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A prospective cohort study of adverse fetomaternal outcomes among overweight, obese, and normal weight pregnant women with term singleton pregnancy in a tertiary care hospital

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ABSTRACT

Background: Globally, overweight and obesity are the common risk factors with increasing frequency for adverse fetomaternal outcomes. In resource-poor countries, it is emerging as a threat for favorable pregnancy outcome even with the prevalence of high hunger index. **Aims and Objectives:** This study aims to determine the impact of obesity and overweight in pregnancy on fetomaternal outcomes in comparison to normal weight mothers. **Materials and Methods:** A prospective cohort study was conducted in a tertiary care center for 1½ years with singleton term pregnancies and 64 mothers with body mass index (BMI) ≥25 kg/m^2 (cases) were compared with 64 normal weight mothers with BMI 18.5–24.9 kg/m^2 (controls). Maternal and perinatal outcome was analyzed during antenatal, intranatal periods and after delivery along with the follow-up of newborns up to early neonatal period. **Results:** After optimizing the two groups in different sociodemographic status, the result shows significantly higher weight gain (P<0.001), incidence of gestational diabetes mellitus (P<0.001), hypertensive disorders of pregnancy (P<0.001), and macrosomia (P<0.001) in overweight and obese pregnant women than their normal weight counterparts. Increased cesarean section rate (P<0.001), postpartum hemorrhage (P<0.005), neonatal low Apgar score at 5 min (P<0.05), neonatal intensive care unit admission (P<0.05), and higher rate of early neonatal death were also observed in cases group than controls group. **Conclusion:** Pre-pregnancy intervention for optimization of maternal weight with proper surveillance of every pregnant mother of this subset and vigilant neonatal care may improve the obstetric and perinatal outcome.

Key words: Apgar score; Macrosomia; Obesity; Overweight

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INTRODUCTION

The incidence of overweight and obesity with their adverse effects on health has been increasing gradually and obesity is considered to be the most prevalent medical disorder worldwide.[1] The World Health Organization (WHO – June 9, 2021) estimated that 13% of total population globally (11% of males and 15% of females) and 39% of adults above 18 years of age are obese. There is a sharp increase in overweight and obese pregnant women in middle- and low-income countries including India (2014) that accounts for 11.1% of global estimation. However in the higher income

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countries like the US, calorie supply and urbanization positively affect the weight gain among pregnant women and every third of them is obese.[2]

Body mass index (BMI) or Quetelet index is a common globally accepted method for the assessment of obesity. Maternal pre-gravid obesity is a real obstetric problem with increasing challenge for the treating obstetricians rather than excessive weight gain, development of gestational.[3]

The categorization of maternal obesity as per the WHO and many other scholars are as follows:[4]

Category	Subgroup	BMI (kg/m²)
Underweight	--	<18.5
Normal weight	--	18.5–24.9
Overweight	--	25–29.9
Obese	Class I	30–34.9
	Class II	35–39.9
	Class III	>40

BMI: Body mass index

Pregnancy with overweight or obesity poses significant risk of miscarriage, congenital anomaly, and complications such as hypertensive disorders of pregnancy (HDP), gestational diabetes mellitus (GDM), instrumental vaginal delivery, cesarean section, postpartum hemorrhage (PPH), and surgical site infections (SSIs).[5] On the other hand, poor neonatal outcomes in terms of macrosomia, stillbirth, shoulder dystocia, and early neonatal death may happen as well.[6]

In obesity, the adipose tissue acts as an endocrine gland causing increased insulin resistance and forms a chronic low-grade inflammatory condition mediated through release of inflammatory mediators such as interleukin-6 and C-reactive protein.[7] Although the effect of obesity on general population is well understood, its impact on pregnancy still needs to be evaluated as nutritional transition and obesity in the developing countries (e.g., India) is real threat.[8] We conducted this study is to determine the adverse maternal and perinatal outcome among pregnant overweight and obese women in comparison to normal weight pregnant women with term singleton pregnancy.

Aims and objectives

This study aims to determine the adverse maternal and perinatal outcome among pregnant overweight and obese women in comparison to normal weight pregnant women with term singleton pregnancy.

