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RESEARCH ARTICLE

EFFECTS OF MATERNAL OVER WEIGHT IN LABOR ON BOTH MOTHER AND FETUS

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ABSTRACT

Background: Excessive weight has become one of the major health problems worldwide, especially with the globally increasing prevalence and the wide range of accompanying health problems, including metabolic syndrome, cardiovascular diseases and hypertension, liver and gall bladder diseases. During pregnancy, obesity is associated with increased maternal and perinatal morbidity, and sometimes mortality. Body Mass Index (BMI) is the most commonly used method to estimate the degree of obesity.

Objectives: The aim of the study is to correlate between high maternal BMI at delivery and adverse pregnancy outcome (maternal and fetal).

Patients and methods: This study is a prospective comparative study based on women attending labor ward at Al-khansaa Maternity Teaching Hospital in Mosul city conducted from the 1st of June 2017 to 30th of December 2017. A total of 200 patients were included, all of them had term, singleton pregnancy, with cephalic presentation and all underwent a trail of vaginal delivery. The patients were classified according to their BMI (calculated after delivery) to control group with normal BMI and case group with high BMI. Case group was further subdivided to three groups (overweight, obese, and severely obese) to find if any of the comparison parameters has linear association with the degree of obesity. Case and control group were compared for maternal and fetal complications during and after labor. Maternal complications included hypertension, gestational edema, gestational diabetes, ante partum or intrapartum hemorrhage, delivery mode, perineal tears and postpartum hemorrhage. Fetal complications included fetal distress during labor, large for gestational age, birth trauma, low apgar score, congenital abnormality, and admission to neonatal intensive care unit.

Results: By comparing case and control groups, results showed that case group were statistically at more risk of having hypertension (OR=3.81), prolonged pregnancy (OR=2.68), lack of progression of labor (OR=7.98), emergency cesarean section (OR=3.57), and postpartum hemorrhage (OR=5.71), with the susceptibility to the first four factors increased linearly with the increase of maternal BMI. A strong association have also been found between maternal obesity and gestational edema (OR=6.74). Although more cases of gestational diabetes mellitus were recorded in case than control group but this difference was not statistically significant. The same was observed regarding the incidence of instrumental vaginal delivery, and deep perineal tears. Regarding fetal and neonatal outcomes, case group had statistically higher susceptibility to have large for gestational age babies (OR=4.94), abnormal fetal heart rate during labor (OR=2.52), low apgar score at 1 minute (OR=5.72). Statistically no significant increase in meconium stained liquor, congenital abnormality, birth trauma and admission to NICU.

Conclusion: Delivery while having high BMI is considered a high risk condition, and requires special attention for early detection and appropriate management of complications and those ladies need more care during and after labor.

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INTRODUCTION

The WHO describes obesity as: 'one of the most blatantly visible, yet most neglected, public health problems that threatens to overwhelm both more and less developed countries' (Swati Vyas *et al.,* 2008). Obesity can be quantified conveniently using the body mass index (BMI). BMI is calculated as the person's weight in kilograms is divided by the square of her or his height in meters (Kg/m^2), this is also known as Quetelet's index (Hanlon *et al.,* 2006; Cunningham *et al.,* 2006). According to the recommendations of the World Health Organization (WHO), over weight is defined as a BMI of equal to, or more than $25.0Kg/m^2$ and obesity is defined as a BMI of equal to, or greater than 30.0Kg/m (Hanlon *et al.,* 2006; Hajio, 2005; Obesity Preventing and managing the global epidemic, 2000). The degree of obesity is classified into

three categories: grade I, II and III (Cunningham *et al.,* 2006) as the table 1.1 shows (Hajio, 2005):

Table 1.

BMI (Kg/m^2)	WHO class
18.5 – 24.9	Normal range
25.0 – 29.9	Overweight
≥30.0	Obese
30.0 – 34.9	grade I
35.0-.39.9	grade II
≥40.0	grade III

The prevalence of obesity has risen worldwide reaching epidemic properties globally (Florence Galtier-Dereuer *et al.,* 2000), with more than one billion adults overweight at least 300 million of them are clinically obese (Swati Vyas *et al.,* 2008). According to the latest data from the US National Center for Health Statistics, around 60% of adults aged equal to or more than 20 years are overweight, half of them are clinically obese (Swati Vyas *et al.,* 2008). In developing countries, the average national rates of obesity is not nearly so high, but these figures disguise alarmingly high rates of obesity in many Urban communities (Hanlon *et al.,* 2006). Among pregnant women 20% are obese at booking for antenatal care in 2002-2004 (Swati Vyas *et al.,* 2008). Obesity is becoming more frequently encountered heath problem (Andrew McCarthy, 2006). It's considered to be the 6th most important risk factors contributing to overall burden of diseases (Swati Vyas *et al.,* 2008). Obesity in pregnancy is considered an important preventable risk factor for adverse maternal and perinatal out comes (Sven Cnattinggius *et al.,* 1998) and this justify the urgent need to have an overview of the current services provided for obese mothers during pregnancy and labor, and to develop effective strategies to overcome the gaps that may exist, and reverse the trends towards increasing obesity by multi disciplinary management (Sven Cnattinggius *et al.,* 1998). Being overweight or obese at delivery is a result of either, high pre-pregnancy body mass index, or excessive gain during pregnancy, or both, with these two - alone or in combination-are associated with many complications.

