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GESTATIONAL DIABETES MELLITUS A PREDICTOR OF POSTPARTUM DEPRESSION: AN INTEGRATIVE EVIDENCE REVIEW

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ABSTRACT:
Gestational diabetes mellitus (GDM) and postpartum depression (PPD) are among the most frequent complications of the perinatal period. Growing evidences suggests that GDM may represent an independent risk factor for subsequent depressive symptoms. However, recent cohort studies and meta-analyses consistently demonstrate an increased likelihood of postpartum depression in women with gestational diabetes mellitus compared with those without, although reported effect sizes range from modest to substantial depending on study design, timing of assessment, and adjustment for confounding variables such as pre-pregnancy mental health, body-mass index, and sociodemographic characteristics. Biological mechanisms linking gestational diabetes mellitus to postpartum depression include insulin resistance, systemic inflammation, and hypothalamic–pituitary–adrenal axis alterations, while psychosocial contributors encompass the stress of a chronic pregnancy complication, concerns about infant health, and heightened caregiving burden. Despite heterogeneity across studies, the overall evidence supports a clinically relevant association underscoring the importance of integrating targeted mental health screening and surveillance into routine care for women diagnosed with gestational diabetes mellitus. Future investigations should incorporate standardized diagnostic frameworks, rigorously designed prospective cohorts, and integrative biomarker-based methodologies to elucidate mechanistic pathways and delineate high-risk subpopulations most amenable to targeted preventive interventions.

KEYWORDS: Gestational, Diabetes, Postpartum, Depression, Perinatal, Mental health.

GRAPHICAL ABSTRACT

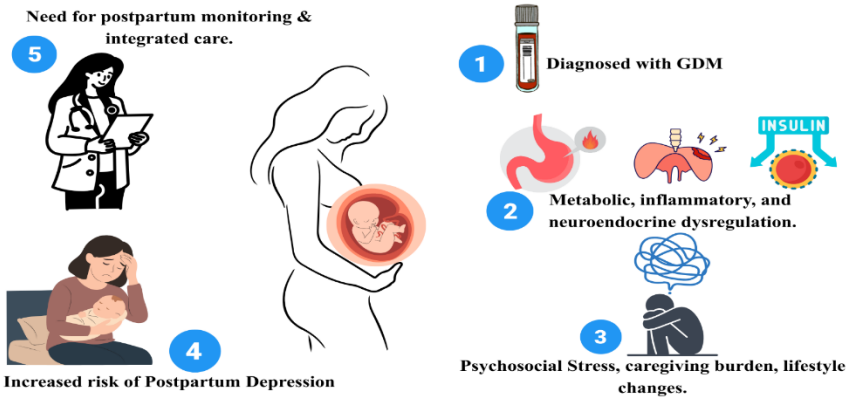

Figure 1: Graphical abstract showing link between gestational diabetes mellitus and risk of postpartum depression.

1. INTRODUCTION

Recent epidemiological evidence highlights a significant overlap between gestational diabetes mellitus (GDM) and postpartum depression (PPD). Women diagnosed with GDM exhibit nearly twice the likelihood of developing depressive symptoms after delivery compared with normoglycemic counterparts. The association persists even after adjustment for confounders such as age, parity, and socioeconomic status, suggesting a possible biological link beyond psychosocial stress. Proposed mechanisms include chronic low-grade inflammation, hormonal dysregulation, and insulin resistance influencing neurotransmitter balance. These findings underscore the need for integrated screening strategies that address both metabolic and mental health

during the perinatal period, promoting early identification and intervention for high-risk mothers (Azami et al., 2019). Globally, the prevalence of GDM varies widely depending on the diagnostic criteria used, population characteristics and screening protocols, but many studies estimate a prevalence in the range of approximately 7 %–15 % of pregnancies (Avilez et al., 2025). GDM is a clinically important condition because it is associated with maternal complications such as pre-eclampsia, gestational hypertension, increased rate of caesarean section, and longer-term risk of developing type 2 diabetes mellitus after pregnancy (Kunarathnam et al., 2025). The fetal/neonatal complications associated with GDM include fetal macrosomia, neonatal hypoglycaemia, shoulder dystocia, respiratory distress, and elevated perinatal morbidity and mortality in some settings (Akter et al., 2023).

