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A Study to Assess the Relation Between Maternal HbA1c Levels in First Trimester and Birth Weight of the Baby

[1]Geetika Gupta, [2]Beauty Gupta and [3]Binod Kumar Gupta

[1]*Department of Obstetrics and Gynaecology, Autonomous State Medical College, Kushinagar, India*

[2]*Department of Obstetrics and Gynaecology, Autonomous State Medical College, Ghazipur, India*

[3]*Department of Community Medicine, Aarogyam Hospital, Ballia, India*

ABSTRACT

HbA1c, the most abundant minor Hb component in human erythrocytes, is formed by the condensation of glucose with the N- terminal amino groups of the beta chains of Hb-A as both glucose and Hb are found in large quantities in the RBCs. HbA1c is slowly formed during the 120-day lifespan of the erythrocyte and therefore the concentration of HbA1c would be higher in older red cells. Hence, it reflects the glycemic control for a period of 6-10 weeks. It is aimed to prospectively evaluate the association between HbA1c levels measured in all trimesters and the birth weight of the newborn. The present study was a case control study with control matched to cases for gestational age and parity study. This Study was conducted from March 2020 to September 2021(18 months) at Department of IPGME and R and SSKM Hospital. We found that in GDM Diagnosis, the mean HbA1C level 1st Trimester (Mean±SD) of patients was 5.1960±0.1969 and in Normal Diagnosis, the mean HbA1C level 1st Trimester (Mean±SD) of patients was 5.1040±0.3084, which was not statistically significant (p = 0.0785). We also found that in GDM Diagnosis, the mean HbA1C level 2nd Trimester (Mean±SD) of patients was 6.1900±0.2178 and in Normal Diagnosis, the mean HbA1C level 2nd Trimester (Mean±SD) of patients was 5.4920±0.2702 which was statistically significant (p<0.0001). It was found that in GDM Diagnosis, the mean HbA1C level 3rd Trimester (Mean±SD) of patients was 6.8940±0.2583 and in Normal Diagnosis, the mean HbA1C level 3rd Trimester (Mean±SD) of patients was 5.5320±0.2004 which was statistically significant (p<0.0001). We also observed that the mean period of gestation at which GDM patients delivered was 37.2000 1.0583 as compared to NORMAL patients with mean period of gestation of delivery being 39.2000 0.9081 and this was statistically significant. In our study HbA1C level 1st Trimester had no significant difference with Birth weight kg group. We also found that HbA1C level at 2nd Trimester and at 3rd Trimester was significantly increased in GDM patients who also had increased Birth weight as compared to NORMAL patients. We concluded that, there is no simple relationship between maternal glycemic status in 1st Trimester and birth weight, but there seems to be an inverse relationship between second and third trimester glycemic control and standardized birth weight. There is no simple relationship between maternal glycaemic status and birth weight, but there appears to be a paradoxical inverse relationship between pre-pregnancy glycaemic control and standardized birth weight. This might implicate that for prevention of congenital malformations and macrosomia in pregnant GDM women there should be a good glycaemic control prenatally as well as intranatally.

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Key Words
Maternal HbA1c Levels, Glycosylated Haemoglobin, First Trimester, Birth Weight and Pregnancy

Corresponding Author
Binod Kumar Gupta,
Department of Community Medicine, Aarogyam Hospital, Ballia, India

Author Designation
[1,2]Senior Resident
[3]Consultant Physician

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INTRODUCTION

HbA1c, the most abundant minor Hb component in human erythrocytes, is formed by the condensation of glucose with the N- terminal amino groups of the beta chains of Hb-A as both glucose and Hb are found in large quantities in the RBCs. HbA1c is slowly formed during the 120-day lifespan of the erythrocyte and therefore the concentration of HbA1c would be higher in older red cells. Hence, it reflects the glycemic control for a period of 6-10 weeks.

