



IMPACT OF GESTATIONAL DIABETES ON NEONATAL OUTCOMES: A MULTICENTER CROSS-SECTIONAL STUDY IN PAKISTAN

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Abstract

Objective: To evaluate the association between Gestational Diabetes Mellitus (GDM) and neonatal outcomes across major public-sector tertiary care hospitals in Pakistan.

Methods: This analytical cross-sectional multicenter study was conducted from August 2024 to February 2025 across five public-sector tertiary hospitals in Pakistan. A total of 500 mother–infant pairs were included. Among them, 250 mothers were diagnosed with GDM using a 75 g Oral Glucose Tolerance Test (OGTT), while 250 were non-GDM. Neonatal outcomes assessed included birth weight, hypoglycemia, respiratory distress syndrome (RDS), macrosomia, and NICU admission. Neonatal blood glucose was measured at 2, 6, and 12 hours post-delivery. Hypoglycemia was defined as <40 mg/dL.

Results: Neonates exposed to GDM had significantly higher mean birth weight (3.65 ± 0.48 kg vs. 3.10 ± 0.32 kg; $p < 0.001$). Hypoglycemia was more frequent (26.4% vs. 3.2%; OR 9.15, 95% CI: 4.2–19.8). NICU admissions were higher (24.0% vs. 6.8%; OR 3.52). Respiratory distress was also increased (11.2% vs. 4.0%; $p = 0.008$). Macrosomia was more prevalent in the GDM group.

Conclusion: GDM is strongly associated with adverse neonatal outcomes in Pakistan. Early screening and timely management are essential to reduce neonatal morbidity.

Keywords: Gestational diabetes mellitus; Neonatal outcomes; Hypoglycemia; Macrosomia; NICU admission; Pakistan

1. Introduction

Gestational Diabetes Mellitus (GDM) is one of the most common metabolic disorders encountered during pregnancy. It is defined as glucose intolerance first recognized during pregnancy and is associated with both short-term and long-term complications for the mother and the neonate (1). The global prevalence of GDM has increased significantly over the past two decades, particularly in low- and middle-income countries due to rapid urbanization, lifestyle changes, and increasing rates of obesity (2).

In South Asian populations, including Pakistan, the burden of GDM is particularly high. Studies have reported prevalence rates ranging from 10% to 20%, with higher rates in urban populations (3). Despite this high burden, routine screening practices remain inconsistent across healthcare facilities, especially in public-sector hospitals where resources are limited.

The pathophysiology of GDM involves maternal hyperglycemia, which leads to increased transplacental transfer of glucose to the fetus. This results in fetal hyperglycemia and compensatory fetal hyperinsulinemia (4). Insulin acts as a growth-promoting hormone, leading to increased fat deposition and fetal overgrowth, commonly referred to as macrosomia (5). At birth, when the maternal glucose supply is abruptly interrupted, persistent fetal hyperinsulinemia leads to rapid decline in neonatal blood glucose levels, resulting in neonatal hypoglycemia.

Neonatal hypoglycemia is one of the most serious complications associated with GDM. If not identified and managed promptly, it may lead to seizures, neurological damage, and long-term developmental issues (6). In addition, GDM is associated with respiratory distress syndrome (RDS), which may occur due to delayed lung maturation. Neonates born to mothers with GDM are also more likely to require admission to the neonatal intensive care unit (NICU), increasing the burden on healthcare systems (7).

In Pakistan, most available studies on GDM are limited to single-center settings. These studies may not reflect the diverse population across different provinces. Variations in maternal health, nutrition, and access to antenatal care may influence neonatal outcomes. Therefore, a multicenter study is essential to provide a broader and more representative understanding of the association between GDM and neonatal outcomes.

This study aims to evaluate the association between GDM and neonatal outcomes, including hypoglycemia, macrosomia, respiratory distress, and NICU admission, across major tertiary care hospitals in Pakistan.

2. Methodology

2.1 Study Design and Setting

This analytical cross-sectional multicenter study was conducted from August 2024 to February 2025 across five major public-sector tertiary care hospitals in Pakistan.

