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Original Article

Obstetrics and Gynaecology Section

Effect of Maternal Body Mass Index on Intrapartum and Neonatal Outcome in Nulliparous Women in North Karnataka: A Prospective Cohort Study

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ABSTRACT

Introduction: Nutrient intake and weight gain are the two main modifiable factors during pregnancy that influence maternal and infant outcome. Body Mass Index (BMI) derived from weight and height is a marker of metabolic and endocrinal status and is used to classify people from underweight to obese. Pregnancy complications related to maternal BMI is a growing problem. Both lean and obese mothers carry an increased risk of adverse perinatal outcome.

Aim: To assess the effect of maternal BMI on labour and mode of delivery, neonatal outcome and to detect the obstetric complications in relation to different BMI's.

Materials and Methods: A prospective study was conducted in Mahadevappa Rampure Medical College, Kalaburagi, Karnataka, India, from August 2014 to July 2016 in which total of 200 primigravidas with singleton pregnancy; in labour after 28 weeks of gestation were included. BMI was calculated using the formula by Quetelet. The women were categorised into underweight, normal, overweight and obese according to World Health Organisation (WHO).

Results: Out of 200 cases, 111 (55.5%) were of normal BMI, 61 (30.5%) overweight, 16 (8.0%) obese and 12 (6.0%) underweight. Pre-eclampsia, oligohydramnios, Intrauterine Growth Restriction (IUGR), anaemia, foetal birth weight <2.5 kg, increased incidence of Neonatal Intensive Care Unit (NICU) admissions and early neonatal complications were commonly seen in underweight which was statistically significant (p<0.01). Gestational hypertension (n=5), increased incidence of caesarean sections (n=13), foetal birth weight >3.5 kg (n=5), failed spinal anaesthesia (n=2), postpartum haemorrhage (n=4), post Lower Segment Caesarean Section (LSCS) wound gape (n=2) and prolonged hospital stay (n=3) were the complications seen in obese individuals.

Conclusion: Maternal BMI showed a strong association between pregnancy complications and outcomes. Therefore, all the pregnant women need to be advised to maintain normal BMI in order to achieve a healthy outcome as both underweight and obese women carry risk for adverse pregnancy outcome.

Keywords: Nulliparity, Obesity, Pregnancy outcome, Quetelet index

INTRODUCTION

India is following the trend of other developing countries that are steadily becoming both more obese and underweight [1]. According to National Family Health Survey (NFHS-5) prevalence of obesity in women in Karnataka has increased to 23.3% and also the underweight women has raised to 20.7% [2]. It has been observed that maternal underweight and obesity are the risk factors for outcomes such as pre-eclampsia, eclampsia, pre and post-term delivery, induction of labour, caesarean section and postpartum haemorrhage, observed in different settings [3-5]. Low BMI and suboptimal weight gain during pregnancy are recognised risk factors for small for gestational age infants, while high BMI in pregnancy has been shown to be associated with longer gestation and increased risk of post-term delivery [6,7]. These results will be of high interest to the primary healthcare providers who care for women before and during pregnancy. With this background, the present study was conducted with an aim to know the effect of maternal BMI on labour and mode of delivery, to detect the obstetric complications in relation to different BMI's.

MATERIALS AND METHODS

A prospective cohort study was conducted on 200 primigravidas with singleton pregnancy in labour after 28 weeks of gestation, from August 2014 to July 2016, after obtaining clearance from the Institutional Ethical Committee (M.R. Medical College IEC, Ref no: HKE'S/MRMCK/IEC/SYA/2014-37 dated 29-11-2014). Participants were enrolled in the study after obtaining informed consent at Basaveshwar Teaching and General Hospital and Sangameshwar Teaching and General Hospital attached to Mahadevappa Rampure Medical College, Kalaburagi, Karnataka, India.

Inclusion criteria: All primigravidas with singleton pregnancy with >28 weeks of gestation were included.

Exclusion criteria: Multiple pregnancy, multigravida, non ambulatory primigravida and those with congenital malformations of the foetus were excluded.

Study Procedure

In all the cases detailed history of the patient was taken including the name, age and socio-economic status according to Kuppuswamy scale [8] and presenting complaints.