Postpartum depression (PPD) is broadly defined as a major depressive episode with onset within the first 4-12 weeks after childbirth, though many studies extend the period to up to a year postpartum, reflecting the perinatal period of increased vulnerability (Khamidullina et al., 2025). It affects approximately 10–20 % of women globally, with meta-analyses of healthy mothers (without prior depression) estimating a prevalence of around 14–17 % (95 % CI 15–20 %) and higher rates in low- and middle-income countries. Given both the metabolic burden of GDM and the psychological burden of PPD, exploring their intersection is critical in the context of perinatal health (Shorey et al., 2018).

1.1 Health Significance

Gestational diabetes mellitus (GDM) carries enduring metabolic implications beyond pregnancy. A recent meta-analysis involving 46 studies and nearly 200,000 women found that progression from GDM to type 2 diabetes mellitus (T2DM) is strongly associated with markers such as pre-pregnancy body mass index (BMI) (OR ≈ 2.97, 95% CI 2.16-4.07), post-partum BMI (OR ≈ 4.17, 95% CI 2.58-6.74), insulin use during pregnancy (OR ≈ 4.35, 95% CI 3.17-5.96) and hypertension (OR ≈ 5.19, 95% CI 1.31-20.51) (Chen et al., 2024). In a large cohort of over 90,000 parous women with up to 30 years of follow-up, a history of GDM was linked to a 25% higher risk of all-cause mortality (adjusted HR 1.25, 95% CI 1.11-1.41) and a 59% increased risk of cardiovascular mortality (HR 1.59, 95% CI 1.03-2.47) (Wang et al., 2023). These findings point to GDM not simply as a transient pregnancy event but as a sentinel marker for long-term maternal health risk. Postpartum depression (PPD) likewise exerts profound consequences on maternal and child health. A 2024 cohort study reported that 31.8% of new mothers screened positive for elevated depressive symptoms (EPDS ≥ 10) and their infants had higher odds of developmental delay (23.0% vs 12.2%; OR 1.77, 95% CI 1.10–2.80) in domains of language, fine motor and socioemotional function (Alfayumi-Zeadna et al., 2025). A further investigation found persistent PPD correlated with lower maternal self-efficacy scores and poorer infant developmental behaviour ($\beta = -0.657$, $P < 0.001$), with maternal self-efficacy mediating 54.8% of the effect (Wu et al., 2025). These data underscore how PPD can disrupt mother–infant bonding, elevate parenting stress and impede infant developmental trajectories, making early detection and integrated perinatal mental-health care crucial.

1.2 Risk Factors and Significance of Study

Gestational diabetes mellitus (GDM) and postpartum depression (PPD) share several overlapping biological and psychosocial risk factors that may explain their co-occurrence. Hormonal fluctuations during pregnancy, particularly in cortisol, progesterone, and estrogen, can dysregulate the hypothalamic pituitary adrenal (HPA) axis, influencing both glucose metabolism and mood regulation (Zhang et al., 2016). Modifiable factors primarily involve lifestyle behaviors, including poor dietary patterns particularly high intake of refined carbohydrates and low fiber physical inactivity, and excessive gestational weight gain. While lifestyle interventions focusing on diet and exercise have demonstrated potential in reducing GDM risk, their effectiveness varies across populations, timing, and intervention strategies. Recognizing these factors is critical for early identification of high-risk women and for implementing timely prevention strategies to improve both maternal and neonatal outcomes (Zhang et al., 2016). Insulin resistance and chronic low-grade inflammation, common in GDM, are associated with neurochemical changes that increase susceptibility to depressive symptoms (Catalano et al., 2003). Additionally, psychosocial stressors, including poor social support, adverse life events, and anxiety during pregnancy, further elevate the risk of both metabolic dysregulation and mood disorders (Horsch et al., 2016). Additionally, increased anxiety and depressive symptoms, along with higher general distress levels, were linked to higher fasting glucose levels. However, when adjusting for age and body mass index (BMI), the associations between general distress and sleep duration with fasting glucose were no longer significant. Interestingly, physiological stress responses, such as salivary cortisol and plasma copeptin levels, did not show a significant association with glucose concentrations during pregnancy. Taken together, these findings underscore a multidimensional interplay between biological and psychosocial pathways, supporting the rationale that women with GDM are at increased risk of developing PPD, highlighting the need for integrated perinatal screening and intervention strategies.

