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Diabetes in Pregnancy: Complications and outcomes

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Name of Author:
Nabeela wazir[1], Khanda Gul[2], Samina Tareen[3], Humaira Sami Ullah[4], Dr. Codjo Laurent Azonvide[5], Afshan Jehan Zeb[6]

Affiliation: *[1]SPR Hayatabad medical complex Peshawar*
[2]Associate Professor Gynae Unit 4 Bolan Medical Complex Hospital Quetta, Balochistan
[3]Assistant professor gynae unit 4 Bolan medical complex hospital Quetta, Balochistan
[4]Department of General Medicine, Unit III. Bolan Medical Complex Hospital, Quetta
[5]Laboratory of Biology and Molecular Typing in Microbiology, Department of Biochemistry and Cellular Biology, Faculty of Sciences and Techniques, University of Abomey-Calavi, 05 BP 1604 Cotonou, Benin
[6]SPR Specialist Registrar Hayatabad medical complex Peshawar

Corresponding Author:
Afshan Jehan Zeb
SPR Specialist Registrar Hayatabad medical complex Peshawar
Email: ajehanzeb93@gmail.com

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Abstract: Background: **Objective:** Pre-gestational Type 1 Diabetes Mellitus (T1DM) is associated with poor maternal, perinatal and neonatal outcomes. In this work, we report the maternal and fetal complications and outcomes of pregnant women with pre-existing Type 1 Diabetes. The aim is to identify potential preventable factors. **Study Design and setting:** The present retrospective study was carried out at Hayatabad medical complex Peshawar from August 2024 to August 2025, and focused on registered pregnancies of women with pre-existing Type 1 Diabetes Mellitus (T1DM), after taking approval from the ethical board of the hospital.**Methodology:** The information was obtained from the Hospital Management System (HMS) records and used a data set that included recorded pregnancies of women with Type 1 diabetes who satisfied the predetermined inclusion requirements. Data on demographics, diabetes, obstetric history, clinical examination results, treatment information, maternal, perinatal, & neonatal outcomes were all recorded using a pre-made questionnaire. Using SPSS version 22, descriptive statistics were used to examine the data.**Results:** This study included 80 pregnancies, with pre-existing Type 1 Diabetes Mellitus (T1DM). The average age was 16.12 ± 6.75 years (at the time of diagnosis of Type 1 Diabetes Mellitus). The mean duration of type 1 diabetes, before pregnancy, was 11.92 ± 8.67. The mean age of the mothers was 22.96 ± 3.80 years at the time of first pregnancy. Majority of the pregnancies were unplanned 60 (75%). At the time of conception, the mean HbA1C was 7.92%. Pregnancy-related maternal complications were hypertension 20 (25%), followed hypoglycemia, UTI and shock 12(15%), acute renal failure 10 (12%), thrombotic embolism 7 (8.7%) and pre-eclampsia respectively. At the time of delivery, the median gestational age was 30.14 ± 10.81 weeks. Mode of delivery was Caesarean in 48 (60%). The commonest neonatal complications were hypoglycemia 16 (20%), followed by preterm birth 12 (15%) and stillbirth in 10 (12.5%). **Conclusion:** The high frequency of unplanned pregnancies, lack of pre-pregnancy care along with poor glycemic control results in compromised maternal, neonatal and perinatal outcomes in this high-risk group. Pregnancy should be anticipated and planned in such cases to limit the risk of adverse outcomes. Strict glycaemic control is the optimal management for pre-existing type 1 diabetes in pregnancy, as raised HbA1C is associated with increased risk of maternal and fetal complications.

Keywords: Risk; Complications; Pregnancy; pre-existing Type 1 Diabetes Mellitus (T1DM)

