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Study of body mass index in pregnancy and correlation with feto maternal outcome

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Abstract
Background: Maternal body mass index (BMI) is one of the most important predictors of nutritional status of pregnant women, it can have a significant impact on outcome of pregnancy.
Aims and Objectives: This study is to evaluate maternal body mass index and its impact on obstetric outcome like (Miscarriage, gestational diabetes mellitus, gestational hypertension, pre-eclampsia, eclampsia, anemia, hypothyroidism, preterm delivery, mode of delivery, post-partum complications).
And neonatal outcomes studied were (birth weight, APGAR at 1 minute and 5 minute, admission to neonatal intensive care unit NICU, stillbirth)
Method: This study includes patients from urban, semi-urban as well as nearby rural areas. This is a prospective observational study of 100 pregnant patients who came to antenatal OPD, in their 1st trimester, in the Department of Obstetrics and Gynecology, at Tertiary care Hospital in Ahmedabad, Western India between March 2024 to February 2025.
Conclusion: We conclude that BMI plays a major role in maternal and perinatal outcomes and both low BMI and high BMI had significant maternal and perinatal outcomes. Women in the underweight BMI group during antenatal suffer from anemia, preterm delivery, IUGR and low birth weight babies. In overweight BMI group, there is an increased incidence of maternal and fetal problems during antenatal period, during labor and postpartum period. Patients suffered from complications like PIH, GDM, PROM and IUGR. There is increased incidence of induction of labor and LSCS.

Keywords: Body mass index, complication during pregnancy, obesity, pregnancy, Underweight, Over weight

Introduction

Maternal body mass index (BMI) is one of the most important predictors of nutritional status of pregnant women. Both nutritional intake and maternal weight are modifiable factors which can influence pregnancy outcome. Either underweight or overweight, both can have a significant impact on outcome of pregnancy [1].

Most of the developing countries including India are now facing a double burden because of extreme socioeconomic distribution [2]. On one side, there is overweight and obesity which has reached epidemic proportions and on the other side there is underweight and undernourishment [3]. There is increase in obesity in Indian women from 10.6% to 14.8% during the last decade in urban areas [4]. At the same time in rural areas, 48.2% of pre-pregnant women are underweight [5]. The body mass index (BMI) or Quetelet index is a measure of human body fat based on an individual's weight and height. It involves two factors: weight and height, irrespective of age, gender, race, family history or sex.

[Weight (kg) ÷ height (m^2)] = BMI.

It is a reliable indicator of body fat that correlates to direct measures of body fat even though it does not measure body fat directly. Although much recent research in developed countries has focused on the association between high maternal BMI and adverse pregnancy outcomes; in many developing countries, maternal underweight remains more common than overweight and therefore represents a more important risk factor for poor birth outcomes. Overweight/Obesity is a risk factor for miscarriage, gestational diabetes mellitus (GDM), Gestational hypertension, and preeclampsia in pregnancy [6].

It is associated with poor labor outcomes as chances of spontaneous labor is less in these women and hence increased chances of instrumental deliveries, cesarean delivery, hemorrhage, infection and other maternal morbidity & mortality during labor. Also, an obese mother increases the risk of a child growing up to be obese themselves [8]. In developing countries like India, we also face the issues of malnutrition complications related to underweight like anemia, premature rupture of membranes, low APGAR score, low birth weight babies, preterm delivery and increased perinatal mortality [11]. The aim of the study is to correlate effect of BMI in pregnancy on maternal and fetal outcomes.

Material and Method

This study include patients from urban, semi-urban as well as nearby rural areas. This is a prospective observational study of 100 pregnant patients who came to antenatal OPD, in their 1st trimester, in the Department of Obstetrics and Gynecology, at Tertiary care Hospital in Ahmedabad, Western India between March 2024 to February 2025.

Inclusion Criteria

1. Age 18-35 years
2. Singleton pregnancy
3. Spontaneous conception
4. First trimester visit for confirmation of pregnancy

Exclusion criteria

1. Women with multiple pregnancy
2. Women with chronic disease like hypertension, diabetes, thyroid disorders, bronchial asthma
3. Women with previous cesarean sections and with uterine and fetal congenital anomalies

After informed written consent, pregnant women satisfying the inclusion criteria were included in the study. A detailed history regarding present & past complaints, menstrual, obstetric and family history was taken. Detailed clinical examination including general & obstetrical examination was performed. All routine antenatal investigations and other investigations necessary to rule out medical disorders were done. Baseline weight was measured in kilograms and height in meters was measured using a stadiometer in the 1st trimester of pregnancy and this data was used to calculate Body Mass Index (BMI) using this formula.

