



Effect of Pre-pregnancy Maternal Body Mass Index on Obstetric Outcomes in a Tertiary Care Hospital in Goa, India

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Abstract

Introduction Maternal body mass index (BMI) is a vital predictor of the nutritional status of any pregnant woman. Several developing countries like India are facing the double burden of both obesity and malnutrition due to the extreme socioeconomic distribution of our population. Thus, this study was undertaken to study the effect of pre-pregnancy maternal BMI on the obstetric outcomes.

Materials and methods A retrospective observational study was conducted during the time period of 1 year (December 2018–December 2019), wherein we analysed 3940 women who delivered in Goa Medical College. Depending on the maternal BMI calculated at the first antenatal visit, all the study participants were divided into five BMI groups and their obstetric outcomes were studied.

Results Majority of the study participants were in the normal BMI category (49.8%); however, a large number of women were overweight (37.3%), 3.2% were obese, 0.1% were morbidly obese, and 9.6% were underweight. Antenatal complications like anaemia and IUGR were more common in underweight women, whereas pre-eclampsia, GDM, macrosomia, antepartum haemorrhage and preterm labour were more common in obese women. Increased rate of Caesarean sections and postpartum complications like PPH, wound sepsis and puerperal sepsis were observed in overweight and obese women.

Conclusion Thus, adverse obstetric outcomes were observed in extremes of maternal BMI. Hence, there is a need to provide pre-conception counselling to all women in the reproductive age group so that they can achieve normal BMI prior to conception and thus reduce maternal morbidity and mortality rates in our country.

Keywords Maternal BMI · Obesity · Malnutrition · Obstetric outcomes

Introduction

Maternal body mass index (BMI) is known to be a significant indicator of maternal nutritional status. Being either underweight or overweight can have adverse effects on the obstetric outcomes. Obesity is an emerging health issue of global concern. Globally more than 1.9 billion adults are overweight and 650 million adults are obese.¹ In India, more than 135 million individuals are obese. [1] According to the NFHS 4 survey (2015–2016), 33.5% of adult women in Goa are either overweight or obese. [2] Studies have shown that maternal obesity is associated with several obstetric adversities like pre-eclampsia, gestational diabetes mellitus, macrosomia, preterm/post-dated deliveries, higher incidence of induced labour, Caesarean sections and postpartum haemorrhage. [3–6]

In a developing country like India, because of the divergent socioeconomic distribution of our population,

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malnutrition and underweight are also a health burden on the country. 14.7% of adult women in Goa are underweight as per the NFHS 4 survey (2015–2016). [2] Maternal under nutrition is associated with obstetric complications like anaemia, intrauterine growth restriction, low birth weight and preterm labour. [4, 5]

Thus, this study was undertaken to study the effects of maternal BMI on obstetric outcomes in the women delivering in Goa Medical College (GMC) during the time period of 1 year (December 2018– December 2019).

Materials and Methods

We conducted a retrospective observational study, wherein we analysed 3940 women who delivered in Goa Medical College during the time period of 1 year (December 2018–December 2019) after the hospital ethical committee approval. This study was performed in line with the principles of the Declaration of Helsinki. The data were obtained from the hospital medical records and antenatal follow-up sheets of these women which included information on their socio-demographic characteristics, past obstetric and medical histories and obstetric outcomes. All women with singleton pregnancies that delivered after 28 weeks of gestation and did not have any medical disorders (like hypertension, diabetes mellitus, chronic renal/hepatic disease and heart disease) were included in the study. An informed consent was obtained from all the study participants.

Gestational age was calculated from the first day of the last menstrual period (LMP) or taken from the dating ultrasound scan that was performed before 20 weeks of pregnancy. The pre-pregnancy BMI was calculated based on the formula $\text{weight}/\text{height}^2$. The pre-pregnancy weight was measured at the first antenatal visit during the first trimester of pregnancy; final pregnancy weight was measured at the last antenatal visit or the time of delivery. Body weight was measured in norms with a standard protocol (barefoot, with light clothes on) using an electronic digital scale with the kilogram mode during each antenatal visit. The study participants were then divided into five groups according to their first trimester BMIs as shown in Table 1. [7]

Table 1 Groups and categories of study participants based on Pre-pregnancy BMI

Group	Category	BMI (kg/m ²)
I	Underweight	≤ 19.9
II	Normal	20–24.9
III	Overweight	25–29.9
IV	Obese	30–34.9
V	Morbidly obese	> 35

The effect of pre-pregnancy BMI on several obstetric outcomes in each BMI group were studied considering the following variables:

- Pre-pregnancy variables: Age, parity.
- Antenatal variables: Pre-eclampsia, gestational hypertension, eclampsia, gestational diabetes mellitus (GDM), anaemia, antepartum haemorrhage (placenta previa, abruptio placenta), malpresentation, intrauterine growth restriction (IUGR) and intrauterine foetal Death (IUFD).
- Intra-partum variables: Induction of labour, mode of delivery, failed induction, etc.
- Postpartum variables: Postpartum haemorrhage, wound sepsis, puerperal sepsis, etc.

