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First Trimester Maternal Body Mass Index and Gestational Weight Gain and Their Association with Feto-Maternal Outcomes

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ABSTRACT

Introduction: Women of reproductive age have also been impacted by the significant rise in the prevalence of obesity. A significant predictor of poor outcomes for the health of the mother and the newborn is excessive gestational weight increase. The study was conducted with an objective to study first trimester maternal Body Mass Index and gestational weight gain and their association with maternal and perinatal outcomes.

Methodology: This was a prospective observational clinical study conducted in 196 primigravida patients presenting in a tertiary care hospital in central India. BMI of women were recorded during the first trimester and followed up to assesses gestational weight gain. Early pregnancy BMI and gestational weight gain were compared with various feto maternal outcome.

Results: The mean of First trimester BMI was 21.3 kg/m^2. In Overweight category, 65.2% had high weight gain (WG) while in obese, 26.1% had High WG. Type of delivery and NICU admission rate significantly differ in BMI categories ($p < 0.05$). LSCS rate were higher in overweight and obese category. Preterm babies and post-partum hemorrhage were higher in higher WG categories; however, the difference was non-significant ($p > 0.05$).

Conclusion: This study conclude that First trimester underweights and overweight/obesity is associated with higher antenatal, intra-natal and postnatal complications as well as neonatal complications. Caesarian rate and instrumental deliver are also common in First trimester overweight and obese women. Preeclampsia is associated with extreme of First trimester BMI.

INTRODUCTION

From a medical as well as a social perspective, the obesity epidemic has spread across the globe. The World Health Organization (WHO) has identified obesity as one of the most urgent global health challenges of the twenty-first century as a result of the alarming rise in obesity globally.[1] Today, obesity is thought to be the most prevalent metabolic illness and a worldwide epidemic. Obesity is characterized as having too much body fat, which is extremely likely to cause health problems, as well as higher rates of morbidity and mortality.

Women of reproductive age have also been impacted by the significant rise in the prevalence of obesity. Body mass index is the most widely recognized indicator of obesity (BMI). The Institute of Medicine (IOM) categorized body weight in 2009 based on the BMI into four categories: underweight (BMI 18.5 kg/m^2), normal weight (BMI = 18.5-24.9 kg/m^2), overweight (BMI =

25.0-29.9 kg/m^2), and obese (BMI 30 kg/m^2). Obesity is classified into three categories based on BMI: class I, class II, and class III, or morbid obesity, which is defined as BMI 40. At the initial prenatal counselling appointment, a BMI of less than 30 kg/m^2 is considered obese. For expecting moms who are underweight (12.5–18.0 kg), normal weight (11.5–16.0 kg), overweight (7.0–11.5 kg), and obese (5.0–9.0 kg), the IOM suggests a range of safe weight increase.[2] One of the risk variables seen most frequently in obstetric practice is maternal obesity. [3,4]

Numerous experimental and epidemiological research have demonstrated that dietary modifications during the prenatal and postnatal periods of life can significantly affect a child's health and development.[5] Professional scientific societies note that there is a higher prevalence of metabolic problems, neurodevelopmental disorders, cancer, and unfavorable changes in an individual's immune system as a result of obesity during pregnancy, in the postnatal period, and in adulthood.[6] In affluent nations, the majority of women of reproductive age are overweight or obese before having children. Growing numbers of pregnant mothers who are fat endanger the health of their unborn infants.

According to the WHO, the percentage of pregnant women who are obese ranges from 1.8% to 25.3%.[1] More over 30% of pregnant women in the majority of European countries are obesity, according to the European Perinatal Health Report.[7] Between 30% and 50% of women are overweight or obese, with prevalence rates of less than 30% in Croatia, Austria, and Slovenia and approximately 50% in the UK. Some EU nations, such as Slovakia, do not consistently add to the Euro-Peristat network's database of BMI information on maternal body weight. Consequently, there are gaps in the literature about maternal obesity in various European nations.