The amount of HbA1c forms 4-5% of the total Hb. In a normal pregnancy, between 6-10 weeks there is a decrease in the fasting blood glucose. HbA1c levels in diabetic pregnancy are lower than in non-pregnant diabetic subjects (mean 7.8±1.6% v/s 9.9±1.9%) and the mean value in non-diabetic pregnant is 4.0±0.7%.

A recent study reported that GDM associated fetal overgrowth starts early in pregnancy before diagnosis of GDM, potentially demonstrating a need to identify pregnancies with glucose intolerance earlier in pregnancy. HbA1c, a measure of glycated hemoglobin which serves as an indicator of blood glucose control in the prior 3-4 months, may be an avenue for earlier identification of women at risk for GDM. However, while HbA1c is currently used among high- risk women at the first prenatal visit to identify women with overt type 2 diabetes, it is not currently used to screen for GDM.

A few prior studies have examined if HbA1c measured in the first trimester is useful for early predication of GDM; however, these studies have been among high-risk populations only[1,2], evaluated an HbA1c threshold only of 5.7% (39 mmol/mol), corresponding to pre-diabetes outside of pregnancy[3], or used GDM diagnosed in the first trimester only as the outcome[4]. Other studies have focused primarily on HbA1c measured in the second trimester or at the time of GDM diagnosis. Thus, research remains limited on HbA1c measured in the first trimester and its relation with GDM among a population based sample, therefore this research started by measuring HbA1c in first trimester but further included 2nd and 3rd trimester HbA1c values also for significant comparison. Adverse birth outcomes, such as preterm birth, macrosomia and LGA are significant public health concerns worldwide[5,6]. These adverse birth outcomes are not only related to perinatal morbidity and mortality, but also have lasting effects throughout their life course, including the increased risk of diabetes, hypertension and cardiovascular disease in adulthood. Fetal macrosomia, defined as birth weight >4000 g may affect 12% of newborns of normal pregnant women and 15-45% of pregnant women with diabetes. It is mainly due to increased insulin resistance of the mother. In diabetes, a higher amount of blood glucose passes through the placenta into the fetal circulation. As a result, extra glucose in the fetus is stored as body fat causing macrosomia, which is also called 'large for gestational age'. Commonly, infants exceeding the 90th percentile for any specific gestation age are considered macrosomic or large for gestation age. In Indians, 3.45 kg corresponds to the 90thpercentile of birth weight and hence the cutoff for macrosomia used is 3.5 kg.

Previous epidemiological studies have identified multiple risk factors of adverse birth outcomes. High gestational blood glucose has been linked to increased risk of adverse birth outcomes. However, previous studies have primarily focused on the associations between gestational blood glucose and adverse birth outcomes in women with gestational diabetes or pre-existing diabetes[7,8]. A few studies focused on the impacts of high but normal gestational blood glucose on adverse birth outcomes[9,10]. A multicenter study, involving 25,505 pregnant women, demonstrated that increased maternal glucose level within the normal range was associated with birth weight above the 90th percentile 10. One meta-analysis concluded that blood glucose levels in women without gestational diabetes mellitus (GDM) were positive associated with macrosomia, LGA, caesarean section and shoulder dystocia 9. However, to our knowledge, studies regarding the normal ranges HbA1c in pregnancy and its adverse birth outcomes are limited.

MATERIALS AND METHODS

All patients attending Gynae OPD in their first trimester were included in this study. The study was to record the details about demographic features, diagnostic tools used and pre-existing risk factor such as past history of diabetes in previous pregnancy, family history of diabetes, maternal age >30, past history of anomalous baby, obesity, past history of unexplained IUFD/abortion, unexplained polyhydramnios, etc. then the patients were diagnosed as GDM (cases) and NORMAL (control) and segregated based on the diagnosis. Then these patients were followed up till delivery, recording the birth weight of the baby, POG at which delivery occurred and the mode of delivery.

This case control study was carried out at SSKM Hospital among the women attending at outdoor and who delivered in labour room or Gynae OT.

Study setting: Women with reproductive age group who come in outdoor with diagnosed or undiagnosed diabetes in IPGME and R and SSKM Hospital. March 2020 to September 2021(18 months).