Weight was measured in kilograms (kg). Patients were weighed without shoes, wearing light indoor clothes. The weighing machine used was from Equinox, an electronic personal scale CE. Model: EB 9300, Strain gauge sensor, Capacity: 150 kg, Division: 0.1 kg (0.216), Low battery/overload indication, Power: 1pc*3 V lithium cells (CR 2032). Height (in metres) was measured using a measuring scale named Bioplus-200 cm scale.

The patients were made to stand straight and erect with their back against the wall such that the ankles are together, heels, buttocks shoulders and occiput were touching the wall. The patient's head was held in such a position that the line joining

the tragus and outer canthus of eye were in a horizontal plane (Frankfurts Plane). The women were categorised into underweight, normal and obese according to WHO classification [6]. The data were used to calculate Quetelet index or the BMI using the formula BMI=weight (kg)/height (in m^2). Per abdomen examination was done for the fundal height, lie, presentation and position of the foetus. Foetal heart rate was recorded by sound doppler. Also, local examination including vulva, vagina, urethra was done. Per speculum examination was done for cervix and vagina and for any leak/bleeding per vaginum. Detailed per vaginal examination was done for dilatation, effacement, position of cervix, station of presenting part and adequacy of pelvis.

Gestational age was calculated from the first day in the last menstrual period. Term birth was defined as that reaching upto 37-41 weeks while pre-term birth was defined as birth before 37 completed weeks and post-term as birth after 41 weeks [4].

Neonatal data included: Birth weight was recorded on a pre zeroed electronic balance with the baby naked to the nearest 5 gm. APGAR scores were estimated at 1 and 5 minutes.

STATISTICAL ANALYSIS

Data was entered in Microsoft excel 20.0 and analysed by using Statistical Package for the Social Sciences (SPSS) Software package version 16.0 with the help of non parametric test Chi-square (χ^2) wherever required for comparison.

RESULTS

In the present study, 111 cases (55.5%) belong to normal BMI, 61 cases (30.5%) to overweight, 16 cases (8%) to obese and 12 cases (6%) to underweight. The Mean± Standard Deviation (SD) of BMI was 24.55±3.47 kg/m^2.

Maximum number of cases in all the categories of BMI belonged to 21-30 years of age group and the mean age in the present study is 23.05±3.31 years. The p-value came out to be <0.05 making the difference statistically significant [Table/Fig-1].

Age (years)	BMI								Total	
	Underweight		Normal		Overweight		Obese			
	No.	%	No.	%	No.	%	No.	%	No.	%
≤20	5	41.7	22	19.8	9	14.7	1	6.3	37	18.5
21-30	7	58.3	85	76.6	48	78.7	14	87.5	154	77
>30	0	0	4	3.6	4	6.6	1	6.3	9	4.5
Total	12	100	111	100	61	100	16	100	200	100

[Table/Fig-1]: Distribution of cases in relation to age and BMI.
χ^2 (Chi-square)= 6.78 p=0.024

In the present study, no cases belonged to Class I socio-economic status. A 43.5% belonged to Class III, of which, 50.8% were overweight; 42.0% belonged to Class V, of which, maximum no. of cases 58.4% were underweight. The p-value came out to be >0.05 which was statistically insignificant [Table/Fig-2].

Socio-economic status	BMI								Total	
	Underweight		Normal		Overweight		Obese			
	No.	%	No.	%	No.	%	No.	%	No.	%
I	0	0	0	0	0	0	0	0	0	0
II	0	0	8	7.2	3	4.9	4	25	15	7.5
III	4	33.3	45	40.5	31	50.8	7	43.8	87	43.5
IV	1	8.3	10	9	3	4.9	0	0	14	7
V	7	58.4	48	43.3	24	39.4	5	31.2	84	42
Total	12	100	111	100	61	100	16	100	200	100

[Table/Fig-2]: Socio-economic status and its relation to BMI.
χ^2 (Chi-square)=3.39; p=0.179

Among underweight (n=12), n=2 (16.7%) were hypertensive and n=5 (31.3%) in obese. Maximum number of cases, n=2 (16.7%) each of pre-eclampsia and IUGR were found in underweight. In underweight, n=8 (66.7%) were anaemic and in obese, n=7 (43.7%) were anaemic. Among underweight, the commonest indication was oligohydramnios, n=3 (33.3%) and among obese it was cephalopelvic disproportion n=6 (37.5%). Failed spinal anaesthesia was observed in n=2 (12.5%) of obese patients.