Pregnancy complications such as the risk of miscarriage, foetal and congenital anomalies, thromboembolism, preeclampsia and gestational hypertension, foetal macrosomia, gestational diabetes mellitus, IUGR (intrauterine growth restriction), stillbirth, as well as intrapartum, postpartum complications, and neonatal mortality are all associated with being obese during pregnancy.[8] In comparison to women with a normal BMI, there are more caesarean sections performed on obese women[9] and fewer lactating mothers[10]. Maternal mortality risk factors include obesity. [11]

A significant predictor of poor outcomes for the health of the mother and the newborn is gestational weight increase. Preterm birth and the delivery of an infant with a low birth weight are more likely when weight gain is insufficient, whereas gestational hypertension, preterm birth, the delivery of an infant with a high birth weight, and caesarean delivery are more likely when weight gain is excessive.[12]

The study was conducted with an objective to study first trimester maternal Body Mass Index and gestational weight gain and their association with maternal and perinatal outcomes.

METHODOLOGY

This was a prospective observational clinical study conducted in patients presenting to OPD of obstetrics department of a tertiary care hospital in central India from June 2021 to Dec 2022.

The study was conducted among primigravida women visiting obstetrics OPD of our hospital during their first trimester pregnancy was comprise of my study population.

Eligibility criteria: Pregnant women with primigravida singleton pregnancy coming in first trimester for antenatal checkup in out patient's department were considered for inclusion in the study. Pregnant women with pre-existing medical conditions like diabetes, chronic hypertension, heart disease, hypothyroidism or multifetal pregnancy were excluded from the study.

Sample size: According to research conducted by KK Lee et al [11] which found small for gestational age babies in 23.5% maternal underweight cases, this study the estimated sample size calculated by formula $n = (Z_{\propto} + Z_{\beta})^2 \ (p_1q_1 + p_2q_2) / (p_2 - p_1)^2$, where P_1 is proportion of small for gestational age babies in underweight 23.5%, q_1 is 100-p_1, P_2 – proportion of small for gestational age babies in others 9.2%, q_2 is 100- p_2, Z_{α} -1.96 (type 1 error) and Z_{β} -1.037(type 2 error with 80 % power). The calculated sample size was 196.

Study Procedure: This was a prospective observational clinical study. All the consecutive pregnant women were screened for inclusion and exclusion criteria. Those eligible were considered for inclusion in the study. Detailed history was taken from patient. Clinical examination was done. Data about first trimester BMI was calculated according to the formula weight in kilograms height in meter and these measurements was taken when patient comes in OPD in first trimester for the checkup. Weight of the patient was taken on digital weight machine and height by stadiometer BMI was calculated by formula BMI = Weight in Kg / Height in meter^2

The weight machine was calibrated every weekly. As per revised values by the Health Ministry of India, 2009 BMI is classified as- a) Underweight BMI <18.5, b) Normal BMI: 18.5-24.9, c) Overweight BMI: 25-29.9, and d) Obese BMI: 30 and above. Thus, women were classified into underweight, normal, overweight, obese BMI groups.

Gestational weight gain was calculated from first trimester to time of delivery. Normal gestational weight gain is categorized as **per IOM guidelines**

Pre pregnancy BMI category	Lower weight gain	Recommended weight gain	Higher weight gain
Underweight	<12.5 kg	12.5-18 kg	>18 kg
Normal weight	<11.5kg	11.5-16 kg	>16 kg
Overweight	<7 kg	7-11.5 kg	>11.5 kg
Obese women	<5 kg	5-9 kg	>9 kg

Maternal Outcome of the study was calculated in terms of perinatal complications and mode of delivery. Fetal outcome was calculated in terms of birth weight and NICU admission. The weight of a newborn baby was taken immediately after birth on baby weight machine, which was calibrated every weekly.

Neonates were classified as a) Small - if the birth weight was below 10 percentiles, b) Normal - if the birth weight was between 10% and 90 percentiles, c) large - if it was above the 90% percentile. Low birth weight and macrosomia was defined as weight at birth of <2500grams and >4000grams.

Statistical Methods: Throughout the study, data was evaluated using the proper statistical techniques, including frequency, percentage, mean, standard deviation (SD), chi-square test, and "t" test.

Before the study began, the "Institutional Ethics Committee" approval was requested. I described to the potential volunteers the nature and goal of the study in terms they could comprehend. We requested written informed permission from the patient. Participant confidentiality and anonymity were upheld at all times.

RESULTS

Table 1 shows various study parameters among the 196 patients included in the study. Out of total 196 cases, 82 (41.8%) were belong to 25-29 years followed by 77 (39.3%) were belong to 20-24 years. The mean height of the study participants was 151.4 cm. The mean of First trimester weight was 50.2 kg. The mean of First trimester BMI was 21.3 kg/m^2.

