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COMPARISON OF UMBILICAL ARTERY DOPPLER AND NON-STRESS TEST IN ASSESSMENT OF FETAL WELL-BEING IN DIABETIC PREGNANT WOMEN

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Abstract

Pregnancy complicated with both overt and gestational diabetes mellitus is well-established risk factor for increasing perinatal and neonatal problems such as fetal malformation as well as maternal complications. It was found that the risk of perinatal mortality is not increased compared to controls but the risk of macrosomia is significantly increased. Other perinatal problems include birth injuries, such as bone fractures and shoulder dystocia, bell's palsies, and hypoglycemia.

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Objectives of the study 1. To assess the reliability of GTC and UA Doppler for assessment of fetal health. 2. To determine the impact of gestational diabetes on the infant. The mode of delivery for women with type 2 diabetes will be determined based on GTC and Doppler measurements.

Results: A total of 100 diabetic pregnant women were included in this study with mean age of 32.7±6.1 years; 4% of them were less than 20 years age, 20% of them were in age group 20-29 years, 57% of them were in age group 30-39 years and 19% of them were 40 years age and more.

Aim of study To evaluate the efficacy of a non-stress test (NST) versus umbilical artery (UA) Doppler in predicting unfavorable newborn outcomes in diabetes mellitus (DM).

Keywords: Umbilical artery Doppler, Cardiotocography (CTG), non-stress test, fetal growth, diabetic pregnant women.

Introduction

Pregnancy and Diabetes mellitus

Pregnancy can cause diabetes in women without it because it affects the metabolism of the mother and the developing baby. In a normal pregnancy, insulin resistance increases and the pancreatic β-cell reserve is exhausted in an attempt to maintain blood glucose within safe limits; gestational diabetes occurs when the β-cells are unable to achieve this balance. The placenta has a significant anti-insulin effect, and removal prior to birth usually restores glucose homeostasis. Gestational diabetes is a compelling predictor for the development of persistent diabetes later in life. It affects 2–17.8% of women; however, this percentage varies depending on the study group and the diagnostic criteria utilized. Normal pregnancy is associated with a complex sequence of hormonal changes that serve to prevent maternal hypoglycemia and to meet the nutritional needs of the developing fetus. This is not a pathological condition. Diabetes and

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
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hyperglycemia, as a defining feature of the disease, are important contributors to the complications for the mother and the fetus in pregnant women. The pregnant women with diabetes are at higher risk of obstetric and neonatal complications and maternal and infant mortality. [2–4] The most common fetal adverse outcomes found in pregnancies of women with diabetes are fetal and neonatal loss, a great variety of congenital abnormalities and malformations, premature delivery (delivery before 37 weeks' gestation), fetal growth acceleration, and macrosomia (defined as a birth weight above 4 kg and >90th percentile weight for gestational age or large for gestational age), which are associated with several obstetric complications like birth trauma, hypertrophic cardiomyopathy, stillbirth, respiratory distress syndrome, neonatal hypoglycemia, hypocalcemia, hyperbilirubinemia, and polycythemia; maternal complications are pregnancy-induced hypertension, pre-eclampsia, hemolysis, elevated liver enzymes, low platelets (HELLP) syndrome, Cesarean section, hypoglycemia, and A poor pregnancy with overt and gestational diabetes mellitus is a well-known risk factor for an increase in perinatal and neonatal problems, including fetal malformation and maternal difficulties. The incidence of macrosomia. Members of the IAD PSG council 10 recently re-evaluated this recommendation and found it to be significantly higher, but not the risk of perinatal mortality. Other pregnancy concerns such as bone fractures, shoulder dystocia, bell's palsy, hypoglycemia, and other delivery issues are also conceivable.

Evaluation and Classification

Debate on IADPSG Diagnostic Criteria

Although a lot of efforts have been made to create widely accepted diagnostic criteria for gestational diabetes mellitus (GDM), disputes are still ongoing, and no consensus has been reached. The O'Sullivan, Carpenter, and Coustan diagnostic criteria were not based primarily on identifying pregnancies with increased risks of unsatisfactory perinatal outcomes but rather on the chance of

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

the mother being a diabetic post-pregnancy. Then, the well-known Hyperglycemia and Adverse Pregnancy Outcomes (HAPO) experiment was developed to define the association between perinatal outcomes and glucose levels below that diagnostic of diabetes with a 75-g Oral Glucose Tolerance Test (OGTT). In 2010, the IADPSG 26 issued a panel recommendation on the categorization and diagnosis of hyperglycemia based largely on the HAPO study 8. The International Association of Diabetes Pregnancy Support Groups (IADPSG) was primarily set up to promote a global plan for better research and management of diabetes in pregnancy. Gestational diabetes mellitus type 1 is diagnosed by any of the following three values following a 75-g, two-hour oral glucose tolerance test (OGTT) between 24 and 28 weeks of gestation: fasting blood glucose (FBG) > 5.1 mmol/L, one-hour value ≥ 10 mmol/L, and two-hour value ≥ 8.5 mmol/L.

First, the International Association of Diabetes and Endocrinology (IADPSG) has proposed a change in the definition of gestational diabetes mellitus (GDM) from “any hyperglycemia first recognized in pregnancy” to “hyperglycemia with first recognition during pregnancy that is not overt diabetes" to distinguish between women who have had diabetes in the past. This change is of critical importance, as the number of pregnant women with undiagnosed diabetes is increasing, and these women are at significantly higher risk of problems for the mother and child if treatment is not initiated sooner. Therefore, Gestational Diabetes Mellitus (GDM) is not diagnosed in pregnancy if any of the following criteria are met: Fasting Blood Glucose (FBG) > 7 mmol/L, Random Glucose ≥ 11.1 mmol/L, or Hemoglobin A1c ≥ 6.5%. [9] 10 These revised diagnostic criteria were approved by the Endocrine Society, the American Diabetes Association (ADA), and the World Health Organization (WHO). These criteria obviously increase the prevalence of DM, rather than the previously commonly used Carpenter and Coustan two-step technique,[10] by including a group with less severe metabolic impairment while excluding previous diabetes. The ACOG did not endorse the

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

revised guidelines, questioning whether treating this new subset of GDM patients with milder symptoms would enhance pregnancy outcomes. [11] Those who were found abnormal on screening were then subjected to a three-hour 100-g glucose tolerance test following a one-hour screening test with a 50-g glucose load, according to their two-step recommendation (12). In their amended practice bulletin in 2017, the ACOG notes that one high number, instead of two, can be used to diagnose GDM 12, although they still advocate utilizing either the National Diabetes Data Group (NDDG) criteria or Carpenter and Coustan for the interpretation of the three-hour 100-g glucose tolerance. This additional consideration came up as a result of a detailed investigation showing that women with even one abnormal value on the 3-h 100-g GTT were at increased risk for adverse pregnancy outcomes. [13]. Nor have societies from other countries adopted the IADPSG criterion 14. However, it is worth noting that the ADA 15 considers the two-step strategy supported by ACOG 11 and the one-step criterion proposed by IADPSG 9 to be adequate. Besides practical benefits, the IADPSG approach might bring uniformity to best practices in patient care, potentially improving the comparability of study findings, the National Institutes of Health (NIH) said. The National Institutes of Health (NIH) is concerned that the adoption of IADPSG standards may lead to a dramatic increase in the prevalence of gestational diabetes mellitus (GDM) from 5-6% to 15-20%. They want to ensure that the treatment has a positive impact on pregnancy outcomes and is cost-effective. impact on pregnancy outcomes and cost-effectiveness They aim to thoroughly examine the treatment's impact on pregnancy outcomes and cost-effectiveness before fully implementing the new criteria. before putting the new rules into effect completely. Weile et al. 14 conducted a thorough literature search of articles from 2002 to 2014 to examine the cost-effectiveness and cost-utility of several techniques for GDM screening and therapy using the updated IADPSG screening and diagnostic criteria (17).