Study variables: Gestational age, blood sugar levels, HbA1c levels, amount of liquor, fetal weight, etc.

Sample size: Being a case control study, the proposal was to include 50 mothers with OGTT diagnosed GDM as cases and 50 mothers with OGTT diagnosis as normal as control and follow they till their delivery to see the baby weight.

Methods of data collection: From women with diagnosed or undiagnosed cases of diabetes in pregnancy at outdoor GYNAE and OBS, IPGME and RSSKM Hospital.

Study design: A case control study with control matched to cases for gestational age and parity.

Criteria

- Carpenter and coustan criteria (upper limits of normal): F 95, 1 hrs 180, 2 hrs 155, 3 hrs 140 mg dL^{-1}
- NDDG (National diabetes data group): F 105, 1 hrs 190, 2 hrs 165, 3 hrs 145 mg dL^{-1}
- As against this, the American Diabetic Association (ADA) and the IADPSG recommend the one-step diagnostic 75 g 2 hrs OGTT. The cut-offs for this OGTT are as follows: F >92 mg dL^{-1} 1 hrs PPBS> 180 mg dL^{-1} 2 hrs PPBS>153 mg dL^{-1}

RESULT

We found that in GDM Diagnosis, 2 (4%) patients were ≤20 years of age, 4 (8%) patients were 21-25 years of age, 30 (60%) patient were 26-30 years of age and 14 (28%) patients were 31-35 years of age. In Normal Diagnosis, 12 (24%) patients were ≤20 years of age, 30 (60%) patients were 21-25 years of age, 8 (16%) patient were 26-30 years of age and 0 patients were 31-35 years of age. Our study showed that in GDM Diagnosis, the mean Age of patients was 28.5600±3.2209 and in Normal Diagnosis, the mean Age (Mean±SD) of patients was 22.8000±2.4744 which was statistically significant (p = 0.0001).

Our study showed that in GDM Diagnosis, 4 (8%) patients had Parity P0+0, 7 (14%) patients had Parity P0+1, 7 (14%) patients had Parity P0+2, 2 (4%) patients had Parity P0+3, 14 (28.0%) patients had Parity P1+0, 10 (20%) patients had Parity P1+1, 2 (4%) patients had Parity P2+0, 1 (2%) patients had Parity P2+1 and 3 (6%) patients had Parity P3+0. In Normal Diagnosis, 4 (8%) patients had P0+0, 10 (20%) patients had P0+1, 3 (6%) patients had P0+2, 5 (10%) patients had P0+3, 8 (16%) patients had P1+0, 9 (18.0%) patients had P1+1, 5 (10%) patients had P2+0, 2 (4%) patient had P2+1, 3 (6%) patient had P3+0 and 1 (2%) patient had P3+1. This was not statistically significant (p = 0.5623).

We observed that in GDM Diagnosis, 25 (50%) patients had Family history of diabetes and in Normal Diagnosis, 10 (20%) patients had Family history of diabetes which was statistically significant (p = 0.0016).

We also observed that in GDM diagnosis, 21(42%) patients had history of diabetes in previous pregnancy whereas in NORMAL diagnosis, 6 (12%) patients had history of diabetes in previous pregnancy which was statistically significant (p = 0.0007). It was also seen that in GDM diagnosis, 6 (12%) patients had past history of anomalous baby whereas in NORMAL diagnosis, 3(6%) patients had past history of anomalous baby which was not statistically significant (p = 0.2945) (Table 1). We also observed that in GDM diagnosis, 22 (44%) patients had past history of unexplained IUFD or abortion whereas in NORMAL diagnosis, 8 (16%) patients had past history of

Table 1: Association between Diabetes in previous pregnancy, Past history of anomalous baby, Past history of unexplained iufd or abortion, Unexplained polyhydramnios and MOD