BMI = Weight (kg)/height²(meter)

WHO classified women into Underweight, Normal and Overweight BMI group as

Underweight <18.5 kg/m²
Normal 18.5-24.9 kg/m²
Overweight 25-29.9 kg/m²
Obese. ≥30 kg/m²

The obstetrical outcomes studied were,

The obstetrical outcomes studied were here in study is miscarriage, gestational diabetes melitus, gestational hypertension, pre-eclampsia, eclampsia, anemia, hypothyroidism, preterm delivery, mode of delivery, postpartum complications.

Neonatal outcomes studied were

The neonatal outcomes studied were here in study is birth weight, APGAR at 1 minute and 5 minute, admission to neonatal intensive care unit (NICU), stillbirth.

***Statistical analysis*:** Results obtained have been analyzed statistically using appropriate software.

Results

Table 1: Distribution of cases on the basis of BMI (n=100)

BMI category	Frequency	Percent (%)
Underweight	12	12.0
Normal weight	37	37.0
Overweight	31	31.0
Obese	20	20.0
Total	100	100

A total of 100 pregnant women were enrolled in our study after applying the inclusion and exclusion criteria. Among these 100 pregnant women; 12 (12%) had BMI<18.5 Kg/m², 37 (37%) had BMI 18.5-24.9Kg/m² and 31 (31%) had BMI 25-29.9 Kg/m² and 20 had BMI ≥30 Kg/m². These women were categorized as underweight, normal, overweight and obese depending upon their BMI.

Table 2: Distribution of cases on basis of age

Age (in years)	Underweight (n=12)	Normal weight (n=37)	Overweight (n=31)	Obese (n=20)
18-23	4(33%)	7(18.9%)	5(16.2%)	4(20%)
24-28	6(50%)	21(56.7%)	13(41.9%)	10(50%)
29-33	2(17%)	9(24.3%)	13(41.9%)	6(30%)

In all categories of BMI, Maximum patients were from 24-28 years of age group.

Table 3: Obstetrics outcome as per BMI

Obstetrical Outcome	Underweight (n=12)	Normal weight (n=37)	Overweight (n=21)	Obese (n=20)	Total
Term	7(58.3%)	33(89.2%)	26(80.9%)	16(80%)	82
Preterm	5(41.7%)	4(10.8%)	5(19.1%)	3(15%)	17
Miscarriage	0	0	0	1(5%)	1

In our study, it was observed that, out of 12 women who were underweight, 58.3% (7) had term delivery and 41.7% (5) had preterm delivery.
Out of 37 women with normal BMI; 89.2% (33) had term delivery and 10 8% (4) had preterm delivery.
Out of 31 women who were overweight; 80.9% (26) women had term delivery, 19.1% (5) had preterm delivery.
Out of 20 obese women, 80% (16) women had term delivery, 15% (3) women had preterm delivery and 5% (1) women had a miscarriage.
It was observed in our study that the incidence of preterm delivery was more common in underweight women which is highly significant.

Table 4: Distribution of cases on the basis of antepartum complications

Antepartum complications	Frequency (n= 100)	Underweight (n=12)	Normal weight (n= 37)	Overweight (n=31)	Obese (n=20)
Gestational Hypertension	19	1(8.3%)	3(8.1%)	9(29%)	6(30%)
Gestational Diabetes Melitus	8	1(8.3%)	3(8.1%)	2(6.5%)	2(10%)
Preeclampsia	7	1(8.3%)	1(2.7%)	3(9.7%)	2(10%)
Intrauterine growth retardation	5	2(16.7%)	2(5.4%)	1(3.2%)	0
Anemia	2	2(16.7%)	0	0	0
Premature rupture of membranes	2	0	0	1(3.2%)	1(5%)
Placenta previa	2	0	0	1(3.2%)	0
HELLP	1	0	0	0	0
Total	46	7	9	17	11

According to maternal outcome in relation to BMI out of 100 women, Gestational Hypertension was present in total 19 (19%) women. Incidence of it in underweight group was 1 (8.3%), incidence in normal weight group was 3(8.1%) and incidence in overweight group was 15 (29%) and in obese group was 6(30%). In this study, it was observed that with increasing maternal BMI, incidence of gestational hypertension increased which is statistically significant.