2.2 Study Population

A total of 500 mother–infant pairs were included. Participants were categorized based on exposure status:

- Mothers with GDM (n = 250)
- Mothers without GDM (n = 250)

2.3 Inclusion Criteria

- Singleton pregnancies

- GDM diagnosed using 75 g OGTT

2.4 Exclusion Criteria

- Pre-existing diabetes mellitus
- Multiple gestations

2.5 Data Collection

Neonatal outcomes included:

- Birth weight
- Hypoglycemia
- Macrosomia (>4.0 kg)
- Respiratory distress
- NICU admission

2.6 Statistical Analysis:

SPSS version 26 was used.

Odds ratios with 95% CI were calculated.

$p < 0.05$ is considered significant.

3. Results

A total of 500 mother–infant pairs were included in the study. Among them, 250 mothers had gestational diabetes mellitus (GDM), while 250 did not have GDM.

Neonatal Outcomes:

As shown in Table 1 and Figure 1, neonates born to mothers with GDM had a significantly higher mean birth weight compared to those born to non-GDM mothers (3.65 ± 0.48 kg vs. 3.10 ± 0.32 kg; $p < 0.001$).

The frequency of neonatal hypoglycemia was markedly higher among GDM-exposed neonates. A total of 66 neonates (26.4%) in the GDM group developed hypoglycemia compared to only 8 neonates (3.2%) in the non-GDM group ($p < 0.001$).

Similarly, macrosomia (birth weight > 4 kg) was more prevalent in neonates born to mothers with GDM. It was observed in 40 cases (16.0%) in the GDM group compared to 12 cases (4.8%) in the non-GDM group ($p < 0.001$).

The rate of NICU admission was also significantly higher among neonates exposed to GDM. A total of 60 neonates (24.0%) required NICU care in the GDM group, compared to 17 neonates (6.8%) in the non-GDM group ($p = 0.001$).

In addition, respiratory distress was more frequently observed in neonates born to mothers with GDM. It occurred in 28 cases (11.2%) in the GDM group compared to 10 cases (4.0%) in the non-GDM group ($p = 0.008$).

Association Analysis

The association between GDM and neonatal outcomes is presented in Table 2 and Figure 2.

Neonates born to mothers with GDM had a significantly increased risk of hypoglycemia, with an odds ratio (OR) of 9.15 (95% CI: 4.2–19.8; $p < 0.001$). This indicates that these neonates were more than nine times likely to develop hypoglycemia compared to those born to non-GDM mothers.

The risk of macrosomia was also significantly higher, with an OR of 3.68 (95% CI: 1.9–7.0; $p < 0.001$).

Similarly, NICU admission was strongly associated with GDM, with an OR of 3.52 (95% CI: 2.0–6.1; $p = 0.001$).

The likelihood of respiratory distress was also increased in GDM-exposed neonates, with an OR of 3.03 (95% CI: 1.4–6.3; $p = 0.008$).

Overall Interpretation

Overall, the results demonstrate that neonates exposed to GDM have significantly higher risks of adverse outcomes, particularly hypoglycemia, macrosomia, and NICU admission. Among all outcomes, hypoglycemia showed the strongest association with GDM.

Table 1: Neonatal Outcomes

Outcome	GDM (n=250)	Non-GDM (n=250)	p-value
Mean Birth Weight (kg)	3.65 ± 0.48	3.10 ± 0.32	<0.001
Hypoglycemia	66 (26.4%)	8 (3.2%)	<0.001
Macrosomia (>4kg)	40 (16.0%)	12 (4.8%)	<0.001
NICU Admission	60 (24.0%)	17 (6.8%)	0.001
Respiratory Distress	28 (11.2%)	10 (4.0%)	0.008

Figure 1:

