



STUDY OF ASSOCIATION BETWEEN POLYHYDRAMNIOS AND GLUCOSE INTOLERANCE IN PREGNANCY

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ABSTRACT

Background: Polyhydramnios is associated with adverse maternal and perinatal outcomes and may be an important indicator of underlying gestational diabetes mellitus (GDM). This study aimed to determine the frequency of GDM among pregnant women with polyhydramnios and compare maternal and neonatal outcomes between women with and without GDM.

Methods: A hospital-based prospective observational study was conducted among 50 pregnant women with polyhydramnios attending the Department of Obstetrics and Gynaecology, SVIMS–SPMCW, Tirupati, India. Eligible women with singleton pregnancies beyond 20 weeks of gestation and an amniotic fluid index (AFI) >24 cm or single deepest pocket >7 cm were enrolled consecutively. Participants underwent screening for glucose intolerance using oral glucose challenge testing followed by oral glucose tolerance testing when indicated. Based on glucose status, participants were categorized into GDM and non-GDM groups and followed until delivery. Maternal characteristics, obstetric complications, mode of delivery, and neonatal outcomes were compared.

Results: Among the 50 women with polyhydramnios, 18 (36.0%) were diagnosed with GDM, of whom 16 (32.0%) required insulin therapy and 2 (4.0%) were managed with medical nutrition therapy. Maternal age ≥ 30 years was significantly associated with GDM (66.7% vs. 26.3%). Women with GDM had significantly higher mean maternal age (30.44 ± 2.01 vs. 27.75 ± 3.10 years) and delivered infants with higher mean birth weights (3.36 ± 0.47 vs. 2.89 ± 0.42 kg) compared with non-GDM women. No significant differences were observed in parity, PROM, preeclampsia, mode of delivery, or low birth weight between the groups.

Conclusions: More than one-third of pregnancies complicated by polyhydramnios had GDM. Advanced maternal age and higher neonatal birth weight were significantly associated with GDM. Routine screening for GDM in women with polyhydramnios may facilitate early diagnosis and timely intervention, thereby improving maternal and neonatal outcomes.

Keywords: Polyhydramnios, Gestational Diabetes Mellitus, Amniotic Fluid Index, Pregnancy Outcomes, Birth Weight, Maternal Age.

INTRODUCTION

Polyhydramnios is defined as a four-quadrant amniotic fluid index greater than 24, or a single maximum vertical pocket > 8cm.

The clinical condition is associated with high risk of poor pregnancy outcomes. ^{1, 2, 3} the reported prevalence of polyhydramnios in pregnancy is 0.2 - 1.6 % of all pregnancies. ^{4,5,6,7} The causes of Polyhydramnios include GDM, foetal anomalies, and infections.⁸ the most common cause of Polyhydramnios is idiopathic.⁹ Gestational Diabetes Mellitus (GDM) accounts for around 20.5% of the polyhydramnios. ¹⁰

Under Physiological conditions, there is a dynamic equilibrium between production and reabsorption of



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Amniotic fluid. Fluid Levels are influenced by foetal urination and foetal lung liquid production. Amniotic fluid is reabsorbed by foetal swallowing & intra membranous & intravascular absorption. The relative attribution of each of these mechanisms varies over the course of the pregnancy. A distributed equilibrium can result from compromised swallowing function, and increased urination can lead to polyhydramnios.^{8,9,10,11} Foetal polyhydramnios results from foetal hyperglycaemia. Increased glucose concentration in Amniotic fluid causes an osmotic gradient, resulting in a shift of water into the amniotic cavity.¹² This study aimed to determine the frequency of GDM among pregnant women with polyhydramnios and compare maternal and neonatal outcomes between women with and without GDM.

MATERIAL AND METHODS

Study design and setting: This hospital-based prospective observational study was conducted in the Department of Obstetrics and Gynaecology, Sri Venkateswara Institute of Medical Sciences–Sri Padmavathi Medical College for Women (SVIMS-SPMCW), Tirupati, and Andhra Pradesh, India. The study was carried out over a period of six months following approval from the Scientific Committee and the Institutional Ethics Committee.

Study participants: Pregnant women attending the Department of Obstetrics and Gynaecology who were diagnosed with polyhydramnios during the study period were screened for eligibility and recruited consecutively.

