Section: Obstetrics & Gynecology

Original Research Article

THE IMPACT OF PRE PREGNANCY MATERNAL BODY MASS INDEX ON PREGNANCY OUTCOME IN AN RURAL REFERRAL CENTRE- A CASE CONTROL STUDY

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ABSTRACT

Background: Prepregnancy body mass index is the best indicator of obesity, overweight or underweight. Maternal and fetal complications are more expected in different abnormal categories of BMI compared to normal BMI category. Pre pregnancy BMI and its effect on adverse maternal and fetal outcomes had been studied extensively. This study which is a case control study also tries to establish the association between the pre pregnancy BMI and its adverse maternal and fetal outcome. **Aim:** To Study the impact of maternal body mass index on maternal and fetal outcome in an Rural referral center. **Objectives:** 1. To determine the impact of maternal body mass index on maternal and fetal outcome. 2. To study the association of gestational weight gain with fetal outcome.

Materials and Methods: This is a case control study done during April 2024 - March 2025 among the women delivered at the department of OBG at Government Medical College, Vikarabad. women who delivered in the labour room complex who had recorded BMI in their antenatal cards during their first trimester visit were explained about the study got the informed consent questionnaire which included detailed antenatal history, mode of delivery and details of the baby data entered into the annexure ii. Depending upon outcomes the subjects are classified as case group or control group. With the above objective out of the study sample of 375 subjects 125 who reported to have complications were taken as cases and 250 patients with no complications were taken as control and with the cases and control groups the study was undertaken

Results: The study had revealed that there is such as age, parity, marital history and gestational weight gain between the case and control group were comparable. In the study LSCS rate was higher compared to the vaginal delivery. The percentage of LSCS is 61.86% compared with 38.13% of vaginal deliveries. Among all the study population 4% were underweight, 27% were normal BMI, 19% were overweight and 50% were obese stating that half of the percentage were obese individuals**.** In this study there was a negative correlation between BMI and corresponded weight gain which was recommended. As the bmi increases gestational weight gain should decrease which happened in my study**.** In the study group obese BMI category had high incidence of complications like GDM, gestational hypertension and large for gestational age babies. In the study group underweight BMI category had high incidence of IUGR and antepartum hemorrhage**.** The incidence of preterm labor was almost same in all the categories of BMI with no statistical significance. In the study subjects who gained excess weight than recommended had high incidence of LGA babies and those who gained inadequate weight gain had high incidence of IUGR babies.

Conclusion: Thus from the above study it is curtained that pre pregnancy obesity is associated with adverse maternal and fetal outcomes like GDM, gestational hypertension and large for gestational age babies and underweight

BMI subjects had high adverse outcomes of antepartum hemorrhage and IUGR. Excessive and inadequate weight gain also had adverse fetal outcomes like IUGR and LGA. Hence, pre pregnancy counseling by obstetricians plays a major role in achieving normal BMI before pregnancy for good fetomaterno outcome of the pregnancy.
Keywords: BMI, IUGR, Gestational Diabetes Mellitus, Antepartum hemorrhage, LSCS.

INTRODUCTION

Obesity is a significant public health concern. The worldwide prevalence of obesity has increased substantially over the past few decades and has become a global epidemic affecting more than 650 million adults worldwide.[1] Economic, technologic and life style changes have created an abundance of cheap, high calorie food coupled with decreased physical activity. There is more evidence of metabolic dysregulation among obese individuals

The prevalence and incidence of obesity are increasing rapidly in both developed and developing countries in the world. This has led to an increase in obesity related morbidities like type 2 diabetes, hypertension, cardiovascular diseases and cancers. Thus developing countries like India are facing the double burden of obesity and under nutrition.

Under nutrition is an age old burden which still exists in significant figures in India.[2,3] This is also related to the socioeconomic status. Accordingly more than half of the women of reproductive age in the country suffer from anemia.

This may be attributed to the effects of westernization such as increased consumption of diet rich in refined sugars and saturated fatty acids as well as increased physical inactivity. Technological and life style changes have created an abundance of cheap and high calorie food. There is more evidence of metabolic dys-regulation among obese individuals.

This trend is also obtainable in pregnant women of both developing and developed countries. Obesity confers high risk status of pregnant women. Underweight in pregnancy also increases morbidity of mother and the fetus. The global obesity epidemic affecting women of reproductive age is a major contributor to adverse pregnancy outcomes.[4]

Adipose tissue

Fat is an essential tissue and performs multiple and diverse functions, including providing nutritional, hormonal and even structural support. Fat is stored in adipose tissue. Adipocytes are cells specifically adapted for fat storage, serve as a future energy source, and help to avoid metabolic consequences of excessive cellular lipid deposits in organs such as muscle, liver and heart. It regulates metabolism through distinct but overlapping pathways.[5]

It also contains nonfat cells like fibroblasts and immune cells such as mast cells, macrophages and leucocytes. Nonfat cells and adipocytes synthesize and secrete numerous peptide and steroid hormones, cytokines and chemokines. They influence the local and systemic physiology. Thus adipose tissue functions as an endocrine organ. Metabolic function of adipose tissue causes much of the pathology associated with obesity.

