

Length of the second stage of labor and preterm delivery risk in the subsequent pregnancy.

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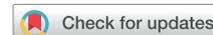
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OBSTETRICS

Length of the second stage of labor and preterm delivery risk in the subsequent pregnancy



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BACKGROUND: Cervical injury is regarded as an important risk factor for preterm delivery. A prolonged second stage of labor may increase the risk of cervical injury that, in turn, may be associated with increased risk of spontaneous preterm delivery in the subsequent pregnancy.

OBJECTIVE: We sought to evaluate whether the duration of the second stage of labor in a term primiparous singleton delivery is associated with an increased risk of singleton spontaneous preterm delivery (<37 weeks) in the second pregnancy.

STUDY DESIGN: We carried out a retrospective cohort analysis of women with 2 consecutive pregnancies: a first term (≥ 37 weeks) delivery and second birth. Data were derived from a single institution's prospectively collected obstetrical database from January 2005 through January 2015. Duration of the second stage of labor was examined as a continuous variable, modeled based on nonparametric restricted cubic regression spline with 4 degrees of freedom. Second-stage duration was also examined as short (<30 minutes), normal (30–179 minutes), and prolonged, defined as ≥ 180 minutes. The association between the duration of the second stage of labor in the first term pregnancy and the risk for spontaneous preterm delivery in the second pregnancy was evaluated before and after adjusting for potential confounders based on the Cox proportional hazards regression model. Associations were expressed based on the adjusted hazard ratio and 95% confidence interval.

RESULTS: In all, 6715 women met inclusion criteria. The hazard of spontaneous preterm delivery in the second pregnancy trended higher

with both shorter and longer second-stage labors. The length of the second stage of labor in the first term delivery was categorized as short (<30 minutes) in 1749 (26.0%), normal (30–179 minutes) in 4551 (67.8%), and prolonged (≥ 180 minutes), in 415 (6.2%) women. Of these 6715 women with a first term delivery, 4.2% ($n = 279$) delivered spontaneously preterm in the second pregnancy. The risks of spontaneous preterm delivery among women with prolonged (≥ 180 minutes) second stage of labor and normal labor duration (30–179 minutes) were 5.4% ($n = 22$) and 3.5% ($n = 158$), respectively (adjusted hazard ratio, 1.81; 95% confidence interval, 1.15–2.84). This increased risk for prolonged second stage of labor was primarily seen among women who underwent a cesarean (hazard ratio, 3.38; 95% confidence interval, 1.09–10.49), but was imprecise among women who delivered vaginally (hazard ratio, 1.52; 95% confidence interval, 0.62–3.74). The risk of spontaneous preterm delivery among women with short second stage of labor (<30 minutes) in their first term pregnancy was 5.8% ($n = 99$; hazard ratio, 1.28; 95% confidence interval, 0.99–1.67).

CONCLUSION: The risk of spontaneous preterm delivery in the second pregnancy was increased in women with a prolonged (≥ 180 minutes) second stage in the first term pregnancy. This risk was even greater among women who were delivered by cesarean in the first pregnancy.

Key words: cervical injury, cervical shortening, cesarean, labor duration, prolonged second stage, second pregnancy, short second stage

Introduction

Preterm delivery refers to a birth that occurs <37 weeks' gestation.¹ The overall preterm delivery rate in the United States is 11%, with 70–80% of preterm deliveries occurring spontaneously.¹ Preterm delivery follows an antecedent preterm delivery in 23% of cases, whereas it can be expected in as few as 5–8% after a term delivery.² Preterm delivery after a prior term delivery may reflect events that occurred in that earlier labor and delivery, which

may enhance future pregnancy risks, or factors totally unrelated to that previous birth. Limited research has suggested a possible association of abnormal labors (eg, a prolonged second stage of labor) with the development in a subsequent pregnancy of cervical shortening, cervical insufficiency, and preterm delivery due to either spontaneous labor or preterm premature rupture of membranes.³ The etiology for cervical shortening or cervical insufficiency and preterm delivery in women without otherwise obvious risk factors may be related to cervical injury that compromises cervical integrity during a previous term delivery, in the setting of a precipitous or prolonged second stage, cervical laceration, or an operative vaginal delivery.^{4,5}

We designed this study to evaluate whether duration of the second stage of

labor in a first (primiparity) term pregnancy is associated with an increased risk of singleton spontaneous delivery <37 weeks gestation in the second pregnancy. We hypothesized that the risk for spontaneous preterm delivery would vary based on the length of the second stage of labor.

