Second Trimester Body Mass Index (BMI) as a Predictor of Adverse Maternal and Perinatal Outcome

Abstract

Objective: This study was undertaken to evaluate whether BMI estimation in the second trimester is predictive of adverse maternal and neonatal outcomes and whether it can be used as a clinically relevant screening tool.

Design & Setting: This retrospective study was conducted at a tertiary care teaching hospital from May 2012 to April 2015.

Population: Low risk women with singleton pregnancies who had presented to the hospital for the first time in their second trimester of pregnancy were recruited.

Methods: BMI was calculated and all patients were followed up and outcomes noted. Nomogram was prepared for the study population. BMI less than 5th centile was taken as 'underweight' and BMI more than 95th centile as 'obese'.

Main Outcome Measures: Maternal outcomes included gestational hypertension and preeclampsia, gestational diabetes, preterm delivery, caesarean delivery and postpartum haemorrhage.

Results: There was a significant increase in gestational hypertension, preeclampsia, gestational diabetes, large for gestational age neonate in women with BMI above the 95th centile. Low birth weight were common in women with BMI < 5th centile.

Conclusion: The present study highlights that both ends of the spectrum of BMI are correlated with adverse outcomes in pregnant women. Hence it is important to record maternal height and weight even when they present in the second trimester. This simple parameter which does not need any specialised equipment can easily triage women.

Significance: Many women present to the healthcare providers in second trimester. The availability of pre-pregnancy or first trimester BMI cannot be totally relied upon. Thus we may miss out on an important predictor of pregnancy outcome. This study was undertaken to evaluate whether BMI estimation in the second trimester is predictive of adverse maternal and neonatal outcomes and whether it can be used as a clinically relevant screening tool.

Keywords: Second trimester; Body mass index; Predictor; Adverse outcome; Obesity

Research Article

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Introduction

Obesity has long been considered to be an affliction of the affluent world. The World Health Organisation (WHO) declared obesity as a 'global epidemic' in 1997 [1]. However since then the 'globesity' epidemic has spread to developing countries as well. The third National Family Health Survey in India showed a staggering increase of 25% in the rates of obesity amongst Indian women [2-4]. High pre-pregnancy body mass index (BMI) as well as high BMI in the first trimester has consistently been associated with adverse maternal and perinatal outcomes [5-12]. However in the developing world, obstetricians see majority of their patients for the first time in the second trimester, thus missing out on an important predictor of outcome of pregnancy. This study was undertaken to evaluate whether BMI estimation in the second trimester is predictive of adverse maternal and neonatal outcomes and whether it can be used as a clinically relevant screening tool.

Materials and methods

This retrospective study was conducted at a tertiary care teaching hospital from May 2012 to April 2015. Low risk women with singleton pregnancies who had presented to the hospital for the first time in their second trimester of pregnancy were recruited. The study was approved by the Hospital Ethical Committee. An informed consent had been taken from all women who were enrolled. All women had their height and weight taken at the booking visit. Exclusion criteria were advanced maternal age, pregnancy conceived by in vitro fertilization (IVF) and pre-existing medical conditions like hypertension, diabetes, heart disease, etc.

A total of 1768 women fitted the inclusion criteria. BMI was calculated as weight in kilograms divided by height in meters squared. All patients were followed up as per hospital protocol and maternal and perinatal outcomes noted. Since there are no defined cut offs for BMI in pregnancy, a nomogram was prepared for the study population. BMI less than 5th centile (2SD below mean) was taken as 'underweight' and BMI more than 95th centile (2SD above mean) was taken as 'obese'. Both maternal and perinatal outcomes were noted for the two extremes. Maternal outcomes that were studied included development of gestational hypertension and preeclampsia, gestational diabetes, preterm delivery (less than 34 weeks and less than 37 weeks), caesarean delivery and postpartum haemorrhage. Gestational hypertension was defined as systolic blood pressure (BP) of more than 140 mm Hg and diastolic BP of more than 90 mm Hg on two separate occasions 4 hours apart, first noted after 20 weeks of gestation. Preeclampsia was defined as gestational hypertension with proteinuria (>+2 urine albumin on dipstick or >300 mg/litre protein in 24 hour urine sample). Gestational diabetes (GDM) was diagnosed as per Carpenter and Coustner criteria after 100 gram oral glucose load given between 24 to 26 weeks gestation. Perinatal outcomes included congenital anomaly in the fetus, prematurity (less than 34 weeks and less than 37 weeks), low birth weight (less than 2500 grams), macrosomia (more than 4000 gm) and perinatal mortality.