Sample size: The sample size was calculated using the formula for estimation of a single population proportion: $X = Z^2 (P(1-P))/d^2$. Where $Z = 1.96$ corresponding to a 95% confidence level, $P = 14.7%$ (0.147)¹³, representing the prevalence of gestational diabetes mellitus (GDM) among pregnancies complicated by polyhydramnios reported in a previous study, and $d = 5%$ (0.05), the desired absolute precision.

Since the study population was finite, the finite population correction formula was applied: $[n = N*X / (X + N - 1)]$. Where n denotes the final sample size, N is the total population size (50), and X is the sample size estimated for an infinite population. The minimum required sample size was calculated to be 40 participants. However, we have included 50 pregnant women with polyhydramnios.

Inclusion criteria: Pregnant women fulfilling all of the following criteria were included in the study:

- Singleton pregnancy;
- Gestational age greater than 20 weeks;
- Presence of polyhydramnios, defined as an amniotic fluid index (AFI) >24 cm or a single deepest vertical pocket (SDP) >7 cm;
- Willingness to provide written informed consent; and

- Willingness to undergo glucose challenge testing and/or oral glucose tolerance testing.

Exclusion criteria: Women with any of the following conditions were excluded:

- Pre-existing diabetes mellitus diagnosed before pregnancy;
- Multiple gestation;
- Major fetal congenital anomalies detected on ultrasonography; and
- Refusal to provide informed consent.

Study procedure: Eligible participants underwent detailed clinical assessment and obstetric ultrasonography. Amniotic fluid volume was assessed using the amniotic fluid index (AFI) and single deepest vertical pocket (SDP) methods. Women with AFI >24 cm were diagnosed with polyhydramnios and enrolled in the study.

Polyhydramnios was graded based on the measurement of the deepest pocket of AF (free of foetal parts) or the Amniotic fluid index.

Mild: Single deepest pocket: 8-11 cm AFI: 25-30

Moderate: Single deepest pocket: 12-15cm AFI = 30-35

Severe: Single deepest pocket: > 16cm AFI = >35

Baseline demographic and obstetric characteristics, including maternal age, parity, gestational age, and ultrasonographic findings, were recorded using a pre-designed proforma. All enrolled women were screened for glucose intolerance using a 50-g oral glucose challenge test (OGCT). Participants with abnormal screening results underwent a diagnostic oral glucose tolerance test (OGTT) according to institutional protocols.

Based on the results of glucose testing, participants were categorized into two groups:

1. Polyhydramnios with gestational diabetes mellitus (GDM); and
2. Polyhydramnios without gestational diabetes mellitus.

All participants were prospectively followed until delivery, and maternal and neonatal outcomes were documented.

Outcome measures: The primary outcome of the study was the prevalence of GDM among pregnant women with polyhydramnios.

Secondary outcomes included the association between GDM and maternal characteristics, mode of delivery, and neonatal outcomes including birth weight and perinatal complications.

Ethical considerations: The study protocol was approved by the Institutional Ethics Committee of SVIMS-SPMCW, Tirupati. Written informed consent was obtained from all participants before enrolment. Participants were informed about the objectives and procedures of the study and were assured that refusal to participate or withdrawal from the study at any stage would not affect their routine medical care. All investigations performed as part of the study were provided free of cost, and

participation did not impose any additional financial burden. Confidentiality of participant information was maintained throughout the study.

Statistical analysis: Data were entered into Microsoft Excel and analysed using the Statistical Package for the Social Sciences (SPSS) software version 26 (IBM Corp., Armonk, NY, USA). Continuous variables were tested for normality and expressed as mean ± standard deviation (SD) or median with interquartile range (IQR), as appropriate. Categorical variables were summarized

as frequencies and percentages. Comparisons between women with polyhydramnios with GDM and those without GDM were performed using the Chi-square test or Fisher's exact test for categorical variables. Continuous variables were compared using the independent Student's *t*-test or Mann–Whitney *U* test, depending on the distribution of the data. A two-sided *p*-value of <0.05 was considered statistically significant.

