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Long-Term Maternal Outcomes of Gestational Diabetes Mellitus: A Systematic Review of Evidence from Low- and Middle-Income Countries

Samantha N. A. Kennedy

Ministry of Health, Primary Healthcare Department, Georgetown, Guyana
Email: samanthakennedy24@hotmail.com

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Abstract

Gestational diabetes mellitus (GDM) is one of the most prevalent metabolic complications of pregnancy, with incidence rising particularly sharply in low- and middle-income countries (LMICs). Despite bearing the greatest share of the global GDM burden, LMIC populations are substantially underrepresented in systematic reviews examining long-term maternal outcomes. This review aimed to synthesise available evidence on long-term maternal outcomes of GDM in LMIC settings, examine health system factors shaping postpartum detection and follow-up, and identify gaps relative to the broader global literature. A structured search of PubMed, Scopus, and Google Scholar was conducted following PRISMA 2020 guidelines. Eighteen peer-reviewed studies published between 2014 and 2024 — covering Ethiopia, sub-Saharan Africa, South Africa, India, Iran, and multi-country LMIC contexts — were included. Given methodological heterogeneity across study designs, populations, and outcome measures, a narrative synthesis approach was adopted. Four thematic domains emerged. First, postpartum progression to type 2 diabetes (T2D) and dysglycaemia was the most consistently documented outcome, with rapid conversion documented in South Asian and Ethiopian cohorts. Second, metabolic syndrome and cardiometabolic risk were measurably elevated as early as six to twelve weeks postpartum, with in-hospital glucose testing demonstrated to be an inadequate substitute for the recommended OGTT. Third, GDM burden across LMIC regions is substantially higher than current prevalence estimates suggest, due to the systematic inadequacy of risk-factor-based screening. Fourth, pervasive health system and diagnostic barriers — fragmented care transitions, personnel shortfalls, and absent postpartum follow-up pathways — render long-term GDM monitoring the exception rather than the rule. GDM in LMIC settings carries serious, predictable, and largely preventable long-term maternal health consequences that current health systems are not organised to detect or address. Integrating evidence-based postpartum surveillance and

cardiometabolic monitoring into LMIC clinical and policy frameworks is both clinically essential and a matter of global health equity.

Keywords

Gestational diabetes mellitus, long-term maternal outcomes, low- and middle-income countries, type 2 diabetes, postpartum surveillance, cardiometabolic risk, metabolic syndrome, systematic review

1. Introduction

Gestational diabetes mellitus (GDM) is increasingly recognised as a significant global public health concern affecting maternal health. According to Plows et al. (2018), GDM prevalence is rising across all world regions, driven by a convergence of biological and environmental factors that reflect broader disruptions in metabolic regulation during pregnancy. The condition has become one of the most common metabolic complications of pregnancy, with rates climbing particularly sharply in populations experiencing rapid dietary and lifestyle transitions. Chiefari et al. (2017) explain that GDM is a major pregnancy complication worldwide and that its increasing frequency is closely tied to global trends in overweight and sedentary behaviour. As a result, GDM is now understood as a condition warranting sustained clinical attention, no longer addressable by approaches designed for an era of far lower prevalence.

In addition to its growing prevalence, GDM reflects broader changes in population health, particularly in relation to metabolic disorders. Plows et al. (2018) suggest that the metabolic disruptions underlying GDM — including altered insulin sensitivity and pancreatic function — do not consistently resolve after delivery, signalling a biological vulnerability that persists beyond pregnancy. These trends indicate that GDM's burden cannot be assessed by examining its immediate obstetric presentation alone. Consequently, its global scale continues to expand, highlighting the need for a more longitudinal understanding of what a GDM diagnosis means for a woman's health across her life course.

Traditionally, research on gestational diabetes mellitus focused primarily on short-term pregnancy complications such as macrosomia, preterm delivery, and neonatal hypoglycaemia. However, growing evidence suggests that GDM's impact extends well beyond the delivery ward. Plows et al. (2018) argue that the pathophysiological mechanisms of GDM — particularly impaired insulin secretion and peripheral resistance — may persist postpartum, placing women at elevated risk of chronic metabolic disease. Similarly, Burlina et al. (2021) highlight that women with a prior GDM diagnosis face significantly increased rates of type 2 diabetes, hypertension, and metabolic syndrome in the years following pregnancy. This shift in understanding positions GDM as a marker of future chronic disease risk, requiring a broader perspective on maternal health outcomes that extends well past the postnatal period.

Understanding the long-term maternal outcomes of GDM is critical for reducing the burden of chronic disease. Vounzoulaki et al. (2020) found that women with a history of GDM were far more likely to develop type 2 diabetes than women with normoglycaemic pregnancies — a margin that remained statistically robust across different diagnostic criteria, study populations, and follow-up durations, with the risk steepest in the first decade following the index pregnancy. In addition, Dennison et al. (2021) report that GDM is independently associated with an elevated lifetime risk of cardiovascular disease, including coronary artery disease and hypertension. These findings reinforce the importance of long-term monitoring and preventive strategies that extend beyond the point of delivery.

Despite the growing body of research on GDM, there remains a significant gap in evidence from low- and middle-income countries (LMICs). Much of the existing literature is based on studies conducted in high-income settings with well-resourced healthcare systems that support regular screening and postpartum follow-up. Kanguru et al. (2014) note that data on GDM in LMICs are sparse, inconsistent, and insufficient to support reliable estimates of disease burden, with major gaps in diagnostic infrastructure and monitoring capacity. Muche et al. (2020) further explain that systemic limitations within LMIC health systems directly constrain GDM detection, resulting in populations where the condition is significantly underdiagnosed and its long-term consequences largely unmonitored.

Although individual studies have examined aspects of gestational diabetes, there is limited synthesis of evidence focusing specifically on long-term maternal outcomes in LMICs. Existing research is often geographically concentrated in affluent settings and fragmented across conditions and time periods in ways that hinder coherent conclusions. Burlina et al. (2021) suggest that a more structured synthesis of long-term GDM outcomes is necessary to establish a reliable evidence base for clinical guidance and public health policy. Furthermore, Dennison et al. (2021) highlight that cardiovascular outcomes research following GDM has been conducted almost exclusively in high-income populations, leaving a profound gap in knowledge about these risks among LMIC women.

