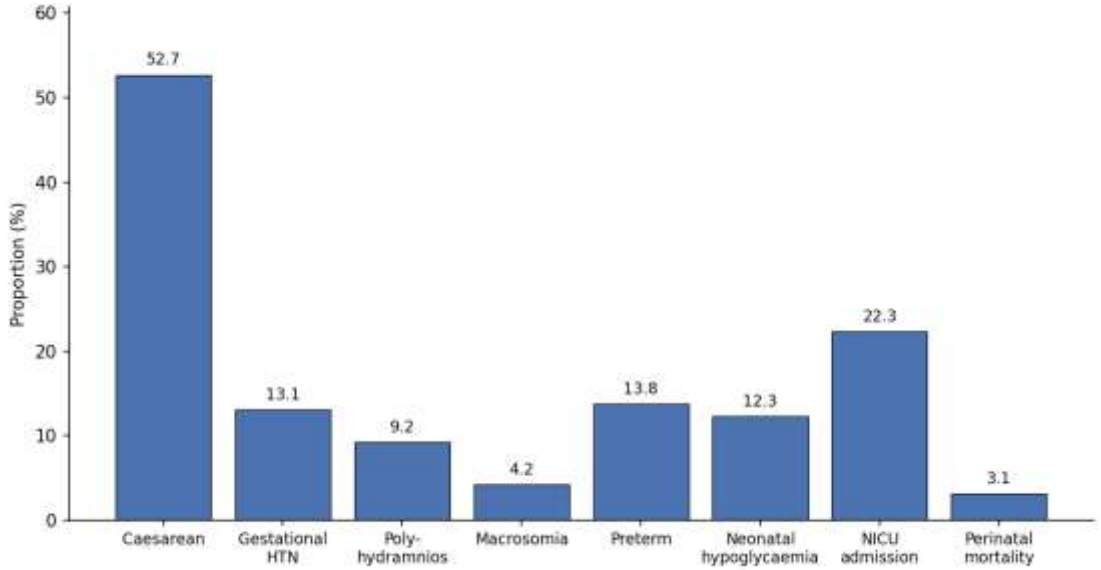

Figure 2. Key maternal and neonatal outcomes expressed as proportions (%) of the study cohort (N = 260). HTN, hypertension; NICU, neonatal intensive care unit.

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Discussion

In this hospital-based cross-sectional study of 260 women with GDM managed at a tertiary care teaching hospital in South India, we observed a cohort that was, on average, overweight before pregnancy, frequently carried a family history of diabetes, and experienced a substantial burden of adverse maternal and perinatal outcomes. The most striking maternal finding was a total caesarean rate of 52.7%, while neonatal morbidity was reflected in a NICU admission rate of 22.3% and a perinatal mortality of 3.1%. These findings are broadly concordant with the direction and magnitude of associations reported in the wider GDM literature and reinforce the clinical rationale for early diagnosis and structured glycaemic management [9,10].

The demographic and risk-factor profile of our cohort mirrors that described in other Indian tertiary care series. The mean pre-pregnancy BMI of 28.1 kg/m² places the cohort in the overweight category, and elevated pre-pregnancy weight is a well-established determinant of both the development of GDM and its adverse sequelae. Deshpande and colleagues highlighted the contribution of pre-pregnancy weight and the rate of gestational weight gain to early GDM among Indian women, and excessive gestational weight gain is recognised as an independent driver of macrosomia and caesarean delivery. The observed family history of diabetes in 28.5% and previous GDM in 11.2% are consistent with the strong familial and recurrent nature of the condition; recurrent GDM in particular has been associated with distinct maternal and neonatal risk trajectories.[4,7] The mean gestational age at diagnosis of 28.9 weeks reflects detection around the conventional screening window, although the recognised adverse impact of early-onset GDM argues for vigilance and, where indicated, earlier testing in high-risk women[11].