The major maternal complications associated with obesity during pregnancy include:

Hypertension: Maternal hemodynamic changes in obese mothers include higher arterial blood pressure, hemoconcentration, and altered cardiac function (Tomoda *et al.,* 1996) the risk of pre-eclampsia is doubled with each 5-7kg/m^2 increase in the pre-pregnancy BMI (Swati Vyas *et al.,* 2008). Many studies have considered obesity as an independent risk factor for pre-eclampsia (Andrew Shennan, 2006; Andrew Shennan, 2004; Asant Walfisch, 2005). Women who have had pre-eclampsia may die from cardiovascular disease (OR=8.1) and stroke (OR=5.1) thus, preventative measures need to be taken especially if the risk factor is reversible (Swati Vyas *et al.,* 2008; Sven Cnattinggius *et al.,* 1998). During pregnancy there is physiologic increase in insulin resistance in maternal tissues, presumably to satisfy the nutritional demands of the fetus (Buchanan *et al.,* 1990; Christine Ang, 2005) Gestational diabetes mellitus (GDM) refers to women who are shown to be diabetic for the first time during pregnancy, regardless of whether the diabetes persists after pregnancy (Christine Ang, 2005; Kjos and Buchanan, 1990). Overweight and obesity are risk factors for impairment of carbohydrate tolerance both in the non-pregnant and pregnant states (Hanlon *et al.,* 2006; Florence Galtier-Dereuer, 2000; Christine Ang, 2005; Geotfrey Chamberlain, 2006) and Even moderately overweight subjects may have increased incidence of gestational diabetes (Perlow *et al.,* 1992; Garbaciak *et al.,* 1985). GDM is affecting up to 17% of obese pregnant women (Swati Vyas *et al.,* 2008; Hajio, 2005). Testing for GDM should be done in the first prenatal visit and should be repeated in the 2nd and 3rd trimesters if the pervious findings were normal (Hajio, 2005; Garbaciak *et al.,* 1985). Obesity with its associated lack of mobility is well recognized cause of increased risk of thrombo-embolism as reported by the confidential Enquiry into Maternal and Child Health (Clark *et al.,* 2006). The Royal college of Obstetricians and Gynecologists reports on maternal deaths concluded that obesity is the most common risk factor for thrombo-embolism. The sequence of events by which obesity contributes to antenatal complications like hypertension, gestational diabetes, and other vascular problems during pregnancy, and later in life are shown in Figure (1) (Jane E Ramsay, 2006). Obesity has been shown to have causal association with asthma and sleep apnoea due to the mechanical effects of bulky fatty tissue around the neck leading to obstruction of breathing particularly during sleep (Swati Vyas *et al.,* 2008).

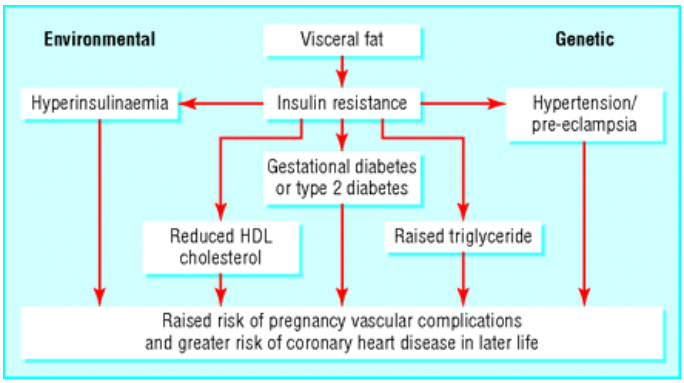

Figure 1. Obesity Contribution to some antenatal complications

Increased incidence of urinary tract infection in obese women. prolonged pregnancy, and longer gestation at term compared with non-obese women (Usha Kiran *et al.,* 2005; Naomi, 2007) induction of labor in obese women than in normal-weight women (Gross *et al.,* 1980; Le Thai *et al.,* 1992; Kaisa Raatikainen *et al.,* 2006) and the estimated increase is 1.7-2.2 folds, which remains significant after adjusting for associated antepartum complications (Swati Vyas *et al.,* 2008). The risk of emergency cesarean delivery is significantly increased with increasing BMI. It's suggested that the uterine contractility may possibly be sub optimal in obese women, or there may be increased fat deposition in the soft tissue of the pelvis (Swati Vyas *et al.,* 2008; Usha Kiran *et al.,* 2005) Obese women tend to have higher rates of postpartum hemorrhage, due to the increased rate of cesarean section pelvis (Swati Vyas *et al.,* 2008; Usha Kiran *et al.,* 2005). Obese mothers who had vaginal delivery, had a greater than 500ml blood loss compared to those with normal BMI pelvis (Swati Vyas *et al.,* 2008; Usha Kiran *et al.,* 2005). Other studies have reported an association between maternal obesity and the risk of having a baby with neural tube defect (Florence Galtier-Dereuer, 2000; Naeye, 1990; Shaw *et al.,* 1997). Fetal macrosomia is other perinatal problem which has an association with maternal obesity as well as maternal gylcemic status (Ahmet Baschat, 2005); Studies have shown that obese parous mothers have a significantly increased risk of antepartum still birth relative to

mothers with normal Studies performed on perinatal mortality rates in neonates of obese mothers have reported that this incidence is increased with more sever obesity, and a recent epidemiologic survey have reported that only late fetal deaths may be higher in obese women as the risk of early neonatal death is not modified (Florence Galtier-Dereuer, 2000; Sven Cnattinggius, 1998), and when high mortality rates are found, the preterm births have the main contributing factor (Hajio, 2005); however, the preterm births were not included in this study.

1. Difficulty in obtaining a venous access (Jane Ramsay, 2006; Naeye, 1990).
2. Ultrasonography in morbidly obese patients can be challenging as the adipose tissue attenuates the ultrasound signals by absorption of the associated energy.
3. Larger cuffs are required to measure the maternal blood pressure accurately.
4. Obese mothers have reduced awareness of fetal movements.
5. Ascertainment of fundal height by palpation or measurement may be difficult to be accurate.
6. External electronic fetal heart monitoring may be problematic.
7. Regional and general anesthesia may be challenging.
8. Surgery is technically difficult, requiring more assistants and possibly longer operation time and larger operating tables.
9. Wound care can be compromised in the event of cesarean section.