RESULTS

Table 1: Distribution of Age, GDM Status and Maternal and Neonatal Complications among Study Participants

Variable	Frequency	Percentage	
Age group	<30 years	38	76
	≥30 years	12	24
Outcome	GDM on insulin	16	32
	GDM on MNT	2	4
	No GDM	32	64
LSCS (n=44)	Primary LSCS	31	70.4
	Repeat LSCS	13	29.6
Scar tenderness (n=13)	Yes	9	69.2
	No	4	30.8
PROM	Yes	6	12
	No	44	88
Preeclampsia	Yes	5	10
	No	45	90
Mode of delivery	Elective LSCS	10	20
	Emergency LSCS	34	68
	FTND	6	12
Mode of delivery (n=37)	Primary LSCS	31	83.8
	NVD	6	16.2
Birth weight	Normal birthweight	44	88
	Low birthweight	6	12
Pre term	Yes	18	36
	No	32	64
Parity	Primi	25	50
	Multi	25	50
Polyhydramnios grading	Mild	45	90
	Moderate	5	10
	Severe	0	0

Table 1 describes the socio-demographic and obstetric characteristics of the 50 study participants. Most women were aged below 30 years (76%), while 24% were aged 30 years or above. Regarding glycaemic status, 64% had no gestational diabetes mellitus (GDM), whereas 32% had GDM requiring insulin therapy and 4% had GDM managed with medical nutrition therapy.

Among obstetric complications, among the 13 participants with a history of a previous cesarean delivery, scar tenderness was clinically identified in 69.2% of cases, premature rupture of membranes (PROM) in 12%, and preeclampsia in 10%. Emergency lower segment caesarean section

(LSCS) was the predominant mode of delivery (68%), followed by elective LSCS (20%) and full-term normal delivery (12%). The majority of newborns had normal birth weight (88%), while low birth weight was noted in 12% of cases. Preterm labor in 36.0% of cases. Equal proportions of primigravida and multigravida women were included in the study (50% each). Obstetric ultrasonography revealed that mild polyhydramnios was present in 90.0% of the cases, while 10.0% presented with moderate severity; no cases of severe polyhydramnios were recorded.

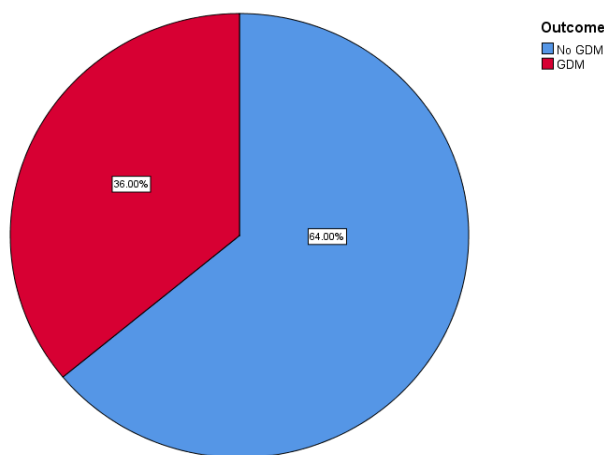


Figure 1: GDM Status

Figure 1 demonstrates that nearly two-thirds of the study participants did not have GDM (64%). Among women diagnosed with GDM, insulin therapy

constituted the major treatment modality (32%), whereas only a small proportion were managed with medical nutrition therapy alone (4%).

Table 2: Distribution of Age and Birth Weight

Variable	Minimum	Maximum	Mean	Std. Deviation
AGE	22	34	28.72	3.07
Weight of the Baby	2.07	4.02	3.06	0.48

Table 2 presents the descriptive statistics of maternal age and neonatal birth weight. Maternal age ranged from 22 to 34 years, with a mean age of 28.72 ± 3.07 years. The birth weight of newborns ranged from 2.07 kg to 4.02 kg, with a mean birth weight of 3.06 ± 0.48 kg.

These findings indicate that the study population predominantly consisted of women in the late twenties, and the average neonatal birth weight was within the normal range.

Table 3: Association between Various Maternal and Neonatal Variables between GDM and Non-GDM Pregnant Women

Variable		No GDM No. (%)	GDM No. (%)	Total	P value
Age group	<30 years	28 (73.7)	10 (26.3)	38	0.011
	≥30 years	4 (33.3)	8 (66.7)	12	
LSCS (n=44)	Primary LSCS	18 (58.1)	13 (41.9)	31	0.830
	Repeat LSCS	8 (61.5)	5 (38.5)	13	
Scar tenderness (n=13)	Yes	5 (55.6)	4 (44.4)	9	0.490
	No	3 (75)	1 (25)	4	
PROM	Yes	3 (50)	3 (50)	6	0.446
	No	29 (65.9)	15 (34.1)	44	
Preeclampsia	Yes	4 (80)	1 (20)	5	0.432
	No	28 (62.2)	17 (37.8)	45	
Mode of delivery	Elective LSCS	4 (40)	6 (60)	10	0.053
	Emergency LSCS	22 (64.7)	12 (35.3)	34	
	FTND	6 (100)	0 (0)	6	
Mode of delivery (n=37)	Primary LSCS	18 (58.1)	13 (41.9)	31	0.071
	NVD	6 (100)	0 (0)	6	
Birth weight	Normal birthweight	26 (59.1)	18 (40.9)	44	0.075
	Low birthweight	6 (100)	0 (0)	6	
Parity	Primi	18 (72)	7 (28)	25	0.239
	Multi	14 (56)	11 (44)	25	
Preterm	Yes	14 (77.8)	4 (22.2)	18	0.128
	No	18 (56.3)	14 (43.8)	32	

