International Journal of Contemporary Pediatrics
Kabir R et al. Int J Contemp Pediatr. 2021 Jan;8(1):13-19
http://www.ijpediatrics.com

pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20205502

Original Research Article

Association between maternal and fetal outcomes in high BMI diabetic and non-diabetic groups

Rezwana Kabir[1]*, Sumona Parvin[2], M. Ubaidul Islam[3], Ferdousi Begum[4]

[1]Department of Obstetrics and Gynaecology, Dhaka Community Medical College, Dhaka, Bangladesh
[2]Department of Pathology, Sir Salimullah Medical College, Dhaka, Bangladesh
[3]Department of Radiology, 250 Bed District Hospital, Moulvibazar, Bangladesh
[4]Department of Obstetrics and Gynaecology, BIRDEM General Hospital, Dhaka, Bangladesh

Received: 19 October 2020
Accepted: 05 December 2020

***Correspondence:**
Dr. Rezwana Kabir,
E-mail: razibchowm@gmail.com

ABSTRACT

Background: BMI has increased among the women of reproductive age worldwide. Insulin resistance associated with obesity and diabetes are mostly responsible for the adverse outcomes like macrosomia, maternal morbidity, increased operative interference and NICU admission. Objectives of the study was to assess maternal high BMI and its association with maternal and neonatal outcomes in diabetic and non-diabetic groups.
Methods: A cross sectional study was conducted in the BIRDEM General Hospital Dhaka on 200 pregnant women with high BMI at 3rd trimester. Patients were allocated in two equal groups- Group I Diabetic and group II Non-diabetic.
Results: 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. BMI was comparatively higher in diabetic group. Overall frequency of C/S was higher (89.5%) and on comparison between the groups, frequency was significantly higher in diabetic group (94% vs 85% in group I and group II respectively). The postpartum complications were also significantly higher in diabetic group (22% vs 7% in Group I and Group II respectively). About 23 (11.5%) of the babies had birth weight more than 3.5 kg (maximum among diabetic mothers 15% vs 8% in group I and II). 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. On the neonatal outcomes, significant number of macrosomia were found in the diabetic group, and NICU admissions were also higher in the diabetic group.
Conclusions: High BMI diabetic mothers have significantly higher maternal and neonatal complications.

Keywords: Caesarean section, Diabetes, Obesity, Macrosomia, NICU

INTRODUCTION

Maternal weight and BMI are good indicators as well as important modifiable factors influencing maternal and neonatal outcomes. Maternal obesity can result in negative outcomes for both women and fetuses.[1] For the last few decades, Bangladesh has been facing dual burden of under nutrition and an escalating rise in overweight and obesity problems due to rapid urbanization, changes of dietary habit and sedentary lifestyle. Pregnant women constitute an important subpopulation with an elevated risk of obesity due to excessive weight gain.[2] Diabetes mellitus is a significant health disorder triggering harmful complications in pregnant women and fetuses.[3] Maternal overweight and obesity are associated with adverse offspring outcome in later life.[4] Increased maternal BMI is also associated with an increased risk for hypertensive complications, peripheral edema, caesarean section, fetal macrosomia and admission of the newborn in NICU. Thus, 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.[5] Recent studies have shown that excessive weight gain and obesity in the pre-pregnancy period are risk factors for future pregnancy and neonatal complications. The birth weight of the infant is a reliable index of intrauterine growth and sensitive predictor of the newborn's chances of survival, growth and long term physical and psychosocial development.[6] The purpose of this study was to analyse the association between maternal overweight and obesity on pregnancy and neonatal outcomes in diabetic and non-diabetic groups.