Materials and Methods

We performed a retrospective cohort analysis of women having their first 2 consecutive deliveries January 2005 through January 2015, both resulting in singleton births. All women were delivered at the Christiana Care Health System Hospital in Newark, DE. The first pregnancy was restricted to term delivery (gestational age ≥ 37 weeks). The risk for spontaneous preterm delivery in the second pregnancy was estimated

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AJOG at a Glance

Why was this study conducted?

This study was conducted to evaluate whether the duration of the second stage of labor in a term primiparous singleton delivery is associated with an increased risk of singleton spontaneous preterm delivery (<37 weeks) in the second pregnancy.

Key findings

The risk of spontaneous preterm delivery in the second pregnancy was increased in women with a prolonged (≥ 180 minutes) second stage in the first term pregnancy.

What does this add to what is known?

A prolonged second stage of labor in a term delivery increases the risk of spontaneous preterm delivery in a subsequent pregnancy. This risk was even greater among women who were delivered by cesarean in the first pregnancy.

based on the duration of the second stage in the first term delivery. We received ethics approval for human subjects research from Christiana Care Health Systems in Delaware, Lehigh Valley Health Network in Pennsylvania, as well as Columbia University Medical Center in New York. Columbia University serves as the biostatistics coordinating center for the Perinatal Research Consortium (<http://perinatalresearchconsortium.org/>).

The exposure of interest was the length of the second stage of labor in the first term pregnancy. This was defined as the duration between the recorded time of complete cervical dilation and delivery of the neonate, and was expressed in minutes. The duration of the second stage of labor from the first term pregnancy was obtained from data prospectively recorded at the time of delivery and entered into the medical record. The primary outcome was spontaneous preterm delivery in the second pregnancy, defined as spontaneous preterm labor or spontaneous preterm premature rupture of membranes with a gestational age at delivery of 16–36 weeks. Maternal sociodemographic characteristics and other relevant clinical information was also ascertained.

Nulliparous women with a singleton pregnancy that delivered at term (≥ 37 weeks of gestation) who also had a subsequent singleton pregnancy delivering >16 weeks 0 days gestation were included in the analysis. Only women with recorded lengths of the second stage

of labor were included. Exclusion criteria included known major fetal anomalies and/or aneuploidy in either pregnancy.

Statistical analysis

Statistical analyses included χ^2 test for categorical variables and the Student *t* test for continuous variables that were normally distributed, and the nonparametric 2-sample median test for variables that were not normally distributed. We fit Cox proportional hazards regression models to estimate the associations between the duration of the second stage of labor in the first term pregnancy on the risk of preterm delivery in the second pregnancy. In the Cox model, gestational age was the used as the time scale, with deliveries at ≥ 37 weeks as being censored. We evaluated the proportional hazards assumption by visually inspecting the plot of the scaled Schoenfeld residuals; the assumption did not appear to be violated for any of the models. Separate regression models were fit for all preterm and then, spontaneous preterm deliveries. From these models, we derived the adjusted hazard ratio (HR) with 95% confidence interval (CI) as the measure of effect.

