Obstetrical and Neonatal Outcomes in Obese Women

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ABSTRACT

Objective: To compare the incidence of antenatal and intrapartum complications and neonatal outcomes among pre-pregnant obese women.

Methods: At the Sud-Reunion Hospital's maternity, Reunion Islands, France, over a 54-month period, each obese pregnant woman (BMI $ 30 kg/m²) delivering a singleton after 22-weeks gestation was compared to the next age and parity-matched woman of normal pre-pregnancy weight (BMI 18.5–25 kg/m²), who delivered after the index case. The Students t *test, Mann and Whitney test, Chi-square test and logistic regression model were used for statistical analysis.*

Results: The study enrolled 2081 obese women and 2081 controls. The incidences of pre-eclampsia, chronic and pregnancy-induced hypertension, chronic and gestational diabetes mellitus were increased in the obese women group. Prenatal care in obese women required a high rate of hospitalizations as well as a high rate of insulin treatment. Obese women were more likely to be delivered by Caesarean section. The rate of in utero *fetal death, neonatal and perinatal death was significantly higher in the obese women group. The high BMI in relation with both pre-eclampsia and* in utero *fetal death remained unchanged after adjustment of other risk factors.*

Conclusion: Obese women were more likely to present several obstetric complications and to be delivered by Caesarean section. Obstetricians who decide on a first Caesarean section in an obese woman should be aware of the cumulated obesity and uterine scar risks that could threaten any subsequent Caesarean section.

Resultados Obstétricos y Neonatales en las Mujeres Obesas

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RESUMEN

Objetivo: Comparar la incidencia de las complicaciones antenatales e intraparto, y los resultados neonatales entre las mujeres obesas pre-embarazadas.

Métodos: Por un periodo de más de 54 meses, cada mujer obesas embarazadas (IMC $ 30 kg/m²) dando a luz singletons después de 22 semanas de gestación, en el Hospital de Maternidad de Sud-Reunion, Reunion Island, Francia, fue comparados con la mujer de peso normal pre-embarazada siguiente, pareada por edad y paridad (IMC 18.5–25 kg/m²) dando a luz después del caso del índice. Para el análisis estadístico se usó la prueba T de Student, la prueba de Mann-Whitney, la prueba de chi-cuadrado, y el modelo de regresión logística.

Resultados: El estudio enroló a 2081 mujeres obesas y 2081 controles. Las incidencias de pre-eclampsia, hipertensión inducida por el embarazo y crónica, así como la diabetes mellitus gestacional y crónica, aumentaron en el grupo de mujeres obesas. El cuidado prenatal en las mujeres obesas requirió una alta tasa de hospitalizaciones así como una alta tasa de tratamiento de insulina. Las mujeres obesas eran más propensas a tener el parto por cesárea. La tasa de muerte fetal in útero, *muerte neonatal y perinatal fue significativamente más alta en el grupo de mujeres obesas. El alto IMC en relación tanto con la pre-eclampsia como con la muerte fetal en útero permaneció igual*

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después del ajuste de otros factores de riesgo. El alto IMC tanto en relación con la pre-eclampsia como con respecto la muerte fetal in útero permaneció igual después del ajuste de otros factores de riesgo.
Conclusión: *Las mujeres obesas tuvieron mayor propensión a presentar varias complicaciones obstétricas y tener el parto mediante cesárea. Los obstetras que deciden practicar una primera cesárea en una mujer obesa deben tener conciencia de la obesidad acumulada y los riesgos de cicatriz uterina que podrían amenazar cualquier cesárea posterior.*

INTRODUCTION

Prevalence of obesity (body mass index, (BMI) $ 30 kg/m^2) in the French population increased slightly but continuously, from 8.2% in 1997 to 9.6% in 2000 and 11.3% in 2003 (1). This tendency was observed in both genders and at all age intervals. Furthermore, within the childbearing age *ie* 15–44 years, obesity was more in women than men (2.6% women from 15 to 24 years old, 9.1% from 25 to 34 years and 11.8% from 35 to 44 years) (1). Subsequently, the management of pregnancies in obese women is not uncommon.

Several studies have shown that maternal obesity is an important contributing factor in chronic hypertension, pre-eclampsia, pre-pregnancy and gestational diabetes, large for gestational age newborns (LGA) as well as neonates and fetal deaths (2–8). Obese women are more likely to undergo a Caesarean section, while the peri-operative complication rate is widely increased by an increased BMI (4, 5, 9). The largest studies concerning pregnant obese women have been conducted in the United States of America, England and Scandinavian countries (2–9). Maternal obesity may be influenced by environmental, socio-economic, nutritional and cultural conditions as well as by race and medical insurance provision making variations across different countries possible (10, 11).

