Association between Maternal High BMI and the Birth Weight of Neonates in Diabetic and Non-Diabetic Group

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Abstract:

Background: *Body mass index (BMI) has increased among the women of reproductive age worldwide. Increased insulin resistance associated with obesity and diabetes are mostly responsible for adverse outcomes like macrosomia, maternal morbidity, increased operative interference, longer hospital stays and increased neonatal complications.*

Objectives: *To assess maternal high BMI and its association with the birth weight of neonates in diabetic and non-diabetic groups.*

Methods: *A cross sectional study was conducted in the obstetrics Department of BIRDEM General Hospital Dhaka during July 2017 to June 2018 on 200 pregnant women with high BMI (>23.1 kg/m^2) at 3rd trimester. Patients were allocated in two groups- Group I (Diabetic-100 patients) and group II (non-diabetic -100 patients). Data was collected in a structured data collection sheet with informed written consent.*

Result: *Age range was 18 to 35 years with mean age of 26.9 ± 8.3 years among diabetic and 25.7 ± 7.8 years among non-diabetic women. Maximum number of participants were socioeconomically in the middle class 117 (58.5%) group. BMI was comparatively higher in diabetic group but the difference was not statistically significant. Among 27% overweight, 18% were in diabetic and 36% were in non-diabetic group. On the other hand, 53% were obese (58% in diabetic and 48% in non-diabetic group); 20% were morbidly obese (24 % diabetic and 16 % non-diabetic). About 23(11.5%) of the babies had a birth weight more than 3.5 kg (maximum among diabetic mothers, 15% vs 8% in group I & II respectively). Only 6 babies were macrosomic (BW >4 Kg) in this study & all of their mothers had diabetes. The mean birth weight was higher in diabetic group 3.7 ± 0.4 kg vs 2.6 ± 0.5 kg in non-diabetic group respectively and the result was statistically significant.*

Conclusion: High BMI diabetic mothers have significantly higher mean birth weight of their newborns.

Keywords: *Neonates, Obesity, Diabetes,GDM, Postpartum, High BMI, NICU*

Introduction:

Birth weight is an important determinant of an infant's wellbeing.[1] Maternal weight and BMI are good predictors of birth weight.[2] Abnormal growth in utero leads to adverse health effects later in life. Bangladesh is facing the dual burden of under nutrition and an escalating rise in overweight and obesity problems.

Due to rapid urbanization, changes of dietary habit & sedentary lifestyle the burden is increasing day by day. Pregnant women constitute an important subpopulation with an elevated risk of obesity due to excessive weight gain.[3] This in turn is an important factor influencing the infant birth weight and is

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associated with adverse obstetric and neonatal outcomes. Diabetes mellitus is a significant health disorder triggering harmful complications in pregnant women and fetuses.[4] Maternal overweight and obesity are associated with adverse offspring outcome in later life.[5] Also it is strongly associated with antenatal complications like gestational diabetes mellitus, gestational hypertension, preeclampsia and increase in need for induction of labour and operative interference. Mothers who are overweight or obese during pregnancy and childbirth, as measured by increasing maternal body mass index (BMI), are known to be at risk of significant antenatal, intrapartum, postpartum and also neonatal complications. The birth weight of an infant is a reliable index of intrauterine growth and also a sensitive predictor of newborns chances of survival, growth and long term physical and psychosocial development.[6] Purpose of this study was to analyze the association between maternal overweight & obesity and the increasing incidence of large for gestational age babies in diabetic and non-diabetic groups.

Methods:

This cross-sectional study was carried out on 200 patients attending in the Department of Obstetrics and Gynaecology of BIRDEM General Hospital, Dhaka, during July 2017 to June 2018. Study patients were divided into two groups, 100 in each group. Group I were diabetic (DM & GDM) women and group II were non diabetic women. Body mass index (BMI) is defined as a person's weight in kilograms divided by the square of his height in meters (BMI = kg/m^2). BMI was classified into overweight, obese and morbidly obese using cut off of Asian population.[7] For Asian population BMI 23.1-25.0 was counted as overweight, BMI 25.1-30.0 was defined as Obese and > 30.0 was called morbidly obese. GDM and DM was diagnosed using the hospital records and BMI, glycemic condition all was noted only during 3rd trimester. The purpose of the study was discussed with the patients who fulfilled the enrollment criteria and informed consent was taken. Information about the patients was recorded in the prescribed data collection form and data was collected by interview and from records. Statistical analysis was performed by using windows based computer software devised with Statistical Package for Social Sciences (SPSS-21) (SPSS, Chicago, IL, USA).

