Risk of Obstetric Anal Sphincter Injury by Delivering Provider Type

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Research Article

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Abstract

Introduction and Hypothesis: Obstetric anal sphincter injuries (OASIs) complicate 5.8% of vaginal deliveries. Our objective was to assess if the primary delivering provider, nurse-midwife versus physician obstetrician, is associated with OASIs.

Methods: We performed a secondary analysis of the *Consortium of Safe Labor*, a multicenter, retrospective cohort study. Included were nulliparous women with singleton, vaginal delivery at ³ 37 weeks from 2002-2008. Women were excluded if delivery was complicated by shoulder dystocia or from sites without midwife deliveries. Student t-tests, chi-squared analysis and Fisher's exact test were used as appropriate. Multivariable logistic regression and propensity score matching analyses were performed.

Results: Of 228,668 births at 19 sites, 2,735 births from 3 sites met inclusion criteria: 1,551 physician and 1,184 midwife births. Of all births, 4.2% (n=116) were complicated by OASIs. Physician patients were older, more often White, privately insured, with higher BMI, more medical co-morbidities, and labor inductions/augmentations. Midwife patients had higher fetal gestational age and infant birth weights (all p<.05). OASIs were more common in physician compared to midwife births (5.9% vs 2.0%, p<.0001). This difference persisted on multivariable logistic regression. OASIs were 2.4 (95%CI 1.5- 3.9) times more likely with physician delivery when controlling for maternal heart disease, episiotomy, increasing maternal age, decreasing maternal BMI, non-white race, and increasing birthweight. AUC was 0.78. With propensity score matching, OASIs remained higher amongst physicians (6.6% vs 1.8%, p<.0001; aOR 3.8 (95%CI 2.0-7.1)).

Conclusion: OASIs were more common in physician compared to midwife deliveries even when controlling for other associated factors.

Brief Summary

In this paper, we assess primary delivering provider, nurse-midwife versus physician obstetrician, as a risk factor for obstetric anal sphincter injury.

Introduction

Obstetrical anal sphincter injury (OASI) is defined as injury to the anal sphincter and/or rectal mucosa sustained during vaginal delivery. OASIs complicates approximately 5.8% of all vaginal deliveries in the U.S. and there is a notable increasing trend in its incidence globally [1, 2]. There is significant associated short- and long-term morbidity of OASIs including wound infection, perineal pain, dyspareunia, fecal incontinence, psychological distress, and impaired quality of life. In addition, risk of OASIs with subsequent deliveries may be up to 5 times as high [2–4]. Risk factors commonly reported are non-modifiable such as nulliparity, increasing maternal age, White race, operative deliveries, episiotomy, and

large fetal weight [1, 5–8]. Only a few studies have attempted to assess modifiable risk factors, such as the type of delivering provider. These studies have yielded varying data regarding the associated risk of OASIs and were limited to specific patient cohorts in Ireland and the United Kingdom [9, 10].

There is a paucity of research that comparatively examines the type of delivering provider as a risk factor for OASIs in racially diverse patient populations, specifically in the United States where the obstetric care model varies from the Europe. We propose that by obtaining a modern cohort of nulliparous women and controlling for factors known to be associated with OASIs, we can investigate whether having a certified nurse-midwife or physician obstetrician as the primary provider during vaginal delivery confers an associated risk of OASIs. Identifying a novel risk factor for OASIs can be used to assist delivering providers minimize the risk of OASIs during vaginal delivery.

Materials And Methods

This is a secondary analysis of the Consortium on Safe Labor (CSL) data. The CSL is a multi-centered, retrospective cohort study which collected birth data from 228,668 deliveries from 19 hospitals within 12 institutions across the United States from 2002 to 2008. Given this nationally available database, this study was exempt from Institutional Review Board.

Inclusion criteria for our analysis consisted of nulliparous women with successful vaginal deliveries of a cephalic, singleton fetus at ≥37 weeks of gestation. Women were excluded if their delivery was complicated by shoulder dystocia, if data regarding perineal lacerations at the time of delivery was missing or if the site did not have midwife led birth-attendants.

