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AN ANALYTICAL STUDY OF PRE-PREGNANCY BMI AND ITS ASSOCIATION WITH FETO-MATERNAL OUTCOMES

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ABSTRACT

Introduction: Obesity and overweight are risk factors for high morbidity and mortality in developing countries, including the feto-maternal outcomes. This study compares and assesses the impact of maternal body mass index in early pregnancy on feto-maternal outcome. **Materials and methods:** This comparative cross-sectional study was done in pregnant women attending ANC clinic at SMS Jaipur during the period of January 2020 to February 2021. 120 pregnant women were enrolled in the study who were then divided into 3 groups using the WHO criteria for BMI classification which were compared using appropriate statistical test. **Results:** Among the overweight women 40% had GDM, 35% had Preclamsia, 20% had Gestational Hypertension, 12.5% Eclampsia and 15% showed Abruption. On statistical analysis it was found that GDM, hypertension, IUGR, APH, abnormal colour doppler, and LSCS are significantly associated with increased BMI. The fatal complications like NICU admissions (35%), early neonatal deaths (15.0%), IUD (12.5%), macrosomia (2.5%) and APGAR score at 1 and 5 minutes, were found statistically significant in overweight pregnant women compare to normal and underweight women. All these parameters were found negatively co-related to the increased BMI. **Conclusion:** The study shows the deleterious effect of increased BMI and overweight on the feto-maternal outcome. Proper risk management of maternal obesity can improve the feto-maternal outcomes associated with it.

KEYWORDS : Pre-pregnancy BMI, Fetal outcomes, Maternal outcomes

INTRODUCTION

Body mass index (BMI) is an approximate measure of one's body habitus commonly used in clinical practice to categorize patients as normally weighed, underweight, overweight and obese. Overweight and obesity is defined as an accumulation of excessive fat in the body such that it may have a negative effect on the health. The issue has grown to epidemic proportions globally, with over 4 million people dying each year as a result of being overweight or obese in 2017[1]. 1.9 billion adults were overweight and 650 million obese in 2016[1].

It is estimated that 38.9 million overweight and 14.6 million obese pregnant women existed globally in 2014[2]. In the upper middle-income countries and lower middle-income countries, there were sharp increases in the number of overweight and obese pregnant women. In 2014, the percentage of female with overweight and obesity in India was 21.7% and India had the largest number of overweight and obese pregnant women (4.3million), which accounted for 11.1% in the world[2].

Females are more likely to be overweight and obese as compared to their male counterparts which has serious reproductive health problems, especially in pregnancy[3]. Maternal obesity increases the risk of obstetric complications during the antenatal, perinatal and postnatal period. The off springs also have an increased risk of perinatal morbidity and long-term health problems[4]. Maternal obesity also leads to foetal complications like intrauterine growth restriction, macrosomia, prematurity and adverse clinical outcomes[5]. Obesity and nutritional status can have long term effects on the energy balance in offspring and contribute to juvenile obesity and diabetes[6].

According to Barker's hypothesis adverse intrauterine events permanently program postnatal structure, function and homeostasis[7]. There are evidences that prove an association of maternal obesity in the first trimester with obesity in children[8]. The foetal adaptation to supply the nutrient by the placenta may permanently change their physiology and metabolism[9].

Low BMI and anaemia are two important indicators of maternal nutrition which affect the health of the mother and the foetus. In the 2015 National Family and Health Survey (NFHS), 23% of Indian women had a BMI less than 18.5 kg/m^2 and 53% were anaemic (haemoglobin (Hb) <11 gm/dL) [10]. Maternal anaemia is also associated with postpartum haemorrhage (PPH), LBW, small for gestational age (SGA) babies and perinatal death[11].