It was observed that Pre-eclampsia was present in 7(7%) women. 1 (8.3%) women belonged to the underweight group, 1 (2.7%) women in the normal weight group, 3(9.7%) in the overweight group and 2(10%) in the obese group. In our study, it was observed that women who were overweight were more prone to develop pre-eclampsia but the difference was not statistically significant.

Out of 8 (8%) women who had developed GDM, 1(8.3%) woman, 3 (8.1%) women, 2 (6.5%) women and 2(10%) women belonged to underweight BMI group, normal BMI group, overweight BMI group and obese BMI group respectively.

IUGR was present in 6 (6%) women. Incidence among the underweight group was 2 (16.7%), among normal weight group was 2 (5.4%) and among overweight women was q (3.2%). This shows that maternal nutritional status is directly linked to the nutritional status of the fetus, as the incidence of IUGR was more common in underweight BMI groups as compared to normal BMI and overweight BMI group.

Anaemia was present in 2 women. Incidence among underweight group was 2 (16.7%) This shows that there is increased incidence of anemia in underweight BMI group and the difference was statistically significant.

Placenta previa was present in 2 women, 1(3.2%) belonged to the overweight BMI group and 1(5%) in obese women.

One (2%) woman who was overweight had premature rupture of membrane.

Only one (2%) case of HELLP syndrome was observed in woman who belonged to the overweight BMI group.

Table 5: Distribution of cases on THR basis of mode of delivery in relation to maternal BMI

Mode of Delivery	Underweight (n=12)	Normal weight (n=37)	Overweight (n=31)	Obese (n=19)	Total
Preterm vaginal delivery	5(41.7%)	4(10.8%)	3(9.7%)	2(10.5%)	14
Full term Normal vaginal delivery	6(50%)	23(62.2%)	13(41.9%)	9(47.4%)	51
Instrumental delivery	0	1(2.7%)	3(9.7%)	2(10.5%)	6
LSCS	1(8.3%)	9(24.4%)	12(38.7%)	6(31.6%)	28
Total	12	37	31	19	99

In our study, it was observed that among 12 underweight BMI women, 6(50%) had FTND, 5(41.7%) had PTVD and 1(8.3%) had LSCS. Among 37 women with normal BMI: 23(62.2%) FTNVD, 9 (24%) had LSCS.

1(2.7%) had instrumental delivery and 4 (10.8%) had PTVD. Among 31 women in Overweight group: 13 (41.9%) had FTND, 12 (38.7%) had LSCS. 3 (9.7%) had Instrumental 22(44%) 3(9.7%) had PTVD. Among 19 women in Obese group: 9 (47.4%) had FTND, 6 (31.6%) had LSCS. 2(10.5%) had Instrumental 22(44%) 2(10.5%) had PTVD.

We observed that PTVD was more common in women who were underweight 41.7%(5) as compared to 10.8% (4) women in the normal BMI group, 3(9.7%) in the overweight BMI group and 2(10.5%) in the obese BMI group.

Table 6: Neonatal Birth Weight and Its Relation to Maternal BMI

Birth weight (kg)	Underweight (n=12)	Normal (n=37)	Overweight (n=31)	Obese (n=19)	Total
<2.5	8(66.7%)	6(16.2%)	5(16.1%)	4(21%)	23
2.5-4	4(33.3%)	31(83.8%)	24(77.4%)	14(73.4%)	73
>4	0	0	2(6.5%)	1(5.6%)	3
Total	12	37	31	19	99

In the present study, in the underweight BMI group, 66.7% (8) babies had birth weight <2.5 kg and 33.3% (4) babies had birth weight between 2.5 to 4 kg. In a normal BMI group. 16.2% (6) babies had birth weight <2.5 kg and 83.8% (31) babies had birth weight Between 2.5 to 4 kg. In the overweight BMI group, 16.1% (5) babies had birth weight <2.5 kg, 77.4% (24) had birth weight between 2.5 to 4 kg and 6.5% (2) had birth weight >4kg. Macrosomia was present in 6.5% (2) cases of overweight BMI group and 5.6% (1) cases in obese BMI group.

It was observed that birth weight of 66.7% (8) neonates was less than 2.5 kg in underweight women as compared to 16.2% (6) in normal weight and 16.1% (5) in overweight women and 21%(4) in obese women.