This is a report on a retrospective cross-sectional age and parity-matched study of 2081 obese and 2081 normal weight women in the Reunion Island, a French overseas territory. The objective of this study is to compare the incidence of antenatal and intrapartum complications and neonatal outcomes among pre-pregnant obese women *versus* pre-pregnant normal-weight controls, matched for age and parity and who delivered singleton pregnancies.

SUBJECTS AND METHODS

The Reunion is an island located in the Indian Ocean (between Madagascar and Mauritius) with 800 000 inhabitants and 14 500 births per year. The current infant and perinatal mortality rates are 6 and 13 per 1000 respectively. The Sud Reunion Hospital maternity department performs 4200 deliveries per year (75% of births in the southern area). Patients benefit from free medical care through the French national social security system. Over a 54-month period (January 2001 to June 2005) all obese pregnant women (pre-pregnant BMI $ 30 kg/m^2) delivering singleton pregnancies after 22 weeks gestation were included in the study. The control group was comprised of the next age and parity-matched pre-pregnancy normal weight women (BMI 18.5–25 kg/m^2) delivering after the index case. The Departmental Research Ethics Committee approved the study.

The Sud-Reunion maternity database provided data used in analysis. This database was made up of an epidemiological folder for each woman that delivered her baby in the hospital and subsequently a folder for her child. Each folder contained 195 items. The folders were created by one of the authors (PYR) who coordinated the data recorded by paediatrics physicians before the discharge of the women and newborns. This prospective recording provides high accuracy data and a low rate of missing information. Items recorded were in regard to patients' socio-demographic characteristics, antecedents, chronic diseases, obstetrical and medical pathologies occurring during pregnancy, delivery, newborn characteristics and neonatal outcomes. The pre-pregnant BMI was calculated using the self-reported weight and height that were recorded at the first antenatal visit.

Prenatal risk factors have been defined by the standards of Williams Obstetrics, 21st edition (12). Chronic hypertension was defined as a diastolic blood pressure of at least 90 mm Hg before 20 week-gestation or a pre-existing history of essential hypertension or antihypertensive medication before the pregnancy. The screening for gestational diabetes mellitus (GDM) was performed using the O'Sullivan test at 24–28-week gestation (cut-off value > 7.8 mmol/L after 50 g glucose load) (13) and the diagnosis made by an oral glucose tolerance test using 100 g glucose (the National Diabetes Data Group criteria) (14). Insulin treatment was given only to women who could not reduce their plasma glucose levels by diet alone. Perinatal mortality was defined to include stillbirths after 22 weeks of gestation and neonatal deaths (deaths within the first 28 days). Early neonatal deaths were defined to include deaths from 0 to 6 days.

Continuous data are reported as mean ± standard deviation or as median (range). The Student *t* test, Mann and Whitney test and chi-square test were used for statistical analysis when appropriate. The logistic regression model determined independent predictors of obstetrical and neonatal morbidities after the control for confounding variables. The variables presenting a particular clinical interest and $p < 0.30$ in univariate analysis were included in the model. A p-value < 0.05 was considered statistically significant. The analysis was performed using the Stata 8.0 (Stata Corporation, 4905 Lakeway Drive, College Station, Texas, USA) and EpiInfo 6 software (Centers for Diseases Control and Prevention, USA).

RESULTS

There were 17 650 singleton births during the 54-month study period. Of these, 2081 obese women (11.7%) were age and parity matched with 2081 controls. This population comprised 87.1% mixed-race Creole women (of European, African and East-Indian origins), 4% white European women (coming from mainland France) and 8.9% black women (from other Indian Ocean islands, the Comores and Madagascar). The BMI was 34.3 ± 4.2 in the study group and 20.9 ± 2.3 in controls.

Patient characteristics and obstetrical data are presented in Table 1. The mean age of each group was 28.9 ±

An increased rate of Caesarean section as well as labour induction (Tables 2, 3) was found in the study group. Obese women were also more likely to develop fever (> 37.8°C) during labour and to have meconium staining at delivery. They also were more likely to have a Caesarean section due to arrest of cervical dilatation: 65 (12.5%) *versus* 22 (7%), OR 1.9, 95% CI 1.1, 3.2, $p = 0.013$.

