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The Relationship of Non-stress Test Results and Pregnancy Outcomes in Insulin-treated Diabetic Pregnant Women

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ABSTRACT

Background & Objective: Diabetes Mellitus refers to a group of specific metabolic diseases with a hyperglycemic phenotype. The present study compares pregnancy outcomes and nonstress tests (NST) in insulin-treated diabetic women with healthy pregnant women.

Materials & Methods: In this cross-sectional study, pregnancy outcomes and NST results were evaluated in 45 diabetic pregnant women who had received insulin therapy and 90 healthy pregnant women. The NST tracings of all women were applied and evaluated regarding reactive and non-reactive parameters. Data were analyzed using SPSS software version 20 and Fisher's exact test.

Results: Our results demonstrated that NST was reactive in 75.6%and was non-reactive in 24.4% of diabetic mothers. There was a significant increase in macrosomia in diabetic mothers with non-reactive NST, while there was no statistical significance between NST results in the two groups.

Conclusion: Pregnant women with diabetes are more prone to complications than healthy women. The main complication is the fetal size which leads to difficulties in delivery and increased incidence of cesarean section.

Keywords: Non-Stress Test, Diabetes Mellitus, Pregnancy Complications, NST

Introduction

Diabetes Mellitus refers to a group of specific metabolic diseases with a hyperglycemic phenotype which is one of the most common complications in different communities is diabetes as a worldwide health problem **(1, 2)**. Gestational diabetes is begun or diagnosed in the form of variable degrees of carbohydrate intolerance for the first time during pregnancy **(3)**. Approximately 10 percent of all pregnancies are complicated by gestational diabetes mellitus (GDM) **(4)**. Some short and long-term adverse effects for the mothers, fetuses and newborns are correlated with GDM **(4, 5)**. When GDM is diagnosed, two strategies are considered: Lifestyle modification and drug treatment.

According to the American Diabetes Association 2020, there are two treatment options based on them GDM is classified into two groups, Class A1 or diet-controlled GDM is seen in 70–85% of women. If the patient needs insulin therapy, it is classified as Class A2. Maternal health associated with gestational diabetes (GDM) has received significant research due to its severe risks and adverse health effects. GDM is the most common metabolic disease and can affect up to 25% of women during pregnancy **(6)**. There are complications related to GDM which cause maternal and fetal morbidities **(7)**.

In a normal pregnancy, fasting blood sugar is low due to the constant transfer to the fetus, while due to the reduced gastric emptying, blood sugar remains higher

for a long time after a meal. Hypertrophy of pancreatic beta cells during pregnancy causes excessive insulin secretion and a state similar to insulin resistance in type 2 diabetes **(8)**.

Large neonatal anthropometric measures in diabetic pregnant women are two times more than in non-diabetic mothers **(9)**. Diabetes mellitus also increases the chance of shoulder dystocia by two to six times compared to non-diabetic mothers (10), and also it is one of the causes of polyhydramnios **(11)**.

Numerous types of fetal health assessment methods have been developed with different sensitivity and specificity. They include fetal movement control, a non-stress test (NST), post-contraction testing, and a biophysical profile.

NST does not impose any stress on the fetus, is performed easily, and is available in all centers. In high-risk pregnancies, obstetricians recommend NST when the fetus has an elevated risk of mortality during the third trimester of pregnancy. The NST presents a 20-minute fetal heart rate recording acquired by an ultrasound transducer placed on the abdomen **(12)**. Poor fetal or neonatal outcomes are often associated with a non-reactive test, while a reactive test is typically associated with a healthy fetus **(13)**. Previous research has shown that NST could improve perinatal outcomes in patients with diabetes mellitus, specifically through a remote electronic fetal monitoring network **(14)**.

There are many disagreements in different studies about the relationship between gestational diabetes mellitus and the adverse consequences of pregnancy **(15, 16)**. Also, different studies have obtained contradictory results about the predictive value of the NST in diagnosing fetal complications **(17, 18)**.

Therefore, the researchers aimed to investigate the complications of diabetes mellitus during pregnancy and the relationship of the NST at the time of hospitalization with these consequences in insulin-treated diabetic patients and non-diabetic pregnant women.

