

ORIGINAL RESEARCH

The Effects of Maternal Body Mass Index on Maternal and Perinatal Outcome

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ABSTRACT

Background: The increasing prevalence of obesity is presenting a critical challenge to health care services. The precipitous rise in the prevalence of obesity is mirrored in the antenatal population and number of women entering pregnancy with obesity is high. In India 26% of pregnant women are overweight and 8% are obese. **Objectives:** To study the women from a variety of ethnic groups and socio-economic strata, to determine the effect of maternal BMI on maternal and perinatal outcome.

Material and Methods: This was a prospective Observational study. A total of 248 pregnant mothers at first visit in first trimester attending the regular antenatal clinics of OBG Department at St. John's medical college Hospital between November 2018 – November 2020 were sorted out based on inclusion and exclusion criteria and were included in the study after informed consent. BMI measured using formula of $BMI = (\text{weight in kilograms} / \text{height in meters}^2)$. The cut-off limits for Asians as per (WHO) was taken. Baseline (ANC) routine investigations were performed as per the hospital protocol. All findings were noted in a Performa and records were maintained till delivery. All pregnant mothers were counselled to have followed up visits till delivery. All the babies were be examined by the Neonatologist. APGAR scores of the babies, and neonatal intensive care unit (NICU) admissions were recorded. The required sample size was 248 for 80% power and 5% statistically significant. The Qualitative data was summarized by count and percentage. Quantitative data was summarized by mean and standard deviation (SD). The association between qualitative variable was assessed by chi square test and contingency table analysis. The quantitative variable was compared according different groups independent t test and ANOVA.

Results: The study observed that there is strong association of increased BMI in pregnant mothers and complications like preeclampsia, GDM, caesarean delivery and larger babies. Whereas, underweight women had more chances of preterm delivery needing NICU care for the child.

Conclusion: Maternal BMI and pregnancy outcome have strong correlation and young women who are conceiving are overweight. Therefore, it is essential to create awareness in the young women to have healthy life style and regular exercise to maintain normal BMI prior to conception as it is a modifiable risk factor.

Keywords: BMI; pregnancy complications; healthy lifestyle; exercise.

INTRODUCTION

Obesity is where a person has accumulated abnormal or excessive body fat that causes negative effects on health. According to National family health survey India-3 (NFHS-3), thirteen percent of women (15-49 Years) and nine percent of men (15-49 Years) were overweight or obese in 2005-06. Overweight prevalence was higher in urban areas than rural areas and lower in people who are involved in agriculture or manual work.[1]

Obesity and overweight have become major health concerns in women of childbearing age, and their prevalence has been increasing worldwide. Data from the Pregnancy Risk Assessment Monitoring System (PRAMS) indicated that 45% of US women who give birth were overweight and obese before pregnancy [2]. The percentage of women who are obese at their first antenatal visit nearly doubled between 1990 and 2004 [2]. High maternal body mass index (BMI) is related to adverse maternal pregnancy outcomes such as pre-eclampsia, eclampsia, pre- and post-term delivery, induction of labour, macrosomia, caesarean section, and postpartum haemorrhage [3]. India has more than 30 million obese people, and the number is increasing alarmingly. The problem is more acute among women than men. In urban India, more than 23% of women are either overweight or obese, which is higher than the prevalence among men (20%) [4]

Emerging evidence suggests obesity is associated with increased complications during pregnancy, labour and delivery, and into the postpartum period, as well as adverse neonatal outcomes which include fetal growth abnormalities such as macrosomia, neural tube defects and stillbirth [5]. These have implications for obstetrical management and maternal and neonatal care. In addition to the deleterious impact on the overall health of pregnancy, obesity may also affect clinical decisions for the management of labour and delivery. Accumulating evidence suggests that obesity contributes to the increased rates of labour induction [6] and obstetrical interventions. Labour progression is significantly slower in obese women [7] whereas duration of labour, oxytocin requirements and caesarean delivery rates increase with increasing maternal body mass index (BMI). Not only obese, but also overweight women are at increased risk of adverse pregnancy and neonatal outcomes. While current knowledge on the complex interactions between obesity and pregnancy outcomes has increased awareness over the past decade to this modifiable risk factor for maternal and neonatal health, a number of gaps remain. Therefore, an understanding of the management of obesity during pregnancy begins prior to conception and continues through the postpartum period; that is, it must be seen from a life-course perspective.