Duration of the second stage of labor in the first term pregnancy was examined 2 ways. Labor duration was analyzed as a continuous variable. For the Cox regression models, to allow for nonlinear association between duration of labor in the first term pregnancy on the risk of spontaneous preterm delivery

in the second pregnancy, labor duration was analyzed based on restricted cubic spline method⁶ based on 4 knots. This nonparametric smoothing method does not impose any arbitrary shape between labor duration and preterm delivery, and is constrained to be linear at the tails (<5th and >95th percentiles) of the labor duration function. The optimal number of knots was assessed by comparing the likelihood ratios of nested models with 3–6 knots.⁶ Duration of the second stage of labor was also examined as short (<30 minutes), normal (30–179 minutes), and prolonged (≥ 180 minutes).⁷

To minimize bias due to confounding, we adjusted the regression models for potential confounders. These included maternal sociodemographic characteristics in the first pregnancy, maternal age (grouped as <20, 20–24, 25–29, 30–34, and ≥ 35 years), race/ethnicity (non-Hispanic Caucasian, non-Hispanic African American, Hispanic, or other race), smoking during pregnancy, chronic hypertension, and patient provider type (private or service). The choice of confounders was determined by developing a directed acyclic graph, and then comparing the unadjusted and confounder-adjusted HR; if these estimates differed by at least 10%, or were confounders of a priori interest, they were retained in the models for adjustment.⁸ For a secondary analysis we also examined whether risk estimates varied based on route of delivery for the first delivery.

We hypothesized that the risk for spontaneous preterm delivery would vary based on the length of the second stage of labor, with an increased risk for women with a prolonged second stage of labor in the first term pregnancy. To estimate a priori the sample size required, we assumed the risk of spontaneous preterm delivery among women with a normal (<180 minutes) second stage of labor in the first pregnancy was 5%.² Based on a 2-tailed type I error of $\alpha = 0.05$, and a type II error of $\beta = 0.1$ (power of 90%) to detect a 1.5-fold increased risk of spontaneous preterm delivery among women with a prolonged second stage ≥ 180 minutes in the first

pregnancy, we estimated that the study would require 858 and 3432 women with and without prolonged second stage (≥ 180 minutes) at term in the first pregnancy, respectively.

Results

From 2005 through 2015, there were 6715 women identified as being eligible for analysis (Figure 1). The distribution of length of the second stage of labor in the first term delivery was short (<30 minutes) in 1749 (26.0%), normal (30–179 minutes) in 4551 (67.8%), and prolonged (≥ 180 minutes) in 415 (6.2%) women. The distribution of maternal demographic characteristics across short, normal, and prolonged second-stage labors are shown in Table 1.

The length of the second stage of labor in the first pregnancy was longer in older patients and Caucasians. No differences in the length of the second stage of labor were seen among women with medical complications such as chronic hypertension or gestational hypertension. Cesarean delivery was performed in nearly half (47.2%) of women with a prolonged second stage of labor. The correlation between the length of second stage of labor in the first term pregnancy and gestational age at delivery in the second pregnancy was $r = -0.01$.

We examined second-stage labor duration as a continuous variable, modeled using regression splines. The hazard of spontaneous preterm delivery (Figure 2) in the second pregnancy trended higher with shorter and longer second-stage labors. We then examined the association between the risk of spontaneous preterm delivery in the second pregnancy in relation to the duration of the second stage of labor in the first term pregnancy categorized as <30 , 30–179, or ≥ 180 minutes. Spontaneous preterm delivery was more common in women after a prolonged second stage of labor ≥ 180 minutes in the first pregnancy (Table 2). After adjustment for maternal age, patient type, race/ethnicity, smoking, chronic hypertension, and epidural anesthesia, there was an 81% increased risk of spontaneous preterm delivery in the second pregnancy if the second stage of

FIGURE 1
Flow diagram of patient population



Flow diagram.

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labor length was ≥ 180 minutes in the first term delivery (HR, 1.81; 95% CI, 1.15–2.84). This increased risk for prolonged second stage of labor was primarily seen among women who underwent a cesarean (HR, 3.38; 95% CI, 1.09–10.49), but was imprecise among women who delivered vaginally (HR, 1.52; 95% CI, 0.62–3.74). There was a 28% risk of spontaneous preterm delivery in the second pregnancy if the second stage of labor length was <30 minutes in the first term delivery, but this association was borderline significant (HR, 1.28; 95% CI, 0.99–1.67).

