Published in final edited form as:

Am J Perinatol. 2018 January ; 35(1): 59–64. doi:10.1055/s-0037-1605574.

Spontaneous Labor Onset and Outcomes in Obese Women at Term

Antonina I. Frolova, MD, PhD¹, Judy J. Wang², Shayna N. Conner, MD, MSCI¹, Methodius G. Tuuli, MD, MPH¹, George A. Macones, MD, MSCE¹, Candice L. Woolfolk, PhD, MPH¹, and Alison G. Cahill, MD, MSCI¹

¹Department of Obstetrics and Gynecology, Washington University in St. Louis, St. Louis, Missouri

²The Ohio State University College of Medicine, Columbus, Ohio

Abstract

Objective—The objective of this study was to compare the rates of spontaneous labor onset and its progression in obese and nonobese women after 37 weeks.

Study Design—We performed a secondary analysis of a retrospective cohort of all women who were admitted for delivery at 37 weeks of gestation at a university-based tertiary care center between 2004 and 2010. The cohort was stratified by weeks of gestation at which the patient presented for delivery. The rates of spontaneous labor, vaginal delivery, and augmentation with oxytocin were compared between obese (body mass index [BMI] ≥ 30) and nonobese (BMI < 30) women.

Results—Obese women had lower rates of spontaneous labor than nonobese women at every gestational week (37 weeks, 6.1 vs. 9.3%, $p < 0.001$; 38 weeks, 12.8 vs. 19.2%, $p < 0.001$; 39 weeks 26.0 vs. 37.0%, $p < 0.001$; 40 weeks, 39.6 vs. 50.2%, $p < 0.001$; 41 weeks, 30.8 vs. 38.0%, $p < 0.012$). Among women who presented in spontaneous labor, obesity was associated with higher rates of augmentation with oxytocin and lower rates of vaginal delivery.

Conclusion—Obese women at or beyond 37 weeks are less likely to experience spontaneous labor compared with nonobese women. In addition, obese women presenting in spontaneous labor are less likely than nonobese women to have a vaginal delivery at 37 to 40 weeks, even after oxytocin augmentation.

Keywords

obesity; spontaneous labor; labor augmentation; parturition

Address for correspondence: Antonina I. Frolova, MD, PhD, Department of Obstetrics and Gynecology, Washington University in St. Louis, 660 S. Euclid Avenue, Box 8064, St. Louis, MO 63110 (frolovaa@wudosis.wustl.edu).

Condensation

Obese women are less likely to experience spontaneous labor and vaginal delivery after 37 weeks compared with nonobese women.

Conflict of Interest

None.

The prevalence of obesity in the United States continues to rise. According to the National Health and Nutrition Examination Survey 2013 to 2014, 37% of reproductive age women (20–39 years old) are obese.¹ Obesity increases maternal and neonatal complications throughout pregnancy, labor and delivery, and the postpartum period.^{2–5} Management of labor is also affected, as obese women are at an increased risk of labor induction and cesarean delivery.^{2–5}

Comorbidities associated with obesity are likely responsible for some of the increase in labor induction rates, but this trend persists among low-risk obese women.⁶ An increased prevalence of postterm pregnancies has also been observed among overweight and obese women.^{2,7} Prolonged gestation is independently associated with maternal and perinatal complications, including increased rates of stillbirth and neonatal deaths.^{8,9} While prolonged gestation may be a medically modifiable risk factor for stillbirth, the interventions would potentially increase the number of obese women undergoing induction of labor.

Obesity is associated with increased rates of labor dystocia, failure of induction, and an overall slower labor curve.^{5,10–12} The mechanisms responsible for the altered labor progression in obese women are not yet clear. We hypothesize that these mechanisms may also be responsible for delaying or inhibiting spontaneous labor onset, resulting in the prolonged gestations observed in obese women. To better understand this phenomenon, we compared the rates of spontaneous labor onset and outcomes between obese and nonobese women at early term and term.

Study Design

This was a secondary analysis of a retrospective cohort of all women who delivered a liveborn infant at the Washington University Medical Center in St. Louis, MO, between April 2004 and April 2010. The Washington University in St. Louis Human Research Protection Office approved this study. Inclusion criteria were a singleton pregnancy, gestational age ≥ 37 weeks and 0 day and admission for delivery. Women who did not have height or weight data were excluded from the analysis ($n = 343$, 2.8% of total cohort).