Given these gaps, this study aims to systematically review and synthesise the available evidence on long-term maternal outcomes of gestational diabetes mellitus in low- and middle-income countries. Specifically, the study seeks to examine the nature and magnitude of GDM-related long-term health outcomes — including progression to type 2 diabetes, cardiovascular disease, and metabolic syndrome — and to assess how health system factors in LMIC settings influence the likelihood of those outcomes being detected and addressed. The research is guided by the following questions: 1. What does the existing evidence indicate regarding the long-term maternal health outcomes, including progression to type 2 diabetes, cardiovascular disease, and GDM recurrence, among women with a history of gestational diabetes mellitus in low- and middle-

income countries? 2. What health system-level factors in low- and middle-income countries influence the detection, management, and long-term follow-up of women with gestational diabetes mellitus, and how do these factors shape maternal outcomes over time? 3. To what extent does the existing evidence from low- and middle-income countries reflect the broader global literature on long-term maternal outcomes of gestational diabetes mellitus, and what gaps remain in terms of geographic representation, methodological rigour, and context-specific interventions?

This study makes an important contribution by addressing gaps in understanding long-term maternal outcomes associated with GDM in LMICs. From a theoretical perspective, the study advances a more geographically inclusive model of GDM that accounts for the structural conditions under which most affected women experience the condition. From a practical perspective, the findings may inform the design of postpartum monitoring programmes and non-communicable disease strategies in resource-constrained settings. The World Health Organization (2016) highlights that diabetes represents one of the most consequential and rapidly growing global health burdens, with the greatest projected increases occurring in low- and middle-income regions — precisely the settings this review examines.

2. Literature Review

Gestational diabetes mellitus is a condition with consequences that extend far beyond the gestational period. The following seven themes synthesise the existing literature on its long-term maternal health implications, with particular attention to the evidence base from low- and middle-income country settings.

2.1. Theme 1: Progression to Type 2 Diabetes

A substantial body of evidence demonstrates that gestational diabetes mellitus is a strong predictor of future type 2 diabetes. Rayanagoudar et al. (2016) found that women who experience GDM during pregnancy are several times more likely to develop type 2 diabetes than women whose pregnancies were normoglycaemic — a finding that held across diverse study populations, diagnostic criteria, and follow-up durations. Burlina et al. (2021) report that GDM is one of the most robust predictors of subsequent type 2 diabetes identified in the maternal health literature, with evidence drawn from longitudinal studies across multiple countries pointing toward a strong, reproducible association between a prior GDM diagnosis and later metabolic disease. These findings suggest that the physiological disruptions of a GDM-affected pregnancy leave a metabolic imprint that persists well beyond delivery.

In addition to the magnitude of risk, studies also emphasise its persistence. Rayanagoudar et al. (2016) note that the elevated T2D risk associated with GDM was not confined to the early postpartum years but continued to accumulate over extended follow-up periods, remaining statistically significant across studies with follow-up durations ranging from two to more than twenty years. This

prolonged risk may be influenced by body mass index, lifestyle behaviours, breastfeeding practices, and access to healthcare — variables whose distribution is distinctly unequal across high- and low-income settings. Vounzoulaki et al. (2020), through a meta-analysis synthesising data from over two million women, similarly confirmed that the elevated T2D risk following GDM persists across different diagnostic criteria and geographic settings, reinforcing the conclusion that GDM is a broadly applicable clinical signal warranting sustained long-term monitoring.

2.2. Theme 2: Cardiovascular and Metabolic Risks

Beyond the risk of type 2 diabetes, gestational diabetes mellitus has been increasingly associated with broader cardiovascular and metabolic complications. Dennison et al. (2021) found that women with a prior GDM diagnosis face significantly elevated long-term risks of cardiovascular disease, including hypertension, coronary artery disease, and heart failure, with these associations persisting across diverse study populations and independent of subsequent type 2 diabetes diagnosis. These cardiovascular associations were present even after adjusting for traditional risk factors, suggesting that GDM exerts an independent influence on vascular health.

From a physiological perspective, Plows et al. (2018) explain that the metabolic dysfunction underlying GDM — specifically the combination of peripheral insulin resistance and impaired pancreatic beta-cell secretory capacity — does not simply remit after delivery in all affected women, predisposing them to progressive vascular damage, dyslipidaemia, and systemic inflammation. Chiefari et al. (2017) highlight that GDM shares important pathophysiological pathways with a range of chronic non-communicable diseases, including type 2 diabetes and cardiovascular disease. In LMIC populations, where hypertension, obesity, and limited preventive healthcare already intersect, the additive effect of a GDM history on overall cardiometabolic burden may be especially consequential, underscoring the need for integrated long-term care approaches.

2.3. Theme 3: Recurrence of GDM and Reproductive Health Outcomes

Another important dimension of long-term maternal outcomes is the recurrence of gestational diabetes in subsequent pregnancies. Burlina et al. (2021) report that GDM recurrence rates are high and closely connected to the persistence of underlying metabolic risk factors — particularly insulin resistance and adiposity — that are not adequately addressed during the inter-pregnancy period for many women. Each recurrent GDM pregnancy represents a further period of sustained hyperglycaemia and metabolic strain that adds to the cumulative biological insult.

In LMIC contexts, these risks may be exacerbated by healthcare system limitations. Muche et al. (2020) found that in Ethiopian populations, the risk of GDM was closely tied to maternal age, elevated pre-pregnancy BMI, family

history of diabetes, and inconsistent access to antenatal care — factors that are not only prevalent but often persistently unaddressed between pregnancies in low-resource settings where preconception care programmes are rare. As a result, women in LMIC settings may face a cyclical pattern of recurring GDM, persistent metabolic risk, and increasing chronic disease burden, highlighting the need for improved antenatal care and monitoring systems that begin well before subsequent conception.

2.4. Theme 4: Health System Challenges in Low- and Middle-Income Countries

The management of gestational diabetes and its long-term outcomes presents significant challenges in LMICs. Kanguru et al. (2014) highlight that GDM in LMICs is characterised by major deficiencies in the availability of screening, diagnostic, and follow-up infrastructure, deficiencies so substantial that the true burden of the condition almost certainly exceeds current prevalence estimates by a considerable margin. These challenges include inadequate access to oral glucose tolerance testing, a critical shortage of trained healthcare personnel, fragmented antenatal care systems, and weak long-term follow-up pathways.

Muche et al. (2020) further emphasise that weak healthcare infrastructure and inconsistent antenatal care provision, particularly in rural and peri-urban areas of sub-Saharan Africa, significantly constrain the identification and ongoing management of GDM. Consequently, the majority of women with GDM in many LMIC settings remain undiagnosed and untreated during the pregnancy itself and receive no structured postpartum follow-up, leading to preventable chronic disease burden. Addressing these systemic deficiencies requires targeted investment in diagnostic capacity, workforce training, and care pathways that span the full transition from antenatal identification to postnatal chronic disease prevention.

