

The Combined Effect of Maternal Obesity and Fetal Macrosomia on Pregnancy Outcomes

Laura Gaudet, MSc, MD,^{1,2,3,4} Shi Wu Wen, PhD,^{1,4} Mark Walker, MSc, MD^{1,2,4}

¹Faculty of Medicine, University of Ottawa, Ottawa ON

²Department of Obstetrics and Gynecology, The Ottawa Hospital, Ottawa ON

³Horizon Health Network, Moncton NB

⁴Ottawa Health Research Institute, Ottawa ON

Abstract

Objective: To examine the combined effect of macrosomia and maternal obesity on adverse pregnancy outcomes using a retrospective cohort.

Methods: Infants with a birth weight of ≥ 4000 g (macrosomia) were identified from an institutional birth cohort. Demographic characteristics and maternal, fetal, neonatal, and pregnancy outcomes of macrosomic infants whose mothers were obese were compared with those whose mothers were non-obese.

Results: Pregnancies in obese women resulting in macrosomic infants are more likely to be complicated by gestational diabetes, gestational hypertension, and smoking than pregnancies in non-obese women with macrosomic infants. Mothers whose infants are macrosomic are significantly more likely to require induction of labour (OR 1.42; 95% CI 1.10 to 1.98) and delivery by Caesarean section (OR 1.45; 95% CI 1.04 to 2.01), particularly for maternal indications (OR 3.7; 95% CI 1.47 to 9.34), if they are obese. Finally, macrosomic infants of obese mothers are significantly more likely to require neonatal resuscitation in the form of free flow oxygen (OR 1.57; 95% CI 1.03 to 2.42) than macrosomic infants of non-obese mothers.

Conclusion: When both maternal obesity and macrosomia are present, adverse pregnancy outcomes are more common than when fetal macrosomia occurs in a woman of normal weight.

Résumé

Objectif : Examiner, à l'aide d'une cohorte rétrospective, l'effet combiné de la macrosomie et de l'obésité maternelle sur les issues de grossesse indésirables.

Méthodes : Des nouveau-nés pesant ≥ 4000 g (macrosomie) à la naissance ont été recensés à partir d'une cohorte de naissance institutionnelle. Les caractéristiques démographiques de mères obèses dont le bébé était de poids élevé à la naissance et leurs issues maternelles, fœtales, néonatales et de grossesse ont été comparées à celles de mères non obèses dont le bébé était de poids élevé à la naissance.

Résultats : Chez les femmes obèses, les grossesses menant à l'accouchement de bébés de poids élevé à la naissance risquent davantage d'être compliquées par le diabète gestationnel, l'hypertension gravidique et le tabagisme, par comparaison avec les grossesses que connaissent les femmes non obèses dont les bébés sont de poids élevé à la naissance. Les mères dont le bébé est de poids élevé à la naissance sont beaucoup plus susceptibles de nécessiter un déclenchement du travail (RC, 1,42, IC à 95 %, 1,10 - 1,98) et une césarienne (RC, 1,45, IC à 95 %, 1,04 - 2,01), particulièrement en raison d'indications maternelles (RC, 3,7, IC à 95 %, 1,47 - 9,34), si elles sont obèses. Enfin, les nouveau-nés de poids élevé à la naissance issus de mères obèses sont beaucoup plus susceptibles de nécessiter une réanimation néonatale à l'aide d'oxygène à débit continu (RC 1,57, IC à 95 %, 1,03 - 2,42) que les nouveau-nés issus de mères non obèses.

Conclusion : En présence d'une obésité maternelle et d'une macrosomie, les issues de grossesse indésirables sont plus courantes qu'en présence d'une macrosomie fœtale chez une femme de poids normal.

Key Words: Pregnancy, obesity, pregnancy outcome, fetal macrosomia, body mass index

Competing Interests: None declared.