METHODS

This cross-sectional study was carried out with an objective to determine the maternal high BMI at 3rd trimester and its association with maternal and neonatal outcomes in diabetic and non-diabetic groups. A total of 200 patients attending in the Department of Obstetrics and Gynaecology of BIRDEM General Hospital, Dhaka, during July 2017 to June 2018, were included in this study. Study patients were divided into two groups, 100 in each group. Group I was diabetic (DM and GDM) women and Group II was non diabetic women. Body mass index (BMI) is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults. It is defined as a person's weight in kilograms divided by the square of his height in meters (BMI = kg/m2). 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 BMI>30.0 was called morbidly obese. For maternal outcomes, mode of delivery, post-partum complications and duration of hospital stay were considered. Neonatal outcomes were: Gestational age at birth, Birth weight, APGAR score at 5 minutes and admission at the neonatal intensive care unit. The purpose of the study was discussed with the patients who fulfilled the enrolment criteria. Information about the patients was recorded in the prescribed data collection form, after taking informed consent. 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).

RESULTS

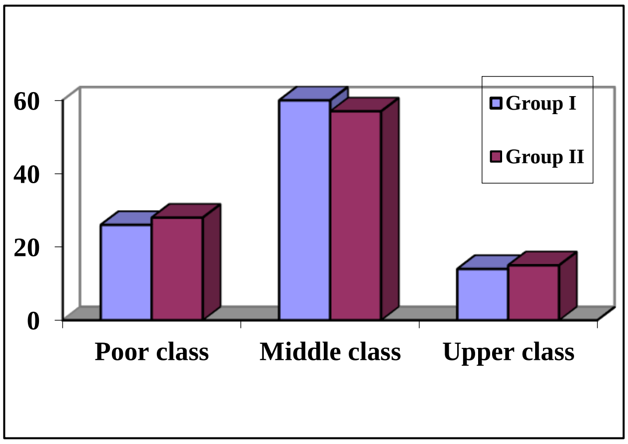
Table 1 showed age distribution of the study patients, age was ranging from 18 to 35 years. It was observed that majority 89 patients (44.5%) belonged to age 24-29 years, followed by 63 patients (31.5%) who belonged to age 18-23 years. The mean age was 26.9±8.3 years in Group-I and 25.7±7.8 years in Group-II. There was no significant difference between two groups. Regarding occupational status, it was observed that maximum patients e.g., 97(48.5%) were housewives, 51.0% in group I and 46.0% in group II respectively. Service holder was 28.0% in group I and 30.0% in group II respectively. The difference was not statistically significant (p>0.05) between two groups. (Table 1).

Table 1: Distribution of respondents by age distribution (n=200) and Occupational distribution of the study patients (n=200)

Age (yrs)	Group-I (n=100)		Group-II (n=100)		P value
	No.	%	No.	%	
18-23	28	28	35	35	
24-29	46	46	43	43	
30-35	26	26	22	22	
Total	100	100	100	100	
Mean±SD	26.9±8.3		25.7±7.8		
Occupational status					
Service	28	28	30	30	
House wife	51	51	46	46	0.158^{ns}
Others	21	21	24	24	
Total	100	100	100	100	

Data were presented as frequency, percentage and mean±SD, Unpaired t-test was used to compare between two groups, Chi-square test was used to see the association between groups, n=Number of study population, ns=Not significant, s=Significant

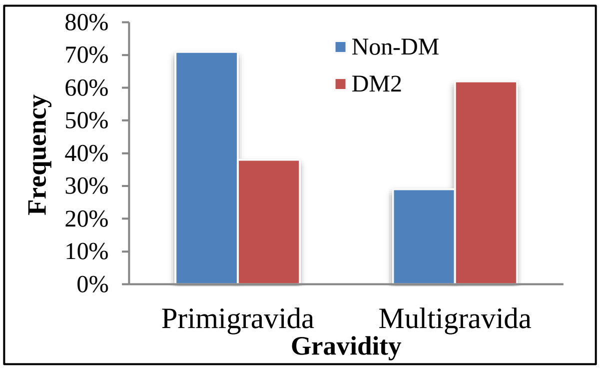
Figure 1 showed socioeconomic distribution between two groups. Socioeconomically patients were grouped into three classes. Among the patients the middle class 117(58.5%) comprising the major percentage, 60.0% in group I and 57.0% in group II respectively. Poor class was 54(27.0%) of subjects and remaining were upper class 29(14.5%). The p-value is 0.12739. The result is not significant at p<0.05 (Figure 1).