For childhood physical growth, many studies determined the negative effect of malnourishment of the mother on motor, cognitive and social-emotional development and worst neuro-development outcomes[12]. India suffers from two fold burden of both obesity and under nourishment[13]. Among women of reproductive age the prevalence of underweight has declined from 36% in2005-2006 to 23% in 2015-2016; the prevalence of overweight/obesity has increased from 13% in 2005-2006 to 21% in 2015-2016[14][15].

MATERIAL & METHODS

Pregnant women attending ANC clinic at Department of Obstetrics and Gynecology, SMS Medical College and attached hospitals were included in the study after fulfilling inclusion and exclusion criteria. Women who gave consent were classified as overweight/obese, normal and underweight on the basis of BMI (weight in kg/height in m^2). Dating ultrasonography scan were done to rule out multiple pregnancies/ectopic pregnancies and to confirm the gestational age. The other investigations required during ANC were done during the following visits and all the women were followed up till 7 days post-partum for any adverse consequences in the mother, fetus and early neonate. Results were collected, compared and statistical analysed.

The maternal outcomes that were compared were Gestational diabetes mellitus, Gestational hypertension, Pre-eclampsia, Anaemia, Antepartum haemorrhage.

The perinatal outcomes compared were Spontaneous labour, Induced labour, Preterm delivery (<37 weeks), Term delivery

(37 to 42 weeks)and Post term delivery (>42 weeks), vaginal delivery and Lower segment caesarean section.

Fetal outcomes like early neonatal death, macrosomia, shoulder dystocia, NICU admissions and Intrauterine growth restriction were compared

RESULTS

Present study was conducted in 120 pregnant women out of which 40 were underweight where as 40 were normal and 40 were overweight classified using WHO criteria for classification of BMI. Mean age of the underweight group was 23.75 ± 3.77 years while that of normal and overweight was 25.48± 4.21 and 25.50 ± 5.47 years respectively. All these group were comparable with respect to parity and other socio demographic characteristics viz. education, socio-economic status and religion etc. (table 1)

40% of overweight women had GDM which was quite higher than underweight and normal BMI group, similarly Preeclampsia, Gestational Hypertension and Eclampsia were 35% , 20% , and 12.5% respectively in overweight group which were higher than rest of the 2 groups, moreover Abruption was present in 15% of the overweight woman while other 2 group did not show a single case of abruption ,

Table 1 Comparison of Socio-demographic parameters according to BMI groups

	BMI			p value
	Underweight (n = 40)	Normal (n = 40)	Overweight (n = 40)	
BMI(Kg/m²)	17.14 ± 0.47	21.44 ± 0.93	29.64 ± 3.21	<0.001
Age (Years)	23.75 ± 3.77	25.48 ± 4.21	25.50 ± 5.47	0.189
Eucation				
Illiterate	1 (2.5%)	1 (2.5%)	0 (0.0%)	0.624
< than 10th	20 (50.0%)	19 (47.5%)	17 (42.5%)	
10th-12th	14 (35.0%)	15 (37.5%)	21 (52.5%)	
Graduate	4 (10.0%)	5 (12.5%)	2 (5.0%)	
≥Post graduate	1 (2.5%)	0 (0.0%)	0 (0.0%)	
Religion				
Hindu	23 (57.5%)	19 (47.5%)	22 (55.0%)	0.647
Muslim	17 (42.5%)	21 (52.5%)	18 (45.0%)	
Socio-Economic Status				
Upper	1 (2.5%)	0 (0.0%)	0 (0.0%)	0.058
Upper Middle	2 (5.0%)	6 (15.0%)	9 (22.5%)	
Lower Middle	16 (40.0%)	21 (52.5%)	21 (52.5%)	
Upper Lower	19 (47.5%)	13 (32.5%)	10 (25.0%)	
Lower	2 (5.0%)	0 (0.0%)	0 (0.0%)	
Gravida				
G1	1 (2.5%)	0 (0.0%)	0 (0.0%)	0.614
G2	22 (55.0%)	20 (50.0%)	26 (65.0%)	
G3	11 (27.5%)	12 (30.0%)	7 (17.5%)	
G4	5 (12.5%)	5 (12.5%)	7 (17.5%)	
G5	1 (2.5%)	2 (5.0%)	0 (0.0%)	
G6	0 (0.0%)	1 (2.5%)	0 (0.0%)	
Parity				
P0	26 (65.0%)	22 (55.0%)	28 (70.0%)	0.286
P1	9 (22.5%)	14 (35.0%)	6 (15.0%)	
P2	5 (12.5%)	3 (7.5%)	6 (15.0%)	
P4	0 (0.0%)	1 (2.5%)	0 (0.0%)	
Previous Caesarean	5 (35.7%)	8 (44.4%)	7 (58.3%)	0.510