As a secondary outcome, we examined the association between the duration of second stage in the first pregnancy and the risk of all preterm deliveries in the second pregnancy (Table 3). These analyses were similar to those for

spontaneous preterm deliveries, with both short (HR, 1.31; 95% CI, 1.04–1.64) and prolonged (HR, 1.72; 95% CI, 1.16–2.55) labors associated with increased risk of all preterm deliveries.

Comment

Principal findings of this study

In this retrospective cohort of 6715 women with their first 2 consecutive singleton deliveries, the risk of spontaneous preterm delivery was increased for women who experienced a second stage of labor ≥ 180 minutes in the first pregnancy. These findings indicate that a prolonged second stage of labor, especially if delivery occurs by cesarean, in a first term delivery is an important risk factor for spontaneous preterm delivery risk in the next pregnancy.

TABLE 1
Maternal characteristics by duration of second stage of labor in first term pregnancy

Maternal characteristics	Duration of second-stage labor in first term pregnancy			Pvalue
	<30 min	30–179 min	≥180 min	
Total pregnancies	1749 (26.0)	4551 (67.8)	415 (6.2)	
Maternal age, y				<.001
<20	441 (25.2)	629 (13.8)	32 (7.7)	
20–24	567 (32.4)	1010 (22.2)	48 (11.6)	
25–29	373 (21.3)	1422 (31.3)	134 (32.3)	
30–34	298 (17.0)	1181 (26.0)	153 (36.9)	
≥35	70 (4.0)	309 (6.8)	48 (11.6)	
Race/ethnicity				<.001
Caucasian	1006 (57.5)	3389 (74.5)	323 (77.8)	
African American	497 (28.4)	626 (13.8)	31 (7.5)	
Hispanic	82 (4.7)	145 (3.2)	12 (2.9)	
Other	164 (9.4)	391 (8.6)	49 (11.8)	
Maternal smoking	322 (18.4)	621 (13.7)	32 (7.7)	<.001
Obstetrical service				<.001
Private	1313 (75.1)	3907 (85.9)	350 (84.3)	
Resident service	436 (24.9)	644 (14.2)	65 (15.7)	
Medical/obstetrical complications				
Chronic hypertension	20 (1.1)	42 (0.9)	5 (1.2)	.67
Preeclampsia	135 (7.7)	321 (7.1)	39 (9.4)	.18
Diabetes mellitus	4 (0.2)	18 (0.4)	1 (0.2)	.56
Gestational diabetes	56 (3.2)	198 (4.4)	21 (5.1)	.07
Tobacco use			32 (7.7)	
Labor induction	643 (36.8)	1708 (37.5)	150 (36.1)	.76
Epidural anesthesia	1497 (85.6)	4308 (94.7)	407 (98.1)	<.001
Mode of delivery				<.001
Spontaneous vaginal	1463 (83.7)	3452 (75.9)	120 (28.9)	
Vacuum-assisted vaginal	240 (13.7)	834 (18.3)	90 (21.7)	
Forceps-assisted vaginal	22 (1.3)	69 (1.5)	9 (2.2)	
Cesarean	24 (1.4)	196 (4.3)	196 (47.2)	
Gestational age of second delivery, mean (SD)	38.7 (1.8)	38.8 (1.5)	39.5 (1.6)	<.001

Values are n (%) unless otherwise specified.