Methods

This cross-sectional study was performed in a hospital affiliated with Zabol University of Medical Sciences, Zabol, Iran, from June 2013 through March 2014. Forty-five GDM or overt diabetic pregnant women under insulin treatment were included in a case group, and 90 healthy pregnant women were assigned as a control group. The participants were more than 37 weeks of pregnancy with intact membranes. None of them were in the active phase of labor and had other past medical histories. The NST was taken and interpreted according to the NICHD algorithm by one obstetrician. During 20 minutes, if there were two accelerations of 15 beats/min that continued for 15 seconds, the NST was considered reactive. If there was no acceleration during 40 minutes, the NST was interpreted as a non-reactive tracing.

Fetal distress during labor (abnormal heart rate tracing), meconium-stained amniotic fluid, cesarean delivery, first and fifth minutes Apgar scores, and the weight of babies were assessed and compared between the two groups.

Statistical Analysis

Statistical analysis was carried out using the SPSS 20.0 (IBM, Chicago, IL, USA). Comparison between the categorical data was compared using the exact Fisher test. The P-value <0.05 was considered to be significant.

Results

Out of 135 pregnant women, 45 and 90 patients were in the case and the control group, respectively. As Figure 1 shows, most participants in both groups were 25-30 years old, and non-diabetic mothers were younger than diabetic mothers.

The comparison of BMI between the two groups is illustrated in Figure 2.

