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Research Article

Effect of Increased Maternal Body Mass Index on Obstetrical and Pregnancy Outcome

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A B S T R A C T

Introduction: Pregnancy is a normal physiological process among normal-weight women but weight gain beyond normal during pregnancy is a major risk factor to affect the pregnancy and its outcome adversely.

Material and Method: A cross-sectional study was conducted in an antenatal care unit of a selected hospital in Gujrat from August 2023 to May 2024 in order to assess the maternal body mass index (BMI) at 20/24 weeks of gestation and compare the obstetrical and pregnancy outcomes between women having normal weight and women with raised BMI. 350 pregnant women with varying BMI were studied, having 150 women with normal weight (Group A) and 200 women with raised BMI (Group B) who were further classified into 4 groups according to their BMI. Women in both groups were assessed during their regular antenatal checkups and during delivery for any obstetrical complications and pregnancy outcomes and their results were compared.

Results: A significant difference was revealed in the obstetrical and pregnancy outcomes between the two groups. Hypertensive disorders and gestational diabetes mellitus was prevalent in moderate and high risk obese subjects. Maximum number of subjects with normal weight overweight, low-risk obesity and moderate risk obesity had spontaneous vaginal delivery (SVD) as compared to subjects with high risk obese subjects where majority had operative delivery (86.67%) who were preterm(40%), had low mean Apgar sore and had low birth weight (13.33%).

Conclusion: The study concluded that an increase in weight and BMI needs to be addressed during the prenatal period in order to have a safe and healthy pregnancy outcome.

Keywords: Body Mass Index (Bmi), Pregnancy, Obstetrical Complications, Pregnancy Outcome, Gestational Hypertension, Gestational Diabetes Mellitus, Antepartum Haemorrhage

Introduction

There are many major health problems affecting the population; obesity is one among them affecting around 35% of the adult population and complicating about 20% of pregnancies.[1]

Obesity has adverse effects on health and healthcare system and a worldwide increase in its prevalence among all age groups including the female reproductive age group and pregnant women has led to an increase in economic burden. During pregnancy, obesity increases the risk of

gestational diabetes mellitus, gestational hypertension and preeclampsia and leads to a higher incidence of operative delivery, delivery of large for gestational age babies and babies with congenital malformations as compared to non-obese women.[2–5]

Due to economic and lifestyle changes, and technological advancement, there is an easy availability of cheap and readymade food which is highly caloric in nature, thus the physical activity required to prepare the food has decreased. People eat and sit, and keep on eating which in turn increases body weight leading to dysregulation of metabolism.

Weight gain in excess during pregnancy makes a woman retain this weight in the postpartum period which again becomes a significant risk factor for obesity in later life of the woman.[6] This obesity affects the foetal environment, foetal health and child's health in later life.[7]

It has been found in many studies that maternal obesity carries a significant risk for both mother and foetus causing diabetes and hypertension in the antepartum period, and increasing the incidence of emergency operative delivery during the intrapartum period. An increase in obesity is directly related to an increase in these risks.[8–10]

Obesity is based on the measurement of body mass index (BMI) of an individual. BMI refers to body weight in kilograms divided by the square of an individual's height in meters. On the basis of BMI, women are classified as overweight when BMI is 25–29.9 kg/m^2, obese class I when BMI is 30–34.9 kg/m^2, obese class II when BMI is 35–39.9 kg/$m^{2\ this}$ is not superscript but squre meter, and obese class III when BMI is > 40 kg/m^{11} BMI is a best available tool to calculate and classify obesity.[12]

Hypertensive disorders, gestational diabetes, and operative delivery are observed to have a strong association with maternal obesity in pregnancy[13,14] which is also linked to having an adverse impact on the foetal period, the neonatal period, and the overall childhood development period. An increase in the incidence of congenital malformation e.g. foetal neural tube defects, too is observed to have a strong association with obesity.[15,16] BMI later in life has shown a direct correlation with birth weight.[17]

Since the risks of pregnancy complications increase due to maternal obesity thus a pregnant woman requires specialised antenatal care, and regular weight, BP, and blood sugar monitoring. It is revealed in some meta-analysis studies that obese women, whether conceived spontaneously or through assisted reproductive technology, have twice more risks of spontaneous abortion and intrauterine foetal deaths than non-obese women. These might be related to the increased risks of hypertensive disorders and gestational diabetes among obese pregnant women. These studies have also indicated the increased risk of complications at the time of labour and delivery as the rate of successful vaginal delivery decreases progressively when the BMI of a woman increases.[18] The success rate of attempted vaginal birth after caesarean (VBAC) is also influenced by maternal obesity.[19]