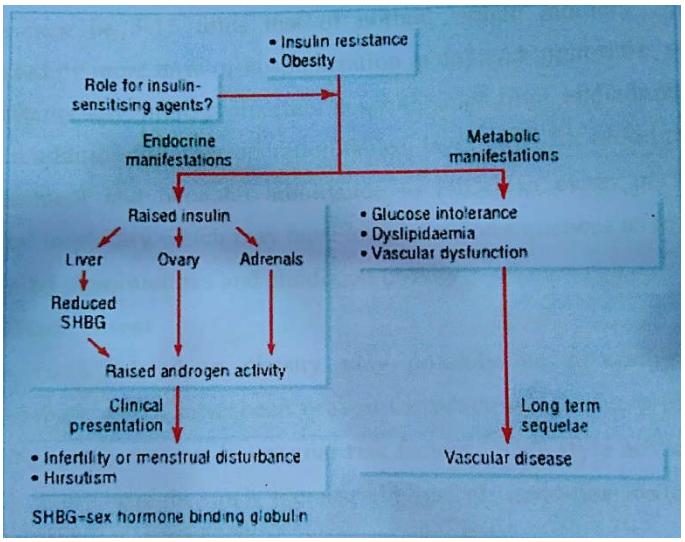

Figure 2. Endocrine and clinical effects of obesity and insulin resistance

The report of the confidential Enquiry into Maternal and Child Health [CEMACH]. (why mothers die) have found that approximately 35% of women who died in 2002-2003 triennia were obese (i.e. had BMI of 30kg/m^2 or greater) and the CEMACH perintal mortality report of 2002 has found that approximately 30% of mothers who have had a still birth or neonatal death were obese (Confidential Enquiry into Maternal and Child Health, 2008). Obesity may affect many aspects of the women reproductive function as it's associated with menstrual irregularity, amenorrhea and infertility through different mechanisms. Obesity has significant association with PCOS, insulin resistance, hyperinsulinemia, menstrual irregularity (Jane Ramsay, 2006) as shown in Figure 2. Obese mothers have about 3 times more risk of early pregnancy loss, and also lower live birth rate in women undergoing IVF or ICSI. These results suggest that sub fertility treatment in obese women is dependent on BMI and weight reduction is beneficial in the treatment (Swati Vyas *et al.,* 2008; Andrew McCarthy, 2006). The cost of prenatal and postnatal care of obese mothers and their babies may be 5-15 folds that of normal weight mothers (Florence Galtier-Dereuer, 2000), this is expressed by more days of hospitalization at day and night time, surgical departments stay, more postpartum hospitalization time, and admission to ICU, in addition to larger operation tables, lager cuffs for blood pressure measurement and neonatal admittance to NICU in cases of fetal or neonatal morbidity which may have long term consequences as in case of congenital abnormalities and childhood obesity (Swati Vyas *et al.,* 2008; Florence Galtier-Dereuer, 2000). Life style advice which lowers body weight and increases physical activities reduces the incidence of type 2 DM (Hanlon *et al.,* 2006; Line Rode *et al.,* 005). Preconception counseling is important in order to inform obese women of child bearing age about the possible risks associated with pregnancy, and she should receive appropriate dietary counseling and encouraged to lose weight, and perform physical activities which both may decrease the occurrence of complications during pregnancy (Swati Vyas *et al.,* 2008; Hanlon *et al.,* 2006; Florence Galtier-Dereuer, 2000). Diet with a deficit of 500-1000kcal/day produces weight reduction of 300-1000gm/week, depending on the patient's weight [5]. It's not recommended that obese mothers should lose weight during pregnancy as it's difficult to achieve, and may carry increased risk of ketosis (Kaisa Raatikainen, 2006), and may have ill effect on the fetal weight and the subsequent health of the neonate (Hajio, 2005); however they should be advised not to gain excessive weight. Testing for diabetes should be done in the 1st prenatal visit and should be repeated in the 2nd and 3rd trimesters if the previous findings were normal (Hajio, 2015; Garbaciak *et al.,* 1985). Monitoring of fetal growth and wellbeing may carry technical difficulty, detailed ultrasonographic screening for congenital anomalies is recommended in 18-20 weeks (Swati Vyas *et al.,* 2008; Andrew McCarthy, 2006; Jane E Ramsay, 2006). Anesthetic consultation is required before labor starts The use of prophylactic antibodies during both elective and emergency cesarean section (Hajio, 2005). Delivery should be planned. Continuous monitoring of the fetal heart rate and of the maternal condition, and the progress of labor during 1st and 2nd and 3rd stages of labor is required to avoid missing any abnormality in fetal or maternal condition, and avoid unnecessary excessive blood loss during 3rd stage (Swati Vyas *et al.,* 2008; Usha Kiran *et al.,* 2005; Sohinee Bhattacharya *et al.,* 2007). Following, the delivery neonatal apgar score should be recorded with birth weight, and blood sample for glucose level should be performed in those large for gestational age babies (Hajio, 2005).

Study setting and duration

This study represents a prospective, case-control study conducted in Al-kansaa maternity teaching hospital in Mosul city from 1st of June 2017 to the 30th of December 2017, and was approved by the committee of Obstetrics and Gynecology of Iraqi Commission for Medical Specializations. This study was designed to compare the pregnancy outcome (fetal and maternal) in those underwent a trail of vaginal delivery in

those with high BMI with those whose BMI was normal. The study sample was composed of 200 patients who were randomly selected after their admission to labor, and delivery ward either for having established labor, or for augmentation of labor. Those whose admission was for elective cesarean section were excluded, and only those who underwent a trail of vaginal delivery were included. Only those with singleton, term pregnancy with cephalic presentation were included in the study to decrease the additional risk of complications caused by conditions like preterm delivery, multiple pregnancy, and abnormal presentation which carry contributing factors to maternal, and fetal risks, and to create more homogenous sample for comparison. Classification of the patients to case and control groups was based on measurement of BMI which was done during the first 2 hours following labor, and calculated from patients' weight in kilograms divided by the square of their heights in meters (Kg/m^2) (Hanlon *et al.,* 2006). Control group represented 100 patients whose BMI rages from 18.5-24.9Kg/m^2, while case group involved 100 patients whose BMI was $\geq 25Kg/m^2$, which was subdivided according to their BMI into three groups:

- Overweight: includes those with BMI of 25-29.9Kg/m^2.
- Obese: includes those with BMI of 30-34.9Kg/m^2.
- Severely obese: includes those with BMI $\geq 35Kg/m^2$.