In the present study, 91.0% were term pregnancies, 6.5% were pre-term and 2.5% were post-term. Among the pre-term, 16.7% were underweight and among post-term 3.6% were normal BMI. The p-value came out to be <0.05 which was statistically significant [Table/Fig-3].

Gestational age	BMI								Total	
	Underweight		Normal		Overweight		Obese			
	No.	%	No.	%	No.	%	NO.	%	No.	%
Pre-term <37 weeks	2	16.7	8	7.2	1	1.6	2	12.6	13	6.5
Term 37-42 weeks	10	83.3	99	89.2	59	96.8	14	87.4	182	91
Post-term >42 weeks	0	0	4	3.6	1	1.6	0	0	5	2.5
Total	12	100	111	100	61	100	16	100	200	100

[Table/Fig-3]: Period of gestation at delivery and its relation to BMI.
χ^2 (chi-square)=7.14; p<0.018

In the present study, 19.0% were free of any complications. Gestational hypertension was seen in 18.0%, commonly in obese (31.3%) pre-eclampsia in 11.5%, commonly in underweight (16.7%). Intrauterine deaths were noted in 2.0% and all the cases belonged to patients with normal BMI accounting to 3.6%. The p-value was <0.01 which was statistically significant [Table/Fig-4].

Pregnancy complications	BMI								Total	
	Underweight		Normal		Overweight		Obese			
	No.	%	No.	%	No.	%	No.	%	No.	%
Gestational HTN	2	16.7	13	11.7	16	26.2	5	31.3	36	18
Pre-eclampsia	2	16.7	9	8.1	10	16.4	2	12.5	23	11.5
Oligohydramnios	3	25	9	8.1	5	8.2	2	12.5	19	9.5
IUGR	2	16.7	2	1.8	0	0	1	6.3	4	2
PROM	3	25	18	16.2	8	13.1	1	6.3	30	15
Anaemia	8	66.7	29	25.2	16	26.3	7	43.7	60	30
Abruptio placenta	0	0	1	0.9	1	1.6	0	0	2	1
Placenta praevia	0	0	1	0.9	1	1.6	0	0	2	1
Intrauterine death	0	0	4	3.6	0	0	0	0	4	2
No complications	1	8.3	29	26.1	8	13.1	0	0	38	19

[Table/Fig-4]: Distribution of cases according to pregnancy complications and BMI.
χ^2 (Chi-square)=12.17; p=0.007

In the present study, 65.0% underwent LSCS, 29.5% normal vaginal deliveries and 5.5% operative vaginal deliveries. 81.3% of the obese patients underwent LSCS. The p value came out as <0.01 which was statistically significant [Table/Fig-5].

Mode of delivery	BMI								Total	
	Underweight		Normal		Overweight		Obese			
	No.	%	No.	%	No.	%	No.	%	No.	%
Normal	6	50	40	36	10	16.4	3	18.7	59	29.5
Operative vaginal delivery	0	0	7	6.3	4	6.6	0	0	11	5.5
LSCS	6	50	64	57.6	47	77	13	81.3	130	65
Total	12	100	111	100	61	100	16	100	200	100

[Table/Fig-5]: Mode of delivery and its relation to BMI.
χ^2 (chi-square)=11.32; p=0.0085; LSCS: Lower segment caesarean section

In the present study, labour was complicated by meconium stained liquor in a total of 29.5% of which, maximum seen in overweight (36%). Prolonged first stage was seen in 8.0%, maximum in underweight (16.7%). The p-value came out as <0.05 being statistically significant [Table/Fig-6].

