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# Comparing Fetal and Maternal Outcomes in Pregestational and Gestational Diabetes Mellitus Patients

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## ABSTRACT

**Background:** Diabetes mellitus in pregnancy, encompassing both pregestational (PGDM) and gestational (GDM) forms, is a major contributor to maternal and neonatal morbidity worldwide. In low-resource settings such as Azad Jammu & Kashmir, inadequate screening and limited preconception care exacerbate these risks. Comparative data on fetomaternal outcomes between PGDM and GDM in this region remain scarce. **Objective:** To compare maternal and fetal outcomes among women with PGDM and GDM delivering at District Headquarters (DHQ) Hospital, Mirpur, Azad Jammu & Kashmir. **Methods:** This comparative cross-sectional study included 276 diabetic pregnant women (138 PGDM and 138 GDM) who delivered at DHQ Hospital between December 2023 and June 2024. Maternal outcomes assessed were preterm labour, pregnancy-induced hypertension (PIH), and postpartum haemorrhage (PPH); fetal outcomes included neonatal intensive care unit (NICU) admission, low birth weight (LBW), stillbirth, and congenital anomalies. Data were analysed using SPSS version 25.0. Chi-square tests compared proportions, with $p \leq 0.05$ considered statistically significant. Stratified analyses were performed for maternal age, gestational age, mode of delivery, and residential status. **Results:** The mean maternal age was 27.6 ± 7.1 years, and mean gestational age at delivery was 34.4 ± 4.1 weeks. Preterm labour (26.8% vs 15.2%; $p = 0.018$) and PPH (10.9% vs 2.9%; $p = 0.009$) were significantly higher among GDM patients, whereas NICU admissions were more frequent in PGDM (47.8% vs 37.0%; $p = 0.068$). No significant differences were found for PIH, LBW, stillbirth, or congenital anomalies. Stratified analysis showed that the excess risks of preterm labour and PPH in GDM were pronounced in older mothers (>25 years), term pregnancies, vaginal deliveries, and urban residents, while NICU admission was significantly higher in PGDM among younger mothers (≤25 years) and preterm births. **Conclusion:** GDM and PGDM are both linked to serious problems throughout pregnancy and after birth. GDM was associated with enhanced risks of preterm labor and postpartum hemorrhage, whereas PGDM was connected to higher newborn morbidity. These findings underscore the significance of early screening, good glycemic management, and multidisciplinary care in all diabetic pregnancies to reduce unfavorable fetomaternal outcomes.

## INTRODUCTION

Gestational diabetes mellitus (GDM) is characterized as a carbohydrate intolerance that manifests for the first time during pregnancy and resolves by the conclusion of the puerperium. Diabetes mellitus diagnosed prior to pregnancy is termed pregestational diabetes mellitus (PGDM). A slight elevation in glucose levels during gestation might negatively impact both the mother and the fetus. (1,2,3). Women exhibit an elevated risk of obstetric problems, including miscarriage, pre-eclampsia, and preterm labor. Fetal exposure to maternal diabetes correlates with birth abnormalities, congenital malformations, macrosomia, birth injuries, perinatal mortality, and postnatal adaption issues, including hypoglycemia (4-8).

A lot of researches has reflected that PGDM is responsible for more unfavorable outcome for both fetal and maternal outcomes which is most probably due to the longer exposure to elevated blood glucose levels, toxicity of glucose levels and vascular disorders (9, 10). A recent systematic study indicated that pregestational diabetes was more often linked to problems such as preterm birth, congenital abnormalities, NICU admission, and stillbirth compared to gestational diabetes mellitus (11). Even though GDM may not last as long, it is nevertheless connected to higher obstetric risk and long-term

cardiometabolic effects for both the mother and the child (4,12).

In low- and middle-income contexts, the difficulties are exacerbated by restricted access to pre-conception care, postponed diagnosis, and inadequate glycaemic regulation. These variables lead to a significant rate of bad outcomes in pregnancies with diabetes (14). Consequently, a direct comparison of maternal and fetal outcomes between PGDM and GDM in our context is crucial for optimizing clinical treatment and resource distribution. Consequently, this study aimed to evaluate maternal and fetal outcomes between women with PGDM and GDM in our local population, thereby addressing a local evidence deficiency and enhancing obstetric care for diabetes pregnancies.