	Diagnosis		
	GDM	Normal	Total
Diabetes in previous pregnancy			
No	29	44	73
Row (%)	39.7	60.3	100.0
Col (%)	58.0	88.0	73.0
Yes	21	6	27
Row (%)	77.8	22.2	100.0
Col (%)	42.0	12.0	27.0
Total	50	50	100
Row (%)	50.0	50.0	100.0
Col (%)	100.0	100.0	100.0
Past history of anomalous baby			
No	44	47	91
Row (%)	48.4	51.6	100.0
Col (%)	88.0	94.0	91.0
Yes	6	3	9
Row (%)	66.7	33.3	100.0
Col (%)	12.0	6.0	9.0
Total	50	50	100
Row (%)	50.0	50.0	100.0
Col (%)	100.0	100.0	100.0
Past history of unexplained iufd or abortion			
No	28	42	70
Row (%)	40	60	100
Col (%)	56	84	70
Yes	22	8	30
Row (%)	73.3	26.7	100
Col (%)	44	16	30
Total	50	50	100
Row (%)	50	50	100
Col (%)	100	100	100
Unexplained polyhydramnios			
No	46	49	95
Row (%)	48.4	51.6	100
Col (%)	92	98	95
Yes	4	1	5
Row (%)	80	20	100
Col (%)	8	2	5
Total	50	50	100
Row (%)	50	50	100
Col (%)	100	100	100
MOD			
LSCS	36	9	45
Row (%)	80	20	100
Col (%)	72	18	45
VD	14	41	55
Row (%)	25.5	74.5	100
Col (%)	28	82	55
Total	50	50	100
Row (%)	50	50	100
Col (%)	100	100	100

Table 2: Distribution of mean HbA1C level 1st trimester, HbA1C level 2nd trimester and HbA1C level 3rd trimester

	Number	Mean	SD	Minimum	Maximum	Median	p-value
HbA1C level 1st Trimester							
GDM	50	5.1960	0.1969	4.8000	5.7000	5.2000	0.0785
Normal	50	5.1040	0.3084	4.5000	5.6000	5.0500	
HbA1C level 2nd Trimester							
GDM	50	6.1900	0.2178	5.8000	6.6000	6.1500	<0.0001
Normal	50	5.4920	0.2702	5.0000	5.9000	5.5000	
level 3rd Trimester GDM							
HbA1 C	50	6.8940	0.2583	6.4000	7.4000	6.9000	<0.0001
Normal	50	5.5320	0.2004	5.1000	5.9000	5.6000	

Table 3: Distribution of mean HbA1C level 1st trimester, HbA1C level 2nd trimester and HbA1 C level 3rd trimester

	Number	Mean	SD	Minimum	Maximum	Median	p-value
HbA1C level 1st trimester							
2.5-3	58	5.1448	0.3085	4.5000	5.6000	5.1500	0.7802
3.1-3.5	30	5.1400	0.1812	4.8000	5.7000	5.2000	
3.6-3.9	12	5.2000	0.1809	5.0000	5.7000	5.1500	
HbA1C level 2nd trimester							
2.5-3	58	5.6190	0.3571	5.0000	6.4000	5.6000	<0.000
3.1-3.5	30	6.1600	0.3616	5.2000	6.6000	6.2000	
3.6-3.9	12	6.1167	0.1337	5.9000	6.3000	6.1500	
HbA1C level 3rd trimester							
2.5-3	58	5.8017	0.5466	5.1000	7.1000	5.6000	<0.0001
3.1-3.5	30	6.7333	0.5915	5.2000	7.3000	6.9000	
3.6-3.9	12	6.9000	0.2763	6.5000	7.4000	6.9500	

unexplained IUFD or abortion which was statistically significant (p = 0.0022).

Our study also showed that in GDM diagnosis, 4 (8%) patients had unexplained polyhydramnios whereas in NORMAL diagnosis, 1 (2%) patients had unexplained polyhydramnios which was not statistically significant (p = 0.1686).

Present study also showed that in GDM Diagnosis, 36 (72%) patients had LSCS as mode of delivery and 14 (28%) patients had VD as mode of delivery. In Normal Diagnosis, 9 (18%) patients had LSCS as mode of delivery and 41 (82%) patients had VD as mode of delivery. This was statistically significant (p = 0.0001).

