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Original Research Article

Relation between Body Mass Index and Mode of Delivery

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Abstract: ***Background:*** Maternal nutritional status is important for health and quality of life in women and growing fetus. Maternal weight gain in pregnancy can offer a good means of assessing the wellbeing of the pregnant mother and her baby. Inadequate prenatal weight gain is a significant risk factor for intrauterine growth restriction, preterm delivery and low birth weight in infants. Obesity and excessive weight gain on the other hand can lead to adverse maternal and fetal outcomes. Interestingly, to get a good fetomaternal perinatal outcome mode of delivery decision is also changed with BMI. ***Objective:*** The aim of the study was to evaluate the effect of maternal BMI on the mode of delivery. ***Methods***: This cross-sectional study was carried out department of obstetrics and gynaecology at Bangabandhu Sheikh Mujib Medical University. A total 100 population of purposive sampling was the methods of choice to select the sample from the hospital admitted patients during the period from August 2016 to December 2017. ***Results:*** The mean age of 100 mothers were 28.4 (± 6.2) years. The maximum mothers attended from 3rd trimester were overweight (55.36%) whereas 44.64% from the same trimester were normal BMI mothers. Maximum mothers (27%) were from 25-29 years age group and the minimum mothers (4%) were from >= 40 years. Forty Seven Percent mothers came as primigravida. Primigravid women and multigravida with LSCS and without LSCS showed different mode of deliveries. The more the gravida with history of caesarean section the more frequency of present occasion of CS (p=0.006). The higher BMI showed more frequency of caesarean section than NVD or assisted delivery (p=<0.00001) Multiparous women showed more BMI than the p nulliparous. (p=0.005). Multiparity, maternal age and pre-existing medical conditions revealed more complicated labor. ***Conclusion:*** The more BMI of mother showed more frequency of caesarean section, assisted delivery than the normal vaginal delivery.

Keywords: Body Mass Index (BMI), maternal, nutritional, fetomaternal, *obesity, excessive weight*.

INTRODUCTION

Maternal nutritional status is important for health and quality of life in women and growing fetus. Maternal weight gain in pregnancy can offer a good means of assessing the wellbeing of the pregnant mother and her baby. Inadequate prenatal weight gain is a significant risk factor for intrauterine growth restriction, preterm delivery and low birth weight in infants. Obesity and excessive weight gain on the other hand can lead to adverse maternal and fetal outcomes [1-7]. But excessive weight gain during pregnancy or pre-pregnancy increased BMI or obesity both has the similar adverse outcome that also influences the decision of obstetricians regarding the mode of delivery. As high BMI has a hidden relation with urbanization and industrialization; so, till today there is a popular belief that high BMI is a matter of tension for economically developed industrial countries. But recently, Bangladeshi women of reproductive age have shown a trend of increasing BMI day by day. A survey conducted among this population found in obesity prevalence increased from 2.7% to 8.9% between 1996 and 2006. In comparison, the prevalence of maternal obesity in the United States ranged from 13.9% to 25.1% between 2004 and 2005 [8]. Current Institute of Medicine (10M) guidelines, published in 1990, recommend that all women can expect to gain one or two kilograms in their first trimester of pregnancy, but additional weight gain above is considered excessive [9]. In recent years, excessive weight gain has led to increased obesity prevalence among pregnant women, resulting in maternal and fetal health complications. Maternal obesity carries significant risks for the mother and fetus with increased health risks to the mother during the antenatal, intrapartum, and postnatal periods [10-13]. Excess accumulation of adipose tissue within the abdominal cavity, or visceral obesity among obese pregnant women has been associated with a cluster of metabolic alterations, which includes: insulin resistance, hyperinsulinemia, elevated TG levels, low HDL cholesterol, and hypertension [14, 15]. It is already commonly known that maternal overweight and obesity are associated with adverse pregnancy outcome, such as maternal hypertension, preeclampsia, gestational diabetes, more frequent cesarean delivery, delivery of large -for- gestational-age (LGA) infants, and stillbirths [16-20]. Perlow further showed that obese women experienced an increased rate emergency cesarean delivery as well as increased total operative time, increased blood loss, multiple epidural placement increased infection, and prolonged hospitalization [21]. Moreover, labour progression is significantly slower in obese women whereas duration of labour, oxytocin requirements and caesarean delivery rates increase with increasing maternal body mass index (BMI) [22, 23].

