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Maternal obesity and obstetric outcomes in a tertiary referral center

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ABSTRACT

Background and aim: Obese women are at an increased risk of various adverse pregnancy outcomes. The aim of our study was to evaluate the impact of obesity on maternal and neonatal outcomes in a tertiary referral center and to compare obstetric outcomes by the level of maternal obesity.

Materials and methods: A cohort study included 3247 women with singleton gestations who gave birth at the Department of Obstetrics and Gynecology, Lithuanian University of Health Sciences, in 2010. Pregnancy complications and neonatal outcomes were identified using the hospital Birth Registry database in normal weight (body mass index [BMI] 18.5–24.9 kg/m^2, $n = 3107$) and prepregnancy obese (BMI ≥30 kg/m^2, $n = 140$) women. Pregnancy outcomes were compared according to the level of obesity (BMI 30–34.9 kg/m^2, $n = 94$ and BMI ≥35 kg/m^2, $n = 46$).

Results: Obese women were significantly more likely to have gestational hypertension (OR = 8.59; 95% CI, 5.23–14.14; $P < 0.0001$), preeclampsia (OR = 2.06; 95% CI, 1.14–3.73; $P < 0.0001$), gestational diabetes (OR = 5.56; 95% CI, 3.66–8.49; $P < 0.0001$), dystocia (OR = 2.14; 95% CI, 1.36–3.38; $P < 0.0001$), induced labor (OR = 2.64; 95% CI, 1.83–3.80; $P < 0.0001$), failed induction of labor (OR = 18.06; 95% CI, 8.85–36.84; $P < 0.0001$), cesarean delivery (OR = 1.76; 95% CI, 1.25–2.49; $P = 0.001$), large-for-gestational-age newborns (OR = 3.68; 95% CI, 2.51–5.39; $P < 0.0001$). Significantly increased risk of gestational diabetes, preeclampsia, dystocia and newborns with Apgar score ≤7 after 5 min was only observed in women with BMI ≥35 kg/m^2.

Conclusions: Maternal obesity is significantly associated with an increased risk of gestational hypertension, preeclampsia, gestational diabetes, dystocia, labor induction, failed induction of labor, large-for-gestational-age newborns and cesarean delivery.

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1. Introduction

The prevalence of obesity in the general population and among women of childbearing age has increased dramatically during past 25 years [1,2]. More than one-third of women of reproductive age are overweight or obese in middle or high income countries [3–6]. Being overweight or obese increases maternal and neonatal morbidity and obese women have higher infertility rates and are at increased risk of various adverse pregnancy outcomes [1,2,5–8]. Moreover, the perinatal nutritional environment may have a direct impact on development of obesity later in the life [9].

Most of the studies that investigated the relation of obesity with adverse perinatal outcomes were done in Western countries [1–4]. Few data exist about new European Union member states. Obesity is a burden for any healthcare system that should not be underestimated. When resources are limited it is important to identify risk groups which may benefit most from target interventions. Analysis of adverse pregnancy outcomes in relation to obesity class allows a better understanding of the risks and thus interventions can be concentrated on the population that needs them most.

The objective of our study was to evaluate the impact of obesity on maternal and neonatal outcomes in the tertiary referral center and to compare pregnancy outcomes by the level of maternal obesity.

2. Materials and methods

A cohort study was conducted at the Department of Obstetrics and Gynecology of the Lithuanian University of Health Sciences, in Kaunas, Lithuania. The department is a tertiary referral center where mainly high-risk pregnant women receive perinatal services. Pregnancy was considered as high-risk for a variety of maternal and fetal reasons: preexisting maternal medical illness, history of complications and poor outcomes during previous pregnancies, various obstetrical complications during current pregnancy, etc. Women who delivered singleton newborns at 22–42 weeks of gestation between January 1 and December 31, 2010, were retrospectively identified ($n = 3371$) using the Birth Registry, a computerized database in which all deliveries at the department have been registered. Data are entered into the registry by the trained midwife assisting at the delivery. Maternal demographic characteristics, medical and obstetrical history and pregnancy outcomes were collected from Birth Registry database along with manual retrieval from medical charts and labor records using standardized data collection forms.

Height and prepregnancy weight was obtained from the prenatal records or was self-reported upon admission for delivery. Body mass index (BMI) was calculated from weight in kilograms divided by height in meters squared (kg/m^2). Prepregnancy obese women (BMI ≥30 kg/m^2, $n = 140$) and normal weight women (BMI 18.5–24.9 kg/m^2, $n = 3107$) were included. Gestational weight gain (GWG) was ascertained according to self-reported data at the time of delivery or documented weight at last prenatal visit subtracted from prepregnancy weight.