As shown in table 2, out of total 35 cases in underweight category, 20 (57.1%) were found LWG, 14 (40%) were found NWG and 1 (2.9%) were found HWG. In normal category out of 72 cases, 23 (31.9%) were found LWG, 41 (56.9%) were found NWG and 8 (11.1%) were found HWG. In Overweight category out of 66 cases, 2 (3%) were found LWG, 21 (31.8%) were found NWG and 43 (65.2%) were found HWG. In Obese category out of 23 cases, 1 (4.3%) were found LWG, 16 (69.6%) were found NWG and 6 (26.1%) were found HWG.

Table 3 shows maternal and perinatal outcome according to first trimester BMI. Type of delivery and NICU admission rate significantly differ in BMI categories. In underweight category, 7 (20%) were found LSCS and 1 (2.9%) were Instrumental delivery. In normal category, 18 (25%) were found LSCS and 3 (4.2%) were found Instrumental delivery. In Overweight category, 26 (39.4%) were found LSCS and 6 (9.1%) were found Instrumental delivery. In Obese category, 11 (47.8%) were found LSCS and 2 (8.7%) were found Instrumental delivery.

Table 1: Study parmeters among the patients included in the study (n=196)

Study Variables	Cases (%)
Maternal age (years):	
< 20	24 (12.2%)
20–24	77 (39.3%)
25–29	82 (41.8%)
30–34	12 (6.1%)
> =35	1 (0.5%)
Height (cm) (mean ± SD)	151.4 ± 4.6
Pre-pregnancy weight (kg) (m ± SD)	50.2 ± 9.1
Pre-pregy BMI (kg/m2) (m ± SD)	21.3 ± 3.5
Underweight (<18.5 kg/m2)	35 (17.9%)
Normal (<18.5-24.9 kg/m2)	72 (36.7%)
Overweight (25.0-29.9 kg/m2)	66 (33.7%)
Obese (>=30.0 kg/m2)	23 (11.7%)
Gestational weight gain (GWG)*	10.2 ± 6.0
Lower weight gain	46 (23.5%)
Normal weight gain	92 (46.9%
Higher weight gain	58 (29.6%)
Gestational age at delivery (weeks)*	39.2 ± 2.6

Table 2: Gestational weight gain according to First trimester BMI category

Gestational weight gain (GWG)	Underweight (n=35) (%)	Normal (n=72) (%)	Overweight (n=66) (%)	Obese (n=23) (%)
Lower weight gain	20 (57.1)	23 (31.9)	2 (3)	1 (4.3)
Normal weight gain	14 (40)	41 (56.9)	21 (31.8)	16 (69.6)
Higher weight gain	1 (2.9)	8 (11.1)	43 (65.2)	6 (26.1)
Total	35 (100)	72 (100)	66 (100)	23 (100)

P value: <0.001

Table 3: Antenatal, intra-natal and post-natal parameters and First trimester BMI

Maternal and Perinatal Outcome	Underweight (n=35) (%)	Normal (n=72) (%)	Overweight (n=66) (%)	Obese (n=23) (%)
Antenatal Complication				
Oligohydramnios	1 (2.9)	2 (2.8)	2 (3)	1 (4.3)
Polyhydramnios	1 (2.9)	3 (4.2)	1 (1.5)	0 (0)
Ante-partum Haemorrhage	0 (0)	1 (1.4)	2 (3)	3 (13)
GDM	2 (5.7)	6 (8.3)	10 (15.2)	5 (21.7)
GHTN	0 (0)	1 (1.4)	4 (6.1)	3 (13)
IUGR	2 (5.7)	2 (2.8)	6 (9.1)	5 (21.7)
Pre-eclampsia	6 (17.1)	4 (5.6)	10 (15.2)	6 (26.1)
Intrapartum & Post Partum Complication				
Preterm (<37 wk) *	11 (31.4)	10 (13.9)	3 (4.5)	2 (8.7)
Post Partum Hemorrhage*	1 (2.9)	2 (2.8)	4 (6.1)	2 (8.7)
Type of Delivery#				
Normal Delivery	27 (77.1)	51 (70.8)	34 (51.5)	10 (43.5)
LSCS	7 (20)	18 (25)	26 (39.4)	11 (47.8)
Instrumental	1 (2.9)	3 (4.2)	6 (9.1)	2 (8.7)
Birth weight*				
Low BW(<2500gm)	3 (8.6)	2 (2.8)	2 (3)	1 (4.3)
Normal BW (2500-4000gm)	32 (91.4)	69 (95.8)	62 (93.9)	20 (87)
Macrosomia (>4000gm)	0 (0)	1 (1.4)	2 (3)	2 (8.7)
NICU Admission#	3 (8.6)	3 (4.2)	7 (10.6)	6 (26.1)