## MATERIALS AND METHODS

This comparative cross-sectional study was performed in the Department of Obstetrics and Gynecology at District Headquarters (DHQ) Hospital, Mirpur, Azad Jammu and Kashmir, over a duration of seven months, from December 2023 to June 2024. The aim of the study was to evaluate maternal and fetal outcomes between individuals with pregestational diabetes mellitus (PGDM) and those with gestational diabetes mellitus (GDM). The Institutional Ethical Review Committee of DHQ Hospital, Mirpur AJK, gave this study its ethical permission. All data were kept completely private. We used the online sample size calculator at https://riskcalc.org/samplesize/ to figure out the sample size, based on the study by Ali A et al. (2020). The calculation parameters were a Type I error rate (α) of 5%, a power (1−β) of 80%, and population proportions of 3.33% stillbirths in pregestational diabetic women and 13.33% stillbirths in gestational diabetic women. The final sample size was 276 people, comprising 138 women with PGDM and 138 women with GDM. Patients of both groups were enrolled until sample size achieved. A non-probability consecutive sampling technique was used for patient selection. All pregnant women with either a known diagnosis of diabetes mellitus before conception (PGDM) or newly diagnosed diabetes during the index pregnancy (GDM) who delivered at DHQ Hospital during the study period were included. Women with multiple pregnancies, chronic medical illnesses other than diabetes (such as chronic hypertension or renal disease), incomplete medical records, or known chromosomal or major structural fetal anomalies were excluded. Demographic and clinical variables, including maternal age, gestational age at delivery, method of delivery (vaginal or cesarean), and residential status (rural or urban), were documented. Maternal and fetal outcomes were documented from delivery and neonatal records. The maternal outcomes encompassed preterm labor, pregnancy-induced hypertension (PIH), and postpartum hemorrhage (PPH); the fetal outcomes included NICU hospitalization, low birth weight (<2.5 kg), stillbirth, and congenital anomalies. The following definitions were used in the work: Preterm labor was characterized as delivery occurring prior to the completion of 37 weeks of gestation. PIH was characterized as the emergence of hypertension, indicated by a blood pressure of ≥140/90 mmHg on two distinct occasions, separated by a minimum of four hours, occurring after 20 weeks of gestation in a woman who was previously normotensive. Postpartum hemorrhage (PPH) was characterized by blood loss of at least 500 mL following vaginal delivery or at least 1000 mL following cesarean section within the initial 24 hours postpartum. NICU admission was deemed necessary when the newborn required entry into the neonatal intensive care unit for any reason soon following birth. We defined low birth weight (LBW) as a weight of less than 2.5 kilos taken within an hour of birth. Stillbirth is the death of a fetus that happens inside the womb after 28 weeks of pregnancy and before the fetus is completely expelled from the mother. Congenital abnormalities encompassed any structural or functional problem identified at birth, either clinically or via ultrasonographic imaging.

All data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0. Categorical variables were presented as frequencies and percentages. The Chi-square test was applied to compare proportions between the two groups, and a p-value of ≤0.05 was considered statistically significant.

## RESULTS

Among the 276 diabetic pregnant women analyzed, the mean maternal age of the study population was 27.55 ± 7.14 years (range: 16–40 years). The mean gestational age at delivery was 34.43 ± 4.10 weeks, ranging from 28 to 41 weeks. The mean birth weight of the newborns was 2.88 ± 0.40 kg, with a minimum of 1.69 kg and a maximum of 3.85 kg. More than half of the mothers in both groups were older than 25 years, showing a comparable age distribution between GDM and PGDM patients. Preterm delivery was more common among GDM patients (66.7 %); while, the proportion of cesarean deliveries was slightly higher in PGDM (50.7 %) although overall distribution was nearly balanced. Most women in both groups resided in urban areas (56.9 %). A detailed analysis of qualitative variables is presented in table 1.

Maternal complications were observed in both study groups with varying frequencies. Preterm labour occurred in 21.0% of all cases and was significantly more frequent in women with gestational diabetes (p = 0.018). Pregnancy-induced hypertension (PIH) was found in 11.2% of the total population, slightly higher among GDM patients than PGDM, though this difference was not statistically significant (p = 0.182). Postpartum hemorrhage (PPH) was recorded in 6.9% of participants overall and was significantly higher among GDM patients than in the PGDM group (p = 0.009). Regarding fetal outcomes, NICU admission was the most frequent neonatal complication, affecting 42.4% of all newborns. Although NICU admission was higher in PGDM than GDM, this difference approached but did not reach statistical significance (p = 0.068). Low birth weight (<2.5 kg) occurred in 9.8% of neonates, being more common in GDM than PGDM, yet not statistically significant (p = 0.156). Stillbirths were relatively uncommon (6.2% overall) and similar across both groups (7.2% vs. 5.1%; p = 0.453). Congenital abnormalities were observed in 5.8% of neonates, more frequent in PGDM compared to GDM, though this difference was also not significant (p = 0.303).

