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Obesity in Pregnancy and Oxytocin Augmentation

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Obesity in Pregnancy and Oxytocin Augmentation

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An abstract of

A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University

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Master of Public Health in Epidemiology

2018

Abstract

Obesity in Pregnancy and Oxytocin Augmentation

By sairah khan

Objective:

Characterize the relation between obese body mass index (BMI) groups and labor interventions and outcomes.

Methods:

Data were abstracted from medical records for a cohort of obese women at a single Colorado hospital from 2005-2012. Women were nulliparous, at term, and aged 18-40 years. Women were grouped into WHO Obesity Groups: I (30≤BMI<35), II (35≤BMI<40), and III (BMI≥ 40). Exclusion criteria included history of diabetes, hypertension, planned cesarean delivery, and diagnosis of fetal anomaly. Logistic regression and survival analysis were used to evaluate associations between obesity class and labor outcomes.

Results:

Women in Obesity BMI III had the shortest median time-to-delivery (314 minutes) among women unexposed to oxytocin and the longest median time-to-delivery among women exposed to oxytocin (864 minutes). The odds of inappropriate oxytocin initiation relative to six centimeters dilation increased with increasing obesity BMI group. The odds of inappropriate oxytocin intervention based on partograph time were higher for women in Obesity BMI II and III than I.

Conclusions:

Obese women were at increased odds of inappropriately timed oxytocin as their obesity group increased at a Colorado Hospital. Identifying factors that affect clinical decisions to administer oxytocin and how they differ by obesity class could provide insight into these results.

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Women who are obese during pregnancy (BMI ≥ 30 kg/m^2) constitute 40% of pregnant women in the United States. It is important to characterize the needs of this understudied subpopulation whose labor and delivery experiences may inherently differ from non-obese women's. Adverse outcomes during labor that are more common for obese women than non-obese women include poor labor progress, risk of unplanned cesarean delivery, and placenta accreta (1,2). Slower, or "inadequate," labor progress increases obese women's risk of cesarean delivery and oxytocin augmentation.

Jensen et al.'s 1999 study of 4,258 complication-free pregnancies reported that oxytocin augmentation was more common among overweight and obese women than normal weight women (4). More recently, Buhimschi et al. also reported that being overweight or obese, BMI >25 kg/m^2, was associated with an increased use of oxytocin augmentation (5).

Obese women who receive the same titration of oxytocin as their non-obese counterparts do not experience the same increase in cervical dilation (3). Because obese women do not progress through labor nor respond to oxytocin augmentation as their non-obese counterparts, obese women often receive higher mean rates of oxytocin infusion (3). Increasing the titration of oxytocin could be harmful because oxytocin use is associated with uterine tachysystole which can lead to fetal distress (3). Given that obese women are more likely to receive higher hourly doses of oxytocin for extended periods despite a lack of apparent effectiveness, it is important to assess the utility of oxytocin augmentation among obese women.

Although research suggests obese women have a poorer response to labor interventions, little is known about whether responses differ across obesity categories. This paper characterizes the relation between obese BMI group and oxytocin intervention. Namely, the length of a woman's labor, appropriateness of oxytocin augmentation timing, and the odds of receiving oxytocin augmentation.

Material & Methods

The medical records of 22,443 women who gave birth at the University of Colorado Hospital from 2005 to 2012, were screened for this study. Eligible participants were obese (BMI≥ 30 kg/m^2), nulliparous women, aged 18 to 40 years old, who presented with a singleton, infant born at 37 weeks to 41 weeks gestation. Medical records missing BMI information were excluded. Women with a history of diabetes or hypertension were also excluded, and pregnancies with nonvertex presentation, low amniotic fluid, contraindication for vaginal birth, or a fetal anomaly were not eligible for study. Although all women planned for vaginal delivery, cesarean delivery was performed when clinically indicated. Three hundred fifty nine women met the inclusion criteria. All women were cared for either by a certified nurse-midwife (CNM) or an obstetrician-gynecologist (OB-GYN). This study was determined to be exempt from Institutional Review Board review.