After tabulating the occurrence of the above variables in different BMI groups, statistical analysis of the data was done using SPSS 22 software and a p value < 0.05 was considered as significant.

Results

A total of 3940 women that delivered in the Department of Obstetrics and Gynaecology, Goa Medical College during a period of 1 year from December 2018–2019, after fulfilling the inclusion and exclusion criteria and obtaining an informed consent were enrolled in the present study.

Depending on the maternal BMI calculated at the first antenatal visit, all the study participants were divided into following BMI groups as shown in Table 2.

As seen in Table 2, majority of the study participants were in the normal BMI category (49.8%); however, many of them were overweight (37.3%).

Table 3 below shows the distribution of the pre-pregnancy variables like age and parity of the study population. Out of the 3940 women studied, majority of the women i.e. 2059 (52.2%) were in the age group of 26–35 years and primigravidas (56%). Majority of the overweight and obese women were in the age group of 26–35 years. The present study showed that most of the obese mothers (67.7%) were multigravidas, unlike the other BMI groups.

Table 2 Distribution of study participants into 5 groups depending upon their booking BMI category

Group	Category	Number of cases (%)
I	Underweight	380 (9.6)
II	Normal BMI	1959(49.8)
III	Overweight	1470 (37.3)
IV	Obese	127 (3.2)
V	Morbidly obese	4 (0.1)

Table 3 Relationship between the pre-pregnancy variables and BMI categories of the study participants

Age (years)	Age distribution of the study participants in the different BMI groups					Total number (%)
	Group I N=380	Group II N=1959	Group III N=1470	Group IV N=127	Group V N=4	
<18	36	11	2	0	0	49 (1.2)
18–25	32	930	454	24	0	1440 (36.6)
26–35	235	906	844	73	1	2059 (52.2)
>35	77	112	170	30	3	392 (10)
b) Parity of the study participants in the different BMI groups						
Primigravida	152	1194	817	41	2	2206 (56)
Multigravida	228	765	653	86	2	1734 (44)

Majority of our study participants, i.e. 99.8% were married. Most of the women belonged to rural areas, i.e. 2421 (61.4%), while only 1519 (38.6%) were from urban areas. A large percentage of our study population (79%) had at least secondary education; however, most of them, i.e. 68% of the women were unemployed. 91.1% of our study participants belonged to a socioeconomic class III and above. Thus a sedentary lifestyle and unhealthy eating habits in women belonging to a higher socioeconomic status was probably responsible for a high incidence of maternal obesity in our study population.

Table 4 shows the summary of statistical analysis of the antenatal complications observed in the different BMI groups of the study population and indicates significantly increased incidence of adverse outcomes in underweight as well as overweight/obese mothers. The incidence of pre-eclampsia and gestational hypertension in the study population was 6.7% and 7.2%, respectively. The highest risk of these two conditions was found in morbidly obese women (Group V). Obese women had a higher incidence of maternal complications like eclampsia (3.9%), gestational diabetes mellitus (90%) in comparison with the normal weight

and underweight mothers. Maternal anaemia (32.1%) and intrauterine growth restriction (44.5%) were found to be significantly high amongst the underweight mothers (Group I) in comparison with those belonging to the other BMI groups. On the other hand macrosomia was found in a significantly higher incidence in obese (3.1%) and morbidly obese women (25%). Antepartum haemorrhage and placental abruption was observed in a higher percentage (8.9%, 7.7%) in overweight women (Group III). Obese (9.4%) and morbidly obese women (50%) had an increased incidence of malpresentation in the present study. A higher incidence of intrauterine foetal demise was observed in underweight (6.6%), obese and morbidly obese women (16.5%, 25%) as compared to women with a normal BMI.

As seen in Table 5, higher Caesarean rates were observed in the obese mothers (42.5%) as compared to the normal weight mothers, with a 100% Caesarean rate amongst the morbidly obese mothers. A higher incidence of emergency Caesarean Sects. (65%) as compared to elective Caesarean sections (35%) was found across all the BMI groups in the present study.