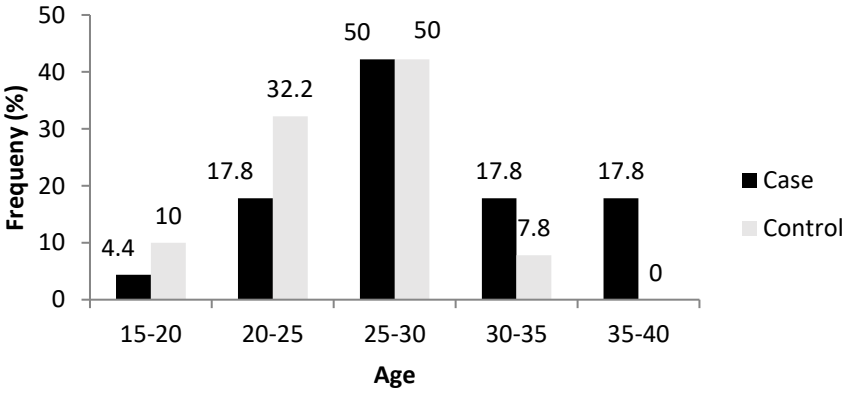

Figure 1. Frequency distribution of age in healthy and diabetic mothers

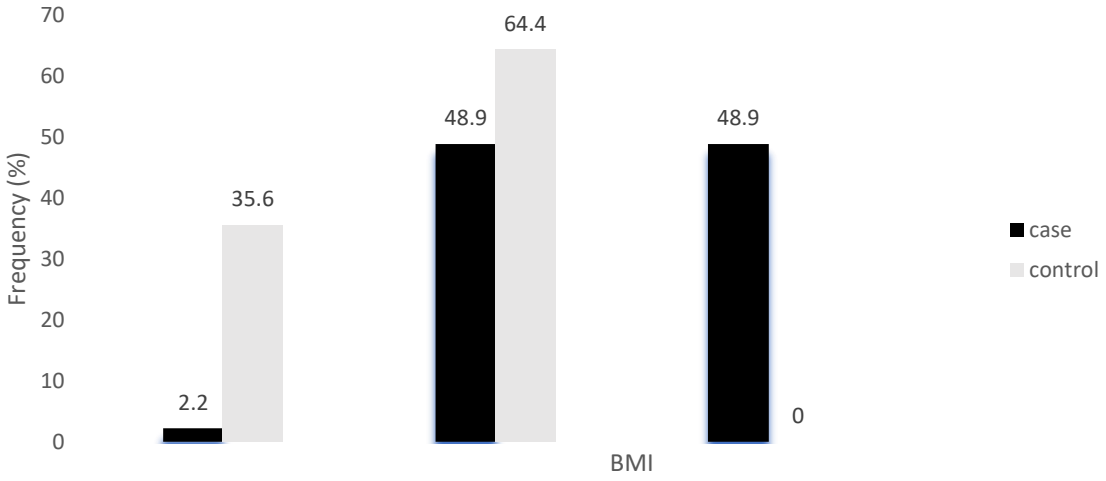

Figure 2. BMI in healthy and diabetic mothers

It demonstrates that 48.9% of diabetic mothers and 64.4% of healthy mothers had BMI between 25 and 29.9. Also, all pregnant women who had BMI >30 had diabetes mellitus.

Pregnancy outcomes in diabetic and non-diabetic mothers, including polyhydramnios, fetal distress, congenital anomalies, amniotic fluid status, and type of delivery, are shown in (Table 1).

Table 1. Pregnancy outcomes in diabetic and healthy mothers

		Case	Control
Type of delivery	NVD	42.2%	74/4%
	Cesarean	57.8%	25.6%
Amniotic fluid	Clear	91.1%	96.7%
	Meconial	9.8%	3.3%
Polyhydramnios	Polyhydramnios	15.6%	4.4%
	Normal	84.4%	95.4%
Fetal	Yes	17.8%	14.4%
Distress	No	82.2%	85.6%
Congenital anomalies	Yes	2.2%	0
	No	97.8%	100

There was no shoulder dystocia in any of the diabetic and non-diabetic mothers. The first and five-minute Apgar scores were >7 and 10, respectively, in both groups. Only 13.3% of infants born to mothers with diabetes had macrosomia .

The results showed that NST was reactive in 75.6% and 86.7 % of diabetic and healthy mothers, respectively. NST was not significantly different in healthy and diabetic mothers (P=0.08). No significant relationship was found between fetal distress, meconium-stained amniotic fluid, and congenital anomalies with NST results, unlike birth weight relation with NST findings(P<0.05) (Table 2).

Table 2. The relationship between NST and pregnancy outcomes between two groups

				NST				P-value
			Reactive		Non-reactive			
Mode of delivery	C/s Case	NVD Case	21 61.8%	13 38.2%	5 45.5%	6 54.5%		0.27
	C/s Control	NVD Control	20 25.6%	58 74.4%	3 25%	9 75%		0.63
Amniotic fluid	Clear Case	Meconial Case	30 88.2%	4 11.8%	11 100%	0 0		0.31
	Clear Control	Meconial Control	75 96.2%	3 3.8%	12 100%	0 0%		0.49
Amniotic fluid volume	Normal Case	Polyhydramnios Case	4 11.8%	30 88.2%	3 27.3%	8 72.7%		0.75
	Normal Control	Polyhydramnios Control	4 5.1%	74 94.9%	0 0%	12 100%		0.8
Fetal Distress	No Case	Yes Case	28 82.4%	6 17.6%	9 81.8%	2 18.2%		0.64
	No Control	Yes Control	67 85.9%	11 14.1%	10 83.3%	2 16.7%		0.64
Birth weight	>4 Kg Case	3.5-4 Kg Case	< 3..5 Kg Case	1 2.9%	6 17.6%	27 79.4%	5 45.5%	2 18.2%	4 36.4%	0.02
	> 4 Kg Control	3.5-4 Kg Control	< 3..5 Kg Control	0 0%	3 3.8%	75 96.2%	0 0%	0 0%	12 100%	0.64

Discussion

In the present study, 135 pregnant women with a gestational age of more than 37 weeks with intact membranes were included. Pregnancy is considered an important period in a woman's life, and diabetes mellitus can expose the mother and fetus to unwanted complications and increase the cost of treatment.

In our study, comparing the BMI in diabetic and healthy mothers showed that only diabetic mothers had BMI> 30 kg/m2, and 6 (48.4%) large babies were born in the diabetic group, which is similar to the result of Lowe *et al.* study in 2012. They reported a higher risk of developing macrosomia in obese diabetic mothers **(19)**. In 2014, Sugiyama *et al.* declared that treating obese diabetic mothers could effectively reduce the incidence of macrosomia. It means that obesity in diabetic mothers can be considered a risk factor for pregnancy complications **(20)**.