An extensive number of studies [24] and reviews [25] report the undesirable effects of increasing maternal BMI on the risk of caesarean section and operative vaginal deliveries. This increased risk has been shown to remain constant across women of varying ethnicities and parity [25]. It is well established that maternal obesity correlates with increased risks of spontaneous abortion, stillbirth and congenital malformations, especially those of the heart and the neural tube. Infants of obese mothers are more often born either very preterm or after prolonged gestation and obese women have an increased risk of labor complications. Infants born to obese women are more often macrosomic, have lower Apgar scores and are more often admitted to a neonatal unit [26]. Nevertheless, it is not clear whether excess mortality in infants of obese mothers is caused by pregnancy complications, because previous studies have either been too small or Jacked pregnancy data [26]. Increases in weight between pregnancies have been shown to be a reproductive hazard in a second pregnancy, supporting a causal link between excess fat tissue and adverse pregnancy outcomes. Also, emerging evidence indicates that prenatal exposure to maternal obesity may leave the child more susceptible to diseases and impaired health during the life course. Such susceptibility may also increase risk of death during the first year of life.

So, to anticipate the obesity related adverse complications and to avoid such situations pre-pregnancy BMI calculation is essential. Recently, The Institute of Medicine (10M) published recommended weight gains by pre- pregnancy BMI which have been the standard for subsequence research. These recommendations are for BMI<19.8 Kg/m^2, total weight gain between 12.5 to 18kg: BMI=19.8 to 26.0 Kg/m^2 total weight gain between 11.5 to 16 Kg; BMI>26.0 to 29.0 Kg/m^2, total weight gain between 7.0 to 11.5 Kg and for BMI >29.0 Kg/m^2, total body weight gain of 7.0 kg [23] have been the standard for subsequent research. These recommendations are for BMI <19.8 Kg/m2. Total weight gain between 12.5 to 18 kg; BMI=19.8 to 26.0 Kg/m2. Total weight gain between 11.5 to 16 Kg; BMI >26.0 to 29.0 kg/m2. Total weight gain between 7.0 to 11.5 Kg and for BMI >29.0 Kg/m2, total body weight gain of 7.0 kg [23]. Unfortunately, little has been described in the literature concerning pregnancy risk in obese women who develop preeclampsia. Additional information is needed to better counsel obese women concerning adverse pregnancy outcome when obesity and preeclampsia coexist. The purpose of this investigation was to examine the impact of BMI on mode of delivery.

METHODS

This cross-sectional study was carried out department of obstetrics and gynaecology at Bangabandhu Sheikh Mujib Medical University. A total 100 population of purposive sampling was the methods of choice to select the sample from the hospital admitted patients during the period from August 2016 to December 2017. Inclusion criteria were age consideration 18-45 years, primigravida gravidity, multigravida, pre-pregnancy BMI ≥18.5 Kg/m2, cephalic presentation, delivery at term (≥37 week's gestation). Exclusion criteria were missing data (i.e. height or pre-pregnancy weight not recorded), pre-pregnancy BMI < 18.5, clinical characteristics: planned Caesarean section or preterm delivery <37 weeks gestation), Patient who does not wish to be included in the study, Prior cesarean section for desired or medically indicated repeat surgical delivery, placenta previa, abruption, fetal malpresentation, aneuploidy, maternal HIV, and non- reassuring fetal status at presentation as these indicators would have contraindicated an induction of labor. Analysis was done based on using SPSS 24 software version. The level of significance was set to 5% ($p < 0.05$).

