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Original Research Article

Effect of body mass index on fetal outcome in pregnancy

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ABSTRACT

Background: Maternal body mass index during pregnancy is one of the important parameter which gives us the clue regarding fetal complications. The objectives of this study were to study distribution of antenatal patients in underweight, normal, overweight (and obese) categories according to booking BMI, to examine the association of BMI with perinatal outcomes in singleton pregnancies.

Materials and Methods: This prospective Study was conducted over a period of 1 year from July 2019 to June 2020 on antenatal women attending O.P.D in the Department of Obstetrics and Gynecology in LLRM Medical College. The enrolled patients were divided into three equal groups(n=50) according to their BMI. In all the groups perinatal outcome was assessed.

Results: The mean baby birth weight for whole study group was 2.807 kg with standard deviation of 0.44. Birth weight found to be related to maternal BMI and mother with low BMI have babies with low birth weight and vice versa.14% of babies born to mothers belonging to underweight BMI group required NICU admission due to reasons like meconium staining, low birth weight, birth asphyxia. 10% babies born to mothers who were overweight were admitted in NICU while 0% of babies born to women with normal BMI got admitted in NICU.

Conclusions: Higher prevalence of complications to fetus when BMI is not in the recommended normal range.

1. Introduction

Maternal body mass index during pregnancy is one of the important parameter which gives us the clue regarding maternal complications and fetal outcome. Routine weight measurement of pregnant women has now become accepted as one of the important tools of prenatal care in modern obstetrics, the importance of which was first enlightened by Gasser in 1962. The women are weighed at their first antenatal visit to note the booking weight and height of the patient which is taken to calculate BMI.

The Body Mass Index(BMI) formula was developed by Belgium statistician Adolphe Quetelet (1796-1874), and was known as the Quetelet Index. BMI does not measure body fat directly, but research has shown that BMI correlates to direct measures of body fat, such as underwater weighing and dual energy x-ray absorptiometry (DXA). BMI can be considered an alternative for direct measures of body fat.

BMI is calculated the same way for both adults and children. The calculation is based on the following formulas:

The standard weight status categories associated with BMI ranges for adults are shown in the following table.

It is a simple useful index for evaluating pre-pregnancy nutritional status in clinical settings. In pregnancy BMI is

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Measurement Units	Formula and Calculation
Kilograms and meters	Formula: weight (kg) / [height (m)]2
Pounds and inches	Formula: weight (lb) / [height (in)]2 x 703

BMI	Weight Status
Below 18.5	Underweight
18.5 – 24.9	Normal
25.0 – 29.9	Overweight
30.0 and Above	Obese

calculated using pre-pregnancy weight. If this is unknown the first weight measurement at pre-natal care is used.

In fact most favourable outcome of pregnancy in terms of low birth weight infants and perinatal death is associated with a moderate rate of weight gain. This can be achieved by recording her BMI in her each antenatal visit and regulating her diet and therapeutic supplement as required.

To promote improved pregnancy outcome, low BMI women should be encouraged to obtain their ideal weight for height by proper diet. When they are found to be overweight at their first antenatal visit (booking weight), outcome can be improved by avoiding them to gain adequate weight antenataly by proper diet which will reduce incidence of FGR and preterm labour.

Booking body mass index (BMI) is of clinical interest for above mentioned reasons and risk.

2. Materials and Methods

This study is a prospective observational study. This Study was conducted on antenatal women attending O.P.D in the Department of Obstetrics and Gynecology in LLRM Medical College and associated SVBP Hospital, after obtaining well-informed consent from the patients. The study was done over a period of 1 year from July 2019 to June 2020. The enrolled patients were divided into three groups according to their BMI. Equal number of patients were taken in each group for an accurate comparison. 50 patients in each group have been taken. After detailed history and examination, and after fulfilling the criterion for inclusion in the study, patients were divided into 3 groups-

1. Underweight (BMI<18 5Kg/m2 -50 patients
2. Normal (BMI18 5-24 99Kg/m2 - 50 patients
3. Overweight (BMI>25Kg/m2 -50 patients

In all the groups maternal outcome was studied along the following lines-

Fetal well being was assessed using mode of delivery, period of gestation APGAR at 1 and 5 minutes, trauma, asphyxia, meconium stained liquor and, babies requiring neonatal ward admissions.

These outcome variables of underweight and overweight group were compared with control group (women with normal BMI).

Detailed history taking and examination was carried out with the measurement of body mass index as weight in kg/height in meter square.