Statistical Analysis

Data were analyzed using SPSS version 17 (IBM, Armonk, NY, USA) and Microsoft Excel (Redmond, WA, USA). A p value of <0.05 was considered statistically significant. Logistic regression models were used to calculate the odds ratios (ORs) with the group of women with BMI between 5th and 95th centiles serving as the reference group.

Results

The mean BMI and 5th and 95th centiles were calculated for the study population and plotted to make a gestational age specific nomogram (Figure 1). BMI appears to remains almost stable throughout the second trimester showing a slight increase after 24 weeks reflecting the physiological weight gain in pregnancy. The study population was thus divided into three groups: group I with BMI less than 5th centile who were considered 'underweight', group II with BMI between the 5th and 95th centile who were considered 'normal' weight and group III including those with BMI above the 95th centile who were categorized as 'overweight'.

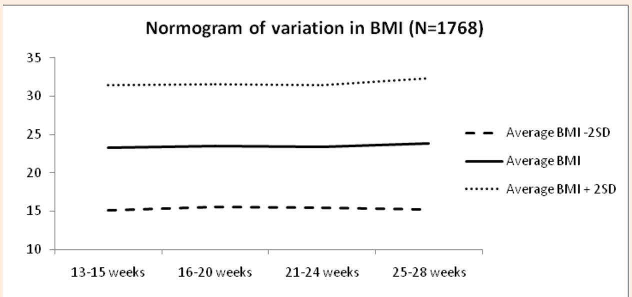

Figure 1: Mean gestational age specific BMI (+ 2SD) of the study population.

The demographic data for each of these groups is summarised in Table 1. The maternal and perinatal complications for women in each group are given in Table 2. Odds ratios were calculated for each complication as a function of BMI and are shown in Figure 2.

Table 1: Demographic data of study population (n = 1768).

Parameter	Group I (BMI<5th centile)	Group II (BMI 5th – 95th centile)	Group III (BMI>95th centile)
Number (%)	89 (5.03)	1583 (89.54)	96 (5.43)
Age (years, mean ± SD)	24.01 (±3.32)	24.03(±2.94)	26.17 (±3.00)
Parity (Median)	1	1	1
BMI (kg/m^2, mean ± SD)	17.85 (± 0.89)	23.21(±2.94)	34.46 (±3.00)
Per capita income (mean ±S D)	1293.01(± 3.32)	1443.55(±3.38)	1476.88 (±4.25)
Birth weight (gm, mean ± SD)	2585.01(± 978.43)	2731.48(±1229.37)	2990.61 (±1321.83)

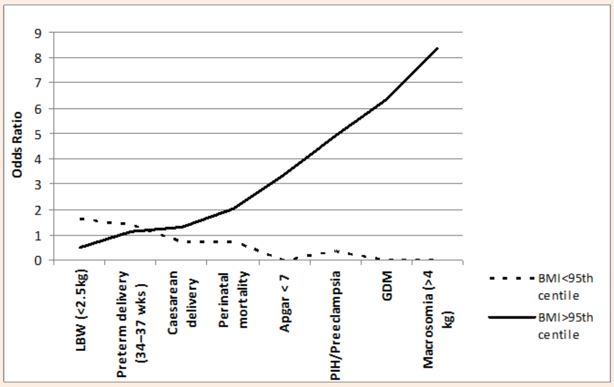

Figure 2: Odds ratio of maternal and perinatal outcome as a function of BMI.

There was a significant increase in the development of gestational hypertension and preeclampsia in women with BMI above the 95th centile. High BMI was also associated with a significant increase in the development of gestational diabetes. Women in the 'overweight' category had significantly more infants who were large for gestational age. Infants born to women with high BMI were more likely to have Apgar scores of less than 7 at 5 minutes; although this difference did not attain statistical significance. There was no significant increase in the perinatal mortality in either group I or group III. There was a significant association between low birth weight and women with BMI less than the 5th centile. There was no significant correlation between preterm delivery and either extreme of BMI.

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Table 2: Comparison of maternal and neonatal complications in each group.