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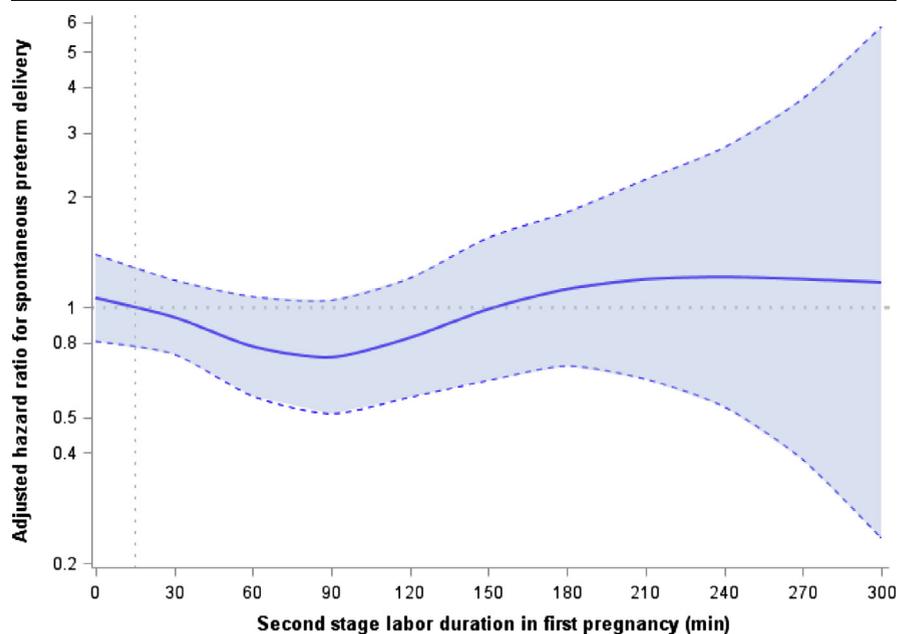
Comparison with existing literature

The findings in this study are consistent with recent literature.⁹ In a large retrospective cohort study of women with 2 consecutive deliveries at the same institution, Levine and colleagues⁵ showed that women with a term second-stage cesarean delivery had a higher than expected risk of subsequent spontaneous

preterm delivery (13.5%), compared to a first-stage cesarean delivery (2.3%). However, the duration of the second stage did not appear to have a strong correlation with subsequent preterm risk. There was no association between the length of the second stage, either as a continuous or categorical variable, and the risk of spontaneous preterm delivery

in a future pregnancy.¹⁰ The risk of spontaneous preterm delivery was not significantly different among women with a second stage ≥3 hours (10.4%) vs those with a second stage <3 hours (7.9%; *P* = .5). Interestingly, the risk of spontaneous preterm delivery was modified by mode of delivery, with the absolute risk of a subsequent

FIGURE 2
Second stage of labor and future preterm delivery risk



Adjusted hazard ratio and 95% pointwise confidence bands for association between duration of second stage of labor in first term pregnancy and spontaneous preterm delivery in second pregnancy.

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spontaneous preterm delivery after a cesarean with a second stage ≥ 3 hours twice as high as the risk of a spontaneous preterm delivery after a vaginal delivery with a second stage ≥ 3 hours (adjusted odds ratio, 2.08; 95% CI, 0.32–13.78), although the association was imprecise. A more recent retrospective cohort study of matched first and second births from a large Canadian perinatal database demonstrated that the risk of spontaneous preterm delivery < 37 and < 32 weeks of gestation in the second birth was increased when the first birth was by cesarean delivery in the second stage of labor (relative risk, 1.57; 95% CI, 1.43–1.73 and relative risk, 2.12; 95% CI, 1.67–2.68, respectively).¹¹

Vyas and colleagues⁴ examined 49 multiparous women experiencing cervical insufficiency after a term birth and found they were more likely to have experienced a precipitous delivery, previous curettage, or a prolonged second stage of labor. Cervical insufficiency was defined as either a midtrimester pregnancy loss and no symptoms of preterm

labor, complete cervical effacement in the midtrimester, or cervical dilation at the external os that met criteria for emergency cerclage placement. Approximately 20% of the women with cervical insufficiency had a prolonged second stage of labor in the previous pregnancy vs none in the control group, composed of multiparous women with a repeat term birth and no history of cervical insufficiency. That study was limited by its small sample size with 49 women in each group, and by the lack of data regarding gestational age at delivery within each group. Nonetheless, that study did suggest a potential relationship between structural damage to the cervix from labor events and subsequent risk of cervical insufficiency. Our study was unable to examine this specific issue since routine cervical length surveillance was not part of antepartum care for the study cohort. Nevertheless, our data are consistent with the hypothesis that a prolonged second stage ≥ 3 hours may have an impact on the cervix that can affect subsequent preterm delivery risk.