Table 4 Antenatal complications observed in the different BMI groups of the study participants

Complications	Group I N=380 (9.6%)	Group II N=1959 (49.8%)	Group III N=1470 (37.3%)	Group IV N=127 (3.2%)	Group V N=4 (0.1%)	Total (%)	p value
Pre-eclampsia	5 (1.3)	35 (1.8)	158 (10.7)	68 (5.4)	1 (25)	267 (6.7)	0.0000
Gestational Hypertension	0	56 (2.8)	146 (9.9)	82 (64.6)	3 (75)	287 (7.2)	
Eclampsia	0	2 (0.1)	12 (0.8)	5 (3.9)	0	19 (0.5)	
Gestational Diabetes Mellitus (GDM)	0	3 (0.1)	386 (26.2)	114 (90)	3 (75)	506 (13)	
Anemia	122 (32.1)	83 (4.2)	50 (3.4)	5 (3.9)	0	260 (6.3)	
Antepartum Haemorrhage (APH)	7 (1.8%)	0	132 (8.9)	4 (3.1)	0	143 (3.6)	
Placental Abruption	7 (1.8)	42 (2.1)	114(7.7)	9 (7)	0	172 (4.4)	
Malpresentation	14 (3.7)	36 (1.8)	93 (6.3)	12 (9.4)	2 (50)	157 (4)	
Intrauterine Growth Restriction (IUGR)	169 (44.5)	136 (6.9)	100 (6.8)	5 (3.9)	0	410 (12.7)	
Macrosomia	0	0	2 (0.1)	4 (3.1)	1 (25)	7	
IUFD	25(6.6)	24(1.2)	42 (2.8)	21 (16.5)	1 (25)	113 (3)	

Table 5 Intra-partum variables and complications in different BMI groups of the study participants

Variables	Group I N=380 (9.6%)	Group II N=1959 (49.8%)	Group III N=1470 (37.3%)	Group IV N=127 (3.2%)	Group V N=4 (0.1%)	Total N=3940	p value
Vaginal Delivery	198 (52.1%)	1345 (68.7%)	1064 (72.4%)	73 (57.5%)	0	2680 (68)	0.0000
Spontaneous labour	152 (77%)	1149 (85%)	854 (80%)	58 (79%)	0	2213 (83)	
Induced labour	46 (23%)	196 (15%)	210 (20%)	15 (21%)	0	467 (17)	
Caesarean delivery	182 (47.9%)	614 (31.3%)	406 (28%)	54 (42.5%)	4 (100%)	1260 (32)	
Elective	75 (41%)	220 (36%)	120 (30%)	18 (33%)	2 (50%)	435 (35)	
Emergency	107 (59%)	394 (64%)	286 (70%)	36 (67%)	2 (50%)	825 (65)	

As observed in Table 5, a higher percentage of underweight and overweight/obese mothers had undergone induced labour as compared to normal weight women. Also, the present study showed an increased incidence of instrumental delivery (35.6%) amongst the obese mothers.

There was a significantly higher incidence of preterm labour (16.5%) and pre-labour rupture of membranes, i.e. PROM (3.1%) observed in the obese mothers as compared to the mothers in other BMI groups. Post-datism was found in a higher percentage of obese mothers (4.7%) as compared to those in the other BMI groups; however, it was not a statistically significant finding (*p* value – 0.2449).

Table 6 shows the statistical analysis of the different postpartum complications in our study population. The present study showed a significantly higher occurrence of postpartum haemorrhage (34.7%) and third-/fourth-degree perineal tears (2.9%) in the obese mothers. Puerperal Sepsis was found to be significantly more in the overweight (1.6%), obese (0.9%) and morbidly obese (25%) mothers as compared to those with normal BMI. A higher incidence of wound infection was observed in obese (20.5%) and morbidly obese (50%) mothers.

Discussion

Maternal BMI has shown to significantly influence the pregnancy outcomes throughout the global literature. Out of the 3940 antenatal mothers studied in the present study, it was

observed that only 1959(49.8%) mothers had normal BMI, while the rest of them were either underweight (9.6%) or overweight (37.3%) and obese (3.3%).

Figure 1 shows comparison of the distribution of women according to their pre-pregnancy BMI across different studies conducted in India and different parts of the world. Highest incidence of maternal obesity was observed in studies by Yazdani et al. in Iran [3] (obese—9.8%, morbidly obese—0.6%) and by Kumar et al. in Kerala [4] (obese—9.09%, morbidly obese—3.63%). This difference may probably be secondary to the lifestyle and dietary variations of the study population in these areas.