RESULTS

The different maternal characteristics of this study have been depicted in the Table I. The 100 patients who visited all three trimesters on regular basis found the following figures of body weight which increase with the progress of pregnancy. Interestingly BMI of mother were increasing with time. Among 100 mothers most of the (27%) were from the age group 25-29 years whereas minimum number of mothers (4%) was from the age group ≥years. The maximum numbers of mothers of the study were nulliparous (47%) whereas minimum numbers of mothers were grand multiparous (7%). The maximum number of mothers (35%) completed their education up-to primary level whereas minimum number of mothers (8%) completed their education up-to graduation and above. The 100 mothers' different profile of pregnancy with demography and their relations with the mode of delivery were depicted in the following table. The hypothesis testing was done by chi square test and the level of significance was determined as <0.05. The obstetric characteristics regarding types of labour and BMI are shown table VI. The relation of different BMI with different mode of deliveries has been shown table IX.

Table I: Distribution of Maternal Characteristics

Characteristics	Value
Age (years) Mean±SD	28.4±6.2
Height (Meters) Mean±SD	1.74±0.5
Weights (Kg) Median (IQR)	66 (58-75)
Gestational age (days) Median (IQR)	284 (276-289)

Table II: Distribution and relation of gestational visits and body weight (n=100)

Gestation at visit	Overall n=100	Normal weight n(%)	Overweight/ Obese n (%)
1st trimester	4	1(25.0)	3(75%)
2nd trimester	40	19(47.5)	21(52.5)
3rd trimester	56	25(44.64)	31(55.36)