Obese women were more likely to give birth to macrosomic infants ($ 4000 g) or to LGA newborns (Table 2). The prevalence of small for gestational age (SGA) new-borns or preterm newborns (< 37-week gestation) was decreased in the study group. However, the rate of *in utero* fetal, neo-

Table 1: Patients' characteristics and obstetrical data broken down by obesity status (Student *t* test, Mann and Whitney test, chi-square test)

	Obese women n = 2081 (%)	Controls n = 2081(%)	OR (IC 95%)	p
Smoking	234 (11.2)	280 (13.4)	0.8 (0.7–0.98)	0.03
Alcohol during pregnancy	7 (0.3)	27 (1.3)	0.3 (0.1–0.6)	0.001
Previous voluntary abortions*	317/1728 (18.3)	409/1682 (24.3)	0.8 (0.7–0.98)	0.024
Prenatal visits**	10 (0–27)	9 (0–32)		< 0.001
Weight gain in pregnancy (kg)	7.8 ± 6.6	12.6 ± 5.3		< 0.001
Pregnancy induced hypertension	145 (7.0)	60 (2.9)	2.6 (1.9–3.5)	< 0.001
Chronic hypertension	140 (6.7)	32 (1.5)	5.3 (3.5–8.1)	< 0.001
Pre-eclampsia	60 (2.9)	29 (1.4)	2.1 (1.3–3.4)	< 0.001
Gestational diabetes mellitus	359 (17.8)	124 (6)	3.4 (2.7–4.2)	< 0.001
Chronic diabetes mellitus	68 (4)	9 (0.5)	8.9 (4.4–17.9)	< 0.001
Insulin-dependent diabetes	203 (9.8)	31 (1.5)	7.6 (5.1–11.5)	< 0.001
Pregnancy termination	5 (0.2)	3 (0.1)		0.96
In utero fetal death	26 (1.2)	12 (0.6)	2.2 (1.1–4.3)	0.02
Fetal malformations	46 (2.2)	64 (3.1)		0.08

*in multiparous women; **median (range).

6.4 years, range 14–50 years (< 25 years, n = 1140; 25–29 years, n = 1140; 30–34 years, n = 968; 35–40 years, n = 702; over 40 years, n = 212). Similarly, in both groups the median parity was one (25th percentile, 1; 75th percentile, 3; range 0–11). The median gestity was three in the study group (25th percentile 2, 75th percentile 4, range 1–14) and three in the control group (25th percentile, 2; 75th percentile, 4; range 1–14; $p = 0.72$).

Obese women were more likely to have had little or no education (none or grade school level, n = 274 (13.1%) *versus* n =193 (9.2%), $p < 0.001$) and not be of European descent (n = 2037 (97.9%) *versus* n = 1959 (94.1%), $p < 0.001$). The incidences of pre-eclampsia, chronic and pregnancy-induced hypertension, chronic and gestational diabetes mellitus were increased in the study group and significantly more obese women required insulin treatment. Prenatal care included an increased number of prenatal visits in obese women.

natal and perinatal deaths was significantly higher in the obese women group.

We used a conditional logistic regression model to identify the independent factors associated with pre-eclampsia and fetal death (Table 4). The relationship of high BMI with both pre-eclampsia and *in utero* fetal death remained unchanged after adjustment of other risk factors.

DISCUSSION

This study is of interest due to the particular social characteristics of this tropical region where a high prevalence of pre-pregnancy obesity coexists with free, high-quality medical care (average nine prenatal visits) possibly alleviating effects of poor social conditions on patients.

Previous retrospective studies have shown increased rates of antenatal, intrapartum and neonatal complications in obese and morbidly obese women (2–8). However, most of them involved obese women who were more likely to present

Table 2: Intrapartum events and neonatal outcomes (after exclusion of in utero fetal deaths and pregnancy termination; see Table 1).