Adipose tissue stores and releases steroid hOrmones, converts precursors to biologically active harmones, active harmones to inactive metabolites. It also expresses many enzymes and harmones like aromatase, 17 B – hydroxyl steroid hydrogenase, 11 B – hydroxyl steroid dehydrogenase type 1 , leptin, TNF alpha and adiponectin.[5]

Obesity complications

preconceptionally: subfertility, contraception failure with oral contraceptive pills antenatal: miscarriage, recurrent pregnancy loss, gestational diabetes,pre-eclampsia,difficulty in obtaining detailed imaging on ultrasound, obstructive sleep apnea, urinary tract infections, preterm labor, antepartum hemorrhage, prolonged pregnancy, induction of labor.[1-10]

Intrapartum: prolonged labor, shoulder dystocia, difficulty in anesthesia, increased rates of cesarean delivery and post –term pregnancy,[6] Post-partum¬: post-partum hemorrhage, wound infections and breakdown, endometritis, venous thrombo embolism, breast feeding difficulty and long postnatal stay.[7]

Long term consequences of obesity also exist, they may continue to be obese still further and are more prone to have metabolic syndrome.

BMI

BMI is the best indicator of obesity and underweight which can be calculated by the formula BMI=Weight in kgs/Height in M2. Various classifications were put forward to classify individuals based on BMI.

Table 1: WHO classification of obesity,[7]

Category	BMI range-kg/M^2
UNDER WEIGHT	<18.5
NORMAL	18.5- 24.9
OVER WEIGHT	25- 29.9
OBESE	>30.0
CLASS 1	30.0 to 34.9
CLASS 2	35.0 to 39.9
CLASS 3	> 40.0

The health risk associated with obesity occurs at a lower BMI in Asian population than compared to the west, thereby making WHO BMI categorization, less relevant to the Asian population. Hence in 2000, the regional office for the western pacific of WHO , the international association for the study of obesity and the international obesity task force together released , the asia-pacific perspective for redefining obesity suggesting diagnostic criteria to identify overweight and obesity in the Asian population.[3]

Table 2: WHO Asia-Pacific criteria.[2]

CATEGORY	BMI range- kg/ m^2
UNDER WEIGHT	<18.5
NORMAL	18.5- 22.9
OVER WEIGHT	23- 24.9
OBESE	>25

BMI, waist hip ratio, waist circumference, absolute weight, weight gain in pregnancy etc.. are the different indices used to measure obesity but BMI is a better measure obesity which is called quitelets index.

Pre pregnancy BMI is ideal to be measured. When pre pregnancy BMI is not measurable or not available first trimester BMI is used since weight gain in first trimester is negligible.

As many of the physiological changes of pregnancy associated with maternal obesity are present from early pregnancy onwards, reducing maternal obesity before conception is probably the best strategy to decrease the health burden of adverse maternal and fetal outcome.

Gestational weight gain⊗GWG

The amount of weight gain during pregnancy can affect the immediate and future health of a woman and her infant. The gestational weight gain guidelines framed by institute of medicine, U.S attempt to balance the risk of having large for gestational age infants , small for gestational age infants , preterm births and post-partum weight retention. Recommended weight gain in second and third trimesters on an average in underweight and normal weight is 1 pound in a week, over weight 0.6 pounds and obese 0.5 pounds a week as per the IOM 2009, GWG guidelines.[3]

Maternal weight gain must increase sufficiently to provide for fetal and placental tissue accrual and for amniotic fluid and maternal blood volume expansion. During pregnancy overweight and obese woman gain more Weight than recommended compared to normal gravidas. GWG more than recommended lead to higher incidence of CS, induction, maternal weight retention, LGA, macrosomia. Low GWG has been linked to higher incidence of preterm delivery, LBW and SGA.[10]

Table 3: Gestational weight gain (GWG) is taken as per Institute of Medicine U.S, weight gain recommendations for Pregnancy.[3]

Category	BMI in kg/ M^2	Gestational weight gain in kgs
UNDER WEIGHT	< 18.5	12.5- 18
NORMAL	18.5- 22.9	11.5- 16
OVERWEIGHT	23- 24.9	7.0- 11.5
OBESITY	>25.0	5.0- 9.0

Research question: Is there an increase in adverse maternal and fetal outcome among mothers with abnormal / variable BMI in the antenatal period?

Aim and objectives

Aim

To Study the impact of maternal body mass index on maternal and fetal outcome in an rural referral center.

Objectives

1. To determine the impact of maternal body mass index on maternal and fetal outcome
2. To study the association of gestational weight gain with fetal outcome.