Our study revealed that mothers who become pregnant at an older age suffer more from diabetes and complications during pregnancy. Given the role of age in diabetes, it can be considered an underlying risk factor.

In our study cesarean delivery was more common in diabetic mothers. Other studies have similar results, which could lead to higher treatment costs, including surgery, longer hospital stays, adverse surgical complications in mothers, and nosocomial infections **(21, 22)**.

In both case and control groups, a high percentage of mothers had clear amniotic fluid. The percentage of polyhydramnios reported in ultrasonography of diabetic mothers was higher than healthy mothers, and a higher percentage of infants of diabetic mothers suffered from fetal distress. In 2015, Aviram *et al.* reported no significant association between the meconium-stained amniotic fluid in diabetic and non-diabetic mothers. They also showed that the rate of pregnancies complicated by polyhydramnios was higher in the GDM group (5.3% vs. 1.2%, P<0.001) **(23)**, which is similar to our findings.

Diabetic mothers have a significantly higher incidence of macrosomic infants. In 2006, Shefali *et al.* reported a high percentage of macrosomia in GDM mothers **(24)**. They also declared A low percentage of

congenital anomalies in diabetic mothers. No significant relationship was found between pregnancy complications and gestational diabetes (P<0.05).

In a study by Evers *et al.*, pregnancy-related complications in patients with type 1 diabetes were preeclampsia (7.12%), preterm delivery (2.32%), cesarean section (3.44%), and maternal mortality (0.6%), and macrosomia (1.45%). All of the above adverse effects were more common in diabetic pregnancies than in the control group. They concluded that despite pre and post-pregnancy care, the prevalence of complications in diabetes was still high **(25)**.

In the study of Dunne *et al.*, out of 182 pregnant women with type 2 diabetes, 88% had a live birth, and 2.1% of women had an intrauterine fetal demise. 3.9% of fetuses were macrosomic, and 53% of patients underwent cesarean section. In these patients, hypertension and preeclampsia were two times, polyhydramnios was three times, and postpartum hemorrhage was six times more than non-diabetic women **(26)**.

We reviewed and compared the NST of healthy and diabetic mothers. Non-reactive NST was not significantly different in the two groups. No significant relationship was found between fetal distress, meconium-stained amniotic fluid, mode of delivery, and polyhydramnios with NST results; however, macrosomia had a significant relationship with NST findings (P<0.05).

Niromanesh *et al.* in 2017 showed a significant relationship between NST results and neonatal respiratory distress syndrome, first and fifth minute Apgar scores less than seven, and poor results in infants **(26)**.

Conclusion

Pregnant diabetic mothers are older and more overweight with a higher incidence of macrosomia than healthy pregnant women, resulting in higher rates of cesarean delivery and shoulder dystocia. This can put mothers and babies at risk for further complications such as surgical complications, Erb palsy, increased hospital stays, surgical site infections, nosocomial infections, and increased treatment costs. Overall, we did not find a significant association between NST and adverse pregnancy outcomes in the two groups. Due to the contradictory results, multi centers studies with more sample sizes are suggested. In general, according to the results of the study, efforts to promote and encourage women to get pregnant at a younger age and their weight control in pre-pregnancy counseling visits should be considered.

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Ethics

This research was accepted by the ethics committee of Zabol University of Medical Sciences for the dissertation with registration code P / 13. Also, after information about the study process, confirmation has been obtained.

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Author’s contribution Nasin Mansouri guarantees the manuscript's accuracy and the contributor-ship. N.A. and N.M. conceived of the presented idea. Kh.R. and S.CH. verified the analytical methods. All authors discussed the results and contributed to the final manuscript. N.A. and S.CH. carried out the experiments. N.M. wrote the manuscript with support from N.A. and Kh.R. Both N.M. and Kh.R. authors contributed to the final version of the manuscript. N.A. supervised the projects.

Conflict of Interest

The authors declared no conflict of interest.

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