2. Hormonal Dysregulation and Gestational Diabetes Metabolic Mechanisms

Gestational diabetes mellitus (GDM) induces significant hormonal changes during pregnancy, which may persist postpartum, contributing to long-term metabolic risks. Key hormones involved include cortisol, progesterone, estrogen, prolactin, and placental lactogen. Elevated cortisol levels can impair insulin sensitivity,

while increased progesterone and estrogen levels promote insulin resistance to ensure adequate glucose supply for fetal development. Prolactin and placental lactogen further modulate maternal metabolism by influencing insulin secretion and glucose utilization. These hormonal adaptations are essential for fetal growth but can lead to metabolic disturbances when dysregulated, highlighting the need for monitoring and management during and after pregnancy. Understanding these hormonal changes is crucial for developing strategies to mitigate the long-term health impacts of GDM (Ornoy et al., 2021; Melero et al., 2023) (Table 1).

Table 1: Impact of Key Hormones on Gestational Diabetes and Postpartum Depression: Mechanisms and Evidence-Based Insights.

Hormone	Role in Pregnancy and Postpartum	Effect on Gestational Diabetes (GD)	Effect on Postpartum Depression (PPD)	References
Estrogen (Estradiol)	Elevated during pregnancy, reduced postpartum	Induces insulin resistance; reduced risk of GD.	Rapid decline postpartum may contribute to mood instability.	Abou-Saleh et al., 1998; Barros et al., 2008
Progesterone	Elevated throughout pregnancy, reduced after delivery	Enhances insulin resistance; may worsen GD.	Sudden drop postpartum linked to mood swings.	Brănişteanu, & Mathieu, 2008
Cortisol	Elevated during pregnancy, increased stress response	Elevated levels associated with insulin resistance and hyperglycemia.	High levels associated with depression and anxiety.	AlShaibani et al., 2024
Prolactin	Elevated level for lactation	May improve β-cell function; potential protective effect against GD.	Dysregulation linked to mood disorders; increased risk of PPD.	Cheng et al., 2022
Oxytocin	Elevated during labor and breastfeeding	May improve glucose metabolism; slight protective role in GD	High levels linked to positive mood and bonding; reduces PPD risk	Thul et al., 2020
Thyroid Hormones (T3, T4)	Elevated slightly in pregnancy	Hypothyroidism increases GD risk	Dysregulation linked to mood disorders; potential risk factor for PPD.	Backer et al., 2023

3. Neuroendocrine and Psychosocial Determinants of GDM and PPD

Gestational Diabetes Mellitus (GDM) and Postpartum Depression (PPD) are increasingly recognized as interrelated conditions, with both neuroendocrine changes and psychosocial factors contributing to their development (Trifu et al., 2019). During pregnancy, significant fluctuations in hormones including estrogen, progesterone, cortisol, prolactin, oxytocin, and thyroid hormones affect both metabolic regulation and mood (Kumar and Magon, 2012). In GDM, placental hormones such as human placental lactogen and progesterone promote insulin resistance, contributing to hyperglycemia. These metabolic disturbances can influence central nervous system function, altering neurotransmitter systems, including GABAergic and monoaminergic pathways, and increasing susceptibility to mood disorders (Maguire, 2019). Following childbirth, the abrupt drop in estrogen and progesterone together with continued activation of the hypothalamic-pituitary-adrenal (HPA) axis due to stress or ongoing metabolic imbalance can trigger neuroendocrine vulnerability to PPD (Zhang et al., 2024). Neuroactive steroids which modulate inhibitory GABAergic signaling appear to play a key role in mood regulation, highlighting a mechanistic connection between metabolic disturbances in GDM and postpartum mood disorders. Psychosocial stressors including inadequate social support, sleep disruption, and financial or caregiving pressures further heighten the risk of PPD in women with GDM. Managing a high-risk pregnancy often imposes additional psychological burden, which may amplify HPA axis dysregulation and inflammatory pathways associated with both insulin resistance and mood disturbances (Yim et al., 2015). The interaction between these metabolic and psychosocial factors suggests a bidirectional relationship, underscoring the need for integrated approaches to screening and management during pregnancy and the postpartum period.