We found that in GDM Diagnosis, the mean Pre-pregnancy BMI (Mean±SD) of patients was 27.4960±2.6849 and in Normal Diagnosis, the mean Pre-pregnancy BMI (Mean±SD) of patients was 21.3800±2.1024 which was statistically significant (p<0.0001) (Table 2).

We examined that in GDM Diagnosis, the mean HbA1C level 1st Trimester (Mean±SD) of patients was 5.1960±0.1969 and in Normal Diagnosis, the mean HbA1C level 1st Trimester (Mean±SD) of patients was 5.1040±0.3084, which was not statistically significant (p = 0.0785). We also found that in GDM Diagnosis, the mean HbA1C level 2nd Trimester (Mean±SD) of patients was 6.1900±0.2178 and in Normal Diagnosis, the mean HbA1C level 2nd Trimester (Mean±SD) of patients was 5.4920±0.2702 which was statistically significant (p<0.0001). It was found that in GDM Diagnosis, the mean HbA1C level 3rd Trimester (Mean±SD) of patients was 6.8940±0.2583 and in Normal Diagnosis, the mean HbA1C level 3rd Trimester (Mean±SD) of patients was 5.5320±0.2004 which was statistically significant (p<0.0001).

In our study in GDM Diagnosis, the mean Birth weight (kg) (Mean±SD) of patients was 3.3080±0.2870 and in Normal Diagnosis, the mean Birth weight (kg) (Mean±SD) of patients was 2.6840±0.1973 which was statistically significant (p<0.0001).

We also observed that in GDM diagnosis the mean period of gestation at which delivery occurred, was 37.1200±1.0583 whereas in NORMAL diagnosis the mean period of gestation at which delivery occurred was 39.5020±0.9081 which was statistically significant (p<0.0001).

Our study showed that in GDM diagnosis, the mean Pre pregnancy BMI (Mean±SD) of patients was 27.4960±2.6849 whereas in NORMAL diagnosis, the mean Pre pregnancy BMI (Mean±SD) of patients was 21.3800±2.1024 which was statistically significant (p<0.0001) (Table 3).

Present study showed that in 2.5-3 kg Birth weight group, the mean HbA1C level 1st Trimester (Mean±SD) of patients was 5.1448±0.3085. In 3.1-3.5 kg Birth weight group, the mean HbA1C level 1st Trimester (Mean±SD) of patients was 5.1400±0.1812. In 3.6-3.9 kg Birth weight group, the mean HbA1C level 1st Trimester (Mean±SD) of patients was 5.2000±.1809. This was not statistically significant (p=0.7802). It was found that in 2.5-3 kg Birth weight group, the mean HbA1C level 2nd Trimester (Mean±SD) of patients was 5.6190±.3571. In 3-3.5 kg Birth weight group, the mean HbA1C level 2nd Trimester (Mean±SD) of patients was 6.1600±0.3616. In 3.6-3.9 kg Birth weight group, the mean HbA1C level 2nd Trimester (Mean±SD) of patients was 6.1167±0.1337. This was statistically significant (p<0.0001). We also found that in 2.5-3 kg Birth weight group, the mean HbA1C level 3rd Trimester (Mean±SD) of patients was 5.8017±0.5466,

Table 4: Distribution of mean HbA1C level 1st trimester, HbA1C level 2nd trimester and HbA1 C level 3rd trimester

	Number	Mean	SD	Minimum	Maximum	Median	p-value
HbA1C level 1st trimester							
2.5-3	46	5.1087	0.3210	4.5000	5.6000	5.0500	0.7190
3.1-3.5	4	5.0500	0.0577	5.0000	5.1000	5.0500	
HbA1C level 2nd trimester							
2.5-3	46	5.4957	0.2781	5.0000	5.9000	5.5000	0.7495
3.1-3.5	4	5.4500	0.1732	5.2000	5.6000	5.5000	
HbA1 C level 3rd trimester							
2.5-3	46	5.5435	0.1962	5.1000	5.9000	5.6000	0.1722
3.1-3.5	4	5.4000	0.2309	5.2000	5.6000	5.4000	

in 3-3.5 kg Birth weight group, the mean HbA1 C level 3rd Trimester (Mean±SD) of patients was 6.7333±0.5915 and in 3.6-3.9 kg Birth weight group, the mean HbA1 C level 3rd Trimester (Mean±SD) of patients was 6.9000±.2763 which was statistically significant (p<0.0001) (Table 4).

