Original Research Article

Pregnancy Outcomes in Diabetic Mothers With Controlled Glycemia: A Case-Control Study

Abstract:

Background: Diabetes mellites complicates pregnancy, whether the patient might be overtdiabetic or confirmed diabetic during pregnancy (gestational diabetes mellitus). Hence it is imperative that an early detection and management of the disease is done to ensure better maternal and fetal outcomes. Our goal is to compare treatment-controlled diabetic women to non-diabetic women in order to evaluate the pregnancy-related unfavourable effects.

Methods and materials: This was a case-control study conducted at a single center with women who gave birth between September 2022 and February 2023. A total of 144 patients were involved in this investigation. Women with diabetes under treatment were counted as cases (72), and their numbers were contrasted with those of non-diabetic women (72). The difficulties were documented and the two groups of women were monitored. The student ttest and SPSS were used to examine the data.

Results: The women were from the Andhra Pradesh districts of Nellore and the neighbouring areas. In the mothers without diabetes, the average age was 24±4.9 years, and those with diabetes were 27.83±6.24 years old. For diabetic women, the mean pregnancy duration was 257.1±31.2 days, while for non-diabetic women, it was 268.15±7.1 days. There were 89 women (61.8%) with obstetric history. Forty-six of the diabetic women in that group had previously experienced MTP (11.1%), spontaneous abortion (22.2%), or newborn loss without death. Thirty-six (50%) women had C-sections during their prior pregnancies, while ten (13.9%) women had normal deliveries. Six (8.3%) of the women with diabetes had a first-degree diabetic relative. Women with primary gravidity are 26 (36%) vs 29 (40.3%), multi gravidity are 44 (61.2%) vs 40 (55.6%) and grand multi gravidity are 2 (2.8%) vs 3 (4.2%). For women with diabetes, the mean HBA1C value was found to be 6.05%.It was discovered that 75% (54) of mothers with diabetes and 51.3% (37) of mothers without diabetes had caesarean births. Although macrosomia was not observed, children of diabetes

moms had a notable 25% decrease in birth weight. 44.4% (32) of infants delivered to diabetic mothers were admitted to NICUs. Hyperbilirubinemia is high in diabetic cases (33.3%) as compared to controls (15.3 %). Four diabetes mothers have lost their children, or 5.55% of them. Family history, gravidity, consanguinity, newborn sex, APGAR score, nuchal cord, asphyxia, and respiratory support did not significantly differ between the cases and controls. However, there was a significant difference in Gestation period (P=0.001), previous neonatal loss (P=0.049), type of previous deliveries (P=0.001), caesarean delivery (P=0.013), Baby weight (P=0.039), hyperbilirubinemia (P=0.011) and neonatal loss (P=0.043) between diabetic mothers and non-diabetic mothers.

Conclusion: In order to control their hyperglycaemia, diabetic mothers need to receive prompt diagnosis, treatment, and close monitoring. This study aimed to illustrate this point. A well-managed chronic hyperglycaemia can prevent a lot of pregnancy-related problems for both the mother and the baby.

Preterm births and caesarean deliveries are common in our study, even in mothers with controlled diabetes. Hyperbilirubinemia, neonatal loss, and lower birth weight were also observed in the babies of diabetic mothers. This highlights how much stricter control over plasma sugar levels is necessary in addition to diabetes prevention strategies. When considered as a whole, this research emphasizes the risks associated with all forms of maternal diabetes and draws attention to the need for better treatment as well as patient education regarding the significance of maintaining ideal glycaemic control.

Index Terms:

Overt diabetic, Gestational diabetes mellitus, APGAR score, Asphyxia, Hyperglycaemia, Macrosomia.

Introduction:

As per the World Health Organization, diabetes is a persistent metabolic ailment marked by high blood glucose levels that eventually cause severe harm to the heart, blood vessels, eyes, kidneys, and nerves. Due to genetic, environmental, and other underlying aetiologies, diabetes can affect people of all ages [(1)]. Women who have diabetes during pregnancy are the primary focus of our research. Maternal women's blood glucose levels rise during pregnancy in response to the needs of the developing foetus. Unfavourable pregnancy outcomes arise when the body's internal mechanisms fail to regulate these levels appropriately. Diabetes mellitus can complicate pregnancy in women, regardless of whether the patient is overtly diabetic or is diagnosed with gestational diabetes mellitus.