INTRODUCTION

Pregnancy in women with type 1 diabetes mellitus is associated with an increased risk of obstetric challenges, neonatal complications, and congenital abnormalities. These adverse outcomes are influenced, at least in part, by the quality of care provided around the time of conception, particularly the level of glycaemic control that is achieved. Pregnancy outcomes are improved and congenital abnormalities are less common with proper pre-conceptional care.1 Type-1 diabetes has become more common in pregnant women in recent years, with a frequency of 1.56 to 4.09 cases/1000 pregnancies. Because Type-1 diabetes is linked to a number of problems for both the mother and the fetus, this increase in occurrences presents serious difficulties in managing pregnancies with the disease. Reports indicate that young type 1 diabetic women experience a high prevalence of comorbid conditions and related complications.2 In addition, macrosomia, respiratory distress syndrome, admission to the Newborn Intensive Care Unit (NICU), intrauterine growth restriction, congenital defects, early delivery, newborn hypoglycemia, and metabolic abnormalities are examples of neonatal difficulties that have been noted in type 1 diabetic mothers during pregnancies. Furthermore, the incidence of congenital abnormalities in newborns of Type-1 diabetic pregnant women is strongly correlated with higher HbA1C. As a result, elevated blood glucose levels are regarded as a major teratogen that contributes to these negative consequences. Therefore, promoting pregnancy planning among women with diabetes, optimizing glycaemic control, and initiating folic acid supplementation prior to conception are well-established goals of care. It is envisaged that by using this approach, the St. Vincent Declaration's objectives would be met and pregnancy outcomes will resemble those of women without diabetes.3 The adverse pregnancy outcomes that are strongly associated with Type 1 diabetes include pregnancy-related hypertension, preeclampsia, stillbirth, eclampsia, cesarean delivery, chorioamnionitis, pulmonary edema, preterm birth, sepsis, puerperal cerebrovascular complications, acute kidney failure, and shock. In addition, another study reported that 73% of Type 1 diabetic women experienced unfavorable pregnancy outcomes. Notably, none of these adverse outcomes were predicted in advance. Furthermore, 47% of the women had pre-existing diabetes-related complications prior to pregnancy. However, many studies have shown that outcomes of pregnancy for women, with type 1 diabetes, were comparable to those of the general population.4-5 However, a lot of the information collected came from facilities that specialized in pregnancy and diabetes, thus they weren't typical of the entire community. According to a recent thorough research, Type-1 diabetic pregnant women may avoid negative outcomes by receiving preconception care, planning their conception, maintaining appropriate glycemic control, taking folic acid supplements, and treating any extra diabetic vascular issues. Even though improving HbA1c levels while treating medical comorbidities and providing preconception counseling can improve maternal mortality and morbidity outcomes, three large-scale UK studies have demonstrated that women with diabetes continue to have poor glycaemic control and significant rates of non-attendance at prenatal care facilities.6-10 The aim of diabetes management is to improve treatment for diabetic patients in order to lower the risk of related problems.11-12 According to reports from 1991 to 2003, type 1 diabetes individuals had poor pregnancy outcomes. Adverse pregnancy outcomes can be attributed to a high incidence of unplanned pregnancies with suboptimal blood glucose management before conception, insufficient metabolic regulation throughout pregnancy, and existing health conditions related to diabetes, including hypertension and kidney disease. High rates of unfavorable outcomes for both mothers and fetuses demonstrate the difficulties doctors have while treating pregnant women with the illness..13-15

Material and method

The present retrospective study was carried out at Hayatabad medical complex Peshawar from August 2024 to August 2025, after taking approval from the ethical board of the hospital. Data was retrieved from the records available on Hospital Management System (HMS). Women with pre-existing Type 1 Diabetes Mellitus (T1DM) and who became pregnant at least once after diagnosis of Type-1 diabetes, were included. Women with gestational diabetes, those who were diagnosed with Type-1 diabetes during pregnancy and Type-2 diabetic pregnant females were excluded from the study. A predesigned questionnaire was developed for data recording, such as details of diabetes and obstetrics, results of clinical examination, details of treatment, neonatal, maternal and perinatal outcomes, as well as demographics. Descriptive statistics were used for data analysis, with SPSS version 22. For continuous variables, both the mean and standard deviation were computed, while frequencies were calculated for categorical variables.

Results

During the study period 125 women became pregnant out of which complete record were obtained of just 80 individuals having pre-existing Type 1 Diabetes Mellitus (T1DM). The mean duration of type 1 diabetes, before pregnancy, was 11.92 ± 8.67. The average age (at the time of diagnosis of Type 1 diabetes mellitus) was 16.12 ± 6.75 years. The average age was 22.96 ± 3.80 years at the time of the first pregnancy. Majority of the pregnancies were unplanned 60 (75%). At the time of conception, the mean HbA1C was 7.92%. Before becoming pregnant, 52.5% of women had received counselling on glycaemic targets, and according to the data collected, 90% of participants had taken folic acid on a regular basis during the first trimester. At delivery, the median gestational age was recorded as 30.14 ± 10.81 weeks, as presented in table 1.