Table 7: APGAR score and its relation to maternal BMI

APGAR	Underweight (n=12)	Normal (n=37)	Overweight (n=31)	Obese (n=19)
Favorable	10(83.3%)	35(94.6%)	27(87.1%)	17(89.5%)
Unfavorable	2(16.7%)	2(5.4%)	4(12.9%)	2(10.5%)

16.7% (2) neonates born to underweight women had an unfavorable APGAR score whereas 5.4% (2), 12.9% (4) and 10.5% (2) neonate, normal weight, overweight and obese BMI group respectively had an unfavorable APGAR score.

Table 8: Maternal BMI and its relation to neonatal admission in NICU

NICU	Underweight (n=12)	Normal (n=37)	Overweight (n=31)	Obese (n=19)	Total
No	10(83.3%)	36(97.3%)	28(90.3%)	17(89.5%)	91(91.9%)
Yes	2(16.7%)	1(2.7%)	3(9.7%)	2(10.5%)	8(7.1%)

In our study, it was observed that out if 99 neonates, 16.7% (2) neonates born to women in underweight BMI group required admission in NICU, whereas 2.7% (1) neonates born to women with normal BMI followed by 9.7% (3) neonates born to women with overweight BMI required NICU admission and The 10.5%(2) neonates born to obese women required NICU admission.

Table 9: Distribution of cases on the basis of maternal. Morbidity

Maternal morbidity	No(Percentage)
Yes	2(2%)
No	98(98%)
Total	100

In our study, it was observed that 2(2%) women had maternal morbidity in the form of surgical site infection. Both were in the obese group of patients.

Discussion

In our study, we found 51(51%) patients were in the overweight and obese BMI group combined whereas only 12(12%) patients were in the underweight BMI group, suggesting that demography and characteristics regarding BMI of pregnant women has changed since the last few years.

Mean age of each 4 BMI groups was between 24-28 years.

It was observed in our study that the incidence of preterm delivery was more common in underweight women (41.7%) than in Normal BMI women (10.8%), overweight women (9.7%) and obese women (10.5%) In our study, one patient had miscarriage which was in an obese group of women.

In study, it was noted that Antenatal complications like Gestational Hypertension, Placenta previa, premature rupture of membrane and HELLP are more common in Overweight and obese women whereas conditions like intrauterine growth retardation and Anemia are more common in Underweight women.

It was observed in our study that Preterm vaginal deliveries are more common in underweight women (41.7%) than Normal BMI women (10.8%), overweight women (19.1%) and obese women (15%) whereas Instrumental deliveries and LSCS are more common in overweight and obese women.

We observed that 8(66.7%) out of 12 underweight women have delivered low birth weight babies (<2.5 kg) which is significantly higher than normal BMI women (16.2%) and overweight women (16.1%) and obese women (21%).

In the study, 16.7%(2) neonates born to underweight women had unfavorable APGAR score whereas 5.4%(2), 12.9%(4) and 10.5%(2) neonates in normal BMI, overweight women and obese women group had unfavorable APGAR score.

It was observed that NICU admission among neonates born to women in underweight BMI group (16.7%) is higher than among neonates born to women in normal BMI (2.7%), overweight BMI group (9.7%) and in obese BMI women (10.5%).

In the study, 2 women from an obese BMI group had maternal morbidity in the form of surgical site infection.

Conclusion

We conclude that BMI plays a major role in maternal and perinatal outcomes and both low BMI and high BMI had significant maternal and perinatal outcomes. Women in the underweight BMI group during antenatal suffer from anemia, preterm delivery, IUGR and low birth weight babies. In overweight BMI group, there is an increased incidence of maternal and fetal problems during antenatal period, during labor and postpartum period. Patients suffered from complications like PIH, GDM, PROM and IUGR. There is increased incidence of induction of labor and LSCS

So, adequate preconception counseling should be given to all women in the reproductive age group so that they can attain normal BMI before conception. With proper management of pregnant women with abnormal BMI during antepartum, intrapartum, and postpartum period, by improving the awareness, and by increasing the accessibility to medical facilities, maternal and perinatal morbidity and mortality can be minimized.

There is also the need to develop guidelines on weight gains to optimize pregnancy and neonatal outcomes as preconception weight loss and adequate recommended weight gain during pregnancy can be helpful in achieving the goal we strive for, a healthy mother and a healthy baby.

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