Detailed analysis of feto-maternal outcomes are illustrated in table 2.

**Table 1**

*Comparison of Qualitative Variables between GDM and PGDM Groups (n = 276)*

| Variable | Category | GDM | PGDM | Total |
|---|---|---|---|---|
| Maternal age group | ≤ 25 years | 59 (42.8%) | 60 (43.5%) | 119 (43.1%) |
| | > 25 years | 79 (57.2%) | 78 (56.5%) | 157 (56.9%) |
| Gestational age group | Preterm (<37 weeks) | 92 (66.7%) | 85 (61.6%) | 177 (64.1%) |
| | Term (≥37 weeks) | 46 (33.3%) | 53 (38.4%) | 99 (35.9%) |
| Mode of delivery | Vaginal | 73 (52.9%) | 68 (49.3%) | 141 (51.1%) |
| | Cesarean section | 65 (47.1%) | 70 (50.7%) | 135 (48.9%) |
| Living status | Rural | 62 (44.9%) | 57 (41.3%) | 119 (43.1%) |
| | Urban | 76 (55.1%) | 81 (58.7%) | 157 (56.9%) |

**Table 2**

*Comparison of Maternal and Fetal Outcomes between GDM and PGDM Groups (n = 276)*

| Outcome | GDM (n=138) | PGDM (n=138) | *p*-value |
|---|---|---|---|
| Maternal Outcomes | | | |
| Preterm labour | 37 (26.8%) | 21 (15.2%) | 0.018 |
| Pregnancy-induced hypertension (PIH) | 19 (13.8%) | 12 (8.7%) | 0.182 |
| Postpartum hemorrhage (PPH) | 15 (10.9%) | 4 (2.9%) | 0.009 |
| Fetal Outcomes | | | |
| NICU admission | 51 (37.0%) | 66 (47.8%) | 0.068 |
| Low birth weight (<2.5 kg) | 17 (12.3%) | 10 (7.2%) | 0.156 |
| Stillbirth | 10 (7.2%) | 7 (5.1%) | 0.453 |
| Congenital abnormalities | 6 (4.3%) | 10 (7.2%) | 0.303 |

**Table 3**

*Fetomaternal Outcomes Stratified by Maternal Age*

| Outcome | GDM | PGDM | p-value |
|---|---|---|---|
| >25 years (GDM n=79; PGDM n=78) | | | |
| Preterm labour | 26.6% | 12.8% | 0.030 |
| PPH | 13.9% | 2.6% | 0.010 |
| PIH | 13.9% | 9.0% | 0.330 |
| NICU admission | 44.3% | 43.6% | 0.928 |
| LBW (<2.5 kg) | 8.9% | 6.4% | 0.563 |
| Stillbirth | 6.3% | 6.4% | 0.983 |
| Congenital anomalies | 5.1% | 6.4% | 0.717 |
| ≤25 years (GDM n=59; PGDM n=60) | | | |
| Preterm labour | 27.1% | 18.3% | 0.253 |
| PPH | 6.8% | 3.3% | 0.390 |
| PIH | 13.6% | 8.3% | 0.361 |
| NICU admission | 27.1% | 53.3% | 0.004 |
| LBW (<2.5 kg) | 16.9% | 8.3% | 0.157 |
| Stillbirth | 8.5% | 3.3% | 0.233 |
| Congenital anomalies | 3.4% | 8.3% | 0.252 |