Data were expressed as frequency and percentage, Chi-square test was used to see the association between groups , n= Number of the study population, ns=Not significant, s=Significant

Figure-1: Economic status of the study patients (n=200).

Figure 2 showed obstetric history. Most of the women in the study were primigravida (54.5%). Multi gravida (two or more gravida) were (45.5%) of mothers. On comparison between groups, in Group I or diabetic women multi gravida had predominance and in Group II or non-DM primigravida was largest part. The p-value is 0.137. The result is not significant at p < .05 (Figure 2).



Data were expressed as frequency and percentage. Chi-square test was used to see the association between groups. n= Number of the study population; ns=Not significant; s=Significant

Figure 2: Obstetrical history of women (n=200).

Mean period of gestation was 37.3±0.8 weeks and 38.1±0.5 weeks in group I and group II respectively. The difference was not statistically significant (p>0.05) between two groups. (Table 2).

Table 2: 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		

Data were presented as frequency, percentage and mean±SD; Chi-square test was used to compare between two groups; n=Number of study population; ns=Not significant; s=Significant; SD=Standard deviation

Table 3 showed mode of delivery of pregnant women and their BMI. Overall frequency of CS was higher (e.g. 89.5%) than normal delivery. On comparison between groups, present study demonstrated that frequency of CS was higher in diabetic women (94.0% vs. 85.0% in group I and II respectively). In obese group frequency of CS was 52.8% in group I and 42.4% in group II women. In morbidly obese group frequency of CS was higher in diabetic group, 60.0% in group I and only 35.0% in group II women. Normal vaginal delivery was higher in group II patients, 6.0% vs. 15.0% in group I and II respectively. The p value was calculated by chi square test and it was found statistically significant. The postpartum complications were also significantly higher in diabetic group (22% vs 7% in group I and II respectively) (Table 3).

Table 3: Mode of delivery of pregnant women and comparison with BMI (n=200) and postpartum complication.

BMI (kg/m^2)	Total	Group-I (n=100)		Group-II (n=100)		P value
		NVD (%)	CS (%)	NVD (%)	CS (%)	
Mode of delivery						
Overweight	54	4 (7.4)	14 (25.9)	10 (18.5)	26 (48.1)	
Obese	106	2 (1.8)	56 (52.8)	3 (2.8)	45 (42.4)	0.0001^{s}
Morbidly obese	40	0	24 (60.0)	2 (5.0)	14 (35.0)	
Total	200	6	94	15	85	
Postpartum complication						
		Yes (%)	**No (%)**	**Yes (%)**	**No (%)**	
Overweight 18,36	54	4 (6.7)	14 (23.3)	2 (3.3)	34 (56.7)	
Obese 58,48	106	12 (20)	46 (76)	39 (5)	45 (75)	0.000^{s}
Morbidly Obese 24,16	40	6 (8.3)	18 (31.7)	2 (3.3)	14 (23.3)	
Total	200	22	78	7	93	

Data were expressed as frequency and percentage ; Chi-square test was used to see the association between groups n= Number of the study population; ns=Not significant; s=Significant

Table 4 showed birth weight of the babies. About 23 (11.5%) of the baby had birth weight more than 3.5 kilogram and maximum were in group I (15.0% vs. 8.0% in group I and II respectively). Only 6 babies were found to be born with macrosomia (birth wt.>4 kg) in this study and all of their mothers had H/O diabetes (group I). The mean birth weight was higher in diabetic group, 3.7±0.4kg vs 2.6±0.5kg in group I and II respectively. This means the number of heavier babies were more in diabetic group above 3 kg. We have seen that prevalence proportion of birth weight above 3 kg is more (70.0%) in DM group than non-diabetic (32.0%). The result was found statistically significant between two groups. Percentage of low birth weight was 23 (11.5%). Only 2 babies had birth weight less than 2 kilogram (Table 4).