Polyhydramnios grading	Mild	32 (71.1)	13 (28.9)	45	0.004
	Moderate	0 (0)	5 (10)	5	

Table 3 evaluates the association between GDM status and selected maternal and obstetric variables. A statistically significant association was observed between maternal age and GDM status ($p = 0.011$). Women aged ≥ 30 years had a higher prevalence of GDM (66.7%) compared with those aged < 30 years (26.3%), suggesting that increasing maternal age may be an important risk factor for GDM. The severity of polyhydramnios was strongly associated with GDM status; while only 28.9% of women with mild polyhydramnios had GDM, 100% of those

presenting with moderate polyhydramnios were diagnosed with the condition.

No significant associations were found between GDM status and scar tenderness ($p = 0.490$), PROM ($p = 0.446$), preeclampsia ($p = 0.432$), parity ($p = 0.239$), repeat LSCS (0.830), mode of delivery ($p = 0.053$), preterm (0.128), or neonatal birth weight category ($p = 0.075$). Although women with GDM appeared more likely to undergo elective LSCS and have normal birth-weight infants, these differences did not achieve statistical significance.

Table 4: Comparison of Mean Age and Birthweight between GDM and Non-GDM Women

Variable	Outcome	Mean	Std. Deviation	P value
AGE	No GDM	27.75	3.1	0.002
	GDM	30.44	2.01	
Weight Of the Baby	No GDM	2.89	0.42	0.001
	GDM	3.36	0.47	

Table 4 compares the mean maternal age and neonatal birth weight between women with and without GDM. Women with GDM were significantly older than those without GDM (30.44 ± 2.01 years vs. 27.75 ± 3.10 years, $p = 0.002$). Similarly, newborns of mothers with GDM had significantly higher mean birth weights compared

with those born to non-GDM mothers (3.36 ± 0.47 kg vs. 2.89 ± 0.42 kg, $p = 0.001$).

These findings suggest that advancing maternal age is associated with an increased risk of GDM and that GDM may contribute to higher neonatal birth weight.

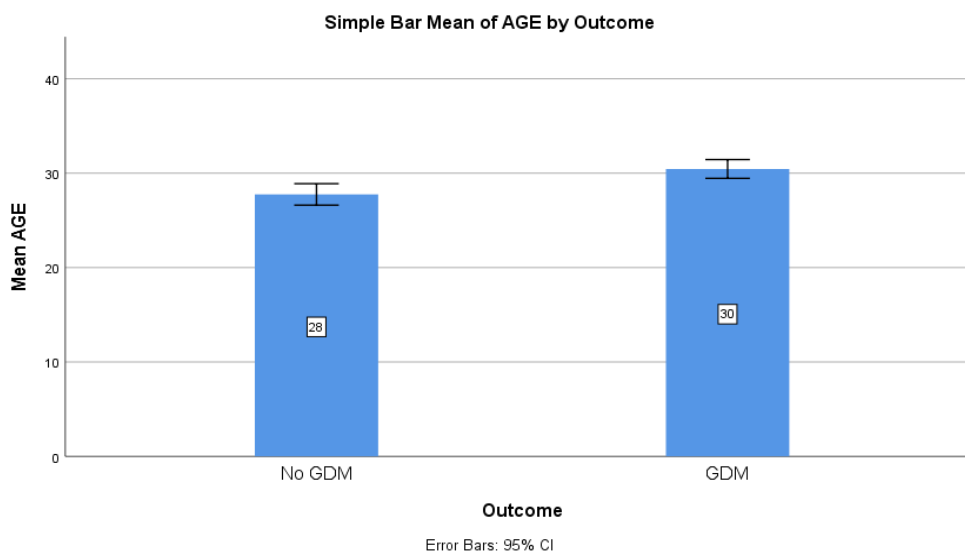


Figure 2: Distribution of Age between GDM and Non GDM Women

Figure 2 illustrates that women diagnosed with GDM had a higher mean age than women without GDM. The difference was statistically significant,

highlighting advanced maternal age as an important determinant of GDM.