BMI was calculated by dividing maternal self-reported weight, in kilograms (kg), by maternal height squared (meters) upon hospital admittance for delivery. Women were grouped into three obesity BMI categories based on World Health Organization's (WHO) standards: Obesity BMI I (30 ≤ BMI < 35), II (35 ≤ BMI < 40), and III (BMI ≥ 40).

Outcome variables of interest include use of oxytocin intervention, use of an intrauterine pressure catheter (IUPC), and whether these interventions were timed appropriately. Appropriate timing was evaluated in two ways. First, administration of oxytocin or IUPC during pre-active labor, defined as before achieving six centimeters' dilation, was treated as inappropriate and administration during active labor, defined as at or above six centimeters, was treated as appropriate among women receive oxytocin. Second, administration of oxytocin or IUPC during a woman's partograph "green zone" was treated as "inappropriate" and administration during the "red zone" was treated as appropriate. For analyses using

partograph-based times, women who did not receive an intervention or received it during the second stage of labor or pre-active 1 phase were excluded.

Covariates of interest included clinician type, maternal age, maternal race and ethnicity, and dilation at time of hospital admission. Potential confounders were identified based on the literature and examining the change in the estimate of the effect of interest comparing the adjusted estimate to the unadjusted estimate. Based on these criteria, no covariates were determined to be confounders.

Kaplan-Meier survival curves of total length of labor were fit stratified by oxytocin augmentation status and by BMI Obesity category. Women who gave birth via cesarean delivery were censored at the time of the cesarean section.

Logistic regression was performed to assess the relation between timing of oxytocin augmentation and WHO Obesity BMI group as well as for the relation between IUPC administration and WHO Obesity BMI group.

SAS 9.4 was used for all analyses.

Results

The distribution of BMI among study participants was right skewed. The median of the distribution was 33.83 (interquartile range (IQR): 31.33, 36.76). When stratified by oxytocin augmentation status, the distribution of BMI was similar across the two exposure groups.

Forty seven percent of study participants received oxytocin and 32% of study participants received an intrauterine pressure catheter (IUPC). Women in Obesity Group I were less likely to receive oxytocin augmentation (43%) than women in Obesity Group II (55%) or III (54%). Women under the care of an obstetrician-gynecologist (OB-GYN) were more likely to receive oxytocin augmentation (54%) than women under the care of a certified nurse midwife (CNM) (41%). Thirty to 40-year-old women were more likely to receive oxytocin augmentation than women aged 18 to 29. However, the median age for those receiving oxytocin (23.0 years, IQR: 21.0, 28.0) was the same as those who did not receive it (23.0 years, IQR: 20.0, 27.0). Excluding multiracial women (n=5), Hispanic women were the least likely to receive oxytocin augmentation (42%), and Asian women were the most likely to receive oxytocin augmentation (68%) but the number of Asian mothers was small (n=19).

Among women not receiving oxytocin, the median survival time for women in Obesity Group I was 390 minutes (95% CI: 335, 458), in Obesity Group II was 411 minutes (95% CI: 343, 532), and in Obesity Group III was 314 minutes (95% CI: 149, 492) (Figure 4). Among women receiving oxytocin, the median survival time for women in Obesity Group I was 723 minutes (95% CI: 593, 779), in Obesity Group II was 680 minutes (95% CI: 553, 752), and in Obesity Group III was 864 minutes (95% CI: 384, 1089) (Figure 5). The survival curves for women receiving oxytocin were similar for the first 500 minutes, but after 500 minutes, the most obese women had the longest duration of labor.

The odds of oxytocin intervention during pre-active labor (<6 cm) dilation were 4.20 times higher for Obese Group III than Obese Group I (95% confidence interval (CI) 1.41, 12.50) (Table 2). The odds of oxytocin intervention during pre-active labor for Obese Group II were 2.04 (95% CI: 1.03, 4.01) times that of Obese Group I's. The odds of IUPC insertion during pre-active labor was 2.19 (95% CI: 0.95, 5.08) times higher among women in Obesity BMI II and 2.65 (95% CI: 0.84, 8.34) times higher among women in Obesity BMI III than women in Obesity BMI I (Table 3).

