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Maternal Body Mass Index as an Impact on Pregnancy Outcomes

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Abstract

Background: BMI is widely accepted as a better measure of underweight or overweight than weight alone. The developing countries including India are facing a dual burden of undernutrition and obesity. Extremes of BMI in pregnancy have been associated with multiple complications affecting maternal and perinatal outcome.

Objective: To observe distribution of antenatal patients in underweight, normal, overweight and obese categories according to booking BMI and to examine the association of BMI with obstetric and perinatal outcomes in singleton pregnancies.

Methods: This prospective observational study was conducted in the dept. of Obstetrics and Gynecology, Shaheed Tajuddin Ahmad Medical College Hospital, Gazipur, Bangladesh from January to December 2023. Out of total 882 antenatal registrations, 305 patients fulfilling the inclusion criteria were enrolled in the study. The antenatal patients were categorized into four categories of BMI according to WHO classification and pregnancy outcomes were compared.

Results: A total of 305 patients were included in the study. Depending on booking BMI, 225 (73.8%) patients enrolled in the study had normal booking BMI, 51 (16.7%) were underweight, 25 (8.1%) were overweight and 4 (1.3%) were obese. The mean age of the study group was 25.3 years. 51% pts were in age group 25-34 years, 47% in 15-24 age group and only 2% in elderly age group. 344 (56.4%) patients registered in this study were primigravida and 266 (43.6%) were multigravida. Postdatism, preterm births, induction of labour, LSCS and prolonged hospital stay were commoner in overweight patients while IUGR, oligohydramnios and BOH were seen more in underweight group. Neonatal resuscitation and neonatal complications were common in both underweight and overweight patients as compared to normal BMI patients.

Conclusion: We conclude that majority of antenatal patients being catered in our hospital have normal BMI. Adverse maternal and perinatal outcomes are associated with extremes of BMI. A pre-pregnancy counseling and general awareness regarding diet and desired weight gain according to booking BMI is essentially required for better pregnancy outcomes.

Keywords: Pregnancy, BMI, Maternal and Perinatal Outcome.

Introduction

The increasing global prevalence of overweight and obesity makes it more likely that a growing number of women with high body mass index (BMI) are becoming pregnant. High maternal BMI during pregnancy has immediate implications for pregnancy complications as well as long-term health implications for both women and offspring^[1, 2]. The developing countries like Bangladesh are facing a dual burden of nutritional problems, with undernourished and underweight women on one side and overweight and obese women on the other side. We were yet struggling to eradicate undernutrition and anaemia from our country and we are already facing an epidemic of obesity in the 21st century probably due to the transition from traditional diets and lifestyles to western diets. Several observational studies and systematic reviews have provided a connection between maternal BMI during pre-pregnancy or early gestation and adverse perinatal outcomes^[3]. Infants of overweight or obese mothers are affected by various pregnancy comorbidities including gestational diabetes, gestational hypertension, preeclampsia, premature birth (PTB), macrosomia and stillbirth^[4, 5]. BMI is widely accepted as a better measure of under or overweight than weight alone. It is an index of weight for- height and is calculated by dividing a person's weight in kilograms by square of height in meters (kg/m²). Increased BMI in pregnancy is related to increasing incidence of preeclampsia, gestational diabetes, postdatism, macrosomia, induction of labour and increased operative interferences;

while low BMI is associated with preterm delivery, low birth weight babies, anemia etc. [6]. The need for present study was to assess the distribution of antenatal women being catered in our hospital in four categories of BMI and to evaluate whether BMI significantly affects pregnancy outcome. More recently, the waist-hip ratio has been used to study the effects of obesity on pregnancy, but data relating to this parameter are seldom available. The height and weight of women as well as the gestational weeks at the first antenatal visit have been systematically logged, thus offering a unique opportunity to study the effect of Body Mass Index (BMI) on pregnancy outcomes. The objectives of the present study were to study distribution of antenatal patients in underweight, normal, overweight and obese categories according to booking BMI, to find out average weight gain in each of the four categories of BMI, to examine the association of BMI with obstetric and perinatal outcomes in singleton pregnancies.