2.1. Inclusion criteria of present study

Pregnant mothers in 1st trimester of pregnancy(<14 week)

1. Singleton pregnancy
2. Age 18-35 years
3. Spontaneous conception
4. Booked pregnant patient who will deliver in our hospital

In general, we have included the pregnancy terminated prematurely, in our study, as it will help us to study the relationship of incidence of premature labour with maternal booking BMI.

The cases which have been excluded are

1. Overt diabetes
2. Multiple pregnancy
3. Hydramnios
4. Intra-uterine fetal deaths

   Diabetic mothers were excluded because the disease process itself has got influence on the baby weight and thus influence the study of relationship of maternal weight gain to birth weight of baby. For the same reason multiple pregnancy, hydramnios, still birth are excluded.
5. Pregnant women with other systemic disorder like kidney, lung, heart, thyroid disease etc. are also excluded from the study for the same reason.

2.2. Methodology

Ante-natal cases fulfilling the above mentioned criteria, coming within first trimester will be enrolled for the study after explaining them the purpose of the study.

Initial detailed history and examination will be recorded. Necessary routine investigations along with iron, folic acid and calcium supplementation as necessary will be prescribed. Weight will be measured by digital weighing machine calibrated to the accuracy of ± 50gm. Height will be measured by height scale. BMI will be calculated using formula: weight / height^2.

Women will be classified into three groups on the basis of BMI (kg/m^2)

1. Under weight (BMI ≤ 19.9)
2. Normal (BMI 20 – 24.9)
3. Over weight (BMI 25 – 29.9)and obese (BMI 30 – 34.9)

All women will be followed up throughout pregnancy for weight gain and any fetal complication and perinatal outcome at the time of delivery in the form of

1. Preterm delivery which was defined as delivery before 37 completed weeks of pregnancy.
2. Macrosomia was defined as birth weight >4000 g, and low birth weight as weight <2500 g at term.
3. Low Apgar score was defined as 5-min Apgar score <5.
4. Admission of new born to neonatal intensive care unit for birth asphyxia, hypoglycemia, jaundice and perinatal mortality was alsonoted.

3. Results

This study includes 150 singeleton pregnant women. Equal number of patients were taken in each group for an accurate comparison 50 patient in each group had been taken.

1. Under weight
2. Normal weight
3. Over weight and obese

3.1. Fetal outcome

The Table 1 shows comparison of APGAR score of the babies, born to mothers in different groups classified according to their BMI, at one minute and five minutes. It was found to be insignificant as p values were 0.356 and 0.451 for APGAR score at one minute and five minute respectively i.e. more than 0.05.

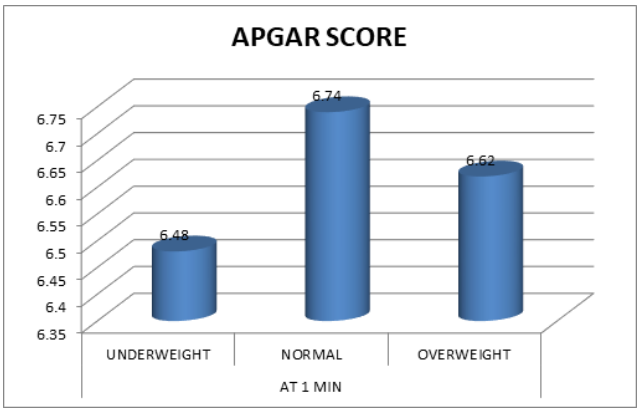

Fig. 1:

APGAR score at 1 and 5 minutes of babies born to different maternal BMI groups.

Graph represents relation between APGAR score at 1 minute in relation to BMI categories which shows that low BMI was associated with low APGAR score. Same result was observed in APGAR score observed in 5 minutes as shown Figure 2.

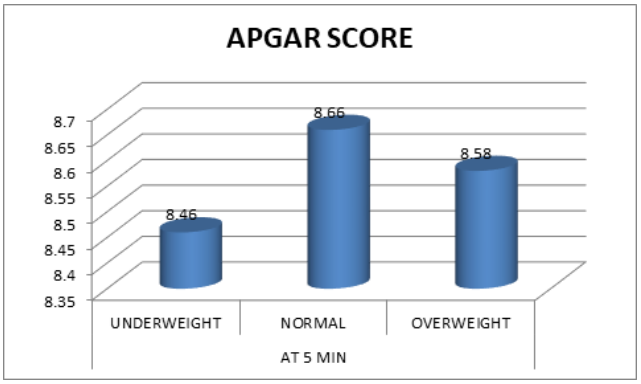

Fig. 2:

3.2. NICU admission

Table 2 shows frequency of NICU admissions of babies born to women in different BMI groups. Of 50 patients belonging to underweight BMI 7 babies required NICU admission due to reasons like meconium staining, low birth weight, birth asphyxia. 5 babies of 50 born to mothers who were overweight were admitted in NICU while 0 baby of 50 born to women with normal BMI got admitted in NICU. P value is 0.040 i.e. statistically significant.

