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An Observational Study on the Effect of Maternal Booking Body Mass Index on Pregnancy Outcomes at the Benue State University Teaching Hospital, Makurdi, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Maternal body mass index (BMI) is a useful indicator of the nutritional status of a pregnant woman. It is well established that maternal body mass index has an impact on pregnancy outcomes be it underweight, overweight or obesity. Thus, nutritional intake and weight gain are modifiable factors in determining pregnancy outcomes.
While it is largely known that obese women are more prone to developing gestational hypertension, preeclampsia, gestational diabetes mellitus, macrosomia, postpartum hemorrhage, and increased incidence of operative deliveries, effect of maternal underweight remains unclear.
Aim: The present study was aimed to determine the maternal risk in terms of antepartum, intrapartum, postpartum complications and perinatal outcome in relation to extremes of maternal BMI at booking.
Materials and Methods: This was a prospective observational study conducted for a period of six months. A total of 146 subjects were recruited for study after satisfying all inclusion and exclusion criteria. All subjects were followed up till delivery and various outcomes were recorded. Analysis was done using Statistical Package for Social Sciences (SPSS) software version 20.
Results: A total of 138 (94.5%) patients were in the age group of 20-39 years.
In underweight group, there was high incidence of miscarriage which affected 100% of patients.
Preeclampsia, Lower Segment Caesarean Section (LSCS), perineal tears, postpartum haemorrhage and foetal macrosomia were more frequent in BMI Group 3, 4, and 5 patients.
Conclusion: It can be concluded that extremes of maternal BMI at booking is associated with adverse maternal and perinatal outcome. Adequate pre-conceptional Counseling should be given to all women of reproductive age group so that they can achieve Normal BMI prior to pregnancy.

Keywords: Body mass index; gestational diabetes mellitus; gestational hypertension; macrosomia; obesity; pregnancy outcome.

1. INTRODUCTION

"Maternal body mass index (BMI) is a useful indicator of the nutritional status of a pregnant woman. It is well established that maternal BMI has an impact on pregnancy outcomes be it underweight, overweight or obesity. Thus, nutritional intake and weight gain are modifiable factors in determining pregnancy outcomes" [1,2,3].

"Most developing countries including Nigeria are now facing a double burden because of extremes of socioeconomic distribution. On one side of the spectrum, there is overweight and obesity which has reached epidemic proportions and on the other side there is underweight and undernourishment" [4,5,6].

The impact of obesity/overweight on pregnancy outcomes both maternal and perinatal is largely negative. On the other hand the effect of underweight on maternal and perinatal outcomes is also negative but advantageous in some respects for example the reduced incidence of pre-eclampsia, foetal macrosomia, etc.

It is recommended that BMI be calculated for all women using appropriate measurements, before pregnancy or during the initial booking visit in the first trimester as it is assumed that weight gain might not be significant at this time [7,8]. However, the average gestational age at booking in our environment tends to be late.

Various studies have placed the incidence of maternal obesity at 9 – 53.7% which is quite significant especially with its added adverse effects in pregnancy [7,8,9]. There are reasons that could account for this increase: growing urbanization and related changes in lifestyle such as changes in diet, physical activity, smoking habits, and alcohol use in part contribute to rising levels of overweight and obesity [10,11,12].

The incidence of underweight in pregnant women has been shown to range from 4.5% to 14.14% [13,14,15]. Lower socioeconomic status and nutritional deficiencies have been identified as contributing factors [1,5].

Some studies have demonstrated a higher risk of gestational hypertension, gestational diabetes, macrosomia and operative deliveries in the obese population [16,17,18]. Increasing BMI has been associated with greater risk of foetal congenital malformations, foetal death, stillbirth, and neonatal, perinatal, and infant death [19,20].

Some studies have shown increased risk of low birth weight, preterm birth, and anaemia in

women who are underweight [21, 22, 23, 24, 25, 26].

2. METHODS

The study was a prospective observational study, over a period of six months (May 2021 to October 2021) at the Benue State University Teaching Hospital (BSUTH). Ethical clearance for the study was obtained at the Ethics and Research Committee of the BSUTH. Consenting pregnant women in the first 19 weeks of pregnancy [27] (late 1st trimester and early 2nd trimester) presenting for booking at the antenatal clinic of BSUTH were recruited into the study after satisfying the inclusion criteria (nulliparae, singleton pregnancy, no history of medical disorders) and exclusion criteria (multiple pregnancy, unbooked). A total of 146 patients were recruited for the study. BMI of patients was calculated using formula:

2.1 BMI = (Weight in Kilograms/Height in Meters^2)

Based on BMI, patients were divided into five groups (according to the WHO and NIH guidelines). "A complete history regarding present and past illness was noted. Detailed general physical and systemic examination was performed. Baseline routine investigations were performed. All findings were noted down in a predesigned pro forma and records were maintained till delivery. All patients under study were counseled to have follow-up visits as per standard protocol till delivery. Decision regarding mode of delivery was taken depending on the particular case. All the babies were examined by a Pediatrician. APGAR scores of the babies were assessed and neonatal intensive care unit (NICU) admissions were recorded" [27].