Trained obstetric research nurses abstracted detailed demographic information, obstetric, gynecologic, prenatal, medical and surgical histories, antepartum history, and labor and delivery course. Gestational age was based on the woman's last menstrual period or first ultrasound.¹³ Body mass index (BMI) was calculated using patient weight and height at the time of admission for delivery. The cohort was divided into two groups: obese women with a BMI ≥ 30 kg/m² and nonobese women with a BMI < 30 kg/m². Admission diagnoses were dichotomized as spontaneous labor or scheduled delivery, which included scheduled indicated and elective inductions and cesarean deliveries. Women presenting with premature rupture of membranes were included in the induction group unless they were spontaneously laboring at the time of presentation. We performed a subanalysis including all women with premature rupture of membranes in the spontaneous labor group. A low-risk cohort was then selected from the overall cohort by excluding all women with a diagnosis of diabetes (gestational or pregestational), chronic hypertension, gestational hypertension, or preeclampsia on admission.

Baseline characteristics were estimated for the entire cohort and compared between obese and nonobese women using the Mann–Whitney’s *U* test and chi-square test for continuous and categorical variables, respectively. The rates of spontaneous labor and scheduled delivery at each gestational week were calculated by dividing the number of events that occurred within the week by the number of women who remained pregnant at the beginning of that gestational week. The rates of spontaneous labor and scheduled delivery were compared between obese and nonobese women within the entire cohort and then within the low-risk cohort.

Further analyses were performed within the low-risk cohort. BMI was stratified into five categories, and multivariable logistic regression was used to determine the relationship between BMI and odds of spontaneous labor at each week of gestation. Other variables included in the models were race, parity, macrosomia, history of prior cesarean delivery, advanced maternal age, and smoking history. The variables included in the models were selected based on factors previously shown to affect rates of spontaneous labor or induction and significant differences identified in the univariate analyses. Advanced maternal age and smoking history did not remain significant after a backward stepwise logistic regression was performed and were not included in the final model. Model fit was assessed with the Hosmer–Lemeshow’s goodness-of-fit test.¹⁴ Finally, the rates of vaginal delivery, augmentation, and completion of the first stage of labor were compared between the obese and nonobese groups among women who presented in spontaneous labor.

All analyses patients meeting inclusion criteria were analyzed; no a priori sample size estimation was performed. Analyses were completed using STATA 12.0 software package.

Results

There were 11,752 women who met inclusion criteria. Of these, 5,007 (42.6%) had a BMI < 30 kg/m² and 6,745 (57.4%) had a BMI ≥ 30 kg/m². On average, obese women were older; however, the proportion of patients with advanced maternal age (≥ 35 years) did not differ significantly between the obese and nonobese groups. Obese women were more likely to be African American, multiparous, and have maternal comorbidities including hypertensive disorders and diabetes (►Table 1).

Obese women had lower rates of spontaneous labor onset than nonobese women at every gestational week ≥ 37 weeks. In addition, obese women had higher rates of scheduled deliveries than nonobese women at every gestational age (►Table 2). In the low-risk cohort, we found that the trend in spontaneous labor onset persisted at all gestational ages, with obese women having significantly lower rates of spontaneous labor at 37 to 41 weeks. In contrast, the rates of scheduled deliveries did not significantly differ between nonobese and obese women at 37 and 38 weeks (4.6 vs. 4.6% at 37 weeks, *p* = 0.90; 7.1 vs. 7.2% at 38 weeks, *p* = 0.82). At ≥ 39 weeks, the rates of scheduled delivery continued to be significantly higher among obese compared with nonobese women in this subanalysis (►Table 3).

