Pregnancy Outcomes Among Women with Epilepsy in Washington State, 1987 – 2012

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Abstract

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Epilepsy, one of the most common neurological disorders, is characterized by chronic recurrent seizures and may be associated with pregnancy complications and adverse outcomes for the mother and infant. We compared the occurrence of selected adverse pregnancy outcomes among women with epilepsy to occurrence among women without epilepsy with deliveries in Washington State, 1987-2012. We conducted a population-based retrospective cohort study using linked vital-hospital discharge records to identify women with epilepsy based on diagnosis codes in the hospital discharge record at delivery. For comparison, a random sample of women without these codes with deliveries during the same years was identified. Adverse maternal and infant outcomes, and rehospitalization and mortality within 2 years of delivery were considered. Relative risks (RRs) and 95% confidence intervals (CI) were calculated using Poisson regression. Women with epilepsy had greater risk of several adverse pregnancy outcomes, including preeclampsia (RR: 1.2; 95% CI: 1.06-1.51) and gestational diabetes (RR: 1.27; 95% CI: 1.08-1.50), and were more likely to require intensive care unit admission after delivery (RR: 7.41; 95% CI: 3.15-17.46). They were more likely to be rehospitalized (RR: 1.32; 95% CI: 1.19-1.45), or to die (RR: 6.15; 95% CI: 2.02-18.73) during the 2 years after delivery, compared to women without epilepsy. Their infants had increased risks of malformation (RR: 1.25; 95% CI: 1.07-1.47) and of being small for gestational age (RR: 1.35; 95% CI 1.20-1.53), but were not at risk for early or late mortality. These findings may be used to inform clinicians caring for women with epilepsy.

Introduction:

Epilepsy is a brain disorder with multiple etiologies characterized by chronic recurrent seizures[1]. This condition may be categorized into multiple types based on disease attributes such as location of seizure onset (focal vs generalized), seizure control (tractable, or controlled vs intractable, or uncontrolled), and seizure characteristics (e.g. convulsive vs non-convulsive)[2,3]. Each of these types may be the result of a genetic, acquired, or provoked event or condition at any stage in an individual's life cycle that disrupts the normal pattern of neuron activity such as infection, abnormal brain development, or head injury[4]. Specifically, neuron activity may be disrupted from neuron ion-channel dysfunction, abnormalities in synaptic transmission, abnormal neuron networks, or a combination of these and other factors[5,6,7].

Epilepsy is one of the most common neurological conditions, with a worldwide lifetime prevalence of approximately 7.6 per 1,000 people[8]. In the United States, it is estimated that 1.1 million women of reproductive age have active epilepsy with 0.3-0.5% of all pregnancies occurring among women with epilepsy[9,10]. Continued treatment with antiepileptic drugs (AEDs) is usually recommended for women with active epilepsy to reduce seizure-related maternal and fetal injury[11]. Prior research on epilepsy and pregnancy-related outcomes has largely focused on associations between treatment with specific AEDs and adverse maternal and infant outcomes, linking specific AEDs with increased risk of congenital malformations and developmental deficits in the infant[9,12].

Less information is available on the overall burden of epilepsy disease on pregnancy-related outcomes in women[12]. Although several large cohort studies have attempted to quantify the risk of selected adverse neonatal and obstetrical outcomes among women with epilepsy, discrepancies in specific outcome risks remain. For example, one population-based study using

health registry data found increased risks for preterm delivery, being born small for gestational age, and congenital malformations that were independent of AED use[13], whereas another population-based study found no such association among pregnant women with epilepsy not using AEDs[14]. Additionally, a 2015 meta-analysis noted a similar risk of admission to the neonatal intensive care unit (NICU) among infants of women with and without epilepsy[15], contrary to two recent publications[16,17]. This lack of consistent findings presents challenges to women with epilepsy making reproductive decisions and to providers caring for this population[9,12]. Without a better understanding of specific risks, women with epilepsy who are concerned about poor obstetrical or neonatal outcomes may elect to forego pregnancy or choose to not adhere to a treatment plan during or prior to pregnancy. It is therefore important to continue to evaluate possible associations between maternal epilepsy and adverse pregnancy outcomes in order to better estimate the risks, or lack thereof, provide guidance for clinical decision-making, and to help affected women make well-informed choices about childbearing.