Interestingly, when examined as a continuous variable graphically (Figure 2), the risk for preterm delivery trended higher (although this did not reach statistical significance) when second-stage labors were very short. When combined with the preliminary observations of Vyas et al,⁴ women with short initial second-stage labors who have a subsequent preterm delivery may be a subgroup with underlying genetic or cervical structure dysfunction predisposition for prematurity.^{12–14}

The etiology for cervical shortening, cervical insufficiency, and spontaneous preterm delivery in women after a prolonged second stage of labor may be structural damage to the cervical stroma leading to tissue injury and thus an increased susceptibility for early dilation in a subsequent pregnancy.¹⁰ Lacerations in women who experience a prolonged second-stage or an operative vaginal delivery in their first term delivery or surgical factors during a cesarean such as the level of the hysterotomy incision and extensions into the cervix at the time of fetal delivery may also impact the risk of spontaneous preterm delivery at an individual level of cervical integrity.^{9,10} The location and/or repair of a hysterotomy incision during a second-stage cesarean may disrupt the muscle body of the cervix affecting its ability to keep the internal os closed.⁹ Cervical or uterine extensions during a second-stage cesarean repair may also potentially affect cervical function in a future pregnancy.⁹

Strengths and limitations of this study

The strengths of the study include the use of a large sample size from a single institution to evaluate a population where information is available for 2 subsequent deliveries. Pregnancies were managed by providers within 1 institution, although details about these providers and the impact of potential temporal changes in clinical care are not available for further study. We also included deliveries as early as 16 weeks for the second pregnancy, which would have captured cases of cervical insufficiency prior to viability. Finally, labor duration was analyzed in 2 different ways

TABLE 2

Risk of spontaneous preterm birth in second pregnancy in relation to duration of second stage of labor in first term pregnancy

First term pregnancy and duration of second stage of labor	Second pregnancy		
	Pregnancies, n	Spontaneous preterm birth, <37 wk, n (%)	Adjusted hazard ratio (95% confidence interval)
All deliveries			
<30 min	1717	99 (5.8)	1.28 (0.99–1.67)
30–179 min	4496	158 (3.5)	1.00 (Reference)
≥180 min	408	22 (5.4)	1.81 (1.15–2.84)
Spontaneous vaginal delivery			
<30 min	1435	79 (5.5)	1.22 (0.90–1.64)
30–179 min	3412	119 (3.5)	1.00 (Reference)
≥180 min	117	5 (4.3)	1.52 (0.62–3.74)
Vacuum-assisted vaginal delivery			
<30 min	236	17 (7.2)	1.63 (0.87–3.06)
30–179 min	824	30 (3.6)	1.00 (Reference)
≥180 min	89	3 (3.4)	—
Forceps-assisted vaginal delivery			
<30 min	22	1 (4.6)	—
30–179 min	69	5 (7.4)	1.00 (Reference)
≥180 min	9	0 (0.0)	—
Cesarean delivery			
<30 min	24	2 (8.3)	—
30–179 min	192	4 (2.1)	1.00 (Reference)
≥180 min	193	14 (7.3)	3.38 (1.09–10.49)

Hazard ratios were adjusted for maternal age (as evaluated as both a continuous and categorical variable), age,² clinic or private patient, race/ethnicity, smoking, chronic hypertension, and epidural anesthesia.

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with the qualitatively similar associations. This approach provides greater confidence in the reported associations between the duration of second stage of labor and subsequent risk of preterm delivery.

Limitations of our study include the reliance on data available from an administrative data set collected for clinical purposes rather than research goals. This led to an inability to examine a number of other potential contributing factors such as additional confounders, detailed individual information on the index term deliveries (eg, obstetric lacerations or cervical injury at the time of either vaginal or cesarean delivery), and the lack of specific information regarding the etiology of spontaneous preterm

delivery in the subsequent pregnancy. Also, the length of the second stage was based on what was recorded in the database and not the exact duration, as exams were not performed at any set schedule.