MATERIALS AND METHODS

Study Design: Case-Control Study.

Study Place: Government Medical College & General Hospital, Vikarabad.

Study Period: April 2024 – March 2025.

Study Population: Women who delivered in Government Medical College & General Hopsital, whose BMI was recorded before 12 weeks of pregnancy in their antenatal cards.

Inclusion Criteria: Women delivered in the hospital whose BMI is taken before 12 weeks of pregnancy.

Exclusion Criteria:

- Pregnant women who came to first antenatal visit after 12 weeks
- Multiple pregnancy
- Women having pre pregnancy co-morbid conditions of Diabetes mellitus, Hypothyroidism, Hypertension

Operational definitions

Case: Those who had adverse maternal and fetal outcomes

Control: Those with normal maternal and fetal outcomes.

Adverse maternal and fetal outcomes

Maternal

Gestational Diabetes: Any degree of glucose intolerance with onset or first recognition during pregnancy.

Gestational Hypertension: Defined as development of hypertension to the extent of 140/90 mm of hg or more with proteinuria after 20 weeks of pregnancy in previously normotensive and non proteinuric patient.

Antepartum Hemorrhage: Any bleeding from the genital tract during pregnancy after the period of viability until the delivery of the fetus.

Preterm labor: delivery of the baby before 37 wks.

Fetal outcome

Fetal growth restriction: designed to identity fetuses with estimated weight below the 10th percentile for the gestational age

Large for Gestational Age: Designed to identify fetuses with estimated fetal weight above the 90th percentile for their gestational age.

Confounding Factors:

Urinary tract infection: urinary tract infection in pregnancy

Polyhydromnios: excessive amniotic fluid.

Oligohrdromnios- less amniotic fluid

Cardiac Diseases: New York Heart Association class 3 and class 4

Incompetent cervix: Painless cervical dilatation in the second trimester.

Classification of Obesity,[1] asia pacific

Under Weight: $\leq$18.5kg/m^2

Normal: 18.5 kg/m^2 -22.9 kg/m2

Over Weight: 23 kg/m^2 -24.9 kg/m2

Obese: $\geq$25kg/m^2

Study method

Questionnaire including detailed antenatal history to women whose BMI was recorded in the first antenatal checkup and delivered during the study period.

Explained about the study giving informed consent (Annexure II and III), questionnaire which includes detailed antenatal history, mode of delivery and details of baby data and fetomaternalcompli entered into annexure II. Depending upon the outcome the subjects are classified into cases and controls

Ethical Consideration

Consent has been obtained after informing about the study design for their participation as (Annexure II and III). The population has been included.

Statistical Analysis

The collected data is entered in Microsoft Excel 2013 and is exported to SPSS v21 for analysis. The frequency distribution of all variables will be expressed in percentages and the association in univariate analysis is done by Chi square test and fisher extract test. The strength of association is expressed as odds ratio. The multivariate analysis is done by binomial regression for predicting abnormal outcome using all significant variables adjusted for cofounding.

RESULTS

Table 4: Distribution of different BMI categories among those who had abnormal fetomaternal outcome vs those who had normal outcome

BMI categories	Pregnancy Outcomes		Total	Statistical Significance*
	Cases	Controls		
Underweight	5 (35.71%)	9 (64.28%)	14 (100%)	0.030
Normal	30 (29.41%)	72 (70.58%)	102 (100%)	
Overweight	23 (31.94%)	49 (68.05%)	72 (100%)	
Obese	67 (35.82%)	120 (64.17%)	187 (100%)	
Total	125 (33.33%)	250 (66.66%)	375 (100%)	

Table 5: Distribution of the subjects by age group among the subjects who had adverse fetomaternal outcome and normal outcome

AGE GROUP	Outcomes		statstat
	Cases	Controls	
	Count %	Count %	
<=25 years	29 (23.2%)	65 (26.0%)	<0.001
26 - 30 years	41 (32.8%)	115 (46.0%)	
31 - 35 years	40 (32.0%)	64 (25.6%)	
> 35 years	15 (12.0%)	6 (2.4%)	

Total 100

This study found to have more adverse fetomaternal outcomes in the age group of 26-30 years , 41(32.8%) followed by 31-35 years, 40 (32%).

Table 6: Distribution of the gravida status of the subjects who had adverse fetomaternal outcomes and normal outcomes

Obstetric History		Outcomes			
		Cases		Controls	
		Count	%	Count	%
Gravida	1	58 46.4%		125 50.0%	
	2	43 34.4%		86 34.4%	
	3	19 15.2%		26 10.4%	
	4	4 3.2%		7 2.8%	
	5	1 .8%		6 2.4%	
Para	1	44 91.7%		103 94.5%	
	2	4 8.3%		5 4.6%	
	3	0 0.0%		1 .9%	
Abortion	1	23 69.7%		36 75.0%	
	2	9 27.3%		9 18.8%	
	3	0 0.0%		2 4.2%	
	4	1 3.0%		1 2.1%	
Live	1	42 91.3%		102 95.3%	
	2	4 8.7%		4 3.7%	
	3	0 0.0%		1 .9%	
Death	1	2 100.0%		5 100.0%	

Regarding the gravidity of the patients, there were more number of primi subjects in both cases and controls with gradual decrease till fifth gravida. There were almost otherwise equal distribution of parity, live children, abortions and dead children in both cases and controls.