Maternal characteristics including age, parity, marital status (married vs. unmarried, including single, divorced, widowed, and separated), educational level, GWG and pregnancy outcomes were compared between obese and normal weight women. Furthermore obese women were subcategorized into two groups (BMI 30–34.9 kg/m^2, $n = 94$ and BMI ≥35 kg/m^2, $n = 46$) and pregnancy outcomes were compared between these and normal weight women. Maternal outcomes of interest included gestational hypertension, preeclampsia, gestational diabetes, induction and augmentation of labor, failed induction, dystocia and cesarean section rate. Neonatal outcomes of interest included gestational age at delivery, birthweight, preterm delivery, stillbirth and low Apgar score at 5 min.

Gestational age at delivery was based on early ultrasound and recorded day of last menstrual period. Low Apgar score was defined as a score ≤7 at 5 min after delivery. A stillbirth was defined as the death of a fetus at any time of pregnancy and delivery after 22 completed weeks of gestation. Large-for-gestational-age (LGA) newborn or fetal macrosomia was defined as birthweight above the 90th percentile adjusted for newborn gender and gestational age. Small for gestational age newborns were defined as those with a weight less than the 10th percentile at birth adjusted for newborn gender and gestational age. Newborns were weighted immediately upon delivery in the nursery.

Gestational hypertension was defined as a blood pressure elevation ≥140 mmHg systolic or ≥90 mmHg diastolic measured on two occasions 6 h apart in previously normotensive women after ≥20 weeks of gestation. Preeclampsia was diagnosed when woman developed gestational hypertension and proteinuria ≥300 mg of protein in a 24-h urine specimen. A fasting glucose screening test was done at initial prenatal visit. An oral glucose tolerance test (OGTT) was done in all prepregnancy obese women. OGTT in women with normal BMI was carried out according to institutional policy if women had the following risk factors: age ≥35 years, familial history of diabetes, prior history of gestational diabetes (GDM), glycosuria, history of unexplained stillbirth, previously delivered LGA newborn. OGTT was conducted with a loading glucose dose of 75 g between 24th and 28th weeks of gestation. The diagnosis of GDM was made on the basis of a 2-h plasma glucose level of ≥7.8 mmol per liter. Class A1 GDM was diagnosed when dietary modification was sufficient to control blood glucose level. Class A2 GDM was diagnosed when additional therapy with insulin was required. Failed induction of labor was diagnosed when physical and pharmacological methods did not generate regular uterine contractions and lead to vaginal delivery. Dystocia was defined as a failure to progress in labor either because of uterine dysfunction, pelvic contraction or disproportion between the head of the fetus and the birth canal.

2.1. Statistical analysis

Statistical analyses were performed using the SPSS (*Statistical Package for the Social Sciences*) version 17.0 (Chicago, IL, USA) for Windows. Descriptive statistics are presented as the arithmetic mean ± standard deviation (SD). The Pearson chi-squared test was used for analysis of categorical variables. The Fisher

exact and Student t tests were used when applicable to compare continuous variables. Odds ratios (OR) and 95% confidence intervals (95% CI) were calculated. A value of $P < 0.05$ was considered significant.

2.2. Ethics

The study was approved by Kaunas Regional Ethics Committee (Protocol No. BE-2-6).

3. Results

The study population consisted of 19 (0.6%) underweight, 3107 (92.1%) normal weight, 105 (3.1%) overweight, and 140 (4.2%) obese parturients. Maternal characteristics are presented in Table 1. The mean age of the obese women was significantly higher than that of normal weight women. Mean parity was 2.4 in obese and 2.1 in normal weight women, mean gestational age was 39 weeks in both groups. Marital status was similar among obese and normal weight women. The range of weight gain during pregnancy was 4.8–32.4 kg in obese, while among the normal weight females it was 2.0–28.0 kg. Educational level was significantly higher in normal weight women.

Obese women were more likely to develop gestational hypertension, preeclampsia and GDM (Table 2). Cesarean section, induced labor, failed induction of labor and dystocia rates were significantly higher in obese women. Class A1 and A2 GDM was diagnosed in 17.8% and 5.8% of obese and in 4.5% and 0.7% of normal weight women, respectively. Labor induction was more often in obese women when compared with normal BMI women. The most common indications for labor induction in both groups were postterm pregnancy (10 days after estimated date of delivery) and preeclampsia. Failed induction of labor also was more common in obese women. Total cesarean delivery rate in obese women was more common than in normal weight women. Emergency cesarean section was performed in 19.3% of obese and 13.6% of women with normal BMI, a non-significant difference. Fetal distress and dystocia were the most common indications for cesarean delivery in both groups of parturients.