The odds of oxytocin intervention in the partograph green zone were 2.06 (95% CI 0.68, 6.23) times higher for Obesity Group II than I and 1.88 (95% CI 0.38, 9.34) times higher for Obesity Group III than Obese Group I (Table 4). The odds of IUPC insertion in the partograph green zone for Obesity Group II were 2.25 times higher than Obese Group I (95% CI 0.58, 8.80) and 1.38 times higher for Obese Group III than Obese Group I (95% CI 0.27, 7.13) (Table 5).

Discussion

Among women exposed to oxytocin, BMI III women had the slowest median duration of labor (864 minutes), creating a median time difference of 9.2 hours between BMI III women receiving oxytocin versus those who did not. In contrast, the differences between the median duration of labor for women receiving and not receiving oxytocin for BMI I (5.6 hours) and BMI II (4.5 hours) were nearly half that of BMI III's. While obese women are known to have longer labor times than non-obese women (6), the most obese group, BMI III, had the fastest median duration of labor among women unexposed to oxytocin augmentation. However, this could be affected by the decision to administer oxytocin to the most obese women after they had been in labor for over 500 minutes, whereas some women who were less obese were allowed to remain in labor longer without administration of oxytocin. Further, this result could be the result of a relatively small sample of women in BMI III. Based on the six centimeter criteria for active labor, higher BMI group was also associated with an increasing odds of having inappropriately timed initial oxytocin infusion.

Obesity was less prevalent in Colorado compared with other states when these data were collected. Few women were categorized as Obesity BMI III, which resulted in imprecise estimates for the most obese group. Women who were included in this study were women who received labor and delivery care at a hospital and women who had recorded BMI information. Thus, the results related to timing may reflect practices at this hospital and may not generalize to hospitals with other practices. It is also possible that measurement error is present in self-reported weights and heights, affecting BMI calculations and grouping. These data were restricted to nulliparous, obese women and therefore, may not be generalizable to obese parous women. In evaluating duration of labor time, the point at which oxytocin was administered was not accounted for. Lastly, why clinicians intervened early when it is not clinically recommended to do is not known.

A strength of this dataset is the number of obese women included in Obesity Groups I (223) and II (99), which exceeds that of published studies addressing questions related to obesity in pregnancy and labor interventions.

BMI may not affect time to delivery directly. Instead it may be a marker of something that affects time to delivery as the most obese women did not have the slowest median time-to-delivery across among those who did not receive oxytocin but did for women receiving oxytocin. For example, the risk of dyslipidemia increases with BMI. Dyslipidemia, which is characterized by high concentrations of very low-density lipoproteins and triglycerides, destabilizes the membranes of myometrial cells (7,8). This destabilization causes oxytocin receptors to leave the cell membrane. Therefore, fewer oxytocin receptors are available for endogenous and synthetic oxytocin to bind to in the membranes of the myometrial cells and convey the signal for contraction. Therefore, oxytocin may be less effective in women who have dyslipidemia, which might mean that lipid profile would be a more appropriate predictor of time-to-delivery and need for oxytocin than obesity.

These results suggest there may be some differences in labor progress across obesity class although the labor duration curves were similar and there were not clear dose response patterns. The most obese women did not consistently have the slowest median time-to-delivery across oxytocin exposure groups yet had the largest gap in median survival time across exposure groups. There was more a difference in whether oxytocin administration was timed appropriately although it was not clear why inappropriately timed oxytocin was more likely in the most obese groups. Identifying factors that affect clinical decisions to administer oxytocin and how they differ by obesity class could provide insight into these results.