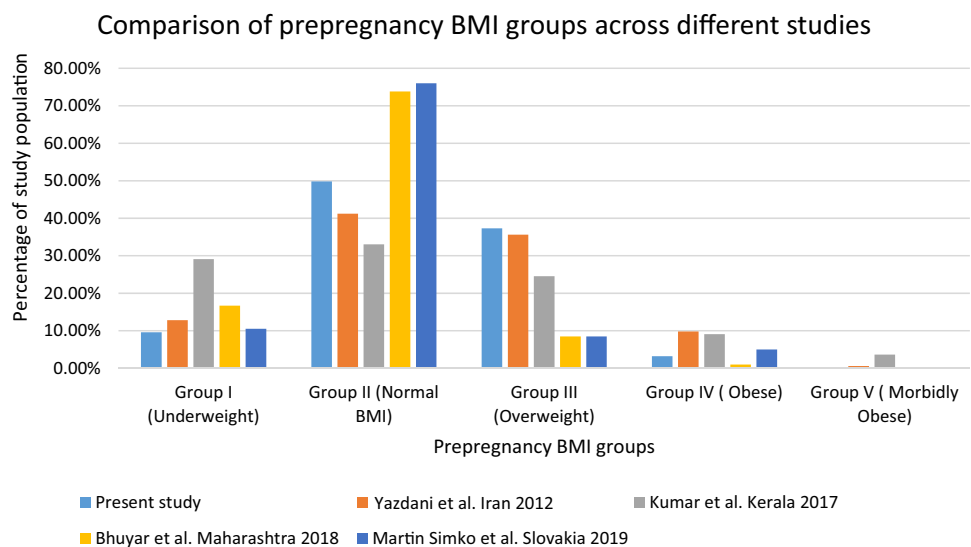
We observed that almost half of our study participants were in the age group of 26–35 years (52.2%) and were primigravidas (56%). Also the study done by Kumar et al. showed majority of the overweight and obese mothers was in the age group of 21–30 years. [4] Bhuyar et al. also found that majority of the study population was in the age group of 25–34 years (51%). [5] Bhuyar et al. also demonstrated that most of the study participants were primigravidas in all the BMI groups, except in the obese group which was a similar finding noted in the present study. [5]

The present study showed that the incidence of pre-eclampsia and gestational hypertension in the study population was significantly higher in the overweight (10.7%, 9.9%) and obese mothers (5.4%, 64.6%). The morbidly obese mothers were most susceptible to these two conditions (25%, 75%). Similar studies showed an increased incidence of pre-eclampsia and gestational hypertension in overweight and

Table 6 Postpartum complications in different BMI groups of the study participants

Complications	Group I N=380 (9.6%)	Group II N=1959 (49.8%)	Group III N=1470 (37.3%)	Group IV N=127 (3.2%)	Group V N=4 (0.1%)	Total (%)	p value
Postpartum Haemorrhage (PPH)	1 (0.3%)	32 (1.6%)	26 (1.8%)	44 (34.7%)	1 (25%)	104 (2.6)	0.0000
Third- and fourth-degree perineal tears	0	3 (0.1%)	7 (0.4%)	5 (2.9%)	0	15 (0.4)	0.0000
Puerperal Sepsis	0	5 (0.2%)	24(1.6%)	14(0.9%)	1 (25%)	44 (1.1)	0.0000
Wound Infection	4 (1%)	12 (0.6%)	44 (3%)	26 (20.5%)	2 (50%)	88 (2.2)	0.0000

Fig. 1 Comparison of distribution of women according to their pre-pregnancy BMI across different studies



obese women. [3–6] Gestational diabetes mellitus was the most common complication observed amongst the obese (90%) and morbidly obese mothers (75%). Kumar et al. showed an increased incidence of gestational diabetes mellitus (7.4%) in overweight women, whereas Martin Simko et al. demonstrated that only 8.6% of the obese women had GDM. The overall incidence of GDM in our study population was high (13%) with almost 90% of the obese mothers developing GDM. This may probably be associated with the lifestyle and diet of our population in Goa.

The underweight mothers in the present study were found to have a significantly higher incidence of maternal anaemia (32.1%) and intrauterine growth restriction (44.5%) in comparison with the other BMI groups. In contrast, macrosomia was more common in obese (3.1%) and morbidly obese mothers (25%). Similar findings were also seen in other studies [4, 5] except the one by Martin Simko, wherein an increased incidence of IUGR in obese women (3.9%) was observed in comparison with underweight women (1.8%). However, a higher incidence of macrosomia was noted in obese women (9.6%) as compared to the other BMI groups, similar to the present study. [6] The increased incidence of IUGR in the obese women may probably be secondary to a higher incidence of pre-eclampsia found in the obese women in the above study (10.9%) as compared to our study (5.4%).