Approximately 536.6 million individuals worldwide suffer from diabetes. India has 77 million diabetes patients, according to the International Diabetes Federation (IDF) 2021 report [(2)]. In India, 16.55% of people have GDM. Approximately 7% of pregnancies worldwide are affected by GDM. In rural India, the prevalence of Diabetes in pregnancy is 6-9%, while in urban areas, it is 12-21% [(3)]. During pregnancy, the risk of developing glucose intolerance is eleven times higher in Indian women. About 90–95% of pregnant women have diabetes. Pregestational diabetes, with prevalence rates of 0.1-0.3%, accounts for only 10% of cases of maternal diabetes. Pregnancies with previous and current diagnosed diabetes are risky for both the mother and the foetus [(4)].

Pregnancy-related diabetes mellitus (DM) increases the risk of diabetes mellitus for both the mother and her unborn child. Perinatal outcomes were linked to poor glycaemic control in diabetic mothers, accounting for 42.9% of mortality [(5)]. In addition to increasing the chance of type 2 diabetes in the future, mothers who have this risk also run the risk of developing cardiometabolic disorders, which include postpartum obesity, metabolic syndromes, hypertension, and cardiovascular disease.

Many unfavourable foetal outcomes, including macrosomia, shoulder dystocia, birth traumas, hypoglycaemia in neonates, congenital defects, stillbirths, and occasionally

elevated neonatal mortality and morbidity, were brought due to diabetes during pregnancy [6]. Obstetric outcomes for mothers include elevated liver enzymes, hypoglycaemia, preeclampsia, caesarean sections, instrumental deliveries, postpartum sepsis, pregnancy-induced hypertension, abortions, and maternal deaths [7,8]. Hence, it is imperative that all medical professionals screen, diagnose, and provide specialized care to pregnant women with diabetes.

The International Association of Diabetes Pregnancy Study Group Criteria employs "A Single Step Procedure" (SSP) in accordance with WHO guidelines from 2013 in order to diagnose GDM. It is not important when the last meal was, this test can be done while fasting or not. When taking the 75g oral glucose test (also known as the glucose challenge test, or GCT), if the plasma glucose level is 7.8 mmol/liter (140 mg/dl), then GDM is diagnosed [9]. In addition to this SSP, measurement of HbA1c, Fasting blood sugar (FBS), Random blood sugar (RBS), and postprandial blood sugar (PPBS) levels can help to diagnose diabetes in pregnancy.

Treatment for diabetes in pregnancy lowers perinatal complications and enhances health and quality of life, according to the Australian Carbohydrate Intolerance Study (ACHOIS), a randomized trial of GDM treatment for women [10]. For pregnant women diagnosed with diabetes, Medical Nutritional Therapy (MNT) should be initiated. In the event that MNT fails to meet the glycaemic targets (less than 95 mg/dl during fasting and less than 120 mg/dl for two hours postprandial), pharmacotherapy needs to be started. Insulin and oral anti-diabetic medications (OADs) are part of the pharmacotherapy.

There is a lack of information regarding the results of treatment-controlled diabetes in pregnancy, despite the fact that numerous studies on the subject have been conducted throughout India, including those by Seshiah et al. in Chennai, Wahi et al. in Jammu, Gajjar et al. in Gujarat, Manni Mohan raj Mahalakshmi et al. in Chennai, and K Ramalingam et al. in Guntur. In order to reinforce the importance of maintaining glycaemic control during pregnancy, our study attempts to determine the impact of diabetes on pregnancy outcomes. Fewer studies in the field show the impact of controlled plasma glucose on pregnancy outcomes. We thought it would be beneficial to share the findings of our investigation and enhance public awareness.

AIMS AND OBJECTIVES

Aims:

- To compare the pregnancy outcomes in treatment controlled diabetic and nondiabetic mothers attending the obstetrics and gynaecology department in a tertiary care hospital.

Objectives:

- To assess the maternal outcomes in treatment-controlled Diabetes complicating pregnancy.
- To assess the foetal outcomes in treatment-controlled diabetes complicating pregnancy.

MATERIALS AND METHODS

Study design and setting:

A case-control study conducted at a single center with women scheduled for deliveries between September 2022 and February 2023 was conducted. A total of 144 patients included in this study were admitted to the tertiary care facility, Narayana Super Specialty Hospital, located in Nellore. The Diabetic and non-diabetic mothers in this study were enrolled with Informed consent.

Sample size and study subjects:

Pregnant women in the age group of 18-40 years were enrolled in the study. The cases in this study were the women who underwent an oral plasma glucose tolerance test, were diagnosed with diabetes, and later achieved control of the illness with treatment. The controls in this study were the pregnant women with normal blood glucose levels.