RESULTS

The study sample included 100 patients with high BMI $\geq 25Kg/m^2$ which was composed of 44% overweight, 31% obese, and 25% severely obese patients. The distribution of these subgroups is shown in Figure (3). The maternal characteristics for the studied groups are shown in Table (1) which included the distribution according to age, education level, residence, and parity. There was no statistically significant difference between case and control group regarding these parameters. The average age group of the mothers in case and control groups was 20-34 years. Average education was equal or less than 12 years of schooling, most of patient were from urban society and the mode parity was 1-4. It was found in this study that case group had statistically significant increase in cases of hypertension compared with control group (OR = 3.81), 32.0% of cases exhibited hypertension, while only 11.0% of control were hypertensive. For the categories of obesity, the risk of hypertension showed a linear increase with the degree of obesity from 1.53 at overweight women to 14.38 in severely obese pregnant women as shown in Table (2). A statistically significant relationship was found between gestational edema and obesity in pregnant women, with 40% positive results for cases versus 9.0% for control. With OR=6.74; although from the short duration of this study we cannot verify whether gestational edema is a result or a cause of high BMI. The association between gestational edema and obesity increased with the degree of obesity from OR=3.79 in overweight mothers to OR=26 in severely obese mothers this is also is shown in Table (2). The same table also showed a statistically non-significant relationship between obesity and APH and intrapartum hemorrhage with 2.0% in controls versus 6.0% in cases except for severely obese which showed a statistically significant increase with 13.6% APH versus 2.0% for controls. Additionally, severely obese pregnant women were 6.68 times more susceptible to develop APH than non-obese. A statistically significant relationship was found between obesity and having post term pregnancy, with 37.0% of cases versus 18% for non-obese (controls). With (OR = 2.68) as shown in Table (3). This ratio again increased linearly from 2.36 in overweight to 3.58 in severely obese mothers. The lack of progression of labor had a statistically significant relationship with obesity as shown in Table (3). Non-obese pregnant women exhibited 2.0% lack of progression versus 14.0% for those with obesity (OR=7.98). The risk of developing failure of progression increased with the degree of obesity with odds ratio of 3.59 in overweight and 15.47 in severely obese mothers. Four percent of case group exhibited perineal tears versus 1.0% for non-obese with statistically non-significance association as shown in Table (3). When considering the categories of case group, of obesity was odd ratios were 6.83 for obese and 8.61 for severely obese. Occurrence of postpartum hemorrhage in pregnant women showed a statistically significant relationship with obesity as shown in Table (3). Members of case group had more cases of PPH than those of control group (OR=5.71).

A statistically non-significant relationship between type of delivery and obesity as shown in Table (4). Assisted vaginal delivery by vacuum extraction occurred at about the same percentage in cases 4.2% and controls 3.3%. For the categories of obesity, only 8.3% assisted vaginal delivery occurred in overweight pregnant women. For cesarean section delivery versus normal vaginal, Table (4) showed a statistically significant relationship between emergency C/S delivery and obesity, with 10.3% for non-obese versus 28.9% for those with obesity (OR=3.57). The risk of C/S delivery increased with the degree of obesity from (OR=2.13) in overweight to (OR=6.67) in severely obese pregnant women. Table (5) showed the distribution of causes of cesarean section in cases and controls. Failure of progression of the labor represented the highest percentage resulting in 50.0% of cesarean sections. It had a statistically significant difference from control in which it represented 20%. No significant difference was recorded in the other causes between cases and controls. This also shown in Figures (4 and 5). For fetal complications, Table (6) showed a statistically non-significant relationship between meconium stained liquor and obesity. It occurred in cases at 14.0% versus 9.0% in controls. Abnormal fetal heart occurred in 18.0% of case group versus 8.0% of controls with a statistically significant relationship between its occurrence and the obesity (OR=2.5) as shown in Table (6). Shoulder dystocia which represent the third studied parameter of fetal complications had statistically non-significant relationship with obesity as shown in Table (6). Four case group (4.0%) was recorded in cases versus no cases (0.00%) in controls. A statistically Significant relationship was recorded between low Apgar score (below 7) at 1 minutes and obesity. 18.0% of the neonates of case group had low Apgar score at 1 minutes versus 4.0% in those of control (OR=5.27). The risk of low Apgar score at 1 minutes increased with the degree of obesity from (OR=2.40) in overweight to (OR=9.33) in severely obese group. For low Apgar score at 5 minutes, the relationship with obesity became statistically non-significant as the percentage decrease to 1.0% in controls versus 2.0% in cases as shown in Table (7). Congenital abnormality occurred in low percentage of neonates, 2.0% in case group and 0.0% in control which was statistically non-significance this also shown in Table (7). Table (7) also showed a statistically non-significant relationship between admission to NICU and maternal obesity. Four percent of neonates of non-obese mothers were admitted to NICU versus 8.0% for those of obese mothers.

Table 1. Maternal characteristics.

Characteristics	Control group (n=100) (BMI=18.5-24.9)		Case group (n=100) (BMI≥25)		Overweight (n=44) (BMI=25-29.9)		Obese (n=31) (BMI=30-34.9)		Severely obese (n=25) (BMI≥35)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Age (years)										
Below 20	21	21.0	9	9.0	5	11.4	3	9.7	1	4.0
20-34	71	71.0	75	75.0	33	75.0	22	71.0	20	80.0
≥35	8	8.0	16	16.0	6	13.6	6	19.3	4	16.0
Education										
>12 years	20	20.0	23	23.0	11	25.0	8	25.8	4	16.0
≤12 years	50	50.0	57	57.0	20	45.4	18	58.1	19	76.0
Uneducated	30	30.0	20	20.0	13	29.6	5	16.1	2	8.0
Residence										
Rural areas	23	23.0	17	17.0	7	15.9	6	19.4	4	16.0
Urban areas	77	77.0	83	83.0	37	84.1	25	80.6	21	84.0
Parity										
Primi parous	35	35.0	35	35.0	18	40.9	9	29.0	8	32.0
Para 1-4	48	48.0	46	46.0	20	45.4	15	48.4	11	44.0
Para >4	17	17.0	19	19.0	6	13.6	7	22.6	6	24.0

Table 2. Relationship between maternal obesity and hypertension, gestational edema, GDM and APH .