The overarching goal of this study was to determine whether or not women with epilepsy and their infants had a greater occurrence of selected adverse pregnancy-related outcomes including mortality and rehospitalization up to 2 years post-delivery, as compared to women and their infants without this condition, using population-based linked birth-hospital discharge records for Washington State 1987-2012. Additionally, we examined epilepsy type-specific associations and overall associations by time period to explore whether there were differences in outcomes pre- and post-use/marketing of specific anti-epileptic medications.

Methods:

Study Design and Data Sources:

This study used a retrospective population-based cohort design to assess the association between epilepsy in pregnant women and the occurrence of select maternal and neonatal outcomes in Washington State, 1987-2012. The Comprehensive Hospital Abstract Reporting System (CHARS) that maintains hospital discharge records for Washington State was linked to birth/fetal death certificates and death records to ascertain information on delivery hospitalizations and rehospitalizations and mortality for the mother and infant up to 2 years post-delivery. This analysis was part of a larger, research study seeking to quantify the occurrence of adverse pregnancy outcomes among women with disabilities who gave birth in Washington State[18]. Institutional review board approvals for this study were obtained from Washington State and the Fred Hutchinson Cancer Research Center.

Study Population:

Women with epilepsy were identified using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis code 345.x (epilepsy and recurrent seizures). All available fields (up to 25) of the maternal discharge diagnosis codes were screened for the delivery hospitalization; a total of 2,199 women were identified. The comparison group comprised a randomly selected sample of women without disabilities (among 17 conditions identified as disabilities within the larger study) with deliveries in Washington State, in a 10:1 ratio (n=21,990), frequency matched on delivery year. Because characteristics of multiple gestations (1% of women with epilepsy, 1.3% of comparison women) and fetal deaths (0.5% of women with epilepsy, 0.4% of comparison women) differ from those of singleton deliveries, these were excluded (data not shown), leaving data for 2,168 singleton live birth deliveries to women with epilepsy and 21,587 deliveries to comparison women.

Outcomes and Covariates:

Select maternal and neonatal outcomes were identified from the birth, hospital discharge, and death records. The Washington State birth records indicate the presence of an outcome using a checkbox and the hospital discharge records contained as many as nine ICD-9 diagnosis and six procedure codes for this project, both of which were used to ascertain outcomes in our study. Where available, outcome data from both sources in combination were used to improve the sensitivity of our measurement of conditions and outcomes[18].

Maternal pregnancy outcomes ascertained from both the hospital discharge and the birth records included preeclampsia/eclampsia (ICD-9 codes 642.4-642.6); gestational diabetes (ICD-9 code 648.8,); placental abruption (ICD-9 codes 641.20, 641.21, 641.23); preterm premature rupture of membranes (PPROM) (ICD-9 code 658.2 and <37 weeks gestation); induction of labor (ICD-9 codes 659.0, 659.1, procedure codes 73.01, 73.1, 73.4, 96.49); malpresentation/breech (ICD-9 codes 652.x, 652.2, 669.6, 763.0, 761.7); preterm labor (ICD-9 codes 644.0, 644.2 and <37 weeks gestation); cesarean delivery (ICD-9 codes 669.7, 763.4, procedure codes 74.0-74.2, 74.4, 74.9); and post-partum hemorrhage (ICD-9 codes 666.x). Admission to the intensive care unit (ICU) was assessed via the birth record only and mortality <2 years of delivery was ascertained through the linked death records. Length of delivery hospitalization and occurrence of rehospitalizations < 2 years post-delivery were ascertained from linkage to subsequent years of hospital discharge records.