2.5. Theme 5: Gaps in Long-Term Monitoring and Follow-Up

A key issue identified in the literature is the lack of effective long-term monitoring and follow-up for women with a history of gestational diabetes. Burlina et al. (2021) note that a substantial proportion of women who have experienced GDM do not receive the postpartum glucose screening recommended by clinical guidelines, and that in practice follow-up rates fall far below the minimum standard considered necessary for effective long-term metabolic surveillance. Without structured monitoring systems and clear clinical pathways connecting obstetric and chronic disease services, the postpartum period, identified by Rayanagoudar et al. (2016) as the period of highest leverage for intervention, is routinely missed as a preventive opportunity. This highlights the importance of embedding systematic postpartum screening into routine maternal healthcare pathways, particularly in LMIC contexts where the consequences of delayed diagnosis fall most heavily on populations with the fewest independent resources.

2.6. Theme 6: Synthesis and Research Gap

Overall, the literature demonstrates that gestational diabetes mellitus is associated with significant long-term health risks, including progression to type 2 diabetes, cardiovascular disease, and recurrence in subsequent pregnancies. These findings are consistent across multiple studies, suggesting that GDM carries a broader and more enduring set of health consequences than its historically obstetric framing acknowledged. However, much of the available evidence is derived from well-resourced, high-income country settings. In LMIC contexts, research remains sparse, methodologically inconsistent, and geographically concentrated, with limited focus on long-term metabolic and cardiovascular outcomes. This geographic concentration is particularly notable for the Caribbean and Latin American regions, which bear a substantial and growing GDM burden but remain almost entirely absent from the systematic review literature. This indicates that the international evidence base does not adequately represent the populations who bear the greatest global burden of GDM, highlighting a critical gap in the literature. A geographically inclusive, contextually grounded synthesis is therefore a prerequisite for translating the global evidence base into clinically actionable guidance for the settings most in need.

2.7. Theme 7: Mechanisms and Risk Pathways

The long-term health outcomes associated with gestational diabetes mellitus can be better understood through the underlying biological and metabolic mechanisms that drive disease progression beyond the pregnancy itself. Plows et al. (2018) explain that GDM arises from two converging processes, peripheral insulin resistance and insufficient compensatory secretion by pancreatic beta-cells, and that the cellular and functional changes these processes produce are not always fully reversible after delivery. This includes processes such as sustained beta-cell stress, mitochondrial dysfunction, lipotoxicity, and chronic low-grade inflammation, which together contribute to persistent metabolic dysfunction beyond pregnancy. Chiefari et al. (2017) highlight that GDM shares aetiological pathways with a broader class of chronic non-communicable diseases through common inflammatory and endocrine dysregulation mechanisms. Understanding these pathways is important because it positions GDM as a systemic and chronic condition rather than a transient obstetric event, explaining why health risks associated with GDM are not confined to the gestational period.

2.8. Literature Review Summary

Overall, the literature provides strong evidence that gestational diabetes mellitus is associated with a range of significant long-term maternal health outcomes. Consistent findings indicate that women with a history of GDM are at increased risk of developing serious chronic conditions, particularly type 2 diabetes and

cardiovascular disease, with this risk persisting over extended time periods and across diverse geographic settings (Rayanagoudar et al., 2016; Dennison et al., 2021). The recurrence of GDM in subsequent pregnancies further contributes to a compounding metabolic burden, reinforcing the cumulative nature of these health risks (Burlina et al., 2021). The persistence of metabolic dysfunction following pregnancy, through well-characterised mechanisms of insulin resistance, beta-cell dysfunction, and systemic inflammation (Plows et al., 2018; Chiefari et al., 2017), helps explain why consequences extend far beyond the postpartum period.

However, much of the existing research is based on populations in high-income countries with robust healthcare infrastructure, with relatively limited attention given to LMICs. In these settings, healthcare system challenges, including inadequate screening coverage, limited diagnostic capacity, and weak postpartum follow-up pathways, restrict effective GDM detection, management, and long-term surveillance (Kanguru et al., 2014; Muche et al., 2020). As a result, there is insufficient understanding of how GDM's long-term health consequences manifest in LMIC contexts, and existing evidence remains fragmented and unevenly distributed. This study therefore seeks to address this gap by systematically reviewing and synthesising evidence on long-term maternal outcomes of GDM within LMIC settings.

3. Materials and Methods

3.1. Study Design

This study adopted a systematic review design to examine the long-term maternal outcomes associated with gestational diabetes mellitus in low- and middle-income countries. Systematic reviews are widely recognised as a rigorous approach for synthesising existing research evidence in a structured and transparent manner (Snyder, 2019). The review was conducted in accordance with the PRISMA 2020 guidelines, which provide a standardised framework for reporting systematic reviews and ensuring transparency in study selection and reporting processes (Page et al., 2021).

3.2. Search Strategy

A structured literature search was conducted to identify relevant peer-reviewed studies. The search was performed across three electronic databases: PubMed, Scopus, and Google Scholar. These databases were selected to provide comprehensive coverage of biomedical and public health literature relevant to the review's scope. It is acknowledged that EMBASE, widely regarded as the gold standard database for biomedical systematic reviews and containing significant non-English language content relevant to LMIC research, was not included in this search strategy. This represents a recognised limitation of the review (addressed further in Section 6) and should be considered when interpreting the comprehensiveness of search coverage. The combination of

PubMed, Scopus, and Google Scholar was adopted to maintain a manageable and reproducible scope while achieving broad coverage of peer-reviewed biomedical and public health literature (Bramer et al., 2017). The search strategy combined key terms including 'gestational diabetes mellitus,' 'long-term maternal outcomes,' 'type 2 diabetes,' 'cardiovascular disease,' and 'low- and middle-income countries,' combined using Boolean operators such as AND and OR to ensure both breadth and relevance of results (Higgins et al., 2022). The search process was iterative, with refinements made to improve precision. In addition, the reference lists of selected articles were manually screened to identify further relevant studies.

