

## Pre-pregnancy Body Mass Index and the Risk of Adverse Pregnancy Outcome in Two Thousand Type 2 Diabetes Mellitus Bangladeshi Women

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### Abstract

**Background:** The aim of the present study were to evaluate the frequency of maternal complications and adverse fetal outcomes in a group of singleton pregnant women with type 2 diabetes mellitus to compare the outcome in three groups (lean, normal and overweight).

**Materials and Methods:** The women were categorized into three groups: lean <18.5, normal from 18.5 to 24.9 and overweight >25.0-29.9 kg/m<sup>2</sup>. The effect of pre-pregnancy BMI was analyzed by comparing the frequencies of various outcomes in three BMI groups. The results were expressed as odds ratio (ORs) and the corresponding 95% confidence intervals (CIs) & p values.

**Results:** The risk of late fetal death was consistently increasing with BMI (ORs were 1.2 (0.9-1.7), 1.6 (1.1-2.3) & 2.6 (1.7-3.8) for lean, normal & overweight respectively). The risk of early neonatal death was also higher among women with higher BMI (ORs was 1.6 (1.1-2.3) for overweight). The rate of preeclampsia is higher among women with lean and overweight BMI in compares to normal BMI (the values were 2.5%, 1.8%, & 7.0% for lean, normal & overweight respectively). Hypertensive disorders was also more common among lean (3.8%) and overweight (3.6%) compared to normal (1.6%). The risk of preterm delivery was significantly increased for overweight group (4.2%) and lean (2.4%), as compare to normal. The risk of SGA was significantly more in lean (2.7%) compared to normal weight (1.5%) & overweight group (1.9%).

**Conclusion:** Pre-pregnancy overweight increases the risk of late fetal death and perinatal mortality.

**Keywords:** Type 2 diabetes; Body mass index; Pre-pregnancy; Obesity

### Introduction

Over the last few decades several studies have shown that women with type1 diabetes mellitus still have a high incidence of adverse maternal, fetal and neonatal morbidity and mortality. [1-9] There is a strongly elevated risk of congenital malformations [1,3,6,7], macrosomia [3,7] and pre-eclampsia [1,7] as well as pre term delivery and increased caesarean section rates[1,6,7]. Neonatal hypoglycemia occurs frequently during the first day after delivery [1]. Elevated plasma glucose levels in first trimester are the major contributor to the development of congenital abnormalities [1,5], in midtrimester pre-eclampsia [10,11] and macrosomia [1,12]. This has suggested to be aimed at reaching normoglycemia or near normoglycemia.

The prevalence of type 2 diabetes is increasing rapidly in all age groups. It is a general clinical observation that the number of pregnant

women with pregestational type 2 diabetes has become more frequent in the recent years, however, little knowledge exists concerning the prevalence and outcome of these pregnancies. [13,14]. During the last decade, five surveys have been published which showed maternal, fetal and neonatal outcome in pregestational type 2 diabetes are similar to those in pregnancy with pregestational type1 diabetes [6,15-19]. Pregestational type 2 diabetes is an emerging problem especially since type 2 diabetes has become a global epidemic [20].

This means that type 2 diabetes occurs with increasing frequency in younger age group since at the same time the maternal age of first and subsequent pregnancies has risen in modern society, more and more women are confronted with the problems and burden of type 2 diabetes during pregnancies.

Obesity before pregnancy is associated with an increased risk of fetal macrosomia & perinatal mortality. [21-23]. The mothers being leaner (underweight) than average, on the other hand, is associated with an increased risk of delivering an infant who is small for gestational age and perhaps also the risk of preterm delivery [23-26].

Pregnancies among underweight or overweight women are therefore often regarded as high-risk pregnancies and thin women are frequently advised to gain weight before becoming pregnant. [27-29] and overweight women are advised for weight reduction.

The aim of the study was to examine the association of the maternal Body Mass Index (BMI) and the obstetric and the perinatal outcomes in singleton pregnancies of type 2 DM mother.

## Methods and Materials

Two thousand women were categorized into 3 groups on the basis of their maternal Body Mass Index (BMI). The maternal and the neonatal outcome were noted in all groups. The obstetrical outcomes included gestational hypertension or pregnancy induced hypertension, preeclampsia, preterm delivery, shoulder dystocia. The neonatal outcomes included late fetal death, early neonatal deaths, small for gestational age (SGA) and macrosomic baby.