Result:

The age range was 18 to 35 years with the majority 89 (44.5%) patients in between 24-29 years. The mean age was 26.9 ± 8.3 years in group I and 25.7 ± 7.8 years in group II respectively without any significant difference. Socioeconomically the middle class comprises the major percentage 117 (58.5%) and maximum patients e.g., 97 (48.5%) were housewives. Mean period of gestation was 37.3 ± 0.8 weeks & 38.1 ± 0.5 weeks in group I and II respectively. The difference was not statistically significant.

In this study BMI was comparatively higher in diabetic patients (group I) but the difference was not statistically significant. Among 27.0% overweight women 18% were in group-I and 36% were in group-II. On the other hand, 53% were obese (58% in diabetic and 48% in non-diabetic group); 20% were morbidly obese (24 % diabetic and 16 % non-diabetic).

Table IV shows the birthweight of the babies. About 23(11.5%) of babies had birth weight more than 4 kg and maximum number of babies were in Diabetic group that is in group I (15% vs 8% in group I and group II respectively). Among those 15 babies most of them that is 13 were born from GDM mothers and 2 babies were born from DM mothers.

In this study, total 106 women had BMI 25.1–30.0 kg/m^2, 58 cases were diabetic and 48 were non-diabetic. In this series we found that amongst the group I or diabetic women, none of the women delivered newborn with birth weight <2.5 kg, 12(20.7%) of women delivered newborn with birth weight 2.5-2.99 kg, 43(74.1%) of women delivered newborn with birth weight 3.0-3.49 kg and 3(5.1%) of women delivered newborn with birth weight >3.5 kg. Amongst the group II or non-diabetic women, 4(8.3%) of women delivered newborn with birth weight <2.5 kg, 24(50.0%) of women delivered newborn with birth weight 2.5-2.99 kg, 14(29.1%) of women delivered newborn with birth weight 3.0-3.49 kg and 6(12.5%) of women delivered newborn with birth weight >3.5 kg. The difference was statistically significant (p<0.05). So, obese diabetic women delivered comparatively higher birth weight baby than non-diabetic women.

In this study total 40 women had BMI >30.0 kg/m^2, among them 24 cases were diabetic and 16 were non-diabetic. In this series we found that amongst the group I or diabetic women, none of the women delivered

newborn with birth weight <2.5 kg, 5(20.8%) of women delivered newborn whose birth weight was 2.5-2.99 kg, 7(29.1%) of women delivered newborn whose birth weight was 3.0-3.49 kg and 12(50.0%) of women delivered newborn with birth weight >3.5 kg. Amongst the group II or non-diabetic women, 1(6.2%) of women delivered newborn with birth weight <2.5 kg, 6(37.5%) of women delivered newborn birth weight 2.5-2.99 kg, 7(43.7%) of women delivered newborn birth weight 3.0-3.49 kg and 2(12.5%) of women delivered newborn birth weight >3.5 kg. The difference was statistically significant (p<0.05). So, morbidly obese diabetic women delivered comparatively higher birth weight baby than non-diabetic women.

Figure 2 shows the overall birth weight pattern of babies in diabetic and non-diabetic women with high BMI. In diabetic group a smaller number of neonates had birth weight <2.9 kg and trends of birth weight >3.0 kg is maximum in diabetic women. It means high BMI women with diabetes delivered larger weight babies.

Other than macrosomia, other neonatal complications like neonatal asphyxia, hypoglycaemia, hyper-bilirubinemia etc. leads to increased admission of babies in NICU (Neonatal intensive care unit). In our study there was increased NICU admission among the babies of diabetic mother (38% vs 18% in Group I and Group II respectively) but the result was not statistically significant (Table VIII).

Table-I

Age distribution of the study patients (N=200)

Age	Group-I (n=100)		Group-II (n=100)	
	No.	%	No.	%
18-23	28	28.0	35	35.0
24-29	46	46.0	43	43.0
30-35	26	26.0	22	22.0
Total	100	100.0	100	100.0
Mean±SD	26.9±8.3		25.7±7.8	
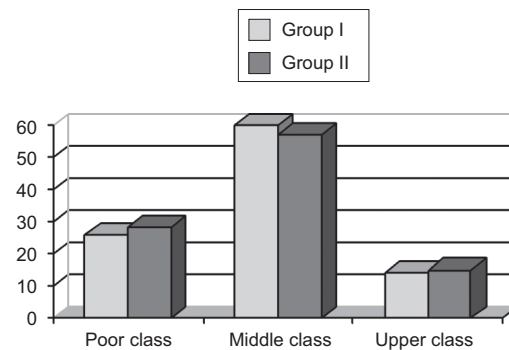
Fig.-1: *Socio-economic status of the study patients (N=200)*

