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# Effect of prenatal care on infants of Diabetic Mellitus mothers

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## Abstract

**Background:** This study evaluates the frequency of diabetes complication in infants of diabetic mothers (IDMs), and investigates its relationship with patients' follow-up care and maternal glucose control.

**Materials and Methods:** Diabetic Mothers who delivered in Ahvaz Imam Khomeini Hospital in 2011 were given questionnaires to gather data on gender of infants, gestational age, type of diabetes (overt versus gestational), birth weight, birth trauma, Apgar score, respiratory distress, neonatal blood glucose, congenital anomalies, LBW and the way the mothers controlled their diabetes (follow-up visits to gynecologist, internist or endocrinologist and maternal glucose control). For each infant of a diabetic mother, one non-diabetic was chosen as a positive control.

**Results:** Out of 199 diabetic mothers, 151 (76%) suffered from gestational diabetes and 48 (24%) had overt DM. Low birth weight was present in 35 (18%) of neonates, macrosomia in 22 (11%), neonatal trauma in 10 (5%), respiratory distress in 28 (15%), congenital anomalies in 8 (4%) and hypoglycemia in 63 (32%). Rate of C/S, hypoglycemia, preterm labor and macrosomia were significantly higher in the diabetic group (P: 0.0001, 0.0001, 0.001 and 0.046 respectively). 130 mothers (66%) had regular follow-up visits and 66 (33%) had maternal glucose control, out of whom only 24 (12%) had correct

and regular glucose control . Hypoglycemia and congenital anomalies had a significant lower rate in neonates of mothers with a regular visit (P: 0.001and 0.02 respectively). Maternal glucose control leads to significant reduction in the rate of congenital anomalies (P: 0.04).

**Conclusion:** Regular visits of diabetic mothers and maternal glucose control can improve pregnancy outcome and decrease congenital anomalies and neonatal hypoglycemia.

**Keywords:** Diabetes Mellitus, Hypoglycemia, Fetal complication, maternal glucose control.

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## Introduction

Diabetes is still a major factor of mortality and prenatal complications. There are a number of complicated problems caused by diabetes (overt and gestational) during pregnancy. Undoubtedly, during recent decades, improvement of maternal and neonatal care has resulted in the reduction of mortality and complications of the neonates (1). Before the discovery of Insulin in 1921, the diabetic women rarely reached reproductive age and if pregnant, they rarely would survive beyond the period. Before the development of specialized maternal, fetal, and neonatal care for women with diabetes and their offspring, morbidity and mortality rates were 65%. Today, abnormal glucose is present in 3-10% of the pregnancies.

IDMs are at high risk of morbidity and mortality. Respiratory distress syndrome, growth anomalies (larger of gestational age (26%) or smaller for gestational age (20%)), hyper viscosity secondary to polycythemia, hypoglycemia (25-40%), congenital anomalies like cardiomyopathy (30%), hypocalcemia, hypomagnesemia and iron imbalance (65%) may exist among them (2). Such pregnancies lead to caesarian section due to many reasons such as shoulder dystocia in big neonate, which probably causes injury to the brachial plexus. Prenatal care is of vital importance for these mothers. If accurate and regular care is provided, the complications caused by these pregnancies are nearly equivalent to that of normal pregnancies (2).

The key to success is an accurate pre-pregnancy care; accurate control of glucose during pregnancy and labor; and also diagnosis and treatment of neonatal complications.

Considering the wide effects of blood glucose control during and before pregnancy, and the health of the mother and fetus, it was decided to survey the prevalence of fetal and neonatal complications in the diabetic mothersIDMs hospitalized in Ahvaz Imam Khomeini Hospital and to compare them with the neonates of non-diabetic mothers and study the effects different care methods on mothers regarding the abovementioned complications.