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INTRODUCTION

The obesity epidemic has become a major health concern, particularly among citizens of developed countries. In one study, 21% of Canadian women between the ages of 20 and 39 who participated in the 2007 to 2009 Community Health Measures Survey were obese, compared with 4% in the 1981 Canada Fitness Survey.¹

Maternal obesity is associated with increased fetal growth among mothers of all ages.²⁻⁶ In a Canadian hospital-based cohort of 61 437 live singleton births, both mean birth weight and the proportion of babies large for gestational age (% LGA) increased significantly ($P < 0.001$) between 1978-79 (mean birth weight 3419 g, % LGA 8.0%) and 1994-6 (mean birth weight 3476 g, % LGA 11.5%).⁷ A major determinant of this increase is thought to be a corresponding increase in maternal BMI over the same time period.⁸

Offspring of obese mothers face significantly increased risks including stillbirth and case fatality (fetal + neonatal deaths/1000 births).^{9,10} Rapid fetal growth associated with increased maternal insulin levels, combined with relative or absolute placental insufficiency, may result in the increased rate of intrauterine fetal demise.¹¹ Further, there is an increase in the risk of adverse perinatal and neonatal outcomes, including dystocia, low Apgar scores (4 to 6) and admission to the NICU.¹²⁻¹⁵ Other neonatal complications that appear to be more common among infants of obese mothers include congenital anomalies, mechanical ventilation, meconium aspiration syndrome, hypoglycaemia, and jaundice.^{16,17} Further, birth trauma (such as brachial plexus injury after shoulder dystocia) is more common among infants of obese mothers.¹⁸ Many of these outcomes are also more common in macrosomic infants.¹⁹

Although there is an abundance of research showing the associations between maternal obesity, adverse maternal and fetal outcomes, and macrosomia and similar negative outcomes, the combined effect of obesity and macrosomia has not been previously investigated. We hypothesized that adverse pregnancy outcomes would be more prevalent when macrosomia occurred in the setting of maternal obesity. Our primary study objective was to determine the effect of macrosomia (infant birth weight ≥ 4000 g) combined with maternal obesity (pre-pregnancy BMI ≥ 30 kg/m²) on adverse outcomes. The secondary objective was to describe the occurrence of adverse pregnancy outcomes in macrosomic infants (birth weight ≥ 4000 g) of non-obese (pre-pregnancy BMI < 30 kg/m²) and obese (pre-pregnancy BMI ≥ 30 kg/m²) mothers.

METHODS

The study population consisted of all singleton deliveries at The Ottawa Hospital, Civic Campus, between December 1, 2007, and March 31, 2010. From that dataset, infants with macrosomia (birth weight ≥ 4000 g) and their mothers were identified for inclusion. Ultimately, 835 mother-infant pairs were included in the analysis (Figure). Although preterm deliveries were not specifically excluded, no infants born before 37 weeks had a birth weight exceeding 4000 g.

The exposure of interest was pre-pregnancy obesity (BMI ≥ 30 kg/m²), as defined by the World Health Organization.²⁰ In the selected dataset, pre-pregnancy BMI was calculated from either self-reported pre-pregnancy weight or measured weight from the first antenatal visit and self-reported or measured height.

From the BORN database (a population-based perinatal dataset that includes pregnancy outcome data for more than 99% of births in the province of Ontario), the following information was abstracted: maternal age at conception, parity, smoking habits, infant sex, presence of gestational hypertension, and presence of gestational diabetes. Gestational hypertension was defined as new onset hypertension during pregnancy in the absence of proteinuria. This diagnosis required at least one of the following criteria: blood pressure $\geq 140/90$ mmHg on at least two occasions at least six hours apart, a rise in systolic pressure of at least 30 mmHg or a rise in diastolic pressure of at least 15 mmHg, a diastolic pressure of at least 90 mmHg, or a mean arterial pressure ≥ 105 mmHg. Gestational diabetes was defined as carbohydrate intolerance of varying severity with first recognition during the present pregnancy, using the oral glucose tolerance test.

The primary outcome for this study was the rate of Caesarean section (for any indication, or for the specific subgroup of failure to progress in labour, non-reassuring fetal heart rate, breech presentation, or maternal indication). To the best of our knowledge there are no published data on the combined effect of maternal obesity and fetal macrosomia on the rate of Caesarean section.

Secondary maternal outcomes felt to be related to fetal macrosomia were identified from the dataset. Relevant issues for management of labour included induction of labour (for two groups: any indication or for suspected LGA fetus only), labour augmentation with oxytocin, and prolonged second stage (≥ 3 hours). Delivery outcomes consisted of operative vaginal delivery (vacuum, forceps, or both) and Caesarean section (for any indication, or specifically for the subgroups of failure to progress in

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