3.3. Inclusion and Exclusion Criteria

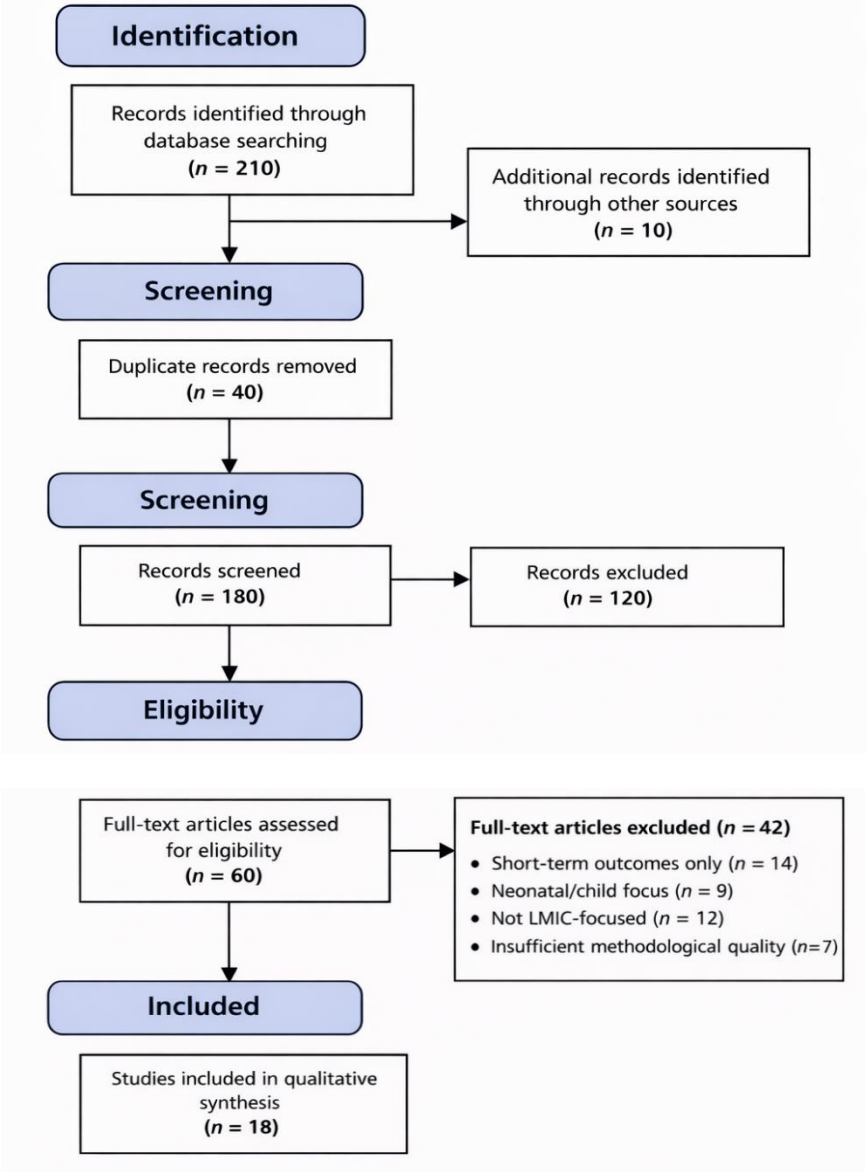
Studies were selected based on predefined inclusion and exclusion criteria. Studies were included if they focused on women diagnosed with gestational diabetes mellitus and examined long-term maternal health outcomes beyond pregnancy. Only peer-reviewed articles available in full text were considered. LMIC status was operationalised using the World Bank income classification framework, which categorises countries as low-income, lower-middle-income, or upper-middle-income based on gross national income per capita; all three categories were considered eligible. Studies set in countries classified as LMICs under this framework at the time of their publication were included; studies set exclusively in high-income countries were excluded. Iran, included via Nouhjah et al. (2018), warrants brief note: the country transitioned between lower-middle-income and upper-middle-income classification at various points during the review period (2014–2024) and was classified as a lower-middle-income country by the World Bank at the time of that study's publication and data collection, justifying its inclusion. Studies were excluded if they focused solely on short-term pregnancy outcomes, neonatal or child outcomes without maternal follow-up, or non-research formats such as editorials and commentaries. The use of explicit inclusion and exclusion criteria enhances transparency and reduces selection bias in systematic reviews (Page et al., 2021).

3.4. Study Selection Process

The study selection process followed a structured multi-stage approach. A total of 220 records were identified through database searching and additional sources. After the removal of 40 duplicate records, 180 studies remained for screening based on titles and abstracts. Following initial screening, 60 full-text articles were assessed for eligibility. Of these, 42 studies were excluded based on predefined criteria, including studies focusing on short-term outcomes, neonatal or child outcomes, non-LMIC contexts, and those with insufficient methodological quality. This resulted in a final sample of 18 studies included in the qualitative synthesis. The full study selection process is illustrated in Figure 1, presented in the Results section, in accordance with PRISMA 2020 guidelines (Page et al., 2021).

Figure 1

PRISMA Flow Diagram of Study Selection Process



Note. PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analyses. Adapted from Page et al. (2021). Numbers reflect the review's search conducted November 2024.

3.5. Data Extraction

Data were systematically extracted from each included study using a structured framework. The extracted information included author(s), year of publication, study location, design, sample size, and key findings related to long-term maternal outcomes. This structured approach enhances consistency and reduces the likelihood of data extraction errors (Higgins et al., 2022).

3.6. Data Analysis and Synthesis

A narrative synthesis approach was used to analyse the findings due to variation in study designs, populations, and outcome measures. Drawing on the Popay et al. (2006) framework, the analysis proceeded inductively: findings from each included study were extracted and compared, themes were generated from convergent patterns across the evidence rather than imposed in advance, and findings were examined both within and across regional and study-design contexts to assess consistency and divergence. The analysis was organised into four primary thematic domains: progression to type 2 diabetes, metabolic syndrome and cardiometabolic risk, GDM burden and prevalence across LMIC regions, and health system and diagnostic barriers.

3.7. Quality Considerations

To enhance the credibility of the review, only peer-reviewed studies were included. Studies were assessed based on methodological clarity, relevance, and reporting quality. This approach aligns with best practices for ensuring reliability in systematic reviews (Snyder, 2019). To address the absence of a uniform quality appraisal tool across all study designs, the synthesis explicitly distinguishes between two evidence tiers: (a) Primary studies (prospective cohort studies and cross-sectional studies), from which direct observational findings are drawn; these include Muche et al. (2020), Muche et al. (2019), Mdoe et al. (2021), Wessels et al. (2020), Coetzee et al. (2018), Nouhjah et al. (2018), Mahalakshmi et al. (2014), and Bagde et al. (2024). Findings from these studies are presented with standard confidence appropriate to their respective designs. (b) Secondary and review sources (systematic reviews, meta-analyses, guideline reviews, and qualitative studies), which synthesise evidence rather than generate primary data; these include Beyene et al. (2023), Kanguru et al. (2014), Natamba et al. (2019), Mwanri et al. (2015), Burlina et al. (2021), Bhavadharini et al. (2016), Goldenberg et al. (2016), Utz et al. (2018), Gupta et al. (2015), Adam and Rheeder (2017), and Muhwava et al. (2018). Conclusions drawn from these sources are presented with appropriately reduced confidence and are not used in isolation to support causal claims. This distinction is applied consistently in the thematic synthesis and discussion sections. The formal application of Newcastle-Ottawa Scale criteria to primary studies and AMSTAR-2 criteria to included systematic reviews was not undertaken due to the methodological heterogeneity across the full evidence base, a limitation explicitly acknowledged in Section 6. Conclusions are therefore drawn from patterns of convergence across multiple studies rather than from any single source.