Many studies have revealed an increased risk of hypertensive disorders of pregnancy due to maternal obesity. A study has shown preeclampsia associated with maternal obesity with an odds ratio (OR) of between 2 and 3.[20] and another study revealed a 2-fold increase in the risk of developing preeclampsia with each increase in BMI of 5 to 7 kg/m^2 and the risk was seen to increases linearly as BMI increases. [21]

The increase in insulin resistance among obese pregnant women might be related to the risk of developing gestational diabetes. Throughout pregnancy, insulin resistance increases progressively due to the continued production of counter-regulatory (anti-insulin) hormones by the growing placenta among these women thus there are increased availability of lipids for foetal growth and development causing large foetal size, and increases the risk of operative delivery.[22] These women also have the risk of getting diabetes in later life, with more than 50% of women with GDM acquiring diabetes within 20 years of delivery.[23] Studies have shown that there is a 4-fold increased risk of perinatal mortality and a 3-fold increased risk of macrosomia in pregnant women having gestational diabetes. It has also been observed that the infants of these women have an increased risk of being obese during their childhood and adulthood and getting type 2 diabetes mellitus.[24]

A theory proposes that obese pregnant women are more likely to experience dysfunctional labour which might be the reason to end up with a caesarean delivery. Denison et al. reported that the higher maternal BMI in the first trimester and a greater increase in BMI throughout pregnancy were found to be associated with decreased chances of spontaneous labour at term and increased risk of post-term pregnancy and risks of complications during the intrapartum period.[25]

Operative delivery carries its own risks which makes an obese woman have an increased risk of intraoperative complications and anaesthetic complications including failed intubation at the time of general endotracheal anaesthesia, increased infectious morbidities and thromboembolic events.[26]

Due to the adverse effects of maternal obesity on women during the antenatal, intranatal and postnatal periods and also on the later life of women and children, this study was done to determine the effect of increased maternal body mass index on obstetrical and pregnancy outcomes.

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Methodology

Three hundred and fifty pregnant women with varying BMI were studied after 20 weeks of gestation in this cross-sectional study, conducted at an antenatal care unit of a selected hospital in Gujrat from August 2023 to May 2024. Ethical approval was obtained from the Ethical Committee of Medical College, Gujrat. The participants were informed about study in detail, their consent was obtained and they were assured of confidentiality. Their height and weight were recorded using th calibrates height scale and weighing machine to estimate BMI using the formula: weight (in kg)/ height (in m^2). According to BMI, women were classified as normal weight when the range of BMI was 18.5–24.9 kg/m^2; overweight when the range was 25.0–29.9 kg/m^2, obese class I when it was 30.0–34.9 kg/m^2, obese class II when it was 35.0–39.9 kg/m^2, and obese class III when it was > 40 kg/m^2.

Women were divided into two groups. 150 pregnant women with normal weight in group A and 200 pregnant women with raised BMI in group B. Pregnant women with raised BMI included 65 overweight women (B_1), 70 low-risk obesity women (B_2), 50 moderate-risk obesity women (B_3) and 15 high-risk obesity women (B_4). Both these groups were assessed during their follow-up visits for obstetric complications like hypertensive disorders, antepartum haemorrhage, gestational diabetes and during labour for induction of labour, mode of delivery, gestational age, mean Apgar score and birth weight and the results of group A were compared with that of group B. Pregnant women with normal gestation having singleton foetuses with no medical co-morbidity or obstetrical complications were included in the study. Subjects with medical and obstetrical complications like early pregnancy bleeding, hypothyroidism, essential hypertension, diabetes, infections, malpresentations, multiple gestations, convulsive disorder, heart diseases, absolute indication for caesarean section or a pre-pregnancy surgery were excluded from the study.

Gestational hypertension was diagnosed as per ACOG guidelines. Women above 20 weeks of gestation who were previously normotensive were assessed to have gestational hypertension when two blood pressure readings taken at intervals of four hours were above 140/90 mmHg.[27] Gestational hypertension with proteinuria or 1 or more relevant end-organ complications was defined as preeclampsia. Gestational hypertension with proteinuria, oedema and associated seizures was defined as eclampsia. Any vaginal bleeding found after 28 weeks of gestation irrespective of its cause was defined as antepartum haemorrhage.