## Materials and Methods

Questionnaire were completed for all diabetic mothers delivering in Ahvaz Imam Khomeini Hospital in 2011. They included: gender of infants, gestational age, type of diabetes (overt versus gestational), birth weight, birth trauma, Apgar score, respiratory distress, neonatal blood glucose, congenital anomalies, LBW and the way the mothers controlled their diabetes (follow-up visit by gynecologist, internist or endocrinologist and maternal glucose control). Type of care refers to obstetric, internal medicine, and endocrine physicians during pregnancy; and amount of referral and maternal glucose control using Glucometer at home. The sample size were 200 applying statistics and Boney *et al.*'s study (3) who reported macrosomia in neonates of diabetic mothers and non-diabetic mothers to be 26% and 10%, respectively. For each infant of a diabetic mother, one of a non-diabetic was chosen as a positive control (randomly) and questionnaires including similar questions about the neonate (sex, gestational age, neonatal weight, Apgar score, pregnancy trauma, respiratory distress, congenital anomalies, and stillbirth) was completed. Neonates less than 2500 g and neonates more than 4000 g were considered as low birth weight (LBW) and macrosomia, respectively. The characteristics of the neonates of diabetic mothers were compared with that of the neonates of healthy mothers. They were compared based on the number times mothers visited physicians, maternal

glucose control and receiving Insulin. In this study, descriptive and analytic tests were used to review the data, compare the results between the two groups of diabetic and non-diabetic mothers, and compare and analyze the data on each group. Descriptive information, including measures of central tendency (mean), measures of variability (standard deviation) and frequency charts were used. Analyzed data used included Chi-square test, Pearson Chi-square test, Fisher's exact test and T-test. In this study, the level of significance was taken as P -value<0.05.

## Results

199 diabetic mothers and 199 non-diabetic mothers with average age of 31 and 28 participated in the study, respectively. The demographic characteristics of the mothers are shown in table 1. In the diabetic group, 151 (76%) had gestatinal diabetes mellitus(GDM) and 48 (24%) had pregestatinal diabetes. 50% of mothers (regardless of type of diabetes) used Insulin. 130 (66%) had regular visits to physicianss. The type care in terms of medical referral and maternal glucose control is shown in the table 2. LBW, macrosomia, neonatal trauma, respiratory distress syndrome, structural malformations, and hypoglycemia were respectively 18%, 11%, 5%, 15%, 4%, and 32% of the IDMs. Forty-eight mothers (24%) had vaginal delivery method and 151 (76%) had caesarian section.

In the two diabetic and control groups, the average gestational age in the control group and in the diabetic group was 37±5 and 36±4 weeks, respectively (P-value=0. 012).

There was a statistically significant difference in the rates of caesarean section, macrosomia, preterm delivery and hypoglycemia (P-value respectively: 0.0001, 0.046, 0.0001, and 0.001). However, no significant difference was found in the Apgar score below eight, LBW, neonatal trauma, respiratory distress syndrome, and congenital anomalies (Table 3). By analyzing the effect of mother's referral to physicians on neonatal complication, the following results were achieved: The mean level of blood glucose in neonatal whose mothers regularly referred to physicians was 55±15 mg/dl and in those whose mothers did not have a regular referral it was 48±15 mg/dl. A significant difference was apparent in the rates of LBW, trauma, respiratory distress syndrome, macrosomia and caesarean section between the two groups. While hypoglycemia (P-value=0. 01) and congenital anomalies (P-value=0. 02) were obviously more in the group with irregular referral (Table 4).

The following results were achieved by studying maternal glucose control in diabetic group: The mean blood glucose of neonates whose mothers checked glucose regularly was 56±17 mg/dl and in those whose mothers did not maternal glucose control, it was 54±15 mg/dl. Hypoglycemia, macrosomia, preterm labor, neonatal trauma, respiratory distress syndrome, LBW and Apgar score under eight did not have significant differences in the two groups. Caesarean section (P –value=0. 037) and congenital anomalies (P-value=0. 042) were significantly lower in the group with regular control (Table 4).

No significant difference was observed between the two groups of mothers with and without insulin therapy in terms of LBW rates, trauma, respiratory distress, congenital anomalies, hypoglycemia, macrosomia, and the mean neonatal blood glucose level.

Evaluating the effect of type of diabetes on the IDMs did not demonstrate a significant difference in the results of macrosomia, LBW, trauma, respiratory distress, congenital anomalies and caesarean rate.