Response	Groups (BMI in kg/m^2)	+ve response		-ve response		OR	p-value
		No.	%	No.	%		
	Control (BMI=18.5-24.9)	11	11.0	89	89.0	1	-
	Cases (BMI≥25)	32	32.0	68	68.0	3.81	<0.001
Hypertension	Overweight (BMI=25-29.9)	7	15.9	37	84.1	1.53	0.41(NS)
	Obese (BMI=30-34.9)	9	29.0	22	71.0	3.31	0.015
	Severely obese (BMI≥35)	16	64.0	9	36.0	14.38	<0.001
	Control (BMI=18.5-24.9)	9	9.0	91	91.0	1	-
Gestational	Cases (BMI≥25)	40	40.0	60	60.0	6.74	<0.001
Edema	Overweight (BMI=25-29.9)	12	27.3	32	72.7	3.79	0.004
	Obese (BMI=30-34.9)	10	32.3	21	67.7	4.82	0.0014
	Severely obese (BMI≥35)	18	72.0	7	28.0	26.0	<0.001
	Control (BMI=18.5-24.9)	0	0.0	100	100	1	-
Gestational	Cases (BMI≥25)	2	2.0	98	98.0	-	0.289(NS)
DM	Overweight (BMI=25-29.9)	0	0.0	44	100	-	-
	Obese (BMI=30-34.9)	2	6.5	29	93.5	-	0.055(NS)
	Severely obese (BMI≥35)	0	0.0	25	100	-	-
	Control (BMI=18.5-24.9)	2	2.0	98	98.0	1	-
	Cases (BMI≥25)	6	6.0	94	94.0	3.13	0.15(NS)
APH	Overweight (BMI=25-29.9)	2	4.6	42	95.4	2.33	0.394(NS)
	Obese (BMI=30-34.9)	1	3.2	30	96.8	1.63	0.419(NS)
	Severely obese (BMI≥35)	3	12.0	22	88.0	6.68	0.049

NS = Not significant

Table 3. Relationship between selected responses and obesity in pregnant women

Response	Groups (BMI in kg/m^2)	+ve response		-ve response		OR	p-value
		No.	%	No.	%		
	Control (BMI=18.5-24.9)	18	18.0	82	82.0	1	-
	Cases (BMI≥25)	37	37.0	63	63.0	2.68	0.003
Post term	Overweight (BMI=25-29.9)	15	34.1	29	65.9	2.36	0.035
	Obese (BMI=30-34.9)	11	35.5	20	64.5	2.51	0.041
	Severely obese (BMI≥35)	11	44.0	14	56.0	3.58	0.006
	Control (BMI=18.5-24.9)	2	2.0	98	98.0	1	-
Lack of	Cases (BMI≥25)	14	14.0	86	86.0	7.98	0.0018
progression	Overweight (BMI=25-29.9)	3	6.8	41	93.2	3.59	0.147(NS)
Of labor	Obese (BMI=30-34.9)	5	16.1	26	83.9	9.42	0.008
	Severely obese (BMI≥35)	6	24.0	19	76.0	15.47	<0.001
	Control (BMI=18.5-24.9)	1	1.0	99	99.0	1	-
Perineal	Cases (BMI≥25)	4	4.0	96	96.0	4.13	0.155(NS)
tears	Overweight (BMI=25-29.9)	0	0.0	44	100	-	0.694(NS)
	Obese (BMI=30-34.9)	2	6.5	29	93.5	6.83	0.127
	Severely obese (BMI≥35)	2	8.0	23	92.0	8.61	0.094
	Control (BMI=18.5-24.9)	3	3.0	97	97.0	1	-
	Cases (BMI≥25)	15	15.0	85	85.0	5.71	0.003
Postpartum hemorrhage	Overweight (BMI=25-29.9)	5	11.4	39	88.6	4.15	0.045
	Obese (BMI=30-34.9)	7	22.6	24	77.4	9.43	0.002
	Severely obese (BMI≥35)	3	12.0	22	88.0	4.41	0.079(NS)

Table 4. Relationship between mode of delivery and obesity in pregnant women

Response	Groups (BMI in kg/m^2)	AVD		NVD		OR	p-value
		No.	%	No.	%		
NVD x AVD	Control (BMI=18.5-24.9)	3	3.3	87	96.7	1	-
	Cases (BMI≥25)	3	4.2	69	95.8	1.27	0.307(NS)
	Overweight (BMI=25-29.9)	3	8.3	33	91.7	2.63	0.170(NS)
	Obese (BMI=30-34.9)	0	0.0	22	100	-	0.515(NS)
	Severely obese (BMI≥35)	0	0.0	14	100	-	0.645(NS)
		C/S		NVD			
NVD x C/S	Control (BMI=18.5-24.9)	10	10.3	87	89.7	1	-
	Cases (BMI≥25)	28	28.9	69	71.1	3.57	0.0012
	Overweight (BMI=25-29.9)	8	19.5	33	80.5	2.13	0.144(NS)
	Obese (BMI=30-34.9)	9	29.0	22	71.0	3.57	0.011
	Severely obese (BMI≥35)	11	44.0	14	56.0	6.67	<0.001

NS = Not significant

Table 5. Causes of cesarean section in cases and control groups

Causes	Control (n=10)		Cases (n=28)	
	No.	%	No.	%
Lack of progression of the labor	2	20	14	50
Severe hypertension and eclampsia	3	30	6	21.4
Fetal distress	3	30	4	40.3
APH	1	10	3	10.7
Meconium stained liquor	1	10	1	3.6