Frequency of NICU admission in babies born to mothers in different maternal BMI groups.

3.3. Meconium stained liquor

Table 3 showed that no. of babies born with meconium stained liquor.it shows that in babies born of underweight women 5 out of 50 babies are meconium stained while in overweight 18 out of 50 babies are meconium stained and in normal 6 babies are meconium stained. P value is statistically significant.<0.05.

Frequency of babies born to mothers of different BMI groups with meconium stained liquor.

The above graph shows the comparison of the mean birth weight among the three BMI groups. It is evident from the graph that with increase in maternal BMI the mean baby birth weight increased.

4. Discussion

Obesity has become an epidemic worldwide. WHO has declared obesity as a major killer disease of the millennium at par with malnutrition and HIV. BMI provides simple numeric measure of a person's fatness or thinness. Various Studies observed that both being overweight and underweight predisposes women to complicated pregnancies The antenatal, intrapartum, postpartum and neonatal assessment was done and outcome of each pregnancy in terms of fetal morbidity and mortality were studied.

Table 1: APGAR score at 1 and 5 minutes of babies born to different maternal BMI groups

APGAR Score	Groups	Mean	SE	SD	F-statistics	p-value*
At 1 Min	Underweight	6.4800	.14067	.99468	1.0382	0.3567
	Normal	6.7400	.08480	.59966		
	Overweight	6.6200	.14816	1.04764		
At 5 Min	Underweight	8.4600	.12192	.86213	1.812	0.451
	Normal	8.6600	.07882	.55733		
	Overweight	8.5800	.12806	.90554		

*p-value>0.05 is insignificant

Table 2: Frequency of babies born to mothers of different BMI groups requiring NICU admission

Groups	NICU Admission	
	No	Yes
Underweight	43/86%	7/14%
Normal	50/100%	0
Overweight	45/90%	5/10%
Total	138/92%	12/8%
Chi square	11.742	
p-value	<0.05	

Table 3: Frequency of babies born to mothers of different BMI groups with meconium stained liquor

Groups	Meconium stained liquor	
	No	Yes
Underweight	45/90%	5/10%
Normal	44/88%	6/12%
Overweight	32/64%	18/36%
Total	121/80.67%	29/19.33%
Chi square	9.112	
p-value	<0.05	

Table 4: Fetal outcomes in different maternal BMI groups

Parameters		Underweight	Normal	Overweight	Chi square	p-value
Gestational Age at Delivery (in Weeks)	32	1/2.0%	0	0	1.921	<0.05
	32 - 34	1/2.0%	1/2.0%	0		
	34 - 36	7/14	3/6	0		
	>36	41/82	46/92	50/100		
Birth Weight (in kg)	1.5	2/4	0	0	2.008	<0.05
	>1.5 - /2	6/12	3/6	0		
	>2 - /2.5	14/28	14/28	16/32		
	>2.5 -/3	22/44	28/56	13/26		
	>3 - /3.5	6/12	14/28	16/32		
	>3.5	0	0	5/10		
Apgar Score at 1 Min	<5	6/12	2/4	6/12	1.712	<0.05
	>5	44/88	48/96	44/88		
NICU Admission	Yes	7/14	0	5/10	5.112	<0.05
	No	43/86	50/100	45/90		
Meconium Stained Liquor	Yes	5/10	6/12	18/36	1.619	<0.05
	No	45/90	42/84	34/68		

Birth weight in different BMI groups

Table 5: Birth weight in different BMI groups

Parameters		Underweight	Normal	Overweight	Chi square	p-value
Birth Weight (in	1.5	2/4	0	0	2.008	<0.05
	>1.5 - /2	6/12	3/6	0		
	>2 - /2.5	14/28	14/28	16/32		
	>2.5 -/3	22/44	28/56	13/26		
	>3 - /3.5	6/12	14/28	16/32		
	>3.5	0	0	5/10		

4.1. Amniotic fluid Index on USG

Oligohydramnios in the normal BMI category was 2% and in the overweight category was 4% and these were also 4%in the underweight category. The difference in ultrasound findings remained statistically insignificant with a p value of 0.56.

