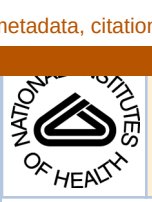

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Increasing Maternal Body Mass Index and Characteristics of the Second Stage of Labor

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Abstract

Objective—To evaluate the length of the second stage of labor in relation to increasing maternal prepregnancy BMI among nulliparous parturients, and to determine whether route of delivery differs among obese, overweight, and normal weight women reaching the second stage.

Methods—We performed a secondary analysis of a multicenter trial of fetal pulse oximetry, conducted among 5,341 nulliparas who were induced or labored spontaneously at 36 weeks or more of gestation. Normal weight was defined as BMI of 18.5-24.9 kg/m^2, overweight was a BMI of 25.0-29.9 kg/m^2, and obese was a BMI of 30 kg/m^2 or higher.

Results—Of the 5,341 women, 97% had prepregnancy BMI recorded. Of these, 3,739 had a BMI 18.5 kg/m^2 or higher and reached the second stage of labor. Increasing maternal BMI was not associated with second stage duration: normal weight 1.1 hr, overweight 1.1 hr, and obese 1.0 hr (p=0.13) . Among women who reached the second stage, as BMI increased, so did the likelihood that the woman had undergone induction of labor. Even so, the lack of association between

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second-stage duration and BMI did not vary by method of labor onset (p=0.84). The rate of cesarean delivery in the second stage did not differ by increasing BMI: normal weight 7.1%, overweight 9.6%, obese 6.9% (p=0.17).

Conclusion—Among nulliparous women who reach the second stage of labor, increasing maternal BMI is not associated with a longer second stage or an increased risk for cesarean delivery.

Introduction

Obesity is an expanding public health concern, with more than half of American women age 20 to 39 classified as overweight or obese[1] and more than one in five women entering pregnancy classified as obese[2]. Obesity is associated with a myriad of pre-pregnancy and antepartum complications[3], and evidence exists that obese women have increased rates of cesarean delivery[3]. Cesarean delivery, moreover, poses particular hazards for obese women, placing them at an even higher risk of wound complications, endometritis, and thromboembolic events[3].

Studies on the characteristics of labor in the obese gravida have been limited. We are aware of only two studies which examined the duration of second stage in a nulliparous population categorized by BMI[4,5] (English language MEDLINE search using the keywords “obstetric, labor” and “obesity”). Obesity was associated with a shorter second stage than normal weight controls in one study[4], whereas the other study demonstrated no difference in second stage duration compared to normal weight controls[5]. Because of the limited data, the association between maternal weight and characteristics of the second stage of labor is uncertain.

The Randomized Trial of Fetal Pulse Oximetry[6] was a randomized controlled trial that assessed whether the use of fetal pulse oximetry resulted in a lower cesarean delivery rate. In this trial, both patient and labor characteristics were prospectively collected. Using the data from this study[6], we examined the relationship between BMI and the characteristics of the second stage of labor in nulliparous women at ≥ 36 weeks of gestation.

Materials and Methods

We performed a secondary analysis of a clinical trial of fetal pulse oximetry conducted at 14 clinical centers of the NICHD Maternal Fetal Medicine Units Network. Participants were laboring nulliparous women 2 to 6 centimeters dilated at randomization with a singleton vertex fetus at ≥36 weeks of gestation. Women with a known last menstrual period (LMP) were dated by first ultrasound if a discrepancy existed of greater than 7 days at less than 20 weeks, greater than 14 days between 20 and 29+6 weeks, or greater than 21 days beyond 30 weeks. If the LMP was unknown, gestational age was established by the first ultrasound examination, using the standard method of ultrasound gestational age determination at that institution. Exclusion criteria for the primary trial included a planned cesarean delivery, maternal fever immediately before randomization or preexisting medical conditions such as diabetes mellitus, known human immunodeficiency virus infection, hepatitis virus infection, heart or renal disease. Pregnancy-associated hypertension was not an exclusion criterion. As part of the research protocol, decisions on labor management were left to the discretion of the managing physician. Each participating center and the biostatistical coordinating center had Institutional Review Board approval for the study.

