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Original Research Article

A Study to Determine the Early Pregnancy BMI, the Prevalence of Various Levels of BMI, and the Correlation in Order to Analyse the Influence of Low Weight, Overweight, and Obesity on Mother and Foetal Outcomes

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Abstract

Aim: To evaluate the effect of BMI and maternal weight gainduring pregnancy on maternal and fetal outcome.

Methods: This prospective observational study was carried out in the Department of Obstetrics and Gynecology, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India from July 2019 to March 2020. Pregnant women with viable singleton pregnancy with 1st antenatal visit in 1st trimester (<12 wks) were included in this study. During antenatal period – Gestational hypertension, antepartum haemorrhage, preeclampsia, gestational diabetes. Period of gestation at delivery – abortion (<24weeks), Preterm (24 to 37 weeks), Term (37 to 40 weeks) and post- term (>40 weeks). Onset of labor-Induced or spontaneous. Mode of delivery-vaginal delivery, instrumental or C-section. Perineal trauma and Post partum haemorrhage were studied.

Results: A total of 100 pregnant women were include in this study. Most of the patients age group were 20-25 years (48%) followed by 25-30 years (25%), below 20 years (22%) while only 5% cases were in the age group above 30 year. In present study, 2 patients were of socioeconomic status of grade I, while only 3% patients were socioeconomic status II. 35%, 36% and 24% patients had their socioeconomic status III, IV and V respectively. Table 3 shows distribution of cases according to BMI group. 10 cases were in group A(≤18.5). 50 cases were in group B (18.51-24.99). 35 cases were in group C (25- 29.99) and 5 cases were in group D (≥30). The mean weight gain in group A is 10.64 ± 5.62, group C is 9.12 ± 1.16, group D is 8.95 ± 1.65 on comparing with group B mean weight gain 10.35 ± 6.0 significantly less mean weight gain in group C and group D (P<0.001,<0.001) respectively. Butthere is no difference in mean weight gain between group A and B (p=0.81). The incidence of live births, stillbirths and IUD were comparable in all the groups. It was observed that there were 9 (90%) subjects in group A, 48 (96%) women in group B, and 33 (94.29%) subjects in group C and 3 (60%) women in group D who had live births. There were three (2%) stillbirths in group B and zero (0%) ingroup A, 1 (2.86%) in group C and 1(20%) in group D. In group B there were 1 (2%) IUD and 1 (10%) IUD in group A. 1 (2.86%) and 1 (20%) cases in group C andgroup D respectively.

Conclusion: The study has shown an association between maternal weight (underweight, overweight and obese) and pregnancy outcome. There is importance of prepreg Nancy

counselling in maintaining weight of women during pregnancy to avoid maternal and fetal outcomes.

Keywords: BMI, maternal nutrition, weight gain, overweight, obese

Introduction

Obesity is defined as abnormal growth of adipose tissue due to an enlargement of fat cell size (hypertrophic obesity) or an increase in fat cell number (hyper plastic obesity).[1]According to the WHO, obesity is one of the most common and most neglected public health problems in both developing and developed countries.[2] Globally 1 out of 6 adults is obese, Due to obesity nearly 2.8 million individuals die each year.[3] India, is having the second highest population overload in the world and malnutrition due to poverty which dominated in the previous years, is being rapidly transisted by obesity associated with affluence.[4] Studies from different parts of India have provided evidence of the rising prevalence of obesity. [5-7] There is increase in obesity in Indian women from 10.6% to 14.8% during last decade in urban areas at the same time in rural area, 48.2% of pre-pregnant women are underweight.[8,9] There are various markers used to diagnose obesity like Body Mass Index (BMI), waist circumference, calculation of waist to hip circumference, measuring the thickness of skin fold, techniques such as ultrasound and biochemical markers like total cholesterol, triglyceride, low density lipoproteins, high density lipoproteins etc. BMI involves two factors i.e height and weight, irrespective of age, gender, race, family history or sex. It is calculated by dividing a person's body weight in kilograms by their height in meters squared (weight [kg] height [m]2) as shown below [Weight (kg) ÷ height (m2)] = BMI"

