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ASSESSMENT OF FIRST TRIMESTER BODY MASS INDEX AND GESTATIONAL WEIGHT GAIN AND ITS EFFECTS ON FETOMATERNAL OUTCOME

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Abstract

Background: Obesity and overweight affect a large number of women who are of reproductive age. The neonate's long-term outcome is directly correlated with both gestational weight gain and birth weight. A major contributing factor to the development of chronic diseases later in life is poor nutrition during the early months of pregnancy. **Aims and objectives:** 1. To investigate the impact of gestational weight gain and first trimester BMI on maternal complications. 2. To examine the impact of gestational weight gain and first trimester BMI on the outcome of the newborn. **Methodology:** In this prospective study, data was collected from 100 pregnant women who attended OPD at Vinayaka Mission's Kirupananda Variyar Medical College and Hospital in their first trimester and followed up regularly throughout pregnancy. Informed and written consent were signed by all participants. Women in the age group between 18 and 45years with uncomplicated singleton pregnancy and delivered between JUNE 2020 – 2021 were included. Preterm delivery, post term delivery, miscarriages, hyperemesis gravidarum were excluded. **Results:** 42.6% of the subjects in this study delivered at term, or between 37 and 40 weeks of gestation, 38% preterm, or less than 37 weeks, and 19.4% postdated, or after 40 weeks of gestation. 46.8% of the participants had weight increases that were appropriate for their BMI. 19.2% of the participants did not gain enough weight while pregnant. Of the women, 34% had gained too much weight. In the study population, 25% of the women belonged to the combined group of overweight and obese, while 45% of the women fell into the normal BMI category. **Conclusion:** Adverse maternal and neonatal outcomes are strongly correlated with early pregnancy BMI and gestational weight gain. Women who are underweight experience anemia, oligohydramnios, and a higher incidence of cesarean sections. Anemia, oligohydramnios, FGR babies, SGA babies, and a rise in NICU admissions are all associated with women who have insufficient GWG. Pregnancy-related complications such as gestational diabetes, gestational hypertension, polyhydramnios, an increased risk of instrumental deliveries and cesarean sections, and postpartum hemorrhage were significantly more common in overweight, obese, and overweight women.

Keywords: Body Mass Index, First Trimester BMI, Gestational Weight Gain, Neonatal Birth Weight.

INTRODUCTION

Maternal first trimester body mass index (BMI) and gestational weight gain (GWG) are highly correlated with the outcomes of pregnancy. Gestational diabetes and hypertension are linked to being overweight or obese. Preterm delivery and low birth weight are associated with low BMI. A child's quality of life and developmental

milestones are significantly impacted by various gestational conditions, which in turn have an impact on the morbidity and mortality of childhood.(1) The incidence of higher birth weight and macrosomia linked to higher maternal weight has been gradually increasing recently.Consequently, there is an elevated chance of mispresentation, shoulder dystocia, cesarean delivery, and childhood obesity. (3) While under- and overnutrition are linked to unfavorable pregnancy outcomes, an adequate intake of micro- and macronutrients during pregnancy supports these processes. (4) Abnormal placental formation brought on by maternal malnutrition can result in changes to the fetus's size, histomorphology, and blood flow, all of which can worsen its nutritional supply. (5) There is a correlation between low birth weight (LBW) and preterm delivery and a low BMI during the first trimester of pregnancy. (6) In light of this, the goal of the research was to determine the relationship between a mother's BMI in the early stages of pregnancy and the birth weight of her child.

Aims And Objectives

This study aimed to analyze the influence of first trimester BMI on neonatal birth weight and to study GWG in pregnancy is associated with neonatal birth weight.

METHODOLOGY

This observational study conducted in the department of Obstetrics and Gynaecology, Vinayaka

Mission’s Kirupananda Variyar Medical College and Hospitals, carried out from July 2020 to July 2021. The study was approved by the Institute Human Ethics Committee (IHEC). The content of Participant Information Sheet (PIS) in local language was provided to the participants (and their attenders) and contents were read to them in their own language to their satisfaction. The participants were enrolled in the study after obtaining written informed consent. The study enrolled all women 18 to 45 years of age booked for regular antenatal care by 10 weeks of gestation and followed up till delivery. Pregnant women aged below 18 and above 45 years, diabetes mellitus, systemic hypertension, multiple gestations, hyperemesis gravidarum, preterm delivery or any medical or systemic illness complicating pregnancy were excluded.