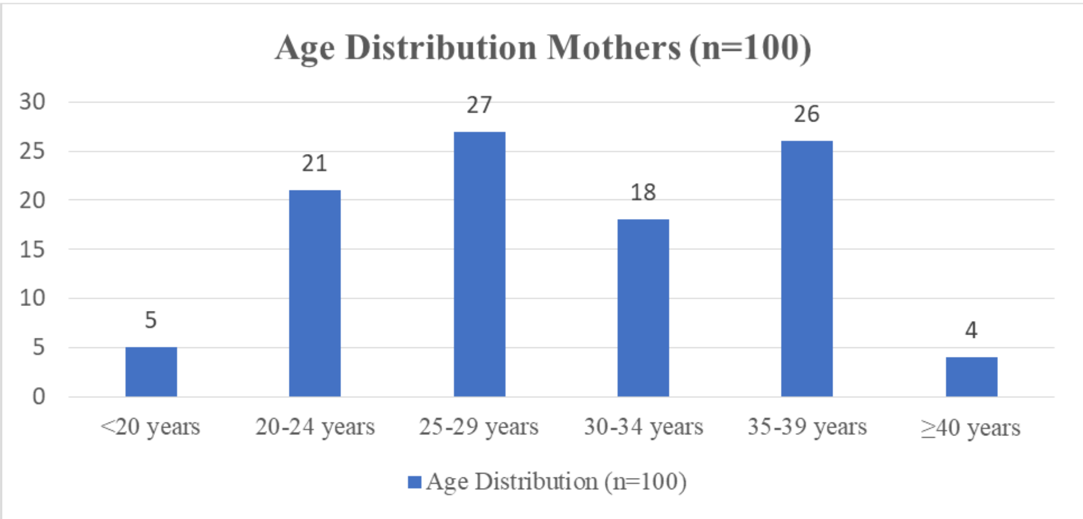

Figure I: Age Distribution of Mothers

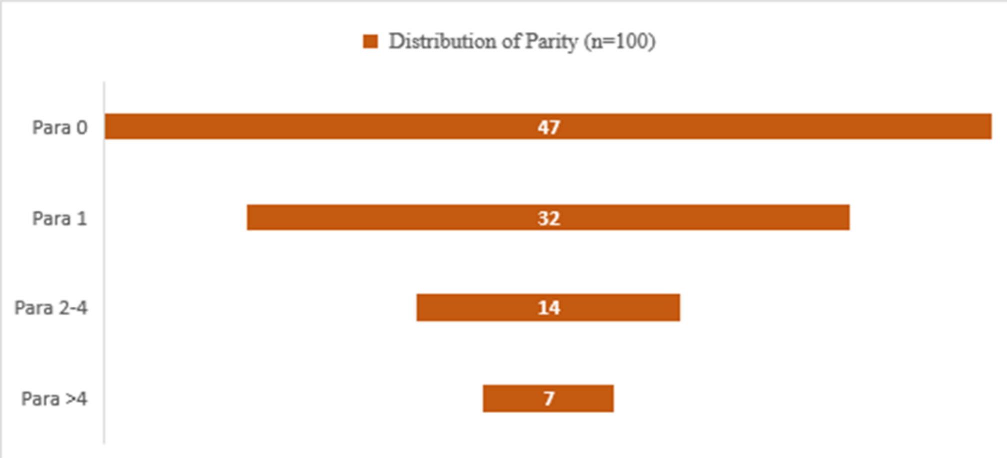

Figure II: Distribution of Parity of mothers (n=100)

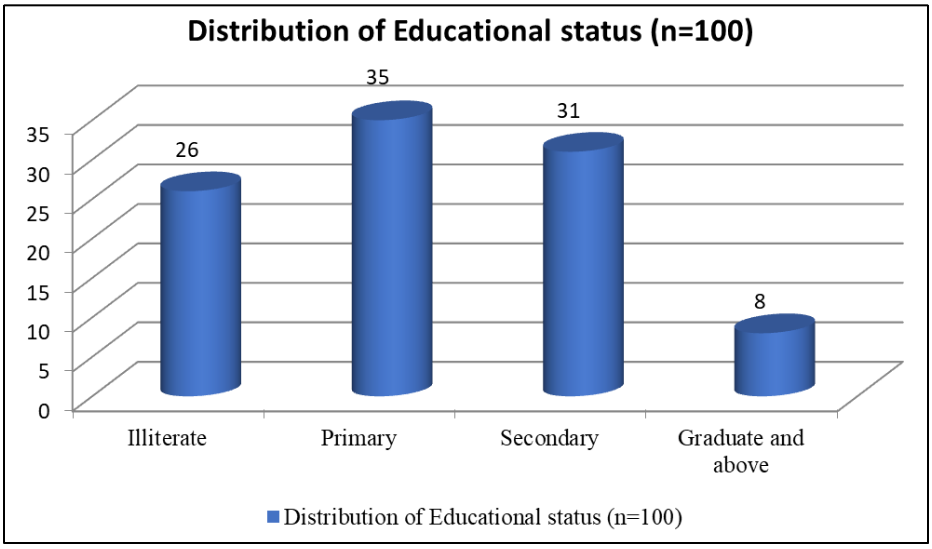

Figure III: Distribution of Educational Status

Table III: Distribution of different characteristics profile of pregnant women with their relation with the mode of delivery (n=100)

Variable	Total	NVD		CS		χ2	P value
	n=100	n	%	n	%		
Age (years)							
<20	5	2	40	3	60	7.97	0.092ns
20-24	21	15	71.42	6	28.58		
25-29	27	19	70..37	8	29.63		
30-34	18	16	88.88	2	11.11		
≥35	30	26	86.67	4	13.33		
Women's level of education							
Less than Secondary	61	33	54.0	28	45.9	0.0006	0.98ns
Secondary and higher	39	21	53.85	18	46.15		
History of abortion							
No	81	53	65.43	28	34.57	1.29	0.25ns
Yes	19	15	78.94	4	21.06		
Pregnant women classifications							
Primigravida	35	33	63.8	2	36.2	10.17	0.006s
Multigravida without CS	34	24	74.5	10	25.5		
Multigravida with CS	31	29	41.5	2	58.5		

ns: no significant, s: significant, p value was calculated by chi square test

Table IV: Mode of delivery of pregnant women and BMI (n=100)