The BMI cut offs are:

- Below 18.5 Underweight
- 18.6-24.9 Normal weight
- 25.0-29.9 Overweight
- 30 and greater Obese
- 40 and greater Morbid or extreme obesity

The risk for obesity related obstetric complications appear to start from a BMI of about 21 kg/m2 . Obese and overweight females undergoing pregnancy and child birth as calculated by maternal BMI will have higher risk for significant antenatal, postpartum and neonatal complications. Diabetes, hypertensive disorders including preeclampsia, postdate pregnancies, caesarean sections, macrosomia, thromboembolism, fetal deaths have all been associated with maternal obesity. [10-13] There is linear relationship between maternal obesity and fetal macrosomia. [14] The women who are overweight and obese have more chances to require a caesarean section for delivery. [15,16] Maternal malnutrition is the most important underlying determinant factor in adverse maternal and fetal outcome A malnourished mother gives birth to undernourished infant who struggle to thrive. The low maternal BMI is associated with increased risk of abortion and intrauterine growth restriction anemia, which may further cause low Apgar scores and increased early neonatal deaths. [17,18] As maternal nutrition and weight gain during pregnancy are modifiable factors, so the knowledge of association between maternal weight gain during pregnancy, obstetric complications and fetal outcomes becomes essential. The objectives of the study was to find out the early pregnancy BMI, prevalence of different level of BMI and the correlation to assess the effect of low weight, over weight and obesity on maternal and fetal outcome, compared to those of normal weight women.

Material and Methods

This prospective observational study was carried out in the Department of Obstetrics and Gynecology, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India from July 2019 to March 2020. after taking the approval of the protocol review committee and institutional ethics committee. Pregnant women with viable singleton pregnancy with 1st antenatal visit in 1st trimester (<12 wks) were included in this study.

Multiple gestation, Essential hypertension, Diabetes mellitus, Cardiovascular disease, Renal disease, Pulmonary disease etc were excluded from this study.

Methodology

All pregnant women participating in the study were informed about the aims and objectives of the study and consent was taken. They were also counselled about the adequate dietary intake during pregnancy.

On their 1st antenatal visit before 12 wks of pregnancy the body weight (in kgs) was measured by a calibrated scale accurate to 0.5 kg and height was measured in meters.

All cases were followed up in antenatal clinic monthly upto 28 weeks, twice a week upto 36 weeks and weekly thereafter. The weight gain was noted on every visit.

Women in the study were divided according to BMI in four categories –

GROUP A Low BMI <18.5kg/m^2
GROUP B Normal BMI 18.5kg/m^2 to 24.9kg/m^2
GROUP C Overweight 25kg/m^2 to 29.9kg/m^2
GROUP D Obese >30kg/m^2

The guidelines (2009 IOM/NCR) [5] for weight gain and rate of weight gain during pregnancy for women with singletonpregnancy are :-

Pre pregnancy BMI	Total weight gain (in lb)	Rate of weight gain in 2nd&3rd trimester (lb/wk)	
A. Low BMI	28-40lb (12.7 – 18.1kg)	1.0(1.0-1.3) lb/wk (<18.5 kg/m^2)	0.45 (0.45 – 0.59) kg/wk
B. Normal BMI	25-35lb (11.3 – 15.9kg)	1.0(0.8-1.0) lb/wk(18.5-24.9 kg/m^2)	0.45 (0.36 – 0.45) kg/wk
C. Overweight	15-25lb (6.8 – 11.3kg)	0.6(0.5-0.7) lb/wk(25-29.9 kg/m^2)	0.27 (0.23 – 0.31) kg/wk
D. Obese	11-20lb (5 – 9.1kg)	0.5(0.4-0.6) lb/wk(>30 kg/m^2)	0.23 (0.18 – 0.27) kg/wk