The low-risk cohort was then additionally stratified into five BMI subgroups and a multivariable logistic regression was used to determine the odds of spontaneous labor. These

analyses were adjusted for nulliparity, African American race, macrosomia, and history of prior cesarean delivery. At 37 to 39 weeks, every subgroup of BMI ≥ 25 kg/m² was associated with a lower likelihood of spontaneous labor onset compared with normal weight women (BMI < 25 kg/m²) (►Table 4). As BMI increased, the odds of spontaneous labor progressively decreased. Women with a BMI ≥ 40 kg/m² were significantly less likely to experience spontaneous labor at all gestational ages. At 41 weeks, the rates of spontaneous labor were not significantly different between women with BMI ≥ 25 to 39.9 kg/m² and women with a BMI < 25 kg/m². However, women with a BMI ≥ 40 kg/m² still had a significantly lower rate of spontaneous labor onset at 41 weeks.

Finally, we analyzed labor progression and the effects of labor augmentation with oxytocin among all women who presented in spontaneous labor (►Table 5). At 37 to 40 weeks of gestation, obese women presenting in spontaneous labor were less likely to have a vaginal delivery (83.0 vs. 88.8%, $p < 0.001$) and more likely to have their labor augmented with oxytocin (49.8 vs. 42.8%, $p < 0.001$) than nonobese women. Similarly, among those whose labor was augmented, obesity was still associated with lower rates of completing the first stage of labor and achieving a vaginal delivery. At 41 weeks of gestation, there was no significant difference in the rates of vaginal delivery between the two groups overall and among those who were augmented.

Conclusion

In this large cohort study, we found that obese women are less likely to experience spontaneous labor at or after 37 weeks. According to prior studies, obese women, on average, have longer gestations with a higher proportion of obese women having late-term (≥ 41 weeks) and postterm (≥ 42 weeks) pregnancies.^{2,3,7,15} Our study expands on these findings by showing that spontaneous labor onset is less likely to occur at all gestational ages in obese women at term.

Obesity has been associated with a slower first stage of labor, higher rates of labor arrest disorders, and an increased risk of induction failure.^{5,10–12,16} These previous studies suggest that there is a general ineffectiveness of labor progression in obese women. In support of this, we also observed a lower rate of vaginal delivery among obese women who presented in spontaneous labor prior to 41 weeks and this trend persisted among those whose labor was augmented with oxytocin. We propose that the decrease in spontaneous labor onset observed in our study, and others, involves some of the same mechanisms that contribute to labor dystocia in obese women.

While mechanistic studies are still few, there are reports of increased oxytocin requirements with higher cumulative doses of oxytocin used in obese women in the setting of augmentation or induction.^{17–19} In addition, in vitro models have suggested abnormal contractility in myometrial samples from obese women.¹⁹ Specific mechanisms responsible for parturition and labor dysfunction have also been proposed and warrant further study to help guide management of labor and develop better interventions for obese women.

The differences in vaginal delivery rates and response to augmentation were not significantly different between obese and nonobese women at 41 weeks. Specifically, our results show a marked decrease in the rate of vaginal deliveries among nonobese women at 41 weeks (►Table 5). Previous studies have shown that overall cesarean delivery rates increase with gestational age for both spontaneous and induced labors,²⁰ and myometrium from women delivering at > 41 weeks has been shown to be less contractile in vitro than myometrium from those delivering at 39 to 41 weeks.²¹ The similar rates of vaginal delivery rates and response to oxytocin augmentation between obese and nonobese women at 41 weeks appear to be a result of increasing cesarean rates among the nonobese women, blunting the effects of obesity. While this finding is limited by the lower number of patients at this gestational age, possibly reflecting type 2 error, it is important to consider as it may suggest two separate mechanisms responsible for labor dystocia. It will be important to differentiate these mechanisms in future studies.

Some strengths of our study include its large sample size and high proportion of obese women (57%). Recent work from Hermes et al reported a decreased proportion of spontaneous labor among women with higher BMI across all gestational ages.²² Our work validates their findings in a more modern cohort and expands to look at progression to vaginal delivery among spontaneously laboring women.