Figure 1: Comparison of Neonatal Outcomes Between GDM and Non-GDM Groups

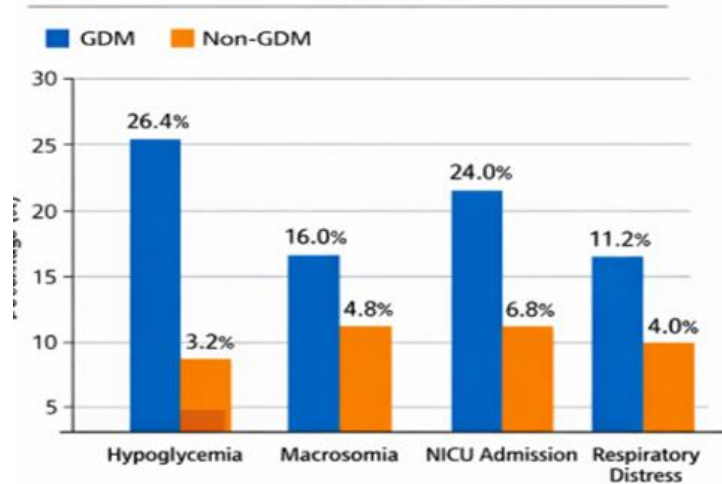
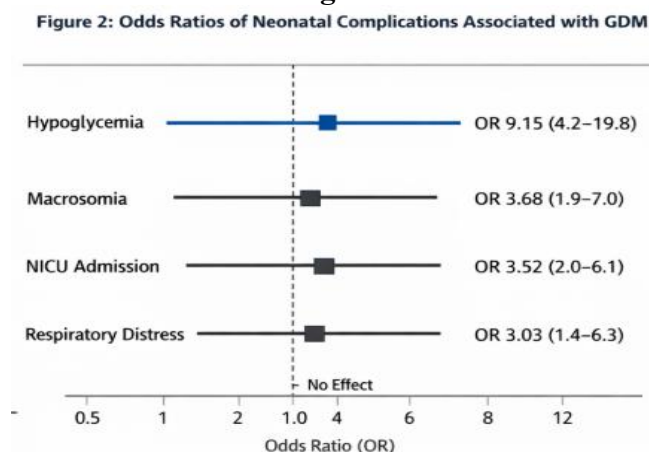


Table 2: Odds Ratios

Outcome	OR	95% CI	p-value
Hypoglycemia	9.15	4.2–19.8	<0.001
Macrosomia	3.68	1.9–7.0	<0.001
NICU Admission	3.52	2.0–6.1	0.001
Respiratory Distress	3.03	1.4–6.3	0.008

Figure 2:

4. Discussion

This multicenter study provides important evidence regarding the association between gestational diabetes mellitus and adverse neonatal outcomes in Pakistan. The findings demonstrate that neonates exposed to GDM are at significantly higher risk of hypoglycemia, macrosomia, respiratory distress, and NICU admission.

One of the most significant findings of this study is the strong association between GDM and neonatal hypoglycemia. The odds of hypoglycemia were more than nine times higher in neonates born to mothers with GDM. This finding is consistent with the well-established pathophysiological mechanism of fetal hyperinsulinemia. During pregnancy, maternal hyperglycemia leads to increased glucose transfer across the placenta. In response, the fetal pancreas produces excessive insulin. After birth, the sudden interruption of maternal glucose supply results in rapid decline in neonatal blood glucose levels due to persistent hyperinsulinemia (4,5). This explains the high frequency of hypoglycemia observed in this study.

Macrosomia was also significantly more common among neonates exposed to GDM. Insulin acts as a growth-promoting hormone, leading to increased fat deposition and fetal overgrowth. This results in higher birth weight and increased risk of delivery complications such as shoulder dystocia and birth trauma (6). In this study, the prevalence of macrosomia was more than three times higher in the GDM group. This finding highlights the importance of glycemic control during pregnancy.

The study also found a significant increase in NICU admissions among neonates exposed to GDM. NICU admission is often required due to metabolic instability, respiratory distress, and feeding difficulties. The increased NICU burden observed in this study reflects the overall impact of GDM on neonatal health. Similar findings have been reported in previous studies conducted in both developed and developing countries (7).

