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Pregnancy Outcomes Among Obese Women and Their Offspring by Attempted Mode of Delivery

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Abstract

Objectives—To compare maternal and neonatal morbidities among obese women and their offspring by attempted delivery approach.

Methods—We performed a retrospective cohort study of 47,372 obese women at delivery (BMI ≥ 30 kg/m²) eligible for vaginal delivery who were carrying singleton vertex fetuses at 37 weeks or greater. Prior cesarean delivery, congenital anomalies, and antepartum stillbirth were exclusion criteria. We analyzed outcomes by attempted delivery route and stratified by parity. The composite maternal outcome included intensive care admission, death, hemorrhage, transfusion, or thromboembolism. The neonatal composite included intensive care unit (NICU) admission, death, seizure, ventilator use, birth injury, or asphyxia. Adjusted relative risks (aRR) and 95% confidence intervals (CIs) were calculated using Poisson regression.

Results—Among nulliparous women attempting vaginal delivery (n=15,268) the success rate was 72.6% and among parous women (n=23,426) it was 93.7%. The maternal composite outcome rate was not statistically higher among nulliparous women (7.7% vs. 4.2%, [aRR 1.58, 95% CI (0.96, 2.59)]) but it was among parous women (7.6% vs 2.5%, [aRR 2.45, 95% CI (1.23, 4.90)]) attempting vaginal delivery, related to hemorrhage, blood transfusion, or both. In contrast, the neonatal composite outcome rate was lower in parous women (6.0% vs. 11.6%, [aRR 0.65, 95% CI (0.51, 0.83)]) but not in nulliparous women (10.2% vs. 12.4%, [aRR 0.91 (0.74, 1.12)] parous

Conclusions—In obese nulliparous women, attempted vaginal delivery was not associated with increased composite maternal or neonatal morbidity. In obese parous women, attempted vaginal

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delivery was associated with increased composite maternal morbidity and lower composite neonatal morbidity.

Introduction

In 2009, approximately 20.5% of reproductive age women in the U.S. were obese as defined by a body mass index (BMI) ≥ 30 kg/m² [1]. While the increased risks of maternal and fetal complications associated with obesity are well documented [2-8], less is known regarding the optimal delivery approach among obese women.

Because of the decreased likelihood of achieving vaginal delivery and potential concerns with intrapartum fetal monitoring, performing an emergent cesarean, and increased risks of macrosomia and labor dystocia, some practitioners consider performing a cesarean in the absence of labor for obese women. However, cesarean in obese women is associated with higher rates of operative and postoperative complications such as excessive blood loss, operative time greater than 2 hours, wound infections, endometritis and anesthetic challenges [9-11].

Data are lacking on whether attempting vaginal delivery is associated with fewer adverse maternal and neonatal outcomes compared to a planned cesarean. Many studies have investigated actual rather than intended delivery approach. The objective of our study was to compare maternal and neonatal outcomes in obese women by attempted delivery approach.

Materials and Methods

The present study utilized data from the Consortium of Safe Labor (CSL), a retrospective cohort study by the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD). The original study was designed in part to assess factors related to cesarean delivery in a modern obstetric cohort. Data on women delivering at one of 12 clinical centers and 19 hospitals were extracted via electronic medical records. A total of 228,562 deliveries occurred from 2002 to 2008 [15]. Institutional review board approval was obtained by all participating institutions and received exempt status for the current analysis given the de-identified data present for analysis.

Women were eligible for this analysis if they had a BMI of ≥ 30 kg/m² at delivery, no contraindication to labor, a singleton fetus in a vertex presentation, and a gestational age at delivery of 37 weeks or greater. Exclusion criteria included previous cesarean delivery (n=14,468), major congenital fetal malformations (n=8,216), or antepartum stillbirth (n=317), leaving 47,372 women for analysis (Figure 1). For women with more than one pregnancy in the database, the analysis was limited to their first pregnancy recorded in the database.

Women were classified as attempting vaginal delivery if they had at least two vaginal examinations in the labor progression database [16]. Women were classified as undergoing planned cesarean delivery if they were less than 6 cm dilated on admission to the labor ward and if the electronic medical record did not include a diagnosis of induction or augmentation of labor, intrapartum tocolysis, shoulder dystocia, vaginal lacerations, episiotomy, a

cesarean indication for failure to progress or failed induction, full cervical dilation, or onset of spontaneous labor noted at admission. Variables definitions were abstracted from the medical record and supplemented with ICD-9 codes where applicable. Gestational age was assigned according to the best obstetrical estimate as recorded in the medical record.