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Table 1.
Maternal characteristics by oxytocin augmentation exposure among a cohort of 359 nulliparous, obese women who delivered at a University of Colorado Hospital, 2005-2012

	Received oxytocin, 170 (47%)	**Did not receive oxytocin, 189 (53%)**
Body Mass Index (BMI) Category		
30≤ BMI < 35 [a]	96 (43%)	127 (57%)
35≤ BMI < 40	54 (55%)	45 (45%)
BMI ≥ 40	20 (54%)	17 (46%)
Clinician		
OB-GYN	97 (54%)	84 (46%)
Certified Nurse Midwife (CNM)	73 (41%)	105 (59%)
Age		
18 to 29 years	137 (45%)	168 (55%)
30 to 40 years	33 (61%)	21 (39%)
Race		
White	61 (58 %)	44 (42%)
African American	24 (52 %)	21(48%)
Hispanic	65 (42%)	88(58 %)
Asian	12 (62 %)	7 (38%)
American Indian	0	0
Pacific Islander	0	1 (100 %)
Multiracial	1 (20 %)	4 (80 %)
Unknown	1 (100 %)	0

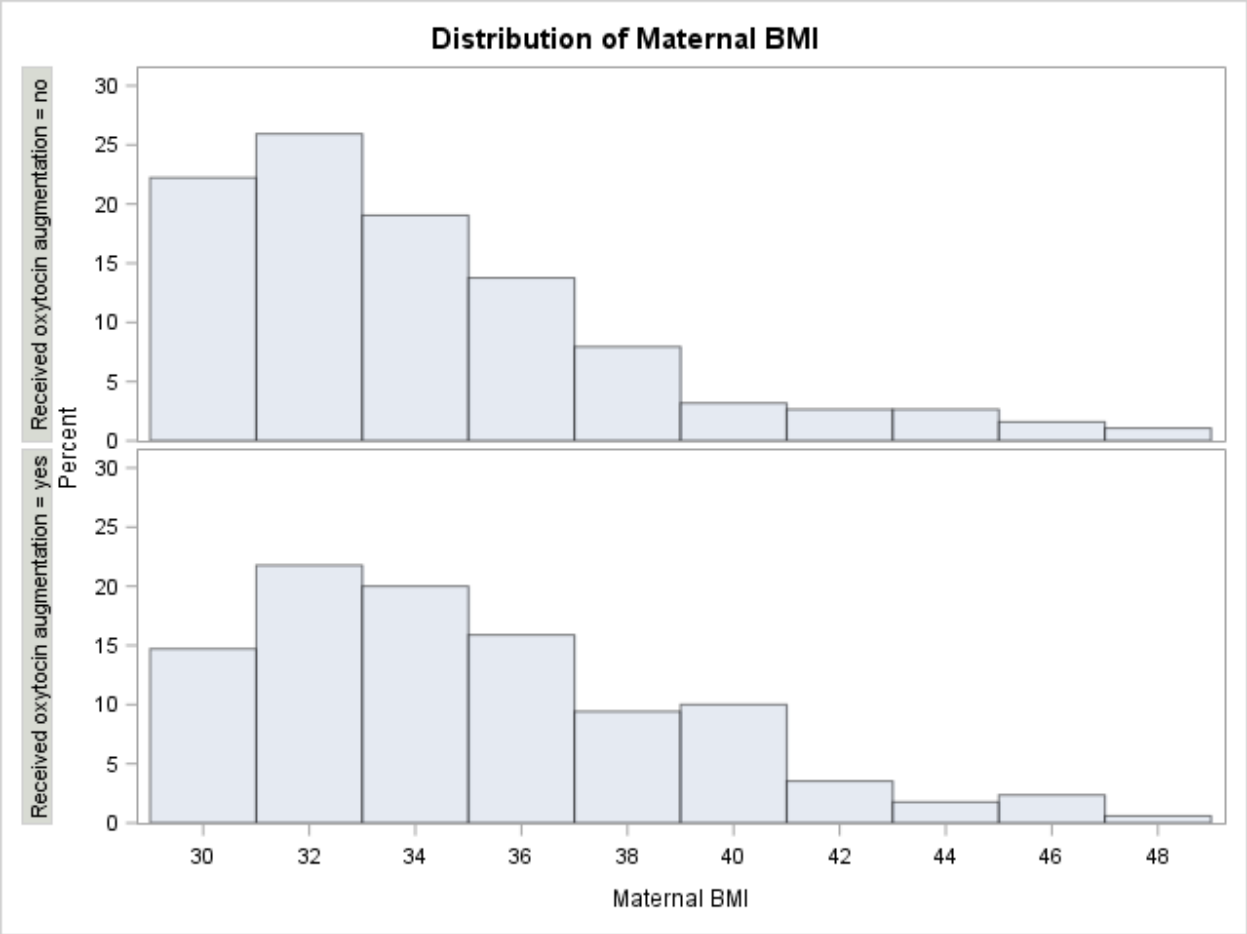

Figure 1. Histograms of distribution of maternal body mass index (BMI) stratified by exposure to oxytocin augmentation.

Table 2.
Unadjusted Odds Ratios (ORs) and 95% Confidence Intervals (CI) for Oxytocin Augmentation (Oxytocin Administration) prior to active labor vs. during active labor among 170 obese women who received oxytocin augmentation

	Received initial oxytocin infusion, prior to 6 cm dilation (87)	**Received initial oxytocin infusion at or after 6 cm dilation (83)**	**OR**	**95% CI**
Maternal BMI				
30≤ BMI < 35	40	56	1.00	Referent