Maternal and neonatal data were collected by trained research nurses who were present during the labor. Due to a prior analysis of this data set detailing duration of second stage of labor in relation to maternal and neonatal outcomes such as chorioamnionitis, third/fourth

degree perineal trauma, postpartum hemorrhage, and neonatal morbidity, outcomes such as these were not examined[7]. The trained research nurses obtained pre-pregnancy weight and height utilizing review of the patient's chart. BMI was calculated with the following formula: BMI= weight (kilograms)/(height [meters])^2. A pre-pregnancy BMI of 18.5-24.9 kg/m^2 was classified as normal body weight, a pre-pregnancy BMI of 25-29.9 kg/m^2 was classified as overweight, and a BMI 30 kg/m^2 or higher was classified as obese.

Women were included in this secondary analysis if they reached the second stage of labor. Duration of the second stage was calculated as the number of minutes from the first cervical examination that revealed full dilation until delivery, irrespective of whether delivery was vaginal or cesarean. Women were excluded if their BMI was < 18.5 kg/m^2, as the purpose of this analysis was to examine second stage labor characteristics in normal body weight, overweight and obese women.

Univariate associations between BMI classification and binary variables (e.g., induced vs. spontaneous labor) were analyzed using the Mantel-Haenszel trend test. For variables of three or more categories (e.g., maternal race), the Pearson chi-square test was used. Univariate comparisons of continuous variables among the BMI classes used Analyis of Variance (e.g., gestational age, second-stage duration). General linear modeling was used to analyze the association between second-stage duration and BMI class, controlling for regional anesthesia, type of labor, oxytocin administration, birthweight, maternal race and mode of delivery. This method was also used both to test the interaction between induced versus spontaneous labor and BMI on the duration of the second stage of labor and to test the association between delivery route and BMI class, controlling for regional anesthesia, type of labor, oxytocin administration, birthweight and maternal race. The time from onset of the second stage to delivery was compared among the three BMI classes using the log-rank test, and Kaplan-Meier survival curves were produced. All tests were two-tailed with $p<0.05$ used to define significance. SAS software (SAS Institute, Inc., Cary, NC) was used for the analysis.

Results

Of the 5341 women in the clinical trial, 5,169 (97%) had pre-pregnancy BMI recorded. Of these, women with a BMI of 18.5 or greater numbered 4,884, of which 3,739 reached the second stage of labor. Table 1 displays the demographics of the 3,739 subjects included in this analysis. Neither maternal age, gestational age at delivery, nor utilization of regional anesthesia differed statistically among women in the different BMI classes. Women of greater BMI were significantly more likely to undergo labor induction, be administered oxytocin, have infants of greater birth weight, and be of African-American race.

Table 2 displays the median duration of the second stage, expressed in hours and classified by BMI. As illustrated in the table, the median duration of the second stage was not associated with BMI (p=0.13). There also was no association between route of delivery and BMI in women who reached the second stage (Table 3). The rates of cesarean delivery in normal weight, overweight, and obese women were 7.1, 9.6, and 6.9 percent, respectively (p=0.17). After controlling for potential confounding with regional anesthesia, type of labor, oxytocin administration, birthweight, race and mode of delivery, maternal BMI still was not associated with duration of second stage (p=0.07). Also, in women who reached the second stage, maternal BMI was not associated with route of delivery (p=0.08) after controlling for regional anesthesia, type of labor, oxytocin administration, birthweight and race.

A graph depicting Kaplan-Meier survival curves of the time in the second stage for each of the BMI classes is shown in Figure 1. When examining successive time intervals to delivery

from the onset of the second stage, there was no association between time to delivery and BMI (p=0.15).

Given the knowledge that obese women have been shown in other studies to be at increased risk for cesarean delivery[8-12], a test was performed in order to discern whether there was an increased risk for cesarean in any stage of labor in the present cohort. Table 4 demonstrates that there is an increased incidence in cesarean delivery among overweight and obese women, although it appears to be confined to the first stage of labor. Among women reaching the second stage who were delivered by cesarean, the indications for cesarean did not differ among BMI classes (p=0.64).