Infant outcomes measured in both the hospital discharge and birth records included congenital malformations (ICD-9 codes 740.x-759.x); fetal distress (ICD-9 codes 656.3, 768.2-768.4) and meconium aspiration (ICD-9 codes 770.1). Variables identified in the birth certificate only included low birth weight (<2500g); gestational age at delivery (<37 weeks, 37+ weeks); size for gestational age (<10^{th} percentile/small, (10^{th}-90^{th} percentile/appropriate, >90^{th}

percentile/large, based on distributions of singleton births in Washington State); Apgar score at 5 minutes (<7, 7-10); assisted ventilation >30 minutes; breastfeeding; and admission to the neonatal intensive care unit (NICU). Linked death certificates were used to identify mortality < 28 days, and < 2 years of delivery. Length of delivery hospitalization and occurrence of rehospitalizations < 2 years were ascertained from the linkage to subsequent years of hospital discharge records. Covariates assessed from the birth certificate included maternal age (12-19, 20-24, 25-29, 30-34, 35-39, 40+ years); marital status; race/ethnicity (white, black, Hispanic, Asian, American Indian/ Alaska Native, Pacific Islander, other); maternal education (<12, 12, 13-16, 17+ years); prenatal smoking; number of prior pregnancies (0, 1, 2+); number of prior births (0, 1, 2+); prior fetal deaths (0, 1+); participation in the Women, Infant, Children (WIC) nutrition program; urban/rural residence); pre-pregnancy body mass index (BMI) (<18.5, 18.5-24.9, 25.0-29.9, 30+ kg/m^2); pregnancy weight gain (less than appropriate, appropriate, more than appropriate); and whether fertility treatment was used for the index pregnancy. Pre-pregnancy BMI was classified based on World Health Organization (WHO) standards[19]. Pregnancy weight gain was classified based on the American College of Obstetricians and Gynecologists (ACOG) guidelines[20]. Covariates assessed using a combination of birth and hospital discharge records included chronic hypertension (ICD-9 codes 401.x-405.x, birth record) and established diabetes (ICD-9 codes 250.0-250.9, 362.0, 648.01-648.02. Type of insurance at hospital discharge (private, Medicaid/Medicare) was assessed from the hospital discharge record only.

Statistical Analyses:

Descriptive statistics were used to assess distributions and missing data; <5% of data was missing for covariates of interest unless otherwise indicated. Relative risks (RRs) were estimated using incidence rate ratios (iRRs) with 95% confidence intervals (CI) calculated from robust Poisson regression models as multiple of our outcomes were not uncommon in the general population. After *a priori* adjustment for maternal age and delivery year, additional confounders were assessed and retained in the final models if the adjusted RRs differed by >10% from the initial estimate. For variables not available during the entire study period (e.g. BMI information was available on the birth certificate for 2003 or later), analyses were restricted to the relevant time period. Interaction was assessed using stratified analysis and inclusion of the interaction term in the regression models. Interaction was considered present and presented as stratified if the ratio of RRs with vs. without the interaction term differed and was clinically/meaningfully important. No examined covariate met our criteria for confounding or interaction.

Variables considered as potential confounders included parity, race/ethnicity, pre-pregnancy BMI, education and type of insurance at delivery as proxies for socioeconomic status, prenatal smoking, established diabetes, and chronic hypertension. Additionally, smoking status, chronic hypertension, and established diabetes were also assessed for interaction with epilepsy as physiological manifestations of smoking and the two comorbidities when combined with an epilepsy diagnosis may produce a synergistic effect on the outcomes of interest, for example, by increasing the frequency and/or severity of seizures[21,22,23].