Pregnancy-related maternal complications were hypertension 20 (25%), followed hypoglycemia, UTI and shock 12(15%), acute renal failure 10 (12%), thrombotic embolism 7 (8.7%) and pre-eclampsia respectively. Mode of delivery was Caesarean in 48 (60%), whereas 32 (40%) had normal vaginal deliveries. While 2 (2.5%) of the women lost their lives, as presented in table 2.

Pregnancy-related neonatal complications in women with pre-existing Type 1 Diabetes Mellitus (T1DM) were hypoglycemia 16(20%), preterm birth (less than 37 weeks) 12(15%), stillbirth 10 (12.5%), respiratory disorders 7(8.7%), low birth weight 6(7.5%), Hypertrophic Cardiomyopathy 4(5%), macrosomia and jaundice 3(3.7%) respectively, as shown in table 3. "

Table 1. Demographic and basic features of the study population N= 80

Features	Frequency /percentage or mean ± SD
Mean age in years	
At diagnosis time of type 1 diabetes	16.12 ± 6.75
Age at first Pregnancy age	22.96 ± 3.80
Mean diabetes duration before pregnancy	11.92 ± 8.67
Median gestation age at delivery	30.14±10.81 weeks
HbA1C	7.92%.
Mean random blood glucose (mg/dl) during pregnancy	211.69 ±89.64
Mean fasting blood glucose (mg/dl) during pregnancy	129.47±61.63
Status of pregnancy	
Unplanned	60 (75%)
Planned	20 (25%)
Preconception advice given	
No	38 (47.5%)
Yes	42 (52.5%)
Number of pregnancy	
1	10
2	18
3	20
4	15
Folic acid taken	
Yes	72(90%
No	8(10%)

Table 2. Pregnancy-related maternal complication in women with type 1 diabetes

Maternal Complications	Frequency /percentage
UTIs	12 (15%)
Hypertension	20 (35%)
Thyroid dysfunction	5 (6.2%)
Puerperal cerebrovascular disorders	3 (6%%)
Acute renal failure	10 (12%)
Shock	12 (15%)
Intracranial injuries	1 (1.2%)
Cardiac arrest	3 (6%)
Thrombotic embolism	7 (8.7%)
Number of women died	2 (2.5%)
Pre-eclampsia	4 (5%)

Hypoglycemia	12 (15%)
Mode of delivery	
Caesarean	48 (60%)
Normal vaginal	32 (40%)

Table 3. Pregnancy-related neonatal problems in type 1 diabetic women

Complications	Frequency/percentage
Hypoglycemia	16 (20%)
Preterm birth (less than 37 weeks)	12 (15%)
Stillbirth	10 (12.5%)
Low birth weight	6 (7.5%)
Respiratory disorders	7 (8.7%)
Hypertrophic cardiomyopathy	4 (5%)
Congenital abnormalities	1(1.2%)
Macrosomia	3 (3.7%)
Jaundice	3 (3.7%)