Materials & Methods

This prospective observational study was conducted in the dept. of Obstetrics and Gynecology, Shaheed Tajuddin Ahmad Medical College Hospital, Gazipur, Bangladesh from January to December 2023. Out of total 882 antenatal registrations, 305 patients fulfilling the inclusion criteria were enrolled in the study. Detailed history, general and abdominal exam findings were noted in a predefined proforma. Women with multiple pregnancies, abnormal presentation, previous LSCS and preexisting medical disorders were excluded from the study. Maternal height was measured by stadiometer and weight was recorded on digital weighing scale and Booking BMI was calculated. Pre-pregnancy BMI is not reliably obtained in our population due to lack of preconceptionally checkups, poor recall of weight by patients and unplanned pregnancies. Besides, first trimester weight usually correlates with prepregnancy weight. Enrolled patients were followed regularly in antenatal OPD and complications were noted if any. When admitted for delivery, weight was recorded, and second BMI was calculated. Intra partum and post-partum events and neonatal details were also recorded in detail. The booking BMI was used to divide the patients into underweight, normal, overweight and obese categories according to the WHO classification. ⁴ The effect of

booking BMI on pregnancy outcomes in each group was studied with respect to the following variables:

- Pre-pregnancy variables: Age, parity.
- Antenatal variables: Preeclampsia, PIH, gestational diabetes, preterm delivery, postdatism, IUGR, macrosomia, prolonged antenatal stay etc.
- Intrapartum variables: Induction of labour, mode of delivery, failed induction, intra-op complications, need for BT etc.
- Postpartum variables: PPH, prolonged hospital stay, impaired wound healing, any infections.
- Neonatal variables: Low birth weight (<2.5 kg), big baby (>3.5kg), preterm, need for resuscitation, admission to NICU, neonatal complications, intrauterine death/ stillbirth/ neonatal death.

After studying the occurrence of above variables in different groups of BMI, the information gathered was converted into tabulations and graphical forms. Data was entered in MS- Excel and was analyzed in SPSS software version-2023. After performing the statistical analysis, mean and percentages were calculated and chi-square test of significance was applied. $P < 0.05$ was considered as statistically significant.

Table 1: WHO classification of nutritional status based on BMI.

Classification	BMI (kg/m ²)
Underweight	<18.5
Normal	18.5-24.9
Overweight	25-29.9
Obese	>30

Results

A total of 305 patients were included in the study. Depending on booking BMI, 225 (73.8%) patients enrolled in the study had normal booking BMI, 51 (16.7%) were underweight, 25 (8.1%) were overweight and 4 (1.3%) were obese. The mean age of the study group was 25.3 years. 51% pts were in age group 25-34 years, 47% in 15-24 age group and only 2% in elderly age group. 344 (56.4%) patients registered in this study were primigravida and 266 (43.6%) were multigravida. In all categories of BMI, primi were more common except in obese group with 3 primi and multigravida each (Table 2).

Table 2: Pre-pregnancy variables (N=305)

	Underweight (51)	Normal (225)	Overweight (25)	Obese (4)	Total (305)
Age (years)					
15-24	26	104	12	2	144 (47.2%)
25-34	24	117	13	2	156 (51.2%)
35-44	1	4	0	0	5 (1.6%)
Gravidity					
Primigravida	27	129	14	2	172 (56.4%)
Multigravida	23	96	12	2	133 (43.6%)

Table 3: Weight gain during pregnancy (N=305)

	Underweight (51)	Normal (225)	Overweight (25)	Obese (4)	Total (305)
Weight gain (kg)					
0-5	4	14	0	1	19
6-10	23	147	19	2	191
11-15	22	60	4	0	86
16-20	2	4	2	1	9

In all categories of BMI, weight gain between 6-15 kg was most common. 4 (21%) patients gaining weight less than 5 kg were from underweight group as compared to 2 (5.2%) from

overweight and obese group. Among 9 patients gaining weight between 16- 20 kg, 4 (44.4%) were from overweight and obese group while 2 (22.2%) were from underweight group (Table 3).