Outcomes were composite and individual maternal and neonatal morbidities. The maternal composite outcome included intensive care unit (ICU) admission, death, hemorrhage, blood transfusion, or thromboembolism. Additional outcomes assessed included hysterectomy, chorioamnionitis, endometritis, and postpartum fever. The neonatal composite outcome included neonatal intensive care unit (NICU) admission, neonatal death, seizure, ventilator use, birth injury defined as mechanical trauma incurred by the infant during labor and delivery, or neonatal asphyxia. Additional outcomes assessed included Apgar score less than 7 at 5 minutes, shoulder dystocia, need for continuous positive airway pressure (CPAP) resuscitation or greater, and transient tachypnea of the newborn (TTN). Not all sites captured the outcome of interest in the electronic medical record; therefore the composite and individual outcome analyses were limited to sites reporting data on the particular outcome.

Maternal and neonatal demographics were compared by attempted delivery approach for nulliparous and parous women using Chi-squared tests. Parametric data was analyzed with Student's t tests and Fisher's exact test. Wilcoxon two-sample test was applied for non-parametric data. To examine the optimal delivery approach among obese women, adjusted relative risks (aRRs) and 95% confidence intervals (CIs) for maternal and neonatal morbidities were calculated using Poisson regression with a robust variance estimator for attempted vaginal compared to planned cesarean delivery (referent group) controlling for maternal age, gestational age, race, parity, marital status, cervical dilation at admission, hospital type, type of anesthesia, insurance status, drug/tobacco/alcohol use, indication for delivery, and medical comorbidities (asthma, pre-existing and pregnancy related hypertensive disorders, pre-existing and gestational diabetes)[17].

BMI at admission for delivery was analyzed as recorded in the medical record and stratified according to the World Health Organization's Obesity Classifications [18]. Class I obesity was defined as BMI between 30.0-34.9 kg/m², Class II Obesity 35.0-39.9 kg/m², and Class III obesity as a BMI greater than or equal to 40.0 kg/m². Our primary analysis included all obese women (BMI ≥ 30 kg/m²) stratified by parity (nulliparous or parous). No correction was made for multiple comparisons. A P value of < 0.05 was considered significant. We conducted supplemental analyses by obesity class. Statistical analyses were performed using SAS, version 9.2 (SAS Institute Inc., Cary, NC).

Results

Of the 47,372 singleton deliveries ≥ 37 weeks of gestation eligible for a vaginal delivery, 46,047 (97.2%) women attempted vaginal delivery and 1,325 (2.8%) women had a planned cesarean delivery. In general, women who attempted vaginal delivery were younger, more likely to have private insurance, and less likely to identify as non-Hispanic Black, to have diabetes or deliver at a university affiliated teaching institution compared to women with a

planned cesarean delivery (Table 1). Neonates of women attempting vaginal delivery compared to planned cesarean weighed 204 g less for nulliparous and 186 g less for parous women, $P=.01$.

Among nulliparous women attempting vaginal delivery ($n=15,268$) the success rate was 72.6% and among parous women ($n=23,426$) it was 93.7%.

(Figure 2). The rates of labor induction among nulliparous women ($n=10,709$) was 50.9% and 46.6% among parous women ($n=11,662$). Overall cesarean delivery rates were similar when comparing induction of labor versus spontaneous labor, with a slightly higher cesarean delivery rate noted with induction of labor in nulliparous women (Figure 2).

For the analysis of nulliparous women with a BMI ≥ 30 kg/m², the maternal composite occurred more frequently among women attempting vaginal delivery (7.7% vs. 4.2%, [aRR 1.58, 95% CI 0.96, 2.59]); however, this difference was not statistically significant. (Table 2) Nulliparous women attempting vaginal delivery had higher risk of postpartum hemorrhage, blood transfusion, and chorioamnionitis, with fewer thromboembolic events compared to women undergoing a planned cesarean (Table 2).