Table 2 Comparison maternal outcomes according to BMI groups

	BMI			p value
	Underweight (n = 40)	Normal (n = 40)	Overweight (n = 40)	
GDM (Yes)	2 (5.0%)	5 (12.5%)	16 (40.0%)	<0.001
Hypertension				
None	40 (100.0%)	37 (92.5%)	13 (32.5%)	<0.001
Pre eclampsia	0 (0.0%)	1 (2.5%)	14 (35.0%)	
Gestational Hypertension	0 (0.0%)	2 (5.0%)	8 (20.0%)	
Eclampsia	0 (0.0%)	0 (0.0%)	5 (12.5%)	
IUGR (Yes)	2 (5.0%)	0 (0.0%)	10 (25.0%)	<0.001
APH				
None	37 (92.5%)	39 (97.5%)	34 (85.0%)	0.001
Abruption	0 (0.0%)	0 (0.0%)	6 (15.0%)	
Placenta Previa	3 (7.5%)	1 (2.5%)	0 (0.0%)	
Anaemia	31 (77.5%)	0 (0.0%)	4 (10.0%)	<0.001
AFI (cm)	9.35 ± 1.92	9 . 5 4 ± 1.92	10.04 ± 5.54	0.715
Abnormal Color Doppler	3 (7.5%)	1 (2.5%)	18 (45.0%)	<0.001
Mode Of Delivery				
Spontaneous Vaginal Delivery	27 (67.5%)	11 (27.5%)	4 (10.0%)	<0.001
Induced Vaginal Delivery	5 (12.5%)	16 (40.0%)	10 (25.0%)	
Emergency Caesarean Section	4 (10.0%)	4 (10.0%)	15 (37.5%)	
Elective 3 Caesarean Section	4 (10.0%)	9 (22.5%)	9 (22.5%)	
Instrumental Vaginal Delivery	0 (0.0%)	0 (0.0%)	2 (5.0%)	
Caesarean Section	8 (20.0%)	13 (32.5%)	24 (60.0%)	<0.001

Table 3 Comparison of fetal outcomes according to BMI groups

	BMI			p value
	Underweight (n = 40)	Normal (n = 40)	Overweight (n = 40)	
Baby Weight	2.51 ± 0.40	2.87 ± 0.32	2.35 ± 0.95	0.001
APGAR (1 Minute)	7.80 ± 0.41	7.90 ± 0.30	6.60 ± 2.60	<0.001
APGAR (5 Minutes)	8.43 ± 0.50	10.38 ± 11.63	7.25 ± 2.84	0.020
NICU admission	10 (25.0%)	2 (5.0%)	14 (35.0%)	0.004
Any Fetal complications	0 (0.0%)	0 (0.0%)	12 (30.0%)	<0.001
Fetal complications				

None	40 (100.0%)	40 (100.0%)	28 (70.0%)	<0.001
Early Neonatal Death	0 (0.0%)	0 (0.0%)	6 (15.0%)	
IUD	0 (0.0%)	0 (0.0%)	5 (12.5%)	
Macrosomia	0 (0.0%)	0 (0.0%)	1 (2.5%)	

Table 4 Correlation between BMI (Kg/m²) and Parameters

Parameters	Spearman Correlation (rho)	p value
Baby Weight	-0.06	0.488
APGAR (1 Minute)	-0.33	<0.001
APGAR (5 Minutes)	-0.18	0.052
AFI (cm)	-0.03	0.778

however contrary to this Placenta Previa was absent in overweight group but 7.5% and 2.5% cases of underweight and normal BMI group developed the same . Occurrence of anaemia was also less in overweight group.

