The Effect of Obesity during Labor on Pregnancy Outcome in Healthy Parturients

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Abstract: Objective: To assess maternal obesity as a risk factor for adverse pregnancy outcome during spontaneous delivery. **Subjects and Methods:** This cross-sectional study involved 2 groups of women with spontaneous onset of labor pains at full term; obese group with body mass index (BMI) ≥ 30 kg/m^2 (n = 600) and a control group with a BMI of 18.5-29.9 kg/m^2 (n = 600). Abdominal ultrasonography was done for assessment of fetal lie and presentation and estimation of fetal weight. The primary outcome measure was the rate of caesarean delivery and secondary outcome measures were rate of instrumental delivery, fetal macrosomia, shoulder dystocia, prolonged labor and admission to NICU. **Results:** The obese group had significantly higher frequency of cesarean deliveries compared to normal weight group (24.2% vs. 11.3%, $p< 0.001$). Neonatal weight was significantly higher obese group (3.6±0.3 kg vs. 3.3±0.3 kg, $p< 0.001$). It was correlated positively with maternal weight ($r = 0.494$, $p < 0.001$) and BMI ($r = 0.526$, $p< 0.001$). Macrosomia and shoulder dystocia were significantly more frequent in the obese group (11% vs. 3.5%, $p< 0.001$ and 17.4% vs. 7.1%, $p = 0.003$, respectively). Maternal weight ≥ 89.5 kg was predictive of macrosomia (sensitivity 70% - specificity of 65%). BMI ≥ 33 kg/m^2 was predictive of macrosomia (sensitivity 69% - specificity 78%). **Conclusion:** In healthy parturients, obesity is associated with higher proportion of macrosomia, shoulder dystocia and cesarean deliveries. Neonatal weight is correlated with maternal weight and BMI.
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1.Introduction:

Obesity is a global health problem presenting one of the supreme challenges to the practicing clinician, through all specialties. The incidence of obesity increased to pandemic proportions over the past 20 years. The World Health Organization (WHO) estimated in 2005 that about 1.7 billion adults worldwide were overweight and 400 million obese with a projected increase to 700 million by 2015.[1,2] It was anticipated that by 2015, 75% of adults in the US will be overweight or obese, and 41% will be obese.[3] The present obesity epidemic is a reflection of the rapidly changing culture with urban lifestyle and globalized food habits [4,5].

Obesity is a known problem in developed countries and is becoming an increasing problem in developing countries too.[5] An Egyptian Demographic and Health Survey in 2005 showed that more wealthy Egyptian women were more than twice as likely to be obese compared with women of the lower socioeconomic class (57.8% vs. 31.8%), irrespective of the educational level.[6]

The childbearing years may result in a significant weight gain that may lead to the development of obesity. Women in the US aged 35 to 44 years experienced the greatest increase in obesity prevalence compared to other age groups in the past 45 years.[7] Studies from England [8] and United Arab Emirates [9] reported prevalence of obesity among adult women of 18% and 40%, respectively. The prevalence of obesity during pregnancy in the UK was reported to range between 16 and 19%.[10] A Turkish study of 9112 women found an incidence of overweight of 24.3% and obesity of 13.3%.[11]

Obesity is a risk factor for a multitude of serious diseases including hypertension, diabetes and cardiovascular diseases.[12] Obesity during pregnancy has been associated with many diverse maternal and neonatal outcomes.[13] Many investigators suggested that pregnant obese women are at greater risk of pre-eclampsia, caesarean section, intrauterine death, and anesthetic complications.[14-16] Moreover, a growing literature suggests an association between maternal obesity, excessive gestational weight gain, and childhood overweight and risk of obesity in later life.[17]

The aim of this work is to assess maternal obesity as a risk factor for adverse maternal and neonatal outcomes during delivery among women with spontaneous onset of labor.

2. Subjects and Methods:

This cross-sectional study involved women admitted to emergency department of the maternity hospital in Ain Shams University with spontaneous onset of labor pains. Inclusion criteria were singleton full term pregnancy (gestational age 37 to 41+3 weeks), longitudinal lie of the fetus at time of delivery and body mass index (BMI) ≥30 kg/m^2. A control group comparable in age and obstetric

characteristics and a normal BMI (18.5-29.9 kg/m^2) were included. Women who undergo elective cesarean section, history of previous cesarean section, medical disorders (eclampsia, HELLP Syndrome and DIC), intrauterine fetal death (IUFD) Preterm deliveries (< 37 weeks), postdate pregnancies (> 41+3 weeks), fetal distress or non-reactive CTG prior to onset of labor, placenta previa or placental abruption were excluded from the study.