MATERIAL & METHODS

After the informed consent from the pregnant mothers they were enrolled in the study. Primigravida with singleton pregnancy with first visit before 12wks of gestation were selected. Multi Para, multiple pregnancy, presence or history of any medical disorders like chronic HTN, T2DM, cardiac disease, coagulation disorder were excluded. Complete history regarding present, past and obstetric history obtained. Detailed general physical and systemic and obstetric examination was performed at the first visit. The measurements of height and weight was taken by means of standard methodology, BMI was calculated using formula (weight in kilograms / height in meters²). cut-off limits for Asians as per World health organization (WHO) are (less than 18.5kg/m² is underweight, 18.5 – 22.9kg/m² is normal, 23- 27.5kg/m² is overweight and 27.5kg/m² or higher is obesity. Baseline (ANC) routine investigations were performed as per the hospital protocol. All findings were noted down in a Performa and records were maintained till delivery. All pregnant mothers were counselled to

have follow up visits as per the standard protocol, till delivery. All the babies were examined by the Neonatologist. APGAR scores of the babies, and neonatal intensive care unit (NICU) admissions were recorded. A sample size of 250 taking relative risk of preterm birth assume to be 1.5 (A.S. Khashan, L.C. Kenny 2009) and prevalence of preterm birth in India 21%. The required sample size is 248 for 80% power and 5% statistically significant. The Qualitative data was summarized by count and percentage. Quantitative data was summarized by mean and standard deviation (SD). The association between qualitative variable was assessed by chi square test and contingency table analysis.

The quantitative variable was according to different groups independent t test and ANOVA. The objectives of the study are to determine the maternal risk in relation to maternal BMI like Gestational hypertension, Pre-Eclampsia, LSCS and macrosomia, and LBW babies. To find out the Prevalence of obesity among the antenatal population coming to St. Johns medical college Hospital and to determine the neonatal outcome in relation to maternal BMI such as preterm birth, macrosomia, large for gestational age, small for gestational age.

RESULTS

A total of 248 booked primigravida were included in the study, with a mean age of 24.64(SD+3.75) years. The mean height and weight of the study population was 155.3(SD+6.35) and 55.98(SD+10.95) respectively. The mean BMI was 23.25 kg/m². Thirty (SD+12.1%) women in the study population were found to be underweight.

Most patients were young mothers, commonly in the age group of 20 - 24yrs (43.95%), while older mothers >30 yrs were 10% of the study population. Among women less than 20 years, 15% were underweight, 45% had normal BMI, 30% were overweight and 10% were obese. Between 20 -24 years, 18.35% mothers were underweight, 37.61% had normal BMI, 33.03% Overweight and 11.01% were obese. Between 25- 29years age group, 7.37% were underweight, 35.79% normal BMI 43.16% were overweight and 13.68% were obese. Greater than 30 years age mothers none were underweight, 25% had normal BMI, 41.67% were overweight and 33.33% were Obese. Also our study shows overweight mothers 93(37.5%) to comprise a major part of the study population, in comparison to other spectrums of malnutrition, such as underweight and obese mothers.

Significant association was observed with age and the BMI of mothers (p=0.028a). Among patients >30yrs, 33.3% women were obese, 41.67% were overweight. (Table 1).

Table 1: Association of age group to BMI category

Age(Years)	Under wt (%)	Normal(%)	Over wt(%)	Obese(%)	p value
<20	15	45.0	30.0	10.0	0.028 ^a
20-24	18.35	37.61	33.03	11.01	
25- 29	7.37	35.79	43.16	13.68	
>=30	0.0	25.00	41.67	33.33	
a=Chi-Square; b=Fisher's exact; *statistically significant at $\alpha=5\%$ and $p<0.05$.					