NS = Not significant according to Chi-square or Fisher Exact test

Table 6. Relationship between fetal complications and obesity in pregnant women

Response	Groups (BMI in kg/m^2)	+ve response		-ve response		OR	p-value
		No.	%	No.	%		
Meconium stained liquor	Control (BMI=18.5-24.9)	9	9.0	91	91.0	1	
	Cases (BMI≥25)	14	14.0	86	86.0	1.65	0.269(NS)
	Overweight (BMI=25-29.9)	7	15.9	37	84.1	1.91	0.226(NS)
	Obese (BMI=30-34.9)	4	12.9	27	87.1	1.50	0.527(NS)
	Severely obese (BMI≥35)	3	12.0	22	88.0	1.38	0.650(NS)
Abnormal Fetal heart	Control (BMI=18.5-24.9)	8	8.0	92	92.0	1	-
	Cases (BMI≥25)	18	18.0	82	82.0	2.52	0.036
	Overweight (BMI=25-29.9)	5	11.4	39	88.6	1.47	0.518(NS)
	Obese (BMI=30-34.9)	9	29.0	22	71.0	4.71	0.0024
	Severely obese (BMI≥35)	4	16.0	21	84.0	2.19	0.226(NS)
Shoulder dystocia	Control (BMI=18.5-24.9)	0	0.0	100	100	-	-
	Cases (BMI≥25)	4	4.0	96	96.0	-	0.061(NS)
	Overweight (BMI=25-29.9)	2	4.6	42	95.4	-	0.092(NS)
	Obese (BMI=30-34.9)	0	0.0	31	100	-	-
	Severely obese (BMI≥35)	2	8.0	23	92.0	-	0.039

NS = Not significant

Table (3.7) Relationship between neonatal complications and obesity in pregnant women

Response	Groups (BMI in kg/m^2)	+ve response		-ve response		OR	p-value
		No.	%	No.	%		
Low Apgar Score (1 min)	Control (BMI=18.5-24.9)	4	4.0	96	96.0	1	-
	Cases (BMI≥25)	18	18.0	82	82.0	5.27	0.0016
	Overweight (BMI=25-29.9)	4	9.1	40	90.9	2.40	0.142(NS)
	Obese (BMI=30-34.9)	7	22.6	24	77.4	7.0	0.003
	Severely obese (BMI≥35)	7	28.0	18	72.0	9.33	0.001
Low Apgar Score (5 min)	Control (BMI=18.5-24.9)	1	1.0	99	99.0	1	-
	Cases (BMI≥25)	2	2.0	98	98.0	2.02	0.377(NS)
	Overweight (BMI=25-29.9)	0	0.0	44	100	-	0.694(NS)
	Obese (BMI=30-34.9)	0	0.0	31	100	-	0.763(NS)
	Severely obese (BMI≥35)	2	8.0	23	92.0	8.61	0.094(NS)
Congenital abnormality	Control (BMI=18.5-24.9)	0	0.0	100	100	-	-
	Cases (BMI≥25)	2	2.0	98	98.0	-	0.249(NS)
	Overweight (BMI=25-29.9)	0	0.0	44	100	-	-
	Obese (BMI=30-34.9)	1	3.2	30	96.8	-	0.237(NS)
	Severely obese (BMI≥35)	0	0.0	25	100	-	0.206(NS)
Admission to NICU	Control (BMI=18.5-24.9)	4	4.0	96	96.0	1	-
	Cases (BMI≥25)	8	8.0	92	92.0	2.09	0.235(NS)
	Overweight (BMI=25-29.9)	2	4.6	42	95.4	1.14	0.333(NS)
	Obese (BMI=30-34.9)	3	9.7	28	90.3	5.57	0.158(NS)
	Severely obese (BMI≥35)	3	12.0	22	88.0	3.27	0.113(NS)

NS = Not significant

Table 8. Causes of admission to neonatal intestine care unit

Causes of admission	Cases		Control	
	No.	%	No.	%
Meconium aspiration	2	25	1	25
Birth asphyxia	2	25	0	0.0
Congenital abnormality	2	25	0	0.0
IUGR	1	12.5	2	50
RDS	1	12.5	1	25

Table 9. Relationship between neonatal birth weight and obesity in pregnant women

Neonatal Birth wt. Groups (BMI in kg/m^2)	SGA		AGA		OR	p-value
	No.	%	No.	%		
Control (BMI=18.5-24.9)	8	8.2	89	91.8	1	
Cases (BMI≥25)	2	2.3	84	97.7	0.265	0.058(NS)
Overweight (BMI=25-29.9)	1	2.6	37	97.4	0.301	0.176(NS)
Obese (BMI=30-34.9)	1	3.6	27	96.4	0.412	0.265(NS)
Severely obese (BMI≥35)	0	0.0	20	100	-	0.212(NS)
	LGA		AGA			
Control (BMI=18.5-24.9)	3	3.3	89	96.7	1	-
Cases (BMI≥25)	14	14.3	84	85.7	4.94	0.008
Overweight (BMI=25-29.9)	6	14.0	37	86.0	4.81	0.021
Obese (BMI=30-34.9)	3	10.0	27	90.0	3.30	0.126(NS)
Severely obese (BMI≥35)	5	20.0	20	80.0	7.42	0.010