Table 4: Antenatal variables (N=305)

	Underweight (51)	Normal (225)	Overweight (25)	Obese (4)	Total (305)
Antenatal complications					
Postdatism	7	45	4	2	58
Preterm	7	27	2	1	37
PIH/eclampsia	2	10	1	0	13
PROM/PPROM	3	7	1	0	11
IUGR	2	5	1	0	8
Oligohydramnios	3	4	1	0	8
BOH	2	5	0	0	7
Anaemia	2	3	0	0	5
Polyhydramnios	0	3	0	0	3
Multiple	7	26	4	1	38
Total (% within BMI category)	32 (62.7%)	135 (60.0%)	14 (56.0%)	4 (100.0%)	185(60.7%)

38 (20.5%) patients had more than one complication. Rare complications observed in the study were ARDS, fibroid with pregnancy, viral hepatitis, DIC and grade I retinopathy. Comparing percentages within BMI category, antenatal complications were observed in 50-60% of patients in all categories of BMI except in obese category where all patients developed either single or multiple complications. Postdatism was found in 50.0% in obese group, while 13.7% and 20.0% in UW and normal groups respectively. Preterm births were also found in 25.0% in obese patients, which was higher than all

other categories of BMI. Multiple complications were observed more in higher BMI patients. 185 (60.7%) patients had one or more antenatal complications, amongst which 31.3% had postdatism, 20.0% preterm, 7.0% PIH, 5.9% PROM, approx 4.3% each had IUGR, oligohydramnios and BOH as single complication. 16.0% and 25.0% pts in OW and obese groups had multiple complications as compared to 13.7% in UW and 11.5% in normal groups. IUGR (3.9%), oligohydramnios (5.9%), PROM (5.9%) and BOH (3.9%) were found to be more common in UW groups (Table 4).

Table 5: Intrapartum variables (N=305)

	Underweight (51)	Normal (225)	Overweight (25)	Obese (4)	Total (305)
Onset of labour					
Spontaneous	43	174	17	2	236
Induced	4	33	5	1	43
Total	47	207	22	3	279
Mode of delivery					
Normal	28	118	15	2	163
Instrumental	3	19	2	0	24
LSCS	20	88	8	2	118

279 (91.4%) patients out of 305 were given trial of labour, of which 43 (15.4%) were induced. Comparing labour onset in patients given trial of labour, 23.9% of OW and obese patients required induction as compared 8.5% patients in UW category and 15.9% in normal BMI category. Average weight gain in each category was also calculated and was found to be 9.7kg in

underweight, 8.9kg in normal, 9.4kg in overweight and 10.7kg in obese groups. 61.2% pts delivered vaginally amongst which 7.8% were instrumental deliveries, while 38.6% delivered by LSCS. Vaginal deliveries constituted approx 60-70% of total deliveries in all categories of BMI except in obese group where 50% patients underwent LSCS (Table 5).

Table 6: Postpartum variables (N=305)

	Underweight (51)	Normal (225)	Overweight (25)	Obese (4)	Total (305)
PPH (% within BMI category)	4 (7.8%)	9 (4%)	2 (8.0%)	0 (0%)	15 (4.9%)
Need for blood transfusion	5 (9.8%)	13 (5.7%)	2 (8.0%)	0 (0%)	20 (6.6%)
Prolonged hospital stay	4 (7.8%)	16 (7.1%)	3 (12.0%)	1 (25.0%)	24 (7.9%)
PNC complications					
Impaired wound healing	1	9	1	0	11
Anaemia	1	5	1	1	8
Fever	1	5	1	0	7
Baby in NICU	2	4	1	0	7
PIH	2	3	1	2	8
Miscellaneous	0	6	1	0	7
Total	7 (13.7%)	32 (14.2%)	6 (24%)	3 (75%)	48 (15.7%)

15 (4.9%) patients had PPH in this study. PPH was observed in 7-8% patients in underweight and overweight categories while 4% in normal BMI patients. Among patients with PPH, 22 had atonic, 4 had traumatic and 4 had atonic and traumatic PPH both. 3 patients required uterine artery ligation, one required internal iliac artery ligation and obstetric hysterectomy was done in one patient. 20 (6.6%) patients required blood transfusion.

9.8% pts in underweight category required blood and 5.7% each in normal and overweight category. Prolonged postnatal stay was considered as more than 4 days in normal and instrumental deliveries and more than 10 days for LSCS patients. 7.9% patients stayed longer than expected due to postnatal or neonatal complications. Prolonged postnatal stay was observed in 25.0% in obese category as compared to 7-10% in other categories.