Table 7: Distribution of the marital history and gestational weight gain among those who had adverse and normal fetomaternal outcomes

		Outcomes		Statistical Significance*
		Cases	Controls	
Marital History	<= 5 years	86 (68.8%)	213 (85.2%)	< 0.001
	> 5 years	39 (31.2%)	37 (14.8%)	
Gestational Weight Gain(IOM guidelines)	Inadequate	26 (20.8%)	39 (15.6%)	0.455
	Adequate	44 (35.2%)	93 (37.2%)	
	Excessive	55 (44.0%)	118 (47.2%)	

****Chi square test***

86 (68.8%) of those married <5 years had more complications compared to 39(31.2%) of those married >5 years and the difference was statistically significant (p<0.001).

The proportions of gestational weight gain were comparable among those who had adverse and normal fetomaternal outcomes outcomes.

Table 8: Distribution of mode of delivery and NICU admissions among the subjects who had adverse fetomaternal outcomes and normal outcomes

		Pregnancy Outcomes				Statistical Significance
		Cases		Controls		
		Count	%	Count	%	
Mode of Delivery	LSCS	103	82.4%	129	51.6%	< 0.001
	Vaginal	22	17.6%	121	48.4%	
NICU admission	Yes	40	32.0%	0	0.0%	< 0.001
	No	85	68.0%	250	100.0%	

Mode of delivery was by Cesarean section in significantly more number 103 (82.4%) among cases compared to 129(51.6%) among controls (p<0.001) NICU admissions were 40(32%) in subjects who had adverse outcomes compared to no NICU admissions in controls statistically significant(p<0.001).

Table 9: Mode of Delivery

BMI categories	Mode of Delivery		Total	Fisher exact p value
	LSCS	Vaginal		
Underweight	**6 (42.85%)**	**8 (57.14%)**	**14 (100%)**	**0.003**
Normal	**56 (54.9%)**	**46 (45.09%)**	**102 (100%)**	
Overweight	**46 (63.88%)**	**26 (36.12%)**	**72 (100%)**	
Obese	**124 (66.31%)**	**63 (33.68%)**	**187 (100%)**	
Total	**232 (61.86%)**	**143 (38.13%)**	**375 (100%)**	

124(66%) Obese and 46(63.88%)over weight subjects had significantly higher rates of LSCS and was statistically significant (P<0.003)

Table 10: Distribution of NICU admissions of subjects among study population between different BMI categories

BMI categories	NICU Admissions		Total	Fisher exact p value
	Yes	No		
Underweight	4 (28.57%)	10 (71.42%)	14 (100%)	0.031728743
Normal	10 (9.8%)	92 (90.19%)	102 (100%)	
Overweight	9 (12.5%)	63 (87.5%)	72 (100%)	
Obese	17 (9.09%)	170 (90.9%)	187 (100%)	
Total	40 (10.66%)	335 (89.33%)	375 (100%)	

In my study NICU admissions was higher in underweight BMI subjects 4(28.57%) compared to 10(9.8%) in normal ,9(12.5%) in overweight and 17 (9.09%) in obese subjects. The results were statistically significant(P<0.03)

Table 11: GDM as outcome among different BMI categories

BMI categories	GDM		Total	Fisher exact p value	OR(CI)
	Yes	No			
Underweight	0 (0%)	14 (100%)	14 (100%)	< 0.001	1.41(0.2 – 4.4) 3.27 (1.22 – 8.78)
Normal	5 (4.9%)	97 (95.09%)	102 (100%)		
Overweight	4 (5.55%)	68 (94.44%)	72 (100%)		
Obese	27 (14.43%)	160 (85.56%)	187 (100%)		
Total	36 (9.6%)	339 (90.4%)	375 (100%)		

Among the obese subjects 14% had GDM, compared to the 4.9% normal BMI subjects had GDM and 5.55% , 0% in overweight and underweight subjects respectively. The difference was statistically . significant(P<0.001). odds of mothers with GDM being obese is 3.72 compared to those without GDM [OR(95% CI)3.27(1.22-8.78)].