4. Epidemiological evidence

4.1 Prevalence of PPD among women with GDM

Reported prevalence of postpartum depressive symptoms in women diagnosed with GDM varies widely across settings and study designs. Estimates in recent systematic reviews and primary studies range from low single digits to nearly half of studied cohorts (examples reported between ≈6.5% and ≈48.4%), reflecting heterogeneity in screening instruments, timing of assessment, and population characteristics (Alqahtani et al., 2024). On average, meta-analytic synthesis indicates that GDM is associated with an increased risk of postpartum depressive symptomatology compared with pregnancies without GDM. A pooled estimate from a comprehensive meta-analysis reported a relative risk (RR) of approximately 1.59 (95% CI 1.22–2.07) although heterogeneity among studies remained substantial (Azami et al., 2019). A more recent meta-analysis and pooled studies (including perinatal depression outcomes) also found a modest but statistically meaningful association between GDM and perinatal depressive outcomes with relative risks generally indicating increased odds of depression among women with GDM. Regional differences and variations in case ascertainment (clinical diagnosis vs. screening questionnaire cutoffs) account for part of the variability (Jin et al., 2024).

4.2 Risk-factor analysis

Multiple factors mediate or moderate the association between GDM and PPD including biological or metabolic mediators such as insulin resistance, systemic low-grade inflammation, altered HPA-axis activity, and peripartum hormonal shifts (estrogen/progesterone, cortisol, thyroid function, neuroactive steroids). These are biologically tenable mediators linking GDM to depressive symptoms. Recent literature emphasises that both chronic low-grade inflammation and neuroendocrine dysregulation serve as credible mechanistic pathways linking metabolic conditions such as Gestational Diabetes Mellitus (GDM) with mood-related disorders including Postpartum Depression (PPD). Elevated pro-inflammatory cytokines, activation of the kynurenine pathway, and disrupted hypothalamic–pituitary–adrenal (HPA) axis function have all been identified in PPD, while insulin resistance altered placental hormone milieu and persistent inflammatory signalling characterize GDM (Tan et al., 2024). Another risk factor includes obstetric and treatment factors which encloses severity of glycaemic dysregulation, need for pharmacologic therapy (insulin), obstetric complications, and neonatal outcomes (e.g., NICU admission) can increase maternal stress and are associated with higher PPD risk in some longitudinal studies (Žutić et al., 2024) (Fig. 2). Another risk factor are sociodemographic moderators which includes pre-pregnancy BMI, socioeconomic status, limited social support, prior psychiatric history, and exposure to psychosocial stressors modify risk. Several cohort studies show stronger GDM–PPD associations among women with particular sociodemographic profiles (e.g., normal BMI in one study showed a bidirectional relationship) (Žutić et al., 2024). On the other hand, timing and measurement remain other risk factor which includes the choice of screening tool (e.g., EPDS cut point), and timing of assessment (early postpartum vs. later months) influence observed prevalences and effect sizes; studies that use clinical diagnostic interviews typically report different absolute rates than those using self-report screening scales (Azami et al., 2019) (Table 2).

