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ORIGINAL RESEARCH ARTICLE

The association between episiotomy or OASIS at vacuum extraction in nulliparous women and subsequent prelabor cesarean delivery: A nationwide observational study

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Abstract

Introduction: Severe perineal injuries at childbirth affect women's postnatal health, including future childbirths. First births with vacuum extraction carry an increased risk of obstetric anal sphincter injuries (OASIS). Lateral or mediolateral episiotomy at vacuum extraction may decrease the risk of OASIS. Our aim was to assess whether lateral or mediolateral episiotomy, or OASIS, at vacuum extraction in nulliparous women is associated with prelabor cesarean delivery in the subsequent childbirth.

Material and methods: This is a nationwide observational study using data from the Swedish Medical Birth Register, including women having a first birth with vacuum extraction and a second birth in 2000–2014. Both births were live, single, cephalic, ≥34 gestational weeks without malformations. The association between episiotomy or OASIS in the first birth and prelabor cesarean delivery in the second birth was examined using univariate and multivariate logistic regression with inverse probability of treatment weighting, and interaction analysis. Main outcome measure was prelabor cesarean delivery in the second birth.

Results: In total, 44 656 women with vacuum extraction at their first birth were included. The rate of prelabor cesarean delivery in the second birth was 5.9% (824 of 13 950) in women with episiotomy, compared with 6.0% (1830 of 30 706) in women without episiotomy. Thus, women with episiotomy did not have an increased risk of prelabor cesarean delivery (adjusted odds ratio [aOR] 1.00, 95% confidence interval [95% CI] 0.83–1.20) compared with women without episiotomy. For comparison, the rate of prelabor cesarean delivery in the second birth was 20.6% (1275 of 6176) in women with OASIS, compared with 3.6% (1379 of 38 480) in women without OASIS (aOR 6.57, 95% CI 5.97–7.23). There was no interaction between episiotomy and OASIS.

Conclusions: Lateral or mediolateral episiotomy at vacuum extraction in nulliparous women did not increase the risk of prelabor cesarean delivery in the subsequent childbirth. OASIS increased the odds of prelabor cesarean delivery more than sixfold.

Abbreviations: CI, confidence interval; OASIS, obstetric anal sphincter injury/injuries; OR, odds ratio; VE, vacuum extraction.

KEYWORDS
cesarean section, episiotomy, nulliparous, obstetric anal sphincter injury, subsequent delivery, vacuum extraction

1 | INTRODUCTION

Severe perineal injuries at childbirth affect women's postnatal health, including future childbirths. Women who sustain obstetric anal sphincter injuries (OASIS) have an increased prevalence of prelabor cesarean delivery in subsequent births or may refrain completely from future pregnancies.[1–4] The most important risk factors for OASIS are nulliparity and operative vaginal delivery, such as vacuum extraction (VE).[5]

One commonly used method to prevent OASIS is episiotomy, although routine use is not recommended for normal vaginal birth as it may increase the risk of severe perineal injuries.[6] For operative vaginal delivery, adequately sized, randomized controlled trials of episiotomy vs no episiotomy are lacking.[6–8] Several large observational studies suggest that a lateral or mediolateral episiotomy may reduce OASIS at VE in nulliparous women by 25%–90%.[9–11] The lack of high-grade evidence contributes to the large variation in the use of episiotomy in women with operative vaginal delivery between hospitals and countries (8%–99%).[12,13]

With increasing observational data favoring episiotomy in VE in nulliparous women, the episiotomy rate at VE may increase even in low-use hospitals and countries.[13] However, increased use of episiotomy has raised concerns about how episiotomy, like OASIS, may have negative effects on subsequent childbirths.[3,14] Importantly, episiotomy does not extinguish the risk of OASIS, and a woman can sustain both, especially in VE. Whether episiotomy, OASIS, or both in VE will have consequences for future mode of delivery has not been evaluated.[2,3] The aim of this study was to assess if a lateral or mediolateral episiotomy, with or without OASIS, at VE in nulliparous women increases the risk of prelabor cesarean delivery in the subsequent childbirth.

Key message

Lateral or mediolateral episiotomy in nulliparous vacuum delivery does not increase the risk of subsequent prelabor cesarean delivery, whereas obstetric anal sphincter injury increases the odds six times.

2 | MATERIAL AND METHODS

2.1 | Source population

We used data from the Swedish Medical Birth Register, which prospectively collects detailed information from standardized antenatal, obstetric and neonatal records at all midwifery antenatal clinics and hospitals. The Swedish Medical Birth Register is validated and contains information on 98% of all births, including demographic data, reproductive history and maternal diseases and pregnancy complications since 1997 classified using the Swedish version of the International Classification of Diseases 10th edition (ICD-10).[15,16]

2.2 | Study population and exposure

We identified 323 748 women who gave birth to a first and second child during the study period 2000–2014. Both births were restricted to live born, single neonates, born in cephalic presentation at gestational week 34 or later, without malformations (excluding all ICD-10 Q-diagnoses) in order to exclude common indications for prelabor cesarean delivery such as multiple pregnancy, breech presentation and malformation. To achieve a sample of women with a first birth with VE, we excluded women with spontaneous vaginal delivery, cesarean delivery, forceps delivery or combined instrumental delivery in the first birth. In total, 45 674 (14.1%) women had a first birth with VE (Figure 1).