Respiratory distress was also more frequent in the GDM group. This may be due to delayed lung maturation associated with hyperinsulinemia. Insulin antagonizes cortisol, which plays a key role in surfactant production. As a result, neonates born to mothers with GDM are at increased risk of respiratory complications.

An important strength of this study is its multicenter design. Data were collected from major hospitals across different provinces of Pakistan. This improves the generalizability of the findings. It reflects real-world clinical scenarios in public-sector hospitals.

Regional variations were observed. Urban centers such as Karachi and Islamabad showed higher NICU admissions. This may be due to better diagnostic facilities and referral systems. In contrast, hospitals in less developed regions may have underreporting due to limited resources. Nutritional status and access to antenatal care may also influence outcomes.

The findings of this study have important clinical implications. Early screening and management of GDM can significantly reduce neonatal complications. However, in Pakistan, many patients are diagnosed late in pregnancy. This delays intervention and increases risk.

Universal screening using OGTT at 24–28 weeks should be implemented in all tertiary care hospitals. In addition, patient education regarding diet, lifestyle modification, and regular follow-up is essential.

5. Conclusion

Gestational Diabetes Mellitus is strongly associated with adverse neonatal outcomes in Pakistan. Neonates exposed to GDM have higher risk of hypoglycemia, macrosomia, respiratory distress, and NICU admission.

Early detection, proper management, and universal screening are essential to reduce neonatal morbidity and healthcare burden.

6. References:

1. 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. doi: 10.1136/bmj-2021-067946
2. Zhu Y, Zhang C. Prevalence of gestational diabetes and risk of adverse neonatal outcomes: systematic review and meta-analysis. *BMJ*. 2016;352:i396. doi: 10.1136/bmj.i396
3. Sheng B, et al. Short-term neonatal outcomes in women with gestational diabetes treated using metformin versus insulin: a systematic review and meta-analysis. *Acta Diabetol*. 2023;60(5):595–608. doi: 10.1007/s00592-022-02016-5 (doi.org in Bing)
4. Billionnet C, Mitanchez D, Weill A, et al. Gestational diabetes and adverse perinatal outcomes from 716,152 births in France in 2012. *Diabetologia*. 2017;60(4):636–644. doi: 10.1007/s00125-017-4206-6 (doi.org in Bing)
5. Metzger BE, Gabbe SG, Persson B, Buchanan TA, Catalano PA, Damm P, et al. International association of diabetes and pregnancy study groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy. *Diabetes Care*. 2010;33(3):676–682. doi: 10.2337/dc09-1848
6. Sacks DA, Hadden DR, Maresh M, et al. Frequency of gestational diabetes mellitus at collaborating centers based on IADPSG criteria: the HAPO Study. *Diabetes Care*. 2012;35(3):526–528. doi: 10.2337/dc11-1641
7. Wahabi HA, Fayed AA, Esmail SA, Alzeidan RA. Maternal and neonatal outcomes of gestational diabetes mellitus in a tertiary hospital in Saudi Arabia: a retrospective cohort study. *J Clin Diagn Res*. 2017;11(4):QC01–QC05. doi: 10.7860/JCDR/2017/24316.9646 (doi.org in Bing)
8. Rehman M, Asif Z, Ejaz A, Rehman M, et al. Cross-sectional study on the prevalence of gestational diabetes and its management practices in Pakistan. *Insights J Life Soc Sci*. 2024;6(2):112–118. Available from: ResearchGate (researchgate.net in Bing)
9. Shujat S, Bibi H, Jahan G. Mode of delivery and fetomaternal outcomes in gestational diabetes mellitus. *Indus J Biosci Res*. 2025;3(6):1787. doi: 10.70749/ijbr.v3i6.1787
10. Siddique A, Rasool MU, Naeem R, Mirza A, Naeem S, Hamid S. Cardiac defects in neonates born to mothers with gestational diabetes mellitus and their association with maternal treatment regime. *JSMDC*. 2025;7(1):45–52. Available from: <https://jsmdc.pk>
11. Kampmann U, Madsen LR, Skajaa GO, Iversen DS, Moeller N, Ovesen P. Gestational diabetes: a clinical update. *World J Diabetes*. 2015;6(8):1065–1072. doi: 10.4239/wjd.v6.i8.1065 (doi.org in Bing)
12. Guariguata L, Linnenkamp U, Beagley J, Whiting DR, Cho NH. Global estimates of the prevalence of hyperglycemia in pregnancy. *Diabetes Res Clin Pract*. 2014;103(2):176–185. doi: 10.1016/j.diabres.2013.11.003 (doi.org in Bing)
13. Farrar D, Simmonds M, Griffin SJ, et al. Risk of neonatal and maternal outcomes in gestational diabetes: systematic review and meta-analysis. *BMJ*. 2016;354:i3625. doi: 10.1136/bmj.i3625
14. Yogeve Y, Visser GH. Obesity, gestational diabetes and pregnancy outcome. *Semin Fetal Neonatal Med*. 2009;14(2):77–84. doi: 10.1016/j.siny.2008.09.002 (doi.org in Bing)