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

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https://eurekaoa.com/index.php/5

The authors concluded that a meaningful definition of global cost-effectiveness could only be presented after universal cost assessments of screening, diagnosis, treatment, and outcomes. China has been adopting the IADPSG GDM diagnostic criteria since 2011. In a large research study of more than 25,000 Chinese women diagnosed with GDM according to IADPSG criteria, the prevalence of GDM increased, but women treated according to these criteria had a lower risk of adverse pregnancy outcomes. [18]

Controversies on HbA1c and First Trimester of Pregnancy

Significantly, though, these revised requirements were not derived from evidence acquired in the first trimester of pregnancy. 19 No new classifications or diagnostic thresholds for hyperglycemia “less than overt diabetes” in the first trimester of pregnancy, especially before 24 weeks' gestation, have been proposed. According to the IADPSG, if the findings are in the 5.1-6.9 mmol/L range, FBG testing should be able to detect GDM 9 during early pregnancy. But they accepted this proposal, even with the World Health Organization’s argument for the benefits of early diagnosis and treatment. This recommendation, members of the IAD PSG council 10, was recently re-evaluated by members of the IAD PSG council 10 in light of 2 publications that have vigorously challenged it. These reports show that fasting blood glucose (FBG) levels of 5.1 mmol/L or higher in early pregnancy don't always mean a woman will have gestational diabetes mellitus (GDM) when tested between 24 and 28 weeks, but they can help find women who are at high risk. Women with hyperglycemia in early pregnancy who do not have DM, though generally classified as GDM, likely had some degree of hyperglycemia before pregnancy. Instead of the term “late GDM,” the term “early GDM” was suggested to describe those patients diagnosed later in pregnancy. But keep in mind that these are different clinical conditions, and only "late GDM" truly originates from pregnancy. Interestingly, 50% of individuals with early-pregnancy fasting blood glucose levels of 5.1-6.9 mmol/L did not fulfil the

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Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

criteria for late-stage gestational diabetes mellitus (GDM) after the age of 21. To improve perinatal outcomes, the risk of stillbirth must be balanced against the risk of newborn and infant morbidity and mortality, and the optimal timing of delivery must be determined. Gestational diabetes is associated with macrosomia and neonatal hypoglycemia but does not appear to raise the risk of newborn and neonatal death. Unlike other studies that correlate macrosomia with a higher risk of death, babies born large-for-gestational age have lower neonatal mortality rates than those born average-for-gestational age or small-for-gestational age. Therefore, the consideration of only short-term morbidities may not fully reflect the actual mortality risk related to GDM 22.

Assessment of Pregnancy Risk in Diabetic Women

Optimal outcomes for women with diabetes mellitus (DM) and their fetuses require careful metabolic management, carefully applied fetal surveillance tools, and cautious selection of the most opportune timing and mode of delivery. Where possible, these clinical decisions should be based on the best available data, and the potential and severity of maternal and fetal/neonatal morbidity should be considered. In the absence of high-level evidence, resources should be allocated to designing and conducting clinical studies to address the gap. This review covers the years 2023 and 2024.

Fetal surveillance:

• All women with DM should undertake fetal movement monitoring for the last 8–10 weeks of pregnancy and report any change immediately if they see a decline. "Women on insulin during pregnancy should seek non-stress testing after 32 weeks, while those managed with diet alone should have it at or near term.

Doppler velocimetry and biophysical profile tests should be done to check the blood flow in the umbilical cord if the baby's growth is unusual, either too fast or too slow, or if there are other issues like preeclampsia. “May be considered."

Eureka Open Access Journals
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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

• A prenatal ultrasound to screen for fetal abnormalities should be performed in women diagnosed with diabetes during the first trimester or with a fasting glucose level greater than 120 mg/dl.

Amniocentesis is not needed to examine fetal lung maturity in anticipation of delivery when the due date is beyond 38 weeks' gestation (23, 24).

Assessment without loading

Cardiotocography (CTG), also known as the contraction stress test (CST) or non-stress test (NST), is the gold standard for the measurement of fetal health during pregnancy. CST assesses utero-placental function, whereas NST monitors fetal health. The nonstress test (NST) is a screening test for fetal hypoxia that can be done during pregnancy. From this the most elementary of interpretations may be derived, that is, Reactive NST and Nonreactive NST. A reactive NST (normal) is defined as two or more fetal heart rate accelerations in a 20-minute period, with or without the woman feeling fetal movement. On the other hand, a nonreactive nonstimulatory transient (NST) is defined as the absence of more than two fetal heart rate accelerations (20 minutes apart) [27]. The system is termed nonreactive after as long as forty minutes. A non-reactive non-stress test can sometimes indicate that everything is fine. The fetus is commonly unconscious throughout the operation. [28] The Non-Stress Test (NST) is a diagnostic procedure used to evaluate fetal health from 32 weeks of gestation to term, using electric fetal monitors to continuously record the fetal heart rate (FHR). The test is done to find out whether a fetus is at risk of intrauterine death or newborn problems in high-risk pregnancies or suspected fetal hypoxemia. The test only indicates fetal hypoxemia at the time of the test and not its predictive value. Hence, frequency of use depends on clinical judgment. However, it is widely used because it is non-invasive and has little risk for the mother and fetus.

The thinking behind the non-stress test is that movement by the fetus will speed up the heart rate. The NST detects the relationship between the fetal brain state

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

and the reflex reactions of the cardiovascular system. In cases of progressive fetal compromise, the non-stress test is one of the first elements to be affected. Interpretation of the nonstress test systematically involves data such as the fetal heart rate at baseline, variability in the fetal heart rate at baseline, accelerations, decelerations, and contractions at 30 weeks. The person giving the test may use a buzzer to stimulate activity or offer the mother something to eat or drink to wake up the fetus. If the test, on the other hand, shows no reaction, it may mean that the baby is not getting enough oxygen. If the placenta or umbilical cord isn't working properly, it can cause low oxygen. Usually, the surgery begins when the fetus is 28 weeks into the pregnancy. If a woman has a history of fetal death in the second trimester, oligohydramnios, polyhydramnios, decreased fetal movement, numerous pregnancies, insulin-dependent diabetes, hypertension, kidney illness, heart disease, thyroid dysfunction, or a post-date pregnancy, she may be suggested to take an NST test. Depending on the reason, some pregnant women may need to be tested weekly or even more often until the baby is born (31 tests total). Initially it was thought that CTG was a strength for early diagnosis of poor fetal outcomes and that the findings implied the need for initiatives to boost newborn infant survival rates. However, there is evidence to suggest that CTG, as a nonstress test,[25],[26] may lead doctors to unwarranted or incorrect interventions.

Velocity measurements

The fetal Doppler uses ultrasound to assess the velocities of blood flow in fetal arteries, most often in the umbilical artery. The most common methods of flow measurement are the pulsatility index or the resistance index. These indices evaluate the change in peak systolic and end-diastolic velocities within a cardiac cycle in the arteries under scrutiny and therefore reflect the downstream vascular resistance. Ratios can be used instead to help the sonographer avoid the infamously erroneous technique of measuring the angle of insonation. A healthily

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

developing fetus has a diastolic flow rate of 32 beats per minute. The diastolic flow in the umbilical artery is usually decreased, absent, or, in severe cases, reversed in fetuses that cannot grow normally. Growth-limited pregnancies are associated with absent diastolic flow and increase odds of perinatal mortality by 4.0. The odds ratio for mortality with reversed diastolic flow is 10.6. Increased mortality risk with erroneous Doppler testing remains after controlling for gestational age 33. The absence of diastolic flow in the umbilical artery at birth is a reliable clinical test for fetal blood gas acidosis (sensitivity 90%) and fetal hypoxia (sensitivity 78%). The negative predictive value is high (98-100%) in the absence of end-diastolic flow. Positive predictive value is 53%-88%.

More randomized trials have studied Doppler-based assessments than any other form of prenatal assessment. A meta-analysis of four randomized studies did not demonstrate a reduction in the risk of newborn death by routine umbilical artery clamping. Doppler screening of all low-risk pregnancies 32. In one study of 2,016 low-risk women and Apgar scores, there was no significant difference in major neonatal morbidity, and clinicians were blinded to the Doppler results. To reduce neonatal deaths, Doppler assessments were carried out on 203 babies. The majority of these studies used Doppler ultrasound in conjunction with other fetal surveillance modalities, such as BPP or NST. But four studies compared women with a higher-risk pregnancy using Doppler ultrasound alone versus nonstress testing alone. This study involved 2813 women, and the researchers assessed the main clinical outcome in a less robust manner. The study involved 2813 women, and the researchers assessed the main clinical outcome in a less robust manner. in a less robust fashion. There was no detectable difference in perinatal mortality. Doppler techniques can also be used to study other fetal arteries. Recently, considerable emphasis Recent studies have placed significant emphasis on the idea that ductus venosus flow serves as a valid indicator of perinatal outcomes. to the notion that ductus venosus flow is a valid indication of the perinatal outcome. While this assessment appears promising, large-scale clinical trials have

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

yet to demonstrate its efficacy. While this assessment shows promise, large-scale clinical trials have yet to demonstrate its efficacy. in large-scale clinical trials. 35 Doppler investigations of the umbilical artery are part of fetal surveillance in high-risk pregnancies with suspected placental insufficiency. There is currently no agreement on the definition of suspected placental insufficiency, the frequency of Doppler scans, or when to deliver if the results are abnormal.