In addition to the inherent limitations of our retrospective and nonrandomized study design, one of the biggest limitations in our study is the confounding of results by scheduled deliveries. Since obese women are known to have higher rates of labor induction,^{11,12} it can be hypothesized that the overall lower rate of spontaneous delivery may be a result of increased indications for induction prior to the onset of spontaneous labor. To account for this potential confounder, we performed further analyses using a low-risk cohort, excluding women with hypertensive disorders and diabetes. Interestingly, at 37 to 38 weeks in the low-risk cohort, obese and nonobese women had similar rates of scheduled deliveries, but the obese women still had significantly lower rates of spontaneous labor onset, suggesting that factors other than comorbidity-indicated deliveries are responsible for the observed decrease in spontaneous labor onset. Additional selective bias may stem from altered labor management practices in obese women and the possibility of subjective factors affecting provider decision making. Continuous electronic fetal heart monitoring using Doppler ultrasonography is more challenging and less accurate in obese women, which may contribute to a lower threshold for interventions.²³ In addition, while studies have shown a prolonged labor curve in obese women, there are no standard recommendations for defining labor arrest in this population which may lead to over diagnosis, contributing to higher rates of augmentation and cesarean delivery in this population.^{10,24}

Perhaps, the two strongest implications of lower spontaneous labor rates in obese women are the higher rates of postterm pregnancies and need for labor induction. Longer gestations have been associated with increased perinatal complications including macrosomia, fetal heart rate abnormalities leading to operative or cesarean deliveries, lower Apgar scores, higher rates of intensive care unit admissions, and stillbirth.^{25–27} Increasing rates of maternal complications and arrest of labor, whether spontaneous or induced, are also seen with prolonged gestations.^{20,28} While evidence suggests that induction of labor does not

increase risk of cesarean delivery in the general population,^{20,29} multiple studies have shown that obesity is a risk factor for failed induction.¹⁶ Obese women have increased morbidity with cesarean deliveries, most notably wound complications, making this population even more susceptible to the morbidity associated with increased cesarean rates.³⁰ However, future studies are needed to investigate whether induction of labor in the obese population increases the cesarean delivery rate compared with expectant management.

In conclusion, our study shows that obese women at or beyond 37 weeks are less likely to experience spontaneous labor compared with nonobese women. In addition, obese women presenting in spontaneous labor are less likely than nonobese women to have a vaginal delivery, even after oxytocin augmentation. Further studies are needed to determine the optimal management of pregnancies in obese women that balances the competing risks of postterm pregnancy and labor induction.

Acknowledgments

Funding

Dr. Cahill is supported by the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (R01HD061619–01, PI Cahill) which partially supported this work.

References

1. Flegal KM, Kruszon-Moran D, Carroll MD, Fryar CD, Ogden CL. Trends in obesity among adults in the United States, 2005 to 2014. *JAMA*. 2016; 315(21):2284–2291. [PubMed: 27272580]
2. Usha Kiran TS, Hemmadi S, Bethel J, Evans J. Outcome of pregnancy in a woman with an increased body mass index. *BJOG*. 2005; 112(06):768–772. [PubMed: 15924535]
3. Sebire NJ, Jolly M, Harris JP, et al. Maternal obesity and pregnancy outcome: a study of 287,213 pregnancies in London. *Int J Obes Relat Metab Disord*. 2001; 25(08):1175–1182. [PubMed: 11477502]
4. Lu GC, Rouse DJ, DuBard M, Cliver S, Kimberlin D, Hauth JC. The effect of the increasing prevalence of maternal obesity on perinatal morbidity. *Am J Obstet Gynecol*. 2001; 185(04):845–849. [PubMed: 11641663]
5. Heslehurst N, Simpson H, Ells LJ, et al. The impact of maternal BMI status on pregnancy outcomes with immediate short-term obstetric resource implications: a meta-analysis. *Obes Rev*. 2008; 9(06):635–683. [PubMed: 18673307]
6. Gilead R, Yaniv Salem S, Sergienko R, Sheiner E. Maternal “isolated” obesity and obstetric complications. *J Matern Fetal Neonatal Med*. 2012; 25(12):2579–2582. [PubMed: 22873440]
7. Stotland NE, Washington AE, Caughey AB. Prepregnancy body mass index and the length of gestation at term. *Am J Obstet Gynecol*. 2007; 197(04):378.e1–378.e5. [PubMed: 17904967]
8. Nakling J, Backe B. Pregnancy risk increases from 41 weeks of gestation. *Acta Obstet Gynecol Scand*. 2006; 85(06):663–668. [PubMed: 16752256]
9. Olesen AW, Westergaard JG, Olsen J. Perinatal and maternal complications related to postterm delivery: a national register-based study, 1978–1993. *Am J Obstet Gynecol*. 2003; 189(01):222–227. [PubMed: 12861166]
10. Norman SM, Tuuli MG, Odibo AO, Caughey AB, Roehl KA, Cahill AG. The effects of obesity on the first stage of labor. *Obstet Gynecol*. 2012; 120(01):130–135. [PubMed: 22914401]
11. Pevzner L, Powers BL, Rayburn WF, Rumney P, Wing DA. Effects of maternal obesity on duration and outcomes of prostaglandin cervical ripening and labor induction. *Obstet Gynecol*. 2009; 114(06):1315–1321. [PubMed: 19935035]
12. Wolfe KB, Rossi RA, Warshak CR. The effect of maternal obesity on the rate of failed induction of labor. *Am J Obstet Gynecol*. 2011; 205(02):128.e1–128.e7. [PubMed: 21621187]