DISCUSSION

The present study was a case control study with control matched to cases for gestational age and parity study. This Study was conducted from March 2020 to September 2021 (18 months) at Department of IPGME and R and SSKM Hospital.

All patients with HbA1c levels of all trimesters were included in this study. The study was to record the details about demographic features, clinical signs, symptoms, diagnostic tools used and pre-existing risk factor such as past history of diabetes in previous pregnancy, pre pregnancy diabetes, family history of diabetes, maternal age >30, previous history of fetal macrosomia, obesity, unexplained polyhydramnios, etc.

This case control study was carried out at SSKM Hospital among the women attending at outdoor and who delivered in labor room from March 2020 to September 2021.

We found that most of the patients were 20-35 years old and the mean Age of GDM patients was 28.5000 years. Our study showed that in GDM Diagnosis, the mean Age of patients was 28.5600±3.2209 and in Normal Diagnosis, the mean Age (Mean±SD) of patients was 22.8000±2.4744 which was statistically significant (p = 0.0001).

In our study Family history of diabetes was [25 (50%)] more observed in patients with GDM which was statistically significant (p = 0.0016).

We also found that diabetes in previous pregnancy and past history of unexplained abortion or IUFD was observed more in GDM patients and was statistically significant (p = 0.0022). Also unexplained polyhydramnios and past history of anomalous baby was observed more in GDM patients [6 (12%)] but this was not statistically significant (p = 0.2945).

It was found that LSCS was more [36 (72%) observed in patients with GDM which was statistically significant (p<0.0001).

Present study showed that Pre-pregnancy BMI was significantly increased in GDM [27.4960±2.6849] patients compared to normal [21.3800±2.1024] patients (p<0.0001).

Sánchez-González *et al*.[11] showed that the HbA1c reference intervals were calculated in terms of the 2.5th to the 97.5th percentiles. They analyzed the HbA1c values of 725 women (T1 n = 84, T2 n = 448 and T3 n = 193). The characteristics of the participants were expressed as mean±standard deviation and included: maternal age (28.2±6.7 years), pre-gestational weight (54.8±5.9 kg), pre-gestational BMI (22.2±1.7 kg m^{-2}) and glucose values using a 75 g-2 h oral glucose tolerance test; fasting 4.5±0.3 mmol L^{-1} (81.5±5.5 mg dL^{-1}), 1 h 6.4±1.5 mmol L^{-1} (115.3±26.6 mg dL^{-1}) and 2 h 5.7±1.1 mmol L^{-1} (103.5±19.6 mg dL^{-1}). Reference intervals for HbA1c, expressed as median and 2.5th to 97.5th percentile for each trimester were: T1: 5.1 (4.5-5.6%), T2: 5.0 (4.4-5.5%) and T3: 5.1 (4.5-5.6%).

Versantvoort *et al*.[12] showed that the multiparous women had no history of macrosomia or small for gestational age infants. In the first trimester mean±SD (range) HbA1c (n = 93) was 4.7±1.25% (27.9±13.7 mmol/mol) (3.9-5.4% (19.1-35.5 mmol/mol)), in the second trimester (n = 86) 4.6±1.33% (26.8±14.6 mmol/mol) (3.7-5.7% (16.9-38.8 mmol/mol)) and in the third trimester (n = 71) 4.9±1.39% (30.1±15.2 mmol/mol) (4.0-6.0% (20.2-42.1 mmol/mol)). The calculated upper reference HbA1c values for the three trimesters were 5.4, 5.5 and 5.8% (35.5, 36.6 and39.9 mmol/mol), respectively, compared with 6.5% (47.5 mmol/mol) in non-pregnant women in their hospital.