In this study 54 women had BMI 23.1–25.0 kg/m2, 18 cases were diabetic and 36 were non-diabetic. In this series we found that amongst the group I or diabetic women, 3(16.7%) of women delivered newborn birth weight <2.5 kg, 10(55.5%) of women delivered newborn birth weight within 2.5-2.99 kg, 5(27.8%) of women delivered newborn birth weight within 3.0-3.49 kg and none of the cases delivered >3.5 kg of newborn. Amongst the group II or non-diabetic women, 15(41.6%) of women delivered newborn birth weight <2.5 kg, 18(50.0%) of women delivered newborn birth weight within 2.5-2.99 kg, 3(8.3%) of women delivered newborn birth weight within 3.0-3.49 kg and none of them delivered >3.5 kg of newborn. The difference was statistically significant (p<0.05). So, overweight diabetic women delivered comparatively higher birth weight neonates.

Table 4: Birth weight of the baby (n=200).

Birth weight of baby (kg)	Group-I (n=100)		Group-II (n=100)		P value
	No.	%	No.	%	
<2.5	3	3.0	20	20.0	
2.5-2.99	27	27.0	48	48.0	0.001[s]
3.0-3.49	55	55.0	24	24.0	
>3.5	15	15.0	8	8.0	
Mean±SD	3.7±0.4		2.6±0.5		

Data were expressed as frequency and percentage; Chi-square test was used to see the association between groups; n= Number of the study population; ns=Not significant; s=Significant

In this study a total of 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 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 babies than non-diabetic obese women.

In this study 40 women had BMI ≥30.0 kg/m^2, among them 24 cases were diabetic and 16 were non-diabetic. We found amongst the group I or diabetic women, none of the women delivered newborn birth weight <2.5 kg, 5 (20.8%) of women delivered newborn with birth weight 2.5-2.99 kg, 7 (29.1%) of women delivered newborn with birth weight 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 with birth weight 2.5-2.99 kg, 7 (43.7%) of women delivered newborn with birth weight 3.0-3.49 kg and 2 (12.5%) of women delivered newborn with birth weight >3.5 kg. The difference was statistically significant (p<0.05). So, morbidly obese diabetic women delivered comparatively higher birth weight babies (Table 5).

In our study there was increased NICU admission among the babies of diabetic mothers (38% vs18% in group I and II respectively) but the result was not statistically significant. 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 and 38.1 ± 0.5 weeks in group I and II respectively.

Table 5: Correlation of maternal BMI with birth weight of the baby (n=100).

	Birth weight of baby				X^2	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 (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		
Body mass index (25.1–30.0 kg/m^2)						
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		
Body mass index (≥30.0 kg/m^2)						
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		

Data were presented as frequency, percentage and mean±SD; Unpaired t-test was used to compare between two groups; n=Number of study population; ns=Not significant; s=Significant; SD=Standard deviation

Table 6: 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

BMI was comparatively higher in diabetic (group I) but the difference was not statistically significant. Overall frequency of C/S was higher than normal delivery (e.g. 89.5%). On comparison, C/S was comparatively higher in diabetic women (94% vs 85% in Group I and Group II respectively). On correlation with BMI, overweight, obese and morbidly obese diabetic women had higher no of C/S. The postpartum complications (PPH, postpartum fever, wound infection and others) were also higher among diabetic women. A significant number of diabetic women (22% vs 7% in Group I and Group II respectively) had postpartum complications.

The mean birth weight was higher in diabetic group 3.7±0.4 kg vs 2.6±0.5 kg in Group I and Group II respectively. The number of heavier babies were more among diabetic mothers (above 3 kg).