Obstetrics Complications**Gestational Diabetes (GDM)**

Although 89.1% of subjects had a normal glucose tolerance test, GDM was present in 10.88% of the total study population. Patients received various treatment modalities ranging from simple diet modification (6.45%), to receive hypoglycaemic drugs (1.61%) and requiring insulin in (2.82%) of the overall study population. Mothers who were underweight who developed GDM were only 3.33% and required only diet modification, mothers with normal BMI 7.78% developed GDM and required only diet control. Mothers who were overweight 12.90% developed GDM of which 7 mothers required only diet control and 2 mothers OHA and 3mothers needed Insulin. Mothers who were obese 20% developed GDM of which only 1 was on diet and 3were on OHA and 3 required insulin to control sugar. Although not significant, associations were observed with respect to BMI and GDM as an antenatal complication. Obese mothers (20%) were at higher risk of developing GDM and its complications in comparison to normal (7.78%) and underweight (3.33%) mothers.

Hypertensive disorders of pregnancy on BMI

A common complication noticed in the study subjects was increase in blood pressure. All spectrums of hypertension in pregnancy were seen including Gestational hypertension 14(5.65%), Non severe preeclampsia 14(5.65%), severe preeclampsia 28(11.29%) and even eclampsia 2(0.81%). (Table 2)

Among the underweight mothers, 6.67% developed GHTN and 13.33% severe preeclampsia and rest had normal BP reading. Mothers with normal BMI had 2.22% GHTN, 4.44% Non-severe PE and another 4.44% had sever PE. Mothers who were overweight 5.38% had GHTN, 7.53% non -severe PE and 16.13% had severe preeclampsia. Obese mothers 14.29% developed GHTN, 8.57% had non-severe PE and 20% had severe preeclampsia. Our study shows a strong correlation with BMI and preeclampsia. Preeclampsia significantly seems to be associated with obese (20%) and overweight (16.13%) pregnant women in comparison to the general population ($p=0.013a$). A similar trend is noticed with respect to BMI and gestational hypertension and non-severe preeclampsia, whereas the relationship is inversed in the normal population. (Table 3).

Table 2: Complication of hypertension in pregnancy

Category	Frequency	Percentage
Normal	190	76.61
GHTN	14	5.65
Non-S.PE	14	5.65
S. PE	28	11.29
Eclampsia	2	0.81

Table 3 BMI and GHTN/Preeclampsia

Category	Normal(%)	GHTN(%)	Non S. PE(%)	Preeclampsia(%)	p value
Under Weight	80	6.67	0.0	13.33	0.013 ^a
Normal	88.89	2.22	4.44	4.44	
Over Weight	70.97	5.38	7.53	16.13	

Obese	57.14	14.29	8.57	20.0	
a=Chi-Square; b=Fisher's exact; *statistically significant at $\alpha=5\%$ and $p<0.05$.					

Gestational Age

Term deliveries especially at 37-40 weeks of gestational age (74.19%) was commonly seen, in comparison to those women who delivered <34wks of GA (4.44%). (Table 4)

Significant association with preterm and BMI in the study population was noticed. Patients with a low BMI had higher chance of preterm (30%) delivery in contrast to that of mothers with normal BMI (13.33%) or obese (5.71%). Inversely, term deliveries were frequently noticed with mothers in the obese (94.29%) and overweight (86.02%) category. (Table 5)

Table 4. BMI and Gestational Age

Gestational Age	Frequency	Percentage
<34	11	4.44
34 – 36+6	25	10.08
37 – 40	184	74.19
>40	28	11.29

Table 5: Gestational age at delivery and association with BMI

Category	Preterm (%)	Term (%)	p value
Under weight	30	70.0	0.04 4 ^a
Normal	13.33	86.67	
Over wt.	13.98	86.02	
Obese	5.71	94.29	
a=Chi-Square; b=Fisher's exact; *statistically significant at $\alpha=5\%$ and $p<0.05$.			