3.8. Ethical Considerations

As this study involved the systematic review and synthesis of previously published research, formal ethical approval was not required. However, ethical considerations remained central to the conduct of the review. Systematic reviews

are expected to adhere to principles of transparency, accuracy, and responsible scholarship, even in the absence of direct human participation (Snyder, 2019). All sources included in the review were appropriately acknowledged and cited to ensure proper attribution of original work. Care was taken to accurately represent the findings of included studies without misinterpretation, selective reporting, or distortion of results, as maintaining accuracy in the synthesis of existing evidence is a key ethical requirement in review-based research (Page et al., 2021).

The review followed the PRISMA 2020 guidelines to promote transparency and reproducibility in study selection, data extraction, and synthesis (Page et al., 2021). Inclusion was limited to peer-reviewed research to ensure the reliability and quality of the evidence base. Limitations in the available literature were reported transparently to avoid overstating conclusions or misrepresenting the strength of evidence (Snyder, 2019). Overall, the study was conducted in accordance with accepted ethical standards for secondary research, including integrity in reporting, accountability in interpretation, and transparency in methodological decision-making.

4. Results

4.1 Research Questions and Thematic Framework

Three research questions guided the design and conduct of this systematic review, establishing the thematic framework within which findings are organised and interpreted.

Research Question 1. What does the existing evidence indicate regarding long-term maternal health outcomes, including progression to type 2 diabetes, cardiovascular disease, and GDM recurrence, among women with a history of gestational diabetes in low- and middle-income countries? This question directed the synthesis toward outcomes that extend beyond the gestational period, with primary interest in the metabolic and cardiovascular consequences that accumulate over months and years following an affected pregnancy.

Research Question 2. What health system-level factors in LMICs influence the detection, management, and long-term follow-up of women with GDM, and how do these factors shape maternal outcomes over time? This question oriented the review toward the structural conditions under which GDM is identified and managed in low-resource settings, not simply as a backdrop to clinical outcomes but as a determinant of whether those outcomes are ever detected or addressed.

Research Question 3. To what extent does the existing evidence from LMICs reflect the broader literature on long-term maternal outcomes of GDM, and what gaps remain in terms of geographic representation, methodological rigour, and context-specific interventions? This question positioned the LMIC evidence base in relation to established findings from high-income settings, enabling an

assessment of where LMIC findings are consistent, where they diverge, and where the evidence simply does not yet exist.

These three questions generated four thematic domains through inductive synthesis: postpartum progression to T2D and dysglycaemia, metabolic syndrome and cardiometabolic risk, GDM burden and prevalence across LMIC regions, and health system and diagnostic barriers. The mapping between research questions and thematic domains is as follows: Research Question 1 is addressed primarily through Themes 1 (T2D progression) and 2 (cardiometabolic risk); Research Question 2 is addressed through Theme 4 (health system barriers); and Research Question 3 is addressed through Theme 3 (burden and prevalence) and the cross-cutting geographic analysis in Section 4.5.

4.2 Search Outcomes and Study Selection

The database search of PubMed, Scopus, and Google Scholar, conducted in accordance with PRISMA 2020 guidelines (Page et al., 2021), identified 220 records in total. Following the removal of 40 duplicate records, 180 unique titles and abstracts were screened. Of these, 120 were excluded at the title and abstract stage on the grounds that they did not address long-term maternal outcomes of GDM, were conducted outside LMIC settings, or addressed only neonatal or short-term obstetric outcomes. Sixty full-text articles were then assessed for eligibility. Of these, 42 were excluded: studies focusing exclusively on short-term outcomes, those examining neonatal outcomes without maternal follow-up data, studies conducted in non-LMIC settings, and those with insufficient methodological quality. The remaining 18 studies met all inclusion criteria and were included in the final narrative synthesis. Table 1 presents the search outcomes by database and selection stage.

Table 1

Search Outcomes by Database and Selection Stage

Database / Stage	Records (n)
PubMed	98
Scopus	74
Google Scholar	48
Total identified	220
Duplicates removed	40
Screened (title and abstract)	180
Excluded at screening stage	120
Full-text articles assessed for eligibility	60

Full-text articles excluded	42
Studies included in final synthesis	18

Note. Search conducted November 2024. PRISMA 2020 reporting standards followed throughout (Page et al., 2021).

4.3. Characteristics of Included Studies

The 18 included studies were published between 2014 and 2024, covering five geographic contexts: Ethiopia (n = 3), sub-Saharan Africa broadly (n = 3), South Africa (n = 4), India (n = 4), Iran (n = 1), and multi-country LMIC reviews (n = 3). Study designs were methodologically diverse: prospective cohort studies (n = 5), cross-sectional studies (n = 2), systematic reviews and meta-analyses (n = 5), review articles (n = 2), a qualitative study (n = 1), a screening and prevalence study (n = 1), and a clinical follow-up study (n = 1). Sample sizes in primary studies ranged from 112 women (Muche et al., 2020) to 1,027 participants (Muche et al., 2019). Review-based studies synthesised evidence across multiple data sources and did not specify fixed sample sizes. The full characteristics and key findings of all 18 included studies are presented in Table 2.