**Table 1. Demographic characteristics of diabetic and non-diabetic mothers**

| | | Age | Persons | % |
|---|---|---|---|---|
| Age | Diabetic mothers | ≤ 20 | 8 | 4 |
| | | 21-30 | 88 | 44 |
| | | 31-40 | 94 | 47 |
| | | ≥40 | 9 | 5 |
| | Non-diabetic mothers | ≤ 20 | 33 | 16 |
| | | 21-30 | 126 | 63 |
| | | 31-40 | 35 | 18 |
| | | ≥40 | 5 | 3 |
| Gravid | Diabetic mothers | 1 | 47 | 24 |
| | | 2-3 | 85 | 43 |
| | | ≥4 | 67 | 33 |
| | Non-diabetic mothers | 1 | 96 | 48 |
| | | 2-3 | 71 | 36 |
| | | ≥4 | 33 | 16 |
| History of abortion | Diabetic mothers | Zero | 126 | 63 |
| | | 1 | 47 | 24 |
| | | ≥2 | 26 | 13 |
| | Non-diabetic mothers | Zero | 166 | 83 |
| | | 1 | 25 | 13 |
| | | ≥2 | 8 | 4 |
| Age of pregnancy | Diabetic mothers | ≤32 | 15 | 8 |
| | | 32-36 | 63 | 31 |
| | | 36-38 | 86 | 43 |
| | | >38 | 35 | 18 |
| | Non-diabetic mothers | ≤32 | 18 | 9 |
| | | 32-36 | 26 | 13 |
| | | 36-38 | 47 | 24 |
| | | >38 | 108 | 54 |
| Type of diabetes | Pregnancy | | 151 | 76 |
| | Type of diabetes | | 48 | 24 |

**Table2. Type of mother's care**

| Type of care | | No. | % |
|---|---|---|---|
| Medical referral | Obstetrician and gynecologist | 185 | 93 |
| | Internal medicine specialist | 17 | 9 |
| | Endocrinologist | 59 | 29 |
| Regularity of referral | Regular | 130 | 66 |
| | Irregular | 69 | 34 |
| Maternal glucose control (by Glucometer) | 3-4 times a day | 24 | 12 |
| | 1-2 times a day | 23 | 12 |
| | Weekly | 19 | 9 |
| | Without control | 133 | 67 |

**Table 3. The comparison of fetal and neonatal complications in the infants of diabetic mothers and control group**

| Type o the complication | No. of Diabetic group (%) | No. of Control group (%) | P |
|---|---|---|---|
| Macrosomia | 22(11) | 11(6) | 0.046 |
| LBW | 35(18) | 49(25) | 0.068 |
| Trauma | 10(5) | 5(3) | 0.195 |
| Respiratory distress Syndrome | 28(14) | 30(15) | 0.726 |
| Pre-term labor | 70(35) | 40(20) | 0.0001 |
| Congenital anomalies | 8(4) | 6(3) | 0.621 |
| Caesarean section | 151(76) | 43(22) | 0.0001 |
| Apgar score under eight | 30(15) | 19(10) | 0.101 |
| Hypoglycemia | 63(32) | 4(2) | 0.0001 |
| Missing pregnancy outcome | 9(5) | 11(6) | 0.646 |

**Table 4. The relationship between medical referral and maternal glucose control with the prevalence of fetal complications**

| | | Monitoring the mother | | | | | |
|---|---|---|---|---|---|---|---|
| | | No. of Regular referral to physician (%) | No. of Irregular referral to physician (%) | P-value | No. of maternal glucose control (%) | No. of no maternal glucose control (%) | P-value |
| Complications | Hypoglycemia | 30(23) | 33(49) | 0. 001 | 17(26) | 46(35) | 0.11 |
| | LBW | 19(15) | 16(24) | 0.11 | 10(15) | 25(19) | 0.525 |
| | Trauma | 5(4) | 5(8) | 0.31 | 2(3) | 8(6) | 0.358 |
| | Respiratory distress syndrome | 18(14) | 10(16) | 0.77 | 8(12) | 20(15) | 0.563 |
| | Congenital anomalies | 2(2) | 6(9) | 0.02 | 0 | 8(6) | 0.042 |
| | Caesarean section | 103(79) | 48(71) | 0.21 | 56(85) | 95(71) | 0.037 |
| | Macrosomia | 12(9) | 10(15) | 0.24 | 5(8) | 17(13) | 0.3 |