The neonatal outcomes are summarized in Table 3. Mean birthweight and newborn gender was similar in both groups. LGA newborns were significantly more common in obese women compared with normal weight women. Low Apgar score at 5 min, preterm birth, small for gestational age newborns and stillbirth rates in both groups were not significantly different. Pregnancy outcomes in women with BMI 30–34.9 kg/m^2 and BMI ≥35 kg/m^2 are presented in Table 4. Significantly increased risk of gestational diabetes, preeclampsia, dystocia and newborns with Apgar score ≤7 after 5 min was only observed in women with BMI ≥35 kg/m^2.

4. Discussion

Women who are obese before pregnancy have an increased risk of hypertensive disorders and GDM [7,10–14]. GDM

Table 1 – Maternal characteristics.

Characteristics	Obese women N = 140	Normal weight women N = 3107	P
Nulliparous	50 (35.7)	1126 (36.2)	0.929
Multiparous	90 (64.3)	1981 (63.8)	
Living place			
Urban	78 (55.7)	2411 (77.6)	<0.0001
Rural	62 (44.3)	696 (22.4)	
Education level			
Primary–secondary	103 (73.6)	1839 (59.2)	0.0006
Higher education	37 (26.4)	1268 (40.8)	
Maternal age, mean ± SD, years	30.7 ± 5.9	28.7 ± 5.2	<0.0001
Weight gain during pregnancy, mean ± SD, kg	11.6 ± 6.5	14.3 ± 4.7	<0.0001
Prepregnancy body mass index, mean ± SD, kg/m^2	36.1 ± 3.4	22.8 ± 0.9	<0.0001

Values are number (percentage) unless otherwise stated.

Table 2 – Maternal outcomes.

Outcome	Obese women N (%) (n = 140)	Normal weight women N (%) (n = 3107)	OR (95% CI)	P
Gestational diabetes	33 (23.6)	160 (5.1)	5.56 (3.66–8.49)	<0.0001
Gestational hypertension	24 (17.1)	73 (2.3)	8.59 (5.23–14.14)	<0.0001
Preeclampsia	13 (9.3)	147 (4.7)	2.06 (1.14–3.73)	0.017
Dystocia	24 (17.1)	274 (8.8)	2.14 (1.36–3.38)	0.001
Induced labor	46 (32.8)	486 (15.6)	2.64 (1.83–3.80)	<0.0001
Failed induction of labor	14 (10)	19 (0.6)	18.06 (8.85–36.84)	<0.0001
Augmentation of labor	51 (36.4)	987 (31.7)	1.23 (0.87–1.75)	0.248
Cesarean delivery	60 (42.8)	927 (29.8)	1.76 (1.25–2.49)	0.001

Table 3 – Neonatal outcomes.

Outcome	Maternal BMI ≥30 kg/m^2 *n* (%)	Maternal BMI 18.5–24.9 kg/m^2 *n* (%)	OR (95% CI)	*P*
Apgar score ≤7 after 5 min	4 (2.8)	51 (1.6)	1.76 (0.63–4.9)	0.282
Preterm birth	15 (10.7)	387 (12.4)	0.84 (0.49–1.46)	0.541
Stillbirth	3 (2.1)	34 (1.1)	1.98 (0.6–6.52)	0.262
Small-for-gestational-age newborn	4 (2.8)	121 (3.9)	0.73 (0.26–1.99)	0.534
Large-for-gestational-age newborn	41 (29.3)	314 (10.1)	3.68 (2.51–5.39)	<0.0001

BMI, body mass index.

Table 4 – Pregnancy outcomes according to the maternal obesity level.

Outcome	Normal BMI versus BMI 30–34.9 kg/m^2 (*n* = 94)		Normal BMI versus BMI ≥35 kg/m^2 (*n* = 46)	
	OR (95% CI)	*P*	OR (95% CI)	*P*
Gestational diabetes	1.95 (0.96 –3.95)	0.0634	20.09 (11.03–6.61)	<0.0001
Gestational hypertension	7.27 (3.94–13.43)	<0.0001	11.55 (5.52–24.15)	<0.0001
Preeclampsia	0.89 (0.32–2.47)	0.83	4.89 (2.32–10.34)	<0.0001
Dystocia	1.37 (0.72–2.6)	0.335	5.84 (2.93–11.67)	<0.0001
Induced labor	2.79 (1.79–4.31)	<0.0001	2.36 (1.25–4.45)	0.008
Failed induction of labor	17.21 (7.57–39.15)	<0.0001	19.82 (7.06–55.64)	<0.0001
Cesarean delivery	1.74 (1.15–2.64)	0.009	1.81 (1.01–3.26)	0.048
Apgar score ≤7 after 5 min	0.65 (0.09–4.74)	0.2924	3.97 (1.20–13.19)	0.0243
Preterm birth	0.94 (0.50–1.77)	0.85	0.70 (0.25–1.95)	0.70
Stillbirth	1.94 (0.46–8.21)	0.37	1.99 (0.27–14.82)	0.50
Small for gestational age infant	0.82 (0.26–2.62)	0.74	0.56 (0.08–4.08)	0.57
Large-for-gestational-age newborn	3.05 (1.89–4.92)	<0.0001	5.21 (2.83–9.59)	<0.0001