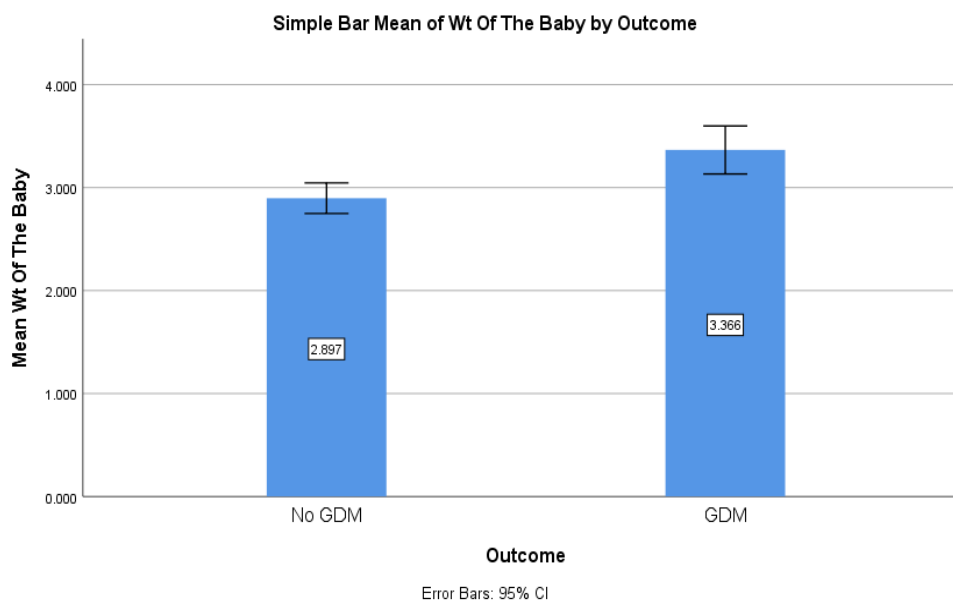


Figure 3: Distribution of Birthweight between GDM and Non GDM Women

Figure 3 shows that infants born to mothers with GDM had significantly higher mean birth weights than those born to mothers without GDM. This finding supports the established association between maternal hyperglycaemia and increased fetal growth.

DISCUSSION

In the present study, the prevalence of gestational diabetes mellitus (GDM) was 36%, with 32% of women requiring insulin therapy and 4% managed with medical nutrition therapy. Maternal age was significantly associated with GDM, with women aged ≥ 30 years showing a higher prevalence of GDM compared with younger women. Furthermore, women with GDM had significantly higher mean maternal age and delivered infants with significantly greater birth weights than those without GDM. However, no statistically significant associations were observed between GDM and obstetric complications such as scar tenderness, premature rupture of membranes (PROM), preeclampsia, parity, mode of delivery, or low birth weight.

The observed prevalence of GDM in our study is comparable to findings reported from South Asian populations, where increasing maternal age has consistently emerged as an important determinant of glucose intolerance during pregnancy. Advanced maternal age is associated with progressive insulin resistance and reduced pancreatic β -cell reserve, thereby increasing susceptibility to GDM. Similar associations between maternal age and GDM have been documented in previous studies from India and other Asian countries.¹⁴⁻¹⁶ Our findings therefore support recommendations advocating intensified screening among older pregnant women.

Women with GDM in the present study had a significantly higher mean age than those without

GDM (30.44 ± 2.01 years versus 27.75 ± 3.10 years; $p=0.002$). This observation is consistent with the findings of Kouhkan A et al., who identified increasing maternal age as an independent risk factor for GDM in an Indian population.¹⁶ Likewise, Blayo A et al. reported that women diagnosed with GDM tended to be older and highlighted the importance of early screening among high-risk groups.¹⁷

Another important finding of our study was the significantly higher neonatal birth weight among infants born to mothers with GDM. Infants of GDM mothers had a mean birth weight of 3.36 ± 0.47 kg compared with 2.89 ± 0.42 kg among non-GDM mothers ($p=0.001$). This finding is biologically plausible and can be explained by the Pedersen hypothesis, whereby maternal hyperglycaemia crosses the placenta, resulting in fetal hyperglycaemia, pancreatic β -cell hyperplasia, fetal hyperinsulinaemia, and accelerated fetal growth. Increased fetal insulin secretion promotes adipose tissue deposition and protein synthesis, predisposing to macrosomia.¹⁸