Our study was underpowered to find a difference in the risk of spontaneous preterm delivery among women who delivered vaginally after a prolonged second stage of labor. Our study was also underpowered to find an increased risk of spontaneous preterm delivery in women with short second-stage labors in the first term pregnancy, although the near significance is suggestive of a type 2 error for demonstrating the association. The near significance suggests that women with short second stages of labor in a first term pregnancy may have

underlying differences in cervical integrity that may increase the risk of spontaneous preterm delivery in a subsequent pregnancy.

Because this was a single-center study, it is not clear whether the findings are generalizable to other obstetrical populations. The operative vaginal delivery rate reported from this institution is higher than average, potentially limiting the generalizability of our results. However, this is the fourth large study that suggests a link between a prolonged second stage of labor and risk for a subsequent preterm delivery.

Conclusion

In summary, in this cohort of women with 2 consecutive singleton deliveries at

TABLE 3

Risk of preterm birth in second pregnancy in relation to duration of second stage of labor in first term pregnancy

First term pregnancy and duration of second stage of labor	Second pregnancy		
	Pregnancies, n	All preterm births, <37 wk, n (%)	Adjusted hazard ratio (95% confidence interval)
All deliveries			
<30 min	1749	131 (7.5)	1.31 (1.04–1.64)
30–179 min	4551	213 (4.7)	1.00 (Reference)
≥180 min	415	29 (7.0)	1.72 (1.16–2.55)
Spontaneous vaginal delivery			
<30 min	1463	107 (7.3)	1.27 (0.98–1.63)
30–179 min	3452	159 (4.6)	1.00 (Reference)
≥180 min	120	8 (6.7)	1.75 (0.86–3.58)
Vacuum-assisted vaginal delivery			
<30 min	240	21 (8.8)	1.55 (0.89–2.72)
30–179 min	834	40 (4.8)	1.00 (Reference)
≥180 min	90	4 (4.4)	—
Forceps-assisted vaginal delivery			
<30 min	22	1 (4.6)	—
30–179 min	68	5 (7.4)	1.00 (Reference)
≥180 min	9	0 (0.0)	—
Cesarean delivery			
<30 min	24	2 (8.3)	—
30–179 min	192	4 (2.1)	1.00 (Reference)
≥180 min	193	14 (7.3)	2.04 (0.87–4.80)

Hazard ratios were adjusted for maternal age (as evaluated as both a continuous and categorical variable), age,² clinic or private patient, race/ethnicity, smoking, chronic hypertension, and epidural anesthesia.

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a single institution, the risk of spontaneous preterm delivery was higher for women who experienced a prolonged second stage in the first pregnancy. Our findings suggest that a longer second stage of labor may be a significant contributor to preterm delivery risk after a prior term delivery. Our results also suggest that women with short second stages of labor in a first term pregnancy may have an underlying predisposition to have an increased risk of spontaneous preterm delivery in a subsequent pregnancy. Future studies addressing the risk of prematurity after a short second stage in a first term pregnancy as well as cervical lacerations, the timing and indication for cesarean delivery, and the surgical approach to cesareans performed in the second stage of labor may

further clarify the role of cervical injury and the risk of spontaneous preterm delivery in future pregnancies.⁹ Current recommendations to not perform a second-stage arrest cesarean in nulliparous patients until at least 4 hours or 3 hours with or without an epidural, respectively, were developed based primarily on data from shorter term outcomes.^{15,16} There may be unintended consequences of prolonging a second stage of labor ≥3 hours for nulliparous women with respect to the outcome of the next pregnancy, particularly in women who undergo a cesarean after a prolonged second stage of labor. The growing body of literature demonstrating an association between longer second stages of labor and risk of subsequent preterm birth strengthens the

likelihood that the observed associations are real and should lead to rigorous study of potential mechanisms of causality such as the location and repair of the hysterectomy incision and the impact of extensions on cervical integrity.⁹ Such knowledge has the potential to lead to targeted management recommendations that can improve outcomes for subsequent pregnancies. ■

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