NS = Not significant

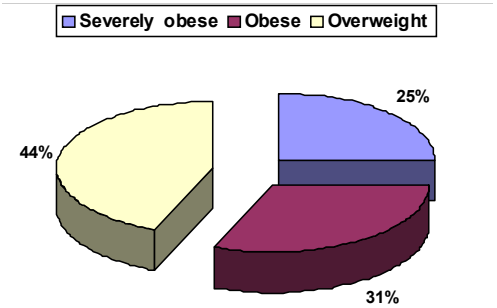

Figure 4. Distribution of causes for cesarean section in control group

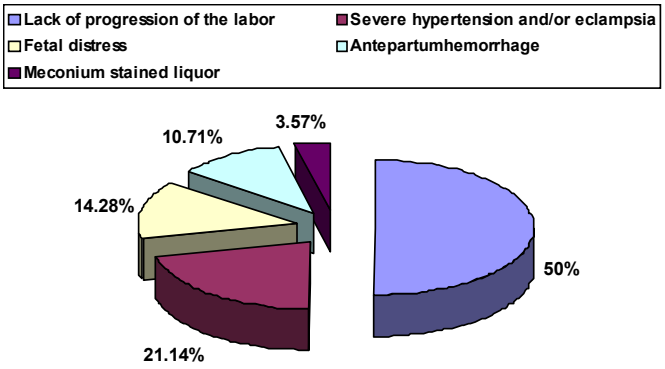

Figure 5. Distribution of obese subgroups in our sample

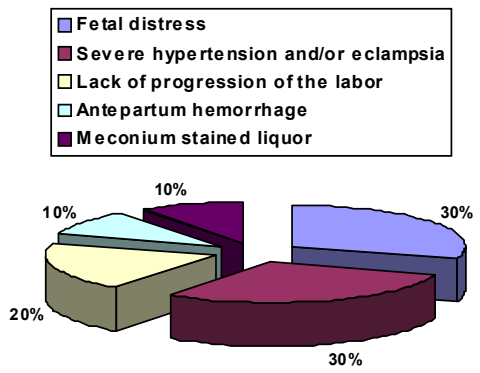

Figure 3. Distribution of causes for cesarean section in case group

The distribution of the causes of admission of neonates to NICU in cases and controlsis shown in Table (8). Meconium aspiration, birth asphyxia and congenital abnormality, IUGR and RDS were the cases of admission and there was no single prominent cause for admission to NICU. Concerning the relationship between neonatal birth weight and maternal obesity, the results showed that maternal obesity was protective against low neonatal birth weight. The highest percentage of low birth weight was recorded in the controls with 8.2% versus 2.3% for cases as shown in Table (9). The Table (9) also shows that member of case group were about 5 times more susceptible to deliver large for gestational age neonates than controls, with statistically significant relationship (OR=4.94). When considering the categories of obesity, it showed an increasing trend with the degree of obesity. It reached to 20.0% in severely obese with odds' ratio of 7.42.

DISCUSSION

The impact of obesity on pregnancy is a major problem (Swati Vyas *et al.,* 2008). The rising prevalence of this health problem may -if kept under estimated- climb even further to lead soon to reduction in life expectancy as it's related consequences affect all ages and nearly any organ system (Johannes Deitl *et al.,* 2005). The maternal weight was recorded after delivery ; although this measurement may not reflect the actual maternal BMI owing to the increase caused by factors like enlarged uterus, expanded plasma volume, etc.., but these changes are present in both of the comparison(case and control); in addition, most of our patients (98%) failed to remember there pre pregnancy BMI, or have irregular antenatal visit with lost, or no records on there booking BMI. A high BMI after delivery reflects pre-pregnancy obesity and/or excessive weight gain during pregnancy and similar studies have been done on similar bases like the one conducted by Sohinee *et al* [46] in 2007 who stated that" in most clinics, pre-pregnancy BMI is not recorded routinely, thereby making booking weight or women recall of pre-pregnancy weight unreliable". In this study we found that mothers with high BMI at labor had higher risk of having hypertension, gestational edema, with odds ratio of 3.81, 6.74 respectively. The risk for both hypertension and gestational edema was highest for severely obese mothers having linear increase with the increase in maternal BMI. Similar results were found by previous studies (Swati Vyas *et al.,* 2008; Florence Galtier-Dereuer, 2000; Sven Cnattinggius *et al.,* 1998; Andrew Shennan, 2004; Jai *et al.,* 2006).

Sohinee *et al* 2007 in 2007 have observed that morbidly obese women are at higher risk of hypertension {OR 7.2 (95% CI 4.7, 11.2)}. Amiri *et al* (Nasiri Amiri *et al.,* 2001) in 2001 have found that the prevalence of gestational edema was more among obese mothers. Although 2% of case group had GDM compared to none in control group, but this increase was not found to be statistically significant, this may be due to the small sample size. Previous studies have reported in concordant results (Swati Vyas *et al.,* 2008; Florence Galtier-Dereuer, 2000; Perlow *e al.,* 1992; Jai *et al.,* 2006; Garbaciak *et al.,* 1985) Swati Vyas *et al* in 2008 have reported the risk of developing GDM to be 17% in obese pregnant mothers compared with 1.3% in normal weight population. The correlation between maternal obesity and APH was not found to be significant although this condition (APH) was emergent in case group more than control (6% viruses 2%).Studies which studied this condition had similar results (Swati Vyas *et*

al., 2008; Garbaciak *et al.,* 1985; Cedergren, 2004; Line Rode *et al.,* 2005). T. Lao *et al* in 2000 have observed anon significant association between obesity and APH.A significant link had been found between obesity and prolonged pregnancy beyond term, obese mothers were at 2.68 times susceptible to have prolonged pregnancy than non obese mothers. Concordant results was observed by previous researches (Usha Kiran *et al.,* 2005; Naomi *et al,* 2007; Gross *et al.,* 1980; Le Thai *et al.,* 1992; Kaisa Raatikainen and Seppo Heinonen, 2006; Line Ro *et al.,* 2005). Naomi *et al* in 2007 have observed that increase BMI was associated with higher gestational age at delivery, he concluded that with each 1 unite increase in the BMI there is an adjusted odds' ratio of 1.29 (95% CI, 1.21-1.38). Lack of progression of the labor was conducted in about 14% of case group compared to 2% of control with odds' ratio of 7.98. failure of progression of labor was the most prominent cause for emergency cesarean section in case group (accounting for 50% of cesarean section cases), while in control group there was an even distribution between all causes of cesarean section with no significant difference between them. The studies which observed progression of labor in obese mothers had concordant results (Swati Vyas *et al.,* 2008; Naomi *et al,* 2007).