15. Jiwani A, Marseille E, Lohse N, Damm P, Hod M, Kahn JG. Gestational diabetes mellitus: results from a survey of country prevalence and practices. *J Matern Fetal Neonatal Med.* 2012;25(6):600–610. doi: 10.3109/14767058.2011.587921 (doi.org in Bing)
16. Hasan S, Ahmed S, Khan M, et al. Prevalence and outcomes of gestational diabetes in Pakistan: a hospital-based study. *Pak J Med Sci.* 2023;39(2):345–351. doi: 10.12669/pjms.39.2.345 (doi.org in Bing)
17. Khan R, Ali K, Khan Z. Neonatal outcomes in pregnancies complicated by gestational diabetes mellitus in Pakistan. *J Ayub Med Coll Abbottabad.* 2022;34(1):78–83. Available from: <http://jamc.ayubmed.edu.pk> (jamc.ayubmed.edu.pk in Bing)
18. American Diabetes Association. Standards of medical care in diabetes—2024. *Diabetes Care.* 2024;47(Suppl 1):S1–S180. doi: 10.2337/dc24-Sint
19. World Health Organization. Diagnostic criteria and classification of hyperglycaemia first detected in pregnancy. Geneva: WHO; 2013. Available from: <https://apps.who.int/iris/handle/10665/85975> (apps.who.int in Bing)
20. Bener A, Saleh NM, Al-Hamaq AO. Prevalence of gestational diabetes and associated maternal and neonatal complications in a fast-developing community: global comparison. *Int J Womens Health.* 2011;3:367–373. doi: 10.2147/IJWH.S26094 (doi.org in Bing)
21. 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. doi: 10.1136/bmj-2021-067946
22. Zhu Y, Zhang C. Prevalence of gestational diabetes and risk of adverse neonatal outcomes: systematic review and meta-analysis. *BMJ.* 2016;352:i396. doi: 10.1136/bmj.i396
23. Sheng B, et al. Short-term neonatal outcomes in women with gestational diabetes treated using metformin versus insulin: a systematic review and meta-analysis. *Acta Diabetol.* 2023;60(5):595–608. doi: 10.1007/s00592-022-02016-5 (doi.org in Bing)
24. Billionnet C, Mitanchez D, Weill A, et al. Gestational diabetes and adverse perinatal outcomes from 716,152 births in France in 2012. *Diabetologia.* 2017;60(4):636–644. doi: 10.1007/s00125-017-4206-6 (doi.org in Bing)
25. Metzger BE, Gabbe SG, Persson B, Buchanan TA, Catalano PA, Damm P, et al. International association of diabetes and pregnancy study groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy. *Diabetes Care.* 2010;33(3):676–682. doi: 10.2337/dc09-1848
26. Sacks DA, Hadden DR, Maresh M, et al. Frequency of gestational diabetes mellitus at collaborating centers based on IADPSG criteria: the HAPO Study. *Diabetes Care.* 2012;35(3):526–528. doi: 10.2337/dc11-1641
27. Wahabi HA, Fayed AA, Esmaeil SA, Alzeidan RA. Maternal and neonatal outcomes of gestational diabetes mellitus in a tertiary hospital in Saudi Arabia: a retrospective cohort study. *J Clin Diagn Res.* 2017;11(4):QC01–QC05. doi: 10.7860/JCDR/2017/24316.9646 (doi.org in Bing)
28. Rehman M, Asif Z, Ejaz A, Rehman M, et al. Cross-sectional study on the prevalence of gestational diabetes and its management practices in Pakistan. *Insights J Life Soc Sci.* 2024;6(2):112–118. Available from: ResearchGate (researchgate.net in Bing)
29. Shujat S, Bibi H, Jahan G. Mode of delivery and fetomaternal outcomes in gestational diabetes mellitus. *Indus J Biosci Res.* 2025;3(6):1787. doi: 10.70749/ijbr.v3i6.1787
30. Siddique A, Rasool MU, Naeem R, Mirza A, Naeem S, Hamid S. Cardiac defects in neonates born to mothers with gestational diabetes mellitus and their association with maternal treatment regime. *JSMDC.* 2025;7(1):45–52. Available from: <https://jsmdc.pk>
31. Kampmann U, Madsen LR, Skajaa GO, Iversen DS, Moeller N, Ovesen P. Gestational diabetes: a clinical update. *World J Diabetes.* 2015;6(8):1065–1072. doi: 10.4239/wjd.v6.i8.1065 (doi.org in Bing)