BMI	Total	NVD		CS		P value
	n=100	n	%	n	%	
Underweight (<18.5)	0	0	0	0	0	
Normal weight (18.5-24.9)	45	41	91.11	4	8.89	$<0.00001^{s}$
Overweight (25-29.9)	39	14	35.89	25	64.1	$<0.00001^{s}$
Obese (≥30)	16	2	12.5	14	87.5	$<0.00001^{s}$

s: significant, p value was calculated by chi square test

Table V: Obstetric characteristics of the participants in the study according to their parity and mode of conception

Obstetrics Characteristic	Total Sample (N=100)	Normal Weight (BMI 18.5 24.9 kg/m^2) n(%)	Overweight (BMI 25-29.9 kg/m^2) n(%)	P*	Obese (BMI ≥ 30 kg/m^2) n(%)	p
Parity						
Primiparous	47	32(68.08)	10(21.27)	$<0.05^{s}$	5(10.63)	0.005^{s}
Multiparous	53	13(24.53)	29(54.72)		11(20.75)	
Assisted conception						
No	89	40(44.94)	36(40.44)	0.594^{ns}	13(14.60)	0.436^{ns}
Yes	11	5(45.45)	3(27.27)		3(27.27)	

ns: no significant, s: significant, p value was calculated by chi square test

Table VI: Obstetric characteristics of the participants in the study according to their labour

Obstetrics Characteristic	Total Sample (N=100)	Normal Weight (BMI 18.5 24.9 kg/m^2) n(%)	Overweight (BMI 25-29.9 kg/m^2) n(%)	P*	Obese (BMI ≥ 30 kg/m^2) n(%)	p
Type of Labour						
Spontaneous	70	27(71.2)	32(60.7)	$<0.027^{s}$	11(51.0)	0.53^{ns}
Induced	30	18(28.8)	7(39.3)		5(49.0)	

ns: no significant, s: significant, p value was calculated by chi square test

Table VII: Obstetric characteristics of the participants in the study according to mode of delivery and obstetrical analgesia (n=100)

Obstetrics Characteristic	Total Sample (N=100)	Normal Weight (BMI 18.5 24.9 kg/m^2) n	Overweight (BMI 25-29.9 kg/m^2) n	P*	Obese (BMI ≥ 30 kg/m^2) n	p
Mode of delivery						
Spontaneous vaginal delivery	77	31	28	0.958^{ns}	7	0.049^{s}
Operative vaginal delivery	10	9	7		3	
Caesarean section	13	5	4		6	
Obstetrical analgesia (epidural)						
No	39	21(53.84)	15(38.46)	0.03^{s}	3(7.69)	0.04^{s}
Yes	61	24(39.34)	24(39.34)		13(21.31)	

ns: no significant, s: significant, p value was calculated by chi square test

Table VIII: Contribution of different risk factor of labour induction (n=100)

Risk factor for labour induction[1]	OR; (95%CI)	aOR; (95% CI)
Maternal age		
≥ years old	1.1; (0.9-1.4)	1.2; (0.9-1.5)
<35 years old	1.0	1.0
Pre-existent conditions[2]		
Yes	1.4; (1.1-1.9)*	1.1; (0.8-1.5)
No	1.0	1.0
Parity		
Multiparity	0.5; (0.4-0.6)**	0.5; (0.4-0.7)**
Primiparity	1.0	1.0

Table IX: Contribution of different risk factor of labour induction (n=100)