Out of the 54 women who were considered overweight (Maternal BMI 23.1-25.0 kg/m^2), among the diabetic group (18 women), 3 babies were in the below 2.5 kg range (16.7%), 10 babies were in the 2.5 - 2.99 kg range (55.5%) and 5 babies were in 3.0 - 3.49 kg range. There were no babies above 3.5kg. In the non-diabetic group (36 women), there were 15 babies below 2.5 kg (41.6%), 18 babies were in the 2.5 - 2.99 kg range (50.0%) and only 3 above 3.0 kg (8.3%). So overweight diabetic women delivered comparatively higher birthweight babies. Similarly, obese diabetic women delivered significantly higher birth weight babies than non-diabetic women.

Out of the 40 morbidly obese women (BMI>30 kg/m^2) among the diabetic group (24 women), none had babies below 2.5 kg. There were 5 babies between 2.5 to 2.99 kg (20.8%), 7 babies between 3.0 to 3.5 kg (29.1%) and 12 babies of birth weight more than 3.5 kg (50%). In the non-diabetic group (16 women), these was one baby below 2.5 kg (6.2%), 6 babies between 2.5 to 2.99 kg (37.5%), 7 babies between 3.0 to 3.5 kg (43.7%) and only 2 babies above 3.5 kg (12.5%). So morbidly obese diabetic women delivered comparatively higher birthweight babies.

Other than macrosomia, other neonatal complications like neonatal asphyxia, hypoglycaemia, hyperbilirubinemia etc. leads to increased admission of babies in NICU. 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 6).

DISCUSSION

This study demonstrates the impact of high maternal BMI and diabetes on maternal and neonatal outcomes. 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 and 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. Overall frequency of C/S was higher than normal delivery. On comparison between groups, C/S was significantly higher in diabetic women (94% vs 85% in group I and group II respectively). Many studies also showed that high maternal BMI was associated with higher incidence of C/S. But diabetes is significantly more associated with increased rate of C/S. A study reported an overall C/S rate of 35.3% for women with GDM compared to 22.0% for glucose tolerant subjects.[11] Many studies are also in line with these findings and suggest that chronic diabetes and gestational diabetes were both significant, independent risk factors for a primary Caesarean delivery.[12] Increased macrosomic fetus rates cause increased caesarean delivery. Postpartum compilations were significantly higher (22% vs 7% in Group I and Group II respectively) in our study. Many other studies have come up with similar findings. The morbidity rates are also higher among pregnant women with diabetes. Pregnant women with type I diabetes present a death rate 109 times greater than the general population.[13]

We found 23 (11.5%) of the babies had birth weight more than 3.5 kg and maximum were in group I (15% vs 8% in group I and 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 and II respectively. Prevalence proportion of birthweight above 3 kg was more (70%) in the diabetic 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.[14] It was observed in another study that offspring of mothers with gestational diabetes mellitus have higher birth weights.[15]

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.[16] Many other studies concluded that maternal, perinatal and neonatal complications are strongly associated with diabetes.[2]

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.[17] Pregnancy is characterized by increase in blood glucose levels, insulin resistance and circulating lipids, which make energy available to the fetus.[18] 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.[19]

CONCLUSION

According to the study, maternal BMI and diabetes during pregnancy both were found to be major contributors to the adverse maternal and perinatal outcomes. High BMI diabetic mothers have significantly higher rate of macrosomia and caesarean section. The babies also had a higher rate of neonatal complications leading to increased NICU admissions. The incidence of obesity along with its complications progressively increased around the world in the last few decades. So, it is important to identify the predictive factors, maternal diabetes is one of the most influencing factors for adverse maternal and perinatal outcomes. We recommend careful monitoring of diabetes during pregnancy and optimum weight gain to improve pregnancy outcomes for both the mother and the baby.