Gestational diabetes was diagnosed as per the recommendations by ADA/ ADPSG (American Diabetic Association/ International Association of Diabetes and Pregnancy Study Group). All non-diabetic pregnant women were exposed to an oral glucose challenge test (OGCT) using a glucose solution made from 50 g of glucose dissolved in 250 to 300 mL of water. If after one hour, the blood sugar result shows < 140 mg/dL, the women were asked to have an oral glucose tolerance test (OGTT). For this OGTT test, 75 g of glucose solution (made from 75 g of glucose dissolved in 250 to 300ml of water) was given to women after eight hours of fasting. If at least one abnormal value (≥ 95,180 and 155 mg/dL for fasting, one-hour and two-hour plasma glucose concentration, respectively) was observed, the woman was diagnosed to have gestational diabetes mellitus.[28]

Other complications were observed from history, direct observation/ assessment and by assessing records. Data collected from both groups was compared and analysed using a computerised calculator.

Results

A total of 350 subjects were included in the study, among whom 150 (42.86%) had normal weight, and 200 (57.14%) had raised BMI [18.57% were overweight and 38.57% were obese (20% low-risk obese; 14.28% moderate-risk obese; and 4.28% high-risk obese)]. BMI was the baseline variable (Table 1).

The data presented in Table 1 indicates the mean BMI of pregnant women with normal weight and women with raised BMI. It was 23.5 ± 2.0 in women of normal weight (Group A), 27.61 ± 0.38 in overweight women, 32.9 ± 1.6 in low-risk obese women, 36.4 ± 0.28 in moderate-risk obese women and 41.2 ± 0.65 in high-risk obese women.

Table 2 presents a comparison of obstetrical complications between two groups, such as hypertensive disorders (e.g. pregnancy-induced hypertension (PIH), preeclampsia, eclampsia); antepartum haemorrhage (APH) and gestational diabetes mellitus (GDM).

Results (Table 2) of this study show that hypertensive disorders like PIH were prevalent in moderate- and high-risk obese subjects (58.00% and 46.67%, respectively); pre-eclampsia was observed in 26.67% of high-risk and 20% of moderate-risk obese subjects. Eclampsia was observed only in 13.33% of high-risk obese subjects and 2% of moderate-risk obese subjects ($p < 0.01$). APH was not found in any subject except one case each from low-risk obesity (1.43%) and high-risk obesity (6.67%). A maximum number of subjects with high-risk obesity (73.33%) and moderate-risk obesity (62.00%) were found to develop GDM in this study ($p < 0.01$).

Table 3 presents a comparison of pregnancy outcomes between the two groups. These include induction of labour, mode of delivery, gestational age, mean Apgar score and birth weight.

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Table 1.Mean Values of Baseline Variable (BMI) of Pregnant Women with Normal Weight and Women with Raised BMI

N = 350

Baseline Variable: Body Mass Index (BMI)	Group A: Normal Weight n = 150	Group B			
		Group B1: Overweight n = 65	Group B2: Low-Risk Obese n = 70	Group B3: Moderate-Risk Obese n = 50	Group B4: High-Risk Obese n = 15
No (%) of subjects	150 (42.86)	65 (18.57)	70 (20.00)	50 (14.28)	15 (4.28)
Normal BMI (kg/m^2) ranges	18.5–24.9	25.0–29.9	30.0–34.9	35.0–39.9	≥ 40.0
Mean ± SD	23.50 ± 2.00	27.61 ± 0.38	32.90 ± 1.60	36.40 ± 0.28	41.20 ± 0.65

BMI=Body mass index; kg=kilogram; m2=square meter; SD= Standard deviation

Table 2.Comparison of Obstetrical Complications between Two Groups

N = 350

Obstetrical Complications	Group A: Normal Weight n = 150 n (%)	Group B				Chi-Square df	p Value
		Group B1: Overweight n = 65 n (%)	Group B2: Low-Risk Obese n = 70 n (%)	Group B3: Moderate-Risk Obese n = 50 n (%)	Group B4: High-Risk Obese n = 15 n (%)		
Hypertensive disorders -PIH -Preeclampsia -Eclampsia -Absent	3 (2.00) 1 (0.67) 0 (0.00) 146 (97.33)	5 (7.70) 0 (0.00) 0 (0.00) 60 (92.30)	15 (21.43) 3 (4.29) 0 (0.00) 52 (74.28)	2 (58.00) 10 (20.00) 1 (2.00) 10 (20.00)	27 (46.67) 4 (26.67) 2 (13.33) 2 (13.33)	195.580 df-12	0.00*
APH -Yes -No	0 (0.00) 150 (100.00)	0 (0.00) 65 (100.00)	1 (1.43) 69 (98.57)	0 (0.00) 50 (100.00)	1 (6.67) 14 (93.33)	2.395 df-4	0.66
GDM -Present -Absent	5 (3.33) 145 (96.67)	5 (7.70) 60 (92.30)	10 (14.29) 60 (85.71)	31 (62.00) 19 (38.00)	11 (73.33) 4 (26.67)	125.830 df-4	0.00*