The present study showed that a significantly higher percentage of overweight women developed antepartum haemorrhage (8.9%) and placental abruption (7.7%) during the course of their pregnancy. Bhuyar et al. observed a higher incidence of antepartum haemorrhage in morbidly obese mothers as compared to others. [5] The higher incidence of pre-eclampsia and placental abruption noted with increased maternal BMI may be responsible for the increased incidence of antepartum haemorrhage in the overweight mothers in our study.

Malpresentation was more commonly observed in obese (9.4%) and morbidly obese mothers (50%) in the present study. As most of the mothers in the obese and morbidly obese group were multigravidas and had an increased incidence of prematurity, a higher incidence of malpresentation was probably found in these groups of women.

In the present study, the incidence of intrauterine foetal demise was found to be significantly higher in mothers with both the extremes of BMI, i.e. underweight (6.6%) as well as obese (16.5%) and morbidly obese mothers (25%), in comparison with mothers with a normal BMI. This finding is probably due to increased incidence of antenatal complications observed in both underweight as well as obese women.

The Caesarean rate of our study population was found to be 32% in the present study. A significantly higher Caesarean rate was observed in the obese mothers, with all the four morbidly obese mothers undergoing a Caesarean delivery. This is because of higher incidence of antenatal complications like pre-eclampsia, gestational diabetes mellitus, macrosomia, antepartum haemorrhage, placental abruption, and malpresentation in these women. These complications may also be responsible for the higher incidence of emergency Caesareans (65%) as compared to elective Caesareans (35%) observed in our study population. Similar studies done in different parts of the world also showed increased incidence of Caesarean sections in obese women. [3–6]

In the present study, a large percentage of underweight (23%) and overweight/obese mothers (20% and 21%, respectively) had undergone induced labour as compared to the mothers in the normal BMI group. This observation is also secondary to the several adverse maternal complications observed in underweight as well as overweight/ obese women. Yazdani et al. [3] (40.9%) and Bhuyar et al. [5] (25.5%) also showed increased incidence of induced labour in the obese mothers.

The present study showed a significantly higher incidence of preterm labour (16.5%) and prelabour rupture of membranes, i.e. PROM (3.1%) in obese mothers compared to the others. Post-dated pregnancy was also commonly observed amongst the obese mothers (4.7%) but was not a statistically significant finding. Similar findings were also found in the other comparative studies. [3, 5]

A significantly higher incidence of postpartum complications like postpartum haemorrhage (34.7%) and third-/fourth-degree perineal tears (2.9%) was noted in the obese mothers in the present study. This is probably because of increased incidence of macrosomia, need for operative/instrumental delivery and other antenatal complications like pre-eclampsia and placental abruption observed in the obese mothers. Bhuyar et al. also found an increased incidence of PPH in the overweight (7.7%) as well as underweight mothers (7.8%). [5] This may probably be because of increased incidence of anaemia in underweight mothers making them high risk for PPH.

In the present study, we found a higher incidence of wound infection in the postnatal/post-operative obese (20.5%) and morbidly obese (50%) mothers which was also observed in the other studies. [3, 5] Kumar et al. also showed increased incidence of postnatal complications like PPH, perineal tears and wound infection in overweight and obese women. [4]

Conclusion

Thus, after a comprehensive analysis of the effects of maternal BMI on the pregnancy outcomes in the present study, we can conclude that extremes of BMI have significant adverse effects on the obstetric outcomes. Underweight mothers developed an increased incidence of anaemia and IUGR, whereas overweight and obese mothers had increased incidence of pre-eclampsia, gestational hypertension, eclampsia, GDM, macrosomia, APH, malpresentation, higher Caesarean rates and need for operative interventions. The incidence of postpartum complications like PPH, perineal injuries, wound infection and puerperal sepsis was more common amongst the overweight and obese mothers. Thus, it is absolutely essential to inculcate pre-conceptional clinics for counselling women on a healthy diet and lifestyle and importance of regular exercise and educating them regarding adequate weight gain in pregnancy, in our routine obstetric and gynaecological practice so as to reduce the risk of maternal complications associated with the extremes of BMI and hence improve the maternal health of our population.

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Declarations

Conflict of interest No conflict of interest in amongst the authors.

Ethics approval Institutional Ethical committee approval was obtained prior to commencement of the study.

Informal consent Informed consent was obtained from all the participants included in the study.

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