Maternal variables of interest include race, ethnicity, age, education level, insurance type, pre-pregnancy BMI and weight, weight at the time of hospital admission, medical history (diabetes, hypertension, renal, heart, or thyroid disease, depression), smoking history, antenatal complications, and history of antenatal hospitalization. Intrapartum variables of interest include use of induction agents and labor augmentation, fetal distress, analgesia use, operative delivery technique, episiotomy, and length of second stage labor. Labor induction included the use of mechanical and/or pharmacological methods including artificial rupture of membranes, mechanical dilation, misoprostol and other prostaglandins, and oxytocin. Fetal variables of interest included gestational age at the time of delivery and fetal birthweight.

The primary outcome was the presence of OASIs in physician obstetrician versus certified nurse-midwife vaginal births. We hypothesized that a higher number of OASIs would be seen amongst midwives compared to physicians. A post-hoc power calculation was performed indicating we have a power of 99.9% at an alpha of 0.05, given the cohort size and difference in OASIs between the groups. Our secondary outcome included assessing whether the difference in OASIs amongst the two provider types continued when adjusting for known risk factors of OASIs.

Student t-tests, chi-squared analyses and Fisher’s exact tests were used as appropriate to assess baseline characteristics, labor factors, and frequency of OASIs within the two groups of providers. Results were

presented as means ± standard deviation for continuous, normally distributed variables and frequencies (percentages) for categorical variables. Multivariable logistic regression and propensity score matching analysis were performed to adjust for characteristics associated with OASI. Factors with a $p < 0.2$ were fit with backward and forward stepwise techniques to create the final model with variables associated with OASIs.

Data are presented as adjusted odds ratio (aOR) with 95% confidence intervals. SAS statistical software was used to perform the analyses (Institute Inc., Cary, NC, USA). This study was categorized as exempt from the George Washington University Institutional Review Board.

Results

Of 228,668 births at 19 sites included in the database, a total of 2,735 births from 3 sites met inclusion criteria: 1,551 physician and 1,184 midwife births. Physician patients were older (23 ± 5 vs 21 ± 4 years), more often white (26.4% vs 14.3%), commercially insured (39.1% vs 22.8%), and had higher pre-pregnancy BMI (25.5 ± 6.4 vs 24.8 ± 5.8 kg/m^2; *all* $p < .05$; Table 1). Pre-existing medical conditions such as diabetes, heart disease, hypertension, thyroid disease, and smoking were more common in the physician cohort (*all* $p < .05$; Table 1). Antenatal medical complications such as gestational diabetes, antenatal hospital admission, and preeclampsia were also more common in the physician cohort (*all* $p < .05$; Table 1). Physician patients were more likely to undergo labor inductions (40.9% vs 20.4%), the most common method being oxytocin infusion (37.1% vs 18.7%), as well as labor augmentation compared to midwife patients (28.2% vs 16.2%, *all* $p < .05$; Table 2). More episiotomies and operative deliveries occurred in the physician cohort (15.5% vs 5.2%, and 5.1% vs 0.08%; *all* $p < .05$). Midwife patients had more advanced fetal gestational ages (39.7 ± 1.1 vs 39.4 ± 1.2 weeks) and greater infant birth weights (3.3 ± .4 vs 3.2 ± .4 kg; *all* $p < .05$) at the time of vaginal delivery (Table 3).

Of all births, 4.24% (n = 116) were complicated by OASIs. OASIs were more common in physician compared to midwife births at 5.9% (n = 92) compared to 2.0% (n = 24) respectively ($p < .0001$). A multivariable logistic regression revealed this difference persisted with an adjusted odds of OASIs being 2.39 times more likely with physician delivery than midwife delivery (95%CI 1.5–3.9). In this regression model other factors associated with OASIs were maternal history of heart disease, receipt of episiotomy, increasing maternal age, decreasing maternal BMI, non-white race, and increasing fetal birthweight (Table 4). Operative delivery was not significant in the multivariable regression and thus was not included in the final model. Area under the curve for this model was found to be 0.78.

Additionally, propensity score matching was conducted to ensure the strength of the regression model. A propensity score match was used to balance all potential confounders. We found 1,054 matches per cohort with OASIs rates of 6.6% and 1.8% for physicians and midwives, respectively. Physician was associated with 3.8 higher odds of OASIs relative to midwife (95% CI2.0- 7.; $p = 0.0002$).