The data was collected in all the enrolled mothers at the time of their delivery. Using a data collection proforma, all complications for the mother and foetus during the pregnancy and after delivery were documented. An institutional ethical committee approved the study, and informed consent was taken from each participant.

Statistical Analysis:

IBM Corp., located in Armonk, New York, provided the statistical product services solution IBM SPSS version 23.0, which was used for all data analyses. To compare the means of the two groups, the Student's T-independent test was employed. The data were shown as percent values and frequencies for categorical variables. For all statistical tests, a two-sided probability of $P < 0.05$ was deemed statistically significant and an ODDs Ratio was calculated.

RESULTS

The research included 144 women in total. About seventy-two women with diabetes following treatment (Case group) were enrolled in the research. Seventy-two women who were not diabetics and who were pregnant without any complications (Control group) were included. These women were monitored until delivery, and at the time of delivery, data on the maternal and neonatal outcomes were recorded.

The women were from Nellore, Andhra Pradesh, and the neighbouring areas of Nellore. In the Control group, the average age was 24±4.9 years, and in the Case group were 27.83±6.24 years old. For the Case group, the mean pregnancy duration was 257.1±31.2 days, while for the Control group, it was 268.15±7.1 days. There were 89 women (61.8%) with obstetric history. In that, 46 women in the Case group had a previous history of neonatal loss by spontaneous abortion (22.2%), MTP (11.1%), and no deaths. Thirty-six (50%) women had C-sections during their prior pregnancies, while ten (13.9%) women had normal deliveries. Six (8.3%) women with diabetes had a first-degree diabetic relative.

Women with primary gravidity are 26 (36%) vs 29 (40.3%), multi gravidity is 44 (61.2%) vs 40 (55.6%) and grand multi gravidity is 2 (2.8%) vs 3 (4.2%) in Case and Control groups respectively. In the case group, the mean HBA1C value was found to be 6.05±0.99%. It was

discovered that 75% (54) of mothers with diabetes and 51.3% (37) of the Control group had caesarean births. Although macrosomia was not observed, children of the Case group had a notable 25% decrease in birth weight. Thirty-two (44.4%) infants delivered by the Case group were admitted to NICU. Four (5.55%) mothers of the Case group have lost their children.

Family history, gravidity, consanguinity, newborn sex, APGAR score, nuchal cord, asphyxia, and respiratory support did not significantly differ between the cases and controls. However, there was a significant difference in preterm labour (odds ratio-6.215; P=0.001), previous neonatal loss (odds ratio-2.83; P=0.049), previous caesarean deliveries (odds ratio-2.85; P=0.001), caesarean delivery (odds ratio-2.85; P=0.013), Baby weight (odds ratio-2.32; P=0.039), and neonatal loss (P=0.043) between Case and Control groups.

DISCUSSION

This case-control study compared the pregnancy-related outcomes for women with (Case group) and without diabetes (Control group) over a specific period of time, at a single center. Out of 144 deliveries, 72 were identified as diabetic cases. Since the data came from a single center and the study was a case-control, it's possible that this does not accurately reflect the true frequency**.**

Adverse outcomes for both the mother and the foetus are linked to poor glycaemic control during pregnancy. Risks to women included in this study were miscarriage, caesarean section, preterm labour, preeclampsia, haemorrhage and other risks that were not included in the study are diabetic retinopathy, ketoacidosis, and progression to renal disease. Premature delivery, macrosomia, NICU admissions, respiratory distress, asphyxia, hypoglycaemia, hyperbilirubinemia, congenital anomalies, IUFD, and other risks to newborns were among those covered by the study.

In the Case group with controlled glycemia, the mean HbA1c value is 6.05±0.99%, which is closer to the 6.0% target that was anticipated in our study. The mean HbA1c in the Control group is 5.47±0.26. We found a significant difference (p=0.002) in the mean HbA1c between the Case and Control groups. The study by Buhary et al. revealed that mothers with diabetes had a mean HbA1C value of 7.7818, which is higher than the value found in our investigation, indicating uncontrolled glycemia.

According to this study, 97.2% of women in the Case group had regular cycles, 2.8% had irregular ones, and 91% of women in the Control group had regular cycles and 9% had irregular ones. None of the studies that we looked at had previously evaluated this parameter. It appears that the menstrual cycle has no impact on or relationship to pregnancy-related diabetes, as most in women the Case group had regular menstrual cycles prior to becoming pregnant. Our sample shows no discernible difference. We intended to study this to evaluate whether the Case population had a known association with menstrual irregularities which can be seen with PCOS (Polycystic ovarian syndrome) or thyroid disorders.