For parous women with BMI ≥ 30 kg/m², the maternal composite occurred more often among women attempting vaginal delivery compared to planned cesarean delivery (7.6% versus 2.5%, [aRR 2.45, 95% CI (1.23, 4.90)]) (Table 2). Women who attempted vaginal delivery had higher rates of blood transfusion, but lower rates of postpartum fever and hysterectomy compared to planned cesarean delivery.

There was no difference in the neonatal composite outcome among nulliparous women attempting vaginal delivery. In the analysis of individual outcomes for attempted vaginal delivery compared to planned cesarean delivery, three neonatal outcomes were statistically different between the two groups. Compared to planned cesarean delivery, nulliparous women attempting vaginal delivery demonstrated a five-fold increase in birth injury, with a 30% reduction in NICU admission, and a 50% reduction in TTN (Table 3).

In parous women, the neonatal composite outcome was decreased in women attempting vaginal delivery (6.0% vs. 11.6%, [aRR 0.65, 95% CI 0.51, 0.83]). Increased rates of birth injury were noted among obese parous women attempting vaginal delivery. However, there were reduced rates of neonatal asphyxia, ventilator use, NICU admission, TTN, and Apgar <7 at 5-minutes parous (Table 3). Analyses by obesity subclass are presented in tabular form in Appendixes 1 and 2, available online at <http://links.lww.com/xxx>.

Discussion

In a large, U.S. multicenter cohort study of obese women, we aimed to compare maternal and neonatal outcomes in obese women by the attempted route of delivery. With regards to maternal morbidity in obese nulliparous women, attempting vaginal delivery was associated with increased rates of blood transfusion, hemorrhage, and chorioamnionitis, but decreased rates of thromboembolism. In parous women, attempted vaginal delivery was associated with increased risks of composite maternal morbidity, blood transfusion, and

chorioamnionitis with decreased risks of postpartum fever and hysterectomy. With respects to neonatal outcomes, birth injury was increased in nulliparous and parous women attempting vaginal delivery. Attempted vaginal delivery was also associated with decreases in NICU admission and TTN in nulliparous women and decreased rates of the neonatal composite, neonatal asphyxia, TTN, NICU admission, ventilation use, and Apgar < 7 at 5-minutes in parous women.

Previous studies have suggested that obese women have higher cesarean delivery rates as compared to their normal weight counterparts [19, 20]. Our study did not compare success rates with patients of normal BMI. We found the majority of obese women attempting vaginal delivery were successful, especially if they had previously delivered vaginally. Utilizing the CSL allowed analysis of less frequent outcomes in a large, contemporary, racially and ethnically diverse cohort of US women, however there are limitations worth noting. Our study is retrospective in design, thus limiting our ability to discern why the provider selected a particular delivery route including whether the intended delivery route was influenced by other factors associated with obesity itself. The manner in which attempted delivery route was defined could have resulted in misclassification of the intended delivery approach. For example, it is possible that if a patient initially scheduled for a planned cesarean delivery presented in labor as previously defined, the patient would have been considered to have a vaginal delivery attempt. However, we only included women with at least two cervical exams in the labor progression database as attempting a trial of labor in order to minimize this misclassification. While this type of error is a limitation of the Consortium, we feel that this classification would more accurately reflect the risks of a cesarean delivery in the absence of labor. However, given the large number of variables available in this database, including detailed information on labor as well as indications for cesarean delivery, this misclassification likely was small. Despite the utilization of a large, contemporary database to perform analysis on maternal and neonatal outcomes, the rarity of various outcomes (e.g. maternal and neonatal death), limit the power to detect small differences between groups. Lastly, due to multiple comparisons, it is possible that some of the significant results occurred by chance..

When discussing route of delivery, the provider and patient should consider the clinical implications of an emergent cesarean delivery in the setting of morbid obesity. While a vaginal delivery attempt was highly successful among obese women, the potential for increased complications such as failed intubation, bladder injury, hemorrhage, and increased incision to delivery time should be taken into account when selecting a delivery approach [9, 22, 23].

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Study diagram detailing the inclusion and exclusion criteria applied for analysis.

Class I is defined as a body mass index between 30-34.9 kg/m², Class II 35-39.9 kg/m², Class III greater than 40 kg/m²

Figure 2.