Discussion

The overall rate of OASIs amongst our study population was 4.24% which is similar to the approximate rate found in the full CSL cohort at 5.8% [1]. We discovered in this cohort, physicians were serving a slightly older, Whiter, and more affluent population than the midwives. Physician patients were also more likely to have medical co-morbidities documented and undergo labor induction and/or augmentation compared to certified nurse-midwife patients. Even when controlling for these population differences and known risk factors for OASIs, we found OASIs at the time of vaginal delivery was more likely with an obstetrician physician as the delivering provider when compared to certified nurse-midwives.

This is one of the first studies to examine the delivering provider as a risk factor for OASIs in the U.S. Only a few studies have examined delivery provider as a risk factor for OASIs which were based in England and Ireland, respectively. One prospective, observational study in compared rates of OASIs in a hospital obstetric unit to those in several freestanding midwifery-led units [10]. Women who delivered in the midwifery-led units more frequently had intact perineum at the time of vaginal delivery. In comparison, a recent study in a university-affiliated district hospital found the risk of OASIs was twice as likely in the midwifery-led units compared to the hospital's obstetrician-led units [9]. Not only do these data conflict, but likely are not generalizable to a diverse patient population and an American treatment paradigm.

We suspect there are a few differences between physicians and midwives that have led to the differences in OASIs. First, a mentioned above, the patient populations, at least in this cohort, are different. Physician patients in our study had more pre-existing and antenatal medical comorbidities, which may have led to more intrapartum complications or higher risk of maternal/fetal distress requiring an expedited delivery. There was a higher frequency of fetal distress and intrapartum magnesium use within the physician cohort comparatively, which may support this theory. Although, interestingly midwife patients had more meconium-stained fluid, which can traditionally be a sign of fetal distress.

Secondly, there are also major differences in practice style. Our findings also reaffirm the pattern of decreased use of labor induction and augmentation agents as well as delivery interventions amongst midwives when compared to physicians [13]. A study exploring the effect of midwives on perinatal outcomes in the U.S. demonstrated that midwife practice favors waiting for spontaneous onset of labor, hospital admission once active labor is reached, and more conservative with use of pharmacologic and/or surgical interventions during the progression of labor which is consistent with our findings [14]. Our analysis demonstrates that with the use of less intrapartum interventions, we see a lower frequency of OASIs specifically amongst the midwife patients. It is possible that our findings reflect and support limited labor or birth interventions, a core aspect of midwifery philosophy, as a tool to reduce OASIs.

A third major consideration for the decreased OASIs amongst midwife providers is that they may be underdiagnosed. A 2012 survey found only 34% of midwives reported they were confident in OASI assessment at the time of delivery and just 22% indicated they felt prepared to repair the laceration [15]. An additional survey conducted in 2020 revealed the overall accuracy of perineal laceration identification amongst the midwife respondents ranged from 49–99% and a high frequency of OASIs misidentification was accompanied by subsequent inappropriate use of the OASIs severity grading scale [16]. Although

these surveys took place in the U.K. where the midwifery model differs from the U.S., there is a possibility that OASIs may be underrepresented amongst our midwife patient cohort.

A final consideration is the presence and participation of physician trainees (fellows, residents, and medical students) in patient care at the time of delivery. This is a delivery factor impacting the physician cohort in our study which we were unable to measure. As the institutions associated with this database are teaching hospitals, we must consider the possibility that by allowing physician trainees particularly those early in their careers to participate in vaginal deliveries this may increase the risk of more advanced obstetric lacerations. While there is not considerable research comparatively examining the role of physician trainees and the incidence of OASIs, a 2016 retrospective cohort study examined the role of midwife experience. Highly experienced midwives, those with greater than 10 years of experience, had the lowest incidence of OASIs when compared to midwives deemed moderately experienced or inexperienced, between 2 and 10years and less than 2 years of experience respectively [3].

A major strength of this study is our large, racially, and socioeconomically diverse patient population from multiple centers. This is more reflective of the general population of the U.S. than previous studies examining the frequency of OASIs amongst varying provider types. In addition, we identified a risk factor that has not been fully assessed for OASIs. It is common knowledge that operative deliveries and episiotomies increase the risk. However, our study findings ask an important question about the way physicians manage labor and how that increases the risk of OASIs.