The obstetrical outcomes studied:

- Miscarriage
- Impaired glucose tolerance (IGT), GDM
- Gestational hypertension
- Pre-eclampsia, eclampsia
- Anemia
- Preterm delivery
- Mode of delivery
- Postpartum complications.

The neonatal outcomes studied:

- Birth weight
- Maturity
- NICU admission
- Perinatal death.

All statistical analysis was performed using SPSS software (version 20). Frequencies and percentages were computed for demographic characteristics of the study population. Test for association for categorical and numerical data were done using Chi square and student t test respectively. A P-value of <0.05 was taken as significant.

3. RESULTS

A total of 146 patients were studied. In all BMI groups maximum numbers of patients were in the age group of 20 to 39 years (Tables 1 and 2). The mean age was 28.27 years (SD = 5.32). Majority of patients were in category 2, 3 and 4.

Incidence of miscarriage was highest in group 1 (100%) while gestational hypertension was highest in group 4 (6.7%).

Compared to women with normal BMI(Group 2), LSCS rate was more common in only Group 4. LSCS rate in Group 2,3,4 & 5 was 25.5%, 16.7%, 25% and 22.2% respectively (Table 4). Compared to women with normal BMI(Group 2), the incidence of perineal tears was higher in groups 3 and 4 - 43.3% and 32.1% respectively (Table 4). Postpartum haemorrhage was more common in Group 4 – 10.7% and was statistically significant when compared to group 2 (P value < 0.003) (Table 4).

Macrosomia was more common in Groups 4 and 5 with mean Birth weight of babies being 3.0 kg (Table 5).

Table 1. Weight Category and group of patients based on Booking BMI

Group	Category	BMI (Kg/m^2)	Number of cases N(%)
1	Underweight	<18.5	2 (1.4)
2	Normal	18.5-24.9	47 (32.2)
3	Overweight	25-29.9	60 (41.1)
4	Obese	30-34.9	28 (19.2)
5	Morbidly obese	≥35	9 (6.2)

Table 2. Booking BMI Group and Age

BMI Group	Age in years		
	<20	**20 – 39**	**≥40**
1	0	2	0
2	7	39	1
3	0	60	0
4	0	28	0
5	0	9	0
Total (%)	**7 (4.8)**	**138 (94.5)**	**1 (0.7)**

Table 3. Booking BMI Group and Antepartum Complications

Complications	BMI group (total number of cases) (%)				
	1 (2)	**2 (47)**	**3 (60)**	**4 (28)**	**5 (9)**
Miscarriage	2 (100)	11 (23.4)	5 (8.3)	2 (7.1)	1 (11.1)
Prematurity	0	8 (17)	5 (8.3)	2 (7.1)	0
IUFD	0	5 (10.6)	1 (1.7)	1 (3.6)	0
GDM	0	0	0	0	0
Preeclamspia/Eclampsia	0	2 (4.3)	4 (6.7)	0	0
Anaemia	1 (50)	31 (66)	39 (65)	14 (50)	4 (44.4)

Table 4. Booking BMI Group and Labour-Delivery Outcome

Labour & Delivery	BMI group	1 (2)	2 (47)	3 (60)	4 (28)	5 (9)	Total
Number of deliveries (%)		0	36(28.8)	55(44)	26(20.8)	8(6.4)	125
Normal delivery (%)		0	24(51.1)	45(75)	19(67.9)	6(66.7)	94
Caesarean section (%)		0	12(25.5)	10(16.7)	7(25)	2(22.2)	31
Instrumental Delivery (%)		0	0	0	0	0	0
Perineal laceration (%)		0	13(27.7)	26(43.3)	9(32.1)	0	48
Postpartum Haemorrhage (%)		0	4(8.5)	1(1.7)	3(10.7)	0	8

Table 5. Booking BMI Group and Neonatal Outcome

	BMI group	1 (2)	2 (47)	3 (60)	4 (28)	5 (9)
Neonatal Outcomes						
<2.5 kg (%)		0	8(17)	5(8.3)	2(7.1)	0
2.5 - 3.9kg (%)		0	28(59.6)	48(80)	22(78.6)	7(77.8)
≥4 kg (%)		0	0	2 (3.3)	2(7.1)	1(11.1)
1st Minute APGAR <7 (%)		0	7(14.9)	3(5)	3(10.7)	1(11.1)
1st Minute		0	29(61.7)	52(86.7)	23(82.1)	7(77.8)

	BMI group	1 (2)	2 (47)	3 (60)	4 (28)	5 (9)
Neonatal Outcomes						
APGAR ≥7 (%)						
NICU admission (%)		0	4(8.5)	4(6.7)	1(3.6)	0
Early Neonatal Deaths (%)		0	0	0	0	0

4. DISCUSSION

In this study, 138 (94.5%) patients were in the age group of 20-39 years, which reflects the normal child bearing age group of women. The mean age was 28.27 years (SD = 5.32).