Risk factor for labour induction[1]	OR; (95%CI)	aOR; (95% CI)
Maternal age		
≥ years old	1.1; (0.9-1.4)	1.2; (0.9-1.5)
<35 years old	1.0	1.0
Pre-existent conditions[2]		
Yes	1.4; (1.1-1.9)*	1.1; (0.8-1.5)
No	1.0	1.0
Parity		
Multiparity	0.5; (0.4-0.6)**	0.5; (0.4-0.7)**
Primiparity	1.0	1.0
Pregnancy complication[3]		
Yes	8.3 (6.4-10.9)**	7.3; (5.6-9.7)**
No	1.0	1.0
Fertility treatments[4]		
Yes	2.0; (1.4-2.9)**	1.4; (0.9-2.2)
No	1.0	1.0
Pre-pregnancy BMI		
Overweight	1.6; (1.2-2.0)**	1.3; (1.0-1.7)*
Obese	2.3; (1.7-3.2)**	1.8; (1.3-2.5)*
Normal weight	1.0	1.0

Table X: Distribution of mode of delivery of different BMI (n=100)

Mode of delivery	Overweight[1] (BMI 25-29.9 kg/m^2)		Obese[2] (BMI	
	Spontaneous labour	Induced labour	Spontaneous labour	Induced labour
Operative vaginal delivery	1.1; (0.7-1.8)	1.5; (0.8-2.7)	0.3; 0.1-1.0	0.4; 0.1-1.4
Caesarean section	1.1; 0.6-1.8	1.2; 0.7-2.0	1.5; 0.7-3.0	2.2; 1.2-4.1
Spontaneous vaginal delivery	1.00	1.00	1.00	1.00

DISCUSSION

In this study we report that obesity affects 16% of women of childbearing age in our study population which is similar to Nova Scotia's Atlee perinatal database [27] but slightly higher than international assessments of obesity in pregnant women of 8% in Spain [28) and 6%in Australia [29]. These differences may reflect differences in social and dietary habits between countries and continents as well as the global trend of increasing in prevalence of obesity in general population. Evidence across different obstetric populations is consistent that increased pre-pregnancy BMI associates with increased perinatal morbidity, including obstetrical interventions at birth such as labour induction and surgical deliveries [30]. In support of these reports, our study showed that the likelihood of labour induction increased with increased pre-pregnancy BMI, and that obese women were more likely to deliver by C-section. 8arau *et al.,* also found a linear trend between pre-pregnancy BMI and the rates of caesarean section, with an OR of 1.89 for normal weight, 2.31 for overweight and 2.71 for obese women, however, they included in their analysis elective caesareans and did not control for prior caesareans and induction [31]. After controlling for parity and prior C-section, Kominiarek *et al.,* found the relative risk of delivery by C-section to be three times higher in nulliparas and multiparas with BMI ≥40 kg/m^2 compared with the reference group with BMI < 25 kg/m^2 [32]. Other studies have shown a proportional increase in the risk of caesarian delivery corresponding to the level of maternal obesity [33] that was largely attributed to the increased likelihood of pregnancy-related complications in obese women, such as preeclampsia, diabetes, fetal macrosomia and consequent labour inductions.

However, studies to date have not stratified the delivery outcome by the type of labour onset. In this study, we showed that obese women who were induced were more likely to deliver by C-section. Additionally, among women with spontaneous onset of labour no differences were apparent in duration of second and third stage of labour and obstetrical interventions at birth between overweight or obese and women with normal body weight priorto conception. This suggests that although obesity In pregnancies not an independent justification for labour induction [34], obese women are more likely to be induced are more likely to undergo delivery by C-section.

