The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 4, Issue 6, 2026

MATERNAL KNOWLEDGE AND MEDICATION ADHERENCE AMONG WOMEN WITH GESTATIONAL DIABETES MELLITUS RECEIVING METFORMIN THERAPY AND ITS ASSOCIATION WITH GLYCEMIC CONTROL

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DOI: https://doi.org/10.5281/zenodo.20962947

Keywords
Gestational Diabetes Mellitus, Metformin, Maternal Knowledge, Medication Adherence, Glycemic Control

Article History
Received: 24 April 2026
Accepted: 06 June 2026
Published: 21 June 2026

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Abstract

Background: *Gestational Diabetes Mellitus (GDM) is a common metabolic complication of pregnancy with increasing global prevalence. Metformin has emerged as an effective oral alternative to insulin for GDM management. However, treatment success depends not only on drug efficacy but also on maternal knowledge and medication adherence. This study aimed to assess maternal knowledge and medication adherence among women with GDM receiving Metformin therapy and examine their association with glycemic control.*

Methods: *This prospective observational study was conducted from January 2025 to September 2025 at Fatima Hospital, Baqai Medical University, Karachi. A total of 54 pregnant women with a confirmed diagnosis of GDM receiving Metformin therapy were enrolled using consecutive sampling. Data were collected using a structured, pretested, interviewer-administered questionnaire covering sociodemographic characteristics, maternal knowledge regarding GDM and Metformin, and medication adherence using a standardized scale. Glycemic control was assessed based on fasting blood glucose <95 mg/dL and postprandial glucose <140 mg/dL. Statistical analysis was performed using statistical package for social sciences (SPSS) version 16, with a p-value <0.05 considered significant.*

Results: *The age of participants was between 31–35 years in 37.0% (n=20), with 59.3% (n=32) being multigravida. The majority (70.4%, n=38) presented at or beyond 28 weeks of gestation. Regarding knowledge, 27.8% (n=15) had good knowledge, 44.4% (n=24) had moderate knowledge, and 27.8% (n=15) had poor knowledge about GDM and Metformin therapy. Medication adherence was high in 37.0% (n=20), moderate in 40.7% (n=22), and low in 22.2% (n=12) of participants. Glycemic control was achieved in 61.1% (n=33) of women, while 38.9% (n=21) remained uncontrolled. A statistically significant association was found between maternal knowledge and glycemic control (p=0.01), with 86.7%*

(n=13) of women with good knowledge achieving controlled glycemia compared to 33.3% (n=5) with poor knowledge. Similarly, medication adherence showed a strong significant association with glycemic control (p=0.001), with 85.0% (n=17) of highly adherent women achieving control versus 33.3% (n=4) with low adherence.

Conclusion: *Maternal knowledge and medication adherence are significant determinants of glycemic control in women with GDM receiving Metformin. The substantial proportion of women with poor knowledge and low adherence highlights the need for targeted educational interventions and adherence support strategies to optimize pregnancy outcomes.*

INTRODUCTION

Gestational Diabetes Mellitus (GDM) is a condition where women first develop high blood sugar during pregnancy. It ranks among the most common metabolic complications of gestation and affects a growing number of women globally. Several factors explain this upward trend. More women are becoming pregnant at older ages. Higher rates of obesity and sedentary lifestyles are widespread. Dietary patterns have shifted toward processed and high calorie foods. The prevalence varies across populations, but the overall increase is clear and concerning [1].

When GDM is poorly managed, the consequences can be serious. Mothers face a greater risk of preeclampsia and may require a cesarean delivery. Babies are more likely to be born with macrosomia, experience neonatal hypoglycemia, or sustain birth injuries. Beyond the immediate risks, both mother and child have a higher chance of developing type 2 diabetes later in life [1,2]. Maintaining good glycemic control during pregnancy is therefore essential. Initial management typically focuses on lifestyle changes, including dietary adjustments and regular physical activity. However, these measures are not always sufficient. When blood sugar targets remain unmet, pharmacological therapy becomes necessary.

For many years, insulin has been the standard treatment for GDM. It is effective and has a well-established safety record. Yet insulin therapy presents real challenges. It requires daily injections, which many women find distressing. It can also cause weight gain and carries a genuine risk of hypoglycemia. These issues often reduce patient acceptability and make consistent treatment difficult [3]. Metformin has emerged as a promising oral alternative. This medication improves insulin sensitivity, reduces sugar production by the liver, and enhances glucose uptake in peripheral tissues. A substantial body of evidence from randomized trials and meta-analyses indicates that Metformin offers glycemic control comparable to insulin for many women with GDM. It also provides additional benefits, such as less maternal weight gain and comparable neonatal outcomes in selected cases [3,4]. Nevertheless, Metformin crosses the placental barrier. Concerns remain about fetal exposure and the potential for long term metabolic effects in exposed children [5].