A major limitation is the exclusion of data from CSL sites with an absence of certified nurse-midwife providers. Although there has been a steady increase in the rate of midwife attended hospital births in the United States since 1975 reaching a peak of 8.6% in 2016, a majority of sites included in the CSL did not include midwives as lead birth-attendants at the time of delivery [14, 17]. Secondly, absent or missing data from the database and inconsistent documentation of factors of interest such as length of induction and length of labor was an additional limitation which prevented full examination of these factor. In addition, in our analysis we were unable to determine if patients underwent intrapartum transfers from midwifery to physician care. This commonly occurs on Labor and Delivery due to evolving complications and may impact the risk of OASIs. Lastly, the only midwife deliveries considered in this database were hospital deliveries which may not be reflective of midwifery care in birth-centers and home births where the incidence of OASIs may differ. Although these limitations may affect the generalizability of our results, there is an association that needs to be further explored to prevent negative impact of OASIs on postpartum women.

We have identified physician providers as a potential modifiable risk factor for OASIs. While women may not be able to choose their provider, differences in risk of OASIs are likely not innate to physicians and thus can be modified. Ultimately, further prospective research is needed to confirm our findings particularly differences in OASIs amongst physician obstetricians and certified nurse-midwives in the U.S. It would also allow for more comprehensive examination of the role of labor induction and augmentation agents, presence of trainees, transfer of care from midwives to physicians, provider experience, as well as

standardized OASIs assessment at the time of delivery. The growth of the field of midwifery in the U.S. is supported by published research promoting safe and effective care and is thought to be a possible solution to the reported national shortage of reproductive and obstetric providers [18]. Our findings may support the idea that collaborative practice amongst physician obstetricians and certified nurse-midwives can improve maternal outcomes, specifically that of anal sphincter injury, at the time of vaginal delivery.

Abbreviations

OASIs
Obstetric anal sphincter injuries
CSL
Consortium on Safe Labor
aOR
Adjusted odds ratio

Declarations

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Contributions:

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References

1. Landy HJ, Laughon SK, Bailit JL et al (2011) Characteristics associated with severe perineal and cervical lacerations during vaginal delivery. Obstet Gynecol 117(3):627–635
2. Naidu M, Sultan AH, Thakar R (2017) Reducing obstetric anal sphincter injuries using perineal support: our preliminary experience. Int Urogynecol J 28(3):381–389
3. Mizrachi Y, Leytes S, Levy M et al (2017) Does midwife experience affect the rate of severe perineal tears? Birth 44(2):161–166

4. Edozien LC, Gurol-Urganci I, Cromwell DA et al (2014) Impact of third- and fourth-degree perineal tears at first birth on subsequent pregnancy outcomes: a cohort study. BJOG 121(13):1695–1703
5. Hopkins LM, Caughey AB, Glidden DV, Laros RK (2005) Jr. Racial/ethnic differences in perineal, vaginal and cervical lacerations. Am J Obstet Gynecol 193(2):455–459
6. Carroli G, Mignini L (2009) Episiotomy for vaginal birth.Cochrane Database Syst Rev.(1):Cd000081
7. Mikolajczyk RT, Zhang J, Troendle J, Chan L (2008) Risk factors for birth canal lacerations in primiparous women. Am J Perinatol 25(5):259–264
8. Williams A, Gonzalez B, Fitzgerald C, Brincat C (2019) Racial/Ethnic Differences in Perineal Lacerations in a Diverse Urban Healthcare System. Female Pelvic Med Reconstr Surg 25(1):15–21
9. O'Leary BD, Ciprike V (2020) Are women attending a midwifery-led birthing center at increased risk of anal sphincter injury? Int Urogynecol J 31(3):583–589
10. Smith LA, Price N, Simonite V, Burns EE (2013) Incidence of and risk factors for perineal trauma: a prospective observational study. BMC Pregnancy Childbirth 13:59
11. Meister MR, Cahill AG, Conner SN, Woolfolk CL, Lowder JL (2016) Predicting obstetric anal sphincter injuries in a modern obstetric population. Am J Obstet Gynecol 215(3):310e311–310e317
12. Yamasato K, Kimata C, Burlingame JM (2019) Associations Between Maternal Obesity and Race, with Obstetric Anal Sphincter Injury: A Retrospective Cohort Study. Hawaii J Med Public Health 78(1):8–12
13. Raipuria HD, Lovett B, Lucas L, Hughes V (2018) A Literature Review of Midwifery-Led Care in Reducing Labor and Birth Interventions. Nurs Womens Health 22(5):387–400
14. Neal JL, Carlson NS, Phillippi JC et al (2019) Midwifery presence in United States medical centers and labor care and birth outcomes among low-risk nulliparous women: A Consortium on Safe Labor study. Birth 46(3):475–486
15. Bick DE, Ismail KM, Macdonald S, Thomas P, Tohill S, Kettle C (2012) How good are we at implementing evidence to support the management of birth related perineal trauma? A UK wide survey of midwifery practice. BMC Pregnancy and Childbirth 12(1):57
16. Diko S, Sheeder J, Guiahi M et al (2020) Identification of obstetric anal sphincter injuries (OASIs) and other lacerations: a national survey of nurse-midwives.International urogynecology journal.
17. Martin JA, Hamilton BE, Osterman MJK, Driscoll AK, Drake P (2018) Births: Final Data for 2016. Natl Vital Stat Rep 67(1):1–55
18. Johantgen M, Fountain L, Zangaro G, Newhouse R, Stanik-Hutt J, White K (2012) Comparison of labor and delivery care provided by certified nurse-midwives and physicians: a systematic review, 1990 to 2008. Womens Health Issues 22(1):e73–81