A detailed history regarding the present pregnancy was taken, information on maternal age, religion, educational status, occupation, socioeconomic status, residence, drug usage, physical activity during pregnancy was recorded. History of previous pregnancy if any and its outcome was taken. Sex and age of the previous child, period of gestation at which delivered or aborted, birth weight, congenital anomaly, early neonatal complications or neuro-developmental delay were recorded. During antenatal period – Gestational hypertension, antepartum haemorrhage, preeclampsia, gestational diabetes. Period of gestation at delivery – abortion (<24weeks), Preterm (24 to 37 weeks), Term (37 to 40 weeks) and post- term (>40 weeks). Onset of labor – Induced or spontaneous. Mode of delivery- vaginal

delivery, instrumental or C- section. Perineal trauma and Postpartum haemorrhage were studied.

Results

A total of 100 pregnant women were included in this study. Table 1 shows distribution of cases according to age.Most of the patient's age group were 20-25 years (48%) followed by 25-30 years (25%), below 20 years (22%) while only 5% cases were in the age group above 30 year.

Table 1: Distribution of cases according to age group.

Age group (years)	No. of cases	Percentage
Below 20	22	22
20-25	48	48
25-30	25	25
Above 30	5	5
Total	100	100
Mean age	23.98±3.76	

In present study, 2 patients were of socioeconomic status of grade I, while only 3% patients were socioeconomic status II. 35%, 36% and 24% patients had their socioeconomic status III, IV and Vrespectively.

Table 2: Distribution of cases according tosocioeconomic status

Socioeconomic status	No. of cases	Percentage
I	2	2
II	3	3
III	35	35
IV	36	36
V	24	24
Total	100	100

Table 3: No. of cases according to BMI group.

BMI Categories	Frequency	%
GROUP A (underweight)	10	10
GROUP B (normal BMI)	50	50
GROUP C (overweight)	35	35
GROUP D (obese)	5	5
Total	100	100

Table 3 shows distribution of cases according to BMI group. 10 cases were in group A(≤18.5). 50 cases were in group B (18.51-24.99). 35 cases were in group C (25- 29.99) and 5 cases were in group D (≥30).

Table 4: Weight Gain During Pregnancy

Weight Gain (Kgs)		BMI Categories (N=100)				P values		
		Group A (N=10)	Group B (N=50)	Group C(N=35	Group D(N=5)	Group B vs Group A	Group B vs Group C	Group B vs Group D
< 8 kgs(n=10)	Frequency	1	4	3	2			
	%	10%	8%	11.67%	40%			
8 – 15.9 kgs (n=70)	Frequency	7	36	25	2			
	%	70%	72%	71.43%	40%			
>16 kgs(n=20)	Frequency	2	10	7	1			
	%	20%	20%	20%	10%			
Mean ± SD		10.64 ± 5.62	10.35 ± 6.0	9.12± 1.16	8.95 ± 1.65	0.81	<0.001	<0.001

The mean weight gain in group A is 10.64 ± 5.62, group C is 9.12 ± 1.16, group D is 8.95 ± 1.65 on comparing with group B mean weight gain 10.35 ± 6.0 significantly less mean weight gain in group C and group D (P<0.001, <0.001) respectively. Butthere is no difference in mean weight gain between group A and B (p=0.81)

Table 5: Antenatal Complications

Antenatal Complications		BMI Categories (N=100)				P values		
		Group A (N=10)	Group B (N=50)	Group C (N=35	Group D (N=5)	Group B vs Group A	Group B vs Group C	Group B vs Group D
Pre-Eclampcia (n=5)	Frequency	1	2	1	1	0.274	0.029	<0.0001
	%	10%	4%	2.86%	20%			
Gestational Diabetes(n=5)	Frequency	1	1	2	1	0.512	0.052	<0.0001
	%	10%	2%	5.71%	20%			
Ante Partum Haemorrhage (n=10)	Frequency	1	5	3	1	0.501	0.74	0.84
	%	10%	10%	8.57%	20%			
Gestational Hypertension (n=6)	Frequency	1	2	2	1	0.332	0.42	0.32
	%	10%	4%	2.86%	20%			