**Table 4**

*Fetomaternal Outcomes Stratified by Gestational Age at Delivery*

| Outcome | GDM | PGDM | p-value |
|---|---|---|---|
| Term (≥37 weeks) (GDM n=46; PGDM n=53) | | | |
| Preterm labour | 19.6% | 17.6% | 0.743 |
| PPH | 7.6% | 3.5% | 0.240 |
| PIH | 15.2% | 9.4% | 0.242 |
| NICU admission | 38.0% | 52.9% | 0.047 |
| LBW (<2.5 kg) | 12.0% | 5.9% | 0.159 |
| Stillbirth | 8.7% | 4.7% | 0.291 |
| Congenital anomalies | 3.3% | 10.6% | 0.053† |
| Term (≥37 weeks) (GDM n=46; PGDM n=53) | | | |
| Preterm labour | 41.3% | 11.3% | 0.001 |
| PPH | 17.4% | 1.9% | 0.007 |
| PIH | 10.9% | 7.5% | 0.566 |
| NICU admission | 34.8% | 39.6% | 0.620 |
| LBW (<2.5 kg) | 13.0% | 9.4% | 0.569 |
| Stillbirth | 4.3% | 5.7% | 0.766 |
| Congenital anomalies | 6.5% | 1.9% | 0.243 |

**Table 5**

*Fetomaternal Outcomes Stratified by Mode of Delivery*

| Outcome | GDM | PGDM | p-value |
|---|---|---|---|
| Cesarean (GDM n=65; PGDM n=70) | | | |
| Preterm labour | 29.2% | 14.3% | 0.035 |
| PPH | 4.6% | 4.3% | 0.926 |
| PIH | 15.4% | 10.0% | 0.346 |
| NICU admission | 35.4% | 48.6% | 0.121 |
| LBW (<2.5 kg) | 13.8% | 10.0% | 0.490 |
| Stillbirth | 6.2% | 5.7% | 0.914 |
| Congenital anomalies | 1.5% | 5.7% | 0.199 |
| Vaginal (GDM n=73; PGDM n=68) | | | |
| Preterm labour | 24.7% | 16.2% | 0.213 |
| PPH | 16.4% | 1.5% | 0.002 |
| PIH | 12.3% | 7.4% | 0.324 |
| NICU admission | 38.4% | 47.1% | 0.296 |
| LBW (<2.5 kg) | 11.0% | 4.4% | 0.147 |
| Stillbirth | 8.2% | 4.4% | 0.355 |
| Congenital anomalies | 6.8% | 8.8% | 0.662 |

**Table 6**

*Fetomaternal Outcomes Stratified by Living Status*

| Outcome | GDM | PGDM | p-value |
|---|---|---|---|
| Rural (GDM n=62; PGDM n=57) | | | |
| Preterm labour | 27.4% | 15.8% | 0.125 |
| PPH | 9.7% | 3.5% | 0.179 |
| PIH | 12.9% | 7.0% | 0.287 |
| NICU admission | 35.5% | 52.6% | 0.060 |
| LBW (<2.5 kg) | 16.1% | 5.3% | 0.058 |
| Stillbirth | 8.1% | 3.5% | 0.291 |
| Congenital anomalies | 4.8% | 8.8% | 0.392 |
| Urban (GDM n=76; PGDM n=81) | | | |
| Preterm labour | 26.3% | 14.8% | 0.074 |
| PPH | 11.8% | 2.5% | 0.021 |
| PIH | 14.5% | 9.9% | 0.377 |
| NICU admission | 38.2% | 44.4% | 0.424 |
| LBW (<2.5 kg) | 9.2% | 8.6% | 0.901 |
| Stillbirth | 6.6% | 6.2% | 0.917 |
| Congenital anomalies | 3.9% | 6.2% | 0.526 |

## DISCUSSION

Our study shows that pregnancies complicated by GDM and PGDM have higher risks of negative outcomes for both the mother and the fetus, such as preterm labor, PIH, PPH, NICU admissions, LBW, stillbirths, and congenital anomalies. This is in line with what is known about diabetic pregnancies in general. Notably, preterm labor was significantly more prevalent in the GDM group (26.8%) compared to PGDM (15.2%; p=0.018), aligning with findings from a Pakistani cohort where 30% of PGDM mothers experienced preterm labor versus 23.3% in GDM, although the direction was reversed, indicating potential regional variations in glycemic control and obstetric management. (12) Likewise, PPH was significantly elevated in GDM (10.9% vs. 2.9%; p=0.009), a pattern reflected in a Saudi Arabian study that reported similar perineal lacerations and cesarean rates in both GDM and PGDM, highlighting the same hemorrhagic hazards associated with diabetic pregnancies. (13) PIH occurred in 11.2% overall, with a non-significant elevation in GDM (13.8% vs. 8.7%; p=0.182), corroborating a Japanese multi-institutional analysis where overt diabetes (analogous to PGDM) showed higher hypertensive disorders (13.3%) than GDM, yet both exceeded non-diabetic rates, emphasizing the diabetogenic stress of pregnancy. (14) Fetal outcomes revealed NICU admissions in 42.4% of neonates, trending higher in PGDM (47.8% vs. 37.0%; p=0.068), which parallels a Bangladeshi cross-

sectional study documenting significantly elevated NICU needs in both PGDM and GDM (APGAR <7 in higher proportions) compared to controls, with hypoglycemia and hyperbilirubinemia as key drivers. (15)