Complication	Group I (BMI<5th centile) (n=89)	Group II (BMI 5th–95th centile) (n=1583)	Group III (BMI>95th centile) (n=96)	P value (Group I & II)	P value (Group II & III)
PIH/Preeclampsia	1	49	13	0.29	<0.001*
Eclampsia	0	1	0	0.81	0.8
GDM	0	8	3	0.5	0.002*
Premature Delivery (%)	26 (2.9)	364 (2.3)	22 (2.3)		
<34 weeks 34–37 wks	2 24	35 329	0 22	0.94 0.16	0.14 0.62
Caesarean Delivery (%)	12 (13.4)	278 (17.5)	21(21.9)	0.32	0.28
PPH	0	2	0	0.74	0.73
Fetal Anomaly	0	3	0	0.68	0.67
LBW (<2500 g)	31 (3.5)	389 (2.5)	13 (1.4)	0.01*	0.2
Macrosomia(>4000 g)	0	4	2	0.63	0.003*
Apgar < 7 at 5 min (%)	0	20 (0.13)	4 (0.41)	0.29	0.17
Perinatal Mortality (%)	1 (0.11)	25 (0.16)	3 (0.03)	0.74	0.25

*p value significant

Discussion

There is a large body of evidence correlating extremes of pre-pregnancy or first trimester BMI with adverse obstetric outcomes [5-16]. Although weight gain in the second and third trimesters has been studied [17], this is the first study evaluating the role of second trimester BMI in prediction of adverse outcomes. There seems to be a disparity in the clinically relevant cut off values for BMI for the western and Asian populations; the latter being at risk of diabetes, cardiovascular diseases and mortality at much lower BMIs [18,19]. Thus population specific cut off points for defining 'abnormal' BMI must be established [18]. We used the mean along with 2 standard deviations above and below the mean to define 'underweight', 'normal' and 'overweight' categories for our study population. Since BMI has not been calculated from self reported values but actually measured in the hospital, we were able to eliminate misclassification bias in this study.

There was a significant increase in the risk of gestational hypertension and preeclamsia in women with high BMI. This is in accordance with studies correlating pre-pregnancy and first trimester BMIs with hypertensive disorders of pregnancy [5-9]. There was a significant increase in gestational diabetes in the overweight group in our study population. This is consistent with the results of previous studies. A recent meta-analysis concluded that the risk for development of GDM is two and four times higher in overweight and obese women respectively [10]. We also found that neonates born to overweight women were significantly more likely to be large for gestational age. This is again in corroboration with studies correlating macrosomia to pre-pregnancy BMI. We did not have information on the incidence of shoulder dystocia in our study population; however previous studies have reported increased risk of shoulder dystocia in obese women [11] mainly attributable to macrosomia. The percentage of caesarean deliveries in our study was higher in the high BMI category; however it did not reach statistical significance. Studies consistently report increased caesarean section rates for obese women [11,12]. *Of note are the low caesarean section rates across all categories which probably reflect the rigorous check on unindicated caesarean deliveries in a teaching hospital. (Can we write this sentence?)* Although increased risk of postpartum haemorrhage is reported in obese mothers [12], we did not find an increase in the rates of PPH in our high BMI group. This might be due to the low absolute caesarean section rate in group III.

We also found that women with low BMI were at increased risk of having low birth weight babies. This is consistent with previous studies correlating low BMI at conception with LBW [13]. The rates of preterm delivery, however, were similar in all three groups. This is in contrast with previous studies reporting an increased risk of preterm delivery both in underweight [14,15] as well as obese women. A recent systematic review and meta-analysis concluded that there is an overall increase in the risk of preterm delivery including iatrogenic preterm delivery in obese women [16]. All the above findings remained same when data was analysed using 10th centile and 90th centile as cut-offs.

Developing countries are struggling with the dual problems of under-nutrition and over-nutrition both of which have an adverse impact on obstetric outcomes. Our study shows that even when women present for the first time in the second trimester, BMI can be a useful clinical parameter for triaging women into 'high risk' category thus allowing appropriate resource allocation. Thus women in the overweight category would benefit from increased surveillance for development of hypertension. This group of women would also be suitable for oral glucose tolerance test for screening as well as diagnosing gestational diabetes. Conversely, women in the 'underweight' group would be candidates for dietary advice and help from the social welfare services which would selectively concentrate in providing nutritional supplements to this group of women.

Conclusion

The present study highlights that both ends of the spectrum of BMI are correlated with adverse outcomes in pregnant women. Hence it is important to record maternal height and weight even when they present in the second trimester. This simple parameter which does not need any specialised equipment can easily triage women. This would translate into limiting frequent hospital visits and monitoring to women who are deemed 'high risk'. This will ensure optimum utilization of resources. However since there are no defined cut offs, local population nomograms and cut offs will need to be established.

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