Sub-group and Sensitivity Analyses:

To examine epilepsy type-specific associations, four epilepsy categories were used. These included status epilepticus grand mal (ICD-9 code 345.3) vs petit mal status (absence status) (ICD-9 code 345.2) / epilepsia partialis continua (EPC) (ICD-9 code 345.70); convulsive

(ICD-9 codes 345.1, 345.3, 345.70) vs non-convulsive epilepsy (ICD-9 codes 345.0, 345.2, 345.4, 345.5); intractable (ICD-9 codes 345.01, 345.11, 345.41, 345.51, 345.71, 345.81, 345.91) vs tractable epilepsy (ICD-9 codes 345.00, 345.10, 345.40, 345.50, 345.70, 345.80, 345.90); and primary generalized (ICD-9 codes 345.0-345.2) vs focal epilepsy (345.4, 345.5, 345.70). Women with more than one epilepsy diagnosis were included in each relevant sub-group. These categories were selected because status epilepticus, convulsive seizures with epilepsy, and intractable epilepsy may put patients at additional risks such as seizure-related outcomes and more intensive AED treatment. Additionally, the primary generalized subgroup was selected as a subpopulation of women in the generalized epilepsy group may be more likely to be prescribed valproic acid associated with higher teratogenicity risk than other AEDs due to ineffectiveness of other less teratogenic options. Therefore, these sub-groups may have different risks of occurrence of selected outcomes in our population.

To assess possible effects of temporal changes in epilepsy management, we also examined selected outcomes by birth year: 1987-1996, corresponding to 1st and several new 2nd generation AED availability[24], and recommendations for monotherapy treatment with 1st generation AEDs; 1997-2006, corresponding to 1st and all new 2nd generation AED availability and new recommendations for monotherapy treatment with 2nd generation AEDs[24,25]; and 2007-2012, corresponding to new 3rd generation AED availabillity[24]. Finally, because women with epilepsy may also have additional disabilities, while the comparison group is comprised of women without any disabilities, we conducted a sensitivity analysis excluding the 49 women with other disability types based on ICD-9 codes (multiple sclerosis, cerebral palsy, spina bifida, paralyses/spinal cord injury, stroke polio, myasthenia gravis, muscular dystrophy,

chondrodystrophy, rheumatoid arthritis, intellectual disability, deafness/blindness, cystic fibrosis, systemic lupus, ankylosing spondylitis) from our exposure group.

Results:

The majority of women with epilepsy (79%) had an ICD-9 of 345.9 (epilepsy, unspecified) diagnosis, followed by 345.1 (generalized, convulsive epilepsy) for 10% (Table 1). No cases had ICD-9 345.7 (epilepsia partialis continua). Women with epilepsy were more likely than comparison women to be white (83% vs 75%) or to smoke during pregnancy (21% vs 13%) (Table 2). They were also more likely to have Medicaid/Medicare insurance (52% vs 40%) or to be WIC recipients (55% vs 40%), but less likely to be married (61% vs 70%). The remaining characteristics were generally similar between the two groups.

Maternal Outcomes:

In analyses adjusted for birth year and maternal age, women with epilepsy had increased risks of preeclampsia/ eclampsia (RR: 1.27; 95% CI: 1.06-1.51), gestational diabetes (RR: 1.27; 95% CI: 1.08-1.50), PPROM (RR: 1.53; 95% CI: 1.10-2.13), induction of labor (RR: 1.16; 95% CI: 1.08-1.25), preterm labor (RR: 1.50; 95% CI: 1.31-1.72), cesarean delivery (RR: 1.24; 95% CI: 1.16-1.33, among women without prior deliveries), ICU admission (RR:7.41; 95% CI: 3.15-17.46), and delivery hospitalizations of 6+ days for vaginal deliveries (RR: 2.28; 95% CI: 1.89-2.74) compared to women without epilepsy (Table 3). During the 2 years after delivery, women with epilepsy were also more likely to be rehospitalized (RR: 1.32; 95% CI: 1.19-1.45), rehospitalized 2 or more times (RR: 1.31; 95% CI: 1.19-1.45), and rehospitalized within the first

6-months (RR: 2.02; 95% CI: 1.64-2.49). Their risk of dying within 2-years post-delivery was markedly increased (RR: 6.15; 95% CI: 2.02-18.73).