Table 2

Characteristics and Key Findings of Included Studies (N = 18)

Author(s) & Year	Country/Region	Study Design	Sample Size	Outcome(s) Measured	Key Findings
Muche et al. (2020)	Ethiopia	Prospective cohort	112	Postpartum glucose intolerance	Common postpartum glucose intolerance; age, fasting glucose, obesity, and antenatal depression were significant predictors
Muche et al. (2019)	Ethiopia	Cross-sectional	1,027	GDM prevalence & associated factors	Measurable GDM prevalence linked to obesity, family history, and low physical activity
Beyene et al. (2023)	Ethiopia	Systematic review & meta-analysis	Multi-study	GDM prevalence & associated factors	High pooled GDM prevalence; metabolic and family-history risk factors identified
Kanguru et al. (2014)	LMICs	Systematic review	Multi-study	Burden of diabetes in pregnancy	Major screening and evidence gaps; true burden likely substantially underestimated
Natamba et al. (2019)	Sub-Saharan Africa	Systematic review & meta-analysis	Multi-study	Burden, risk factors, maternal outcomes	High GDM burden; better evidence on locally important risk factors remains a gap
Mwanri et al. (2015)	Sub-Saharan Africa	Systematic review & meta-regression	Multi-study	GDM prevalence & risk factors	Synthesised evidence on prevalence and risk factors across sub-Saharan African populations
Mdoe et al. (2021)	Tanzania	Cross-sectional	468	GDM prevalence & predictors	Significant GDM burden; maternal age and BMI as principal predictors
Adam & Rheeder (2017)	South Africa	Prevalence study	3,690	GDM prevalence; diagnostic criteria	Universal screening substantially raises estimated prevalence; risk-factor screening poorly sensitive

Muhwava et al. (2018)	South Africa	Qualitative study	N/A	Antenatal and postnatal management	Policy and practice gaps identified; care continuity weakened at antenatal-to-postnatal transition
Wessels et al. (2020)	South Africa	Prospective cohort	115	Postpartum glucose testing	In-hospital fasting glucose at 24–72 hours postpartum could not reliably replace the 4–12 week OGTT
Coetzee et al. (2018)	South Africa	Prospective cohort	202	Early postpartum diabetes	Diabetes prevalence measured at 6–12 weeks postpartum; prenatal predictors of postpartum diabetes identified
Nouhjah et al. (2018)	Iran	Cohort study	456	Early postpartum metabolic syndrome	Higher metabolic syndrome prevalence at 6–12 weeks postpartum among women with prior GDM
Gupta et al. (2015)	India	Guideline review	N/A	GDM screening & follow-up guidelines	Updated GDM screening guidelines; structured postpartum glucose testing and mandatory follow-up recommended
Bagde et al. (2024)	India	Prospective cohort	100	Postpartum hyperglycaemia	Antenatal predictors of postpartum hyperglycaemia identified in a central India cohort

Bhavadharini et al. (2016)	India/LMIC	Review article	N/A	Screening & diagnosis in LMICs	LMIC-adapted screening models (WINGS) highlighted; conventional approaches poorly suited to resource-constrained settings
Mahalakshmi et al. (2014)	India	Clinical follow-up	174 followed	Progression to type 2 diabetes	Rapid progression to T2D; many women converted within 5 years of index GDM pregnancy
Utz et al. (2018)	LMICs	Systematic review	Multi-study	Detection & management of diabetes	Major gaps in detection and management modalities across low-resource settings
Goldenberg et al. (2016)	LMICs	Review article	N/A	Diabetes in pregnancy; health systems	Infrastructure and systems constraints limit maternal care quality; coordinated strengthening required

Note. GDM = gestational diabetes mellitus; LMIC = low- and middle-income country; OGTT = oral glucose tolerance test; T2D = type 2 diabetes; BMI = body mass index; WINGS = Women in India with GDM Strategy; N/A = not applicable (review or guideline study with no primary sample). Sample sizes for Adam & Rheeder (2017), Coetzee et al. (2018), Nouhjah et al. (2018), and Bagde et al. (2024) were verified against original publications.

4.4. Thematic Synthesis of Findings

Four thematic domains emerged from the inductive narrative synthesis. These are summarised in Table 3 and described below.

Table 3

Thematic Summary of Evidence from Included Studies

Theme	Key Studies	Primary Outcomes	Health System Implications
Progression to Type 2 Diabetes	Muche et al. (2020); Gupta et al. (2015); Mahalakshmi et al. (2014); Bagde et al. (2024)	High rates of postpartum dysglycaemia and T2D conversion; rapid onset within 5 years in Indian cohorts	Structured 4–12 week OGTT and annual glycaemic surveillance required
Metabolic Syndrome & Cardiometabolic Risk	Nouhjah et al. (2018); Coetzee et al. (2018); Wessels et al. (2020)	Elevated metabolic syndrome prevalence at 6–12 weeks postpartum; in-hospital glucose testing insufficient	Multidisciplinary postpartum clinics needed; OGTT cannot be replaced by simpler tests
GDM Burden & Prevalence Across LMIC Regions	Natamba et al. (2019); Mwanri et al. (2015); Mdoe et al. (2021); Adam & Rheeder (2017); Bhavadharini et al. (2016); Kanguru et al. (2014)	High and rising GDM burden; risk-factor screening systematically undercounts affected population	Universal or context-adapted screening and improved antenatal data infrastructure required
Health System & Diagnostic Barriers	Muhwava et al. (2018); Goldenberg et al. (2016); Utz et al. (2018); Kanguru et al. (2014)	Fragmented care transitions; personnel and diagnostic shortfalls; absent postpartum follow-up	Integrated antenatal-to-postpartum pathways and NCD policy reform required

Note. GDM = gestational diabetes mellitus; LMIC = low- and middle-income country; OGTT = oral glucose tolerance test; T2D = type 2 diabetes; NCD = non-communicable disease.

Theme 1: Postpartum Progression to T2D and Dysglycaemia

Postpartum progression to T2D and dysglycaemia emerged as the most consistently documented long-term outcome. South Asian cohorts showed particularly rapid conversion rates: Mahalakshmi et al. (2014) found that many followed-up Indian women had converted to T2D within five years of the index pregnancy, while Bagde et al. (2024) demonstrated that antenatal fasting glucose and BMI at GDM diagnosis function as actionable risk stratification tools available before delivery. Muche et al. (2020) found equivalent predictive value in routinely collected Ethiopian antenatal data. Gupta et al. (2015), in updated Indian screening guidelines, established mandatory postpartum follow-up as a clinical non-negotiable rather than an optional component of GDM management. The pattern across settings is consistent: the clinical information needed to identify high-risk women exists in antenatal records; what is absent is the health system architecture to act on it.

Theme 2: Metabolic Syndrome and Cardiometabolic Risk

Nouhjah et al. (2018) found significantly higher metabolic syndrome prevalence in women with prior GDM compared with normoglycaemic controls at the six-to-twelve-week postpartum mark. Coetzee et al. (2018) reported comparable findings in South Africa, identifying prenatal predictors of postpartum dysglycaemia. Wessels et al. (2020) demonstrated that in-hospital fasting glucose measurement taken at twenty-four to seventy-two hours postpartum failed to identify a meaningful proportion of women who would test positive at the four-to-twelve week OGTT interval, directly challenging the simplification of postpartum protocols in resource-constrained settings.