The exposure lateral or mediolateral episiotomy was defined by a checkbox in the standardized maternal medical record marking a left- or right-sided episiotomy. In total, 13 950 (31.2%) women had a lateral or mediolateral episiotomy and 30 706 (68.8%) had no episiotomy. Women with a midline ($n = 209$, 0.5%) or undefined type of episiotomy (with the procedure code TMA00 but no indication of side, $n = 809$, 1.8%) were excluded. The final cohort included 44 656 women with a lateral/mediolateral episiotomy or no episiotomy (Figure 1).

2.3 | Main outcome measure

The outcome prelabor cesarean delivery in the second birth was retrieved from information on onset of labor (cesarean delivery before labor, as opposed to spontaneous onset or induction of labor).

2.4 | Covariates

Several factors were considered possible confounders and were assessed using a directed acyclic graph (Figure S1). Maternal age at delivery was derived from the personal identification number and categorized in 5-year intervals. Maternal height, weight, body

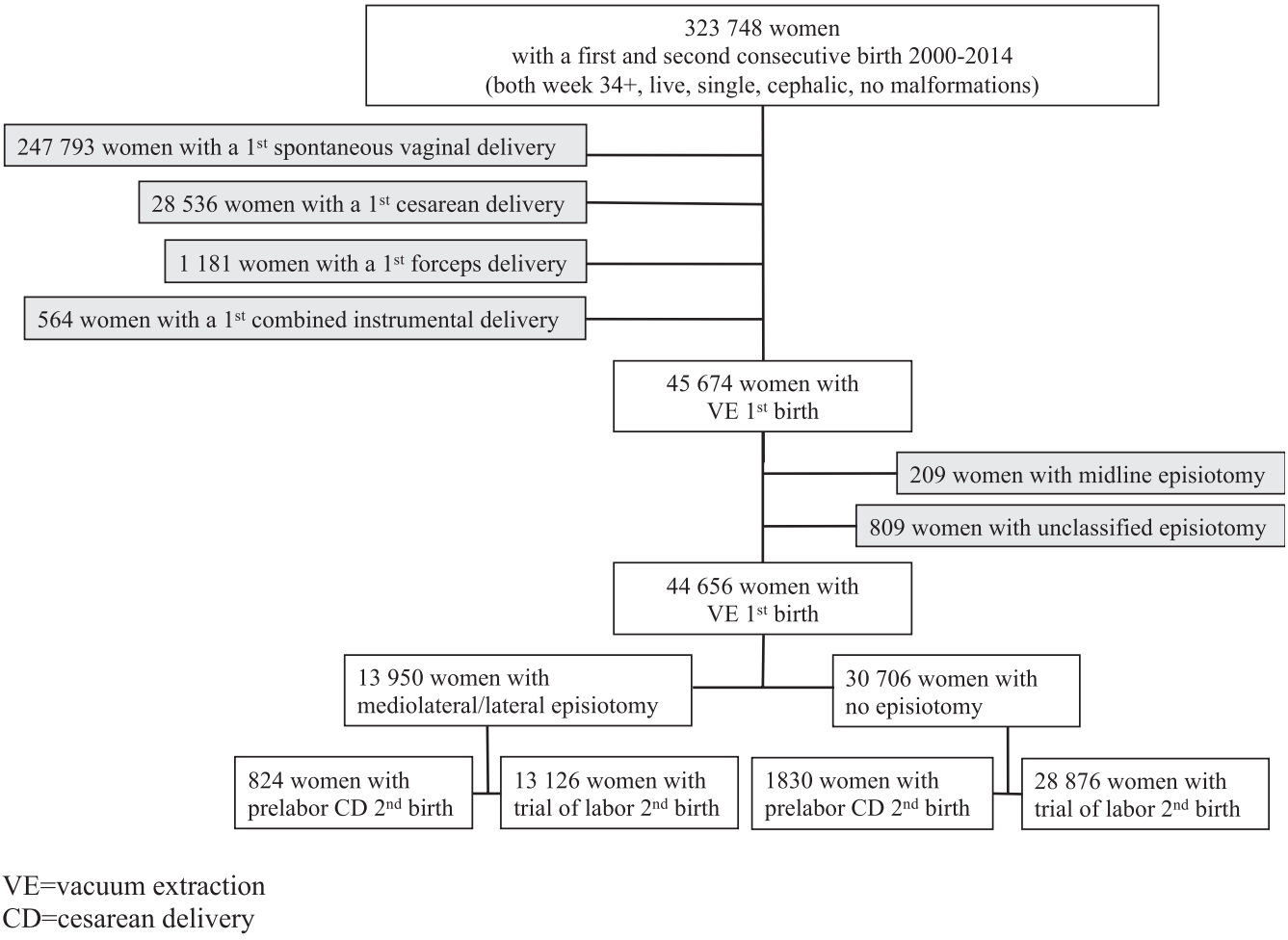


FIGURE 1 Flowchart of cohort.