Infant Outcomes:

Relative to infants of comparison women, infants of women with epilepsy were at a modestly increased risk for congenital malformation (RR: 1.25; 95% CI: 1.07-1.47) and had increased risks of meconium aspiration (RR: 2.58; 95% CI: 1.29-5.17), low birth weight (RR: 1.70; 95% CI: 1.45-1.99), preterm birth (RR: 1.53; 95% CI: 1.33-1.76), being small for gestational age (RR: 1.35; 95% CI: 1.20-1.53), requiring assisted ventilation >30 minutes (RR: 1.93; 95% CI: 1.27-2.94), NICU admission (RR: 1.69; 95% CI: 1.41-2.03), or not being breastfed (RR: 3.01; 95% CI: 2.66-3.40) (Table 4). Their delivery hospitalizations were longer than those of comparison infants regardless of delivery type. Although there is a suggestion that they were more likely to be rehospitalized during their first two years of life (RR: 1.14; 95% CI: 1.00-1.31), especially during the first 6 months after delivery; they did not have increased risk of early or late death.

Subgroup Analyses:

Due to the majority of women having an unspecified epilepsy diagnosis at discharge, we had limited power to estimate risks within epilepsy type-specific subgroups. Women with status epilepticus as well as their infants had slightly greater proportions of selected outcomes such as preterm delivery and admission to the ICU/NICU than women with petit mal status and their infants (Tables 5-6). Similarly, the convulsive epilepsy group had a greater proportion of infants who were not breastfed than did the non-convulsive epilepsy group (Tables 7-8). Intractable epilepsy presented slightly greater risks for preterm labor and cesarean delivery than did tractable disease and a higher proportion of infants not being breastfed (Tables 9-10). There were

no large differences in outcomes between women classified as having focal vs. generalized epilepsy, although a greater proportion of women with focal seizures had longer delivery hospitalizations (Table 11). Finally, the proportion of congenital malformations was slightly higher among infants of women with primary generalized epilepsy than observed in infants of women with focal epilepsy (Table 12).

Most maternal outcomes were generally similar across study years (1987-1996; 1997-2006; 2007-2012) with a few exceptions (Supplementary Tables 1-3). The occurrence of preeclampsia/eclampsia increased in both women with and without epilepsy over time, but to a greater extent in women with epilepsy (4% in both groups in the earliest time period; 8% and 5% during 1997-2006, and 7% and 5% during 2007-2012 in women with and without epilepsy, respectively), resulting in approximately 2-fold increased risks of preeclampsia/eclampsia in the later years (RR: 1.60; 95% CI: 1.11-2.35). Whereas the occurrence of PPROM remained the same in women without epilepsy over time (1%), the occurrence doubled in women with epilepsy in the latter time period (1% in earliest time period; and 2% in the latter two time periods), corresponding to a 2-fold increased risk for PPROM for the latest time period (RR: 1.81; 95% CI: 1.20-2.72). Outcomes for infants were similar across all study periods (Supplementary Tables 4-6).

Sensitivity Analysis:

Exclusion of women with other disabilities from our exposed cohort provided comparable risk estimates for all outcomes (data not shown).

Discussion:

In this study of women with epilepsy with deliveries in Washington State, both women with epilepsy and their infants were at an increased risk for several adverse pregnancy and birth outcomes including preeclampsia/eclampsia, preterm labor, being small for gestational age, and NICU admissions. Of concern, women with epilepsy were also nearly 7 times more likely to be admitted to the ICU and 6 times more likely to die <2 years after delivery than were comparison women. Additionally, infants of women with epilepsy were 3 times less likely to be breastfed compared to infants of women without epilepsy. Finally, women with epilepsy, but not their infants, were more likely to be rehospitalized within 2 years of delivery.

Several population-based studies and meta-analyses have previously established associations between several adverse pregnancy and neonatal outcomes; our study further contributes to this growing body of literature[12,13,16,26,27,28]. Notably, a 2015 US population-based study using medical records found nearly an 11-fold increase of maternal mortality during the delivery hospitalization time period among women with epilepsy. This high risk could potentially be a result of obstetrical complications, seizure-related outcomes, or AED-related complications, as well as higher rates of sudden unexpected death in epilepsy (SUDEP).[27] While both of our studies were not without limitations including inability to rule out unmeasured confounding such as presence of comorbidities that may put these women at higher risk, additional research including an exploration of causes of mortality is warranted and extra vigilance may be warranted for women with this condition.