Pre-eclampsia was present in 1 (10%) cases in group A (p value = 0.274), and 1 (2.86%) in group C (p value = 0.029) and 1(20%) in group D (p value<0.0001) when compared withcomparison group B 2 (4%) cases. There were 1 (10%) cases (p value = 0.512), 2(5.71%) cases (pvalue = 0.052) and 1 (20%) cases (p value<0.0001) of gestational diabetes in group A, C and D respectively on comparing with 1 (2%) group B cases. There were more cases of gestational diabetes in obese and overweight.

The incidence of antepartum hemorrhage was comparable in all BMI groups in group A, C and D APH is present in 1 (10%), 3 (8.57%) and 1 (20%) subjects which was compared to 5(10%) subjects in group B.

Table 6: Onset of Labour

Onset Of Labour		BMI Categories (N=100)				P values		
		Group A (N=10)	Group B (N=50)	Group C (N=35	Group D (N=5)	Group B vs Group A	Group B vs Group C	Group B vs Group D
Spontaneous (n=80)	Frequency	8	45	24	3	0.511	0.074	<0.0001
	%	80%	90%	68.57%	60%			
Induced (n=20)	Frequency	2	5	11	2			
	%	20%	10%	31.43%	40%			

There are significantly more inductions and less spontaneous deliveries in obese (group D) women.

It was observed that the spontaneous onset of labour was seen in 45 (90%) women in group B and when compared to 8(80%) women in group A (p=0.511) and 24 (68.57%) womenin group C (p=0.074) the difference was not significant. In group D there were 3 (60%) subjects which were significantly less than group B (p<0.0001). Women who had induced onset of labour were 5 (10%) in group B and 11 (31.43%) in group C (p=0.074), 2 (40%) ingroup D (<0.0001) and 2 (20%) in group A (p=0.511).

Table 7: Mode of Delivery

Mode Of Delivery		BMI Categories (N=100)				P values		
		Group A (N=10)	Group B (N=50)	Group C (N=35	Group D (N=5)	Group B vs Group A	Group B vs Group C	Group B vs Group D
Normal Vaginal Delivery (n=70)	Frequency	8	40	20	2	0.822	0.001	<0.0001
	%	80%	80%	57.14 %	40%			
Instrumental Delivery (n=20)	Frequency	1	6	12	1	0.587	0.069	0.177
	%	10%	12%	34.29 %	20%			
C-Section (n=10)	Frequency	1	4	3	2	0.41	0.017	<0.0001
	%	10%	8%	8.57%	40%			

Table 8: Fetal Outcome

Fetal Outcome		BMI Categories (N=100)				P values		
		Group A (N=10)	Group B (N=50)	Group C (N=35	Group D (N=5)	Group B vs Group A	Group B vs Group C	Group B vs Group D
LIVE BIRTH (n= 90)	Frequency	9	48	33	3	0.87	0.74	0.12
	%	90%	96%	94.29%	60%			
STILL BIRTH (n=3)	Frequency	0	1	1	1	0.45	0.71	0.27
	%	0.0%	2%	2.86%	20%			
IUD (n=4)	Frequency	1	1	1	1	0.62	0.54	0.27
	%	10%	2%	2.86%	20%			

The incidence of live births, stillbirths and IUD were comparable in all the groups. It was observed that there were 9 (90%) subjects in group A, 48 (96%) women in group B, and 33 (94.29%) subjects in group C and 3 (60%)women in group D who had live births.