Tables

Table 1. Baseline Maternal Demographics by Provider Type

	Provider Type		
Variable	**Physician**	**Midwife**	**P-Value**
	N=1551	**N=1184**	
Age (years)	23.71 (±5.49)	21.53 (±4.50)	<0.0001
Race/Ethnicity			<0.0001
White/non-hispanic	410 (26.43%)	169 (14.27%)	
Black/non-hispanic	654 (42.17%)	609 (51.44%)	
Hispanic	325 (20.95%)	326 (27.53%)	
Asian/Pacific Islander	91 (5.87%)	20 (1.69%)	
Other	71 (4.58%)	60 (5.07%)	
Highest level of education			<0.0001
Less than HS diploma	204 (13.15%)	257 (21.71%)	
HS diploma	202 (13.02%)	223 (18.83%)	
More than HS diploma	351 (22.63%)	232 (19.59%)	
Unknown	794 (51.19%)	472 (39.86%)	
Insurance type			<0.0001
Commercial	607 (39.14%)	270 (22.80%)	
Public	919 (59.25%)	895 (75.59%)	
Self-pay	24 (1.55%)	15 (1.27%)	
Other/ Unknown	1 (0.06%)	4 (0.34%)	
Pre-pregnancy BMI (kg/m^2) *	25.46 (±6.39)	24.83 (±5.84)	<0.0001
Pre-pregnancy weight (kg) *	68.08 (±18.58)	66.07 (±17.05)	<0.0001
Pre-existing Maternal Medical History			
Diabetes	36 (2.32%)	3 (0.25%)	<0.0001
Heart Disease	16 (1.03%)	2 (0.17%)	0.003
Renal Disease	4 (0.26%)	1 (0.08%)	0.2238
Depression	83 (5.35%)	56 (4.73%)	0.463
Thyroid Disease	28 (1.81%)	3 (0.25%)	<0.0001
Chronic Hypertension	59 (3.80%)	2 (0.17%)	<0.0001

Smoking during Pregnancy	187 (12.06%)	108 (9.12%)	0.014
Maternal Antenatal History			
Antenatal Hospital Admission *	159 (10.25%)	58 (4.90%)	<0.0001
External Cephalic Version	3 (0.19%)	1 (0.08%)	0.316
Antepartum Group B Step	432 (27.85%)	371 (31.33%)	0.048
Gestational Diabetes	80 (5.16%)	2 (0.17%)	<0.0001
Preeclampsia/HELLP *	7 (0.45%)	0	<0.0001
Superimposed Preeclampsia *	15 (0.97%)	0	<0.0001

* Variable had greater than 5% of missing data during the analysis

HS: High school; BMI: Body Mass Index; HELLP: Hemolysis, Elevated Liver enzymes, Low Platelet count

Diabetes: Includes both Type I and Type II Diabetes Mellitus

Data are presented as mean (± standard deviation) or frequency (%)