Even the most effective drug cannot succeed without proper use. Treatment outcomes depend not only on pharmacology but also on maternal understanding and consistent adherence. When women comprehend their condition and appreciate why treatment matters, they are more likely to follow their prescribed regimens. Conversely, poor adherence can undermine glycemic control and increase the likelihood of complications. Studies in general diabetic populations have repeatedly shown that higher knowledge correlates with better adherence and improved clinical results. However, research focusing specifically on pregnant women with GDM who take Metformin remains limited [5,6].

This study therefore aims to evaluate maternal knowledge and medication adherence among women with GDM receiving Metformin therapy. We also aim to examine how these factors relate to achieving adequate glycemic control during pregnancy.

METHODOLOGY

This prospective observational study was conducted from January 2025 to September 2025. Ethical approval was obtained from the Institutional Research and Ethical Review Board at Baqai Medical University, Karachi. Participants visited to outpatient clinics of Fatima Hospital, Baqai Medical University-Karachi were recruited. Every participant provided written informed consent after receiving a clear explanation of the study purpose, procedures, and their rights. We assured all women that their participation was voluntary and that they could withdraw at any time without affecting their medical care. A total of 54 pregnant women who had a confirmed diagnosis of GDM and were actively receiving Metformin therapy were included. We used a consecutive sampling technique and included every eligible woman who visited the clinics during the study period and met our criteria.

Women were eligible if they had a confirmed GDM diagnosis and were taking Metformin. We excluded those with preexisting type 1 or type 2 diabetes, women using insulin alone without Metformin, and those with serious obstetric or medical conditions unrelated to GDM that could interfere with the study outcomes. To collect information, a structured questionnaire was developed after a thorough review of published literature. The questionnaire was pretested on a small group of women before the actual data collection began. This step helped us ensure that the questions were clear, easy to understand, and relevant. The final version was administered by trained interviewers in a face-to-face setting.

The questionnaire covered three main areas. The first section gathered sociodemographic details such as age, education, and occupation, along with obstetric history including parity and gestational age. The second section assessed maternal knowledge about GDM and Metformin therapy. We asked about awareness of the condition, its risk factors, possible complications, dietary recommendations, the importance of glycemic control, and how Metformin works. Each correct answer received a score, and we calculated a total knowledge score for every participant. The third section focused on medication adherence using a standardized scale. We measured how consistently women took their Metformin, whether they followed the correct timing and dosage, and if they ever missed doses.

Clinical information, including blood glucose levels were extracted from participants' medical records. These parameters helped us determine whether each woman had achieved adequate glycemic control. Glycemic control was defined according to internationally accepted guidelines for GDM, where optimal control was considered as fasting blood glucose <95 mg/dL, 1-hour postprandial glucose <140 mg/dL, and 2-hour postprandial glucose <120 mg/dL [2].

Our primary outcome measures were the maternal knowledge score, the level of medication adherence, and the status of glycemic control. We entered all data into statistical package for social sciences (SPSS) version 16 for statistical analysis. Descriptive statistics, such as frequencies, percentages, means, and standard deviations, were used to summarize the characteristics of the study population. To explore relationships between knowledge, adherence, and glycemic control, we applied appropriate statistical tests. A p value of less than 0.05 was considered statistically significant.

RESULTS

A total of 54 pregnant women with GDM receiving metformin therapy were included in this study. Sociodemographic and obstetric characteristics of study participants are presented in table 1. The largest age group was 31 to 35 years, accounting for 37.0% of participants, followed by those aged 26 to 30 years at 33.3%. More than half of the women (59.3%) were multigravida. A substantial majority (70.4%) presented at or beyond 28 weeks of gestation, suggesting late diagnosis or referral in most cases. Regarding education, 37.0% had completed secondary schooling, while 14.8% had no formal education.

Table 1: Sociodemographic and Obstetric Characteristics of Study Participants (n=54)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–25	6	11.1
	26–30	18	33.3
	31–35	20	37.0
	>35	10	18.5
Education	No formal education	8	14.8
	Primary	12	22.2
	Secondary	20	37.0
	Graduate	14	25.9
Parity	Primigravida	22	40.7
	Multigravida	32	59.3
Gestational age	<28 weeks	16	29.6
	≥28 weeks	38	70.4

Table 2 presents the maternal knowledge regarding GDM and metformin therapy. Nearly half of the participants (44.4%) demonstrated moderate knowledge about GDM and Metformin therapy. Only slightly more than one quarter (27.8%) showed good knowledge, while an equal proportion (27.8%) had poor understanding.