Table 12: Gestational hypertension in different BMI categories

BMI categories	GHTN		Total
	Yes	No	
Underweight	0 (0%)	14 (100%)	14 (100%)
Normal	7 (6.86%)	95 (93.13%)	102 (100%)
Overweight	7 (9.72%)	65 (90.27%)	72 (100%)
Obese	27 (14.43%)	160 (85.56%)	187 (100%)
Total	41 (10.93%)	334 (89.06%)	375 (100%)

Among obese subjects27(14.43%) had gestational hypertension compared to7 (6.86%) of the normal BMI subjects and the difference was statistically significant(P<0.004). Odds of mothers with gestational hypertension being obese is 2.29 compared to those without gestational hypertension[OR(95% CI)2.29(0.96-5.46)]

Table 13: Pre-eclamsia of subjects among different BMI categories

BMI categories	PRE-ECLAMSIA		Total	Fisher exact p value	OR(CI)
	Yes	No			
Underweight	0 (0%)	14 (100%)	14 (100%)	0.162	1 0.71 (0.06 - 7.91) 0.54 (0.07 – 3.89)
Normal	2 (1.96%)	100 (98.03%)	102 (100%)		
Overweight	1 (1.38%)	71 (98.61%)	72 (100%)		
Obese	2 (1.06%)	185 (98.93%)	187 (100%)		
Total	5 (1.33%)	370 (98.66%)	375 (100%)		

In our study obese subjects had2(1.06%) compared to normal BMI subjects who had 2(1.96%) complication of preeclamsia and was not statistically significant

Table 14: Preterm labor as outcome among study population between different BMI categories

BMI categories	PTL		Total	Statistical significance *	OR(CI)
	Yes	No			
Underweight	2 (14.28%)	12 (85.71%)	14 (100%)	0.059	0.96 (0.19 – 4.76)
Normal	15 (14.7%)	87 (85.29%)	102 (100%)		1
Overweight	10 (13.88%)	62 (86.11%)	72 (100%)		0.93 (0.39 – 2.21)
Obese	25 (13.36%)	162 (86.63%)	187 (100%)		0.89 (0.44 – 1.78)
Total	52 (13.86%)	323 (86.13%)	375 (100%)		

*Fisher extract test

In our study Prevalence of preterm labor is comparable in all the categories of BMI and the difference was statistically insignificant.

Table 15: Distribution of antepartum haemorrhage as outcome of the subjects between different BMI categories

BMI categories	APH		Total	Fisher exact p value	OR(CI)
	Yes	No			
Underweight	1 (7.14%)	13 (92.85%)	14 (100%)	0.069	3.85 (0.33 - 45.43
Normal	2 (1.96%)	100 (98.03%)	102 (100%)		-
Overweight	3 (4.16%)	69 (95.83%)	72 (100%)		2.17 (0.35 - 13.35
Obese	2 (1.06%)	185 (98.93%)	187 (100%)		0.54 (0.08 - 3.9
Total	8 (2.13%)	367 (97.86%)	375 (100%)		

Among the underweight subjects 1 (7.14%) had APH comparedto 2(1.96%) of normal BMI subjects and 3(4.16%) of overweight subjects and 2(1.06%) of obese hadAPH but was statistically insignificant.

Table 16: IUGR among different BMI categories

BMI categories	IUGR		Total	Fisher exact p value	OR(CI)
	Yes	No			
Underweight	4 (28.57%)	10 (71.42%)	14 (100%)	0.034	13.2 (2.58 – 87.51)
Normal	3 (2.94%)	99 (97.05%)	102 (100%)		1
Overweight	4 (5.55%)	68 (94.44%)	72 (100%)		1.94 (0.42 – 8.95)
Obese	8 (4.27%)	179 (95.72%)	187 (100%)		1.47 (0.38 – 5.68)
Total	19 (5.06%)	356 (94.93%)	375 (100%)		

Prevalence of IUGR is high in underweight 4(28%) BMI compared to overweight 4(5.5%), obese8(4.27%) and normal 3(2.94%) BMI subjects respectively. There was a statistical significant difference(P<0.034). Odds of mothers having IUGR babies being underweight is 13.2 compared to those who do not have IUGR[OR(95%CI13.2(2.58-87.51)].

Table 17: LGA among different BMI categories

BMI categories	LGA		Total	Statistical significance*	OR(CI)
	Yes	No			
Underweight	0 (0%)	14 (100%)	14 (100%)	0.101	-
Normal	1 (0.98%)	101 (99.01%)	102 (100%)		1
Overweight	4 (5.55%)	68 (94.44%)	72 (100%)		5.94 (0.65 – 54.3)
Obese	5 (2.67%)	182 (97.32%)	187 (100%)		2.77 (0.32 – 24.07)
Total	10 (2.66%)	365 (97.33%)	375 (100%)		

fisher extract test

In our study Among overweight subjects 4 (5.55%) had higher rates of LGA babies but the difference was statistically insignificant.