MATERIALS AND METHODS

It is a prospective cohort study conducted at the Department of Obstetrics and Gynaecology of R.G. Kar Medical College and Hospital, Kolkata, India, over a period from February 2020 to July 2021. A total of 128 pregnant mothers attending antenatal clinic participated after getting approval from the Institutional Ethics Committee. Informed consent was obtained from every participant. Pregnant mothers with singleton pregnancy at gestational age up to 12 weeks (diagnosed by ultrasonography) were included and divided into two groups of cases and controls following BMI calculations. Since early pregnancy BMI does not defer much from pre-pregnancy BMI and most women cannot state their pre-pregnancy weight accurately, we considered the first trimester BMI as equivalent to the pre-pregnancy BMI.[9] Maternal medical disorders that may affect BMI including hypo/hyperthyroidism, adrenal disorders, type 2 diabetes mellitus, and renal disorders were excluded from the study. Participants who had a history of preterm birth (<37 completed weeks of gestation) and/or cesarean deliveries in the previous pregnancy were also excluded from the study.

The sociodemographic variables such as age, residence, parity, and socioeconomic status are tabulated and compared to optimize the study subjects between the controls (normal weight) and cases (overweight and obese) group. Modified Kuppuswamy classification was used to categorize the study subjects into lower, upper-lower, and middle class mothers according to their socioeconomic status (no upper or upper-middle class mother was found in this government medical college).[10]

Study outcome variables including maternal weight gain, development of GDM, gestational hypertension, preeclampsia, eclampsia, failure of induction of labor, duration of labor, PPH, mode of delivery, incidence of perineal injury, and SSI were compared between the two groups. Neonatal outcomes in terms of congenital anomaly, macrosomia, stillbirth, shoulder dystocia, Apgar score at birth, early neonatal death, and neonatal intensive care unit (NICU) admission were also recorded and analyzed. Birth weight of 90th percentile (>3.45 kg) was considered as macrosomia in Indian population.[11]

Ethics

The study follows the Helsinki Declaration regarding its bioethics policy. Informed consent was taken from every participant. Anonymity as well as data confidentiality were also maintained.

Statistical analysis

Continuous variables were analyzed by independent Student's t-test or Mann–Whitney U-test depending on the data distribution. Categorical data were analyzed by Chi-square or Fisher's exact test, as appropriate. Statistical significance was considered when $P<0.05$ was considered.

MedCalC version 16.1.0 (MariaKerke Belgium, MedCalC software 2012) was used for statistical analysis.

RESULTS

In this study, 64 pregnant women with singleton term pregnancy having BMI ≥25 kg/m^2 were compared with 64 controls with singleton term pregnancy with BMI 18.5–24.9 kg/m^2, and obstetric and perinatal outcome was critically analyzed among two groups. Sociodemographic characteristics were similar in normal BMI and obese/overweight groups (Table 1). Fetomaternal morbidities or adverse outcomes during antepartum, labor, and postpartum periods are compared in Table 2. Antenatal maternal morbidities including the weight gain during pregnancy, occurrence of GDM, and HDP (gestational hypertension, preeclampsia, and eclampsia) were significantly higher (P≤0.001) in obese and overweight women when compared to pregnant individuals with normal BMI. Labor was induced in 40.6% of obese and overweight mothers and it was significantly (P<0.05) higher if compared with controls and the rate of induction failure was much higher too in the cases group (61.5%) though no statistical significance was found. Operative morbidity was increased due to cesarean section (51.56%) in the cases group (P<0.001). Although, the rate of instrumental vaginal delivery in the cases group (12.7%) was higher than the control group (4%), the difference was not statistically significant. Incidence of perineal laceration in the cases group (35.5%) was higher than the control group (6%) with statistical significance. Incidence of shoulder dystocia was not significantly high among obese and overweight mothers. Incidence of macrosomia in the cases group (26.56%) was much higher than the controls group (4.7%) and the difference was statistically significant. Postpartum complications such as PPH (21.9%) and SSI (36.4%) of cesarean wound happened significantly more (P<0.05) in the cases group. On the other hand, though stillbirth rate and incidence of congenital anomaly in the cases group were 5 times (7.8%) and 4 times (6.25%) more than the controls group, respectively, the differences were found to be statistically insignificant.

Table 3 compared the newborn outcome variables of both groups in relation to Apgar score at 5 min, NICU admissions, and early neonatal death in live births. Apgar score and NICU admission showed a statistically significant negative outcome for the newborns of overweight and obese mothers. Early neonatal death (within 7 days after birth) was nil in newborns of normal weight mothers but there were three early neonatal deaths in the cases group among the live births, but no statistical significance was found (P=0.110).