mass index (BMI) and cohabitation status were retrieved from routinely collected data in antenatal care at booking (week 8–12). Height was dichotomized into <160 or ≥160 cm. BMI was categorized in five groups collating the two most obese groups (BMI 35–39.9 and ≥40 kg/m^2). Maternal country of birth was retrieved from Statistics Sweden, and was categorized as Sweden, other Nordic country (Norway, Finland, Denmark, Iceland) or non-Nordic country. Information on education was collected from the Education Register at Statistics Sweden through linkage using the personal identification number. Higher education was defined as university or college study. Information on smoking was retrieved from standardized antenatal care data (checkbox). Maternal smoking was defined as smoking during the 3 months before the first visit in antenatal care or during pregnancy.

Information on medical history was retrieved from routinely collected data in antenatal care at booking and ICD-10 codes at discharge from the delivery hospital. Maternal pregestational diabetes was defined by antenatal care data (checkbox) or ICD-10 codes E10-E14 and O241-O243. Gestational diabetes was defined by ICD-10 code O244. Preeclampsia included ICD-10 codes O14–O15. Hypertension was defined using both antenatal care data (checkbox) and ICD-10 codes O10-O11 and I10-I15.

Gestational age was calculated using the estimated date of delivery by early second trimester ultrasound, offered to all women in antenatal care, free of charge; when ultrasound estimation was missing, it was calculated using the first day of the last menstrual period. Gestational age was categorized into intervals of complete weeks.

Fetal position was categorized as occiput anterior or occiput posterior. Fetal station was defined using the procedure codes for VE: MAE00 (outlet) and MAE03 (mid-cavity). Fetal distress, labor dystocia or shoulder dystocia was considered to increase the likelihood of episiotomy as well as the risk of prelabor cesarean delivery in the subsequent pregnancy. Suspected intrapartum fetal distress at the first birth by VE was identified by ICD-10 codes O680, O682, O683, O688, O689 in the maternal medical record. Apgar score at 1 min was categorized into <4 or ≥4 and <7 or ≥7, respectively, and used as a proxy for fetal distress or a non-reassuring fetal heart rate at the VE. Labor dystocia was identified by ICD-10 codes O620–O622, O628 and O629. Shoulder dystocia was defined by ICD-10 code O660. We categorized birthweight into 500-g intervals and head circumference into <38 cm or ≥38 cm (90th percentile) to adjust for the perception of a large infant, when choosing to perform an episiotomy or not. We also considered giving birth to a large infant by VE to be a risk factor for prelabor cesarean delivery in the subsequent

pregnancy. The rates of episiotomy and prelabor cesarean delivery may vary with year of delivery and region, thus we categorized these into 5-year-intervals and six healthcare regions.[17]

OASIS was considered a possible mediator and was defined by either a marked checkbox in the maternal medical record called "sphincter" or "rectum", indicating an injury to these tissues, ICD-10 codes O702–O703, or procedure code MBC33 in the first birth. We did not adjust for OASIS in the regression models but performed interaction analyses to examine whether episiotomy and OASIS synergistically affected the outcome.

2.5 | Statistical analyses

Analyses were performed in SPSS 26.0 (IBM Corp, Armonk, NY, USA). Firstly we constructed a directed acyclic graph to establish possible confounders and mediators (Figure S1). Then we explored differences between women exposed to episiotomy or not in the first birth by VE using test of proportions, based on the directed acyclic graph. We considered differences with a *p*-value of <0.10 as possible confounders since these covariates had a 90% likelihood or more of being associated with the outcome (Table 1). Factors analyzed but omitted from Table 1 due to nonsignificant differences were smoking, cohabitation, hypertension and preeclampsia (data not presented).

Secondly, we assessed risk factors for prelabor cesarean delivery in the second birth using covariates from Table 1 in univariate and multivariate regression models. Results are presented as crude and adjusted odds ratios (aOR) with 95% confidence intervals (95% CI) in Table 2. The multivariate model included all factors significant in the univariate analysis: maternal age, country of birth, education, gestational age, epidural, labor dystocia, intrapartum fetal distress, station, head position, head circumference, birthweight, shoulder dystocia, Apgar 1 min <4, Apgar 1 min <7, episiotomy, year of delivery and region of delivery.