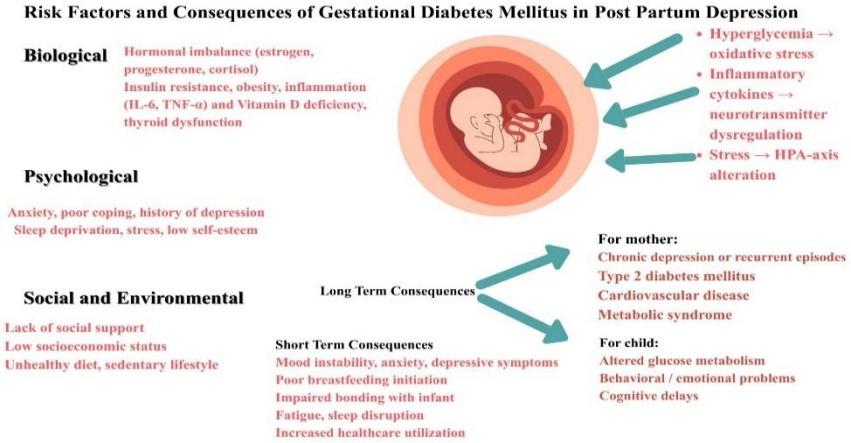

Fig. 2: Risk Factors and Consequences of Gestational diabetes Mellitus in Post Partum Depression.

Table 2: Recent Studies on Psychosocial and Lifestyle Factors in Women with GDM and Postpartum Depression.

Experimental Design	Exposure / Intervention	Outcome Measured	Key findings	Reference

RCT, INTER-ACT	Postpartum lifestyle programme (diet + physical activity + behaviour change)	Depressive symptoms (short-term)	Short-term improvement in depressive symptoms among normal/overweight women receiving the INTER-ACT intervention vs usual care.	Van Uytsel et al., 2023
RCT (HIPP behavioural trial); N = large pregnancy sample	Behavioural intervention spanning pregnancy → 6 mo postpartum (diet, PA, support)	PA, diet, HRQoL, depressive symptoms	No significant difference in PA/diet/HRQoL at 6–12 mo; highlights challenges of sustained behaviour change postpartum.	Wilcox et al., 2024
1-yr prospective, multicentre	Blended mobile lifestyle intervention after recent GDM	Metabolic outcomes; depressive symptoms secondary	Mobile programme improved some metabolic markers; psychosocial impacts reported and warrant further study.	Minschart et al., 2024
Prospective cohort; N = regional birth cohort	GDM diagnosis (exposure)	Peripartum depression (screened)	Found a bidirectional association between GDM and peripartum depression in women with normal pre-pregnancy BMI (effect modification by BMI).	Žutić et al., 2024
Randomised, single-centre, blinded; N = trial sample	Tailored behavioural + psychosocial strategies (diet, PA, social support)	Composite: diet, PA, mental-health outcomes	Intervention targeted multiple domains; demonstrated feasibility and positive signals for combined metabolic/mental-health outcomes.	Quansah et al., 2024
Cross-sectional / observational; N = community sample	Measured perceived social support	Self-reported postpartum depressive symptoms	Low perceived social support strongly associated with higher postpartum depressive symptom scores.	Holicky et al., 2024
Systematic review / meta-analysis of PA studies	Antenatal and postpartum physical activity	Postnatal depression	Regular physical activity associated with reduced postnatal depressive symptoms; supports exercise as preventive strategy.	Kołomańska-Bogucka et al., 2019
Review of influencing factors	Multiple psychosocial/lifestyle factors (GDM included)	PPD risk	GDM is identified as a risk factor for PPD; psychosocial and neonatal factors modulate risk.	Tan et al., 2024

5. Psychosocial and Lifestyle Factors

Psychosocial stressors have a significant impact on both metabolic regulation in gestational diabetes mellitus (GDM) and the probability of postpartum depression. Low perceived social support, high life stress, and a prior psychiatric history all predict increased postpartum depressive symptoms, and social isolation is a significant indicator of PPD across settings. Sustained psychosocial stress also activates the hypothalamic-pituitary-adrenal axis and systemic inflammatory signaling, which may aggravate insulin resistance in GDM while increasing vulnerability to mood disorders (White et al., 2023). Behavioral decisions during pregnancy and the postpartum period, notably nutrition quality, physical activity (PA), and weight management, influence both glycaemic outcomes and perinatal mental health. Programmed physical activity and dietary interventions during pregnancy reduce excessive gestational weight gain and lower GDM incidence and severity; similar multicomponent programs delivered in the peripartum period are associated with improved postpartum weight trajectories and metabolic markers in women with prior GDM (Papadopoulou et al., 2023). Furthermore, the financial strain of managing GDM (dietary restriction, frequent monitoring, and pharmaceutical therapy) increases psychological distress for many patients, leading to a bidirectional relationship in which metabolic dysregulation and treatment burden increase the risk of depression, whereas depressive symptoms impair adherence to lifestyle recommendations (Ouyang et al., 2021).