Table 18: IUGR babies among different gestational weight gain categories

Gestational Weight Gain	IUGR		Total	Statistical significance*	Odds ratio
	Yes	No			
inadequate	8 (12.3%)	57 (87.69%)	65 (100%)	0.008	
Adequate	5 (3.64%)	132 (96.35%)	137 (100%)		
Excessive	6 (3.46%)	167 (96.53%)	173 (100%)		
Total	19 (5.06%)	356 (94.93%)	375 (100%)		

Fisher extract test

In this study the subjects who had inadequate weight gain had more IUGR babies 8(12.3%). The difference was statistically significant(P<0.008).

Table 19: LGA babies among different gestational weight gain categories

GestationalWeight Gain	LGA		Total	Fisher exactp value
	Yes	No		
Lessthan Recommended	0 (0%)	65 (100%)	65 (100%)	0.003
Recommeded	1 (0.72%)	136 (99.27%)	137 (100%)	
Morethan Recommended	9 (5.2%)	164 (94.79%)	173 (100%)	
Total	10 (2.66%)	365 (97.33%)	375 (100%)	

In this study the subjects who had excessive weight gain had more LGA babies 9(5.2%). The difference was statistically significant(P<0.003).

Table 20: Outcomes using multivariate analysis between different BMI Categories

ADJUSTED ODDS RATIO	UNDERWEIGHT	OVERWEIGHT	OBESE
PREG. OUTCOMES	0.64 (0.12 - 3.31)	1.11 (0.46 - 2.66)	1.41 (0.65 - 3.03)
APH	2.55 (0.91 – 34.11)	1.2 (0.15 – 9.2)	0.23 (0.02 – 2.2)
GDM	-----	0.83 (0.19 – 3.4)	3.51 (0.81 – 7.71)
GHTN	-----	0.95 (0.28 – 3.15)	1.28 (0.45 – 3.61)
PRE ECLAMPSIA	-----	0.29 (0.01 - 5.9)	0.21 (0.01 – 3.07)
PTL	0.43 (0.06 – 3.25)	1.67 (0.5 – 5.61)	1.65 (0.52 – 5.17)
IUGR	40.7 (2.8 – 588.48)	6.25 (0.69 – 56.75)	12.02 (1.16 – 123.7)
LGA	------	1.87 (0.17 – 19.3)	0.75 (0.07 – 7.45)

Odds of mothers with adverse fetomaternal outcomes being obese is 1.41 compared with those with normal fetomaternal outcomes.

DISCUSSION

This study which is a case control study also tries to establish the association between the BMI among the pregnant women and adverse maternal fetal outcomes and gestational weight gain and fetal outcomes.

When compared with the prospective study done by Anjana verma, et al,[11] to evaluate the impact of the maternal body mass index on the pregnancy outcome using WHO criteria among 784 women showed that, women with obesity had 7.1% of GDM, 11.9% of gestational hypetension and 5.9% of iugrand antepartum hemorrhage in 2.38%.

The prevalence of complications is more 34.19% in my study which used asia pacific guidelines of BMI compared with 27.28% in anjanavermaetal study who had used WHO criteria for BMI classification stating that cut off of obesity BMI to>25 by asia pacific criteria is an essential tool to pick up more complications in indian women.

When compared with the meta-analysis done by Lei Liu, et al,[12] to assess the maternal body mass index and neonatal adverse outcomes showed that there was

no significant association between underweight and PTL(odds ratio-1.03, CI(0.95-1.15)), higher odds are found for obese women(OR=1.38, CI,1.25-1.52) for preterm labor.

UnderweightBMI subjects had increased risk of IUGR (OR=1.75(CI-1.51-2.02)), no association was found between IUGR and overweight/ obesemothers. (OR=0.89,CI(0.75-1.05)).

LGA was significantly seen in overweight/ obese persons (OR=1.88,CI(1.64-2.15)) where as underweight reduced the risk of LGA(OR=0.48, CI(0.39-0.59)).

In our study there was no association between PTL and underweight/overweight and obese bmi categories. Similar outcomes were observed among LGA and IUGR in underweight and obese bmi categories.

In an indian population study conducted by Narayani BH, et al,[13] the relationship between first trimester maternal BMI and pregnancy outcome among1506records of pregnant women showed that gestational diabetes was significantly higher among obese women compared to the overweight, normal and underweight BMI. preterm delivery was not statistically significant Preeclampsia was significantly higher in obese women (1.89%) than overweight, normal weight and underweight women. Compared to the above study our study had similar outcomes of gdm and ptl were observed in obese, overweight and underweight BMI categories. In our study Preeclampsia was not statistically significant among obese population.