Table 2. Hospital Admission and Labor Factors by Provider Type

	Provider Type		
Variable	**Physician**	**Midwife**	**P-Value**
	N=1551	**N=1184**	
Admission Factors			
Weight at admission (kg)	83.64 (±18.67)	81.51 (±17.49)	<0.0001
Reason for admission			<0.0001
Fetal indications	25 (1.61%)	23 (1.94%)	
Induction	553 (35.65%)	194 (16.39%)	
Labor	596 (38.43%)	673 (56.84%)	
Maternal indications	105 (6.77%)	18 (1.52%)	
SROM[a] without labor	222 (14.31%)	243 (20.52%)	
Other/ Unknown	50 (3.23%)	33 (2.79%)	
Labor Factors			
Induction of labor	634 (40.88%)	242 (20.44%)	<0.0001
Type of induction agent used			
AROM	279 (17.99%)	82 (6.93%)	<0.0001
Misoprostol	32 (2.06%)	0 (0.00%)	<0.0001
Mechanical	10 (0.64%)	1 (0.08%)	<0.0001
PGE2	89 (5.74%)	4 (0.34%)	<0.0001
Oxytocin	576 (37.14%)	222 (18.75%)	<0.0001
Method of rupture			<0.0001
AROM	340 (21.92%)	128 (10.81%)	
SROM	1198 (77.24%)	1054 (89.02%)	
Other/Unknown	13 (0.84%)	2 (0.17%)	
Labor augmented	438 (28.24%)	192 (16.22%)	<0.0001
Magnesium received	118 (7.61%)	18 (1.52%)	0.001
Labor analgesia			<0.0001
Epidural/Spinal/ Combination	1186 (76.47%)	573 (48.4%)	

Local	72 (4.64%)	113 (9.54%)	
Other/Unknown/ Missing	213 (13.73%)	368 (31.08%)	
None	80 (5.16%)	130 (10.98%)	
Intrapartum fever	114 (7.35%)	101 (8.53%)	0.257
Intrapartum fetal distress	98 (6.32%)	51 (4.31%)	0.022
*Variable had greater than 5% of missing data during the analysis			
SROM: Spontaneous rupture of membranes; AROM: Artificial rupture of membranes			
PGE2: ProstaglandinE-2			
Data are presented as mean (± standard deviation) or frequency (%)			

Table 3. Delivery Variables by Provider Type

	Provider Type		
Variable	**Physician N=1551**	**Midwife N=1184**	**P-Value**
OASIs	92 (5.9%)	24 (2.0%)	<.0001
Operative delivery	79 (5.09%)	1 (0.08%)	<0.0001
Episiotomy	241 (15.54%)	62 (5.24%)	<0.0001
Meconium present	214 (13.80%)	231 (19.51%)	<0.0001
Total length of labor (hours) *	16.17 (±10.83)	17.85 (±13.12)	<0.0001
Length of 2nd stage labor (minutes) *	77.84 (±88.04)	63.81 (±103.23)	<0.0001
Length of induction (hours) *	10.18 (±7.39)	10.83 (±9.42)	<0.0001
Fetal Birthweight (kilograms)	3.23 (±0.44)	3.26 (±0.41)	<0.0001
Estimate fetal gestational age (weeks)	39.43 (±1.17)	39.71 (±1.12)	<0.0001
37	191 (12.31%)	86 (7.26%)	
38	346 (22.31%)	201 (16.98%)	
39	455 (29.34%)	363 (30.66%)	
40	559 (36.04%)	534 (45.10%)	
*Variable had greater than 5% of missing data during the analysis OASIs: Obstetrical Anal Sphincter Injuries			
Data are presented as mean (± standard deviation) or frequency (%)			

Table 4. Multivariable Logistic Regression of Factors Associated with OASIs

Maternal Variable	Adjusted Odds Ratio	95% Confidence Interval
Physician as delivering provider	2.39	1.5- 3.9
Maternal history of heart disease	3.90	1.03- 14.6
Episiotomy	3.10	2.0- 4.9
Maternal age	1.08	1.04- 1.1
Maternal Body Mass Index	0.95	0.92- 0.99
Non-white race	0.61	0.4- 0.96
Fetal birthweight	1.03	1.02- 1.05