6. Clinical Implications

Routine screening for perinatal depression is effective in identifying affected individuals and enabling timely treatment; recommended practice is to screen at multiple perinatal timepoints using validated instruments (for example, the Edinburgh Postnatal Depression Scale) and to ensure systems for follow-up and referral are in place (Kendall-Tackett, 2024). Several studies and reviews recommend targeted mental-health screening during pregnancy and the early postpartum period because of the observed elevated prevalence of depressive symptoms in this group and the additional metabolic stressors they experience (Kendall-Tackett et al., 2024). Barriers to

effective screening and postpartum metabolic follow-up include limited access to services, competing clinical priorities, and low uptake of recommended postpartum glucose testing; integrated care pathways that combine diabetes follow-up with perinatal mental-health assessment can improve detection and continuity of care (Brown et al., 2022).

7. Preventive Interventions and Management

Emerging evidence highlights several scalable preventive and therapeutic strategies to address postpartum depression (PPD) among women with gestational diabetes mellitus (GDM). Psychological preventive programmed particularly cognitive-behavioral and interpersonal interventions tailored to the perinatal period have demonstrated efficacy in reducing PPD incidence among high-risk women. Brief antenatal or early postpartum approaches, such as the PREPP and Mothers and Babies programmes, have proven effective when supported by structured referral systems, while digital and web-based cognitive-behavioral therapy (CBT) adaptations further enhance accessibility and adherence. Complementary lifestyle interventions that integrate dietary counselling, physical activity promotion, and behavioral support throughout pregnancy and the postpartum period yield improvements in metabolic profiles and depressive symptoms, particularly when designed with flexible, family-oriented, and remote delivery options (Grubb et al., 2024). Additionally, integrated care models that embed depression screening and psychological support within diabetes or obstetric clinics show promise in improving both metabolic and mental health outcomes. Current guidelines recommend comprehensive postnatal pathways combining glycaemic monitoring, mental health assessment, and timely referral to ensure holistic management of women at the intersection of metabolic and affective vulnerability (Werner et al., 2016).

8. CONCLUSION

Current research illustrates a multifaceted relationship between gestational diabetes mellitus (GDM) and postpartum depression (PPD), which is mediated by neuroendocrine, inflammatory, metabolic, and psychological factors. Women with GDM are substantially more likely to have PPD due to hormonal changes, insulin resistance, and increased stress reactivity, which are exacerbated by psychosocial stressors such as insufficient assistance, socioeconomic constraints, and body image difficulties. The clinical significance of this association derives from the possibility of early detection and targeted intervention throughout pregnancy and postpartum periods. Integrating metabolic and mental health screening into obstetric and diabetes treatment can result in a more rapid diagnosis and enhanced maternal health. Preventive interventions, including as lifestyle modification, cognitive behavioral therapy, and collaborative treatment models, have shown demonstrable benefits in reducing the signs of depression and enhancing postpartum recovery.

9. Future Directions

Future research ought to concentrate on prolonged, ethnically diverse cohort research in order to establish a connection among dysregulation of metabolism and psychological consequences. Advanced omics technologies and neuroimaging could identify biomarkers that predict PPD risk in women with GDM. Furthermore, adaptable, digitally delivered treatments that include metabolic monitoring and mental health support necessitate meticulous consideration. Establishing comprehensive, interdisciplinary postnatal care frameworks incorporating endocrinology, psychiatry, and medical professionals will be crucial for developing targeted preventive maternal mental health intervention.

10. Conflict of Interest

The authors declare no conflicts of interest relevant to this manuscript.

11. ACKNOWLEDGEMENT

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12. Authors Contribution

Leeyan Dias conceptualized the study, performed the literature review, led the writing of the original manuscript draft, contributed to the methodological framework, data interpretation, and critical revision of the manuscript. Sumita Kumari provided supervision, refined the scope of the review, and contributed to final approval. All authors have read and approved the final manuscript.

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