The data obtained was manually entered into Microsoft Excel, coded, and recoded. Analysis was done using Statistical Package for the Social Sciences (SPSS) v23. Descriptive analysis was presented using numbers and percentages for categorical variables and mean (standard deviation) or median (interquartile range) for continuous variables. To test for association, Chi-square test or Fisher’s exact test (two sided) was used for categorical data. Statistical significance was considered at $p<0.05$.

RESULTS

Of the 100 pregnant women in this study, 42 percent had normal BMIs. 10% were obese, 16% were overweight, and 32% were underweight. 50% of women met the IOM criteria for appropriate gestational weight gain (GWG), 34% for insufficient GWG, and 16% for excessive GWG.

The majority of women with normal BMI, or 64.3%, were between the ages of 25 and 29. Sixty percent of overweight women were over thirty years of age (Table 1). The majority of underweight women (32%) belonged to the 20–24 age group, making up 71.8% of the sample. Women in the 20–24 age range who had normal BMIs made up

64.3% of the sample. 10% of obese women belonged to the age group of women over thirty (60%) (Table 2, Table 3). The majority of women with appropriate GWG (50%) belonged to the 25–29 age group, accounting for 64.4% of the total.

The majority of women with appropriate GWG (50%) belonged to the 25–29 age group, accounting for 64.4% of the total. Women in the age group of 20–24 years old accounted for 82.3% of those with insufficient GWG (34%). The majority of women with excess GWG (16%) were in the age group over 30, accounting for 56.3% of cases ($p<0.01$). (Table 4) Of the women with normal BMI, 64.4% are in socioeconomic class III. The socioeconomic class IV, which comprises 46.9% of underweight women, was found to contain these women ($p<0.001$). Table 5 shows that 56.3% of overweight women belonged to socioeconomic class II. Class II ($p<0.01$) included 42% of women with appropriate GWG and 55.9% of women with inadequate GWG (Table 6). The women with excess GWG were of SEC II (43.8%).

The majority of underweight women (75%), were primigravidas. Table 7 shows that the majority of multigravida women (62.5%) and obese women (66.7%) belonged to these categories. Primagravidas were more likely to have inadequate GWG (82.4%) ($p<0.001$). GWG was typically either excessive (44.7%) or appropriate (48%) in multigravida women. (Refer to Table 8) 59% were delivered naturally through labor, with 41% requiring intervention. Table 9 shows that vaginal deliveries were normal for women with normal BMI (76.2%), underweight (62.5%), obese (20%), and overweight (31.3%) ($p<0.0001$). Women with excess GWG had the highest rate of interventional deliveries (75%). Women with insufficient GWG had a low rate of interventional delivery (37.3%). (Refer to Table 10) Compared to those in the overweight and obese category, pregnant women with normal BMI (54.8%) and underweight (46.8%) were significantly anemic. On the other hand, pregnant women who were obese or overweight were significantly more likely to experience maternal comorbidities such as polyhydramnios, postpartum hemorrhage, thromboembolic events (CVT/DVT), gestational hypertension (GHT), and gestational diabetes mellitus (GDM). The risk of complications such as oligohydramnios and FGR babies was higher in underweight women. (Table 11) Compared to pregnant women with appropriate GWG (10%), those with inadequate GWG were significantly anemic (82.4%) and had complications such as oligohydramnios (29.4%) and FGR babies (79.4%). On the other hand, compared to individuals who gained GWG insufficiently and appropriately, those who gained excess GWG had higher rates of maternal co-morbidities such as GHT (75%), GDM (68.8%), CVT/DVT (43.8%), PPH (56.3%), and polyhydramnios (62.5%). (Table 12) 60% of deliveries in the obese group were post-term ($p<0.001$). In the overweight group, 62.5% of deliveries were post-term.