Theme 3: GDM Burden, Prevalence, and Risk Factors Across LMIC Regions

Adam and Rheeder (2017) established that universal screening in South Africa would reveal substantially higher GDM prevalence than risk-factor-based approaches suggest, indicating that current estimates systematically undercount the affected population. Natamba et al. (2019), Mwanri et al. (2015), and Mdoe et al. (2021) each documented high and rising GDM burden in sub-Saharan Africa. Bhavadharini et al. (2016) highlighted the WINGS model in India as an example of context-sensitive diagnostic adaptation that trades some precision for substantially broader population reach.

Theme 4: Health System and Diagnostic Barriers

Muhwava et al. (2018) traced how care continuity for GDM patients dissolved at the transition from antenatal to postnatal services. Kanguru et al. (2014), Utz et al. (2018), and Goldenberg et al. (2016) each documented pervasive infrastructure gaps, inadequate screening coverage, insufficient laboratory capacity, personnel shortfalls, and absent postpartum surveillance pathways, that together make coordinated long-term GDM monitoring the exception rather than the rule across LMIC health systems.

4.5. Geographic Distribution and Research Concentration

The geographic distribution of the 18 included studies was markedly uneven. Sub-Saharan Africa contributed the largest cluster, three Ethiopian studies, three broader sub-Saharan systematic reviews, and four South African primary studies, accounting for ten of the eighteen included studies. South Asia (primarily India) accounted for four primary studies. The Middle East was represented by a single cohort study from Iran. No primary studies from Latin America, the Caribbean, South-East Asia, or most of the Middle East met inclusion criteria. The three multi-country LMIC reviews provided broader geographic framing but were constrained by the sparsity and heterogeneity of available primary data. The near-total absence of evidence from large LMIC regions, particularly Latin America and South-East Asia, represents a significant gap in the current evidence base.

4.6. Summary of Key Findings

The evidence synthesised across 18 studies converges on four findings of direct clinical and policy significance. First, postpartum progression to T2D and dysglycaemia in LMIC women with GDM history is both common and predictable from antenatal data, yet structural barriers prevent this predictive information from being translated into effective postpartum surveillance. Second, cardiometabolic risk is measurably elevated as early as six to twelve weeks after delivery. Third, the true burden of GDM across LMIC settings is substantially higher than current prevalence estimates indicate. Fourth, health system barriers, particularly fragmented care transitions, inadequate screening infrastructure, and absent postpartum follow-up pathways, are structural properties that shape GDM outcomes at every stage of the clinical trajectory. These findings establish that GDM in LMIC settings is generating serious, sustained, and largely preventable long-term maternal health consequences that current health systems are not organised to detect or address. Notably, follow-up durations across included primary studies were predominantly short-term (six weeks to five years postpartum), with limited longitudinal evidence beyond this window; findings should be interpreted with this constraint in mind. Given the absence of a uniform quality appraisal framework across all study designs, conclusions are weighted according to study type, with primary cohort evidence accorded the highest confidence and review-based findings treated as corroborating rather than primary evidence (see Section 3.7).

5. Discussion

5.1. Overview

The findings of this review are consistent and clinically significant. Across 18 studies spanning Ethiopia, sub-Saharan Africa, South Africa, India, Iran, and multi-country LMIC contexts, a coherent pattern emerges: gestational diabetes mellitus in LMIC settings carries long-term maternal health consequences that are serious, predictable, and largely preventable, yet they remain systematically unaddressed by the health systems responsible for the women who experience them. The four interpretive threads developed in the sections below, how quickly postpartum dysglycaemia develops, how early cardiometabolic abnormalities are detectable, how substantially GDM burden is underestimated, and how comprehensively health system barriers compound these risks, together make the case that closing the gap between what is known and what is done requires structural change, not clinical guidance alone.

5.2. Postpartum Progression to Type 2 Diabetes and Dysglycaemia

What makes the T2D progression data from LMIC settings particularly striking is not the magnitude of risk — which is consistent with what has been documented in high-income populations — but the pace and the predictability. Mahalakshmi et al. (2014) found that many followed-up Indian women had converted to T2D within five years of the index pregnancy. Bagde et al. (2024) showed that the antenatal clinical record already contains the information needed for risk stratification: fasting glucose and BMI at GDM diagnosis predict postpartum hyperglycaemia with sufficient reliability to guide targeted follow-up before delivery occurs. Muche et al. (2020) reached analogous conclusions in an Ethiopian context. The convergence of these findings across settings as different as urban India and rural Ethiopia is clinically significant: the prognostic information needed to identify at-risk women is routinely collected but rarely actioned.

The reason it is not actioned is structural. As Burlina et al. (2021) establish, most women with GDM, globally, not only in LMICs, do not receive systematic postpartum glucose screening. In LMIC settings, the absence of this surveillance has additional consequences because there is no safety net: no chronic disease register, no automated recall system, and often no primary care encounter that would independently detect evolving dysglycaemia. Rayanagoudar et al. (2016) identified the postpartum window as the period of highest leverage for intervention; the evidence from this review confirms that LMIC health systems are systematically failing to use it.

5.3. Metabolic Syndrome and Cardiometabolic Risk

The six-to-twelve week postpartum window is not merely a window for glycaemic testing; it is a window for cardiometabolic risk identification that most LMIC care systems do not use for this purpose. Nouhjah et al. (2018)

documented significantly elevated metabolic syndrome prevalence in Iranian women with prior GDM at this interval, a finding that describes present clinical status rather than projected future risk. Coetzee et al. (2018) reported comparable findings in South Africa. Wessels et al. (2020) demonstrated that in-hospital fasting glucose taken at twenty-four to seventy-two hours after delivery cannot reliably substitute for the four-to-twelve week OGTT. In LMIC settings where resource constraints create persistent pressure to simplify postpartum protocols, this evidence provides a direct counter-argument: the simpler test does not do what the standard test does, and the cost of that substitution is missed diagnosis.

The broader cardiometabolic implications are established by Dennison et al. (2021), who document elevated lifetime risks of hypertension, coronary artery disease, and heart failure in women with GDM history. These risks are seeded in the physiological changes of the GDM pregnancy itself and are detectable within weeks of delivery. Postpartum protocols that address only glycaemia while leaving blood pressure, lipid status, and body weight unmonitored are examining a fraction of the available clinical signal (Burlina et al., 2021; ElSayed et al., 2023).