DISCUSSION

The number of pregnant women with Type-1 diabetes has increased from 1.56 to 4.09 per 1000 pregnancies, in recent years.[16] Type 1 diabetes mellitus mostly occurs before the age of thirty. Thus, a large number of women of reproductive age may be impacted by this illness. According to reports, young Type-1 diabetic women have a significant frequency of comorbidities and complications.[17] Their death rate has increased by two to three times.[18] However till now only a few studies have been conducted in Pakistan, for assessing complications and outcomes of pregnancy in this high risk group, in our setup. The present study was carried out to find out the risk of complications in pregnant type 1 diabetic women and to identify potentially reversible factors. Both the maternal and neonatal complications were evaluated. During the study period, 125 women became pregnant out of which, the complete records were obtained for just 80 individuals. The average age was 22.96 ± 3.80 years at the time of the first pregnancy, while the average diabetes duration was 11.92 ± 8.67 years prior to pregnancy. The average age at the diagnosis time of Type 1 diabetes was 16.12 ± 6.75 years. At delivery, the median gestational age was recorded as 30.14 ± 10.81 weeks. The findings of our study are similar to the study conducted by Riaz et al.[19] Their study included 100 women with pre-existing Type-1 diabetes (mean age: 15.11 ± 5.64 years at diabetes diagnosis). Of those, 72% reported unplanned pregnancies, with a mean HbA1C at conception 8.29%. Median gestational age at delivery was 32.15 ± 10.82 weeks. Delivery outcomes included 60% C-sections. Stillbirths occurred in 14 cases, neonatal complications included hypoglycemia in 13 and low birth weight in 12 neonates.[19] But contrast with previous studies that reported a mean (±SD) age of 29 ± 5.42 years[9] and 28 years[11], correspondingly, and a diabetes duration of 14.1 ± 8.05 years.[6] Females who have unplanned pregnancies have increased likelihood of poor pregnancy outcomes.[20] Additionally, evidence indicates a connection between prenatal care attendance and reduced HbA1c levels during the initial phases of pregnancy and fewer negative consequences, such as premature birth, congenital defects, and perinatal death.[21] The majority of patients in the current study 60 (75%) had a pregnancy that was not planned, which is consistent with previous data showing a nearly equal prevalence of unplanned pregnancies.[21] However, Knorr S et al observed that in mothers with diabetes and HbA1c <8% in the first trimester and normal pre-gestational urinary albumin excretion rate, mortality rate was comparable with that of control mothers. Maternal mortality rate increased with higher levels of HbA1c in early pregnancy HbA1c ≤9%.[21] In our study the HbA1C was 7.92%, while the mean random blood glucose (mg/dl) during pregnancy was 211.69 ±89.64 and the mean fasting blood glucose (mg/dl) during pregnancy was 129.47±61.63, but still the number of women who died was 2 (2.5%)." Strict blood glucose control before and during pregnancy, regular monitoring, and modifications to insulin and prescription regimes under the supervision of a specialist medical team are all necessary for the proper treatment of type 1 diabetes during pregnancy. To maximize health, preconception planning is essential. During pregnancy, treatment includes routine examinations, nutritional recommendations, and modifications to care during birth and the postpartum period. The National Institute for Health and Care Excellence (NICE) recommends taking 5 mg of folic acid daily until 12 weeks of pregnancy. Ninety percent of the women in our research consumed folic acid during the first trimester, whereas only 41.8% of women used it, according to the National Pregnancy in Diabetes (NPID) audit. [22] In a similar study, just 21.7% of participants in another research reported taking folic acid at the conception time.[16] According to the management of Diabetes and problems Trial, rigorous glycaemic management reduces the frequency and T1DM severity problems and may