DISCUSSION

Pregnant mothers with obesity are at higher risk of having maternal and perinatal complications and these risks are further amplified with increasing severity of the condition.[12,13] It has been estimated that one-quarter of adverse pregnancy outcomes including HDP, GDM, preterm births, and large for gestational age babies are due to maternal obesity or overweight.[13] In this study, weight gain during pregnancy was more in overweight and obese women which is similar to the observations by Dodd et al., and they recommended limitation of weight gain in this subset of women for better pregnancy outcome.[14] Antenatal medical morbidities such as HDP and GDM were also found to be significantly high in overweight and obese women in our study, and the findings were comparable to the observations by Ramya et al., who showed significant increase in incidence of both in obese and overweight women separately (more in obese) than normal weight mothers.[15] Fetal macrosomia results in several maternal and/or fetal complications and maternal obesity seems to have a greater impact on prevalence of macrosomia than diabetes.[16] In this study, the incidence of macrosomia was significantly higher in overweight and obese women which is comparable to the study conducted by Gaudet et al.[17] The incidence of stillbirth was 5 times more, that is, approximately 7.8% in the cases group than the controls group. Higher incidence was found particularly in extreme obesity (Class III) in a study conducted by Yao et al.[18] They also concluded that the association is strongest at early- and late-term gestational

Table 1: Distribution of patients (cases and controls) according to socio-demographic characteristics

PARAMETERS		CONTROLS (n=64)	CASES (n=64)	P VALUE
Mean age in years±standard deviation		21.98±0.96	22.64±0.994	0.803
Residence	Urban	39 (61%)	35 (54.7%)	
	Rural	25 (39%)	29 (45.3%)	0.474
Socio-Economic	Lower	36 (56.25%)	34 (50%)	
Status	Upper Lower	23 (35.94%)	24 (37.54%)	0.919
	Middle	5 (7.81%)	6 (9.4%)	
Gravida	Primigravida	43 (67.2%)	39 (60.9%)	
	Multigravida	21 (32.8%)	25 (39.1%)	0.461

P value for continuous variables was calculated by independent student t test and categorical variables by Chi-square test/Student's t-test. Values less than 0.05 were considered significant and values less than 0.001 were considered highly significant

Table 2: Distribution of patients (cases and controls) according to the maternal and fetal antenatal and postnatal parameters

PARAMETERS		CONTROLS (n=64)		CASES (n=64)		P VALUE
Weight gain during pregnancy	<13 kg	62 (96.9%)		43 (67.2%)		<0.001
	≥13 kg	2 (3.1%)		21 (32.8%)		
Gestational Diabetes Mellitus	Yes	4 (6.3%)		23 (35.9%)		<0.001
	No	60 (93.7%)		41 (64.1%)		
Hypertensive Disorders of Pregnancy	Normotensive	58 (90.6%)		36 (56.25%)		<0.001
	Gestational Hypertension	3 (4.7%)		6 (9.37%)		
	Pre-eclampsia	2 (3.1%)		20 (31.25%)		
	Eclampsia	1 (1.6%)		2 (3.13%)		
Induction of Labor		**Not Induced**	**Induced**	**Not Induced**	**Induced**	
		51 (79.7%)	13 (20.3%)	38 (59.4%)	26 (40.6%)	<0.05
		--	**Failure** / **Success**		**Failure** / **Success**	0.636
			4 (30.8%) / 9 (69.2%)		10 (61.5%) / 16 (38.5%)	
Mode of Delivery		**Cesarean Section**	**Vaginal Delivery**	**Cesarean Section**	**Vaginal Delivery**	
		14 (21.9%)	50 (78.1%)	33 (51.56%)	31 (48.44%)	<0.001
		--	**Normal** / **Instrumental**	--	**Normal** / **Instrumental**	0.196
			48 (96%) / 2 (4%)		27 (87.3%) / 4 (12.7%)	
Perineal Laceration	Yes	--	3 (6%)	--	11 (35.5%)	<0.001
	No		47 (94%)		20 (64.5%)	
Shoulder Dystocia	Yes	--	0	--	1 (3.2%)	0.382
	No		50 (100%)		30 (96.8%)	
Cesarean section Surgical Site Infection	Infected	1 (7.1%)	--	12 (36.4%)	--	<0.05
	Healthy	13 (92.9%)		21 (63.6%)		
Postpartum Hemorrhage	Yes		3 (4.7%)		14 (21.9%)	<0.05
	No		61 (95.3%)		50 (78.1%)	
Macrosomia	Yes		3 (4.7%)		17 (26.56%)	<0.001
	No		61 (95.3%)		47 (73.44%)	
Baby Born	Stillbirth		1 (1.6%)		5 (7.8%)	0.094
	Livebirth		63 (98.4%)		59 (92.2%)	
Congenital Anomaly	Present		1 (1.6%)		4 (6.25%)	0.361
	Absent		63 (98.4%)		60 (93.75%)	