Pregnancy with type 2 diabetes was managed according to our routine procedures. Current treatment with oral hypoglycemic agents was stopped at admission & the women were treated with diet and exercise alone or diet, exercise and insulin. Women treated with diet alone performed home blood glucose measurements before breakfast (fasting) and 2 hours after breakfast, after lunch and after dinner respectively, 2 days per week. Goals were pre-prandial capillary blood glucose levels <6 mmol/L, postprandial levels <7 mmol/L, and a mean <6 mmol/L. If these goals were not obtained treatment with daily dose of insulin (soluble short acting and intermediate acting) was advised.

The women were categorized according to their BMI (kg/m<sup>2</sup>): lean <18.5, normal from >18.5 to 24.9 and overweight >25.0-29.9kg/m<sup>2</sup>. Information regarding maternal age, parity, complications during pregnancy or delivery and perinatal outcomes were obtained from hospital records. Late fetal death was defined as still birth occurring at 28 or more completed weeks of gestation and early neonatal death as death occurring during the first week after birth, preterm delivery was less than 37 completed weeks of gestation. SGA infants were defined as the birth weight more than 2SD below the mean birth weight for gestational age. Gestational age was calculated based on last menstrual period (LMP) and ultrasound examination performed routinely at less than 12 weeks of gestation. The estimates were adjusted for maternal age, parity, smoking, education, regular menstrual cycle and weight gain during pregnancy. The effect of pre-pregnancy BMI was analyzed by comparing the frequencies of various outcomes in three BMI groups by both univariate and multivariate logistic regression analysis. The results were expressed as odds ratio (ORs) and the corresponding 95% confidence intervals (CIs) & p values.

## Statistical Analysis

We used multiple-logistic regression analysis to evaluate the association between pre-pregnancy body-mass index & late fetal death, early neonatal death, preterm delivery & delivery of a small for gestational age infant.

## Results

On the basis of the BMI, out of the 2000 women, 348 (17.4%) were underweight or lean group, 1200 (60%) belonged to the normal weight category, while 452 (22.6%) women were from the overweight category.

Factor	Lean	Normal	Overweight
Age	24 ± 5	23 ± 4.5	25 ± 3
Parity	3	2	2
Duration of DM (yrs)	5 ± 1.	6 ± 1.	4 ± 1

**Table 1:** Maternal Characteristics of 2000 type 2 DM

The maternal complications according to the BMI have been displayed in Table II and III. The mean ± SD age of the study subjects were 25 ± 5 years, the median (range) duration of diabetes was 5 (4-6) years.

Body Mass Index	Early Neonatal Death	Late Fetal Death	Pre-eclampsia	Hypertensive disorders
<18.5	1.1 (0.8-1.6)	1.2 (0.9-1.7)	0.025	3.8 (2.5-5.6)
18.5-24.9	1.3 (0.9-1.9)	1.6 (1.1-2.3)	0.018	1.6 (1.1-2.2)
>25.0-29.9	1.6 (1.1-2.3)	2.6 (1.7-3.8)	0.07	3.6 (2.4-4.5)

**Table 2:** Adjusted Odd's Ratio for the early and late neonatal death, preeclampsia and Hypertensive disorders associated with pre-pregnancy BMI among type 2 DM mothers

The risk of late fetal death was consistently increasing with BMI (ORs were 1.2 (0.9-1.7), 1.6 (1.1-2.3) & 2.6 (1.7-3.8) for lean, normal & overweight respectively). The risk of early neonatal death was also higher among women with higher BMI (ORs was 1.6 (1.1-2.3) for overweight).

The rate of preeclampsia is higher among women with lean and obese BMI in compare to normal BMI (the values were 2.5%, 1.8%, & 7.0% for lean, normal & overweight respectively). Hypertensive disorders was also more common among lean (3.8%) and overweight (3.6%) compared to normal (1.6%) (ORs 3.8 (2.5-5.6), 1.6 (1.1-2.2) & 3.6 (2.5-4.5) lean, normal and overweight respectively).