In Indian population study conducted by Bhavadharini B, et al,[1] adverse pregnancy outcomes with weight gain during pregnancy and among different categories 4081 records of the pregnant women shown that Preeclampsia was 1.9%, 0.7%, 0.3% and 0.6%, p=0.006 among obese, overweight, normal weight and underweight women. Preterm labour was 7.3%, 6.9%, 6.1% and 5.8% among among obese, overweight, normal weight and underweight women respectively which was statistically not significant. In our study preterm labor and preeclampsia were statistically not significant

When compared with a prospective cohort study by Jenny G.Y .Chung et al,[5] investigate the relationship between gestational weight gain and adverse pregnancy outcomes among 1950women, high gestational weight gain had fourfold increase in the LGA babies (OR=3.92(2.21-6.97)) compared to the normal weight gain anddecreased risk of IUGR babies(OR=0.72,(0.5-1.04)). Low gestational weight gain had an increased risk of IUGR (OR=1.85 ,(1.13-3.03) In our study similar outcomes of LGA and IUGR was observed .

When compared with this retrospective sudy done by N.Morisaki et al,[15] to evaluate the pre pregnancy BMI-specific optimal gestational weight gain for women in japan among 104070 women showed that the prevalence of preeclampsia is 10% in obese bmicategory compared to 4%, 5% and 8% in underweight, normal BMI and overweight BMI subjects. Preterm labor was 9.9%, 10.1%, 10.9% and 11.2% among underweight, normal, overweight and obese bmi subjects respectively which was statistically insignificant. Present study also shows that the prevalence of preterm labor and preeclampsia was statistically insignificant.

Compared to this prospective cohort study conducted by Jie Shen, et al,[4] prepregnancy obesity status and risks on pregnancy outcome in shanghai says that both prepregnancy obesity and excessive gestational weight gain had 2.2 to 5.9 fold high risk of GDM, gestational hypertension, cesarean delivery and LGA compared with normal BMI subjects. The present study also provides the same finding of similar maternal complications.

This cross-sectional study conducted by Bhushan N, et al,[14] impact of maternal body mass index on maternal and perinatal outcome says that there is increased incidence of eclampsia, preeclampsia, GDM, LGA and cesarean deliveries in obese BMI category. Present study also shows the similar outcomes.

Limitations: As the study was a case control and retrospective study the cause of complications cannot be attributed to abnormal BMI alone. As the sample size is small and does not encompass a large population, the attributary factor cannot be well ascertained.

This study which is a case control study also tries to establish the association between the BMI among the pregnant women and adverse maternal, fetal outcomes and gestational weight gain and fetal outcomes.

When compared with the meta-analysis cohort study done by Lei Liu, et al,(12) to assess the maternal body mass index and neonatal adverse outcomes46 unique studies were incorporated from different databases showed that compared with mothers of normal BMI there was no significant association between underweight and PTL(odds ratio-1.03, CI(0.95-1.15)),significantly higher odds are found for combined overweight and obese women(OR=1.38, CI,1.25-1.52). compared to the normal BMI, underweight increased the risk of IUGR (OR=1.75(CI-1.51-2.02)), no association is found between IUGR and overweight/ obese mothers. (OR=0.89, CI (0.75-1.05)). LGA was significantly seen in overweight / obese persons (OR=1.88, CI (1.64-2.15)) where as underweight reduced the risk of LGA(OR=0.48, CI(0.39-0.59)).

In an indian study retrospective analysis by Narayani BH , et al,[13] who studied the relationship between first trimester maternal BMI and pregnancy outcome among1506 records of pregnant women showed that gestational diabetes was significantly higher among obese women(8.25%) compared to the overweight, normal and underweight BMI(5.56%, 4.67% and 3.51%, $p<0.001$). preterm delivery was not statistically significant 7.08%, 6.48%, 5.92% and 5.26% among obese, overweight, normal and underweight categories respectively. Preeclampsia was significantly higher in obese women (1.89%)

than overweight, normal weight and underweight women (0.93%, 0.31% and 1.75%, p<0.004) respectively.

In an Indian study retrospective analysis by Bhavadharini B, et al,[1] who studied adverse pregnancy outcomes with weight gain during pregnancy and among different categories among 4081 records of the pregnant women shown that LGA babieswas seen in 14.2%, 12.7%, 8.9% and 6.5% ,p=0.001 among obese, overweight, normal and underweight BMI categories respectively. Preeclampsia was 1.9%, 0.7%, 0.3% and 0.6%, p=0.006 among obese, overweight, normal weight and underweight women. Preterm labour was 7.3%, 6.9%, 6.1% and 5.8% among among obese, overweight, normal weight and underweight women respectively.

When compared with a prospective cohort study by Jenny G.Y .Chung ,et al, to investigate the relationship between gestational weight gain and adverse pregnancy outcomes among 1950women, high gestational weight gain had fourfold increase in the LGA babies (OR=3.92(2.21-6.97)) compared to the normal weight gain and had a decrease risk of IUGR babies(OR=0.72,(0.5-1.04)). Low gestational weight gain had an increased risk of IUGR (OR=1.85, (1.13-3.03).

When Compared with the prospective study done by Anjana Verma, et al, to evaluate the impact of the maternal body mass index on the pregnancy outcome, using WHO criteria among 784 women showed that, women with obesity had 7.1% of GDM, 11.9% of gestational hypetension and 5.9% of IUGR compared with normal BMI where GDM is seen in 0.24% , gestational hypertension in 8.86% and IUGR in 6.1% antepartum hemorrhage in 2.38%.