BMI, body mass index.

generally is diagnosed in 4%–7% of pregnant population. Obese women have the risk of GDM three to eightfold higher when compared with normal weight pregnant women [6,10,11]. In our study GDM was diagnosed in 23.6% of obese women and OR increased dramatically among the women with prepregnancy BMI of 35 kg/m^2 and more (OR 20.1). Our results also show an association between increased prepregnancy BMI and hypertensive disorders. The OR for gestational hypertension and preeclampsia in our patients population with BMI ≥35 kg/m^2 was 11.55 and 4.9, respectively. The risk of hypertensive disorders and GDM is much higher as compared to the data published in the literature and maybe due to different definitions and also because of the fact that the data for the current study were obtained from tertiary referral center where more pregnant woman with pregnancy complications are referred.

Obese women more commonly have postterm pregnancy and are less likely to have spontaneous onset of labor, more likely to require induction of labor, and more likely to have a failed induction of labor [15–17]. The results from our study show that induction of labor was registered more often among the women with pregestational BMI >30 kg/m^2. The OR of failed induction of labor was significantly higher in women with BMI 30–34.9 kg/m^2 and increased only slightly among the women with BMI ≥35 kg/m^2, 17.2 and 19.8, respectively. Failure of labor induction, narrowing of the birth canal by increased maternal pelvic soft tissue and associated dystocia, fetal macrosomia and cephalopelvic disproportion increase risk of cesarean and operative vaginal delivery in obese parturients [5–7,18,19]. Cesarean section rate in women with obesity in our study was 42.8%, very similar to reported in other studies [19]. In general, a nearly two-fold increased risk of cesarean delivery in women who are obese even after controlling for other factors is reported [14,20]. In our study fetal distress and dystocia were the most common causes for cesarean section among normal weight and obese patients.

Obese women have 18%–26% increased chance of delivering macrosomic newborns [6,21]. In our study 29.3% rate of LGA newborns was even higher than noted in previous studies. Crane et al. found an increased risk of fetal macrosomia with increasing maternal BMI [7]. Similarly, we found significantly increased OR of LGA newborns in women with BMI 30–34.9 kg/m^2 and BMI ≥35 kg/m^2 as compared to normal weight women, 3.1 and 5.2 respectively. LGA newborns are at increased risk of shoulder dystocia, birth trauma and meconium aspiration [13,21,22]. Neonates born to obese women have a higher rate of low Apgar score and more common admittance to an intensive care unit [7]. In our study women with BMI ≥35 kg/m^2 had an increased risk of delivering newborns with Apgar score ≤7 at 5 min.

The major limitation of the study is that our department is a tertiary referral center. High-risk pregnancy cases consist almost two-thirds of our patients. Thus the rates of complicated obstetric outcomes related to obesity maybe higher in our study population and this could be a potentially confounding factor that may have influenced the results.

However, the goal of the present study was to evaluate the impact of obesity on obstetric complications in the perinatal center. The risk of nearly all pregnancy and labor complications was significantly increased in obese women, but this had little impact on serious immediate neonatal complications such as the rate of stillbirth. The other limitation is that we do not have data on long-term follow-up of neonates. One of the greatest problems with maternal obesity is impaired metabolic environment, which may influence fetal and neonatal growth, and determine the health of the offspring [9,22]. Weight control by diet and physical activity during pregnancy was shown to be effective in reducing complications such as preeclampsia, GDM, gestational hypertension, and preterm delivery [23]. The importance of maternal metabolic status during pregnancy could be illustrated by the effect of bariatric surgery on pregnancy outcomes. Bariatric surgery reduces the risk of GDM, hypertensive disorders, fetal macrosomia and offspring obesity [9,24]. However, bariatric surgery is a costly intervention currently recommended for the fertile age women with BMI ≥40 kg/m^2 [25]. The tertiary perinatal referral centers should not only manage obstetric complications related to obesity but also provide nutritional and physical activity counseling to obese pregnant women. Also there is a need to identify the most effective and safe interventions during pregnancy that are aimed to optimize pregnancy outcomes and improve maternal and neonatal health in Lithuania.

5. Conclusions

Maternal obesity is significantly associated with an increased risk of gestational hypertension, preeclampsia, gestational diabetes, dystocia, labor induction, failed induction of labor, LGA newborns and cesarean delivery.

Conflict of interest

The authors state no conflict of interest.

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