35≤ BMI < 40	32	22	2.04	(1.03,4.01)
BMI ≥ 40	15	5	4.20	(1.41, 12.50)

Table 3.
Unadjusted Odds Ratios (ORs)[a] and 95% Confidence Intervals (CI) for intrauterine pressure catheter (IUPC) use prior to 6 cm dilation vs. at or after 6 cm dilation among 115 obese women who received an IUPC

	Received IUPC prior to 6 cm dilation (45)	**Received IUPC at or after 6 cm dilation (70)**	**OR**	**95% CI**
Maternal BMI				
30≤ BMI < 35	19	44	1.00	Referent
35≤ BMI < 40	18	19	2.19	(0.95,5.08)
BMI ≥ 40	8	7	2.65	(0.84,8.34)

Table 4.
Unadjusted Odds Ratios (ORs) and 95% Confidence Intervals (CI) for oxytocin infusion at inappropriate partograph timing vs. appropriate partograph timing

	Oxytocin infusion administered in "green zone" of partograph	Oxytocin infusion administered in "red zone" of partograph	OR	95% CI
Maternal BMI				
30≤ BMI < 35	48	15	1.00	Referent
35≤ BMI < 40	33	5	2.06	(0.68, 6.23)
BMI ≥40	12	2	1.88	(0.38, 9.34)

Table 5.

Unadjusted Odds Ratios (ORs) and 95% Confidence Intervals (CI) for intrauterine pressure catheter (IUPC) use at inappropriate partograph time ("green zone") vs. appropriate partograph time ("red zone")

	IUPC administered in "green zone" of partograph	**IUPC administered in "red zone" of partograph**	**OR**	**95% CI**
Maternal BMI				
30≤ BMI < 35	44	11	1.00	Referent
35≤ BMI < 40	27	3	2.25	(0.58,8.80)
BMI ≥40	11	2	1.38	(0.27, 7.13)