P value for variables was calculated by Chi-square/Fisher's Exact test. Values less than 0.05 were considered significant and values less than 0.001 were considered highly significant

Table 3: Newborn outcome comparison in live births between cases and controls

PARAMETERS		CONTROLS (64 – Stillbirth, n=63)	CASES (64 – Stillbirth, n=59)	P VALUE
Apgar score at 5 minutes	≤7	8 (12.7%)	18 (30.5%)	<0.05
	>7	55 (87.3%)	41 (69.5%)	
NICU Admission	Yes	11 (17.46%)	25 (42.37%)	<0.05
	No	52 (82.54%)	34 (57.63%)	
Early Neonatal Death	Yes	0	3 (5.1%)	0.110
	No	63 (100%)	56 (94.9%)	

P value for variables was calculated by Chi-square test/Fisher's Exact test. Values less than 0.05 were considered significant and values less than 0.001 were considered highly significant

period. In this study, the incidence of congenital anomaly was about 6.25% in overweight and obese mothers which is comparable to the study conducted by Persson et al.[19] The cesarean section rate was 51.5% in the cases group in comparison to only 21.9% in the controls group which is similar to the observations of Ramya et al., who found the cesarean section rate to be 60% and 36.84% in the respective groups.[15] However, they also showed significantly increased rate of induction failure in overweight and obese mothers which differed from the findings of this study which failed to establish any statistically significant association between increased BMI and increased rate of induction failure.[15]

Pregnancy with obesity increases infective morbidity particularly wound infection due to poor vascularity of the adipose tissue and formation of seromas.[20] In our study, operative morbidity was increased not only for increased caesarean sections but also SSI rate was also significantly high. Although the incidence of shoulder dystocia was very rare (3.2%) in the cases group, incidence of perineal laceration in vaginal delivery even with episiotomy was very high (35.5%) in this group in comparison to the controls group (6%). This observation is not corroborating with the observation of Lindholm et al., where obstetric anal sphincter laceration was less associated with overweight and obesity.[21] In our study, instrumental delivery rate was increased that might result in higher perineal laceration rate as it is an independent risk factor for perineal laceration or birth trauma.[22] We found that the incidence of PPH was significantly increased among obese and overweight women. Elevated BMI as a significant risk factor for primary PPH was also observed in a study conducted by Gollop et al.[23]

This study also evaluated the newborn outcomes in relation to Apgar score at 5 min, NICU admission, and early neonatal death. All parameters showed significant negative effects by overweight and obesity. Low APGAR and ultimate neonatal morbidity and mortality showed positive correlation with perinatal asphyxia, macrosomia, and birth injury as observed by Chen et al., and Santangeli et al.[24,25]

Limitations of the study

It includes that the causal association cannot be established firmly as all confounding factors were not eliminated. It also did not reflect the actual scenario of rural set up with poor infrastructure, workforce, and logistics factors. The outcomes of overweight and different classes of obesity were not evaluated separately, so the difference of adverse outcomes in relation to increasing BMI could not be measured separately.

CONCLUSION

The persistently increasing prevalence of obesity in pregnancy is a growing public health concern globally. It is often neglected in poor and developing countries where hunger index is high. This study shows strong association between increasing maternal BMI and several antepartum, intrapartum, and postpartum complications of mother, as well as the fetus and newborn.

Pre-conceptional assessment, health education, and counseling regarding exercise and adopting healthy and nutritious diet even with school going girls as target population should be considered. The overweight and obese women should be encouraged for losing weight at pre-pregnancy period to optimize a favorable pregnancy outcome.

The baby born to overweight and obese women may have deleterious effect that surpasses the intrauterine life with extension to infancy, childhood, and even in adult period. This needs a multicentric study with large sample size and for a long duration before making recommendations regarding interventions that are necessary to achieve the birth of a healthy baby from a healthy mother.

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SDG- Concept and design of the study, first manuscript writings, and final approval of draft; **PR-** Study design, data entry and manuscript writing, and discussion; **CG-** Methodology planning, data analysis, and final draft approval; **JB-** Literature review, discussion and interpretation of results, and acted as a corresponding author; **PD-** Data analysis and revision of manuscript for final draft; **UG-** Review of literature and data statistics interpretation; **AP-** Data collection and entry, discussion, and revision of final draft; **SM-** Data collection and entry, discussion, and revision of final draft

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