Induction of labor is a commonly recognized risk factor for cesarean delivery and prolonged labor. Due to a higher frequency of labor induction within this cohort in overweight and obese women compared to their normal weight counterparts (Table 1), the data were analyzed to determine whether the relationship between BMI and second stage duration differed between those with induced versus spontaneous labor. The relationship between BMI and second stage duration did not differ between those women with induced versus spontaneous labor (p=0.84).

Discussion

This secondary analysis demonstrates no association between maternal BMI and the length of the second stage in nulliparous women. In addition, maternal BMI in nulliparous women reaching the second stage is not associated with a higher incidence of cesarean delivery.

In a retrospective case-control study including spontaneously laboring women, Verdiales and colleagues[5] found no difference between second stage duration in 51 very obese nulliparous women (BMI >35 kg/m^2) and 60 nulliparous normal weight controls (BMI <26 kg/m^2). Buhimschi and colleagues[13] performed a prospective cohort study in 71 women during the second stage of labor and determined that second stage duration between obese women and non-obese controls were similar. They also found no increase in frequency of operative delivery or perineal lacerations. These data suggest that the portion of labor most significantly impacted by increased maternal weight is not the second stage but rather the first stage of labor. Buhimschi's study[13] did not analyze the effect of parity on outcomes nor differentiate between induced and spontaneously laboring patients. On the other hand, the Vahratian study[4], which contained 612 subjects, found that obese, nulliparous women had a shorter second stage than normal weight controls, contradicting the theoretical notion that soft tissue dystocia may lead to longer labors in obese women. An investigation by Cheng and colleagues[14] examined perinatal outcomes associated with the duration of second stage in more than 5000 multiparous women and found no association between BMI and length of the second stage. Our study supports the findings of Verdiales[5], Buhimschi[13], Vahratian[4], and Cheng[14], in that we found no evidence of increased second stage duration in women with increasing BMI, nor did we find an association between BMI and cesarean delivery in women reaching the second stage. Furthermore, our results mirror those of Fyfe and colleagues[12] in that increasing BMI appears to be a risk factor for cesarean delivery in the first stage but not the second stage of labor.

This study has inherent strengths and weaknesses. The prospective nature of the data collection by research nurses who were present during labor supports the accuracy of the data. This was also a multi-center trial, which means that the practice patterns may better represent national practices and enhance external validity. Another strength of our analysis is the large population size and inclusion of only nulliparous parturients to examine associations between BMI and labor characteristics. Among women reaching the second

stage, no association was found between BMI and time interval to delivery, suggesting that there was not a quicker or slower tendency on behalf of providers to perform a cesarean or otherwise expedite delivery based on maternal BMI. Though analysis did not demonstrate that providers were predisposed to more commonly choose a cesarean due to a patient's weight, the lack of standardized second stage management is a potential limitation of the study and this study does not address adherence by providers to guidelines for management of a prolonged second stage[15]. Additionally, the inclusion of women who were delivered by cesarean after reaching the second stage may introduce bias into the duration of the second stage based on factors which may not have been captured, like the availability of an operating room. The external validity of our findings may also be limited to populations with high frequencies of women receiving regional anesthesia and undergoing induction of labor. Lastly, due to a recruitment protocol that did not include standardized measures in the enrollment process to avoid weight-based selection bias, the internal validity of the frequency of spontaneous versus induced labors, as well as the frequency of delivery in the first stage of labor, by BMI, should not be regarded as conclusive.