Research Plan and Research Environment

The study was carried out at the Diabetic Clinic and Labor Room at the Maternity Teaching Hospital, Erbil, Iraq, between April 1, 2019, and March 31, 2020. The study design was cross-sectional.

Study population

One hundred pregnant women with diabetes in the last stages of pregnancy, cared for at the Diabetic Clinic, were included in a study.

Inclusion criteria

People must be 18 years of age or older.
2. Get to parity.
If the cervix is dilatable to four centimeters, it implies that the labor is ongoing.
4. 28 weeks' gestation or more.
(5) Willingness to participate.

Exclusion Criteria

1. Having more than one child.
The second condition is gestational hypertension.
Third. Bleed.
4. Congenital anomalies.
5. Cardiovascular system diseases.
6. Didn't want to be involved.

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Data collecting

The initial subjects in the trial were 100 pregnant women with diabetes mellitus who presented to the Diabetic Clinic in the later stages of pregnancy or in labor.

Information Gathering

To obtain their data, pregnant ladies were requested to participate in a pre-prepared questionnaire. The questionnaire was developed jointly by the researcher and supervisor. The survey included:

First, the typical age of diabetic pregnant mothers.

2. In one study, pregnant women with diabetes were classified as normal (not exceeding 25 kg/m²), overweight (25 to 29.9 kg/m²), or obese (≥30 kg/m²) according to their BMI.

Thirdly, the gestational age of the diabetic pregnant women.

4. Types of diabetes mellitus in pregnancy: Type 1 and type 2 diabetes mellitus are also known as preexisting diabetes mellitus (pregestational), which is diagnosed before the onset of pregnancy.

Alternatively, preexisting glucose intolerance,[51] which is characteristic of gestational diabetes mellitus, could play a role.

5. Baby outcomes with maternal diabetes in pregnancy: gestational age, birth weight, 1- and 5-minute Apgar scores, NICU admission, respiratory distress syndrome (RDS), fetal distress, hypoglycemia, hypocalcemia, low glucose, and newborn mortality (including cause of death).

Evaluation of pregnant women

According to the American Diabetes Association (ADA) 15, the majority of the pregnant women participating in the study had diabetes mellitus, type I or type II, and were prescribed medication to regulate their blood sugar levels, such as Metformin or Insulin. Gestational diabetes mellitus was diagnosed in pregnant

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

women according to the American Diabetes Association's 15-point criteria for the glucose tolerance test (GTT).

The “One Step Procedure” is one of the two strategies recommended by the American Diabetes Association (ADA) for diagnosing gestational diabetes mellitus (GDM) in women who do not have the illness before pregnancy. This includes doing an oral glucose tolerance test (OGTT) in the morning following an 8-hour fast the night before. Fasting plasma glucose levels are obtained at 1-hour and 2-hour intervals. GDM is diagnosed with PG levels ≥15.

• Fasting blood glucose levels of 92 mg/dl (5.1 mmol/l) • Serum glucose 180 mg/dl (10.0 mmol/l) after 1 hour • Serum glucose 153 mg/dl (8.5 mmol/l) after 2 hours" "Two-Step Process": The first phase is a 50-gram glucose challenge test at 24-28 weeks for women without diabetes. If PG at 1 hour after loading is >=140 mg/dl (7.8 mmol/l), Continue with the 100 g oral glucose tolerance test. Second, when the patient is fasting, GDM is diagnosed if two or more PG values are equal to or greater than 15.

• Fasting serum glucose of 5.5 or 6.8 mmol/l (or 95 or 105 mg/dl) correspondingly

• Blood glucose levels of 180 or 190 millimoles per deciliter (10.0 or 10.6 mmol/l) after 1 hour.

• A blood glucose of 155 mg/dl or 165 mg/dl (8.6 / 9.2 mmol/l) at 2 hours

3-hour serum glucose level of 140 or 145 mg/dl (7.8 or 8.0 mmol/l)

An NST test may be nonreactive or reactive If the woman does not feel any fetal movements but detects two or more accelerations in the fetal heart rate within a twenty-minute timeframe, the NST is deemed reactive and normal. However, if there are fewer than two accelerations of the fetal heart rate in 20 minutes, then it is a non-reactive NST (27). Reactive 38. This condition occurs when two or more accelerations of the fetal heart rate, which last for at least fifteen seconds after fetal movements were identified by the NST and peak at least fifteen beats per minute above the baseline, occur. If there is no fetal movement, the NST can be repeated. Women showing no reaction were tested further. This Doppler study of

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

the umbilical artery measured 52 systolic to diastolic ratios. Umbilical artery Doppler scans were classified as 1) normal (S/D less than the 95th percentile for each gestational age) or 2) abnormal (S/D greater than the 95th percentile for each gestational age) [52].

Follow up

All neonates were reassessed 1 week after delivery. The follow-up methods consisted of regular check-ins at the Maternity Teaching Hospital's Outpatient Clinic, the transfer of infants to the neonatal intensive care unit (NICU), and, if necessary, phone calls to the expecting moms up to one week after the baby's birth. The pediatrician assessed the newborn outcomes throughout follow-up. The following neonatal complications were considered adverse: premature birth (GA < 37 weeks) 53, low birth weight (< 2.5 Kg) 53, Apgar scores at 1 minute and 5 minutes < 7 54, admission to the NICU > 24 hrs 54, dyspnea 55, fetal distress 56, hypocalcemia 57, hypoglycemia 58, and early neonatal death within the first week of life [59].

Pregnant women in this study with two or more problems during pregnancy were judged to have a poor neonatal outcome.

Ethical considerations

1. Approved by the Scientific Committee for Gynecology and Obstetrics of the Arab Board for Health Specializations.
2. The researcher provided appropriate care to the mother and child.

Three pregnant women willing to participate were asked to provide their consent orally.

Statistical analysis

All data for the women were entered using the Statistical Package for Social Sciences (SPSS) version 20. Frequencies are expressed in percentages.

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Descriptive statistics are expressed as mean ± standard deviation. A chi-square test was used for the comparison of categorical variables. Fisher's exact test was used for predicted variables less than 20% of the total. Some contingency tables were also produced, and proper statistical tests were conducted. Two-by-two tables were used to calculate the reliability of non-stress testing and umbilical artery Doppler ultrasound in identifying unfavorable infant outcomes. All statistical analyses were performed with tables and/or graphs with a significance level (p value) < 0.05. The expert of community medicine was responsible for performing the statistical analysis of the study.

Results:

A total of 100 diabetic pregnant women were included in this study with mean age of 32.7±6.1 years; 4% of them were less than 20 years age, 20% of them were in age group 20-29 years, 57% of them were in age group 30-39 years and 19% of them were 40 years age and more. All these findings were shown in table 1.

Table 1: Age of diabetic pregnant women.

Variable	No.	%
Age mean±SD (32.7±6.1 years)		
<20 years	4	4.0
20-29 years	20	20.0
30-39 years	57	57.0
≥40 years	19	19.0
Total	100	100.0

Mean BMI of diabetic pregnant women was 28.6±4.6 Kg/m^2; 26% of them had normal BMI, 31% of them were overweight and 43% of them were obese. All these findings were shown in table 2.

Eureka Open Access Journals
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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Table 2: Body mass index of diabetic pregnant women.

Variable	No.	%
BMI mean±SD (28.6±4.6 Kg/m^2)		
Normal (18-24.9 Kg/m^2)	26	26.0
Overweight (25-29.9 Kg/m^2)	31	31.0
Obese (≥30 Kg/m^2)	43	43.0
Total	100	100.0

BMI=Body Mass Index.