LBW was more frequent in GDM (12.3% vs. 7.2%; p=0.156), contrasting somewhat with the macrosomia predominance in GDM neonates reported in cystic fibrosis cohorts but aligning with general diabetic populations where intrauterine growth restriction affects 6.67% equally across types.(12,16) Stillbirth rates were low and comparable (7.2% vs. 5.1%; p=0.453), while congenital anomalies trended higher in PGDM (7.2% vs. 4.3%; p=0.303), consistent with a western Indian tertiary center study noting 6% intrauterine deaths and anomalies in diabetic pregnancies overall, attributable to early teratogenic exposures in PGDM.(17) Stratified analyses further illuminated interactions: among mothers >25 years, preterm labor and PPH were amplified in GDM (p=0.030 and 0.010, respectively), mirroring age-related risks in diagnostic comparison studies where older GDM cohorts faced higher preterm deliveries (30%) and neonatal hypoglycemia (50%).(18) In preterm gestations (<37 weeks), PPH increased in GDM (17.4% vs. 1.9%; p=0.007), and congenital abnormalities approached significance in PGDM (10.6% vs. 3.3%; p=0.053), underscoring the necessity for rigorous monitoring in high-risk diabetic populations according to biophysical profiling methods. (13) Living in a city reduced some differences (for example, lower LBW in urban GDM, p=0.901), possibly because it was easier to get multidisciplinary care, which is similar to how better outcomes happen in groups that are managed by institutions. (14) Cesarean rates were balanced (48.9% overall), but vaginal deliveries in GDM had a higher rate of PPH (16.4% vs. 1.5%; p=0.002), which shows how important it is to be careful about bleeding during labor. These findings collectively confirm that, although GDM and PGDM exhibit unfavorable profiles, GDM may impose distinct preterm and hemorrhagic risks, while PGDM exacerbates congenital risks—outcomes that can be improved through preconception optimization, early screening, and insulin-focused management, as supported by global research. (12-19)

The higher risk of preterm labour in GDM in our setting may relate to poorer antenatal glycaemic control or delayed diagnosis of GDM key factors implicated in preterm birth among diabetic pregnancies. The local health-system context may have amplified this risk. The elevated PPH rate may reflect uterine atony associated with diabetic myopathy, macrosomia, or obstetric interventions, as well as possible sub-optimal intrapartum management (20). Although PGDM is typically associated with more vascular and placental challenges leading to adverse outcomes, it may paradoxically lead to lower PPH if obstetric teams anticipate risk and manage proactively (21). NICU admissions being more frequent in PGDM in certain strata may reflect that PGDM women often have longer duration diabetes, more micro-vascular changes, and more frequent neonatal complications (e.g., hypoglycaemia, respiratory distress) (22). The subgroup findings (younger mothers, preterm deliveries) highlight that even within PGDM populations, risk is modified by maternal age and gestational age at delivery. The non-differences in low birth weight, stillbirth, and congenital anomalies in our study are reassuring; it may reflect improvements in antenatal monitoring, or the underlying sample size and setting may have limited power to detect differences.

The findings have several implications: first, the elevated preterm birth and PPH rates in GDM underscore the need for heightened surveillance and targeted preventive measures in GDM pregnancies, not only PGDM. Antenatal clinics should emphasise early screening, prompt initiation of management and multidisciplinary coordination even for GDM. Secondly, PGDM pregnancies still warrant close neonatal monitoring, especially in younger mothers and preterm births, given the higher NICU admission rate found. Thirdly, obstetric teams in this context should anticipate and prepare for PPH in GDM, particularly in term, vaginal, and urban-resident subgroups as identified in stratified analysis. Fourth, the absence of differences in certain fetal outcomes may encourage care providers that with adequate monitoring and management, risk can be attenuated.