Table-II

Period of gestation of the patients (N=200)

Gestation (week)	Group-I (n=100)		Group-II (n=100)		P value
	No.	%	No.	%	
37-38	84	84.0	71	71.0	0.523[ns]
38-39	16	16.0	18	18.0	
40-41	0	0	11	11.0	
Mean ± SD	37.3±0.8		38.1±0.5		

Table-III

Distribution of study subjects according to BMI (N=200)

Body mass index (kg/m^2)	Group-I (n=100)		Group-II (n=100)		P value
	No.	%	No.	%	
23.1–25.0	18	18.0	36	36.0	
25.1–30.0	58	58.0	48	48.0	0.162[ns]
>30.0	24	24.0	16	16.0	
Total	100	100.0	100	100.0	

Table-IV
Birth weight of the baby (N=200)

Birth weight of baby (kg.)	Group-I (n=100)			Group-II (n=100)		P value
	No. of GDM	No. of DM	% of weight group	No.	%	
<2.5 kg	3	0	3.0	20	20.0	
2.5-2.99 kg	24	03	27.0	48	48.0	0.001^s
3.0-3.49 kg	49	06	55.0	24	24.0	
>3.5 kg	13	02	15.0	8	8.0	
Mean ± SD		3.7±0.4		2.6±0.5		

Table-V
*Correlation of overweight (maternal BMI 23.1–25.0) women with birth weight of the baby (N=54)*

Body mass index (23.1–25.0 kg/m^2)	Birth weight of baby				x^2	p-value
	<2.5 kg	2.5-2.99 kg	3.0-3.49 kg	>3.5 kg		
Diabetic (n=18)	3(16.7%)	10(55.5%)	5(27.8%)	0		
Non-diabetic (n=36)	15(41.6%)	18(50.0%)	3(8.3%)	0	21.94	0.00001^s
Total	18	28	8	0		

Table-VI
Correlation of obese (maternal BMI 25.1–30.0) women with birth weight of the baby (N=106)

Body mass index (25.1–30.0 kg/m^2)	Birth weight of baby				x^2	p-value
	<2.5 kg	2.5-2.99 kg	3.0-3.49 kg	>3.5 kg		
Diabetic (n=58)	0	12(20.7%)	43(74.1%)	3(5.1%)		
Non-diabetic (n=48)	4(8.3%)	24(50.0%)	14(29.1%)	6(12.5%)	40.97	0.00001^s
Total	4	36	57	9		

Table-VII
Correlation of morbidly obese (maternal BMI >30.0) women with birth weight of the baby (N=40)

Body mass index (≥30.0 kg/m^2)	Birth weight of baby				x^2	p-value
	<2.5 kg	2.5-2.99 kg	3.0-3.49 kg	>3.5 kg		
Diabetic (n=24)	0	5(20.8%)	7(29.1%)	12(50.0%)		
Non-diabetic (n=16)	1(6.2%)	6(37.5%)	7(43.7%)	2(12.5%)	34.92	0.00001^s
Total	1	11	14	14		
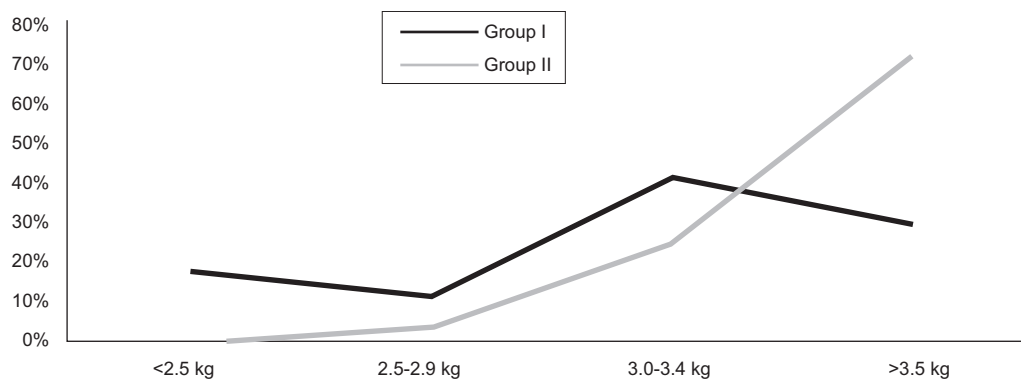
Fig.-2: *Birth weight trends of neonates in high BMI women (n=100 in each group)*

Table-VIII
Correlation with maternal BMI and Neonatal ICU admission.