Mode of delivery

It was found that frequency of caesarean deliveries was very high in our study. 114 (46%) had normal vaginal deliveries, 128(52%) had caesarean and 6(2%) had instrumental deliveries. (Figure 1)

Among underweight mothers 70% had normal vaginal delivery and 30% underwent caesarean section, mothers with normal weight 54.44% had normal vaginal delivery and 45.56% had caesarean section and overweight mothers 56.99% had caesarean section and obese mothers 71.43% underwent caesarean section. Compared to mothers with normal BMI, over weight and Obese mothers had LSCS rate of 56.99% and 71.43% which is extremely high. Least is in underweight constituting to 30%.

Birth Weight

Low birth weight babies 55(22.18%) and babies with birth weight exceeding 3.5kgs 24 (9.68%) were seen when compared to the 68.15% of the general study participants who delivered babies of normal birth weight.

Underweight mothers had a higher chance of delivering low birthweight babies (36.7%) and no babies were >3.5kg in underweight mothers. where as in obese mothers 22.86% of babies were >3.5kg and only 11.43% babies were below 2.5kg. Overweight mothers had 27.96% low birthweight babies and 5.38% had >3.5kg babies, mothers with normal BMI had 15.56% had <2.5kg babies and 12.22% had >3.5kg babies. (Table 6)

Table 6: Maternal BMI and Birth weight of babies

Category	<2.5 Kg (%)	2.5-3.5kg (%)	>3.5kg (%)	p value
Underweight	36.7	63.33	00	0.003 ^a
Normal	15.56	72.22	12.22	
Over wt.	27.96	66.67	5.38	
Obese	11.43	65.71	22.86	
a=Chi-Square; b=Fisher's exact; *statistically significant at $\alpha=5\%$ and $p<0.05$.				

NICU Admission

157(63.31%) babies did not require admission to intensive care units. RDS (20.97%) was the major indication for NICU stay in neonates, followed by other major complications like HIE (2.02%), sepsis(1.61%) etc.

Although not statistically significant at p value, a higher proportion babies of mothers who were underweight had been admitted to NICU with RDS (23.3%) as a major indication. It is seen that the overall admission to NICU was seen in mothers with low BMI, in all categories. In obese mothers 14.29% babies needed NICU admission for RDS and in overweight 15.05% required NICU. (Table 7)

Table 7: Maternal BMI and NICU admission

Category	No (%)	RDS (%)	Others (%)	P Value
Underweight	50	23.3	26.67	0.709 ^a
Normal	65.56	21.11	13.33	
Over wt.	64.52	20.43	15.05	
Obese	65.71	20.0	14.29	

DISCUSSION

This is a prospective study conducted in the department of Obstetrics and Gynaecology, St. John's Medical College, from November 2018 – November 2020. It is done to study the effect of prepregnancy weight on the pregnancy and its perinatal outcome. Consumption of energy dense food, sedentary life style, lack of health care services and financial support, are high risk factors for Obesity. All these risk factors can be overcome, corrected and optimized. And it is well known that a normal pre pregnancy BMI has better obstetric outcomes, as compared to those women with obesity. Our study suggests that obesity measured by BMI, predisposes women to complicated pregnancies and increased obstetric interventions. In our study of 248 primigravida, majority were in normal child bearing age group out of which 12.1% were underweight, 37.5% were Overweight, 14.11% were Obese and only 36.29% had normal BMI.

Since most of our women belonged to middle or low socioeconomic class, this high risk of prevalence of overweight and obesity was contrary to our expectation, Which could be due to

an increasing influx of IT industry in Bangalore. The food habits and sedentary lifestyle changes could have resulted in weight gain.