*P value >0.05 (non-significant), #P value < 0.05 (significant)

Table 4: Antenatal, intra-natal and post-natal parameters and gestational weight gain

Maternal and Perinatal Outcome	Lower weight gain (n=46) (%)	Normal weight Gain (n=92) (%)	Higher weight Gain (n=58) (%)
Antenatal Complication			
Oligohydramnios	2 (4.3)	2 (2.2)	2 (3.4)
Polyhydramnios	2 (4.3)	1 (1.1)	2 (3.4)
Antepartum haemorrhage	1 (2.2)	2 (2.2)	3 (5.2)
GDM	1 (2.2)	10 (10.9)	12 (20.7)
GHTN	1 (2.2)	4 (4.3)	3 (5.2)
IUGR	3 (6.5)	4 (4.3)	8 (13.8)
Pre-eclampsia	7 (15.2)	7 (7.6)	12 (20.7)
Intrapartum and post-partum period complications			
Preterm (<37 wk)*	5 (10.9)	11 (12)	10 (17.2)
Post-Partum Haemorrhage*	2 (4.3)	3 (3.3)	4 (6.9)
Type of Delivery*	(0)	(0)	(0)
Normal Delivery	32 (69.6)	61 (66.3)	29 (50)
LSCS	12 (26.1)	28 (30.4)	22 (37.9)
Instrumental	2 (4.3)	3 (3.3)	7 (12.1)
Birth weight*			
Low birth weight (<2500gm)	4 (8.7)	3 (3.3)	1 (1.7)
Normal birth Weight (2500-4000gm)	42 (91.3)	88 (95.7)	53 (91.4)
Macrosomia (>4000gm)	0 (0)	1 (1.1)	4 (6.9)
NICU Admission*	3 (6.5)	9 (9.8)	7 (12.1)

*P value >0.05 (non-significant), #P value < 0.05 (significant)

Table 4 shows maternal and perinatal outcome according to various weight gain categories. Preterm babies and post-partum hemorrhage were higher in higher weight gain categories; however, the difference was statistically non-significant. Type of delivery and birth weight were also not associated with weight gain. NICU admission rate was higher in higher weight gain categories; however, the difference was statistically non-significant.

DISCUSSION

The body mass index (BMI) of pregnant women has risen recently, mirroring an overall rise in the incidence

of obesity.[13] Pregnancy outcomes are adversely affected by high BMI before conception and/or excessive gestational weight gain (GWG), which increases the burden of chronic diseases and jeopardises the health of both the mother and the unborn child.[14]

The present study was conducted among 196 pregnant women to study first trimester maternal Body Mass Index and gestational weight gain and their association with maternal and perinatal outcomes.

In present study, out of total 196 cases, first trimester BMI of 72 (36.7%) were found normal (<18.5-24.9 kg/m^2) followed by 66 (33.7%) were found overweight (25.0-29.9 kg/m^2). 35 (17.9%) were found in underweight (<18.5 kg/m^2) whereas 23 (11.7%) were found Obese (>=30.0 kg/m^2). Sun Y et al (2020) [15], found significant difference in pre-pregnancy BMI of cases. A significant fraction of the pregnant women in the Soltani H et al (2017) [14], cohort of Indonesians from West Sumatra were underweighted (20.1%), whereas the percentages of overweight and obese women ranged from 14.6% to 27.0%, according to international or Asian BMI classification systems, respectively. More over half of all pregnant women in this study had inadequate GWG overall.

In the present study, 15.2% and 21.7% pregnant women developed GDM among the overweight and obese categories respectively while underweight and normal BMI women had GDM complications in 5.7% and 8.3% cases. In terms of maternal problems, a study by Sun Y et al (2020) [15] found that being overweight prior to conception increased the incidence of gestational diabetes mellitus (GDM), which is in line with previous recent findings. [17,18]

Type of delivery and NICU admission rate significantly differ in BMI categories. LSCS and instrumental delivery proportion increases as the BMI increases. In the study by Bhattacharya S et al (2007) [19], LSCS delivery rate increase from 22.6% in underweight category to 61.8% in obese category.