5.4. GDM Burden, Prevalence, and Risk Across LMIC Regions

A prerequisite for managing GDM's long-term consequences is knowing how many women are affected. The evidence from this review suggests that current estimates substantially undercount the true burden. Adam and Rheeder (2017) demonstrated directly that risk-factor-based screening in South Africa misses a meaningful proportion of GDM cases that universal screening would detect — a finding not particular to South Africa, as Kanguru et al. (2014) identified inadequate screening as a pervasive feature of LMIC healthcare systems. Bhavadharini et al. (2016), describing the WINGS model in India, illustrate a more productive design logic: context-sensitive screening that trades diagnostic precision for population reach. Natamba et al. (2019), Mwanri et al. (2015), and Mdoe et al. (2021) collectively document that the GDM burden in sub-Saharan Africa is high, its determinants are increasing with urbanisation and lifestyle change, and the infrastructure to manage it lags far behind its epidemiological trajectory.

5.5. Health System and Diagnostic Barriers

The structural analysis in this review converges on a single observation: the health system failures documented here are not random deficiencies but predictable consequences of organising maternity care around the acute episode of pregnancy rather than the chronic metabolic trajectory that GDM initiates. Muhwava et al. (2018) traced this in qualitative detail in South Africa, showing how institutional responsibility for the GDM patient effectively dissolved at the antenatal-to-postnatal transition. Kanguru et al. (2014), Utz et al. (2018), and Goldenberg et al. (2016) documented this pattern systemically across LMICs, in

each setting, the multiple components of effective GDM management were absent or inadequate, and their simultaneous absence made it impossible to compensate for any individual shortfall.

The policy response implied by this analysis is not a list of individual programme components to be added to existing systems. It is a reorientation of how GDM is categorised and funded. Where GDM sits outside national non-communicable disease frameworks, it receives no dedicated resources and no accountability mechanisms. The World Health Organization (2016) identified diabetes as a priority NCD, and the 2023 WHO Global Diabetes Compact extended this commitment (World Health Organization, 2023). Translating these global commitments into country-level action would benefit from GDM being explicitly recognised as a gateway condition — one that, left unmanaged, is likely to contribute to the T2D and cardiovascular disease burden that NCD strategies are designed to reduce.

5.6. Comparison with Global Literature

The LMIC evidence synthesised here is broadly consistent with what has been established in high-income settings. The direction of risk, elevated T2D and cardiometabolic outcomes following GDM, is replicated across every study context in this review, aligning with the large-scale meta-analytic evidence of Vounzoulaki et al. (2020) and Rayanagoudar et al. (2016). What the LMIC data add is evidence about what these risks look like when they unfold in the absence of structural buffers, postpartum surveillance, accessible preventive care, chronic disease monitoring, available in better-resourced settings. The rate of T2D progression in South Asian cohorts appears faster than high-income country data would suggest, though whether this reflects a genuine biological difference, a higher baseline of unaddressed modifiable risk factors, or differential follow-up is not resolvable from the current evidence. The global literature cannot adequately guide LMIC practice without the context-specific evidence that is still largely missing.

5.7. Implications for Clinical Practice, Health Policy, and Research

For clinical practice, the most immediate implication of this review is that postpartum glucose screening, using the four-to-twelve week OGTT, should be embedded as a non-negotiable component of postnatal care for women with GDM across LMIC settings. This screening should be extended to include cardiometabolic assessment: blood pressure, lipid profile, and weight measurement alongside glucose testing. The antenatal period offers a viable risk stratification opportunity: fasting glucose and BMI at GDM diagnosis, as demonstrated by Bagde et al. (2024), can identify which women require enhanced postpartum follow-up before they leave the maternity setting.

For health policy, GDM must be formally recognised within national NCD strategies as a gateway condition requiring dedicated funding, minimum follow-up standards, and accountability mechanisms. The context-adapted screening

models proposed by Bhavadharini et al. (2016) and the structural continuity of care reforms identified by Muhwava et al. (2018) offer practical starting points for policy design responsive to LMIC realities. For research, the most pressing priorities are longitudinal cohort studies from LMIC settings tracking GDM outcomes over five to ten years using standardised outcome definitions, and primary studies from Latin America, the Caribbean, and South-East Asia. Without this evidence, the global understanding of GDM's long-term consequences will remain anchored in the experience of a minority of the world's affected women.

6. Limitations

Several limitations of this review should be acknowledged. First, the restriction of the database search to PubMed, Scopus, and Google Scholar, combined with the exclusion of non-English publications, may have introduced selection bias by omitting relevant studies published in other languages or indexed in regional databases. The exclusion of EMBASE, recommended for comprehensive systematic reviews (Bramer et al., 2017), is an acknowledged limitation. Second, the narrative synthesis approach, while appropriate for the methodologically heterogeneous evidence base, does not permit statistical pooling of effect estimates; conclusions about the magnitude of individual outcomes therefore carry more uncertainty than a meta-analysis would. Third, formal quality appraisal instruments such as the Newcastle-Ottawa Scale or AMSTAR-2 were not applied owing to methodological heterogeneity across study designs, limiting the degree of confidence that can be assigned to findings from individual studies. Fourth, the geographic concentration of included studies in South Asia and sub-Saharan Africa limits the generalisability of the review's conclusions to other LMIC regions. Fifth, the absence of extended longitudinal follow-up data from most included studies means that conclusions are largely based on short-term postpartum observations rather than sustained tracking of disease trajectories over years or decades.

7. Conclusion

This systematic review has demonstrated that gestational diabetes mellitus carries serious and sustained long-term consequences for maternal health in LMIC settings, and that these consequences remain largely unaddressed due to structural health system failures. Evidence from 18 included studies confirms rapid postpartum progression to type 2 diabetes, particularly in South Asian settings, elevated cardiometabolic risk detectable within the first weeks after delivery, a high and substantially underestimated GDM burden, and pervasive barriers that prevent effective long-term monitoring.

These findings are consistent with the established global literature while demonstrating the specific ways in which LMIC health system constraints amplify risk and widen the gap between evidence and practice. GDM must be reconceptualised in LMIC policy and clinical frameworks as a chronic disease

risk marker, not a self-resolving obstetric condition, and managed accordingly through sustained, integrated, evidence-based postpartum surveillance. The imperative is both clinical and ethical: as the World Health Organization (2016) projects, the coming decades will see the greatest increases in diabetes burden in precisely the low- and middle-income regions where GDM is most prevalent and least managed. Translating this evidence into concrete improvements in screening, follow-up, and health system capacity is a matter of global health equity.

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Conflict of Interest Statement

The author declares no conflicts of interest.

AI Statement

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