Cedergren *et al*. in 2004haveobserved 3 times increase the susceptibility of obese mothers to cesarean section compared to non obese mothers. No significant association was found in this study between obesity and instrumental delivery and the same for deep perineal tears, this may be due to the practice of mediolateral episiotomy practiced commonly for primigrivida and some multigravida patients. Studies on this variable have resulted in concordant results (Gross *et al.,* 1980; Le Thai *et al.,* 1992; Kaisa Raatikainen and Seppo Heinonen, 2006; Sebire *et al.,* 2001). Cedergren *et al*. in 2004 have reported minimal increase in instrumental delivery rate in obese pregnant women more prominent increase for severely obese women. In this study 4% of case group had shoulder dystocia compared with none in control group, this results although is statistically considered not significant but it's much higher than the expected incidence of such relatively rare condition. Controversy exist in the results of previous studies (Swati Vyas *et al.,* 2008; Cedergren *et al*., 2004; Sebire *et al.,* 2001) but it may be accepted that those fetuses of non diabetic mothers whose estimated weight is considered to be average for gestational age are not at increased risk for this complication as reported by Swati Vyas *et al* in 2008 A significant association existed in this study between high BMI and risk of emergency cesarean section during a trail of labor which increased linearly with the maternal BMI with odds ratio raised from 2.13 for overweight women, to 6.67 for severely obese women. These results were similar to results of previous studies (Swati Vyas *et al.,* 2008; Andrew McCarthy, 2006; Hajio, 2005; Line Rode *et al.,* 2005; Robinson *et al.,* 2003; Chu *et al.,* 2007; Hamsiu *et al.,* 2007; Sebire *et al.,* 2001). Chu Sy *et al*. in 2007 in meta analysis of 33 studies found an increased risk of cesarean section in high BMI group the analysis of these results found that this increase was not biased by the characteristics of these studies. Case group in this study had a significant increase in the risk of postpartum hemorrhage with OR = 5.71. Concordant results have been observed by pervious researchers (Swati Vyas *et al.,* 2008; Sohinee Bhattacharya *et al.,* 2007; Sebire *et al.,* 2001). Sebire *et al* in 2001 had observed 70% increase in the risk of postpartum hemorrhage in high BMI group compared to normal BMI group. In this study a statistically significant association was found in case group between high maternal BMI and low apgar score only in 1st minute, but this association became nonsignificant in 5 minutes apgar score with no significant increase in admittance neonatal intensive care unit. In concordance with these results Line Rode *et al* in 2005 have reported no difference or increase in the risk of neonatal morbidity or admittance to NICU in overweight and obese mothers. Results of this study did not find statistically significant association with meconium stained amniotic fluid during labor, and the risk of congenital anomalies was not increased in case compared with control group, this may be due to low incidence of GDM in the case group of this studay. Previous studies reported dissimilar results on this concern. Florena *et al* in 2000 have observed an increased incidence of congenital anomalies among obese mothers, and in these studies higher incidence of GDM was found among their patients. The same was applied to meconium stained liqor, where some studies have described increased association occurrence in obese mothers like Kaisa *et al* in 2006, while others failed to found an association between obesity and fetal distress during labor like Line Rode *et al* in 2005. This study had reported a significant increase in the risk of abnormal fetal heart rate in case compared to control group (OR=2.52). Cedergren *et al* in 2004 have reported similar results among morbidly obese mothers. Case group in this study were found to have more babies who were large for gestational age than control group with odd ratio increased from 4.94 in overweight mothers to 7.42 in severely obese mothers. This result is similar to what's observed from previous studies (Swati Vyas *et al.,* 2008; Lao and Ho, 2000; Jane Ramsay, 2006; Ahmet Baschat *et al.,* 2005). Jane *et al* in 2005 have observed an increased incidence of delivering large for gestational age babies in obese mothers. Similar results have been reported by T. Lao *et al* in 2000 who considered maternal delivery weight as the only significant predictor for neonatal birth weight percentile.

Conclusions and Recommendation

1. Obesity is a common health problem that may affect women reproduction, health, and increasing the risk of many obstetric problem including hypertension, prolong pregnancy, lack of progression of labor, emergency cesarean section, PPH.
2. Obesity is also associated with high rates of fetal distress during labor and higher rates of LGA babies.
3. Preconception counseling for obese women should include encouragement of weight loss, and explanation of the risks associated with obesity during pregnancy.
4. Antenatal care of this high risk pregnancy should include screening for early detection of GDM, and early anticipation of those at risk to develop hypertension and thrombo-embolic complications so that prophylactic measures can be used; in addition, detailed ultrasonographic screen for any fetal anomaly and monitoring of fetal growth.
5. The Plan for delivery should be tailored according to the maternal and fetal risk factors and experienced anesthetic, obstetrics and neonatological teams should be provided
6. Postpartum care should include active management of 3rd stage to prevent the occurrence of PPH, antibiotic cover to both elective and emergency cesarean deliveries, and thrombo-prophylaxis when indicated.

7. There is an urgent need to organize the efforts of the health institutions to provide the suitable equipments required for the appropriate care for the obese mothers including suitable sphygmomanometers, operation tables.

Abbreviations

BMI	Body mass index
Kg	Kilogram
m^2	Square meter
PCOS	Polycystic ovary syndrome
WHO	World Health Organization
CEMACH	Confidential Enquiry into Maternal and Child Health
APH	Antepartum Hemorrhage
ICU	Intensive Care Unit
NICU	Neonatal Intensive Care Unit
IVF	*In Vitro* Fertilization
ICSI	Intracytoplasmic Sperm Injection
C/S	Cesarean Section
PPH	Postpartum Hemorrhage
OR	Odd ratio
P – value	Probability value
NVD	Normal vaginal delivery
AVD	assisted vaginal delivery
IUGR	intrauterine growth retardation
RDS	respiratory distress syndrome
SGA	small for gestational age
AGA	average for gestational age
LGA	large for gestational age

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