*Significant at 0.01; PIH= Pregnancy induced hypertension; APH= Antepartum haemorrhage; GDM= Gestational diabetes mellitus

Table 3.Comparison of Pregnancy Outcomes between Two Groups

N = 350

Pregnancy Outcome	Group A: Normal Weight n = 150 n (%)	Group B				Chi-Square df	p Value
		Group B1: Overweight n = 65 n (%)	Group B2: Low-Risk Obese n = 70 n (%)	Group B3: Moderate-Risk Obese n = 50 n (%)	Group B4: High-Risk Obese n = 15 n (%)		
Labour induction -Yes -No	80 (53.33) 70 (46.67)	35 (53.85) 30 (46.15)	10 (14.29) 60 (85.71)	5 (10.00) 45 (90.00)	3 (20.00) 12 (80.00)	57.306 df-4	0.00*

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Mode of delivery -SVD -Operative	130 (86.67) 20 (13.33)	45 (69.23) 20 (30.77)	48 (68.57) 22 (31.43)	37 (74.00) 13 (26.00)	2 (13.33) 13 (86.67)	43.864 df-4	0.00*
Gestational age -Full term -Preterm	146 (97.33) 4 (2.67)	62 (95.38) 3 (4.62)	66 (94.29) 4 (5.71)	4 (88.00) 6 (12.00)	9 (60.00) 6 (40.00)	33.915 df-4	0.00*
Mean Apgar score -Normal: 7–10 -Low: 4–6 Very low: < 4	146 (97.33) 4 (2.67) 0 (0.00)	62 (95.38) 3 (4.62) 0 (0.00)	62 (88.57) 8 (11.43) 0 (0.00)	44 (88.00) 5 (10.00) 1 (2.00)	10 (66.67) 3 (20.00) 2 (13.33)	53.009 df-8	0.00*
Birth weight (kg) -Normal: ≥ 2.5 -Low: 1.5–2.5 Very low: < 1.5	148 (98.67) 2 (1.33) 0 (0.00)	63 (96.92) 2 (3.08) 0 (0.00)	66 (94.29) 4 (5.71) 0 (0.00)	45 (90.00) 4 (8.00) 1 (2.00)	11 (73.34) 2 (13.33) 2 (13.33)	63.215 df-8	0.00*

*Significant at 0.01, SVD: Spontaneous Vaginal Delivery

Regarding pregnancy outcomes (Table 3), it is indicated in the study that labour was induced in about 50% of subjects with normal weight (53.33%) and overweight subjects (53.85%) as compared to obese subjects where labour was induced in about 10–20% ($p < 0.01$). With regard to the mode of delivery, the maximum number of subjects with normal weight (86.67%), overweight (69.23%), low-risk obesity (68.57%), and moderate-risk obesity (74.00%) had a spontaneous vaginal delivery (SVD) as compared to high-risk obese subjects where the majority had operative delivery (86.67%) ($p < 0.01$).

With regard to gestational age, the majority of all the subjects delivered full-term babies (normal weight: 97.33%, overweight: 95.38%, low-risk obese: 94.29%, moderate-risk obese: 88.00%, and high-risk obese: 60.00%) but 40% of high-risk obese subjects delivered preterm babies, which was comparatively higher in number ($p < 0.01$).

Normal mean Apgar score (7–10) was found in the majority of all the subjects (normal weight: 97.33%; overweight: 95.38%; low-risk obese: 88.57%; moderate risk obese: 88%) and in high-risk obese subjects, it was towards the higher side (66.67%). However, among high-risk obese subjects, 20% low mean Apgar score (4–6) and 13.33% had a very low mean Apgar score (< 4; $p < 0.01$).

The majority of all the subjects had shown normal birth weight (≥ 2.5 kg) (normal weight: 98.67%, overweight: 96.92%, low risk obese: 94.29%, moderate risk obese: 90.00%, and in high-risk obese: (73.34%) but an equal number of high-risk obese subjects (13.33%) had given birth to low birth weight (1.5 kg–2.5 kg) and very low birth weight babies (< 1.5 kg) ($p < 0.01$).