The twofold increase in the risk of C-section rates in obese women after induction was independent of pregnancy complications, parity, prior caesarean deliveries, chronic maternal health conditions, treatments for infertility, or maternal age. Thus, other factors may have contributed to our findings. One hypothesis for the increased risk of C-section subsequent to induction includes altered uterine contractility combined with dysfunctional labour which may increase the rate of emergent surgical interventions [35]. Furthermore, priming the myometrium for transitioning from quiescence to contractility may be altered with increased BMI and adipose tissue mass [35]. The present findings point to such possible mechanisms in obese but not in overweight women. In addition, the alterations in function appear to occur under conditions of labour induction when the transition from uterine quiescence to active contractility is introduced mechanistically and does not occur at physiologic pace. To date, no BMI thresholds have been reported above which the rates of labour dystocia, and consequently operative delivery, climbs significantly. Future research focused on understanding labor mechanisms may provide insights into the molecular mechanisms that govern myometrial contractility and explain a potential causal relationship between obesity and increased risks at birth.

The association between higher pre-pregnancy BMI and increased risk of C-section delivery in women with induction of labour is of clinical and public health importance, If the trend towards increased pre-pregnancy BMI perststs and these women remain at elevated risk of labour induction, then the C-section rate would be expected to increase. Our findings demonstrate that increased pre-pregnancy BMI adversely influence pregnancy outcomes and obstetrical management at birth even among women receiving obstetrical care in community-based settings. This study allows to the missed opportunities in the routine care to address the issue of obesity prior to pregnancy, and advocates for the importance of preconception counseling and weight management prior to pregnancy for optimal pregnancy and birth outcomes.

This study is limited by reliance on self-reported pre-pregnancy Weight data, which may have led to under reporting [36], Under reporting of BMI would render these findings, more conservative and as such, the risks associated with BMI may be underestimates of the true risk [37]. Previous publication from our group demonstrates high level of agreement between maternal self-report on demographics, environmental, and obstetrical information [38]. Another limitation of the current study includes collapsing obese and extremely obese groups into a single group. As the size of our severely obese group was relatively small, we could not perform further subgroup analyses of all BMI categories as defined by the Institute of Medicine and World Health Organization [39]. Finally, it is possible that controlling for pregnancy complications in an effort to determine the independent effect of obesity may have yielded conservative estimates of the effect because of the complicated relationship between obesity and physiologic changes that may be associated with these complications. However, when hypertension or diabetes is present in late pregnancy, the decision of obstetrical management including the optimum time and mode of delivery is based on the maternal and fetal wellbeing, regardless of underlying aetiology. Further studies are warranted to refine these relationships.

The findings from the present study reflect pregnancy and labour outcomes for women who received care under a universal publicly funded system where the majority was seen in the first trimester of pregnancy. Women were delivered in academic hospitals with access to highly qualified tertiary care if needed. Although provider preferences may have influenced management of labour and delivery in obese and overweight women, our rates of induction and C- section delivery are within our norms.

This study has several strengths. The characteristics of study sample are reflective of the urban parenting population in, which suggests these results can be generalized. To reduce recall bias associated with the events in labour and at deliver, this data was obtained from medical records. Prospective data collection from detailed questionnaires reduces recall bias and increases accuracy for numerous potential exposures.

CONCLUSION

BMI before pregnancy can influence the future conception to a safe as well as through an unsafe way. Different maternal medical conditions are usually present in mothers with high BMI that can compel the attending obstetricians in future to choose caesarean section to save lives of both mothers and neonates. So, there is an intimate relationship of BMI with the mode of deliveries. We can conclude after completion of the study that induced labor is higher than spontaneous labor in higher BMI as well as caesarean section and assisted deliveries were more in higher BMI than the normal vaginal delivery. The findings in this study were all statistically significant.

Limitations of the Study

- This is single blinded, single centered study.
- Duration is short.
- Sample size's small.
- Does not proclaim the scenario of whole country

RECOMMENDATIONS

A multicentered double blinded study in the divisional tertiary hospitals of whole Bangladesh can reveal the real picture of risk factors, presentations and perinatal complications in postdated pregnancy. The study period should be long. Multi-disciplinary approach of research work can make a study precise & more authentic in this regard.

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