It is also discouraging to note that despite several studies finding no association between AED use in epilepsy and adverse infant outcomes and current literature advising providers to encourage breastfeeding among women with epilepsy, infants of women with epilepsy were 3 times less likely to be breastfed[29,30,31]. While studies on perceptions of women with epilepsy on

breastfeeding safety are limited, one study conducted out of Iran found that women with epilepsy were less likely to initiate breastfeeding due to concerns over infant AED exposure through breastmilk[32].

To our knowledge no study has previously assessed the risk between epilepsy and rehospitalization post-delivery. However, a previous study has found that women with epilepsy were more likely to be hospitalized during pregnancy[28]. Rehospitalization post-delivery could result from increased pregnancy complications, which is supported by our findings that women with epilepsy were also at an increased risk for being hospitalized within the first 6 months after delivery, whereas no association was found for the 12 to 24-month period. Alternately, this could correspond to the increased rehospitalization risk that is epilepsy-specific and independent of pregnancy.

The lack of data available limited our ability to assess associations by epilepsy subtype. However, the increased proportions of adverse maternal and birth outcomes for status epilepticus were in line with the severity of this seizure condition that may require admission to the ICU, with some adverse outcomes documented in prior non-controlled studies [33,34]. Encouragingly, no maternal deaths were noted among this group contrary to the other observations[33]. Prior research has suggested that treatment non-compliance may be a trigger for status epilepticus[35]. Women concerned about AED use impacting their pregnancies may decide to forego medications, which may potentially result in this more severe form of epilepsy. It is possible that the uncontrolled nature of the seizures and/or the corresponding increased likelihood of polytherapy AED among women with intractable epilepsy may have contributed to the greater occurrence of adverse outcomes. The higher likelihood of polytherapy use could have also contributed to the higher proportion of infants not being breastfed among this group than among infants of women with

tractable, well-controlled epilepsy. Similarly the greater occurrence of congenital malformations among infants of women experiencing primary generalized epilepsy may also potentially be a result of increased AED use for seizure control throughout the pregnancy[36]. As this is the first study to our knowledge examining pregnancy outcomes by epilepsy type, additional research is warranted to better describe the risks and of women belonging to these groups.

This exploratory analysis was not without limitations. Because the epilepsy outcome was ascertained with ICD-9 codes at time of hospitalization, we did not have access to information on disease duration, severity, or frequency of seizures, and may have excluded women with less severe disease. Although our sub-group analyses allowed us to assess the severity and nature of the illness, we were limited by small numbers as the majority of our exposed population had an epilepsy, unspecified diagnosis. Despite this, our findings generally agreed with our expectation that adverse outcomes would be more commonly observed in the more severe condition groups such as status epilepticus. We also lacked data on medication use, including AEDs, as well as information on treatment adherence. Nevertheless, this study allowed us to estimate the risks associated with epilepsy as a whole, including potential effects of pharmaceuticals on these outcomes. Furthermore, our sub-group analyses gave us an insight into the severity of illness and therefore an increased likelihood of treatment for more severe epilepsy types. Although our comparison group was composed of women without any disabilities, whereas women with epilepsy could have a co-disability present, exclusion of women with multiple disabilities from the exposed population resulted in similar findings for all outcomes. Finally, we were missing data in some years for some covariates, such as maternal education, BMI, and gestational weight gain, which limited our ability to assess their effects, however missingness of our data appeared to be non-differential for the majority of covariates.

Despite our study limitations, our study also had many strengths. It was a large population-based study, therefore limiting the possibility of selection bias. The large sample size allowed us to explore how risks of adverse outcomes in women with epilepsy may have differed by epilepsy type as well as over time. Access to rehospitalization data for mother and their infants up to 2 years post-delivery also allowed us to look at longer-term adverse outcomes potentially associated with maternal epilepsy.