There were three (2%) stillbirths in group B and zero (0%) in group A, 1 (2.86%) in group C and 1(20%) in group D. In group B there were 1 (2%) IUD and 1 (10%) IUD in group A. 1 (2.86%) and 1 (20%) cases in group C andgroup D respectively.

Table 9: Birth Weight of Neonate

Birth Weight		BMI Categories (N=100)				P values		
		Group A (N=10)	Group B (N=50)	Group C (N=35	Group D (N=5)	Group B vs Group A	Group B vs Group C	Group B vs Group D
VLBW (<1500gms) (n=4)	Frequency	1	1	1	1	0.41	0.87	0.52
	%	10%	2%	2.86%	20%			
LBW (1500-2500)gms(n=10)	Frequency	3	5	1	1	<0.0001	0.002	0.041
	%	30%	10%	2.86%	20%			
NORMAL WEIGHT (2500-4000)gms (n=80)	Frequency	5	41	32	2	<0.0001	0.061	0.51
	%	50%	82%	91.43%	40%			
MACROSOMIC (>4000gms) (n=6)	Frequency	1	3	1	1	0.52	0.32	0.0002
	%	10%	6%	2.86%	20%			
Mean ± SD		2.82 ± 0.75	2.99 ± 0.62	2.73 ± 0.56	3.16 ± 0.48	0.001	0.019	0.005

There were 1(10%) women in group A and 1 (2%) womenin group B who delivered a very low birth weight baby . There were 1 (2.86%) VLBW babies in group C and 1 (20%) VLBW baby in group D.

There were 3 (30%) LWB babies born in group A and 5 (10%) in group B. In group C and D there were 1 (2.86%) and one (20%) LBW baby respectively. There were more LBWbabies in group A and less in group C and D.

In group A, B, C and D there were 5 (50%), 41(82%), 32 (91.43%) and 2 (40%) normal weight babies respectively. There was one (10%) women in group A and 3 (6%) women in group B who delivered a

macrosomic baby. There were 1(2.86%) macrosomic babies in group C and 1 (20%) in group D.There were more macrosomic babies in group D (pvalue=0.0002).

There is a significant difference in mean birth weight betweengroup B 2.85 ± 0.62 kgs and 2.82 ± 0.75 kgs group A (p=0.001), 2.73 ± 0.62 kgs group C (p= 0.032) and 3.16 ± 0.48 kgs group D(p=0.005). Babies born to underweight women had less mean birth weight and those born to overweight and obese women hadsignificantly more mean birth weight.

The APGAR score was taken at 5 minutes and it was observed that there was no difference found in any of groups. The neonates who admitted to NICU were also comparable in all groups.

Discussion

Obesity has become an epidemic worldwide. The World Health Organization (WHO) has declared obesity as a major killer disease of the millennium on par with HIV and malnutrition. BMI provides a simple numeric measure of a person's "fatness" or "thinness". For a fixed body shape and body density, and given height, BMI is proportional to weight. The weight excess or deficiency may, in part, be accounted for by body fat (adiposetissue) although other factors such as muscularity also affect BMI significantly.[19] This study adds to the increasing body of evidence which suggests that both being overweight and underweight, measured by BMI, predisposes women to complicated pregnancies, obstetric interventions and significant risks to the fetus.

In the present study, BMI distribution was comparable to Michlin R et al.[20] and Crane JMG et al.[21] The ratio of obese women was less and underweight was more in the present study.In the observed period, although the women with overweight and obesity in our sample belonged to a lower limit of theobesity, based on our results, we derive the conclusion that not only obesity with BMI ≥ 30.0 but also overweight with BMI between 25.0 and 29.0 is a high risk factor for the occurrence of pathological conditions in pregnancy, such as preeclampsia, GDM, gestational hypertension and IUGR.