Intrapartum complications	BMI								Total	
	Underweight		Normal		Overweight		Obese			
	No.	%	No.	%	No.	%	No.	%	No.	%
Meconium	4	33.3	28	25.2	22	36	5	31.3	59	29.5
Prolonged first stage (>12 hrs)	2	16.7	8	7.2	4	6.6	2	12.5	16	8
Postpartum haemorrhage	0	0	6	5.4	2	3.2	4	25	12	6
Retained placenta	0	0	1	0.9	0	0	0	0	1	0.5

[Table/Fig-6]: Intrapartum complications and its relation to BMI.
χ^2 (chi-square)=5.98; p=0.027

In the present study, live births were 98% and stillborn were 2%. Out of 98% live births, 16.8% had NICU admissions, of which 15% had survived and 1.6% had early neonatal deaths. Maximum number of NICU admissions was seen in newborns born to underweight (33.3%) and also early neonatal complications (25%). Early neonatal deaths were noted one each in underweight (8.3%), normal (0.9%) and obese (6.3%) [Table/Fig-7].

Perinatal outcome	BMI								Total	
	Underweight		Normal		Overweight		Obese			
	No.	%	No.	%	No.	%	No.	%	No.	%
Live births	12	100	107	96.4	61	100	16	100	196	98
Stillborn	0	0	4	3.6	0	0	0	0	4	2
NICU admissions	4	33.3	18	16.7	8	13.1	3	18.7	33	16.8
Early neonatal complications	3	25	7	6.6	3	4.9	1	6.3	14	7.14
Survival in NICU	3	25	17	15.8	8	13.1	2	12.5	30	15
Early neonatal deaths	1	8.3	1	0.9	0	0	1	6.3	3	1.6

[Table/Fig-7]: Perinatal outcome and its relation to BMI.
χ^2 (chi-square)=6.73; p=0.028

Mean and SD of APGAR score at one minute and 5 minute was 6.37±0.93 and 8.56±0.90, respectively. In the present study, APGAR at 1 minute were <5 in 61.0% newborns born to mothers with normal BMI, 29.9% to overweight, 6.6% to obese and 2.5% to underweight. There was no statistical significance difference of APGAR score at 1minute among the categories of BMI. In the present study, APGAR at 5 minutes were <7 in 50.0% newborns born to mothers with underweight BMI, 33.3% to normal and 16.7% to obese. There was statistical highly significant difference of APGAR score at 5 minute among the categories of BMI [Table/Fig-8].

BMI	APGAR score							
	At 1 Min.				At 5 Min.			
	<5		≥5		<7		≥7	
	No.	%	No.	%	No.	%	No.	%
Underweight	2	2.5	10	8.4	3	50	9	4.7
Normal	47	61	60	50.4	2	33.3	105	55.2
Overweight	23	29.9	38	31.9	0	0	61	32.2
Obese	5	6.6	11	9.3	1	16.7	15	7.9
Total	77 (38.5%)	100	119 (59.5%)	100	6 (3.5%)	100	190 (96.5%)	100
χ^2-test	χ^2 (chi-square)=3.61; p=0.073 not significant				χ^2 (chi-square)=20.27; p=0.001 highly significant			

[Table/Fig-8]: APGAR score and its relation to BMI.

The mean foetal weight was 2.77±0.55 kg. A 66.7% of underweight patients had newborns with birth weight <2.5kg and 31.3% of obese patients had newborns with birth weight >3.5kg. Maximum number of patients (70.5%) had newborns with birth weight of 2.5-3.5 kg (including 04 cases of stillbirth). The p-value came out to be <0.01 which was statistically significant [Table/Fig-9].

Foetal weight	BMI								Total	
	Underweight		Normal		Overweight		Obese			
	No.	%	No.	%	No.	%	No.	%	No.	%
<2.5 kg	8	66.7	28	25.2	6	9.8	3	18.7	45	22.5
2.5 kg-3.5 kg	4	33.3	76	68.5	53	86.9	8	50	141	70.5
>3.5 kg	0	0	7	6.3	2	3.3	5	31.3	14	7
Total	12	100	111	100	61	100	16	100	200	100

[Table/Fig-9]: Foetal weight and its relation to BMI.
χ^2 (Chi-square)=15.30; p=0.04

In the present study, out of 16.8% who had NICU admissions, 7.14% had early neonatal complications of which, neonatal sepsis 3.6% was found to be most common complication, commonly seen in underweight (16.7%) followed by hypoxic ischemic encephalopathy seen in 2% [Table/Fig-10].