Underweight women had a higher percentage of preterm deliveries (62.5%), but this difference was not statistically significant compared to women with normal BMIs (37.5%). Mothers with insufficient GWG were responsible for 70.6% of preterm deliveries. Women with high GWG had a higher rate of post-term deliveries (62.5%). 43 requested NICU admission (Table 14). Mothers who were obese (40%) or overweight (31.2%) gave birth to the majority of macrosomic babies ($p<0.001$). The majority of LBW infants were seen with mothers who had a normal BMI (47.6%), followed by mothers who were underweight (37.5%) (Table 15). Compared to newborns of mothers with adequate GWG (13.9%), they were more common among mothers with excess GWG (25.6%) and inadequate GWG (60.5%). (Table 16)

Table 1: Frequency distribution of type of BMI class observed in the study

SL. NO	Type Of BMI	Percentage (%)
1	Underweight	32
2	Normal BMI	42
3	Overweight	16
4	Obese	10

Table 2: frequency distribution of type of gestational weight gain (GWG) based on IOM criteria observed in the study

SL. NO	GWG	Percentage (%)
1	Appropriate	50
2	Excess	16
3	Inadequate	34

Table 3: Comparision of age category with respect to BMI class in the study

Sl. No	Age (yrs)	Underweight		Normal BMI		Overweight		Obese	
		N=32	Freq (%)	N=42	Freq (%)	N=16	Freq (%)	N=10	Freq (%)
1	20-24	23	71.8	27	64.3	2	12.4	1	10
2	25-29	7	21.8	12	28.6	11	68.8	3	30
3	>30	2	6.4	3	7.1	3	18.8	6	60
				p value <0.001					

Table 4: Comparision of age category with respect to IOM class of GWG in the study

Sl. No	Age (yrs)	Appropriate		Excess		Inadequate	
		N=50	Freq (%)	N=34	Freq (%)	N=16	Freq(%)
1	20-24	15	30	28	82.3	3	18.7
2	25-29	32	64	12	11.7	11	25
3	>30	3	6	3	5.8	3	56.3
p value <0.001							

Table 5: Comparision of socio economic status with respect to BMI class in the study

Sl. No	Class	Underweight		Normal BMI		Overweight		Obese	
		N=32	Freq (%)	N=42	Freq (%)	N=16	Freq (%)	N=10	Freq (%)
1	Class I	1	3.1	1	2.4	4	25	1	10
2	Class II	5	15.6	8	19	9	56.3	6	60
3	Class III	10	31.3	27	64.4	3	18.7	3	30
4	Class IV	15	46.9	5	11.9	0	0	1	10
5	Class V	1	3.1	1	2.4	0	0	0	0
p value <0.0001									

Table 6: Comparision of socio economic class with respect to IOM class of GWG in the study

Sl.No	Class	Appropriate		Excess		Inadequate	
		N=50	Freq(%)	N=34	Freq(%)	N=16	Freq(%)
1	Class I	1	2	3	18.8	0	0
2	Class II	21	42	7	43.8	2	5.8
3	Class III	18	36	6	37.4	19	55.9
4	Class IV	10	20	0	0	12	35.4
5	Class V	0	0	0	0	1	2.9
p value <0.001							

Table 7: Comparision of parity with respect to BMI class in the study

Sl. No	Gravida	Underweight		Normal BMI		Overweight		Obese	
		N=32	Freq (%)	N=42	Freq (%)	N=16	Freq (%)	N=10	Freq (%)
1	Primi	24	75	30	71.4	6	37.5	3	33.3
2	Multi	8	25	12	28.6	10	62.5	7	66.7
p value <0.0001									

Table 8: Comparision of parity with respect to IOM class of GWG in the study

Sl. No	Gravida	Appropriate		Excess		Inadequate	
		N=50	Freq(%)	N=34	Freq(%)	N=16	Freq(%)
1	Primi	26	52	9	56.3	28	82.4
2	Multi	24	48	7	44.7	6	17.6
p value <0.001							

Table 9: Comparision of mode of delivery with respect to BMI class in the study

Sl. No	Mode of delivery	Underweight		Normal BMI		Overweight		Obese	
		N= 32	Freq (%)	N=42	Freq (%)	N=16	Freq (%)	N=10	Freq (%)
1	Labour natural	20	62.5	32	76.4	5	31.3	2	20
2	Intervention	12	37.5	10	23.8	11	68.7	8	80
p value <0.0001									

Table 10: Comparision of mode of delivery with respect to IOM class of GWG in the study

Sl. No	Mode of delivery	Appropriate		Excess		Inadequate	
		N=50	Freq (%)	N=34	Freq (%)	N=16	Freq (%)
1	Labour natural	29	58	4	25	22	64.7
2	intervention	21	42	12	75	12	37.3
p value <0.0001							