	Birth weight of baby				P value
	<2.5 kg	2.5-2.99 kg	3.0-3.49 kg	>3.5 kg	
Body mass index (23.1–25.0 kg/m^2)					
Diabetic (n=18)	3	2	1	0	
Non-diabetic (n=36)	3	1	0	0	.250[ns]
Total	6	3	1	0	
Body mass index (25.1–30.0 kg/m^2)					
Diabetic (n=58)	0	4	10	3	
Non-diabetic (n=48)	2	2	2	2	.193[ns]
Total	2	6	12	5	
Body mass index (>30.0 kg/m^2)					
Diabetic (n=24)	0	2	3	10	
Non-diabetic (n=16)	1	1	2	2	.147[ns]
Total	1	3	5	12	

Chi-square test was used to compare between two groups; n=Number of study population; ns=Not significant; s=Significant; SD=Standard deviation

Discussion:

This study demonstrates the impact of high maternal BMI and diabetes on the neonatal birth weight. The age was ranging from 18-35 years with majority 89(44.5%) patients belonging to age 24-29 years. The mean age was 26.9 ± 8.3 years in group I and 25.7 ± 7.8 years in group II without any significant difference. Our findings are also in accordance with the findings of a study conducted in rural Bangladesh where more than 50% of the pregnant women with DM diagnosed by WHO criteria had an age range from 21-30 years.[8]

Socioeconomically the middle class comprises the major percentage of patients. A study in rural Bangladesh confirmed that higher education was associated with higher use of antenatal care.[9]The most important basic factors possibly indirectly influencing child growth are the general social, cultural, economic and political contexts.[10]

Mean period of gestation was 37.3 ± 0.8 weeks & 38.1 ± 0.5 weeks in group I and II respectively. Most of the women in this study were primigravida (54.5%).

In this series we found that BMI was comparatively higher in diabetic patients (group I) than non-diabetic (group II), the difference was not statistically significant between two groups. We found 23 (11.5%) of the babies had BW more than 3.5 kg and maximum were in group I (15% vs 8% in group I & II respectively). Only 6 babies were macrosomic (BW>4kg) and all of their mothers were diabetic. The mean birthweight was higher in diabetic group 3.7 ± 0.4 kg vs 2.6 ± 0.5 kg in group I & II respectively. Prevalence proportion of birthweight above 3 kg is more (70%) in the diabetes mellitus group than non-diabetic (32%) and the result was statistically significant. This was in line with other studies that also shows that birth weight monotonically rises as the mother's weight increases.[11] It was observed in another study that offspring of mothers with gestational diabetes mellitus have higher birth weights.[12] Our study also noticed that GDM mothers had higher birthweight babies than DM mothers.

There was increased NICU admission among the babies of diabetic mothers (38% vs 18% in group I and group II respectively). Although antenatal care has been able to reduce the rate of perinatal mortality, but NICU admissions are still higher in diabetics than non-diabetics. Our findings were similar to findings in the literature indicating that NICU admission rates were significantly higher in the DM group than in the controls. The incidence of shoulder dystocia, brachial plexus injury or malpresentations were increased in macrosomic fetuses.[13] Many other studies concluded that maternal, perinatal and neonatal complications are strongly associated with diabetes.

At birth, fetal weight is accepted as a parameter that is directly related to the health and nutrition of the mother as well as an important determinant of the chances of the newborn to survive and experience healthy growth and development. Maternal height, malnutrition, obesity, maternal pregnancy weight gain,

parity, ambient attitude, maternal hemoglobin concentration, paternal height, cigarette smoking and glucose intolerance all factors determine birth weight.

Obesity and diabetes added to the burden of pregnancy and is associated with adverse maternal and neonatal outcomes. Women with low prepregnancy weight (BMI less than 18) are at more risk of low-birth-weight infants. In contrast, those who are overweight (BMI more than 24) have increased risk of large birth weight babies.[14] Pregnancy is characterized by increase in blood glucose levels, insulin resistance and circulating lipids, which make energy available to the fetus.[14] The availability of glucose to the fetus leads to a larger baby. So, women with normal BMI have a better outcome for pregnancy itself and also for the baby.[16]

Conclusion:

According to the study, maternal BMI and diabetes during pregnancy both were found to be major contributors to the higher birth weight of neonates. High BMI diabetic mothers have significantly higher mean birth weight for their babies. The incidence of obesity along with its complications progressively increased around the world in the last few decades. Because of the significant complications related to large birth weight babies, it can result in higher degree of maternal morbidity and perinatal mortality. So, it is important to identify the predictive factors, maternal diabetes is one of the most influencing factors for higher birth weight babies.

Limitation

As we noted the glycemic status of the diabetic patients only at third trimester so their blood sugar level throughout the pregnancy cannot be correlated with the weight of the baby.

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