The incidence of obesity in this study was found to be 25.4%. this is far higher than that seen by Ezeanochie et al [7] with 9.63% and Takai et al [8] with 15.3%. Possible reasons for this could be that obesity is more of a problem in the north central than in other parts of Nigeria. It could also be that over the years the burden of obesity has increased since these studies were done. This study shows that the burden of obesity appears to be similar to that seen in developed countries.

"A growing body of evidence suggests that obesity, measured by BMI, predisposes women to complicated pregnancies and increased obstetric interventions. This study has shown that both underweight and overweight women had adverse maternal and perinatal outcome. The women who were overweight/obese/morbidly obese had higher risk of preeclampsia with an incidence of 6.7%" [1]. This is quite low when compared with Ezeanochie et al [7] with incidence of 17.4%. However this could be due to his higher study sample size and that it was a case control study focusing on obesity. Obesity and preeclampsia have some similar features. "For instance, obesity is associated with oxidative stress as well as circulating inflammation markers" [9,10,11]. On the other hand, plasma level of C-reactive protein, which is another significant marker of inflammation, is elevated in obese individuals, as are plasma levels of inflammatory cytokines, tumor necrosis factor-α (TNF-α), interleukin-6 (IL-6), and interleukin-8 (IL-8) [12,13,14]. Similarly, preeclampsia is associated with oxidative stress and circulating markers of inflammation [15].

There was no single case of gestational diabetes mellitus in all the BMI groups. This is in sharp contrast to the studies by Kumar et al [1], Ezeanochie et al [7], Sharmila et al [16] and Bharpoda et al [17] that showed increased association between maternal obesity and gestational diabetes mellitus. Perhaps the sample size of this study was too small and also because it was carried out only in a hospital setting.

Rate of lower segment Caesarean section (LSCS), perineal tears, postpartum haemorrhage and foetal macrosomia was also higher in Groups 3, 4 and 5 with incidence of 63.9%, 75.4%, 12.4%, and 21.5% respecively. This is in line with other studies like Kumar et al [1], Takai et al [8] and Ezeanochie et al [7].

This study did not show any correlation between the maternal BMI and Apgar score as well as NICU admission. This is in contrast to the study by Calik et al [9] who reported an increased incidence of low Apgar scores and NICU admission in the obese population. Ezeanochie et al [7] and Takai et al [8] found that severe birth asphyxia and NICU admission were higher in the obese population.

In this study the incidence of underweight in pregnancy was 1.4%, far lower than 11.4% by Takai et al in Kano. This could be due to either the sample size not being large enough or that underweight is not a common problem in our environment. "There was increased incidence of miscarriage in the underweight group (100%). While several studies have shown increased incidence of anaemia, low birth weight and preterm delivery in the underweight group" [1,11,17], this study found no such correlation.

5. CONCLUSION AND RECOMMENDATIONS

It can be concluded from this study that extremes of maternal BMI is associated with adverse maternal and perinatal outcome. While

underweight was associated with miscarriage, obesity and overweight was associated with Preeclampsia, increased LSCS rate, perineal tears, postpartum haemorrhage and macrosomia.

Adequate pre-conceptional counselling should be given to all women in reproductive age group so that they can attain normal BMI before conception through appropriate nutrition and exercise.

6. LIMITATIONS OF THE STUDY

1. It is a hospital based study and thus the findings may not be generalizable to the entire population of women in Makurdi or Nigeria, necessitating a larger population based study in the future. However Makurdi being a cosmopolitan city is expected to give a decent reflection of the general population and not limited by unique cultural practices.
2. Pre-pregnancy body mass index is a better assessment of maternal weight gain and nutritional status. However many of our women book late in pregnancy and very few if any know their pre-pregnancy weight thus the weight gain in pregnancy may be a confounding factor in assessing the outcome of the study.
3. There may be other confounding factors influencing pregnancy outcomes such as age, educational status, socioeconomic status, etc which would be difficult to exclude and these factors may affect the overall outcome of the study.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

CONSENT

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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