Sample size Estimation:

Prior data indicate that the probability of cesarean delivery among controls is 0.23 and a probability among cases of 0.27. Thus, 600 cases are needed to project the difference between the two groups at an alpha level of 0.08 and power of the study of 0.8

Study procedure:

The included patients were divided into two groups: Obese Group (n = 600) and Control Group (n = 600) of women with normal BMI. All included women were subjected to full history taking and general examination to confirm absence of medical and obstetric disorders. Weight and height were measured and BMI was calculated using the formula: BMI = weight (kg)/[height (cm)]^2. Abdominal ultrasonography was done for assessment of fetal lie and presentation and estimation of fetal weight. Vaginal examination was done to detect phase of labor and degree of cervical dilatation and effacement and fetal descent. Progress of labor and fetal condition were monitored until delivery. To avoid the bias, the investigator was blinded with the process of management of labor and decision making. The primary outcome measure of the study was the rate of caesarean delivery and secondary outcome measures were rate of instrumental delivery, fetal macrosomia, shoulder dystocia, prolonged labor and admission to NICU.

Statistical Analysis:

Data was analyzed using IBM SPSS Advanced Statistics version 20.0 (SPSS Inc., Chicago, IL). Chi-square test (Fisher's exact test) was used to examine the relation between qualitative variables. For quantitative data, comparison between two groups was done using independent sample t-test or Mann-Whitney test. Pearson product-moment was used to estimate correlation between numerical variables. Odds ratio (OR) with it 95% confidence interval (CI) were used for risk estimation. The Receiver Operating Characteristic (ROC) curve was used for prediction of cut off values. A p-value < 0.05 was considered significant.

3.Results:

Table 1 shows baseline clinical characteristics of the two studied groups. The two groups were comparable in age (p = 0.080) and parity (p = 0.715). By definition, the obese group had significantly heavier weight and higher BMI.

Table (1): Clinical characteristics of the two studied groups

	Obese group (n = 600)	**Control group (n = 600)**	***p* value**
Age, mean±SD (years)	27.4±4.7	27.9±4.7	0.080
Parity, median (range)	1 (0-5)	1 (0-5)	0.715
Weight,mean±SD(kg)	94.1±9.2	70.6±8.6	**<0.001**
Height,mean±SD(m)	1.68±0.08	1.74±0.07	< 0.001
BMI,mean±SD(kg/m^2)	33.1±1.3	23.2±2.0	< 0.001

Table (2): Outcome of pregnancy in the two studied groups

	Obese group (n = 600)	**Control group (n = 600)**	***p* value**
Mode of Delivery			
Vaginal	455 (75.8%)	532 (88.7%)	< 0.001
Cesarean	145 (24.2%)	68 (11.3%)	
Instrumental delivery	103 (17.2%)	122 (20.3%)	0.160
Fetal weight, mean±SD (kg)	3.6±0.3	3.3±0.3	< 0.001

The obese group had significantly higher frequency of cesarean deliveries compared to normal weight group (p< 0.001). Meanwhile, there was no significant difference between the two groups regarding the frequency of instrumental deliveries (p = 0.160).Neonatal weight was significantly higher obese group (p< 0.001). Indications of cesarean deliveries were mainly cephalopelvic disproportion in 178 women (83.6%) followed by fetal distress (21 cases, 9.9%).

The birth weight of neonates delivered by cesarean section was ≤ 3.5 kg in 37 cases (17.4%), > 3.5-3.9 kg in 127 cases (59.4%) and > 4.0 kg in 49 cases (23%). Among the 987 vaginal deliveries, 117 cases (11.9%) of shoulder dystocia were encountered (Table 3).