Thirdly, the propensity score (the conditional probability of being assigned episiotomy or not) was calculated using all covariates with a *p*-value of <0.10 in Table 1: maternal age, country of birth, maternal height, maternal BMI, higher education, gestational age, epidural, labor dystocia, intrapartum fetal distress, fetal station, head position, head circumference, birthweight, shoulder dystocia, Apgar 1 min <4, Apgar 1 min <7, year of delivery and region of delivery. The propensity score was then used to perform a regression analysis and to calculate an inversed probability of treatment (episiotomy) weight for each individual as initially described by Rosenbaum.[18] We used a modified computer syntax for SPSS provided by Thoemmes et al.[19] The weight was used to account for bias due to observed confounders creating a pseudo-population in which the covariates and the treatment assignment (episiotomy or not) are independent of each other, to mimic a randomized treatment assignment.[20–22] We assessed the outcome using all obtained stabilized weights, as well as truncated stabilized weights, at the 5th and 95th percentiles or the 1st and 99th percentiles.

Fourthly, since episiotomy and OASIS are associated, we explored the prevalence and association of prelabor cesarean delivery in the second birth in women with four principal groups of exposure: "neither episiotomy nor OASIS", "episiotomy, no OASIS", "OASIS, no episiotomy" and "both OASIS and episiotomy", using "neither episiotomy nor OASIS" as reference. The association was tested using multivariate logistic regression adjusting for maternal age, country of birth, higher education, gestational age, epidural, labor dystocia, intrapartum fetal distress, station, head position, head circumference, birthweight, shoulder dystocia, Apgar at 1 min, year of delivery, and region of delivery. Moreover, interaction between episiotomy and OASIS was formally tested using multivariate logistic regression entering the interaction term "episiotomy*OASIS", "episiotomy", "OASIS", and all the confounders used in the multivariate model.

2.6 | Ethics statement

This study was approved by the Regional Ethical Review Board of Stockholm on October 17, 2018 (2018/1858–31/1) prior to study start. This study is reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.[23]

3 | RESULTS

There were some differences between women with lateral/mediolateral episiotomy and women without episiotomy at the first birth by VE (Table 1). Women with episiotomy were younger, shorter and were more often born in Sweden, and had a large infant and a mid-cavity VE for labor dystocia (Table 1). Women with episiotomy less often sustained OASIS (12.0%) than women without episiotomy (14.7%) (Table 1). There were no significant differences with regard to diabetes or induction of labor (Table 1).

In all, 2654 (5.9%) of 44 656 women had a prelabor cesarean delivery in the second birth. Factors contributing to a prelabor cesarean delivery in the second birth were increasing maternal age, increasing gestational age, epidural in the first birth, increasing birthweight, shoulder dystocia, low Apgar score and OASIS in the first birth (Table 2). Being non-Nordic or having the VE in the first birth for suspected intrapartum fetal distress decreased the risk of having a prelabor cesarean delivery in the second birth (Table 2).

Of 13 950 women who had episiotomy in the first birth by VE, 824 (5.9%) had a prelabor cesarean delivery in the second birth, compared with 1830 (6.0%) of the 30 706 women who did not have an episiotomy (Table 2). For comparison, of 6176 women who sustained OASIS at the first birth by VE, 1275 (20.6%) had a significantly increased risk of prelabor cesarean delivery in the second birth, compared with 1379 (3.6%) of women who did not sustain OASIS (Table 2).

TABLE 1 Characteristics in women exposed to episiotomy or no episiotomy in the first birth by VE

	Episiotomy *n* = 13 950		No episiotomy *n* = 30 706		*p*-value
	n	%	*n*	%	
Maternal age (years)					
<25	2855	20.5	5647	18.4	<0.001
25–29	5596	40.1	11 946	38.9	
30–34	4489	32.2	10 501	34.2	
≥35	1010	7.2	2612	8.5	
Country of birth					
Sweden	11 768	84.4	25 610	83.4	0.03
Other Nordic	163	1.2	411	1.3	
Non-Nordic	1966	14.1	4561	14.9	
Missing	53	0.4	124	4.0	
Maternal height (cm)					
<160	1838	13.1	3664	11.9	<0.001
≥160	11 331	81.2	25 156	81.9	
Missing	781	1.3	1886	6.1	
Maternal BMI (kg/m^2)					
<18.5	373	3.0	699	2.6	0.07
18.5–24.9	8372	67.0	18 477	67.5	
25.0–29.9	2862	22.9	6156	22.5	
30.0–34.9	670	5.4	1520	5.6	
≥35.0	223	1.8	535	2.0	
Missing	1450	10.4	3319	10.8	
Higher education					
Yes	8091	58.0	18 530	60.3	<0.001
No	5816	41.7	12 091	39.4	
Missing	43	0.3	85	0.3	
Diabetes, all types					
Yes	178	1.3	337	1.1	0.10
Onset of labor					
Spontaneous	11 736	84.8	25 906	84.6	0.42
Induction	2188	15.2	4729	15.4	
Missing	26	0.2	71	0.2	
Gestational age (weeks)					
34–36	299	2.1	736	2.4	<0.001
37–38	1428	10.2	3402	11.1	
39–40	6519	46.7	15 130	49.3	
41	3668	26.3	7632	24.9	
≥42	2036	14.6	3806	12.4	
Epidural					
Yes	8370	60.0	19 768	64.4	<0.001
VE for labor dystocia					
Yes	7052	50.6	14 910	48.6	<0.001
VE for intrapartum fetal distress					
Yes	5849	41.9	13 447	43.8	<0.001
Fetal station					
Outlet	6209	44.5	14 958	48.7	<0.001