LSCS rate was 60% in overweight group which was quite higher than other group (20% in underweight group and 32.5% in normal BMI group) When maternal outcome were compared according to the BMI groups, GDM, hypertension, IUGR, APH , Anaemia , mode of delivery , abnormal colour doppler and LSCS showed significant association with maternal BMI. (Table 2)

Mean birth weight in overweight group is 2.35 ± 0.5 kg which was lowest among 3 groups similar to APGAR score which was 6.6 ± 2.6 and 7.25 ± 2.84 at 1 and 5 minutes respectively. NICU admission was 30% in overweight group which was significantly higher than rest of 2 groups. All foetal complications including early neonatal death, IUD and Macrosomia developed only in overweight group which constituted 30% of overweight women. Among foetal outcomes, all studied variables like birth weight, APGAR score at 1 and 5 minute, NICU admission & foetal complications showed significant differences with respect to BMI. (Table 3)

When correlations were studied for birth weight, APGAR at 1 & 5 minute and AFI with BMI, it was found that increased in BMI adversely affect these parameters i.e., Negatively co-related. APGAR at 1 minute had significantly negative co-relation with BMI (Rho-0.33; p<0.001) however birth weight and AFI also showed negative co-relation but it was not found statistically significant. (Table 4)

DISCUSSION

This study aimed to establish the clinical utility of BMI as a simple tool to identify high risk pregnancies and to assess the possibility of poor feto-maternal outcomes. In this study we found BMI to be significantly associated with Gestational diabetes mellitus, hypertension, anaemia, mode of delivery, proteinuria, and fetal complications like IUGR and macrosomia.

Out of 40 patients in each subset namely underweight, normal and overweight the incidence of GDM was highest in the overweight subset indicating the role of obesity and overweight in developing GDM. Najafi F et al in 2019 published a metanalysis showing an increasing incidence of GDM with increasing BMI[16]. Agrawal S et al in 2016 published an observational study of 1000 pregnant women of which 23 had developed GDM, all of whom were obese thus coherent with our study showing correlation of BMI with GDM[13].

In this study Hypertensive disease in pregnancy show a clear association with a higher BMI. Savitri Al et al did a prospective cohort study including 2252 pregnant women to evaluate the association of BP with pre pregnancy BMI and observed that higher pre-pregnancy BMI was associated with higher pregnancy systolic and diastolic BP[17]. Agrawal S et al, 2016 also found higher incidence of pregnancy induced hypertension in higher BMI[13]. In present study there is a graded increment in BMI with increasing severity of hypertensive disease in pregnancy that is, the mean BMI in gestational hypertension, pre-eclampsia and eclampsia is 26.93 ± 2.91, 29.92 ± 3.51 and 31.06 ± 5.69 respectively which shows the ascending trend.

The present study found a significantly higher proportion of cases of APH in the overweight category of pregnant females as found in 2016 by Agrawal S et al in her study of Even though the incidence was higher in overweight females in this study the association was not statistically significant (p=0.042) unlike in our study where statistical significance is also present with similar finding.

Intra Uterine Growth Restriction (IUGR) / fetal growth restriction has been found to be closely associated with obesity in this study with very high occurrence of 25% of obese pregnant women developing IUGR. In a study by Lewandowska M. et al a multiple analysis showed that pre-pregnancy obesity increased the risk of low birth weight (LBW) as well as fetal growth restriction (FGR)[18].