Vaginal Delivery Success Rates. Represents the percentages of women attempting vaginal delivery that were successful by obesity class. Class I is defined as a body mass index between 30-34.9 kg/m², Class II 35-39.9 kg/m², Class III greater than 40 kg/m²

Blue: Overall Vaginal Delivery Success Rate- Nulliparous Women

Red: Vaginal Delivery Success Rate after Induction- Nulliparous Women

Green: Overall Vaginal Delivery Success Rate- Parous Women

Purple: Vaginal Delivery Success Rate after Induction

Demographics and obstetric characteristics for attempted vaginal delivery compared to planned cesarean (referent group) by parity.

Table 1

Characteristic	Nulliparous Women n=21,775			Parous Women n=25,597		
	Attempted Vaginal Delivery n=21,035	Planned Cesarean Delivery n=740	P	Attempted Vaginal Delivery n=25,012	Planned Cesarean Delivery n=585	P
Age - mean (S.D.)	24.8(5.8)	29.7(6.9)	<.01	28.9(5.5)	31.2(6.0)	<.01
Race/Ethnicity			<.01			<.01
Non-Hispanic white	10,051(47.8)	343(46.4)		11,472(45.9)	220(37.6)	
Non-Hispanic black	5,333(25.4)	195(26.4)		6,385(25.5)	190(32.5)	
Hispanic	3,816(18.1)	137(18.5)		5,353(21.4)	126(21.5)	
Other/Unknown	1,835(8.7)	65(8.8)		1,802(7.2)	49(8.4)	
Married	10,094(49.1)	426(59.0)	<.01	15,112(61.9)	354(61.3)	0.74
Insurance status			0.31			<.01
Private	10,917(51.9)	370(50.0)		12,609(50.4)	239(40.9)	
Public, self-pay, unknown	10,118(48.1)	370(50.0)		12,403(49.6)	346(59.2)	
Diabetes (pre-existing and gestational)	12,51(6.0)	138(18.7)	<.01	1,955(7.8)	127(21.7)	<.01
Hypertension (pre-existing and pregnancy induced)	3,595(17.1)	127(17.2)	0.96	2,605(10.4)	67(11.5)	0.42
Asthma	1,776(8.4)	51(6.9)	0.14	1,870(7.5)	38(6.5)	0.37
Cervical dilation on admission - median (10th, 90th percentile)	2(0.5,5)	1(0.4)	<.01	3(1.6)	2(0.4)	<.01
Anesthesia type			<.01			<.01
None	212(1.2)	1(0.2)		1,394(6.4)	1(0.2)	
General ±other type of anesthesia	216(1.2)	47(7.3)		230(1.1)	41(8.2)	
Regional	12,904(71.9)	447(69.7)		14,120(65.2)	322(64.7)	
Sedation/narcotic	1,271(7.1)	4(0.6)		1,043(4.8)	2(0.4)	
Other/unknown	3,374(18.7)	142(22.2)		4,858(22.4)	132(26.5)	
Gestational age at delivery, weeks	39.48(1.2)	38.97(1.1)	<.01	39.2(1.1)	38.92(1.0)	<.01
Hospital type			<.01			<.01
University affiliated teaching hospital	10,307(49.0)	557(75.3)		11,351(45.4)	457(78.1)	
Teaching community hospital	9,018(42.9)	182(24.6)		10,892(43.6)	125(21.4)	
Non-teaching community hospital	1,710(8.1)	1(0.1)		2,769(11.1)	3(0.5)	

Data are n (%) unless otherwise specified.

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Table 2

Maternal outcomes of combined obesity classes for attempted vaginal delivery compared to planned cesarean (referent group) by parity.