The prevalence of complications is more 34.19% in the present study which used Asia Pacific guidelines of BMI compared with 27.28% in Anjana Verma, et al study who had used WHO criteria for BMI classification stating that cut off of obesity BMI to>25 by Asia Pacific criteria is an essential tool to pick up more complications in indian women.

The retrospective sudy done by N.Morisaki et al,[15] to evaluate the pre pregnancy BMI-specific optimal gestational weight gain for women in japan among 104070 women showed that the prevalence of preeclampsia is 10% in obese BMI group compared to 4%, 5% and 8% in underweight, normal BMI and overweight BMI subjects. Preterm labor was 9.9%, 10.1%, 10.9% and 11.2% among underweight, normal, overweight and obese BMI subjects respectively which was statistically insignificant Ref No.. Present study also shows that the prevalence of preterm labor is statistically insignificant and prevalence preeclampsia was also insignificant.

Limitations: As the study was a case control and retrospective study the cause of complications cannot be attributed to abnormal BMI alone. As the sample size is small and does not encompass a large population, the attributable factor cannot be well ascertained.

CONCLUSION

Thus from the above study it is curtained that pre pregnancy obesity is associated with adverse maternal and fetal outcomes like GDM, gestational hypertension and large for gestational age babies and underweight BMI subjects had high adverse outcomes of antepartum hemorrhage and IUGR. Excessive and inadequate weight gain also had adverse fetal outcomes like IUGR and LGA. Hence, pre pregnancy counseling by obstetricians plays a major role in achieving normal BMI before pregnancy for good fetomaterno outcome of the pregnancy.

Recommendations

Normal BMI should be achieved before conception to prevent maternal and fetal complications by preconceptional counseling for better pregnancy outcomes. Adequate gestational weight gain also prevents the complications which will result in better perinatal outcome.

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REFERENCES

1. Bhavadharini B,Anjana RM, Deepa M, Jayashree G. Gestational weight gain and pregnancy outcomes in relation to body mass index in Asian Indian Women .Indian J Endocr Metab 2017;21:588-93
2. Institute Of Medicine and National Research Counsil committee to reexamine IOM Pregnancy Weight Guidelines; Rasmussen KM, YaktineAL,editors.Weight gain during the pregnancy: Reexamining the guidelines.Washington DC: National Acadamies Press(US);200921
3. Li N, Liu E, Guo J, Pan L, Li B.(2013) Maternal Prepregnancy Body Mass Index and Gestational Weight Gain on Pregnancy Outcome.PLoS ONE 8(12):e82310.
4. Jie Shen, et al.Prepregnancy obesity status and risks on pregnancy outcomes in Shanghai. Medicine(2018)97:40(e12670).
5. Chung JGY,etal.Gestational Weight Gain and adverse pregnancy outcomes in a nulliparous cohort.Euro j obstetgynecol (2012)
6. Meaghan A. Leddy, MichelL.Power, JaySchulkin,.The Impact of Maternal Obesity on Maternal and Fetal Health. Rev Obstet Gynecol.2008;1(4):170-178.
7. Young TK, Woodmansee B. Factors that are associated with cesarean delivery in a large private practice: The importance of prepregnancy body mass index and weight gain. Am J Obstet Gynecol. 2002; 187:312–8
8. Lisonkova S,etal. Association Between Pregnancy Body Mass Index and Severe Maternal Morbidity.JAMA.2017 Nov14;318(18):1777-1786.
9. Yogev Y, Visser GHA. Obesity, gestational diabetes and pregnancy outcome. Semin Fetal Neonatal Med.2009;14(2):77-84.
10. James M. Roberts, Lisa M.Bodnar, Thelma E.Patrick,Robert W Powers. The Role of Obesity in Preeclampsia.Pregnancy Hypertense. Pregnancy Hypertens.2011 january1;1(1):6-16.
11. Anjana V, Lalit S. Metarnal body mass index and pregnancy outcome. J Clin Diagn Res,2012 Nov;6 (9);1531 -1533
12. Liu et al.Maternal body mass index and risk of neonatal adverse outcomes in china: a systematic review and meta-analysis.BMC Pregnancy and Childbirth(2019)19:105
13. BH Narayani and Baby Shalini .First trimester maternal BMI and pregnancy outcome. Int J Gynecol Obstet.2018;2(4):72-75.

14. Bhushan N et al, the impact of maternal body mass index on maternal and perinatal outcome. Int J Reprod Contracept Obstet Gynecol.2017 Jul;6(7):2862-2866.
15. N.Morisaki et al,.pre-pregnancy BMI-specific optimal gestational weight gain for women in japan. Int J Epidemiol.2017; 27:492-49827.