Postnatal complication rate in UW and Normal BMI category was 13.7% and 14.2% respectively while 24.0% in OW and 75.0% in obese category (Table 6). Among 11 patients with impaired wound healing, 4 had wound discharge and required only dressing, while 10 patients had wound gape of which 8 patients had LSCS wound gape, 1 had episiotomy gape and 1

had puerperal tubectomy gape. In miscellaneous category, 3 patients had Urinary tract infection, 3 had anaemia, 2 had PIH with Diabetes, 1 each urinary retention and chest pain, 1 had undergone Obstetric hysterectomy and 2 patients required ICU admission of which 1 required ventilator support.

Table 7: Neonatal variables (N=305)

	Underweight (51)	Normal (225)	Overweight (25)	Obese (4)	Total (305)
GA at delivery (weeks)					
<37	7	27	2	1	37 (12.1%)
37-40	36	152	21	1	210(68.9%)
>40	8	45	4	1	58 (19%)
Birth weight (kg)					
<2.5	10	51	4	1	66 (21.8%)
2.5-3.0	33	125	16	2	176 (57.7%)
3.1-3.5	6	41	5	1	53 (17.4%)
>3.5	1	8	2	0	10 (3.2%)
Neonatal outcome					
Alive	50	218	25	3	296 (97%)
Stillbirth	1	4	1	0	6 (2%)
Early NND	0	3	0	0	3 (1%)
Need for resuscitation	8	22	1	1	32 (10.3%)
NICU admission	9	35	3	1	48 (15.7%)

Various neonatal variables were also compared in different categories of BMI. 68.9% patients delivered between 37-40 weeks of gestation, 19% were postdated and 12.1% delivered preterm. Mean gestational age at delivery in the study was 38.4 wks. Majority (75.1%) of patients delivered babies with a birth weight between 2.5- 3.5 kg. 21.8% babies were LBW and 3.1% weighed >3.5 kg. Mean birth weight in the study was found to be 2.71 kg. Unfavourable neonatal outcome was seen in only 3%

of patients in the form of 6 stillbirths and 3 early neonatal deaths. Among 6 stillbirths, 4 patients were admitted with intrauterine death and 2 were intra partum deaths. Total 32 (10.3%) neonates required resuscitation. 15.7% and 16.7% babies born to women in UW and obese categories respectively needed resuscitation, while 10% in normal category. 48 (15.7%) babies required NICU admission and percentages within all BMI categories were found to be comparable (Table 7).

Table 8: Neonatal complications (N=305)

NN complications	Underweight (51)	Normal (225)	Overweight (25)	Obese (4)	Total (305)
Preterm LBW	1	8	0	1	10 (3.1%)
IUGR LBW	1	5	1	0	7 (2.3%)
Meconium liquor	2	4	1	0	8 (2.5%)
Resuscitation	4	13	0	0	17 (5.6%)
Jaundice	1	2	1	0	3 (0.8%)
Big baby	0	1	1	0	3 (0.8%)
Fever	0	2	0	0	2 (0.7%)
Miscellaneous	0	3	1	0	3 (0.8%)
Total (% within BMI category)	9 (17.6%)	38 (16.9%)	5 (20.0%)	1(25.0%)	53 (17.3%)

53 (17.3%) babies had neonatal complications, common amongst which were preterm LBW, IUGR LBW, meconium stained liquor and requirement of resuscitation. Miscellaneous category included septicemia, cephalhaematoma, congenital heart disease, inborn errors of metabolism and absent radius. Though rate of neonatal complications observed in all categories of BMI was comparable, differences were noted in few complications; such as meconium stained liquor was found in 3.9% and 4.0% in UW and OW categories respectively as compared to 1.8% in normal BMI group. Neonatal jaundice was observed in 0.8% patients with normal BMI, while 1.0% and 1.9% in UW and OW groups. Neonates born with birth weight more than 3.5kg were found in 4.0% in OW group as compared to 0.5% in normal BMI group (Table 8).