4.2. Preterm labor

Preterm labor pains occurred in 12% of the pregnancies with normal BMI, 32% in the low BMI and 4% in overweight group. The difference was statistically significant with a p value of 0.000. The study was similar to a study by Hendler et al[1] who stated that obese women had fewer spontaneous preterm births at <37 weeks of gestation (6.2% vs 11.2%; # <.001) and at <34 weeks of gestation (1.5% vs 3.5%; # = .012). Women with a body mass index of <19 kg/m' had 18% spontaneous preterm birth, with a body mass index of 19 to 24.9 kg*m' had 8% spontaneous preterm birth, with a body mass index of 25 to 29.9 kg/m' had 0% spontaneous preterm birth, Hence, when controlling for confounders, obesity and morbid obesity were not associated with prematurity. Similar results were reported by Ehrenberg et al (2003)[2] who concluded that low weight and BMI at conception or delivery, as well as poor weight gain during pregnancy, are associated with LBW, prematurity, and maternal delivery complications patients.

4.3. Fetal outcome

4.4. Birth weight

Birth weight was found to be related to maternal BMI and mother with low BMI have babies with low birth weight and vice versa. The mean birth weight (in kg) in normal group was 2.80, in underweight group 2.54 and in over weight group it was 2.97. This is statistically significant as p value is 0.011. (i.e< 0.05). The study was consistent with Sebire NJ et al.[3] who found that in comparison to women with normal BMI, the birth weight was found to be above 90th centile (1.57 (1.50–1.64), 2.36 (2.23–2. 50) in obese pregnant women (odds ratio (99% confidence interval) for BMI 25–30 and BMI>30 respectively).

4.5. APGAR score

APGAR score were compared amongst babies born to women in different BMI group at one and five minutes. The mean APGAR score at one minute in normal, underweight and overweight group were 6.74, 6.48 and 6.62 respectively. While the mean APGAR score at five minutes in above mentioned groups were 8.66, 8.46and 8.58 respectively. This came out to be statistically insignificant with p value of 0.356 and 0.451 for one and five minute respectively. The result was in contrast to Ellen Anohr et al(2008)[4] who mentioned that greater weight gains and high maternal BMI decreased the risk of growth restriction and increased the risk of the infant's being born large-for-gestational-age or with a low Apgar score**.** Generally, low gestational weight gain was advantageous for the mother, but it increased the risk of having a small baby, particularly for under weight women.

4.6. Meconium stained liquor

12% of babies born to women with normal BMI had meconium stained liquor while the number rose to 36% in babies born to overweight mothers. 10% of the babies born to underweight females had meconium stained liquor. The data was statistically significant with p value of 0.00. Results matched with study by Marie I. Cedergren[5] stating that meconium aspiration occurred more often in infants of morbidly obese women than in women with normal BMI values: adjusted OR 2.85 (95%CI).

4.7. NICU admission

Of 50 patients belonging to normal BMI none of the babies required NICU admission. 5 babies of 50 born to mothers who were overweight were admitted in NICU while 7 baby of 50 born to women with low BMI got admitted in NICUdue to reasons like meconium staining, low birth weight, birth asphyxia. P value is 0.040 i.e. statistically significant. Results were consistent with Leonie K Callaway(2006)[6] concluding that neonates born to morbidly obese women were at increased risk of admission to intensive care (2.77 [1.81-4. 25]).

5. Conclusion

From this study it may be concluded that:-

1. Pre-pregnancy counselling, health programs and appropriate multi- disciplinary management should be done.
2. With proper management of pregnant women with a higher BMI, improvement in awareness amongst the women and increasing their accessibility to medical facilities, maternal and perinatal morbidity and mortality can be minimized
3. Higher prevalence of complications to both the fetus and the mother when BMI is not in the recommended normal range.
4. Overweight women were associated with significantly increased, meconium stained liquor and NICU admissions.
5. Underweight women had higher incidence of preterm labor and an insignificantly higher incidence of low birth weight babies and low APGAR scores.

Therefore, it is a must for all pregnant and non pregnant women to be aware of the feto-maternal complications arising due to inappropriate Body Mass Index. To conclude, pregnancy complications related to maternal BMI is a growing problem. Both lean and obese mothers carry an increased risk of adverse perinatal outcome. Because many obstetrician & gynecologists are the primary health care providers, encouraging attainment of ideal body weight before pregnancy through responsible lifestyle measures is a laudable, albeit difficult, goal. As health care providers to young women, we are in a unique position to affect both short-and long- term risks and morbidities for our patients and families at a time when they may be most amenable to alterations in life style.

6. Acknowledgement

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7. Source of Funding

No funding resources.

8. Conflict of Interest

None declared.

9. Ethical Approval

This study was approved by the institutional Ethics committee.

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