Early neonatal complications	BMI								Total	
	Underweight		Normal		Overweight		Obese			
	No.	%	No.	%	No.	%	No.	%	No.	%
Neonatal sepsis	2	16.7	4	3.8	0	0	1	6.3	7	3.6
Hypoxic ischaemic encephalopathy	1	8.4	2	1.9	1	1.6	0	0	4	2
Hyperbilirubinemia	0	0	1	0.9	2	3.2	0	0	3	1.6
Total	3	25.0	7	6.6	3	4.9	1	6.3	14	7.14

[Table/Fig-10]: Early neonatal complications and its relation to BMI.
χ^2 (chi-square)=1.40; p=0.732

The most common postpartum complication was post LSCS wound infection (3.5%) seen in 12.5% of obese patients, followed by prolonged hospital stay (6.0%) seen in 18.9% of obese patients. There was statistical significant difference of postpartum complications among the categories of BMI [Table/Fig-11].

Postpartum complications	BMI								Total	
	Underweight		Normal		Overweight		Obese			
	No.	%	No.	%	No.	%	No.	%	No.	%
Wound infection	0	0	2	1.8	3	4.9	2	12.5	7	3.5
Puerperal fever	1	8.3	1	0.9	1	1.6	0	0	3	1.5
Urinary tract infection	1	8.3	2	1.8	1	1.6	1	6.3	5	2.5
Respiratory tract infections	0	0	3	2.7	2	3.3	0	0	5	2.5
Prolonged hospital stay	2	16.7	2	1.8	5	8.2	3	18.9	12	6
Total	4	33.3	10	9	12	19.7	6	37.5	32	16

[Table/Fig-11]: Postpartum complications and its relation to BMI.
χ^2 (chi-square)=10.47; p=0.018

Pre-eclampsia, oligohydramnios, IUGR, anaemia, foetal birth weight <2.5 kg, increased incidence of NICU admissions and early neonatal complications were commonly seen in underweight which was statistically significant (p<0.01). Gestational hypertension (n=5), increased incidence of caesarean sections (n=13), foetal birth weight >3.5 kg (n=5), failed spinal anaesthesia (n=2), postpartum haemorrhage (n=4), post LSCS wound gape (n=2) and prolonged hospital stay (n=3) were the complications seen in obese individuals.

DISCUSSION

Obesity measured by BMI predisposes women to complicated pregnancies and increased obstetric interventions [7,9]. The mean age in the present study was 23.05±3.31 years which is comparable with other studies, Jain D et al., and El-Gilany A-H and Hammad S, [7,9]. Pre-term gestation in the present study was comparable with the Bhattacharya S et al., study among the underweight, normal and obese BMI categories but among the overweight category where the present study has 1.6% cases and Bhattacharya S et al., study had 10.8% of pre-term pregnancies [10]. Gestational hypertension in the present study was comparable to the Bhattacharya S et al., among all BMI categories [10].

Pre-eclampsia in the present study was comparable to the Bhattacharya S et al., and Verma A and Shrimali L, among the normal, overweight and obese BMI categories but not among underweight [10,11] wherein, the present study shows 16.7% cases in underweight, Bhattacharya S et al., 3.3% and Verma A and Shrimali L, 3.4% cases [10,11]. Anaemia in the present study was comparable to Verma A and Shrimali L, among the underweight, normal, overweight but not obese [11] wherein, the present study has 43.7% cases and Verma A and Shrimali L, had 9.5% cases, similarly the present study was comparable to El-Gilany AH et al study among the obese which had 45.6% cases but not comparable with other categories of BMI [11]. Abruptio placenta and placenta praevia in the present study was comparable with the Bhattacharya S et al., study among all the categories of BMI [Table/Fig-12] [9-11].