Discussion

The study was conducted to explore the impact of various degrees of maternal body mass index on obstetrical and pregnancy outcomes of 350 subjects. In this study, 57.14% were with raised BMI where 18.57% were overweight and 38.57% were obese. In a meta-analysis, 14 studies were observed where 12 studies (85.71%) reported maternal obesity which was higher (85.71%) than reported in the present study (38.57%).[29] The present study findings are consistent with the findings of Ali and Lakhani where 29.1% of pregnant women were obese.[30]

Hypertensive disorders like PIH, pre-eclampsia and eclampsia were prevalent in obese subjects and no subjects among the overweight and normal groups reported it. The risk of pre-eclampsia was reported higher among obese women compared to overweight and normal-weight women as reported in various studies.[30–33]

In this study, obese women have depicted a high prevalence of hypertension and diabetes as compared to normal-weight subjects, whereas the percentage of antepartum haemorrhage among obese subjects, in spite of being less in number, was towards the higher side. Similar findings were reported by other studies.[30,34–37] The OR of developing GDM was reported as 2.14 (95% CI, 1.82–2.53), 3.56 (95% CI, 3.05–4.21), and 8.56 (95% CI, 5.07–16.04) among overweight (BMI 25-30 kg/m^2), obese (BMI > 30 kg/m^2),

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and severely obese women (BMI > 40 kg/m^2), respectively as evident from meta-analysis of 20 studies.[38]

This study has reported that obese women had undergone caesarean sections, and had delivered preterm and low birth weight babies with low mean Apgar scores, and this trend was on the higher side than reported among overweight and normal weight subjects, but the percentage of induction of labour was only 10–20% in obese subjects. Decrease or failure in cervical dilatation rate and increase of soft tissue in the maternal pelvis can cause cephalopelvic disproportion (CPD) and obstructed labour thus increasing the chances of operative delivery.[39]

Vahratian et al. found that as the BMI increases in nulliparous women, the rate of cervical dilation in spontaneous labour decreases.[40] They found that the median duration for the cervix to dilate from 4 to 10 cm among obese women (BMI > 29.0 kg/m^2) was 6.98 hours which was comparatively more than normal-weight women (BMI 19.8–26.0 kg/m^2) where median duration was 5.43 hours. They reported almost the same findings among women undergoing induction of labour at term.

Nuthalapaty et al. also reported that an increase in maternal weight was directly associated with a decreased rate of cervical dilation and an increase in the duration of labour among both nulliparous as well as multiparous women who otherwise progress faster during induced labour than nulliparous women.[41]

The risk of caesarean delivery increased by more than 50% in obese women as compared to normal-weight women. [46] Obesity is found to carry a higher risk of induced labour and caesarean section as compared to normal-weight women.[31,42–45]

Obese women are seen to face a higher risk of complications at the time of labour and delivery. As maternal BMI increases, the rate of successful vaginal delivery decreases progressively. Results of a meta-analysis of 33 studies showed that the ORs of caesarean delivery were 1.46 (95% CI, 1.34–1.60), 2.05 (95% CI, 1.86–2.27), and 2.89 (95% CI, 2.28–3.79) among overweight, obese, and severely obese women, respectively, as compared with normal weight pregnant women.[44] The results of this study are further endorsed by other studies. [8,37,43,46]

Conclusions

Maternal obesity, even if getting adequate antenatal care, is associated with increased adverse effects on pregnancy and perinatal outcomes. The investigator has observed an increased percentage of operative delivery, antepartum haemorrhage, gestational hypertension, and gestational diabetes mellitus which increases the risk of delivering a baby before term, with low birth weight and low Apgar score. Thus there are increased risks of neonatal and postnatal morbidities like postpartum haemorrhage, puerperal infection and anaemia. Maternal obesity also affects the health of the child by increasing the risk of childhood obesity and diabetes, thus has major public health implications. Thus there is a need for lifestyle modification, preconception and prenatal counselling, weight, BP and blood sugar monitoring, regular antenatal follow-ups and hospital delivery in order to control the weight gain and minimise the associated complications.

Obstetricians are in a key position to prevent and treat obese women by having routine oral glucose tolerance tests for all women weighing more than normal. They should perform OGTT for all obese and overweight women to screen for gestational diabetes. They need to counsel all pregnant mothers routinely about weight control, though the significant effect of prenatal counselling on the incidence of obesity, is believed to be only in 35% of cases.[47]

Appropriate policies and guidelines should be made and followed for special antenatal care to all obese women by considering them a high-risk group which is anticipated from the results of this study.

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