13. Committee on Practice Bulletins—Obstetrics and the American Institute of Ultrasound in Medicine. Practice Bulletin No. 175: ultrasound in pregnancy. *Obstet Gynecol.* 2016; 128(06):e241–e256. [PubMed: 27875472]
14. Hosmer, DW., Lemeshow, S., Sturdivant, R. *Applied Logistic Regression.* 3rd. New York: Wiley; 2013. p. 528
15. Denison FC, Price J, Graham C, Wild S, Liston WA. Maternal obesity, length of gestation, risk of postdates pregnancy and spontaneous onset of labour at term. *BJOG.* 2008; 115(06):720–725. [PubMed: 18410655]
16. Bogaerts A, Witters I, Van den Bergh BR, Jans G, Devlieger R. Obesity in pregnancy: altered onset and progression of labour. *Midwifery.* 2013; 29(12):1303–1313. [PubMed: 23427851]
17. Roloff K, Peng S, Sanchez-Ramos L, Valenzuela GJ. Cumulative oxytocin dose during induction of labor according to maternal body mass index. *Int J Gynaecol Obstet.* 2015; 131(01):54–58. [PubMed: 26210857]
18. Soni S, Chivan N, Cohen WR. Effect of maternal body mass index on oxytocin treatment for arrest of dilatation. *J Perinat Med.* 2013; 41(05):517–521. [PubMed: 23515101]
19. Zhang J, Bricker L, Wray S, Quenby S. Poor uterine contractility in obese women. *BJOG.* 2007; 114(03):343–348. [PubMed: 17261121]
20. Caughey AB, Nicholson JM, Cheng YW, Lyell DJ, Washington AE. Induction of labor and cesarean delivery by gestational age. *Am J Obstet Gynecol.* 2006; 195(03):700–705. [PubMed: 16949399]
21. Arrowsmith S, Quenby S, Weeks A, Burdya T, Wray S. Poor spontaneous and oxytocin-stimulated contractility in human myometrium from postdates pregnancies. *PLoS One.* 2012; 7(05):e36787. [PubMed: 22590608]
22. Hermes AC, Allshouse AA, Heyborne KD. Body Mass Index and the Spontaneous Onset of Parturition. *Obstet Gynecol.* 2016; 128(05):1033–1038. [PubMed: 27741178]
23. Cohen WR, Hayes-Gill B. Influence of maternal body mass index on accuracy and reliability of external fetal monitoring techniques. *Acta Obstet Gynecol Scand.* 2014; 93(06):590–595. [PubMed: 24684703]
24. Vahratian A, Zhang J, Troendle JF, Savitz DA, Siega-Riz AM. Maternal prepregnancy overweight and obesity and the pattern of labor progression in term nulliparous women. *Obstet Gynecol.* 2004; 104(5 Pt 1):943–951. [PubMed: 15516383]
25. Alexander JM, McIntire DD, Leveno KJ. Forty weeks and beyond: pregnancy outcomes by week of gestation. *Obstet Gynecol.* 2000; 96(02):291–294. [PubMed: 10908780]
26. Yudkin PL, Wood L, Redman CW. Risk of unexplained stillbirth at different gestational ages. *Lancet.* 1987; 1(8543):1192–1194. [PubMed: 2883499]
27. Caughey AB, Washington AE, Laros RK Jr. Neonatal complications of term pregnancy: rates by gestational age increase in a continuous, not threshold, fashion. *Am J Obstet Gynecol.* 2005; 192(01):185–190. [PubMed: 15672023]
28. Caughey AB, Stotland NE, Washington AE, Escobar GJ. Maternal and obstetric complications of pregnancy are associated with increasing gestational age at term. *Am J Obstet Gynecol.* 2007; 196(02):155.e1–155.e6. [PubMed: 17306661]
29. Walker KF, Bugg GJ, Macpherson M, et al. 35/39 Trial Group Randomized trial of labor induction in women 35 years of age or older. *N Engl J Med.* 2016; 374(09):813–822. [PubMed: 26962902]
30. Conner SN, Verticchio JC, Tuuli MG, Odibo AO, Macones GA, Cahill AG. Maternal obesity and risk of postcesarean wound complications. *Am J Perinatol.* 2014; 31(04):299–304. [PubMed: 23765707]