In present study, 2 patients were of socioeconomic status of grade I, while only 3% patients were socioeconomic status II. 35%, 36% and 24% patients had their socioeconomic status III, IV and V respectively. In lower class, class V there were significantly more underweight and less obese women. It was observed that higher the socio economic class more was the BMI. The women who had received higher education and had higher family income chose to bear children at a later stage of their life and they were usually obese and overweight.

In our study, The mean weight gain in group A is 10.64 ± 5.62, group C is 9.12 ± 1.16, group D is 8.95 ± 1.65 on comparing with group B mean weight gain 10.35 ± 6.0 significantly less mean weight gain in group C and group D (P<0.001,<0.001) respectively. Butthere is no difference in mean weight gain between group A and B (p=0.81). These results were similar to those reported by Michlin R et al.[20] while they were not comparable with study done by Cadergren et al.[22] The study by Cadergren et al.[22] was conducted in Sweden and the mean weight gain was more in all BMI categories and the prevalence of obesity is more in European countries due to sedentary life style they tend to gain more weight. According to the 2009 IOM/NRC guidelines the optimal weight gain for underweight is 12.7 – 18.1kgs and for obese it is 5 – 9.1kgs. Both extremes, excessive or inadequate gestational weight gain, can lead to adverse pregnancy outcomes.

Pre-eclampsia was present in 1 (10%) cases in group A (p value = 0.274), and 1 (2.86%) in group C (p value = 0.029) and 1(20%) in group D (p value<0.0001) when compared withcomparison group B 2 (4%) cases. There were significantlymore cases

of pre-eclampsia in obese and overweight women. Similar findings were reported by Tharihalli and Thathagiri.[23] There were 1 (10%) cases (p value = 0.512), 2(5.71%) cases (pvalue = 0.052) and 1 (20%) cases (p value<0.0001) ofgestational diabetes in group A, C and D respectively on comparing with 1 (2%) group B cases. There were more cases of gestational diabetes in obese and overweight. The incidence of preeclampsia, gestational hypertension, GDM was higher in obese group which was similar to Crane JMG et al.[21] There were more abortions in higher BMI groups. This is probably because obese women are usually older in age and there oocytes aremore susceptible to aneuploidy and chromosomal abnormalities leading to abortions.

A high incidence of vaginal delivery 70% was observed in the present study, maximum vaginal deliveries were in group B (80%) followed by group A (80%), C (57.14%) and group D (40%). The incidence of vaginal delivery decreased with increasing BMI due to increased obstetric complications. The rate of c-section was 10%, 8.57% and 40.0% in underweight, overweight and obese women respectively. The results were comparable to the study conducted by Bhattacharya S et al.[24] 11.3%, 24.1% and 30.8% and Crane JMG et al.[21] 13.13%, 31.10% and 38.16% in underweight, overweight and obese women respectively. The c- section rates increased as BMI increased as there were more obstetric complications in obese subjects which lead to increasedrates of c-section.

The incidence of instrumental deliveries, Perineal trauma and PPH was more in group D (obese). As compared to the study done by Bhattacharya S et al.[24] the incidence was less in all groups in the present study. This could be related to the more number of inductions in the studies done by Liu X et al.[25] and Bhattacharya S et al.[24] Stringent anti obesity measures need to be implemented in women to prevent complications of obesity in reproductive years. The mean birth weight of neonate in normal BMI group (group B) was 2.82 ± 0.75 kgs, 2.99 ± 0.62 kgs, 2.73 ± 0.56 kgs and 3.16 ± 0.48 kgs in group A, C and D respectively. The mean birth weight of neonate in the present study was less than the studies conducted by Crane JMG et al.[21] and Choi SK et al.[25] in all the groups. The mean birth weight of neonates is less in India as compared to the western countries as there were more underweight and less obese subjects in the present study.

Conclusion

The study has shown an association between maternal weight (underweight, overweight and obese) and pregnancy outcome. There is importance of prepregnancy counseling in maintaining weight of women during pregnancy to avoid maternal and fetal outcomes.

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