Discussion

We found a linear relationship between increasing body mass index and the risk of developing pre-eclampsia, gestational hypertension, induction of labour and emergency caesarean

section. Conversely, low BMI had a protective effect on some obstetric complications. Previous research has found a strong association between increasing BMI and pregnancy induced hypertension. This study adds to the increasing body of evidence that suggests that women with low and high BMI are both predisposed to complications in pregnancy. In present study, 21% of patients with weight gain less than 5kg were from UW group while 39% of patients gaining weight between 16-20kg were from OW group, highlighting the importance of dietary advice according to the booking BMI right from the first trimester itself. Ideally UW women should gain weight between 12.7- 18 kg and OW women only 7-11kg [6]. Addo V N also found a statistically significant high total weight gain (>16kg) in overweight and obese patients as compared to normal BMI patients [7]. All patients in obese category and 62.7% in UW group in the present study developed antenatal complications. Among the obese patients, 50.0% patients each had postdatism, preterm labour and multiple complications (mainly combination of PIH, IUGR, anaemia, oligohydramnios etc.), higher than all

other categories. This was in accordance with a study by Donna R H et al. which showed that prolonged or post term pregnancy was common with increasing pre-pregnancy weight and increasing maternal weight gain^[8]. Also, in a study by Deepika Jain et al., risk of PIH was found to be eight times higher in obese patients than those with normal BMI^[9]. The study by Baeten et al. quotes increased risk of preterm births in obese patients^[10]. Bianco et al. also found no association between BMI and preterm labour, while in a systematic review and meta-analysis by Han Z et al., it was determined that singletons born to UW women have higher risks of overall spontaneous and induced preterm birth and LBW <2.5kg^[11,12]. The present study observed that low birth weight babies were found to be more in UW group though the difference was not statistically significant. Average weight gain in each category was also calculated and was found to be 9.7kg in underweight, 8.9kg in normal, 9.4kg in overweight and 10.7kg in obese groups. 61.2% pts delivered vaginally amongst which 7.8% were instrumental deliveries, while 38.6% delivered by LSCS. Vaginal deliveries constituted approx 60-70% of total deliveries in all categories of BMI except in obese group where 50% patients underwent LSCS. This study also showed a higher LSCS rate in OW (45.1%) and obese (52.5%) patients as compared to normal BMI patients which supported findings of present study showing that 50% of obese patients underwent LSCS.^[5] The rate of PPH in present study was found to be higher in UW as well as OW patients (7-8%) as compared to normal BMI patients though the difference was not statistically significant. In a study by Deepika Jain et al., the maximum occurrence of PPH (14.29%) was in obese group^[9]. Also Sebire et al. observed an increase in PPH with an increase in BMI^[13]. In contrast to these studies, Paglia M J et al. found that women with BMI<30 and Hispanic women are more likely to have severe PPH^[14]. Bianco et al. observed no such relation of BMI and PPH. In addition, in present study, blood transfusions were required more in UW (9.8%) as compared to 5.7% in normal and OW patients reflecting the undernourished state of UW group. In the present study, prolonged postnatal stay was observed in 25.0% in obese category as compared to 7-10% in other categories. Postnatal complication rate in UW and normal BMI category was 13.7% and 14.2% respectively while 24.0% in OW and 75.0% in obese category. Meenakshi et al. in their study observed that prolonged hospital stay (25.0%), impaired wound healing (38.1%), urinary tract infection (12.5%) and pyrexia (18.8%) had a higher incidence in obese group^[5]. 15.7% and 25.0% babies born to women in present study UW and obese categories respectively needed resuscitation, while 10% in normal category. Unfavourable neonatal outcome and NICU admission were comparable in all categories of BMI. In a study by Tharihalli C, low APGAR score at birth was seen more in obese (24%) and in UW (17.3%) groups^[15]. Neonates born with birth weight more than 3.5kg were found in 8.0% in OW group as compared to 0.7% in normal BMI group. This result is in accordance with the study by Weiss JL which showed that obese women have an 18-26% increased chance of delivering large for date infants^[16]. In present study, few neonatal complications like jaundice and meconium stained liquor also were found to be more in UW and OW categories as compared to normal BMI patients.

Conclusion

We conclude that majority of antenatal patients being catered in our hospital have normal BMI. Adverse maternal and perinatal outcomes are associated with extremes of BMI. A pre-pregnancy counseling and general awareness regarding diet and desired

weight gain according to booking BMI is essentially required for better pregnancy outcomes.

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