Body Mass Index	Pre-term delivery	Small for gestational age (SGA)
<18.5	1.6 (1.3-2.1)	2.7 (1.7-2.8)
18.5-24.9	1.0 (0.8-1.4)	1.2 (0.9-1.5)
>25.0-29.9	2.2 (1.9-2.6)	1.0 (0.6-1.4)

**Table 3:** Adjusted ODD's Ratios for the preterm delivery & small for gestational age (SGA) associated with pre-pregnancy Body Mass Index among type 2 DM mothers

The risk of preterm delivery was significantly increased for overweight group (2.2%) and lean (1.6%), as compare to normal weight (1.0%) (ORs 1.6 (1.3-2.1), 1.0 (0.8-1.4) & 2.2 (1.9-2.6) lean, normal, overweight respectively). The risk of SGA was significantly more in lean (2.7%) compared to normal weight (1.2%) & overweight group (1.0%) (ORs 2.7 (1.7-2.8), 1.2 (0.9-1.5) & 1.0 (0.6-1.4) respectively).

BMI (kg/m <sup>2</sup> )	% of affected	OR Vs Baseline	95% CI
<18.5	1.4	0.9	0.4-2.2
18.5-24.9	1.6	1	0.6-2.3
>25.0-29.9	1.8	1.1	0.5-2.5

**Table 4:** Shoulder Dystocia associated with pre-pregnancy BMI among type 2 DM mothers

The risk of shoulder dystocia & macrosomic baby was higher in overweight group.

## Discussion

Lean BMI has been shown in study to be associated with an increased risk of preterm deliveries, small for gestational age babies [4]. With regards to small for gestational age group (SGA), in our study we found an association of preterm delivery & SGA with the lean BMI group. Apart from an increased risk of SGA, the mothers with a BMI of <18.5 kg/m<sup>2</sup> appeared to be at a lower risk for other labor complications (shoulder dystocia) as compared to the women with higher BMI group, which was consistent with other studies [30,31]. The results of this study showed that lean (underweight) as well as overweight were associated with adverse maternal and perinatal outcomes. The women who were overweight had significantly increased risks for preeclampsia, gestational or pregnancy induced hypertension and large for gestational age babies (macrosomic baby), which was consistent with the findings of other studies [12,13,5]. The neonatal ICU admission rate was more in the overweight group which was attributed to the Macrosomic babies and the diabetic mothers. In another study done by Clansen TD et al. in Netherland while comparing pregnancy outcome of women with type 2 DM during 1996-2001 and women of type2 DM during 1980-92, found higher rate of perinatal mortality in 1996-2001 group. Major congenital malformation and preterm delivery were more in their newer group. Women in this study with newer group were more overweight and more from non nordic Caucasian group. Despite the fact that the newer group in this study had better glycemic control, they showed worse outcome. One of the speculations of the worse outcome in the newer group was probable association of insulin resistant syndrome in this group [15]. As there is different rates of insulin resistance in ethnic group and as the newer group in the study included more patients with overweight and non nordic Caucasian group, it was suggested by the author that further studies to be done to see if rising prevalence of the metabolic syndrome which is higher in proportion in women with non nordic Caucasian and adverse fetal outcome of pregnancy in those populations is related to rising prevalence of the metabolic syndrome [15]. The Asian trait of DM is consisting with higher prevalence of Insulin resistance syndrome. The patients with increased BMI in our study probably reflect the component of insulin resistance. Our study of pregnancy outcome is the diabetic population and in this part of world by showing increase fetal and maternal outcome in overweight group, supports the hypothesis that probably insulin resistance syndrome itself is the cause for increased adverse fetal outcome in this population.

A study which was done by handler et al. [6] evaluated the relationship between the pre pregnancy BMI and the spontaneous preterm birth & they found a significant occurrence of the preterm birth among the lean and obese pregnant women [32-38]. In the

present study, correlation of the preterm deliveries was seen in lean BMI group.

## Conclusions

Both the extremes of the maternal BMI showed a strong association with pregnancy complications and perinatal morbidity and mortality. Overweight was associated with an increased incidence of preeclampsia, pregnancy induced hypertension, macrosomia and the lean DM women's group is associated with SGA, preterm delivery, PIH, preeclampsia. Women with higher BMI needs medical treatment before and during pregnancy and should reduce the body weight before pregnancy and women with low BMI are advised to take adequate diet to meet the basic requirements of pregnancy.

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