These data suggest that the characteristics of the second stage of labor may be independent of maternal BMI. The second stage in the nulliparous parturient does not appear to be longer or more likely to end in cesarean delivery based on a woman's pre-pregnancy BMI. This knowledge may aid obstetric providers in counseling women about the expected impact of their BMI on their intrapartum course, as well as assist in clinical decision-making in women who reach the second stage of labor.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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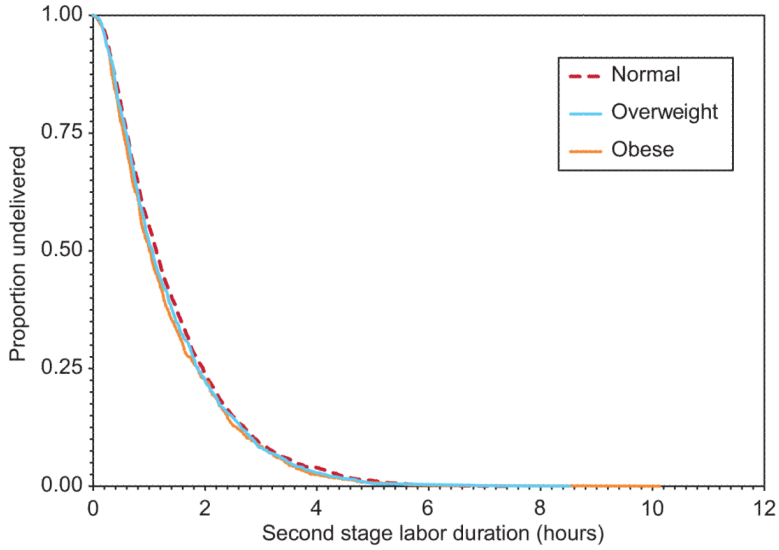

Figure 1.
Duration of second stage and proportion of women undelivered, by body mass index (BMI).

Table 1

Patient Characteristics

	Normal Weight (n=2176)	Overweight (n=899)	Obese (n=664)	*P*
Maternal age (years)	23.5 ± 5.6	23.2 ± 5.3	23.3 ± 5.1	0.30
Race				<0.01
African-American	548 (25.2)	279 (31.0)	286 (43.1)	
White	1258 (57.8)	461 (51.3)	305 (45.9)	
Asian	46 (2.1)	7 (0.8)	0 (0)	
Other	324 (14.9)	152 (16.9)	73 (11.0)	
Gestational age at delivery (weeks)	39.7 ± 1.3	39.7 ± 1.3	39.8 ± 1.4	0.37
Type of labor				<0.01
Induced	814 (37.4)	345 (38.4)	318 (47.9)	
Spontaneous	1362 (62.6)	554 (61.6)	346 (52.1)	
Oxytocin use	1875 (86.2)	802 (89.2)	603 (90.8)	<0.01
Regional anesthesia	2066 (95.0)	856 (95.2)	642 (96.7)	0.08
Birthweight (g)	3330 ± 454	3356 ± 443	3385 ± 458	0.02

Data are n (%) or mean ± standard deviation unless otherwise specified.

Table 2

Duration (Hours) of Second Stage

BMI	n	Median	*P* *
Normal weight	2176	1.1	0.13
Overweight	899	1.1	
Obese	664	1.0	

BMI, body mass index.

***P*-value from analysis of variance

Table 3

Route of Delivery for Women Reaching the Second Stage

	Normal Weight (n=2176)	Overweight (n=899)	Obese (n=664)	*P*
				0.17
Spontaneous vaginal delivery	1580 (72.6)	663 (73.8)	506 (76.2)	
Operative vaginal delivery *	442 (20.3)	150 (16.7)	112 (16.9)	
Cesarean delivery	154 (7.1)	86 (9.6)	46 (6.9)	

Data are n (%) unless otherwise specified.

* Operative vaginal delivery refers to forceps or vacuum deliveries.

Table 4

Stage of Delivery and Primary Indications for Cesareans in the Second Stage

	Normal Weight	Overweight	Obese	*P* *
Stage of delivery				<0.01
1st stage via cesarean	500 (18.7)	324 (26.5)	321 (32.6)	
2nd stage	2176 (81.3)	899 (73.5)	664 (67.4)	
Incidence of cesarean for women reaching 2nd stage	154 (7.1)	86 (9.6)	46 (6.9)	0.54
Primary indication for cesareans in women reaching 2nd stage				0.64
Non-reassuring fetal status	31 (20.1)	21 (24.4)	10 (21.7)	
Dystocia or macrosomia	123 (79.9)	65 (75.6)	36 (78.3)	

Data are n (%).

* *P*-values achieved using Mantel-Haenszel trend test