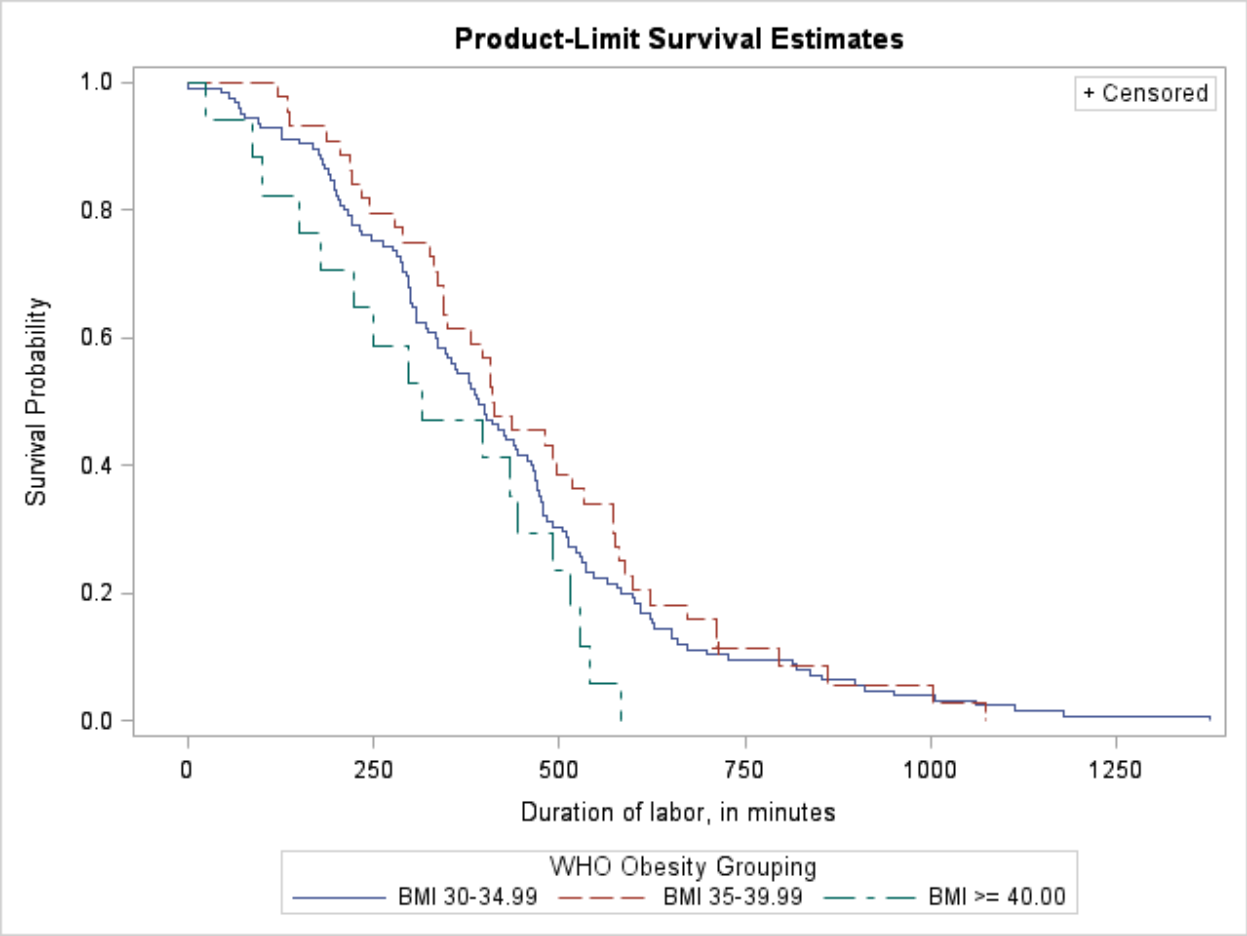

Figure 2. Kaplan-Meier curves of duration of labor (minutes) stratified by obesity group (I, II, III) among women who did not receive oxytocin augmentation. Women are censored at cesarean section.