We observed that HbA1C level at 1st Trimester had no significant difference with Diagnosis (p = 0.0785). Present study showed that HbA1C level at 2nd Trimester and at 3rd Trimester was significantly increased in GDM patients compared to normal patients (p<0.0001).

Karcaaltincaba *et al*.[13] showed that mean birth weight was 3313±426 g and 15.7% of neonates were classified as large-for-gestational age (LGA). Mean Hb1Ac was 4.96±0.28%. Median AFI was 145 mm and polyhydramnios rate was 2.9%. Birth weight was positively correlated with HbA1c level (r = 0.373, p<0.001) and pre-pregnancy body mass index

(BMI; r = 0.351, p<0.001). Linear regression analysis showed that HbA1c and pre-pregnancy BMI were positive independent determinants of neonatal birth weight and HbA1c was positive independent determinant of AFI. Receiver operating characteristics curve identified HbA1c level of 4.99 as optimal threshold for prediction of LGA with 93.8% sensitivity, 61.6% specificity and positive likelihood ratio (+LR) of 2.45 and pre-pregnancy BMI value of 25.2 as optimal threshold for prediction of LGA with 81.3% sensitivity, 57% specificity and +LR of 1.9.

Our study showed that Birth weight was decreased in Normal (2.6840±0.1973) Diagnosed patients compared to patients with GDM (3.3080±0.2870) which was statistically significant (p<0.0001).

Mañé *et al*.[14] showed that women with HbA1c ≥5.9% (n = 48) showed a higher rate of macrosomia (16.7% vs. 5.9%, p = 0.008) and a tendency toward a higher rate of preeclampsia (9.32% vs. 3.9%, p = 0.092). There were no statistically significant differences in other pregnancy outcomes. After adjusting for potential confounders, an HbA1c ≥5.9% was independently associated with a 3-fold increased risk of macrosomia (95% confidence interval, 1.127 to 8.603, p = 0.028) and preeclampsia (95% confidence interval, 1.086 to 11.532, p = 0.036).In a multiethnic population, an early HbA1c ≥5.9% measurement identifies women at high risk for poorer pregnancy outcomes independently of gestational diabetes mellitus diagnosis later in pregnancy.

Versantvoort *et al*.[11] showed that a significant correlation between the differences of the first and second trimester HbA1c values and the birth weight percentiles (r =-0.251; p = 0.032). All 44 women with a decrease in the HbA1c value from the first to the second trimester had a birth weight percentile ≤90. In the 30 women with no change or an increase in the HbA1c value from the first to the second trimester there was no relation between HbA1c values and birth weight percentiles, but seven of the 30 (23.3%) had a birth weight percentile of >90. HbA1c is lower in all three trimesters of normal pregnancy compared with the level in non-pregnant women and the change in HbA1c from the first to the second trimester predicts (the percentile of) birth weight.

We also observed that the mean period of gestation at which GDM patients delivered was 37.2000 1.0583 as compared to NORMAL patients with mean period of gestation of delivery being 39.2000 0.9081 and this was statistically significant.

In our study HbA1C level 1st Trimester had no significant difference with Birth weight kg group.

We also found that HbA1C level at 2nd Trimester and at 3rd Trimester was significantly increased in GDM patients who also had increased Birth weight as compared to NORMAL patients.

CONCLUSION

In conclusion, there is no simple relationship between maternal glycemic status in 1st Trimester and birth weight, but there seems to be an inverse relationship between second and third trimester glycemic control and standardized birth weight. There is no simple relationship between maternal glycaemic status and birth weight, but there appears to be a paradoxical inverse relationship between pre-pregnancy glycaemic control and standardized birth weight. This might implicate that for prevention of congenital malformations and macrosomia in pregnant GDM women there should be a good glycaemic control prenatally as well as intranatally.

Further studies are required to establish cutoff points adapted to each ethnic group and to assess whether early detection and treatment are of benefit.

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