Mean parity of diabetic pregnant women was (2.6); 15% of them were nullipara, 61% of them had parity of 1-3 and 24% of them had parity of more than 3. The previous delivery mode for diabetic pregnant women was normal vaginal delivery for 48.2% of them and cesarean section for 51.8% of them, while current delivery mode was vaginal delivery in 45% of diabetic pregnant women and cesarean section in 55% of them. All these findings were shown in table 3.

Table 3: Gestational history of diabetic pregnant women.

Variable	No.	%
Parity mean±SD (2.6±1.8)		
Nulliparous	15	15.0
1-3 para	61	61.0
>3 para	24	24.0
Total	100	100.0
Previous delivery mode		
Vaginal delivery	41	48.2
Cesarean section	44	51.8
Total	85	100.0
Type of current delivery		
Vaginal delivery	45	45.0
Cesarean section	55	55.0
Total	100	100.0

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

About two thirds (74%) of diabetic pregnant women had type II DM, while 22% of them had type I DM and 4% of them had gestational DM. The non-stress test was reactive in 66% of diabetic pregnant women and non-reactive in 34% of them. The umbilical artery Doppler was normal in 81% of diabetic pregnant women and abnormal in 19% of them. All these findings were shown in table 4.

Table 4: DM types and screening tests of diabetic pregnant women.

Variable	No.	%
Type of DM		
Type I	22	22.0
Type II	74	74.0
Gestational DM	4	4.0
Total	100	100.0
Non-stress test result		
Reactive	66	66.0
Non-reactive	34	34.0
Total	100	100.0
Umbilical artery Doppler result		
Normal	81	81.0
Abnormal	19	19.0
Total	100	100.0

DM=Diabetes mellitus, US=Ultrasound.

Mean gestational age of diabetic pregnant women was (37.4 weeks); 23% of neonates were preterm. Mean neonatal weight was (3.4 Kg); 5% of them had birth weight of less than 2.5 Kg. Mean apgar score for neonates at 1 minute was (6); 43% of them had apgar score of less than 7. Mean apgar score for neonates at 5 minutes was (8.1); 9% of them had apgar score of less than 7. All these findings were shown in table 5A.

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Table 5A: Neonatal outcomes of diabetic pregnant women.

Variable	No.	%
Gestational age mean±SD (37.4±2 weeks)		
Preterm	23	23.0
Term	77	77.0
Total	100	100.0
Neonatal weight mean±SD (3.4±0.6 Kg)		
< 2.5 Kg	5	5.0
≥2.5 Kg	95	95.0
Total	100	100.0
Apgar score at 1 minute mean±SD (6±1.3)		
<7	43	43.0
≥7	57	57.0
Total	100	100.0
Apgar score at 5 minutes mean±SD (8.1±1)		
<7	9	9.0
≥7	91	91.0
Total	100	100.0

Admission to NICU was reported for 57% of neonates; 32% of neonates were admitted to NICU for 1 day and 25% of them were admitted for more than one day. Respiratory distress syndrome was observed in 22% of neonates, while fetal distress was detected in 27% of them. The hypocalcaemia was shown in 38% of neonates and hypoglycemia was shown in 38% of the. The neonatal death was reported for three neonates; all of dead neonates were died earlier. In general, 29% of diabetic pregnant women had poor neonatal outcomes and 71% of them

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

had good neonatal outcomes. All these findings were shown in table 5B and Figure 1.

Table 5B: Neonatal outcomes of diabetic pregnant women.

Variable	No.	%
Admission to NICU		
Yes	57	57.0
No	43	43.0
Total	100	100.0
NICU stay duration		
No	43	43.0
1 day	32	32.0
>1 day	25	25.0
Total	100	100.0
RDS		
Yes	22	22.0
No	78	78.0
Total	100	100.0
Fetal distress		
Yes	27	27.0
No	73	73.0
Total	100	100.0
Hypocalcaemia		
Yes	3	3.0
No	97	97.0
Total	100	100.0

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Hypoglycemia		
Yes	38	38.0
No	62	62.0
Total	100	100.0
Neonatal death		
Yes	3	3.0
No	97	97.0
Total	100	100.0

NICU=Neonatal Intensive Care Unit, RDS=Respiratory Distress Syndrome.

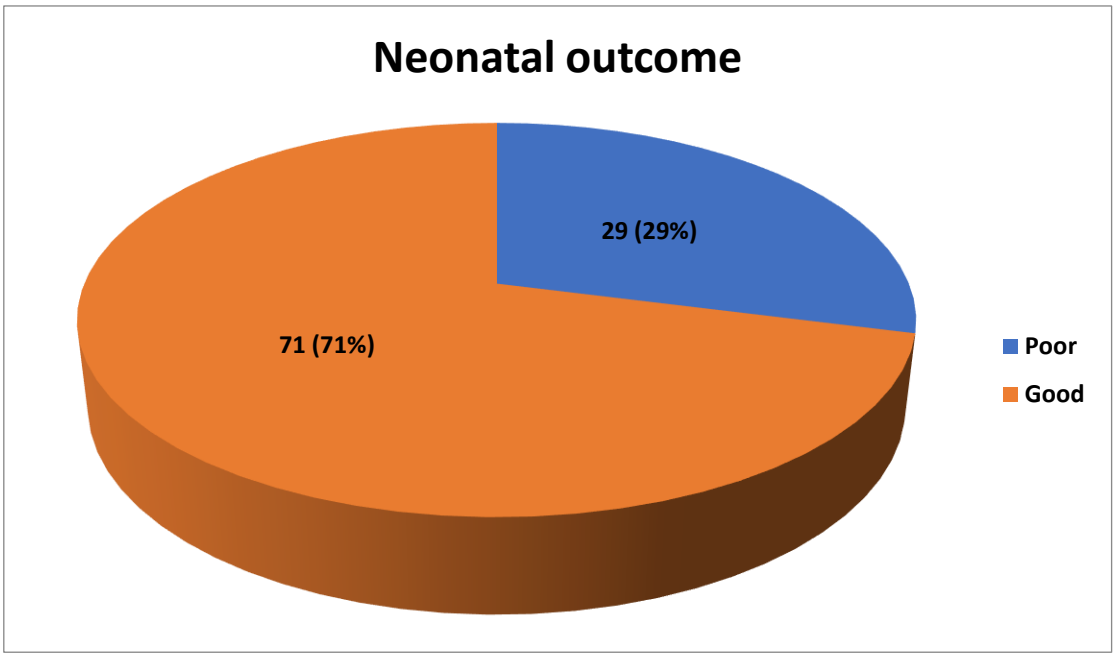

Figure 1: Neonatal outcome of diabetic pregnant women.

As shown in table 6 and figure 2, there was a significant association between younger age of diabetic pregnant women and poor neonatal outcomes (p=0.009).

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Table 6: Distribution of woman's age according to neonatal outcomes.

Variable	Poor		Good		P
	No.	%	No.	%	
Age					**0.009***[S]
<20 years	4	13.8	0	-	
20-29 years	4	13.8	16	22.5	
30-39 years	14	48.3	43	60.6	
≥40 years	7	24.1	12	16.9	

**Fishers exact test, S=Significant.*

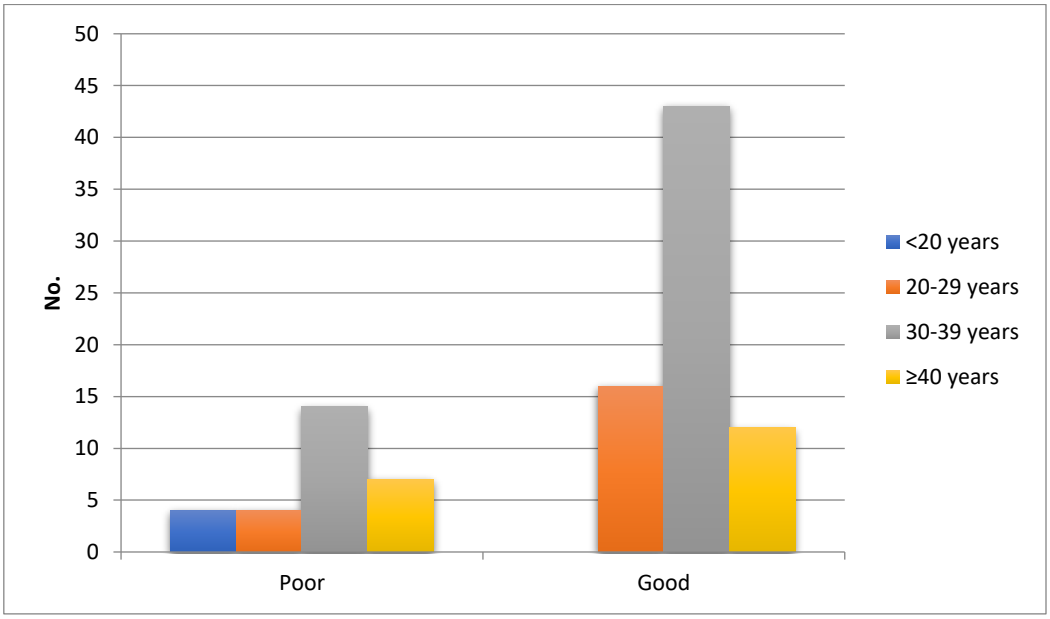

Figure 2: Age of diabetic pregnant women according to neonatal outcomes.