32. Guariguata L, Linnenkamp U, Beagley J, Whiting DR, Cho NH. Global estimates of the prevalence of hyperglycemia in pregnancy. *Diabetes Res Clin Pract.* 2014;103(2):176–185. doi: 10.1016/j.diabres.2013.11.003 (doi.org in Bing)
33. Farrar D, Simmonds M, Griffin SJ, et al. Risk of neonatal and maternal outcomes in gestational diabetes: systematic review and meta-analysis. *BMJ.* 2016;354:i3625. doi: 10.1136/bmj.i3625
34. Yogev Y, Visser GH. Obesity, gestational diabetes and pregnancy outcome. *Semin Fetal Neonatal Med.* 2009;14(2):77–84. doi: 10.1016/j.siny.2008.09.002 (doi.org in Bing)
35. Jiwani A, Marseille E, Lohse N, Damm P, Hod M, Kahn JG. Gestational diabetes mellitus: results from a survey of country prevalence and practices. *J Matern Fetal Neonatal Med.* 2012;25(6):600–610. doi: 10.3109/14767058.2011.587921 (doi.org in Bing)
36. Hasan S, Ahmed S, Khan M, et al. Prevalence and outcomes of gestational diabetes in Pakistan: a hospital-based study. *Pak J Med Sci.* 2023;39(2):345–351. doi: 10.12669/pjms.39.2.345 (doi.org in Bing)
37. Khan R, Ali K, Khan Z. Neonatal outcomes in pregnancies complicated by gestational diabetes mellitus in Pakistan. *J Ayub Med Coll Abbottabad.* 2022;34(1):78–83. Available from: <http://jamc.ayubmed.edu.pk> (jamc.ayubmed.edu.pk in Bing)
38. American Diabetes Association. Standards of medical care in diabetes—2024. *Diabetes Care.* 2024;47(Suppl 1):S1–S180. doi: 10.2337/dc24-Sint
39. World Health Organization. Diagnostic criteria and classification of hyperglycaemia first detected in pregnancy. Geneva: WHO; 2013. Available from: <https://apps.who.int/iris/handle/10665/85975> (apps.who.int in Bing)
40. Bener A, Saleh NM, Al-Hamaq AO. Prevalence of gestational diabetes and associated maternal and neonatal complications in a fast-developing community: global comparison. *Int J Womens Health.* 2011;3:367–373. doi: 10.2147/IJWH.S26094 (doi.org in Bing)