Maternal outcomes	Nulliparous Women (BMI 30 kg/m ²) (N=21775)			Parous Women (BMI 30 kg/m ²) (N=25597)		
	Attempted VD n=21,035 n (%)	Planned CD n=740 n (%)	aRR ^a (95% CI)	Attempted VD n=25,012 n (%)	Planned CD n=585 n (%)	aRR (95% CI)
Maternal Composite Outcome	939(7.7) 1331(6.3)	17(4.2) 28(3.8)	1.58(0.96, 2.59)	1119(7.6) 1576(6.3)	8(2.5) 17(2.9)	2.45(1.23, 4.90)*
Maternal death	1(0.01)	0(0.0)	N/A	1(<0.01)	0(0.0)	N/A
Maternal ICU admission	60(0.4)	1(0.2)	2.46 (0.31, 19.55)	103(0.5)	1(0.2)	2.48 (0.34, 18.10)
Thromboembolism	53(0.3)	10(1.4)	0.26 (0.13, 0.53)***	139(0.6)	2(0.3)	1.99 (0.49, 8.15)
Blood transfusion	476(3.7)	4(1.0)	3.25 (1.06, 9.97)*	654(4.2)	1(0.3)	8.25 (1.15, 59.18)*
Hemorrhage	813(3.9)	15(2.0)	1.93 (1.14, 3.26)*	749(3.0)	13(2.2)	1.37 (0.79, 2.37)
Postpartum fever	868(4.1)	20(2.7)	1.46 (0.93, 2.30)	264(1.1)	16(2.7)	0.40 (0.24, 0.69)***
Chorioamnionitis	1401(6.7)	8(1.1)	8.92 (4.44, 17.94)***	331(1.3)	4(0.7)	2.78 (1.01, 7.66)*
Endometritis	280(1.3)	7(1.0)	1.46 (0.68, 3.16)	78(0.3)	4(0.7)	0.54 (0.18, 1.64)
Hysterectomy	8(0.04)	1(0.1)	1.28 (0.09, 17.85)	6(0.02)	2(0.3)	0.11 (0.02, 0.61)*

^a aRR, Adjusted relative risk. Models were adjusted for age, race/ethnicity, marital status, insurance type, diabetes (pre-existing and gestational), hypertension (pre-existing and pregnancy induced), asthma, cervical dilation at admission, anesthesia type, gestational age, and hospital type

BMI, Body Mass Index; CD, Cesarean Delivery; CI, confidence interval; ICU, intensive care unit; n/a, not applicable; VD, Vaginal Delivery;

Bold indicates statistical significance

*The asterisk symbol indicates P-value <0.05 from the statistic testing;

** the double asterisk symbol indicates P<0.01;

*** the triple asterisk symbol indicates P<0.001.

Table 3

Neonatal outcomes of combined obesity classes for attempted vaginal delivery compared to planned cesarean (referent group) by parity.

Neonatal outcomes	Nulliparous Women (BMI 30 kg/m ²)(21775)		Parous Women (BMI 30 kg/m ²)		aRR, 95% CI
	Attempted VD n=21,035 n (%)	Planned CD n=740 n (%)	Attempted VD n=25,012 n (%)	Planned CD n=585 n (%)	
Neonatal composite outcome	2,145(10.2)	91(12.4)	1,489(6.0)	67(11.6)	0.65 (0.51, 0.83) ***
Neonatal death	9(0.04)	1(0.1)	12(0.1)	0(0.0)	N/A
Neonatal asphyxia	39(0.2)	2(0.3)	34(0.1)	5(0.9)	0.11 (0.04, 0.33) ***
Birth Injury	638(3.0)	5(0.7)	338(1.4)	3(0.5)	3.55 (1.14, 11.05) *
Ventilation use	89(5.6)	6(7.0)	62(5.2)	10(15.4)	0.40 (0.21, 0.76) **
NICU admission	1,655(7.9)	91(12.3)	1,234(4.9)	70(12.0)	0.52 (0.41, 0.66) ***
Transient tachypnea of the newborn	674(3.2)	55(7.4)	488(2.0)	49(8.4)	0.33 (0.24, 0.45) ***
5 minute Apgar <7	205(1.0)	11(1.5)	121(0.5)	10(1.7)	0.33 (0.17, 0.63) ***
Birthweight - mean (S.D.)	3,399 (445)	3,603 (632)	3,464 (450)	3,650 (615)	(P<0.001)

^a Adjusted relative risk. Models were adjusted for age, race/ethnicity, marital status, insurance type, diabetes (pre-existing and gestational), hypertension (pre-existing and pregnancy induced), asthma, cervical dilation at admission, anesthesia type, gestational age, and hospital type

CD, Cesarean Delivery; NICU, neonatal intensive care unit; VD, Vaginal Delivery; S.D., Standard Deviation

Bold indicates statistical significance

* The asterisk symbol indicates P-value <0.05 from the statistic testing;

** the double asterisk symbol indicates P<0.01;

*** the triple asterisk symbol indicates P<0.001.