TABLE 1 (Continued)

	Episiotomy $n = 13\,950$		No episiotomy $n = 30\,706$		p-value
	n	%	n	%	
Mid-cavity	5258	37.7	10 044	32.7	
Missing	2483	17.8	5704	18.6	
Head position					
Occiput ant	12 265	87.9	28 729	93.6	<0.001
Occiput post	1685	12.1	1977	6.4	
Head circumference (cm)					
≥38	1020	7.3	2023	6.6	<0.001
<38	12 203	87.5	27 871	90.8	
Missing	727	5.2	812	2.6	
Birthweight (g)					
<3000	1371	9.9	3564	11.6	<0.001
3000–3499	4191	30.1	10 256	33.5	
3500–3999	5335	38.3	11 426	37.3	
4000–4499	2522	18.1	4555	14.9	
≥4500	496	3.6	858	2.8	
Missing	35	0.3	47	0.2	
Shoulder dystocia					
Yes	138	1.0	187	0.6	<0.001
OASIS					
Yes	1671	12.0	4505	14.7	<0.001
Apgar at 1 min					
<4	557	4.0	846	2.8	<0.001
<7	2307	16.6	4223	13.8	<0.001
Missing	43	0.3	49	1.6	
Year of delivery					
2000–2004	6576	47.1	10 236	33.3	<0.001
2005–2009	5326	38.2	14 126	46.0	
2010–2014	2048	14.7	6344	20.7	
Region of delivery					
Sthlm-Gotland	2604	18.7	11 010	35.9	<0.001
West	4016	28.8	4352	14.2	
South	1160	8.3	3377	11.0	
South-East	2084	14.9	4019	13.1	
Middle	2425	17.4	5736	18.7	
North	1656	11.9	2207	7.2	

Note: Missing values estimated when appropriate.

Abbreviations: BMI, body mass index; OASIS, obstetric anal sphincter injuries; Sthlm-Gotland, Stockholm Gotland.

Compared with women without episiotomy, women with episiotomy at the first birth by VE had no increased risk of prelabor cesarean delivery in the second birth (Table 3). This result was consistent using different methods for adjustment. Compared with women without OASIS, women with OASIS at the first birth had five to seven times increased risk of prelabor cesarean delivery in the second birth, among women with or without episiotomy in the first VE birth (Table 4). Of the 1671 women who both sustained OASIS and had episiotomy, 330 (19.7%) women had a prelabor cesarean delivery in the second birth, which did not differ significantly from women with OASIS without episiotomy (Figure 2). Compared with women with neither episiotomy nor OASIS, women with episiotomy