Parameters	Studies	BMI			
		Underweight	Normal	Overweight	Obese
Gestational hypertension	Present	16.7%	11.7%	26.2%	31.3%
	Bhattacharya S et al., [10] (2007)	13.6%	19.7%	28.5%	37.2%
Pre-eclampsia	Present	16.7%	8.1%	16.4%	12.5%
	Bhattacharya S et al., [10] (2007)	3.3%	5%	8.1%	14.7%
	Verma A and Shrimali L, [11] (2012)	3.4%	8.8%	9.6%	11.9%
IUGR	Present	16.7%	1.8%	0%	6.3%
	Verma A and Shrimali L, [11] (2012)	17.2%	6.1%	6.6%	5.9%
Anaemia	Present	66.7%	25.2%	26.3%	43.7%
	Verma A and Shrimali L, [11] (2012)	58.6%	36.2%	15.1%	9.5%
	El-Gilany A-H et al., [9] (2010)	49.2%	47.2%	40.1%	45.6%
Abruptio placenta	Present	0%	0.9%	1.6%	0%
	Bhattacharya S et al., [10] (2007)	0.4%	0.6%	0.6%	0.7%
Placenta praevia	Present	0%	0.9%	1.6%	0%
	Bhattacharya S et al., [10] (2007)	0.4%	0.2%	0.2%	0.2%

[Table/Fig-12]: Comparison of pregnancy complications [9-11].

Stillbirth in the present study which has 3.6% cases among normal BMI is comparable to the El-Gilany AH and Hammad S, had 0.7% cases and Bhattacharya S et al., which had 0.9% [8,9]. But the present study was not comparable to El-Gilany AH et al., and Bhattacharya S et al., among underweight, overweight and obese BMI categories as the present study has no cases in those categories [9-10].

Foetal weight <2.5 kg in the present study was comparable to the Jain D et al., among the normal, overweight and obese BMI categories but not among the underweight [7], wherein the present study 66.7% cases of foetal weight <2.5 kg and the Jain D et al., had 80.0% cases [Table/Fig-13] [7,9,10].

Parameters	Studies	BMI			
		Underweight	Normal	Overweight	Obese
Stillbirth	Present	0.0%	3.6%	0.0%	0.0%
	Bhattacharya S et al., [10] (2007)	0.8%	0.9%	1.1%	1.9%
	El-Gilany A-H and Hammad S, [9] (2010)	1.5%	0.7%	1.1%	1.1%
Foetal weight <2.5 kg	Present	66.7%	25.2%	9.8%	18.7%
	Jain D et al., [7] (2012)	80.0%	18.09%	15.5%	15.6%

[Table/Fig-13]: Comparison of perinatal outcome [7,9,10].

Wound infection in the present study was comparable to the Verma A and Shrimali L, study only in the obese BMI category where the present study shows 12.5% cases and Verma A and Shrimali L who, showed 16.1% cases [11]. One of the major healthcare concern in India is the rising rate of obesity, which can be considered as an important factor in the intrapartum and neonatal outcome [12]. However, low and middle income countries can encounter patients at both extremes of maternal BMI which cannot be ignored as the complications weigh equally [13]. Study conducted by Dalbye R et al., showed no associations between maternal BMI and neonatal outcomes though there was a gradient of risk for intrapartum caesarean section, with highest risk for women in obesity classes II and III [14].

Studies conducted by Kumar HSA and Chellamma VK, showed that among 72 (65.45%) patients between 21-30 years [15], both underweight and overweight women had adverse maternal and perinatal outcome commonest being anaemia (35%) in underweight women. Low APGAR score and NICU admissions were more frequent with obese.

High rate of caesarean sections (34.76%) and prolonged postnatal hospital stay (28.66%) were seen in obese women in the study conducted by Dahake STand Shaikh UA, which were in concordance with the present study [16].

Limitation(s)

As the present study was conducted in a single institution belonging to the backward area of North Karnataka with limited number of patients attending to the hospital. This may affect the external validity of the findings, and most of the patients do not have preconception counselling and their weight goes unrecorded.

CONCLUSION(S)

The relatively limited impact of obesity on perinatal outcomes found in the present study may suggest increased awareness of healthcare providers of the potential risks of maternal and perinatal morbidity in women with increased BMI. Therefore, it is a must for all pregnant and non pregnant women to be aware of the fetomaternal complications arising due to higher and lower BMI. With proper management of pregnant women with a higher and lower BMI, improvement in awareness amongst the women and increasing their accessibility to medical facilities, maternal and perinatal morbidity and mortality can be minimised.

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