In present study, LBW rate was 8.6%, 2.8%, 3% and 4.3% in underweight, normal BMI, overweight and obese categories respectively. Neonatal outcomes showed significant variations in birth weights and GA (both P <0.001) across the 4 pre-pregnancy BMI groups in the study by Sun Y et al (2020). [15]

Mohapatra J et al [20] discovered that the BMIs of every instance in the LGA group were either obese or overweight. 13 of the 17 women in the LGA group belonged to the GWG, which was above the IOM recommendation. None of the LGA group's female participants belonged to a GWG that fell below IOM guidelines. Every woman in the SGA group had a BMI that was either normal or underweight. Twelve out of the fourteen women in the SGA group were members of the GWG that fell below the IOM recommendation, and none was members of the GWG that rose above the IOM recommendation.

In the study by Sun Y et al (2020) [15], it was found that pregnant women with pre-pregnancy BMIs between 20 and 25 years old did not regulate them to be within the normal range. According to studies [30,31,32], premature or late birth increases the risk of both abnormalities [24,25] and unfavourable pregnancy outcomes. Therefore, it should be encouraged for women in these age categories to maintain a healthy weight before becoming pregnant. In contrast to earlier studies that indicated that these women had an increased risk for such complications, the Bhavadharini B et al [26] study found that normal weight and overweight women gained less weight than was recommended and that this weight gain was associated with a lower risk of caesarean sections and macrosomia. [27] The employment of differing BMI criteria may be the primary cause of this variation.

The delivery style, GDM, and GHp among the 4 First trimester BMI groups varied significantly (all P < 0.001) in the study by Sun Y et al (2020) [15] on mother outcomes.

In the Ramya S et al (2019) [28] study, found a statistically significant rise in the incidence of GHTN in the group with high BMI.

Verma A et al (2012) [29], found non-significant results. Out of 116 cases in underweight group 4(3.4%) were found PPH. In normal group 6 (1.47%) out of 406 cases, in overweight group 2 (1.2%) out of 165 cases were found PPH.

When maternal weight growth was taken into account, Edwards et al [30] and Graham et al [31] discovered that there was no conclusive link between obesity and caesarean delivery. However, according to some reports, obese pregnant women who gain more weight during their pregnancies are more likely to have caesarean sections. [32]

Verma A et al (2012) [29], found significant results in NICU admission. Out of total 116 cases in LWG, 7 (6.03%) were required to NICU admission. In Normal category 19 (4.68%) out of 406 cases, in overweight group 13 (7.87%) out of 165 cases and in obese group 8(9.5%) out of 84 cases were required to NICU admission. (P= 0.03) The neonatal ICU admission rate was higher in the morbidly obese group (25%) and was mostly related to LGA infants and moms with diabetes.

Ramya S et al (2019) [28], found out of 16 cases in underweight group 6 (37.5%) were required to NICU admission. In normal category 3 (8.34%) out of 36 cases, in overweight group 1 (2.63%) out of 38 cases were required to NICU admission.

Hendler et al [33] study investigated the association between pre-pregnancy BMI and spontaneous preterm birth and indicated preterm birth, and they discovered a statistically significant preterm birth rate among both lean and obese pregnant women. No BMI group in the current investigation showed a statistically significant link with preterm births (p=0.86).

CONCLUSION

From this study we conclude that First trimester underweight and overweight/obesity is associated with higher antenatal, intra-natal and postnatal complications as well as neonatal complications. Caesarian rate and instrumental deliver are also common in First trimester overweight and obese women. Though macrosomia is uncommon, it is higher in obese women. NICU admission rate was also higher in extreme of BMI. Gestational weight gain is higher in higher First trimester BMI. Oligohydramnios, polyhydramnios, preterm, post-partum hemorrhage are not associated with First trimester BMI. Gestational diabetes, gestational hypertension and intrauterine growth retardation are associated with higher First trimester BMI, especially overweight and obesity. Preeclampsia is associated with extreme of First trimester BMI.

In clinical practice, this study recommend that women of childbearing age can be advised on the importance of maintaining an optimal BMI when planning to become pregnant. Obstetrician can advise pregnant women to manage and control excessive weight gain during pregnancy in order to reduce the risk of adverse pregnancy outcomes.

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