Table 1

Baseline characteristics

	BMI < 30 (n = 5,007)	BMI 30 (n = 6,745)	p-Value
Maternal age (y)	23 (20–29)	25 (21–29)	<0.001
Maternal age ≥ 35 y	397 (7.9)	600 (8.9)	0.063
Ethnicity			
African American	3,204 (64.0)	5,003 (74.2)	<0.001
Caucasian	1,176 (23.5)	1,228 (18.2)	
Other	627 (12.5)	514 (7.6)	
Nulliparous	2,233 (44.6)	2,396 (35.5)	<0.001
Chronic hypertension	51 (1.0)	297 (4.4)	<0.001
Gestational hypertension	244 (4.9)	515 (7.6)	<0.001
Diabetes	100 (2.0)	391 (5.8)	<0.001
Prior cesarean	625 (12.5)	1,348 (20.0)	<0.001
Delivery method			
Vaginal	3,454 (69.0)	3,868 (57.3)	<0.001
Operative vaginal	492 (9.8)	475 (7.0)	
Cesarean	1,061 (21.2)	2,401 (35.6)	
Infant EGA			
37.0–38.6	1,835 (36.6)	2,119 (31.4)	<0.001
39.0–40.6	2,771 (55.3)	3,899 (57.8)	
41.0	401 (8.0)	727 (10.8)	
Infant weight ≥ 4,000 g	207 (4.1)	601 (8.9)	<0.001

Abbreviations: BMI, body mass index; EGA, estimated gestational age. Note: Data are *n* (%), unless otherwise specified. Maternal age is presented as median (interquartile range). Missing *n* = 1 infant weight ≥ 4,000 g.

Table 2

Rates of spontaneous labor and scheduled delivery in total cohort

	N		Spontaneous labor		p-Value	Scheduled delivery		p-Value
	BMI < 30	BMI 30	BMI < 30	BMI 30		BMI < 30	BMI 30	
37 wk	5,007	6,745	464 (9.3)	409 (6.1)	<0.001	271 (5.4)	459 (6.8)	0.002
38 wk	4,272	5,877	820 (19.2)	752 (12.8)	<0.001	347 (8.1)	581 (9.9)	0.002
39 wk	3,105	4,544	1,150 (37.0)	1,181 (26.0)	<0.001	461 (14.8)	1,118 (24.6)	<0.001
40 wk	1,494	2,245	750 (50.2)	888 (39.6)	<0.001	389 (26.0)	734 (32.7)	<0.001
41 wk	355	623	135 (38.0)	188 (30.8)	0.012	203 (57.2)	406 (65.2)	0.013
42 wk	17	29	12 (70.6)	4 (13.8)	<0.001	5 (29.4)	25 (86.2)	<0.001

Abbreviation: BMI, body mass index.

Note: Data are n (%). N is the number of women pregnant at the beginning of stated week.