enhance outcomes of pregnancy, particularly during conception.[17] In our study, 32 women (40%) had a usual vaginal delivery and 48 women (60%) had a caesarean section (c-section). Similarly, a number of studies found that moms with diabetes are more likely to give birth via caesarean section.[23] In the present study the most prevalent pregnancy-related maternal complication in women with type 1 diabetes were hypertension 20 (25%), followed hypoglycemia, UTI and shock 12(15%), acute renal failure 10 (12%), thrombotic embolism 7 (8.7%) and pre-eclampsia respectively. Our study findings were also comparable to the previous study[24] in which the most prevalent condition was hypertension followed by acute renal failure. Acute renal failure (ARF) can be brought on by hypertension, which destroys and constricts the blood vessels in the kidneys, reducing blood flow and impairing kidney function. This can be made worse by underlying renal illness, which can lead to hypertension, resulting in a risky vicious cycle where each ailment exacerbates the other. Acute renal failure can be directly caused by significant, abrupt blood pressure increases (malignant hypertension), even while persistent elevated blood pressure is a risk factor. In our study, neonatal complications in women with pre-existing Type 1 Diabetes Mellitus (T1DM) were hypoglycemia 16(20%), preterm birth (less than 37 weeks) 12(15%), stillbirth 10 (12.5%), respiratory disorders 7(8.7%), low birth weight 6(7.5%), Hypertrophic Cardiomyopathy 4(5%), macrosomia and jaundice 3(3.7%) respectively. According to other studies, people with T1DM frequently experience the aforementioned newborn complications, particularly those with worse glycaemic control. According to Guarnotta et al., women with T1DM showed lower Δ_total_insulin requirement (IR) at the first, second and third trimesters (all $p < 0.001$) and higher weight gain during pregnancy ($p < 0.001$), pregestational HbA1c ($p = 0.040$), HbA1c in the first ($p = 0.004$), second ($p = 0.020$) and third ($p = 0.010$) trimesters compared to T2DM. Women with T1DM had a higher risk of macrosomia ($p = 0.005$) than T2DM.[23] Pregnancy is biologically characterized by reduced insulin sensitivity because of the activities of placental hormones such as human placental lactogen.[24] Meta-analysis suggested that preconception care is effective in reducing congenital malformation, preterm delivery and perinatal mortality. Preconception care lowers HbA1c in the first trimester of pregnancy by an average of 2.43. Women who received preconception care booked earlier for antenatal care by an average of 1.32 weeks.[25] Murphy et al, observed that women with Type 1 diabetes are less likely to achieve the recommended glucose control target of HbA1c < 48 mmol/mol (6.5%) (14.9% vs. 38.1%; $P < 0.05$). They suggested the following opportunities for improvement. First, the need to integrate reproductive health into the diabetes care plans of all women with diabetes aged 15–50 years. Second, to develop more innovative approaches to improve uptake of pre-pregnancy care in women with diabetes in primary care settings. Third, to integrate insulin pump, continuous glucose monitoring and automated insulin delivery technologies into the pre-pregnancy and antenatal care of women with Type 1 diabetes. Fourth, to improve postnatal care with personalized approaches targeting women with previous pregnancy loss, congenital anomaly and perinatal mortality.[26] High rates of unfavorable outcomes for both the mother and the fetus demonstrate the challenges that doctors have while treating pregnant individuals with the illness. The widespread usage of self-monitoring of blood glucose has made it possible for patients to control their blood glucose levels by altering their lifestyle and quickly modifying their insulin dose. When compared to human insulin, a rapid-acting insulin analogue has demonstrated lower the risk of adverse fetal outcomes. By linking an insulin pump, a control algorithm, and a continuous glucose monitor (CGM), closed-loop insulin delivery systems also referred to as artificial pancreas, it automatically regulates insulin supply. These devices improve glycemic control for individuals with type 1 diabetes by automatically adjusting insulin levels based on sensor data. For mealtime insulin, hybrid closed-loop systems, the most popular kind at the moment remain user-managed, whereas fully closed-loop systems would be completely automated.[26] Insulin pump therapy, also known as continuous subcutaneous insulin administration (CSII), is a diabetes treatment technique in which a portable, battery-operated pump distributes fast-acting insulin continuously via a cannula placed beneath the skin. By continuously delivering an ongoing baseline (basal) rate of insulin and enabling the user to administer greater, immediate (bolus) injections for meals or high glucose levels, it substitutes many daily injections. Many contemporary pumps employ automated mechanisms that react to glucose readings or interact with a continuously recording of glucose (CGM) to modify insulin administration.[27] To summarize, pre-gestational diabetes is becoming more common in women who are of reproductive age. About 1% of pregnant women have pre-gestational type 1 diabetes mellitus. Personalized approaches can reduce maternal, neonatal and perinatal mortality.

CONCLUSION

The current study concluded that pregnancy related maternal, perinatal and neonatal complications were most prevalent in women with type 1 diabetes. To minimize the occurrence of complications, beginning at the onset of puberty or at diagnosis, all adults and adolescents with diabetes of childbearing potential should receive education about the risks of complications associated with unplanned pregnancies, even with mild hyperglycemia. Effective preconception counseling could avert substantial health and associated cost burdens related to the

mother as well as the offspring. However, further research is needed to clarify the root causes of adverse outcomes in the pregnancies of women with diabetes.

Limitations

Due to the lack of a consistent referral system for obstetric treatment, this single-centered study presented difficulties for data gathering. Furthermore, patient recall was used to collect data. As a result, some details are lacking. However, our center's strength is its excellent pool of Type-1 diabetic women, and each visit's data is stored on a specialized HMS.

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Authors Contribution:

Nabeela wazir: Conception, design
Khanda Gul: interpretation
Samina Tareen: Interpretation
Afshan Jehan Zeb: corresponding author
Humaira Sami Ullah: Analysis, final approval
Dr. Codjo Laurent Azonvide: Literature Review

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