ACKNOWLEDGEMENTS

Authors would like to thank to their teachers, colleagues, friends and family members for their support and all the patients involved in the study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Leddy MA, Power ML, Schulkin J. The impact of maternal obesity on maternal and fetal health. Rev Obstet Gynecol. 2008;1(4):170-8.
2. Miao M, Dai M, Zhang Y, Sun F, Guo X, Sun G. Influence of maternal overweight, obesity and gestational weight gain on the perinatal outcomes in women with gestational diabetes mellitus. Sci Rep. 2017;7:305.
3. Ali A, Mehrass A, Al-adhroey A, Al-shammakh A. Prevalence and risk factors of gestational diabetes mellitus in Yemen. Int J Women's Health. 2016;8:35-41.
4. Modi N, Murgasova D, Martin R. The influence of maternal body mass index on infant adiposity and hepatic lipid content. Pediatr Res. 2011;70:287-91.
5. John J, Mahendran M. Maternal and fetal outcomes of obese pregnant women: a prospective cohort study. Int J Reprod Contracept Obstet Gynecol. 2017;6:725-9.
6. Metgud CS, Naik VA, Mallapur MD. Factors affecting birth weight of a newborn - a community based study in rural Karnataka, India. PLoS ONE. 2015;7(7): e40040.
7. Lim J, Lee J, Kim J, Hwang Y, Kim T, Yong S, et al. Comparison of World health Organization and

Asia-Pacific body mass index classifications in COPD patients. International J COPD. 2017;12:2465-75.
8. Sayeed MA, Mahtab H, Khanam PA, Begum R, Banu A, Khan AK. Diabetes and hypertension in pregnancy in a rural community of Bangladesh: a population-based study. Diabet Med. 2005;22(9):1267-71.
9. Begum S, Huda SN, Musarrat N, Ahmed S, Banu LA, Ali SM. Nutritional status and birth outcomes of the diabetic and non-diabetic pregnant women. Bangladesh Med Res Counc Bull. 2002;28(3):97-103.
10. Huong NT. Birth weight and growth during the first two years of life: a study in urban and rural Vietnam. Doctoral thesis at the Nordic School of Public Health NHV, Gothenburg, Sweden 2014:1-23.
11. Goldman M, Kitzmiller JL, Abrams B, Cowan RM, Laros RK. Obstetric complications with gdm: effects of maternal weight. Diabetes. 1991;40(2):79-82.
12. Rosenberg TJ, Garbers S, Lipkind H, Chiasson MA. Maternal obesity and diabetes as risk factors for adverse pregnancy outcomes: differences among 4 racial/ethnic groups. Am J Public Health (AJPH). 2005;2:87-9.
13. Negrato CA, Mattar R, Gomes MB. Adverse pregnancy outcomes in women with diabetes. Diabetol Metab Syndrome. 2012;4:41.
14. Abanihe U, Olubukola A. Maternal and environmental factors influencing infant birth weight in Ibadan, Nigeria. Afr Population Studies. 2011;25(2):250-66.
15. Gillman MW, Shiman SR, Berkey CS, Field AE, Colditz GA. Maternal gestational diabetes, birth weight, and adolescent. Obesity Pediatrics. 2003;111(3):e221-e6.
16. Timur BB, Timur H, Tokmak A, Isik H, Eyi EG. Influence of maternal obesity on pregnancy complications and neonatal outcomes in diabetic and non-diabetic women. Geburtshilfe Frauenheilkd. 2018;78(4):400-6.
17. Barrere D. There are a number of factors, actually. Available at http:// pregnancy and baby. com/ baby/articles/940601/what-affects-a-babys-birth-weight. Accessed on 11 November 2017.
18. Shengqi L. Maternal body composition late in pregnancy and infant body composition at birth. University of Kansas Ku Scholarworks. 2013.
19. Lumbanraja S, Lutan D, Usman I. Maternal weight gain and correlation with birth weight infants. Int Edu Technol Con. 2013;103:647-56.

Cite this article as: Kabir R, Parvin S, Islam MU, Begum F. Association between maternal and fetal outcomes in high BMI diabetic and non-diabetic groups. Int J Contemp Pediatr 2021;8:13-9.