Table 3

Rates of spontaneous labor and scheduled delivery among low-risk cohort

	<i>N</i>		Spontaneous labor		<i>p</i> -Value	Scheduled delivery		<i>p</i> -Value
	BMI < 30	BMI 30	BMI < 30	BMI 30		BMI < 30	BMI 30	
37 wk	4,568	5,560	422 (9.2)	346 (6.2)	<0.001	211 (4.6)	254 (4.6)	0.90
38 wk	3,935	4,960	766 (19.5)	651 (13.1)	<0.001	280 (7.1)	359 (7.2)	0.82
39 wk	2,889	3,950	1,093 (37.8)	1,092 (27.6)	<0.001	398 (13.8)	831 (21.0)	<0.001
40 wk	1,398	2,027	717 (51.3)	826 (40.7)	<0.001	338 (24.2)	624 (30.8)	<0.001
41 wk	343	577	132 (38.5)	180 (31.2)	0.024	194 (56.6)	369 (64.0)	0.026
42 wk	17	28	12 (70.6)	3 (10.7)	<0.001	5 (29.4)	25 (89.3)	<0.001

Abbreviation: BMI, body mass index.

Note: Data are *n* (%). *N* is the number of women pregnant at the beginning of stated week.

Table 4

Spontaneous labor onset by BMI among low-risk cohort

	BMI < 25	BMI 25–29.9	BMI 30–34.9	BMI 35–39.9	BMI 40
37 wk	Ref	0.66 (0.54–0.81)	0.53 (0.42–0.66)	0.52 (0.40–0.68)	0.42 (0.31–0.57)
38 wk	Ref	0.81 (0.68–0.96)	0.64 (0.53–0.76)	0.50 (0.40–0.62)	0.40 (0.31–0.51)
39 wk	Ref	0.85 (0.71–1.00)	0.66 (0.55–0.78)	0.53 (0.43–0.65)	0.41 (0.33–0.51)
40 wk	Ref	0.85 (0.67–1.08)	0.63 (0.50–0.81)	0.51 (0.39–0.66)	0.50 (0.38–0.66)
41 wk	Ref	0.99 (0.58–1.67)	0.70 (0.41–1.19)	0.70 (0.40–1.22)	0.56 (0.31–1.02)

Abbreviation: BMI, body mass index.

Note: Data are adjusted odds ratio (95% confidence interval). Adjusted for nulliparity, African American race, history of prior cesarean delivery, and macrosomia.

Table 5

Labor progression among low-risk women presenting in spontaneous labor

	Vaginal delivery			Augmentation			Complete first stage among augmented				Vaginal delivery among augmented		
	BMI < 30 (n = 3,142)	BMI 30 (n = 3,098)	p-Value	BMI < 30 (n = 3,142)	BMI 30 (n = 3,098)	p-Value	BMI < 30 (n = 1,344)	BMI 30 (n = 1,542)	p-Value		BMI < 30 (n = 1,344)	BMI 30 (n = 1,542)	p-Value
Total	2,789 (88.8)	2,570 (83.0)	<0.001	1,344 (42.8)	1,542 (49.8)	<0.001	1,216 (90.5)	1,292 (83.8)	<0.001		1,158 (86.2)	1,230 (79.8)	<0.001
37 wk	398 (94.3)	299 (86.4)	<0.001	169 (40.0)	168 (48.5)	0.018	164 (97.0)	148 (88.1)	0.002		162 (95.9)	146 (86.9)	0.003
38 wk	686 (89.6)	546 (83.9)	0.002	310 (40.5)	294 (45.2)	0.075	288 (92.9)	244 (83.0)	<0.001		278 (89.7)	239 (81.3)	0.003
39 wk	964 (88.2)	919 (84.2)	0.006	472 (43.2)	525 (48.1)	0.022	424 (89.8)	446 (85.0)	0.021		398 (84.3)	426 (81.1)	0.19
40 wk	631 (88.0)	659 (79.8)	<0.001	324 (45.2)	449 (54.4)	<0.001	285 (88.0)	367 (81.7)	0.019		269 (83.0)	338 (75.3)	0.01
41 wk	110 (76.4)	147 (80.3)	0.39	69 (47.9)	106 (57.9)	0.072	55 (79.7)	87 (82.1)	0.70		51 (73.9)	81 (76.1)	0.71

Abbreviation: BMI, body mass index.

Note: Data are n (%).