Anaemia is very prevalent among pregnant Indian women and can be a very important predictor of poor feto-maternal outcome. Anaemia was seen in 35 of our 120 cases of which 31 were from the underweight category thus showing a very high preponderance of anaemia in the low BMI category of pregnant females. A study by Tan J et al in 2018 including 11,782 pregnant women from 24 hospitals showed that underweight pregnant women, compared with normal women, were associated with higher risk of test Iron Deficiency Anaemia[19].

It is observed in this study that a higher preterm delivery occurred in women with higher BMI. Kosa JL et al conducted a study in 2011 found that for women with BMI > 24 kg/m², the odds of PTD increased with increasing BMI[20].

23 emergency caesareans were done in this study of 120 cases of which 15 were in the overweight category which was found to be associated with higher incidence of pre-eclampsia and eclampsia which had to be managed by terminating the pregnancy immediately.

Low APGAR Score at 1 minute and NICU admissions were found higher in the overweight category probably reflecting the high incidence of preterm deliveries. 35% of the overweight deliveries had NICU admission. Early neonatal death was seen in 6 pregnancies in our study, all of which were in the overweight category. Intra uterine fetal death was seen in 5 cases in our study all of which were in the overweight category. Nohr EA et al examined 54,505 pregnant women. In this study, compared with normal-weight women (18.5 < or = BMI < 25), the risks of fetal death among obese women (BMI > or = 30), expressed as adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) were as follows: before week 14: 0.8 (0.5-1.4), weeks 14-19: 1.6 (1.0-2.5), weeks 20-27: 1.9 (1.1-3.3), weeks 28-36: 2.1 (1.0-4.4), weeks 37-39: 3.5 (1.9-6.4), and weeks 40+: 4.6 (1.6-13.4). Overweight women (25 < or = BMI < 30) also experienced a higher risk after 28 weeks, and especially after 40 weeks of gestation (HR 2.9, 95% CI 1.1-7.7)[21]. of the 120 cases we had 1 case of macrosomia which was as expected in the overweight category. The patient also had gestational diabetes mellitus. Vinturache AE et al published a study in 2017 of 1996 singleton term deliveries, of which 198 had macrosomia[22]. In this study 8% of the normal weight category females delivered babies with macrosomia while 13.3% of the overweight and obese categories delivered babies with macrosomia thus suggesting a significant association of high

pre pregnancy BMI with macrosomia[22]. Of the 21 abnormal color doppler findings seen in our study 18 were from the overweight category. 18 of the 40 patients that is 45% of the overweight and obese pregnant women had abnormal color doppler finding thus correlating with the high prevalence of hypertensive disease in pregnancy and fetal growth restriction in the same group. Laura Sarno et al in her study of one hundred eighty-five women found that mean pulsatility index of umbilical artery at 32+0 was significantly higher in obese women (0.95±0.01 vs 0.87±0.01 vs 0.67±0.01; p<0.05) [23]. They found a positive correlation between Pulsatility Index of Umbilical Artery and maternal BMI (r2=0.7; p<0.05). Thereby concluding that there is a positive correlation between BMI and pulsatility index of umbilical artery, These findings suggest that obesity has a negative effect on feto-placetal vessels[23].

CONCLUSIONS

The findings of our study suggest that early pregnancy BMI is a good indicator of possible complications in the antenatal and postnatal period. Our study shows a higher fetal and maternal complications in women with abnormal BMI. Recognition of the underweight and the overweight/obese women in early pregnancy can help obstetricians to focus on high-risk pregnancies that require close monitoring.

A simple and easy to derive parameter like BMI can work as a promising tool to anticipate the possible feto-maternal complications, its prevention and better management. Underweight and overweight/obese women if identified early allow a proper planning throughout the antenatal and postnatal period for better risk management. Proper dietary assessment and counselling can be provided to women as per their BMI in early pregnancy.

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