Our findings are in agreement with Dashe JS et al., who demonstrated that women with uncontrolled GDM had significantly higher amniotic fluid glucose concentrations, higher amniotic fluid indices, and increased neonatal birth weights compared with women whose glycaemic levels were well controlled.¹⁹ The authors further reported that amniotic fluid glucose concentration correlated positively with maternal fasting glucose levels ($r=0.589$) and AFI ($r=0.330$, $p=0.002$), indicating that maternal glycaemic status directly influences the intrauterine environment and fetal growth.¹⁹

Similarly, Dashe et al. observed significantly higher AFI values among diabetic women compared with non-diabetic controls and demonstrated a positive

correlation between amniotic fluid glucose concentration and AFI ($r=0.32$, $p=0.04$).⁷ These findings support the hypothesis that maternal hyperglycaemia contributes to fetal osmotic diuresis, resulting in increased fetal urine production and excessive accumulation of amniotic fluid.

Although obstetric complications such as scar tenderness, PROM, and preeclampsia were more frequent among women with GDM in our study, these associations did not reach statistical significance. This lack of significance may be attributable to the relatively small sample size and consequent limited statistical power. Previous studies have also produced inconsistent findings regarding maternal complications associated with GDM. Sawant et al. reported increased maternal morbidity among women with GDM, whereas other investigators found no significant differences after adjusting for confounding factors.¹⁶

In the present study, the association between GDM and mode of delivery approached nearly statistical significance ($p=0.053$), with emergency lower segment caesarean section being the predominant mode of delivery. This finding is clinically important because pregnancies complicated by GDM are often associated with suspected macrosomia, labour abnormalities, and increased concerns regarding shoulder dystocia. Idris et al., in a retrospective study involving 314 pregestational diabetic pregnancies, reported significantly higher caesarean section rates among women with polyhydramnios than among those with normal amniotic fluid volumes (83.0% versus 62.0%, $p=0.006$).²⁰

Idris et al. also observed significantly higher rates of preterm delivery in pregnancies complicated by polyhydramnios (54.2% versus 33.3%, $p=0.004$), although perinatal mortality and neonatal complications did not differ significantly between groups.²⁰ The authors concluded that polyhydramnios reflected poor glycaemic control rather than serving as an independent predictor of adverse neonatal outcomes.²⁰

Our findings further emphasize the importance of adequate glycaemic control during pregnancy. Khanduri et al. prospectively evaluated 104 women with polyhydramnios and found that 82 women were subsequently diagnosed with GDM after 28 weeks of gestation.²¹ They demonstrated that restriction of oral sugar intake resulted in progressive reductions in AFI, suggesting that timely dietary modification and improved glycaemic control may ameliorate the intrauterine consequences of maternal hyperglycaemia.²¹

The absence of a statistically significant association between GDM and low birth weight in our study is consistent with existing evidence, as maternal hyperglycaemia generally predisposes to fetal overgrowth rather than fetal growth restriction. Nevertheless, careful monitoring remains essential

because both poorly controlled hyperglycaemia and overtreatment-induced maternal hypoglycaemia can adversely affect fetal outcomes.

The strengths of this study include the assessment of both maternal and neonatal outcomes and the direct comparison between women with and without GDM within the same tertiary-care setting. However, several limitations warrant consideration. First, the relatively small sample size limits the precision of effect estimates and generalizability of findings. Second, serial indicators of glycaemic control such as HbA1c levels were unavailable. Third, important confounding variables including pre-pregnancy body mass index, gestational weight gain, family history of diabetes, and socioeconomic status were not evaluated. Finally, the cross-sectional nature of the analysis precludes the establishment of causal relationships.

Despite these limitations, the present study contributes valuable evidence from an Indian tertiary-care setting. The findings underscore the importance of universal antenatal screening, particularly among women aged 30 years and above, and support early institution of lifestyle modification and insulin therapy when indicated. Such interventions may reduce the burden of GDM-related adverse maternal and neonatal outcomes.

In conclusion, women with GDM in the present study were significantly older and delivered infants with higher birth weights than women without GDM. Although other obstetric complications were not significantly associated with GDM, the observed trends and supporting evidence from previous studies highlight the importance of early diagnosis, meticulous glycaemic control, and close fetal surveillance to optimize pregnancy outcomes.

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