Table 2: Maternal Knowledge Regarding GDM and Metformin Therapy (n=54)

Knowledge Level	Score Range	Frequency (n)	Percentage (%)
Poor	≤50%	15	27.8
Moderate	51–75%	24	44.4
Good	>75%	15	27.8

Table 3 presents the medication adherence to metformin therapy. The majority of women showed moderate (40.7%) to high (37.0%) adherence to their prescribed Metformin

regimen. However, more than one fifth (22.2%) exhibited low adherence, which is a concerning finding.

Table 3: Medication Adherence to Metformin Therapy (n=54)

Adherence Level	Frequency (n)	Percentage (%)
High adherence	20	37.0
Moderate adherence	22	40.7
Low adherence	12	22.2

Table 4 shows the glycemic control status based on recommended pregnancy targets. More than three fifths of the women (61.1%) achieved adequate glycemic control according to recommended pregnancy targets. Nevertheless, a considerable proportion (38.9%) remained uncontrolled despite receiving metformin therapy.

Table 4: Glycemic Control Status Based on Recommended Pregnancy Targets (n=54)

Glycaemic Control	Definition	Frequency (n)	Percentage (%)
Controlled	FBS <95 mg/dL and/or PP <140 mg/dL	33	61.1
Uncontrolled	Above target range	21	38.9

A statistically significant association was observed between maternal knowledge and glycemic control (p = 0.01). Among women with good knowledge, 13 (86.7%) achieved controlled glycemia compared to only 5 (33.3%) among those with poor knowledge.

Similarly, medication adherence demonstrated a strong and highly significant association with glycemic control (p = 0.001). Of the women with high adherence, 17 (85.0%) achieved glycemic targets, whereas only 4 (33.3%) of those with low adherence attained controlled status (table 5).

Table 5: Association Between Knowledge, Adherence, and Glycemic Control (n=54)

Variable	Category	Controlled (n)	Uncontrolled (n)	p-value
Knowledge Level	Good	13	2	0.01
	Moderate	15	9	
	Poor	5	10	
Adherence Level	High	17	3	0.001
	Moderate	12	10	
	Low	4	8	

Discussion

Our findings reveal that nearly half of the participants had only moderate knowledge regarding GDM and its management, while more than one quarter demonstrated poor understanding. Medication adherence was suboptimal in a considerable proportion of women, with over one fifth exhibiting low adherence. Encouragingly, 61.1% of participants achieved adequate glycemic control according to recommended pregnancy targets. Most importantly, both knowledge and adherence showed statistically significant positive associations with glycemic control, underscoring their critical role in optimizing pregnancy outcomes.

Most participants (37.0%) were aged 31–35 years, followed by 26–30 years (33.3%), consistent with the global trend of advancing maternal age as a GDM risk factor due to decreased insulin sensitivity and impaired beta cell function [1,2]. Over half (59.3%) were multigravida, aligning with studies linking multiparity and short interpregnancy intervals to higher GDM risk from cumulative metabolic stress [3]. Notably, 70.4% presented at ≥28 weeks, suggesting late diagnosis and limited intervention windows, a common issue in low-resource settings due to poor healthcare access and awareness [4,5]. Educationally, 37.0% had secondary schooling and 14.8% had none, with lower education linked to poor health literacy and self-care, partly explaining our knowledge deficits [6].

Only 27.8% of participants demonstrated good knowledge about GDM and Metformin, while 44.4% had moderate and 27.8% had poor knowledge. This gap is concerning, as understanding the condition and treatment is fundamental to self-management. Comparable findings have been reported in China, where mean knowledge scores were moderate [7], and in Saudi Arabia, where limited health literacy and poor counseling contributed to low awareness [8]. Our knowledge deficits may stem from late antenatal presentation (70.4% at ≥28 weeks), reducing time for education [9], healthcare system constraints like heavy patient loads and insufficient staff [5], and sociocultural factors including low educational attainment (only 25.9% graduates), which is linked to poor dietary management adherence [10]. Notably, knowledge was significantly associated with glycemic control ($p = 0.01$), with 86.7% of women with good knowledge achieving control versus 33.3% with poor knowledge, consistent with diabetes literature showing patient education as a cornerstone of effective self-management [11].