Table (3): Maternal and neonatal complications in the two studied groups

Variables	Obese group (n = 600)	Control group (n = 600)	*p* value
Need for Blood Transfusion	23 (3.8%)	19 (3.2%)	0.530
Shoulder Dystocia*	79 (17.4%)	38 (7.1%)	<0.001
Macrosomia	66 (11.0%)	21 (3.5%)	< 0.001
Admission to NICU	20 (3.3%)	10 (1.7%)	0.064

* among vaginal deliveries; obesegroup(n = 455), normal group (n = 532)

Macrosomia and shoulder dystocia were significantly more frequent in the obese group (p< 0.001 and p = 0.003, respectively). There was no significant difference between the two groups regarding maternal need for blood transfusion (p = 0.530) and admission of neonates to intensive care units (p = 0.064) despite the apparently higher number of neonates of the obese group admitted to the NICU (Table 3).

Table (4): Neonatal weight in relation to cesarean section and shoulder dystocia

Variables	Yes		No		*p* value
	n	Mean±SD	n	Mean±SD	
Cesarean Section	213	3.8±0.4	987	3.4±0.3	< 0.001
Shoulder Dystocia*	117	3.7±0.3	870	3.3±0.3	< 0.001

* among vaginal deliveries; (n = 987)

Table 4 shows that neonatal weight was significantly heavier in women delivered by cesarean section (p< 0.001) and in cases of shoulder dystocia (p< 0.001). Neonatal weight was correlated positively with maternal weight (r = 0.494, p< 0.001) and BMI (r = 0.526, p< 0.001) (Figs. 1,2).

Using ROC curve, maternal weight ≥ 89.5 kg was predictive of macrosomia with a sensitivity of 70% and specificity of 65%. BMI ≥ 33 kg/m^{2}was predictive of macrosomia with a sensitivity of 69% and specificity of 78%.

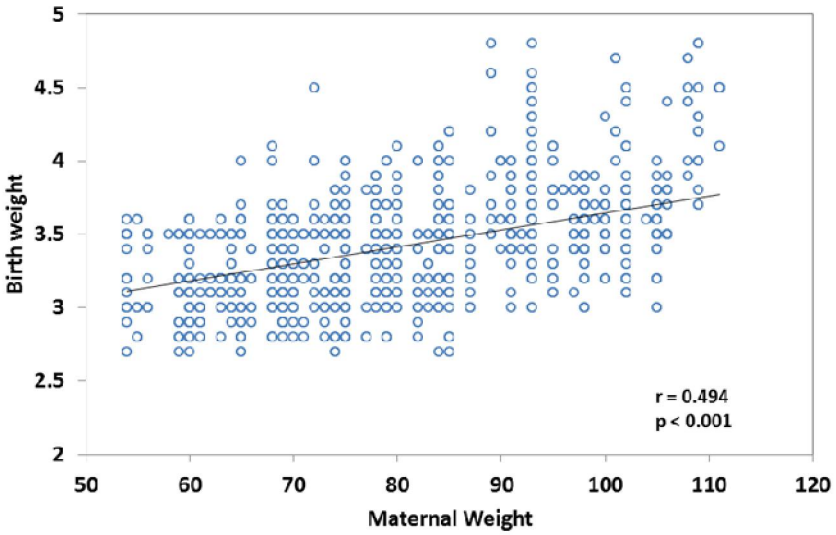

Figure 1: Correlation between maternal body weight and neonatal birth weight in the whole study group (n = 1200).