No significant differences were observed between diabetic pregnant women with poor neonatal outcomes and diabetic pregnant women with good neonatal outcomes regarding body mass index (p=0.8). All these findings were shown in table 7.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Table 7: Distribution of woman's BMI according to neonatal outcomes.

Variable	Poor		Good		P
	No.	%	No.	%	
BMI					0.8*NS
Normal (18-24.9 Kg/m^2)	7	24.1	19	26.8	
Overweight (25-29.9 Kg/m^2)	10	34.5	21	29.6	
Obese (≥30 Kg/m^2)	12	41.4	31	43.7	

**Chi square test, NS=Not significant, BMI=Body Mass Index*.

A highly significant association was observed between nulliparity of diabetic pregnant women and poor neonatal outcomes (p<0.001). There was a significant association between current cesarean section of diabetic pregnant women and poor neonatal outcomes (p=0.002). All these findings were shown in table 8.

Table 8: Distribution of women's gestational history according to neonatal outcomes.

Variable	Poor		Good		P
	No.	%	No.	%	
Parity					**<0.001***S
Nulliparous	11	37.9	4	5.6	
1-3 para	11	37.9	50	70.4	
>3 para	7	24.1	17	23.9	
Type of current delivery					**0.002***S
Vaginal delivery	6	20.7	39	54.9	
Cesarean section	23	79.3	32	45.1	

**Fishers exact test, NS=Not significant*.

There was a highly significant association between type I DM of diabetic pregnant women and poor neonatal outcomes (p<0.001). 62% of pregnant women with poor neonatal outcomes were type I DM, while 91.5% of pregnant women with good neonatal outcomes were type II DM. All these findings were shown in table 9.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Table 9: Distribution of women's DM types according to neonatal outcomes.

Variable	Poor		Good		P
	No.	%	No.	%	
Type of DM					**<0.001*S**
Type I	18	62.0	4	5.6	
Type II	9	31.0	65	91.5	
Gestational DM	2	7.0	2	2.9	

**Fishers exact test, S=Significant, DM=Diabetes mellitus*.

The validity findings of non-stress test regarding poor neonatal outcomes of diabetic pregnant women were sensitivity (55.2%), specificity (74.6%), +ve predictive value (47.1%), -ve predictive value (80.3%) and accuracy (69%). All these findings were shown in table 10.

Table 10: Validity findings of NST regarding neonatal outcomes.

Validity test			Neonatal outcome		
			Poor	Good	Total
			No. (%)	No. (%)	No. (%)
NST	**Non-reactive**	No. (%)	16 (47.1)	18 (52.9)	34 (100.0)
	Reactive	No. (%)	13 (19.7)	53 (80.3)	66 (100.0)
	Total	No. (%)	29 (29.0)	71 (71.0)	100 (100.0)
Sensitivity		55.2%			
Specificity		74.6%			
+ve predictive value		47.1%			
-ve predictive value		80.3%			
Accuracy		69%			

***P=0.004 (Significant)**, *NST=Non-stress test.*

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

The validity findings of umbilical artery Doppler U/S regarding poor neonatal outcomes of diabetic pregnant women were sensitivity (51.7%), specificity (94.4%), +ve predictive value (78.9%), -ve predictive value (82.7%) and accuracy (82%). All these findings were shown in table 11.

Table 11: Validity findings of UA Doppler U/S regarding neonatal outcomes.

Validity test			**Neonatal outcome**		
			Poor	**Good**	**Total**
			No. (%)	**No. (%)**	**No. (%)**
UA Doppler U/S	**Abnormal**	No. (%)	15 (78.9)	4 (21.1)	19 (100.0)
	Normal	No. (%)	14 (17.3)	67 (82.7)	81 (100.0)
	Total	No. (%)	29 (29.0)	71 (71.0)	100 (100.0)
Sensitivity		51.7%			
Specificity		94.4%			
+ve predictive value		78.9%			
-ve predictive value		82.7%			
Accuracy		82%			

***P<0.001 (Significant)**, *UA=Umbilical artery.*

The validity findings of non-stress test regarding preterm neonates of diabetic pregnant women were sensitivity (47.8%), specificity (70.1%), +ve predictive value (32.1%), -ve predictive value (80.3%) and accuracy (65%). All these findings were shown in table 12.

Eureka Open Access Journals
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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Table 12: Validity findings of NST regarding GA.

Validity test			Gestational age		
			Preterm	Term	Total
			No. (%)	No. (%)	No. (%)
NST	Non-reactive	No. (%)	11 (32.4)	23 (67.6)	34 (100.0)
	Reactive	No. (%)	12 (19.7)	54 (80.3)	66 (100.0)
	Total	No. (%)	23 (23.0)	77 (77.0)	100 (100.0)
Sensitivity		47.8%			
Specificity		70.1%			
+ve predictive value		32.4%			
-ve predictive value		80.3%			
Accuracy		65%			

***P=0.1 (Not significant)**, NST=Non-stress test.*

The validity findings of umbilical artery Doppler U/S regarding preterm neonates of diabetic pregnant women were sensitivity (43.5%), specificity (88.3%), +ve predictive value (52.6%), -ve predictive value (84%) and accuracy (78%). All these findings were shown in table 13.

Table 13: Validity findings of UA Doppler U/S regarding GA.

Validity test			Gestational age		
			Preterm	Term	Total
			No. (%)	No. (%)	No. (%)
UA Doppler U/S	Abnormal	No. (%)	10 (52.6)	9 (47.4)	19 (100.0)
	Normal	No. (%)	13 (16.0)	68 (84.0)	81 (100.0)
	Total	No. (%)	23 (23.0)	77 (77.0)	100 (100.0)

Eureka Open Access Journals
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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Sensitivity	43.5%
Specificity	88.3%
+ve predictive value	52.6%
-ve predictive value	84%
Accuracy	78%

***P=0.001 (Significant)**, *UA= Umbilical artery.*

The validity findings of non-stress test regarding low neonatal weight of diabetic pregnant women were sensitivity (100%), specificity (69.5%), +ve predictive value (14.7%), -ve predictive value (100%) and accuracy (71%). All these findings were shown in table 14.

Table 14: Validity findings of NST regarding neonatal weight.

Validity test			**Neonatal weight**		
			<2.5 Kg	**≥2.5 Kg**	**Total**
			No. (%)	**No. (%)**	**No. (%)**
NST	**Non-reactive**	No. (%)	5 (14.7)	29 (85.3)	34 (100.0)
	Reactive	No. (%)	0 (0)	66 (100.0)	66 (100.0)
	Total	No. (%)	5 (5.0)	95 (95.0)	100 (100.0)
Sensitivity		100%			
Specificity		69.5%			
+ve predictive value		14.7%			
-ve predictive value		100%			
Accuracy		71%			

***P=0.001 (Significant),** *NST=Non-stress test.*

The validity findings of umbilical artery Doppler U/S regarding low neonatal weight of diabetic pregnant women were sensitivity (100%), specificity (85.3%),

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Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

+ve predictive value (26.3%), -ve predictive value (100%) and accuracy (86%). All these findings were shown in table 15.

Table 15: Validity findings of UA Doppler U/S regarding neonatal weight.