TABLE 2 Risk factors for prelabor cesarean delivery in the second birth

	No prelabor CD $n = 42002$ n (row %)	Prelabor CD $n = 2654$ n (row %)	Crude OR (95% CI)	Adjusted OR (95% CI)
Maternal age				
<25 years	8110 (95.4)	392 (4.6)	Ref (1.0)	Ref (1.0)
25–29 years	16 593 (94.6)	949 (5.4)	1.18 (1.05–1.34)	1.12 (0.97–1.30)
30–34 years	13 934 (93.0)	1056 (7.0)	1.57 (1.39–1.77)	1.44 (1.24–1.66)
≥35 years	3365 (92.9)	257 (7.1)	1.58 (1.34–1.86)	1.50 (1.24–1.81)
Country of birth				
Sweden	35 071 (93.8)	2307 (6.2)	Ref (1.0)	Ref (1.0)
Other Nordic	542 (94.4)	32 (5.6)	0.90 (0.63–1.29)	0.79 (0.52–1.19)
Non-Nordic	6218 (95.3)	309 (4.7)	0.76 (0.67–0.85)	0.83 (0.73–0.96)
Maternal height				
≥160 cm	34 333 (94.1)	2154 (5.9)	Ref (1.0)	-
<160 cm	5191 (94.3)	311 (5.7)	0.96 (0.85–1.08)	-
Maternal BMI				
<18.5 kg/m^2	1004 (93.7)	68 (6.3)	1.09 (0.85–1.40)	-
18.5–24.9 kg/m^2	25 276 (94.1)	1573 (5.9)	Ref (1.0)	-
25.0–29.9 kg/m^2	8475 (94.0)	543 (6.0)	1.03 (0.93–1.14)	-
30.0–34.9 kg/m^2	2064 (94.2)	126 (5.8)	0.98 (0.81–1.18)	-
≥35.0 kg/m^2	720 (95.0)	38 (5.0)	0.85 (0.61–1.18)	-
Higher education				
Yes	24 973 (93.8)	1648 (6.2)	1.12 (1.03–1.21)	1.00 (0.91–1.11)
Gestational age				
34–36 weeks	1012 (97.8)	23 (2.2)	Ref (1.00)	Ref (1.00)
37–38 weeks	4614 (95.5)	216 (4.5)	2.06 (1.33–3.18)	1.80 (1.06–3.05)
39–40 weeks	20 480 (94.6)	1169 (5.4)	2.51 (1.65–3.81)	1.81 (1.08–3.05)
41 weeks	10 469 (92.6)	831 (7.4)	3.49 (2.30–5.31)	2.20 (1.31–3.70)
≥42 weeks	5427 (92.9)	415 (7.1)	3.37 (2.20–5.15)	1.84 (1.09–3.13)
Epidural[a]				
Yes	26 111 (92.8)	2027 (3.8)	1.97 (1.80–2.16)	1.68 (1.51–1.87)
Labor dystocia[a]				
Yes	20 403 (92.9)	1559 (7.1))	1.51 (1.39–1.63)	1.08 (0.97–1.20)
Fetal distress[a]				
Yes	18 429 (95.5)	867 (32.7)	0.62 (0.57–0.68)	0.76 (0.68–0.84)
Station[a]				
Outlet	20 102 (95.0)	1065 (5.0)	Ref (1.00)	Ref (1.00)
Mid-cavity	14 156 (92.5)	1146 (7.5)	1.53 (1.40–1.67)	1.15 (1.05–1.27)
Head position[a]				
Occiput ant	38 594 (94.1)	2400 (5.9)	Ref (1.00)	Ref (1.00)
Occiput post	3408 (93.1)	254 (6.9)	1.20 (1.05–1.37)	1.13 (1.07–1.19)
Head circumference[a]				
<38 cm	37 836 (94.4)	(2238 (5.6)	Ref (1.00)	Ref (1.00)
≥38 cm	2752 (90.4)	291 (9.6)	1.79 (1.57–2.03)	1.15 (0.99–1.34)
Birthweight[a]				
<3000 g	4782 (96.9)	153 (3.1)	Ref (1.00)	Ref (1.00)
3000–3499 g	13 844 (95.8)	603 (4.2)	1.36 (1.14–1.63)	1.25 (1.01–1.55)
3500–3999 g	15 720 (93.8)	1041 (6.2)	2.07 (1.74–2.46)	1.66 (1.34–2.06)

TABLE 2 (Continued)

	No prelabor CD $n = 42002$ n (row %)	Prelabor CD $n = 2654$ n (row %)	Crude OR (95% CI)	Adjusted OR (95% CI)
4000–4499 g	6430 (90.9)	647 (9.1)	3.15 (2.63–3.77)	2.37 (1.89–2.98)
≥4500 g	1158 (85.5)	196 (14.5)	5.29 (4.24–6.60)	3.54 (2.66–4.71)
Shoulder dystocia[a]				
Yes	233 (71.7)	92 (28.3)	6.44 (5.04–8.22)	2.77 (2.02–3.80)
Apgar at 1 min[a]				
<4	1203 (85.7)	200 (14.3)	2.77 (2.37–3.23)	1.70 (1.35–2.13)
<7	5917 (90.6)	613 (9.4)	1.84 (1.67–2.02)	1.40 (1.23–1.59)
Year of delivery				
2000–2004	15751 (93.7)	1061 (6.3)	Ref (1.00)	-
2005–2009	18369 (94.4)	1083 (5.6)	1.04 (0.93–1.16)	-
2010–2014	7882 (93.9)	510 (6.1)	0.91 (0.82–1.02)	-
Region of delivery				
Sthlm-Gotl	12560 (92.3)	1054 (7.7)	Ref (1.00)	Ref (1.00)
West	7927 (94.7)	441 (5.3)	0.66 (0.59–0.74)	0.74 (0.65–0.86)
South	4337 (95.6)	200 (4.4)	0.55 (0.47–0.64)	0.69 (0.58–0.83)
South-East	5816 (95.3)	287 (4.7)	0.59 (0.51–0.67)	0.61 (0.52–0.72)
Middle	7699 (94.3)	462 (5.7)	0.72 (0.64–0.80)	0.83 (0.73–0.95)
North	3655 (94.6)	208 (5.4)	0.68 (0.58–0.79)	0.75 (0.63–0.90)
Episiotomy[a]				
Yes	13126 (94.1)	824 (5.9)	1.00 (0.99–1.01)	0.98 (0.89–1.09)[b]
OASIS[a]				
Yes	4901 (79.4)	1275 (20.6)	7.00 (6.45–7.60)	6.57 (5.97–7.23)[c]

Abbreviations: BMI, body mass index; CD, cesarean delivery; CI, confidence interval; OASIS, obstetric anal sphincter injury/injuries; OR, odds ratio; Sthlm-Gotl, Stockholm-Gotland.

[a]First birth factor (for example intrapartum fetal distress at first birth by VE).

[b]The adjusted model for prelabor CD after episiotomy included all covariates in Table 1 except maternal height and BMI (nonsignificant in the univariate analyses) and OASIS (mediator).