	Obese women n = 2050 (%)	Controls n = 2066 (%)	OR (IC 95%)	p
Gestational age at delivery (wg)	38.3 ± 2.4	38.3 ± 2.1		0.93
Preterm delivery < 37 wg	186 (9.1)	226 (10.9)	0.8 (0.6 ± 0.97)	0.03
Preterm delivery < 34wg	68 (3.3)	57 (2.7)	1.2 (0.8–1.7)	0.32
Labour induction	599 (28.8)	416 (20)	1.6 (1.4–1.9)	< 0.001
Pathological fetal heart rate	356 (17.1)	323 (15.5)	1.1 (0.9–1.3)	0.17
Fever during labour ($ 38°C)	151 (7.3)	82 (4.1)	1.9 (1.4–2.5)	< 0.001
Meconium staining at delivery	412 (20.1)	305 (14.8)	1.5 (1.2–1.7)	< 0.001
Caesarean section	524 (25.2)	314 (15.1)	1.9 (1.6–2.2)	< 0.001
Instrumental delivery (% of vaginal deliveries)	98 (6.3)	103 (5.8)	1.1 (0.8–1.4)	0.58
Birthweight (g)	3,241 ± 603	3,069 ± 538		< 0.001
Birthweight < 2500 g	168 (8.2)	251 (12.1)	0.65 (0.52–0.79)	< 0.001
Birthweight ≥ 4000 g	166 (8.1)	57 (2.8)	3.1 (2.2–4.3)	< 0.001
Small for gestational age	133 (6.4)	198 (9.1)	0.68 (0.54–0.86)	0.001
Large for gestational age	374 (18.2)	178 (8.6)	2.4 (1.9–2.9)	< 0.001
Recoveries in NICU	135 (6.5)	134 (6.5)	1 (0.8–1.3)	0.96
Malformation in living newborns	46 (2.2)	64 (3.1)	0.7 (0.5–1)	0.08

Table 3: Indications for Caesarean section and labour induction.

	Obese women n (%)	Controls n (%)	p
Caesarean section	524 (100)	314 (100)	
Uterine scar	149 (28.6)	73 (23.3)	< 0.001
Fetal distress	103 (19.8)	80 (25.6)	
Breech	41 (7.9)	33 (10.5)	
Labour induction failure	46 (8.8)	28 (8.9)	
Pre-eclampsia	35 (6.7)	16 (5.1)	
Arrest of cervical dilatation	65 (12.5)	22 (7.0)	
Macrosomia	19 (3.6)	0	
Other reasons	63 (12.1)	61 (19.6)	
Labour induction	599 (100)	416 (100)	
Rupture of membranes	95 (15.9)	116 (27.9)	< 0.001
Diabetes mellitus	102 (17)	20 (4.8)	
Postdate	107 (17.9)	57 (13.7)	
Programmed delivery	76 (12.7)	85 (20.4)	
Pre-eclampsia	19 (3.2)	14 (3.4)	
Macrosomia	24 (4)	10 (2.4)	
Hypertension	58 (9.7)	10 (2.4)	
Abnormal fetal heart rate	24 (4)	17 (4.1)	
Other reasons	94 (15.7)	87 (20.9)	

Table 4: Increased BMI and its independent relationship with pre-eclampsia and in utero fetal death (conditional logistic regression model).

Risk factor	Pre-eclampsia Adjusted OR (95% CI)	p	In utero fetal death Adjusted OR (95% CI)	p
BMI $ = 30	1.7 (1.04–2.7)*	0.032	2.1 (1.04–4.3)*	0.037
Chronic hypertension	7.1 (4.1–12.2)*	< 0.001	0.39 (0.05–3.1)	0.37
Chronic diabetes mellitus	0.24 (0.03–1.9)	0.17	4.1 (1.2–14.4)*	0.026
Gestational diabetes mellitus	1.2 (0.69–2.1)	0.50	0.59 (0.18–2.0)	0.39
Pre-eclampsia	–	–	2.0 (0.32–12.2)	0.46
Smoking	0.60 (0.26–1.4)	0.24	1.3 (0.55–3.2)	0.52

*Statistically significant difference

with increased age and parity than their normal-weight controls (7, 9). We carried out a case control study as both age and parity are factors associated with several unfavourable obstetric and neonatal outcomes. Older pregnant women were more likely to develop vascular disorders (chronic and pregnancy-induced hypertension and pre-eclampsia), diabetes mellitus (chronic or gestational), fetal malformation and in *utero* fetal death as well as increased instrumental or Caesarean deliveries (15, 16). High parity has been associated with an increased rate of *in utero* fetal death (15, 17) and primiparity with a higher rate of pre-eclampsia and intrapartum complications. Subsequently, we chose to perform an age and parity-matched study, using multivariate analysis to control for other confounding variables (*eg* vascular disorders, diabetes mellitus) without excluding women presenting with these obesity-associated pathologies (4).

The association between pre-pregnancy high BMI and pre-eclampsia has already been observed by several authors (5, 18–20). This association might be confounded by the presence of chronic hypertension, diabetes mellitus or other elements of the dysmetabolic syndrome (18). However, after adjustment for either chronic hypertension or diabetes mellitus, the relation between high BMI and pre-eclampsia remained unchanged suggesting that elevated BMI is an

independent predictive factor for pre-eclampsia (Table 4). These results agree with those of other studies previously reported in the literature (5, 18-20). The pathophysiology of this strong association is still unknown but there is likely to be more than one mechanism underlying this relationship. Hypertriglyceridaemia, abnormal prostaglandin regulation leading to arteriolar constriction, high levels of biomarkers of insulin resistance might concur to lead to endothelial dysfunction (21, 22). Obstructive sleep apnoea, commonly associated with obesity, increases blood pressure during obstructive periods and this has been shown also in pre-eclamptic obese women (23).