Age plays a significant role in the obstetrics and it is seen in our study. Significant association was noted with age and body mass index of mothers ($p = 0.028$). Among mothers <20yrs (45%) of them are observed to have normal BMI. Whereas in older mothers 41.67% were overweight and 33.3% were obese. Study by Bhushan N et al, states that overweight and obese women were slightly older and short statured compared with normal BMI. [8]

Sohinee Bhattacharya et al in their study found that the underweight category was significantly younger (mean age 24.8 SD 5.2) while those in the morbidly obese group were significantly older (mean age 28.3 SD 5.3) [9]

Gestational hypertension occurs frequently in overweight and obese women. Certain factors like oxidative stress and circulating inflammation markers are seen in Obesity along with elevated plasma levels of C- reactive protein, inflammatory cytokines, tumour necrosis factor- α (TNF- α), interleukin-6 (IL-6) and interleukin-8 (IL8) which have implications in preeclampsia as well. [10]

There is strong correlation with BMI and preeclampsia. Preeclampsia significantly seems to be seen in obese(20%) and overweight(16.13%) pregnant women in comparison to the general population ($p=0.013a$). Similar outcome observed in the study performed by Syed Uzme et al, hypertensive disorders were significantly greater ($p = 0.025$) on obese as compared to normal weight women.[11]. Bianco and colleagues conducted a retrospective cohort study of 613 obese women and 1131 non obese women. A fourfold increased risk of preeclampsia was reported in obese women. [12]

Although not significant, association was observed in our study with respect to BMI and GDM as an antenatal complication. Obese mothers (20%) were at higher risk of developing GDM and requiring interventions like OHA and Insulin to control sugars in comparison to normal (7.78%) and underweight (3.33%) mothers who had good control with diet. Bianco and colleagues reported a increase of three fold of GDM for obese patients (12). A retrospective cohort study of a multi-ethnic population also revealed GDM was the most common adverse pregnancy outcome in obese and overweight mothers.

Strong association has been observed in our study in the mode of delivery and the BMI. Caesarean rates of normal, overweight and Obese mothers were 45.56%, 56.99% and 71.43% respectively. Least is in underweight 30%. Weiss and colleagues reported that rate of caesarean section among nulliparous women to be 20.7% for normal weight women, 33.8% for class 1 obese and 47.4% class 2 obese patients. [13].

Significant association with preterm and BMI in our study population was noticed. Patients with a low BMI had higher chance of preterm (30%) delivery in contrast to that of mothers with normal BMI (13.33%) or obese (5.71%). Inversely, term deliveries were frequently noticed with mothers in the obese (94.29%) and overweight (86.02%) category. The contrary results were seen in study by Sarah D McDonald, et al (14) in the pooled cohort studies the overall risk of preterm birth before 37 weeks did not differ significantly among overweight or obese women with singleton pregnancies (relative risk 1.06, 0.87 to 1.30, 38 studies,) very obese women having a relative risk of 1.15, 1.56, and 1.71 respectively. In our study underweight mothers had a higher chance of delivering low birthweight babies (36.7%) when compared to their counterparts, where in 22.86% of women who delivered big babies of birthweights >3.5kgs were obese($p=0.003a$).

This is consistent with other studies such as Han et al (15) and Kanadys (16) that macrosomia or babies with higher birth weight is common in obese and overweight women. The study by

Nisha Bhushan (8) showed that the mean birth weight of babies increased with increase in BMI ($p < 0.0001$), they also found that the risk of macrosomia increased with increased with increase in BMI ($p < 0.05$, $p < 0.001$ respectively).[8]

Although P value is not statistically significant, a higher proportion babies of mothers who were underweight had been admitted to NICU with RDS (23.3%) as a major indication. It is seen that the overall admission to NICU was seen in mothers with low BMI, in all categories. Contrary outcomes were seen in in babies in study by Nisha Bhushan, that the number of NICU admissions increased significantly with increase in BMI ($p=0.02$).

CONCLUSION

Women of reproductive age group have increase BMI, Pregnancy complications increases with increase in BMI such as pre- Eclampsia, GDM, caesarean delivery and big baby. Whereas, underweight is associated with preterm and low birth weight. Also, NICU admission of the new-born was seen in foetuses of mothers who were underweight.

It is a modifiable risk factor therefore it is the need of the hour to educate and motivate the women of reproductive age group to maintain normal BMI by regular exercise, cutting down in their junk food and to have healthy diet active lifestyle prior to conception to prevent obesity associated complications and to have healthy motherhood and baby.

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