Our findings suggest that women with epilepsy as well as their infants are at a greater risk for adverse pregnancy and neonatal outcomes including a high risk of maternal mortality when compared to women without epilepsy. The risks of outcomes may differ by epilepsy type, although additional research is needed to further explore this hypothesis. Taken together, our findings contribute to the growing body of literature on epilepsy and may be used to inform clinical practice as well as allow women to make more informed choices about childbearing.

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Table 1 - Disease characteristics of women with epilepsy who had singleton live birth deliveries in Washington State, 1987-2012.

		Women with Epilepsy (N=2168)	
		Number	**%**
ICD-9 Codes [a]			
345.0X	Generalized non-convulsive	93	4.2
345.1X	Generalized convulsive	206	9.5
345.2X	Petit mal status	23	1.1
345.3X	Grand mal status	29	1.3
345.4X	Partial, with impairment of consciousness	31	1.4
345.5X	Partial, without impairment of consciousness	32	1.5
345.6X	Infantile spasms	0	0.0
345.7X	Epilepsia partialis continua	0	0.0
345.8X	Other forms of epilepsy	33	1.5
345.9X	Epilepsy, unspecified	1728	79.7
Epilepsy Types			
Status epilepticus[c]			
Petit mal (345.2, 345.70)		23	1.0
Grand mal (345.3)		29	1.4
Convulsive seizures[c]			
Non-convulsive seizures (345.0, 345.2, 345.4, 345.5)		178	8.2
Convulsive seizures (345.1, 345.3, 345.70)		234	10.8
Intractable epilepsy[c]			
Tractable (345.00, 345.10, 345.40, 345.50, 345.70, 345.80, 345.90)		1852	98.7
Intractable (345.01, 345.11, 345.41, 345.51, 345.71, 345.81, 345.91)		27	1.3
Primary generalized epilepsy[c]			
Focal epilepsy (345.4, 345.5, 345.70)		63	15.2
Primary generalized epilepsy (345.0-345.2)		322	77.8

[a] A woman may have more than one ICD-9 epilepsy diagnosis.

Table 2 - Characteristics of women with and without epilepsy with singleton live birth deliveries in Washington State, 1987-2012.

	Women with Epilepsy (N=2168)		Comparison Women (N=21587)	
	Number	%	Number	%
Age (years)				
12-19	189	8.7	1933	8.9
20-24	568	26.2	4902	22.7
25-29	678	31.3	6432	29.8
30-34	498	23.0	5346	24.8
35-39	199	9.2	2418	11.2
40+	36	1.6	556	2.6
Marital status				
Married	1324	61.4	15020	69.8
Single	834	38.6	6513	30.2
Race/ethnicity				
White	1750	82.5	15768	74.8
Black	75	3.6	888	4.2
Hispanic	147	6.9	2032	9.6
Asian	60	2.8	1485	7.0
American Indian/Alaska Native	78	3.7	528	2.5
Pacific Islander	11	0.5	391	1.9
Other	0	0	2	0
Education (years) [a]				
<12	353	20.4	3060	17.9
12	513	29.7	4320	25.2
13-16	768	44.4	8057	47.1
17+	96	5.5	1678	9.8
Smoked prenatally				
No	1587	79.4	17245	86.7
Yes	412	20.6	2643	13.3
Missing	169	(7.8)	1699	(7.9)
No. prior pregnancies				
0	673	31.7	6883	32.5
1	594	27.9	5927	27.9
2+	859	40.4	8395	39.6
No. prior births				
0	957	44.8	9011	42.3
1	665	31.1	6720	31.6
2+	514	24.1	5549	26.1
No. prior fetal deaths[b]				
0	370	63.5	3927	67.2
1+	210	36.5	1907	32.8
Insurance at discharge				