A key strength of this study is the stratified analysis by maternal age, gestational age, mode of delivery and living status which helps to identify effect-modification and sub-groups at particular risk. The equal group sizes (138 each) provide balanced comparison. Conducting the study in a district hospital in Azad Jammu & Kashmir adds valuable regional data where much of the literature is lacking. However, the study has limitations. Glycaemic control data (HbA1c, preconception care, insulin use) were not included, limiting adjustment for an important confounder. The cross-sectional comparative design limits causal inference, and unmeasured factors (maternal BMI, socio-economic status, detailed neonatal morbidities) may have influenced results. The sample size, while adequate for some outcomes, may have been underpowered to detect differences in less frequent events like congenital anomalies. Also, single-centre data limit generalisability beyond this hospital setting.

## CONCLUSION

This study shows that pregestational and gestational diabetes mellitus are associated to a lot of risks for poor outcomes for both the mother and the baby. The pattern of problems differs between the two disorders. Women diagnosed with gestational diabetes demonstrated significantly higher rates of preterm labour and postpartum haemorrhage, particularly among older, term, and urban-dwelling mothers, underscoring the need for enhanced intrapartum monitoring. Pregestational diabetes was associated with heightened newborn morbidity, as seen by elevated rates of NICU hospitalisations, particularly among younger and preterm mothers, underscoring the consequences of chronic hyperglycemia and enduring vascular modifications.There were no significant differences in low birth weight, stillbirth, or congenital malformations; however, the results underscore the importance of preconception counselling, early screening, and meticulous glycaemic control during pregnancy.