## Discussion

This study was conducted to survey the complications of diabetes in the neonates of diabetic mothers and to compare it with the neonates of non-diabetic mothers and the effect of the way of the diabetic mothers' care during pregnancy (mother's referral to physicians and maternal glucose control) on the fetal and neonatal complications of diabetes. In this study LBW in the diabetic and the control group were 18% and 25%, respectively. While in Boney *et al.*'s study this was 20% and 10%in diabetic group and in the control group, respectively (3). It seems that the higher rate in the control group is due to not excluding the mothers with high blood pressure, although they were present in the diabetic group, which causes improper conception and incomplete fetal nutrition; in addition, it may be due the fact that there were more neonates with high weight in the diabetic mother groups. In the present study, the macrosomia rate was 11% which is low compared to Dadkhah *et al.*'s in Ardebil (4) and Behjati Ardekani *et al.*'s in Yazd (5), 20% and 19%, respectively and also studies out of Iran (Peterson *et al.*'s (6), DeBoer *et al.*'s (7), and Boney *et al.*'s (3) 29%, 45% and 26%, respectively). Although in a study conducted by Port Harcourt University in 2010, this was 62%, very higher than the rates seen in Iran (8), seemingly due to poorer control of diabetes diabetic mothers. The morbidity and mortality rate and pregnancy outcome miss was 4.5% in the present study, 3% in the studies of Evers *et al.* and1% in Jason *et al's* (9,10) which seem due rare and late referral to physicians and lack of permanent follow-ups. Although the study of Upara *et al.* as the present study, did not indicate a significant increase in morbidity and mortality rate in the IDMs compared to that in the control group (8). In this study, congenital malformations were lower compared to Plagemann *et al.*'s study (5-9%) (11) And it was more compared to Jason *et al.*'s study (2%) (10). In this study, neonatal trauma was 5% (twice less than that in the control group) and in the Plagemann *et al.*'s study it was 3 times more than that in the control group (11).

In addition, neonatal trauma, respiratory distress syndrome, structural anomalies, hypoglycemias were present 5%, 14%, 4% and 32% of the neonates, respectively. The rate of hypoglycemia in the neonates of diabetic mothers was 32%, which was similar to the achieved statistics of Dadkhah *et al.*'s study in Ardebil (33%) and Boney *et al.*'s study (25-40%) (3,4). But in the study of Port Harcourt in Nigeria, hypoglycemia was apparent in 64% of the neonates (8) which is higher than that of this study which can a result of improper control of mother's blood glucose.

Rates of caesarean section, preterm labor, hypoglycemia and macrosomia were significantly more in the diabetic group compared to the control group. The caesarean rate in diabetic mothers was 76% in this study and 74% in the study of the Port Horcourt University in Nigeria, which are approximately equal (8). In Plagemann *et al.*'s study in 2008, the probability of caesarean was three times more than non-diabetic mothers, approximately the same rate as in this study (11). The statistic of respiratory distress syndrome was approximately the same as Dadkhah *et al.*'s study (13%) (4). In addition, gestational age in diabetic patients was significantly lower than in the control group with a . The mean gestational age in this study was near to the Port Harcourt study (38 weeks) (8). While this rate was lower and more variable in DadKhah *et al.*'s study (26±8) (4). In addition, in Opara *et al.*'s study as this study, it was shown that the neonatal complications do not depend on the type of diabetes in mothers (8).

In the diabetic group, regular referral to physicians was 66% and maternal glucose control was done in 33% of the cases, though only 12% had regular and proper glucose control. Regular referral of mother to physicians brings about reduction in the rate of hypoglycemia and congenital anomalies. In addition, maternal glucose control in the diabetic group, led to a significant reduction of congenital anomalies in the IDMs.

There were no data on maternal glucose control in the previous studies but in the studies conducted Mohammad Zadeh *et al.*, and Dadkhah *et al.* it was shown that the referral of pregnant diabetic mothers to physicians was not proper and correct care and monitoring on mother and fetus before delivery decreases fetal and neonatal complications (4,12).

The results of this study indicate that the rate of healthcare in diabetic pregnant women is not desirable in this study. Therefore, it is recommended that the patients of home health village and other referral centers be taken under adequate education in respect to self-care, regular maternal glucose control and regular referral to obstetrics, internal specialists or endocrinologist to control glucose. The rate of maternal glucose control ($HBA_1C$) and the relation with neonatal complications and the type of mother's care was not evaluated in this study, therefore future studies are recommended.

In Conclusion The results of this study indicate that the rates of macrosomia, hypoglycemia, preterm pregnancy, and caesarean section in the infants of diabetic mothers are higher than the non-diabetic mothers. In addition, regular medical referral and regular maternal glucose control lead to reduction pregnancy complications, congenital anomalies and fetal complications especially hypoglycemia.

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