Table 11: Comparision of comorbidities with respect to BMI class in the study

Sl. No	Parameter	Underweight		Normal BMI		Overweight		Obese	
		N=32	Freq (%)	N=42	Freq (%)	N=16	Freq (%)	N=10	Freq (%)
1	Anaemia	15	46.8	23	54.8	3	18.8	2	20
2	G-HTN	4	12.5	5	11.9	9	56.3	8	80
3	GDM	1	3.1	2	4.8	10	62.5	7	70
4	Abruption	2	6.3	1	2.4	1	6.3	1	10
5	Oligohydramnios	12	37.5	11	26.2	1	6.3	2	20
6	Polyhydramnios	2	6.3	4	9.5	10	62.5	5	50
7	FGR	14	43.8	20	47.6	1	6.3	3	30
8	CVT/DVT	1	3.1	1	2.4	2	12.5	6	60
9	PPH	4	12.5	4	9.5	8	50	7	70
p value <0.001									

Table 12: Comparision of comorbidities with respect to IOM class of GWG in the study

Sl. No	Parameter	Appropriate		Excess		Inadequate	
		N=50	Freq (%)	N=16	Freq (%)	N=34	Freq (%)
1	Anaemia	35	70	4	25	28	82.4
2	G-HTN	10	20	12	75	3	8.8
3	GDM	11	22	5	68.8	0	0
4	Abruption	1	2	5	31.3	1	2.9
5	Oligohydramnios	5	10	2	12.5	10	6.3
6	Polyhydramnios	2	6.3	4	9.5	10	29.4
7	FGR	13	26	1	6.3	27	79.4
8	CVT/DVT	1	2	7	43.8	1	2.9
9	PPH	12	24	9	56.3	2	5.9
p value <0.001							

Table 13: Comparision of time of delivery with respect to BMI class in the study

Sl. No	Time of delivery	Underweight		Normal BMI		Overweight		Obese	
		N=32	Freq (%)	N=42	Freq (%)	N=16	Freq (%)	N=10	Freq (%)
1	Post term	1	3.1	5	11.9	10	62.5	6	60
2	Pre term	20	62.5	20	47.6	2	12.5	1	10
3	Term	12	37.5	17	40.5	4	25	3	30
p value <0.001									

Table 14: Comparision of time of delivery with respect to IOM class of GWG in the study

Sl. No	Time of delivery	Appropriate		Excess		Inadequate	
		N= 50	Freq (%)	N=34	Freq (%)	N=16	Freq (%)
1	Post term	10	20	10	62.5	0	0
2	Pre term	10	20	2	12.5	24	70.6
3	Term	30	66	4	25	10	29.4
p value <0.001							

Table 15: Comparision of neonatal outcome with respect to BMI class in the study

Sl. No	Neonatal outcome	Underweight		Normal BMI		Overweight		Obese	
		N= 32	Freq(%)	N=42	Freq(%)	N=16	Freq(%)	N=10	Freq(%)
1	AGA	20	62.5	21	50	10	62.5	5	50
2	LBW	12	37.5	20	47.6	1	6.3	1	10
3	Macrosomia	0	0	1	2.4	5	31.2	4	40
4	NICU admission	10	31.3	22	52.4	6	37.5	6	60
p value <0.001									

Table 16: Comparision of neonatal outcome with respect to IOM class of GWG in the study

Sl. No	Neonatal outcome	Appropriate		Excess		Inadequate	
		N=50	Freq (%)	N=34	Freq (%)	N=16	Freq (%)
1	AGA	35	70	9	56.3	8	23.5
2	LBW	9	18	4	25	26	76.5
3	Macrosomia	6	12	3	8.7	0	0
4	NICU admission	6	13.9	11	25.6	26	60.5
p value <0.001							

DISCUSSION

Different health risks are independently increased by maternal first trimester BMI and GWG. (7) A woman's early pregnancy BMI and GWG are determined by her lifestyle choices, though other factors like genetics also play a role. (8) The IOM guidelines are helpful for monitoring GWG and intervening to minimize risks of several adverse outcomes such as cesarean delivery, macrosomia, preterm birth, and LBW. Patient education is the only tool available to doctors and other healthcare providers to implement the IOM guidelines, but lifestyle choices are difficult to change with education alone and may call for additional interventions. To better understand the role of various factors contributing to the gap we identify here and respond appropriately, a survey of expectant mothers may be helpful.