Validity test			**Neonatal weight**		
			<2.5 Kg	**≥2.5 Kg**	**Total**
			No. (%)	**No. (%)**	**No. (%)**
UA Doppler U/S	**Abnormal**	No. (%)	5 (26.3)	14 (73.7)	19 (100.0)
	Normal	No. (%)	0 (0)	81 (100.0)	81 (100.0)
	Total	No. (%)	5 (5.0)	95 (95.0)	100 (100.0)
Sensitivity		100%			
Specificity		85.3%			
+ve predictive value		26.3%			
-ve predictive value		100%			
Accuracy		86%			

***P<0.001 (Significant)**, *UA= Umbilical artery.*

The validity findings of non-stress test regarding low neonatal apgar score at 1 minute of diabetic pregnant women were sensitivity (51.2%), specificity (78.9%), +ve predictive value (64.7%), -ve predictive value (68.2%) and accuracy (67%). All these findings were shown in table 16.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Table 16: Validity findings of NST regarding neonatal apgar score at 1 minute.

Validity test			Apgar score at 1 minute		
			<7	≥7	Total
			No. (%)	No. (%)	No. (%)
NST	Non-reactive	No. (%)	22 (64.7)	12 (35.3)	34 (100.0)
	Reactive	No. (%)	21 (31.8)	45 (68.2)	66 (100.0)
	Total	No. (%)	43 (43.0)	57 (57.0)	100 (100.0)
Sensitivity		51.2%			
Specificity		78.9%			
+ve predictive value		64.7%			
-ve predictive value		68.2%			
Accuracy		67%			

P=0.002 (Significant), *NST=Non-stress test.*

The validity findings of umbilical artery Doppler U/S regarding low neonatal apgar score at 1 minute of diabetic pregnant women were sensitivity (34.9%), specificity (93%), +ve predictive value (78.9%), -ve predictive value (65.4%) and accuracy (68%). All these findings were shown in table 17.

Table 17: Validity findings of UA Doppler U/S regarding neonatal apgar score at 1 minute.

Validity test			Apgar score at 1 minute		
			<7	≥7	Total
			No. (%)	No. (%)	No. (%)
UA Doppler U/S	Abnormal	No. (%)	15 (78.9)	4 (21.1)	19 (100.0)
	Normal	No. (%)	28 (34.6)	53 (65.4)	81 (100.0)
	Total	No. (%)	43 (43.0)	57 (57.0)	100 (100.0)
Sensitivity		34.9%			
Specificity		93%			
+ve predictive value		78.9%			
-ve predictive value		65.4%			
Accuracy		68%			

P<0.001 (Significant), *Umbilical artery.*

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

The validity findings of non-stress test regarding low neonatal apgar score at 5 minutes of diabetic pregnant women were sensitivity (44.4%), specificity (67%), +ve predictive value (11.8%), -ve predictive value (92.4%) and accuracy (65%). All these findings were shown in table 18.

Table 18: Validity findings of NST regarding neonatal apgar score at 5 minutes.

Validity test			**Apgar score at 5 minutes**		
			<7	**≥7**	**Total**
			No. (%)	**No. (%)**	**No. (%)**
NST	**Non-reactive**	No. (%)	4 (11.8)	30 (88.2)	34 (100.0)
	Reactive	No. (%)	5 (7.6)	61 (92.4)	66 (100.0)
	Total	No. (%)	9 (9.0)	91 (91.0)	100 (100.0)
Sensitivity		44.4%			
Specificity		67%			
+ve predictive value		11.8%			
-ve predictive value		92.4%			
Accuracy		65%			

***P=0.4 (Not significant)**, *NST=Non-stress test.*

The validity findings of umbilical artery Doppler U/S regarding low neonatal apgar score at 5 minutes of diabetic pregnant women were sensitivity (33.3%), specificity (82.4%), +ve predictive value (15.8%), -ve predictive value (92.6%) and accuracy (78%). All these findings were shown in table 19.

Eureka Open Access Journals
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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Table 19: Validity findings of UA Doppler U/S regarding neonatal apgar score at 5 minutes.

Validity test			**Apgar score at 5 minutes**		
			<7	**≥7**	**Total**
			No. (%)	**No. (%)**	**No. (%)**
UA Doppler U/S	**Abnormal**	No. (%)	3 (15.8)	16 (84.2)	19 (100.0)
	Normal	No. (%)	6 (7.4)	75 (92.6)	81 (100.0)
	Total	No. (%)	9 (9.0)	91 (91.0)	100 (100.0)
Sensitivity		33.3%			
Specificity		82.4%			
+ve predictive value		15.8%			
-ve predictive value		92.6%			
Accuracy		78%			

***P=0.2 (Not significant)**, *UA= Umbilical artery.*

The validity findings of non-stress test regarding neonatal admission to NICU of diabetic pregnant women were sensitivity (40.4%), specificity (74.4%), +ve predictive value (67.6%), -ve predictive value (48.5%) and accuracy (55%). All these findings were shown in table 20.

Table 20: Validity findings of NST regarding neonatal admission to NICU.

Validity test			**Admission to NICU**		
			Yes	**No**	**Total**
			No. (%)	**No. (%)**	**No. (%)**
NST	**Non-reactive**	No. (%)	23 (67.6)	11 (32.4)	34 (100.0)
	Reactive	No. (%)	34 (51.5)	32 (48.5)	66 (100.0)
	Total	No. (%)	57 (57.0)	43 (43.0)	100 (100.0)

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Sensitivity	40.4%
Specificity	74.4%
+ve predictive value	67.6%
-ve predictive value	48.5%
Accuracy	55%

***P=0.1 (Not significant)**, *NST=Non-stress test.*

The validity findings of umbilical artery Doppler U/S regarding neonatal admission to NICU of diabetic pregnant women were sensitivity (33.3%), specificity (100%), +ve predictive value (100%), -ve predictive value (53.1%) and accuracy (62%). All these findings were shown in table 21.

Table 21: Validity findings of UA Doppler U/S regarding neonatal admission to NICU.

Validity test			**Admission to NICU**		
			Yes	**No**	**Total**
			No. (%)	**No. (%)**	**No. (%)**
UA Doppler U/S	**Abnormal**	No. (%)	19 (100.0)	0 (0)	19 (100.0)
	Normal	No. (%)	38 (46.9)	43 (53.1)	81 (100.0)
	Total	No. (%)	57 (57.0)	43 (43.0)	100 (100.0)
Sensitivity		33.3%			
Specificity		100%			
+ve predictive value		100%			
-ve predictive value		53.1%			
Accuracy		62%			

***P<0.001 (Significant)**, *UA= Umbilical artery.*

Eureka Open Access Journals
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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

The validity findings of non-stress test regarding neonatal RDS of diabetic pregnant women were sensitivity (59.1%), specificity (73.1%), +ve predictive value (38.2%), -ve predictive value (86.4%) and accuracy (70%). All these findings were shown in table 22.

Table 22: Validity findings of NST regarding neonatal RDS.

Validity test			**RDS**		
			Yes	**No**	**Total**
			No. (%)	**No. (%)**	**No. (%)**
NST	**Non-reactive**	No. (%)	13 (38.2)	21 (61.8)	34 (100.0)
	Reactive	No. (%)	9 (13.6)	57 (86.4)	66 (100.0)
	Total	No. (%)	22 (22.0)	78 (78.0)	100 (100.0)
Sensitivity		59.1%			
Specificity		73.1%			
+ve predictive value		38.2%			
-ve predictive value		86.4%			
Accuracy		70%			

***P=0.005 (Significant)**, *NST=Non-stress test.*

The validity findings of umbilical artery Doppler U/S regarding neonatal RDS of diabetic pregnant women were sensitivity (50%), specificity (89.7%), +ve predictive value (57.9%), -ve predictive value (86.4%) and accuracy (81%). All these findings were shown in table 22.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Table 23: Validity findings of UA Doppler U/S regarding neonatal RDS.

Validity test			RDS		
			Yes	No	Total
			No. (%)	No. (%)	No. (%)
UA Doppler U/S	Abnormal	No. (%)	11 (57.9)	8 (42.1)	19 (100.0)
	Normal	No. (%)	11 (13.6)	70 (86.4)	81 (100.0)
	Total	No. (%)	22 (22.0)	78 (78.0)	100 (100.0)
Sensitivity		50%			
Specificity		89.7%			
+ve predictive value		57.9%			
-ve predictive value		86.4%			
Accuracy		81%			

***P<0.001 (Significant)**, *UA= Umbilical artery.*

The validity findings of non-stress test regarding fetal distress of diabetic pregnant women were sensitivity (55.6%), specificity (74%), +ve predictive value (44.1%), -ve predictive value (81.8%) and accuracy (69%). All these findings were shown in table 24.