The number of Caesarean sections was significantly increased in the study group in agreement with similar studies previously reported (4–6, 24, 25). In the literature, this delivery choice can be justified by the presence of obesity associated pathologies (vascular disorders, diabetes), fetal macrosomia, post-term deliveries or labour induction failures.

In this study sample, 28.6% of Caesarean sections were justified by the presence of a uterine scar resulting from a previous Caesarean section and their number (n = 149) was two-fold higher than in the control group (n = 73). Other reasons *eg* macrosomia (n = 19 *vs* n = 0), the arrest of cervical dilatation (n = 65 *vs* n = 22), labour induction failure (n = 46 *vs* n = 28) or fetal distress (n = 103 *vs* n = 80) were all responsible for an increased number of Caesarean sections in the study group. An important question is whether the incidence of these events resulting in Caesarean section was really higher in obese women or whether physicians were more likely to carry out a Caesarean section in obese women anyway. Crane *et al* showed that obesity was a predictive factor for Caesarean delivery after adjustment for hypertension, diabetes mellitus, parity, age and macrosomic newborn (9). In the literature, obese women appear to be more likely to have a Caesarean section even when free of obesity associated pathologies. In a recent study, we found a linear association between pre-pregnancy body mass index and risk of Caesarean section at term, independent of height, gestational diabetes, primiparity and maternal age beyond 35 years (26). Several authors have discussed the concept of soft-tissue dystocia in the pelvis of obese women, by the accumulation of fat tissues narrowing the genital tract (9). During the last two decades, the percentage of obesity-attributable Caesarean deliveries has tripled from 3.9 to 11.6 (3). However, it must be stressed that performing a Caesarean section in obese women can be considerably more difficult and may increase peri-operative and postpartum complication rates *eg* increased blood loss, thromboembolic diseases or parietal infections (24, 25, 27, 28). Furthermore, subsequent pregnancies will add risks linked to uterine scarring to those linked to obesity, resulting in a greater increase in peri-operative morbidity. These considerations should be taken into account at the moment of decision making for both Caesarean section and labour induction.

We did not find a higher rate of instrumental deliveries despite the significantly higher results for gestational age and macrosomic newborns. In the literature, results concerning instrumental deliveries are conflicting, possibly due to variations in obstetrical practice from one country to another (2, 4).

We observed that *in utero* fetal death increased two-fold in the study group as did early neonatal death. High rates of *in utero* fetal death in obese women have already been reported by several authors (4, 7, 8, 29). In a population of 54 505 Danish pregnant women of which 4411 were obese, Nohr *et al* reported an increased risk of stillbirth among obese women, even after the exclusion of women presenting with obesity-related diseases (pre-eclampsia, hypertensive disorders and diabetes mellitus) (7). Two independent predictive factors were associated with stillbirths: "placental dysfunction" and "unexplained circumstances". The birthweights of unexplained intrauterine deaths were lower than the median birthweights of all live births suggesting the presence of some intrauterine growth restriction and, consequently, of a probable placental dysfunction. The authors postulated that the hyperlipidaemia of obesity may reduce prostacyclin secretion and enhance peroxidase production, resulting in vasoconstriction and platelet aggregation and thus affecting placental perfusion (7). Despite the real cause of placental dysfunction not being proven, this hypothesis might also explain the higher rate of pre-eclampsia in pre-pregnancy obese women (4). Sebire *et al* suggested that rapid fetal growth due to fetal hyperglycaemia may increase the risk of fetal death by hypoxia where placental oxygen transfer is deficient (2).

CONCLUSION

This population-based study described the outcomes of 2081 obese women from a country with access to modern healthcare and free social security systems. After controlling for age and parity, obese women were more likely to present several obstetric complications and to be delivered by Caesarean section. Pre-eclampsia was significantly more frequent in the obese women cohort, and chronic hypertension and high BMI were independent predictive factors for pre-eclampsia. Obese women also present an increased risk for *in utero* fetal death due to high BMI and pre-pregnancy diabetes mellitus. They also were more likely to be delivered by Caesarean section despite the increased risk of peri-operative complications. Obstetricians who perform a first Caesarean section in an obese woman should be aware of the cumulated obesity and uterine scar risks that could threaten any subsequent Caesarean section in these patients.

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