The Case group of our study had a history of Spontaneous abortions (22.2% Vs 9.7%), MTP (11.1% Vs 4.1%), and stillbirth (0 Vs 5.5%) when compared to the Control group respectively.

The family history of Diabetes for women was 8.3% in the Case and Control groups respectively with p=0.551 which is slightly lower than 11.26% in cases of diabetes from Ramalingam et al. According to Kumari et al.'s findings, families with a history of diabetes had 22.4% of diabetic women and 10.5% of non-diabetic women (p=0.02). Our results were not statistically significant when compared to those of other family history studies.

Among the Case group, multigravida (61.2%) predominates over primigravida (36%) and grand multigravida (2.8%). Comparing Ramalingam et al. findings to ours, they reported primigravida (29.5%) and multigravida (69.01%). According to our study, the multigravida is significantly more in the Case group.

The mean gestational period in this study was 257.1±31.2 days for women in the Case group and 268.15±7.1 days for women in the Control group (P=0.001). This suggests that the deliveries are earlier in the Case group than in Controls.

According to this study, 26 (36.1%) women in the Case group and 6 (8.3%) women in the Control group experienced preterm labour (odds ratio-6.215; P=0.001). Similar findings are found in the Mahalakshmi et al. study concerning preterm labour in diabetic women (8.6%) and non-diabetic women (6.9%) (p=0.069).

According to Mahalakshmi et al., women in the Case group had a higher overall caesarean section rate of 26.2% compared to 18.7% in women in the Control group. Based on a study by Kumar et al., women with diabetes mellitus had a 50% caesarean section rate, while

women without the disease had a 55.5% rate. The findings of our study bear some resemblance to those of Mahalakshmi et al, Women with Diabetes in pregnancy had a higher overall caesarean section rate of 75% (54) compared to 51.4% (37) in women without the condition in this study. Our study found that among the Case group, 55.5% had emergency caesarean sections and 19.5% had elective caesarean sections, while among the Control group, 37.5% emergency caesarean sections and 13.5% elective caesarean sections (odds ratio-2.85; P=0.013). This suggests that there is a higher risk of caesarean delivery in Case group, though the risk may not vary based on plasma glucose control.

The mean birth weight was found to be 2.84±0.67 kgs for the neonates born to the Case group. The Ramalingam et al. study reports that only 14% of babies born over 4 kg indicate macrosomia and 68.11% of babies born between 2.6 and 3.9 kg. According to our research, 25% of babies born to the Case group weigh less than 2.4 kg, 75% weigh between 2.4 and 4 kg, and there are no newborns found macrosomic. This study shows a significant difference (odds ratio-2.32; $p<0.05$) in the prevalence of low birth weight in infants born to the Case group when compared to controls.

In the Case group, the neonatal loss is approximately 4 (5.55%), while the Control group experienced no loss. Whereas an IUD was not identified in our study, the Mahalakshmi et al. study included a 0.3% neonatal IUD in the Case group and a 0.7% IUD in Controls.

According to the findings of Manju Yadav et al., 29.63% of NICU admissions are related to the Case group, while 9.5% are related to Controls. According to Buhury et al. study, diabetic cases accounted for 21.5% of NICU admissions. In contrast, our study found that 44.4% of NICU admissions were diabetes-related and 55.6% were not. Comparing our study to previous research, no increase in NICU admissions has been observed.

Asphyxia or respiratory distress is observed in 33.3% of the Case group and 36.1% of the Control group which are not statistically significant. According to studies by Ramalingam et al. and Aruna Nigam et al., neonates of the Case and Control groups experienced respiratory distress at rates of 25.3% and 10%, respectively. According to a study by Kumari et al., respiratory distress syndrome affects 4.7% of the Case group and 1.6% of the Controls. The fact that the respiratory problems in our study did not differ considerably, may be attributed to proper glycaemic control in the Case group.

The APGAR scores at 1st minute in this study, mothers Case and Control groups are 5.08±1.54 and 4.9±1.35, respectively, which are not statistically significant. The APGAR

score at the 5th minute was 7.03±1.24 in the Case group and 7.11±1.88 in the Control group. Compared to our study, Kumari et al.'s results indicated APGAR scores of 8.61±1.36 for diabetics and
8.73±0.82 for non-diabetics at the 5th minute.

In comparison to controls (15.3%), hyperbilirubinemia is more prevalent in the Case group (33.3%). There is no discernible difference between 1.6% cases of hyperbilirubinemia in the Case group and 1.2% in the Control group, according to Mahalakshmi et al. However, this study shows a significant difference (odds ratio-2.77; $p<0.05$) in the prevalence of hyperbilirubinemia in infants born to the Case group.