Our treatment distribution—MNT alone in 41.9%, with the remainder requiring insulin, metformin, or their combination—is in keeping with contemporary stepped-care practice, in which lifestyle measures form the foundation and pharmacotherapy is escalated as needed. The predominance of insulin among those requiring pharmacotherapy accords with its longstanding status as the reference agent in pregnancy, while the appreciable use of metformin reflects the accumulating randomised evidence supporting oral therapy. Trials comparing metformin with insulin have reported comparable glycaemic control and obstetric outcomes, and studies of early metformin initiation have further informed treatment algorithms. The observation that good glycaemic control at term was achieved in 58.8% of women, leaving a substantial minority with suboptimal control, echoes the world challenge of attaining glycaemic targets and is clinically relevant given the graded relationship between maternal glycaemia and adverse outcomes. Comparable variation in treatment distribution and outcomes across modalities has been documented in rural Indian tertiary settings[12].

The high caesarean rate in our cohort is consistent with the meta-analytic finding that GDM independently increases the odds of caesarean delivery, and with regional Indian reports describing elevated operative delivery rates among affected women. Multiple mechanisms likely contribute, including fetal overgrowth, a lower threshold for intervention in pregnancies labelled as high-risk, and coexisting hypertensive disorders. Gestational hypertension complicated 13.1%

of pregnancies in our series, in line with the recognised clustering of hyperglycaemia and hypertensive disease within a shared metabolic and vascular milieu. Polyhydramnios, present in 9.2%, is a familiar accompaniment of maternal hyperglycaemia and may itself contribute to obstetric intervention. Maternal complications such as postpartum haemorrhage, wound infection, and the need for ICU admission, though less frequent, underscore that GDM carries tangible maternal morbidity beyond the peripartum period[13].

Neonatal outcomes in our cohort reflect the characteristic consequences of intrauterine hyperglycaemia. Neonatal hypoglycaemia in 12.3% and NICU admission in 22.3% are consistent with fetal hyperinsulinaemia and the metabolic vulnerability of infants of diabetic mothers. Preterm birth in 13.8% aligns with the increased risk reported in the meta-analytic literature and may be partly iatrogenic, reflecting planned early delivery in complicated pregnancies.[1] Notably, macrosomia occurred in only 4.2% of neonates, a relatively modest frequency given the emphasis placed on fetal overgrowth in the diabetic literature. This may reflect the comparatively favourable mean birth weight of 3060 g, reasonable glycaemic control in the majority, and the background nutritional and anthropometric characteristics of South Asian neonates, who tend to be lighter yet more adipose than their Western counterparts. The reported predictors and frequency of macrosomia vary widely across populations, and our finding sits at the lower end of that spectrum. The composite perinatal outcome, with 69.2% of pregnancies ending in a live birth without major morbidity but a perinatal mortality of 3.1%, quantifies the residual risk that persists despite active management and supports the case for structured antenatal and neonatal surveillance[14].

Several ancillary considerations merit attention. Coexisting thyroid dysfunction and autoimmunity are more common among pregnant women with diabetes and may modulate both maternal and fetal outcomes; their assessment could refine risk stratification in future work.[15] The heterogeneity of outcomes reported across international and regional cohorts—reflecting differences in diagnostic criteria, glycaemic thresholds, obstetric practice, and population characteristics—reinforces the value of locally derived outcome profiles for benchmarking and counselling. Collectively, our observations reaffirm that GDM is a condition with meaningful short-term maternal and perinatal implications and important long-term metabolic consequences for both mother and child [15].

Strengths and limitations

The principal strength of this study is its structured, STROBE-compliant reporting of a comprehensive panel of sociodemographic, glycaemic, treatment, and outcome variables within a single tertiary care framework, providing an integrated profile of GDM. However, several limitations must be emphasised. The cross-sectional design precludes inference about causality or temporal sequence. As a single-centre study conducted in a tertiary referral setting, the profile may not be generalisable to community or primary care populations, where case mix and outcomes may differ. The absence of inferential analysis means that associations between exposures and outcomes were not formally quantified

Conclusion

In this hospital-based cross-sectional analysis of 260 women with GDM from a tertiary care teaching hospital in South India, GDM was associated with a high caesarean rate (52.7%) and

appreciable maternal and neonatal morbidity, including gestational hypertension, neonatal hypoglycaemia, and NICU admission, together with a perinatal mortality of 3.1%. Medical nutrition therapy managed a substantial proportion of women, but a large minority required pharmacotherapy and had suboptimal control at term, highlighting the importance of early diagnosis, structured stepped-care glycaemic management, and vigilant maternal and neonatal surveillance.

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