[c]The adjusted model for prelabor CD after OASIS included all covariates in Table 1 except maternal height, BMI and episiotomy (nonsignificant in the univariate analyses).

TABLE 3 Episiotomy in first birth by vacuum extraction and risk of prelabor cesarean delivery in the second birth

Method of adjustment	OR (95% CI)
Univariate logistic regression	1.00 (0.99–1.01)
Multivariate logistic regression	0.98 (0.89–1.09)
Propensity score regression	0.99 (0.89–1.09)
Inverse probability weighting, SW	0.99 (0.82–1.19)
Inverse probability weighting, tSW5-95	1.00 (0.83–1.20)
Inverse probability weighting, tSW1-99	0.99 (0.82–1.20)

Abbreviations: CI, confidence interval; OR, odds ratio; SW, stabilized weights; tSW5-95, truncated stabilized weights, values <5th and >95th percentiles are truncated; tSW1-99, truncated stabilized weights, values <1st and >99th percentiles are truncated.

but no OASIS had a marginally increased risk of a prelabor cesarean delivery in the second birth (aOR 1.19, 95% CI 1.04–1.36). However, there was no interaction between episiotomy and OASIS ($p = 0.84$).

4 | DISCUSSION

In this nationwide cohort study of 44656 women with two consecutive births of a live, cephalic, single, non-malformed infant after 34 complete gestational weeks, we found that there was no association between a lateral or mediolateral episiotomy at a first birth with VE and having a prelabor cesarean delivery in the second birth. For comparison, an OASIS at the first birth by VE increased the risk six times of having a prelabor cesarean delivery in the second birth.

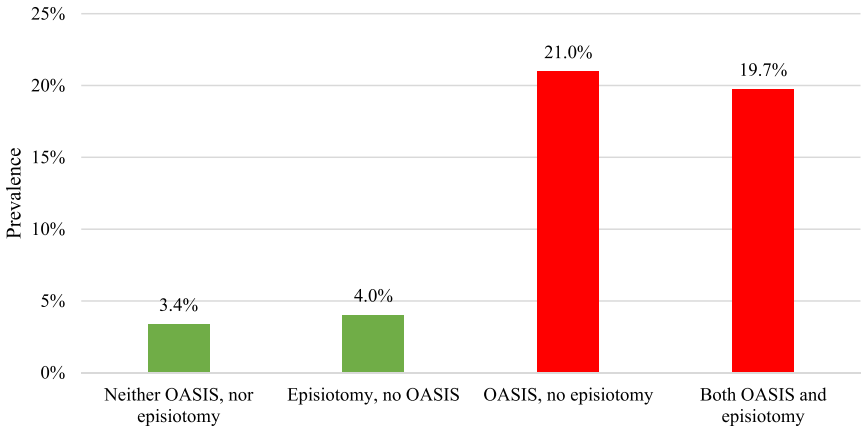
The main strength of this study is the nationwide, comprehensive data and the large sample size. Furthermore, we used several statistical methods to adjust for confounding and selection bias. With logistic regression, we could identify characteristics contributing to episiotomy in women undergoing VE in the first birth, as well as contributors to a prelabor cesarean delivery in the second pregnancy. Using inverse probability of treatment weights, we could balance all known characteristics prior to episiotomy and thereby emulate the average treatment effect that would be seen in a randomized

TABLE 4 Prelabor cesarean delivery in the second birth stratified by episiotomy and OASIS at vacuum extraction in the first birth

Exposure in first birth	No prelabor CD in the second birth	Prelabor CD in the second birth		
	n = 42002	*n* = 2654		
	n (row %)	*n* (row %)	OR (95% CI)	aOR (95% CI)
No episiotomy, *n* = 30706				
No OASIS, *n* = 26201	25316 (96.6)	885 (3.4)	1.00 (ref)	1.00 (ref)
OASIS, *n* = 4505	3560 (79.0)	945 (21.0)	7.59 (6.88–8.38)	7.01 (6.24–7.87)
Episiotomy, *n* = 13950				
No OASIS, *n* = 12279	11785 (96.0)	494 (4.0)	1.00 (ref)	1.00 (ref)
OASIS, *n* = 1671	1341 (80.3)	330 (19.7)	5.87 (5.05–6.82)	5.89 (4.93–7.04)

Note: Adjustments were made for the following covariates from Table 2: maternal age, country of birth, higher education, gestational age, epidural, labor dystocia, intrapartum fetal distress, station, head position, head circumference, birthweight, shoulder dystocia, Apgar at 1 min, year of delivery and region of delivery.

Abbreviations: aOR, adjusted OR; CD, cesarean delivery; CI, confidence interval; OASIS, obstetric anal sphincter injury; OR, odds ratio (unadjusted).



OASIS=obstetric anal sphincter injuries.

FIGURE 2 Prelabor cesarean delivery in the second birth in women with episiotomy and/or obstetric anal sphincter injuries (OASIS) at vacuum extraction in the first birth according to four principal exposure groups.

controlled trial of episiotomy or no episiotomy in VE with similar inclusion criteria.