## REFERENCES


1. Malaza N, Masete M, Adam S, Dias S, Nyawo T, Pheiffer C. A Systematic Review to Compare Adverse Pregnancy Outcomes in Women with Pregestational Diabetes and Gestational Diabetes. Int J Environ Res Public Health. 2022;19(17):10846. https://doi.org/10.3390/ijerph191710846
2. Saravanan P; Diabetes in Pregnancy Working Group; Maternal Medicine Clinical Study Group; Royal College of Obstetricians and Gynaecologists, UK. Gestational diabetes: opportunities for improving maternal and child health. Lancet Diabetes Endocrinol. 2020;8(9):793-800.
3. Egan AM, Dow ML, Vella A. A Review of the Pathophysiology and Management of Diabetes in Pregnancy. Mayo Clin Proc. 2020;95(12):2734-2746. https://doi.org/10.1016/j.mayocp.2020.02.019
4. Harrison J, Melov S, Kirby AC, Athayde N, Boghossian A, Cheung W, et al. Pregnancy outcomes in women with gestational diabetes mellitus by models of care: a retrospective cohort study. BMJ Open. 2022;12(9):e065063. https://doi.org/10.1136/bmjopen-2022-065063
5. Wang X, Zhang X, Zhou M, Juan J, Wang X. Association of Gestational Diabetes Mellitus with Adverse Pregnancy Outcomes and Its Interaction with Maternal Age in Chinese Urban Women. J Diabetes Res. 2021;2021:5516937. https://doi.org/10.21203/rs.3.rs-136722/v1
6. Ye W, Luo C, Huang J, Li C, Liu Z, Liu F. Gestational diabetes mellitus and adverse pregnancy outcomes: systematic review and meta-analysis. BMJ. 2022;377:e067946. https://doi.org/10.1136/bmj-2021-067946
7. Chatzakis C, Eleftheriades A, Demertzidou E, Dinas K, Vlahos N, Sotiriadis A, Eleftheriades M. Pregnancy outcomes in the different phenotypes of gestational diabetes mellitus based on the oral glucose tolerance test. A systematic review and meta-analysis. Diabetes Res Clin Pract. 2023;204:110913. https://doi.org/10.1016/j.diabres.2023.110913
8. Oros Ruiz M, Perejón López D, Serna Arnaiz C, Siscart Viladegut J, Àngel Baldó J, Sol J. Maternal and foetal complications of pregestational and gestational diabetes: a descriptive, retrospective cohort study. Sci Rep. 2024 Apr 19;14(1):9017. PMID: 38641705; PMCID: PMC11031602. https://doi.org/10.1038/s41598-024-59465-x.
9. Clement NS, Abul A, Farrelly R, Murphy HR, Forbes K, Simpson NAB, Scott EM. Pregnancy outcomes in type 2 diabetes: a systematic review and meta-analysis. Am J Obstet Gynecol. 2025 Apr;232(4):354-366. Epub 2024 Dec 9. PMID: 39662865. https://doi.org/10.1016/j.ajog.2024.11.026.
10. Koivunen S, Viljakainen M, Männistö T, Gissler M, Pouta A, Kaaja R, Eriksson J, Laivuori H, Kajantie E, Vääräsmäki M. Pregnancy outcomes according to the definition of gestational diabetes. PLoS One. 2020 Mar 5;15(3):e0229496. PMID: 32134959; PMCID: PMC7058278. https://doi.org/10.1371/journal.pone.0229496.
11. Ye W, Luo C, Huang J, Li C, Liu Z, Liu F. Gestational diabetes mellitus and adverse pregnancy outcomes: systematic review and meta-analysis. BMJ. 2022 May 25;377:e067946. PMID: 35613728; PMCID: PMC9131781. https://doi.org/10.1136/bmj-2021-067946.
12. Hufnagel A, Dearden L, Fernandez-Twinn DS, Ozanne SE. Programming of cardiometabolic health: the role of maternal and fetal hyperinsulinaemia. J Endocrinol. 2022 Apr 5;253(2):R47-R63. PMID: 35258482; PMCID: PMC9066586. https://doi.org/10.1530/JOE-21-0332.
13. Alia A, Ahmad R, Husain M, Chaudry B. Feto-Maternal Complications in Gestational Diabetes and in Pre-Existing Diabetes Mellitus. Med Forum. 2020;31(4):45-9.
14. El Mallah KO, Narchi H, Kulaylat NA, Shaban MS. Gestational and pre-gestational diabetes: comparison of maternal and fetal characteristics and outcome. Int J Gynaecol Obstet. 1997;58(3):203-9. https://doi.org/10.1016/s0020-7292(97)00084-2
15. Sugiyama T, Saito M, Nishigori H, Nagase S, Yaegashi N, Sagawa N, et al. Comparison of pregnancy outcomes between women with gestational diabetes and overt diabetes first diagnosed in pregnancy: a retrospective multi-institutional study in Japan. Diabetes Res Clin Pract. 2014;103(1):20-5. https://doi.org/10.1016/j.diabres.2013.10.020
16. Fatema K, Sultana N, Noor F. Characteristics of Pre-gestational and Gestational Diabetes: A Comparison of Maternal and Fetal Outcome. Sch Int J Obstet Gynecol. 2019;2(12):319-26.
17. Oxman R, Roe AH, Ullal J, Putman MS. Gestational and pregestational diabetes in pregnant women with cystic fibrosis. J Clin Transl Endocrinol. 2022;27:100289. https://doi.org/10.1016/j.jcte.2021.100289
18. Dixit M, Kapadia SN, Parmar KG. Pregnancy with diabetes: The study of fetomaternal outcome in a tertiary care teaching centre in western India. Indian J Obstet Gynecol Res. 2023;10(1):12-6. https://doi.org/10.18231/j.ijogr.2023.003
19. Sinha S, Mayadeo NM. Comparison of maternal and fetal outcomes in gestational diabetes mellitus diagnosed either by oral glucose tolerance test or diabetes in pregnancy study group India. Int J Reprod Contracept Obstet Gynecol. 2017;6(10):4526-33. https://doi.org/10.18203/2320-1770.ijrcog20174436
20. Driessen M, Bouvier-Colle MH, Dupont C, Khoshnood B, Rudigoz RC, Deneux-Tharaux C; Pithagore6 Group. Postpartum hemorrhage resulting from uterine atony after vaginal delivery: factors associated with severity. Obstet Gynecol. 2011 Jan;117(1):21-31. PMID: 21173641; PMCID: PMC3319503. https://doi.org/10.1097/AOG.0b013e318202c845.
21. Pubu ZM, Bianba ZM, Yang G, CyRen LM, Pubu DJ, Suo Lang KZ, Zhen B, Zhaxi QZ, Nyma ZG. Factors Affecting the Risk of Postpartum Hemorrhage in Pregnant Women in Tibet Health Facilities. Med Sci Monit. 2021 Feb 13;27:e928568. PMID: 33579890; PMCID: PMC7887994. https://doi.org/10.12659/MSM.928568.
22. Hillick D, O'Reilly D, Murphy L, Breathnach F, McCallion N. Increased risk of admission to neonatal intensive care unit in neonates born to mothers with pregestational diabetes. Eur J Pediatr. 2025 May 22;184(6):354. PMID: 40402196; PMCID: PMC12098415 https://doi.org/10.1007/s00431-025-06170-0.