We can only determine whether most women are ignorant of the guidelines, are aware of them but rely more on false information, or choose to ignore them by using a survey of this caliber. A survey can also assist in determining the reasons behind women's behavior if the majority of them are aware of the guidelines but choose to ignore them. (9) Women in our study who were obese or overweight had a higher chance of developing comorbid conditions such as gestational diabetes, hypertension, polyhydramnios, postpartum hemorrhage, and thromboembolic events. In Ogawa's study, women whose perceived ideal GWG was below the upper bound in the current Japanese recommendations were more likely to be multi-para, older, and have higher BMIs (even though all the women were underweight or normal). They also made less money and were less likely to have graduated college.and were less likely to have graduated college. However, there was no difference in the categories for maternal height, smoking status, infant sex, or prior experience with preterm delivery. GWG (observed or expected weight gain at 40 weeks), birth weight, birth weight z-score, and gestational age at delivery were all lower in women who fell into lower perceived ideal GWG categories. In addition, they had lower PPWR and a higher rate of preterm delivery; however, there was no discernible trend in the rates of cesarean sections and SGA. (10) This was consistent with what we had found. Of the underweight women in Mohapatra's study, 72% gave birth to SGA babies. 97% of women with normal BMI gave birth to neonates weighing appropriately for their gestational age. According to our study, 33% of overweight women and 50% of obese women gave birth to LGA babies. (11)

CONCLUSION

The current study discovered a strong link between the mother's and the fetus's adverse outcomes and GWG and BMI. BMI and patterns of weight gain during pregnancy need to be given the utmost importance because they are modifiable risk factors of unfavorable pregnancy outcomes. Understanding the symptoms and warning signs of unfavorable pregnancy outcomes is crucial. A greater understanding of the complex relationships between mother and fetus has led to a significant improvement in antenatal recommendations.

In India, low body mass index (BMI) was previously more frequently linked to pregnancy problems; however, as lifestyles change, obesity rates are rapidly rising, especially in urban areas, and could eventually become a major health risk. The possible detrimental effects of BMI and GWG on pregnancy outcomes and fetal health could be evaluated thanks to this study. The purpose of this study was to determine

the relative risk of various pregnancy outcomes that a patient with extremes in GWG and BMI may experience. The results of the study were consistent. It was also possible to investigate the connection between BMI and gestational weight gain in our Indian setup, and the results are all very interesting.

Obstetricians face a dilemma as our research indicates that women with high body mass index and obesity have higher rates of obstetric and neonatal complications. Furthermore, health issues resulting from pregnancy weight gain continue into the late 40s and early 50s.

Additionally, it has been shown that pregnant women who get plenty of food and rest do not continue to gain weight during the early stages of pregnancy. Obstetricians need to be aware of the dietary and lifestyle guidelines for women in the reproductive age range in order to prevent the problems that arise from having a high BMI during pregnancy.

Therefore, medical professionals must offer these women a great deal of support as they seek counseling regarding healthy eating and exercise prior to becoming pregnant, as well as maintaining a healthy lifestyle during pregnancy, in order to have a healthy mother and child.

Limitations:

As this was a single center study with a comparatively short sample size, results of this study cannot be generalized. Generalization requires the support of results from similar large studies.

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Conflicts of interest: There are no conflicts of interest**.**

Ethical statement:

Institutional ethical committee accepted this study. The study was approved by the institutional human ethics committee, Vinayaka Mission's Kirupananda Variyar Medical College and Hospitals, Vinayaka mission's research foundation (DU), Salem. Informed written consent was obtained from all the study participants and only those participants willing to sign the informed consent were included in the study. The risks and benefits involved in the study and the voluntary nature of participation were explained to the participants before obtaining consent. The confidentiality of the study participants was maintained.

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Authors' contributions:

All authors equally contributed for this article and approved the final manuscript as submitted and agree to be accountable for all aspects of the work. All authors have read and agreed to the published version of the manuscript*.*

Data Availability:

All datasets generated or analyzed during this study are included in the manuscript.

Informed Consent:

Written informed consent was obtained from the participants before enrolling in the study

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