Out of the 72 women in the Case group, 12 (16.7%) had pregnancy-induced hypertension. This figure is marginally higher than that of the study by Kumari et al., which found that 13.5% of diabetic mothers experienced pregnancy-induced hypertension. This suggests that mothers who have diabetes have a very high risk of developing pregnancy-induced hypertension as a maternal complication.

In comparison to control groups, there is no significant difference in the clinical parameters such as APGAR score, respiratory support, asphyxia, and nuchal cord. This may be due to prompt assessment, treatment, and strict monitoring of maternal glycemia. The higher frequency of these complications in the sample reported by other studies can be explained by the characteristics of the sample population and the treatment given.

CONCLUSION

This study aimed to demonstrate the importance of prompt diagnosis, treatment, and close monitoring of hyperglycaemia in diabetic mothers during pregnancy. While maintaining controlled chronic hyperglycaemia can prevent many pregnancy complications, our findings show that risks still remain elevated even with treatment.

Preterm births and caesarean deliveries were more common among diabetic mothers despite glycaemic control. We also observed lower birth weights, higher rates of hyperbilirubinemia, and increased neonatal loss in infants of diabetic mothers. This highlights the need to reevaluate targets for plasma glucose control during pregnancy beyond standard recommendations.

Further large-scale, population-based studies on diabetic pregnant women with controlled blood sugars are warranted. Our study, while limited to a single center, adds to the evidence that achieving glycaemic control alone may not be sufficient to normalize all pregnancy risks related to diabetes.

As the burden of gestational and pre-gestational diabetes climbs globally, preventing complications remains a priority. Our findings emphasize the risks associated with any maternal diabetes, controlled or not, and underscore the critical importance of optimal glycaemic control and patient education on diabetes in pregnancy. Tighter glucose targets and additional preventative strategies should be explored to improve outcomes for mothers and babies alike.

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Treatment controlled (n=72) (%)	Without DM (n=72) (%)	ODDS Ratio	Clinical Parameters	DM	p
Mother age	27.83±6.24	24±4.9	0.001		
Gestation period	257.1±31.2	268.15±7.1	0.001		
Prev neonatal loss					
Death	0	4 (5.5%)	0.049	0	
MTP	8 (11.1%)	3 (4.2%)		2.38	
SA	16 (22.2%)	7 (9.7%)		2.533	
Family history of DM	6 (8.3%)	6 (8.3%)	0.551	1	
Previous cesarean delivery	36 (50%)	19 (26.4%)	0.001	2.793	

HbA1c	6.05±0.99	5.47±0.26	0.002	
Gravidity				
PRIMI		29 (40.3%)		
MULTI		40 (55.6%)		
Grand Multi	26 (36%)	3 (4.2%)		0.838
	44 (61.2%)			1.259
	2 (2.8%)		0.761	0.651
Pregnancy induced HTN	12 (16%)	0		

Table 1: Clinical parameters of mothers with Treatment controlled DM and Mothers without DM

Treatment controlled Ratio (n=72) (%)	**Without DM (n=72) (%)**	**ODDsPregnancy outcomes**	**DM**	**p**
Cesarean delivery	54(75%)	37 (51.4%)	0.013	2.85
Baby Birth weight Microsomia (<2.4 kgs)	18 (25%)	9 (12.5%)		2.32
Normal (2.4-4 kgs)	54 (75%)	62 (86.1%)		0.544
Macro (>4 kgs)	0	1 (1.4%)		0
Mean	2.84±0.67	2.945±0.41	0.039	
Preterm labor	26 (36.1%)	6 (8.3%)	0.001	6.215

APGAR SCORE 1st min	5.08±1.54	4.9±1.35	0.454	
APGAR SCORE 5th min	7.11±1.88	7.03±1.24	0.753	
Nuchal cord	4 (5.6%)	8 (11.1%)	0.725	0.47
NICU admission	32 (44.4 %)	40 (55.6 %)	0.015	0.64
Asphyxia	24 (33.3%)	40 (55.6%)	0.729	0.4
Respiratory support	26 (36.1%)	26 (36.1%)	0.854	1
Hyperbilirubinemia	24 (33.3%)	11 (15.3%)	0.011	2.77
Neonatal loss	4 (5.55%)	0	0.043	∞

Table 2: Pregnancy Outcomes of mothers with Treatment controlled DM and Mothers without DM