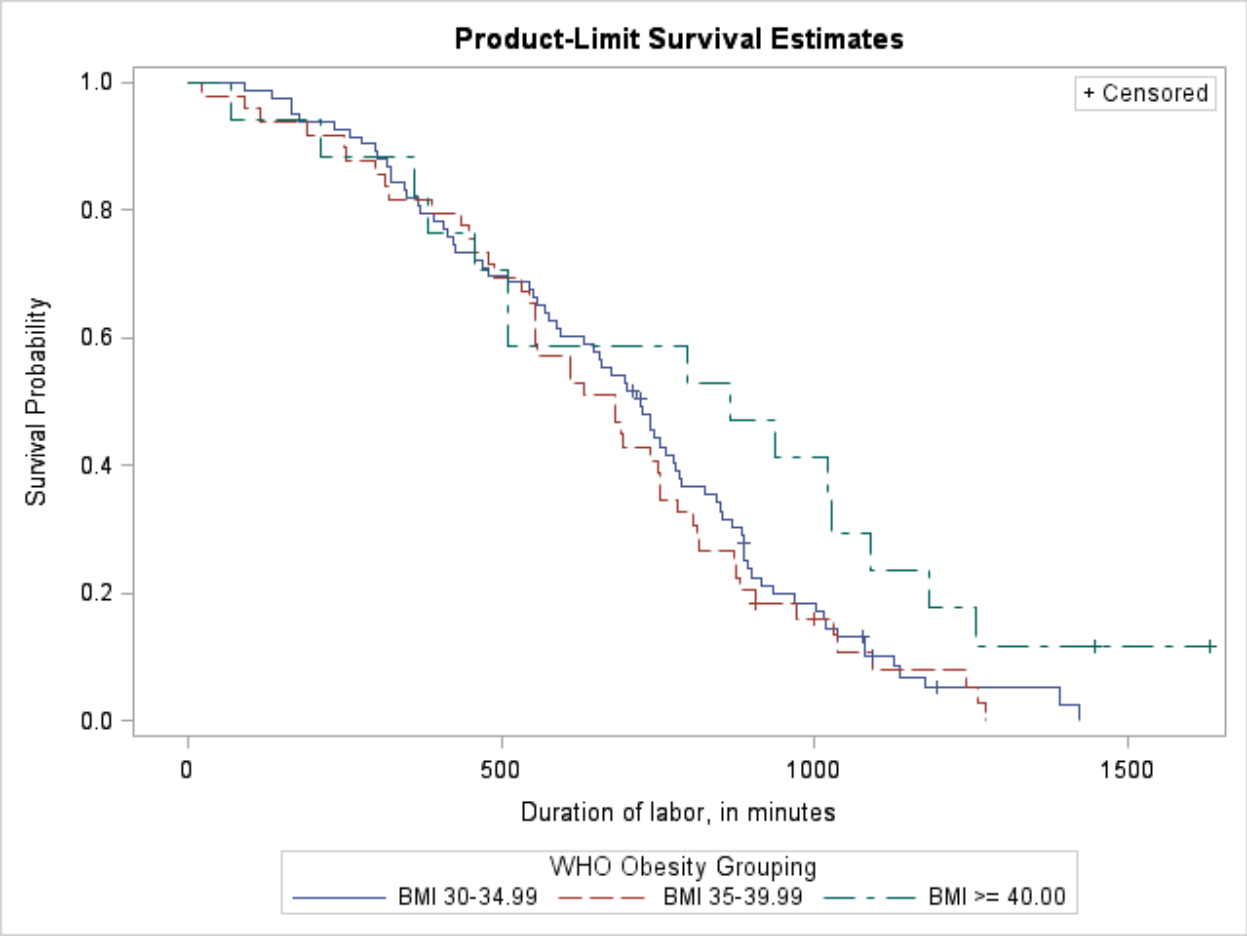

Figure 3. Kaplan-Meier curve of total duration of labor (minutes) stratified by obesity group (I, II, III) among women who received oxytocin augmentation. Women are censored at cesarean section.

Appendix

Appendix Table 1.
Maternal Characteristics by Intrauterine Pressure Catheter (IUPC) exposure in a cohort of nulliparous, obese pregnant women who delivered at a University of Colorado Hospital, 2005-2012

	Received IUPC	**Did not receive IUPC**
Main Exposure		
30≤ BMI < 35	63 (28%)	160 (72%)
35≤ BMI < 40	37 (37%)	62 (63%)
BMI > 40	15 (40%)	22 (60%)
Clinician		
OB-GYN	75 (41%)	106 (59%)
Certified Nurse Midwife (CNM)	40 (22 %)	138 (78%)
Age		
18 to 29 years	97 (32%)	208 (68%)
30 to 40 years	18 (33%)	36 (67%)
Race		
White	40 (38%)	65 (62%)
African American	19 (42%)	26 (58 %)
Hispanic	46 (30 %)	107 (70%)
Asian	3 (16%)	16 (84%)
American Indian	0	0
Pacific Islander	1 (100%)	0
Multiracial	1 (20 %)	4 (80 %)
Unknown	1 (100%)	0