A potential limitation is that unmeasurable confounding may reside. For example, tissue properties or doctors' preferences cannot be examined. To adjust for the variation in use of episiotomy we included year and region of delivery in the model.[13] Moreover, women with missing values were excluded in the adjusted analyses. Albeit, since both unadjusted and adjusted models showed no significant difference in prelabor cesarean delivery in the second birth, it is not likely that imputation of missing values would change the result. Another limitation is that we could not establish the indication for the prelabor cesarean delivery in the second birth since this is not comprehensively registered in the Swedish Medical Birth Register. Thus, we did not exclude women with certain diagnoses such as fetal growth restriction or placenta previa. Therefore, it is uncertain whether the indication for prelabor cesarean delivery differed between women with and without episiotomy in the first birth by VE. With regard to the first VE, the diagnosis codes intrapartum fetal distress and labor dystocia are almost only used to motivate the procedure and were used to estimate the indication. Interestingly, and despite the commonly accepted indication "fetal distress" for episiotomy in Sweden, a diagnosis code of suspected fetal distress was slightly less common in women with episiotomy. In addition, women with this diagnosis had a lower risk of prelabor cesarean delivery in the second birth, perhaps reflecting that this indication results in less physical and emotional sequelae than when VE is performed for labor dystocia.

Our finding of no increased risk of prelabor cesarean delivery after episiotomy in VE is somewhat contrary to previous studies.[2,3] A British and an Australian study found a slight (10%–18%) increase in prelabor cesarean delivery after episiotomy, perhaps because they included all vaginal first births without stratification for vacuum, forceps or spontaneous vaginal delivery.[2,3] Women with episiotomy, if not stratified for type of vaginal birth, could have experienced a more difficult birth than women without episiotomy, and could therefore require an elective cesarean delivery in the subsequent birth. The Australian study points out operative vaginal delivery as the strongest contributor to elective cesarean

delivery in the subsequent birth,[3] and episiotomy is more commonly used in operative vaginal delivery. In addition, the type of episiotomy was not specified in the previous studies,[2,3] which generalized the estimation for lateral or mediolateral episiotomy with midline episiotomies, which are known to be associated with severe perineal injuries.[24]

Compared with women with neither episiotomy nor OASIS, women with episiotomy but no OASIS had a marginally increased rate of prelabor cesarean delivery in the second birth. The difference was minor and the interaction between episiotomy and OASIS was not significant. Therefore, these results should be interpreted with caution. Moreover, the comparison with women with neither episiotomy nor OASIS is not informative for decision-making when considering to perform an episiotomy or not, since the outcome of having OASIS or not is not guaranteed.

Similar to our second finding, both the British and Australian studies found a marked increase (5–18 times) in prelabor cesarean delivery after OASIS.[2,3] This increase is probably seen in many countries, due to common guidelines recommending doctors to counsel women on the elevated risk of recurrent OASIS in subsequent vaginal births,[1,25–27] and to suggest an elective cesarean delivery after OASIS.[28] There are no such recommendations after episiotomy, although we acknowledge that women may have bothering sequels after episiotomy as well.

Our study forecasts a null effect on future prelabor cesarean delivery if lateral or mediolateral episiotomy were to become routine in VE in nulliparous women based on inverse probability of treatment weighting as well as logistic regression methods. Sustaining an OASIS at the first birth with VE is more tangible with a sixfold risk of subsequent prelabor cesarean delivery. Preventing OASIS is the main reason of routine episiotomy in VE. However, as the highly inconsistent use of episiotomy in VE in nulliparous women suggests, there may be several reasons to perform or not perform an episiotomy in VE.[12,13] We suggest that fear of increased subsequent prelabor cesarean delivery should not be a reason to avoid a lateral or mediolateral episiotomy in VE. To confirm this null effect, a long-term follow-up of participants in randomized controlled trials of episiotomy or no episiotomy in VE, such as the ongoing multicenter EVA trial in Sweden,[8] is desirable. Further research should also include the effect of lateral or mediolateral episiotomy on future risk of repeat episiotomy, subsequent OASIS and long-term pelvic floor function.

5 | CONCLUSION

In this nationwide cohort study, there was no association between routine lateral or mediolateral episiotomy at a first birth with VE and increased prelabor cesarean delivery in the second birth. In contrast, OASIS at the first birth with VE entailed a sixfold risk of subsequent prelabor cesarean delivery. Routine episiotomy (lateral or mediolateral) need not be avoided for fear of increased subsequent prelabor cesarean delivery.

AUTHOR CONTRIBUTIONS

SBW and CL conceived the study. OS acquired the data and SBW and CL and managed the dataset. SBW, CL and OS planned the analyses. SBW and CL performed the analyses. SBW, CL and OS interpreted the results. SBW wrote the first draft, with critical and technical input from CL and OS. All authors approved of the final version of the paper.

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CONFLICT OF INTEREST

All authors declare no conflict of interest.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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