Table 24: Validity findings of NST regarding fetal distress.

Validity test			Fetal distress		
			Yes	No	Total
			No. (%)	No. (%)	No. (%)
NST	Non-reactive	No. (%)	15 (44.1)	19 (55.9)	34 (100.0)
	Reactive	No. (%)	12 (18.2)	54 (81.8)	66 (100.0)
	Total	No. (%)	27 (27.0)	73 (73.0)	100 (100.0)
Sensitivity		55.6%			
Specificity		74%			
+ve predictive value		44.1%			
-ve predictive value		81.8%			
Accuracy		69%			

***P=0.006 (Significant)**, *NST=Non-stress test.*

Eureka Open Access Journals
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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

The validity findings of umbilical artery Doppler U/S regarding fetal distress of diabetic pregnant women were sensitivity (70.4%), specificity (100%), +ve predictive value (100%), -ve predictive value (90.1%) and accuracy (92%). All these findings were shown in table 25.

Table 25: Validity findings of UA Doppler U/S regarding fetal distress.

Validity test			**Fetal distress**		
			Yes	**No**	**Total**
			No. (%)	**No. (%)**	**No. (%)**
UA Doppler U/S	**Abnormal**	No. (%)	19 (100.0)	0 (0)	19 (100.0)
	Normal	No. (%)	8 (9.9)	73 (90.1)	81 (100.0)
	Total	No. (%)	27 (27.0)	73 (73.0)	100 (100.0)
Sensitivity		70.4%			
Specificity		100%			
+ve predictive value		100%			
-ve predictive value		90.1%			
Accuracy		92%			

***P<0.001 (Significant)**, *UA= Umbilical artery.*

The validity findings of non-stress test regarding neonatal hypocalcaemia of diabetic pregnant women were sensitivity (100%), specificity (68%), +ve predictive value (8.8%), -ve predictive value (100%) and accuracy (69%). All these findings were shown in table 26.

Eureka Open Access Journals
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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Table 26: Validity findings of NST regarding neonatal hypocalcaemia.

Validity test			Hypocalcaemia		
			Yes	No	Total
			No. (%)	No. (%)	No. (%)
NST	Non-reactive	No. (%)	3 (8.8)	31 (91.2)	34 (100.0)
	Reactive	No. (%)	0 (0)	66 (100.0)	66 (100.0)
	Total	No. (%)	3 (3.0)	97 (97.0)	100 (100.0)
Sensitivity		100%			
Specificity		68%			
+ve predictive value		8.8%			
-ve predictive value		100%			
Accuracy		69%			

***P=0.01 (Significant)**, *NST=Non-stress test.*

The validity findings of umbilical artery Doppler U/S regarding neonatal hypocalcaemia of diabetic pregnant women were sensitivity (100%), specificity (83.5%), +ve predictive value (15.8%), -ve predictive value (100%) and accuracy (84%). All these findings were shown in table 27.

Table 27: Validity findings of UA Doppler U/S regarding neonatal hypocalcaemia.

Validity test			Hypocalcaemia		
			Yes	No	Total
			No. (%)	No. (%)	No. (%)
UA Doppler U/S	Abnormal	No. (%)	3 (15.8)	16 (84.2)	19 (100.0)
	Normal	No. (%)	0 (0)	81 (100.0)	81 (100.0)
	Total	No. (%)	3 (3.0)	97 (97.0)	100 (100.0)

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Sensitivity	100%
Specificity	83.5%
+ve predictive value	15.8%
-ve predictive value	100%
Accuracy	84%

***P<0.001 (Significant)**, *UA= Umbilical artery.*

The validity findings of non-stress test regarding neonatal hypoglycemia of diabetic pregnant women were sensitivity (42.1%), specificity (71%), +ve predictive value (47.1%), -ve predictive value (66.7%) and accuracy (60%). All these findings were shown in table 28.

Table 28: Validity findings of NST regarding neonatal hypoglycemia.

Validity test			**Hypoglycemia**		
			Yes	**No**	**Total**
			No. (%)	**No. (%)**	**No. (%)**
NST	**Non-reactive**	No. (%)	16 (47.1)	18 (52.9)	34 (100.0)
	Reactive	No. (%)	22 (33.3)	44 (66.7)	66 (100.0)
	Total	No. (%)	38 (38.0)	62 (62.0)	100 (100.0)
Sensitivity		42.1%			
Specificity		71%			
+ve predictive value		47.1%			
-ve predictive value		66.7%			
Accuracy		60%			

***P=0.1 (Not significant)**, *NST=Non-stress test.*

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

The validity findings of umbilical artery Doppler U/S regarding neonatal hypoglycemia of diabetic pregnant women were sensitivity (31.6%), specificity (88.7%), +ve predictive value (63.2%), -ve predictive value (67.9%) and accuracy (67%). All these findings were shown in table 29.

Table 29: Validity findings of UA Doppler U/S regarding neonatal hypoglycemia.

Validity test			**Hypoglycemia**		
			Yes	**No**	**Total**
			No. (%)	**No. (%)**	**No. (%)**
UA Doppler U/S	**Abnormal**	No. (%)	12 (63.2)	7 (36.8)	19 (100.0)
	Normal	No. (%)	26 (32.1)	55 (67.9)	81 (100.0)
	Total	No. (%)	38 (38.0)	62 (62.0)	100 (100.0)
Sensitivity		31.6%			
Specificity		88.7%			
+ve predictive value		63.2%			
-ve predictive value		67.9%			
Accuracy		67%			

***P=0.01 (Significant)**, *UA= Umbilical artery.*

The validity findings of non-stress test regarding neonatal death of diabetic pregnant women were sensitivity (66.7%), specificity (67%), +ve predictive value (5.9%), -ve predictive value (98.5%) and accuracy (67%). All these findings were shown in table 30.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Table 30: Validity findings of NST regarding neonatal death.

Validity test			Neonatal death		
			Yes	No	Total
			No. (%)	No. (%)	No. (%)
NST	Non-reactive	No. (%)	2 (5.9)	32 (94.1)	34 (100.0)
	Reactive	No. (%)	1 (1.5)	65 (98.5)	66 (100.0)
	Total	No. (%)	3 (3.0)	97 (97.0)	100 (100.0)
Sensitivity		66.7%			
Specificity		67%			
+ve predictive value		5.9%			
-ve predictive value		98.5%			
Accuracy		67%			

***P=0.2 (Not significant)**, *NST=Non-stress test.*

The validity findings of umbilical artery Doppler U/S regarding neonatal death of diabetic pregnant women were sensitivity (100%), specificity (83.5%), +ve predictive value (15.8%), -ve predictive value (100%) and accuracy (84%). All these findings were shown in table 31.

Table 31: Validity findings of UA Doppler U/S regarding neonatal death.

Validity test			Neonatal death		
			Yes	No	Total
			No. (%)	No. (%)	No. (%)
UA Doppler U/S	Abnormal	No. (%)	3 (15.8)	16 (84.2)	19 (100.0)
	Normal	No. (%)	0 (0)	81 (100.0)	81 (100.0)
	Total	No. (%)	3 (3.0)	97 (97.0)	100 (100.0)
Sensitivity		100%			

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Specificity	83.5%
+ve predictive value	15.8%
-ve predictive value	100%
Accuracy	84%

***P<0.001 (Significant)**, *UA= Umbilical artery.*

Discussion

Diabetes mellitus is related to high maternal and fetal morbidity and mortality. 59 In particular, antepartum monitoring of fetal health is life-saving in high-risk pregnancies. For the past 30 to 60 years, a range of screening procedures Over the past 30 to 60 years, researchers have developed a range of screening procedures developed to assess fetal activity in high-risk pregnancies. Over the past 30 to 60 years, researchers have developed a range of screening procedures developed to assess fetal activity in high-risk pregnancies. Over the past 30 to 60 years, researchers have developed a range of screening procedures to assess fetal activity in high-risk pregnancies. Over the past 30 to 60 years, researchers have developed a range of screening procedures to assess fetal activity in high-risk pregnancies. Over the past 30 to 60 years, researchers have developed a range of screening procedures to assess fetal activity in high-risk pregnancies. Over the past 30 to 60 years, researchers have developed a range of screening procedures to assess fetal activity in high-risk pregnancies. Over the past 30 to 60 years, researchers have developed a range of screening procedures to assess fetal activity in high-risk pregnancies. Over the past 30 to 60 years, researchers have developed a range of screening procedures to assess fetal activity in high-risk pregnancies. Over the past 30 to 60 years, researchers have developed a range of screening procedures to assess fetal activity in high-risk pregnancies. Over the past 30 to 60 years, researchers have developed a range of screening procedures to assess fetal activity in high-risk pregnancies. Over the past 30 to 60 years,

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

researchers have developed a range of screening procedures to assess fetal activity in high-risk pregnancies. Over the past 30 to 60 years, researchers have developed a range of screening procedures to assess fetal activity in high-risk pregnancies. Over the past 30 to 60 years, researchers have developed a range of screening procedures to assess fetal activity in high-risk pregnancies. Over the past 30 to 60 years, healthcare professionals have employed a variety of screening procedures to evaluate and assess fetal activity in high-risk pregnancies.