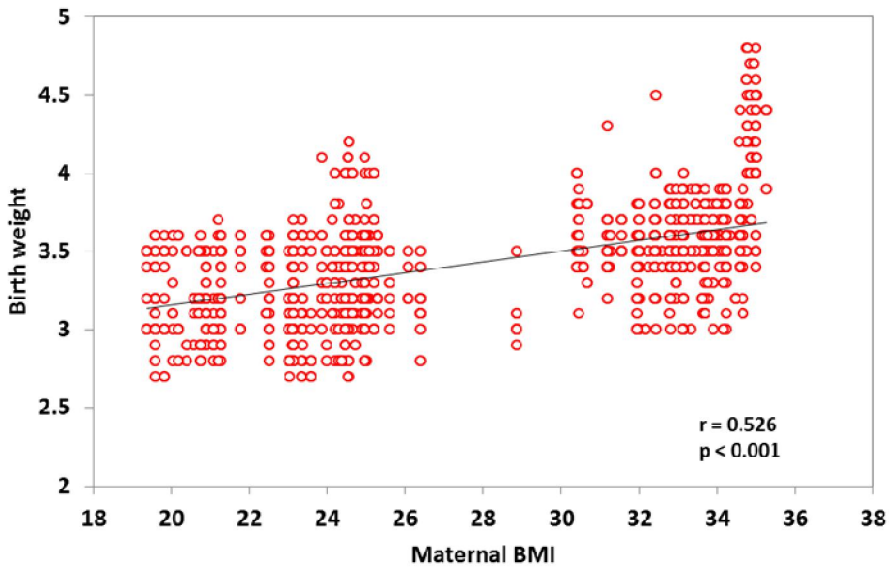

Figure 2: Correlation between maternal body mass index (BMI) and neonatal birth weight in the whole study group (n = 1200).

4.Discussion:

This study demonstrated a significantly higher cesarean section rate among obese women compared to normal-weight counterparts ($p< 0.001$). The main indication for cesarean delivery was cephalopelvic disproportion owing mainly to a large fetus. About 12% of vaginal deliveries were complicated by shoulder dystocia, which was more frequent in the obese group ($p< 0.001$). Neonatal weight was significantly higher obese group ($p< 0.001$). In all women (n = 1200), there was a positive correlation between neonatal birth weight and maternal weight (r = 0.494) and BMI (r = 0.526).

A similar retrospective study of 9,112 singleton pregnancies in a group of Turkish population was conducted to investigate the relation between BMI during labor and pregnancy outcome. In agreement with our results, they reported a significantly CS rate among obese women and a positive association between high BMI and macrosomia – defined as a neonate > the 90th percentile.[11]

These results are consistent with other articles in literature. A large retrospective Chinese study of 29,303 women reported increasing incidence of cesarean section and large-for-gestational age fetuses. However, contrary to our findings, they did not found an association between increasing BMI and shoulder dystocia.[18] Another study confirmed association between negative outcomes for mothers and neonates and increasing BMI. Mothers were at high risk of hypertension, diabetes, and cesarean section. The neonates were more likely to be macrosomic and entail admission to intensive care unit.[19] Among a group of Australian obstetric population, 34% of women were overweight, obese or morbidly obese. These women were at increased risk of cesarean delivery, hypertensive disorders of pregnancy and gestational diabetes. Neonates of morbidly obese women were at increased risk of admission to intensive care.[20]

A meta-analysis of 33 studies reported increasing risk of cesarean delivery with increasing BMI. Compared to normal weight women, odd ratios of a cesarean delivery were 1.46, 2.05 and 2.89 for overweight, obese and severely obese women, respectively.[21] However, a recent study of obese women who are otherwise healthy reported unexpected results. They found more common vaginal deliveries among obese women compared to those with a BMI < 30).[22]

In the current study, we selected parturients free of medical disorders such as hypertension and diabetes mellitus. Nevertheless, we found a significant obstetric risk for this merely-obese group of women. Previous studies reported higher probability of complications among women with BMI > 30 kg/m2. In obese women, the incidence of gestational diabetes may reach 20 times as women with physiological bodyweight.[23,24]

Similarly, hypertension and preeclampsia were reported to be much more common in association with maternal obesity. In addition, obese mothers are at increased risk of thromboembolic diseases [20,24-27] and perinatal mortality [28-30].

A recent retrospective study of 30298 singleton pregnancies, confirmed the increasing risk of adverse outcomes across BMI categories. Overweight and obese women were at significantly increased risk of hypertensive disorders of pregnancy, gestational diabetes mellitus, cesarean section, postpartum hemorrhage, macrosomia, preterm delivery, stillbirth and infant admission to a neonatal care unit.[31]

The current study found a higher frequency of macrosomia (defined as a birth weight of ≥ 4000 gm) in obese women (11%) compared to normal weight women (3.5%, $p< 0.001$). A systematic review of 35 studies found a strong evidence supporting the association between high gestational weight gain and increased birth weight and macrosomia.[32] A recent Brazilian study of 2244 women found that excessive weight gain in the second trimester was associated with LGA fetuses and in the third trimester, excessive weight gain increases the incidence of cesarean delivery.[33]

We can conclude that in healthy parturients, obesity is associated with higher proportion of macrosomia, shoulder dystocia and cesarean deliveries. Neonatal weight is correlated with maternal weight and BMI.

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