Medication adherence was suboptimal, with only 37.0% showing high adherence, 40.7% moderate, and 22.2% low adherence. This is

concerning, as consistent intake is essential for glycemic control. Similar challenges have been reported in developing countries, with low compliance to dietary advice (46.9%) and self-monitoring (37.4%) [8]. In the MiG trial, 7.4% discontinued Metformin, mainly due to gastrointestinal side effects [3]. Our findings may be explained by GI intolerance, daily life demands, childcare responsibilities, lack of social support, and cultural misconceptions about oral medication safety during pregnancy [12]. Adherence was strongly associated with glycemic control ($p = 0.001$), with 85.0% of highly adherent women achieving control versus 33.3% with low adherence, reinforcing that consistent medication intake is critical, as even minor lapses can cause glycemic fluctuations [13]. Given that 38.9% remained uncontrolled, addressing adherence barriers through clear instructions, family involvement, pill organizers, mobile reminders, and routine adherence assessment should be a clinical priority [14].

Our study found that 61.1% of women achieved adequate glycemic control according to recommended pregnancy targets, while 38.9% remained uncontrolled. This rate of uncontrolled glycemia is concerning, as poor glycemic control during pregnancy is associated with a range of adverse outcomes, including macrosomia, neonatal hypoglycemia, preeclampsia, and cesarean delivery [15]. The proportion of women achieving controlled glycemia in our study is comparable to findings from other studies evaluating Metformin in GDM. The MiG trial reported that 46.3% of women in the Metformin group required supplemental insulin to achieve glycemic targets, indicating that Metformin alone may not be sufficient for all patients [3]. A more recent study from Thailand investigating Metformin prolonged-release formulation reported that optimal glycemic control (fasting plasma glucose <95 mg/dL and 2-hour postprandial glucose <120 mg/dL) was achieved in a substantial proportion of women, though treatment failure necessitated insulin therapy in some cases [16]. The relatively high rate of uncontrolled glycemia in our population may be attributed to multiple interacting factors. As discussed earlier, knowledge deficits and suboptimal adherence likely contribute significantly. Additionally, the progressive insulin resistance that characterizes advancing pregnancy may overwhelm the effects of Metformin, necessitating dose adjustments or addition of insulin therapy. The late presentation of many women (70.4% at ≥28 weeks) means that treatment was initiated relatively late, potentially reducing the opportunity for achieving optimal control. Research has shown that early-onset GDM is associated with higher rates of insulin requirement and adverse outcomes, emphasizing the importance of timely diagnosis and intervention [9]. Other factors such as dietary practices, physical activity levels, psychological stress, and sleep quality also influence glycemic control and were not assessed in our study. The significant associations between knowledge, adherence, and glycemic control suggest that addressing these modifiable factors could substantially improve outcomes. Women with good knowledge and high adherence were far more likely to achieve controlled glycemia, highlighting the synergistic effect of these two factors. Clinically, this means that simply prescribing Metformin is insufficient; comprehensive management must include patient education, regular adherence assessment, and individualized support. Healthcare providers should adopt a holistic approach that addresses the physical, psychological, and social dimensions of GDM care to optimize glycemic outcomes and reduce complications [17].

Strengths, Limitations and Future Recommendation

Strengths include the prospective design and focus on an understudied population. Limitations include the small sample size ($n = 54$), single center setting, and cross-sectional design, which limit generalizability and causal inference. Self reported adherence is prone to recall and social desirability bias, potentially overestimating compliance. Glycemic control relied on fasting and postprandial glucose, as continuous monitoring or HbA1c were

unavailable. Larger, multicenter studies with objective adherence measures are needed.

Conclusion

Maternal knowledge and medication adherence are significant determinants of glycemic control in GDM women on Metformin. The high proportion with poor knowledge and low adherence highlights missed opportunities for better outcomes. Clinicians should prioritize early, culturally tailored education with repeated reinforcement and routinely assess adherence during visits. Addressing barriers like side effects and forgetfulness, alongside early GDM screening, can optimize glycemic control, reduce complications, and improve long term maternal and child health.

Acknowledgment: None

Conflict of Interest: The authors declare that they have no financial or non-financial conflict of interests to disclose.

Funding Statement: This manuscript did not receive any type of grant from any funding agencies in the public, commercial or not-for-profit sectors.

AI Use Disclosure: ChatGPT was used only for language improvement and readability. All ideas, analysis, and content in this manuscript were developed entirely by the authors.

Author's Contribution

UA: Data collection, interpretation and wrote the manuscript

NW: Conceived and designed the study, supervised the study, interpretation of results, and critical review, and was responsible for data integrity.

RN: Data analysis, Interpretation, and manuscript revision

EA: Reviewed, edited, and approved the manuscript

IAS: Critical review and approval of the final manuscript

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