In the present study, the validity of the umbilical artery was proven. The non-stress test validity findings for poor neonatal outcomes in diabetic pregnant women were lower than the Doppler ultrasound (sensitivity 51.7%, specificity 94.4%, positive predictive value 78.9%, negative predictive value 82.7%, and accuracy 82% vs. sensitivity 55.2%, specificity 74.6%, positive predictive value 47.1%, negative predictive value 80.3%, and accuracy 69%). This study supports the findings of research conducted in the United States by Williams et al.[61], which found that the assessment of high-risk pregnant women utilizing the umbilical artery was related to the umbilical artery being better measured using a Doppler ultrasound scan than with a non-stress test. Doppler ultrasonography was linked to a decrease in the requirement for cesarean section. In a prospective cohort study of 50 pregnant women with GDM in Iran, non-stress testing was more accurate in predicting unfavorable newborn outcomes compared to umbilical artery Doppler ultrasonography, which was contrary to the findings of Niromanesh et al.[62]. This discrepancy can be due to the different methods of investigation and the number of subjects examined in the two studies, and also to the fact that a lesser number of pregnant women with gestational diabetes mellitus were included in our study. Similar to other previous investigations, our study indicated that umbilical artery Doppler ultrasonography was more successful than other approaches in predicting perinatal issues in both low- and high-risk pregnancies (32, 35). With circulatory pregnancy problems such as diabetes mellitus, hypertension, and preeclampsia, the fetus is often small for its gestational age,

Eureka Open Access Journals
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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

and the Doppler ultrasound is a better predictor of the turning point when the fetus decompensates from decreasing perfusion and delivery is essential (63). Large-for-gestational-age fetuses have a large placenta with a normal wave curve and a high blood flow; therefore, conventional perfusion indices are unable to detect placental insufficiency. Umbilical artery Doppler ultrasonography is better than an ultrasound of the uterine arteries for predicting stillbirth and neonatal morbidity in pregnant women with diabetes. [64] The main disadvantages of Doppler umbilical ultrasonography include a possible sudden death of the fetus due to a fall in the blood flow within the uterus (64). Our results are consistent with the study of Rahman and Begum from Bangladesh, who reported that the non-stress test alone was not a reliable predictor of the neonatal outcome. [25]

The use of doppler ultrasound of the umbilical artery in this investigation enhanced the prediction of low birth weight, hypocalcemia, and newborn death. These findings are in keeping with those of a New Zealand study by McCowan et al.[65], who showed that a history of aberrant Doppler ultrasonography of the umbilical artery in pregnancy was a marker for severe fetal growth restriction. Both the Middle Cerebral Arterial Doppler ultrasound and the UA Doppler ultrasound are focused on the determinants of growth limitation; however, the Iranian study by Niromanesh et al. 66 showed that the latter is more effective in predicting infant outcomes. In the present study, non-stress tests were revealed to be better predictors of low birth weight and hypocalcemia. These results are consistent with the findings of investigations carried out in Iran by Niromanesh et al. 62 and India by Bano et al. (67).

A recent study indicated that 71% of pregnant women with diabetes had healthy babies, while 29% had newborns with problems. This incidence of fetal co-morbidity is lower than the results of the study by Aziz and Fattah in Sulaimani, which showed that 39% of pregnant women with diabetes had fetal issues (68). Another Iraqi study from Baghdad also found that prematurity (26.7% of cases), macrosomia (26.7% of cases), hypoglycemia (56.6%), hyperbilirubinemia

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

(26.1%), congenital abnormalities (12.5% of cases), and sepsis (11.4%) were more frequent among pregnant women with diabetes. We found results similar to those of Prakash et al.[70] in India, which reported that among pregnant women with diabetes, there were 3 neonates with macrosomia, 26 neonates admitted to the NICU, and a 3% neonatal death rate.

In the present study, younger gestational age of diabetic moms was strongly related to worse newborn outcomes ($p = 0.009$). Domaniski et al. 71 found age and body mass index to be common risk factors of diabetes mellitus in a population-based study in Germany among pregnant women. Metanchez et al. 72 reviewed the literature and reported that poor glycemic control during pregnancy, especially in type I diabetes mothers in low-income countries, can be detrimental to their newborns. In our study nulliparity was substantially related to poor newborn outcomes in pregnant mothers with diabetes ($p < 0.001$). A Brazilian study demonstrated nulliparity as a risk factor for poor glycemic control in pregnancy, especially in association with obesity and family history of DM (Nicolosi et al., 1973). Another Turkish study (Kahveci et al., 74) suggests that nulliparous singleton pregnancies are more likely to develop issues, for example, gestational diabetes mellitus, and other complications for the mother and the infant. The recent research indicated that pregnant women with diabetes who underwent cesarean sections in the past were more likely to have babies with problems ($p=0.003$). Similarly, a Brazilian study by Gascho et al. 75 found that mothers with diabetes mellitus who had had a previous caesarean section in a previous pregnancy were far more likely to undergo another, and their babies would have worse outcomes overall. We found a significant association between women with diabetes who had cesarean sections during pregnancy and poor newborn outcomes ($p=0.002$). No matter the reason for the cesarean section, kids delivered to women who had cesarean sections had poor health outcomes 76 percent of the time. Moreover, a recent Swiss study by Antoniou et al. 77 among

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

pregnant women with diabetes mellitus demonstrated a direct link between current cesarean surgery outcome and unfavorable newborn outcome.

The present investigation has also found a forceful association between type I DM in diabetic pregnant women and adverse newborn outcomes ($p < 0.001$). These results are consistent with those of a retrospective survey performed in South Korea on 163 diabetic pregnant women by Jang et al.[7] [8] Compared to women with type 2 diabetes mellitus, women with type 1 diabetes had worse neonatal outcomes, especially with regard to macrosomia, admission to the neonatal intensive care unit (NICU), and being large for gestational age, researchers found. In new Brazilian retrospective cohort research (de Silva et al., 79), babies delivered to mothers with diabetes mellitus had a greater risk of problems during pregnancy and the first year of life.

Conclusions

Umbilical artery Doppler ultrasound is a better predictor than a non-stress test for predicting unfavorable perinatal outcomes in pregnant women with diabetes mellitus.

In pregnant women with diabetes mellitus, umbilical artery Doppler ultrasound was more likely to correctly predict low infant weight, hypocalcemia, and neonatal death.

Poor perinatal outcomes occur at a very acceptable rate in pregnant mothers with diabetes mellitus.

Risk factors for worse perinatal outcomes among pregnant women with diabetes mellitus were type I diabetes mellitus, younger maternal age, having had a cesarean section in the past or having one now, and never having given birth before.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 2, Issue 8, August 2026

https://eurekaoa.com/index.php/5

Recommendations

Prenatal fetal assessment in pregnant diabetic women should be performed by umbilical artery Doppler ultrasound to decrease newborn mortality and morbidity.

Risk factors for poor neonatal outcomes, such as being younger, having no children, or having type I diabetes mellitus, should be evaluated in pregnant women with diabetes at the time of evaluation.

Financial support should be provided for further research on the effectiveness of screening methods in predicting neonatal outcomes in pregnant women with diabetes mellitus.

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