Private	1035	47.7	13050	60.5
Medicaid/Medicare	1133	52.3	8536	39.5
WIC participant[c]				
No	543	45.2	6860	58.1
Yes	659	54.8	4948	41.9
Residence[d]				
Urban	1102	76.7	10793	75.9
Rural	334	23.3	3430	24.1
Pre-pregnancy body mass index (kg/m^2)[c]				
<18.5	29	2.4	337	2.8
18.5-24.9	542	44.5	5633	47.4
25.0-29.9	300	24.7	3077	25.9
30.0+	346	28.4	2836	23.9
Pregnancy weight gain[c]				
Less than appropriate	264	20.6	2405	22.3
Appropriate	349	32.5	3796	29.4
More than appropriate	573	46.9	5480	48.3
Chronic hypertension				
No	2092	96.5	21090	97.7
Yes	76	3.5	497	2.3
Established diabetes				
No	2132	98.3	21400	99.1
Yes	36	1.7	187	0.9
Fertility treatment				
No	1282	99.1	12700	99.1
Yes	12	0.9	117	0.9

[a] Data for 1730 women with and 17115 women without epilepsy with deliveries 1992 and later.

[b] Restricted to 580 women with epilepsy and 5828 women without epilepsy with prior pregnancies with deliveries 1987-2002.

[c] Restricted to 1310 women with epilepsy and 12979 women without epilepsy with deliveries 2003 and later.

Table 3 - Pregnancy outcomes and complications among women with and without epilepsy with singleton live birth deliveries in Washington State, 1987-2012.

	Women with Epilepsy (n=2168)	%	Comparison Women (n=21587)	%	RR[a]	95% CI
During pregnancy						
Preeclampsia/Eclampsia						
No	1970	93.7	19668	95.0	1.00	Ref
Yes	133	6.3	1026	5.0	1.27	1.06-1.51
Gestational diabetes[b]						
No	1986	93.2	20182	94.3		
Yes	146	6.8	1218	5.7	1.27	1.08-1.50
Placental abruption						
No	2137	98.6	21328	98.8	1.00	Ref
Yes	31	1.4	259	1.2	1.21	0.84-1.75
Preterm rupture of membranes						
No	2128	98.2	21326	98.8	1.00	Ref
Yes	40	1.8	261	1.2	1.53	1.10-2.13
During/after delivery						
Labor induction						
No	1543	71.2	16252	75.3	1.00	Ref
Yes	625	28.8	5335	24.7	1.16	1.08-1.25
Breech/ Malpresentation						
No	2059	95.0	20699	95.9	1.00	Ref
Yes	109	5.0	888	4.1	1.24	1.02-1.51
Preterm labor						
No	1929	89.8	19930	93.2	1.00	Ref
Yes	219	10.2	1446	6.8	1.50	1.31-1.72
Delivery Method[c]						
Vaginal	657	68.7	6658	73.9	1.00	Ref
C-section	300	31.3	2351	26.1	1.21	1.10-1.34
After delivery						
Post-partum hemorrhage						
No	2076	95.8	20799	96.4	1.00	Ref
Yes	92	4.2	788	3.7	1.15	0.93-1.42
ICU admit[d]						
No	1280	99.3	12760	99.9	1.00	Ref
Yes	9	0.7	12	0.1	7.41	3.15-17.46
Hospital days - Vaginal [e]						
0-2	1154	76.6	13742	84.9	1.00	Ref
3-5	313	20.8	2330	14.4	1.46	1.31-1.62
6+	39	2.6	123	0.7	2.28	1.89-2.74

Hospital days – Cesarean[f]						
<3	184	27.8	1766	32.8	1.00	Ref
3-5	428	64.8	3389	62.9	1.07	1.01-1.13
6+	49	7.4	233	4.3	1.03	1.01-1.05
<2 years after discharge						
Rehospitalized						
No	1799	83.0	18826	87.2	1.00	Ref
Yes	369	17.0	2761	12.8	1.32	1.19-1.45
No. of rehospitalizations						
0	1799	83.0	18826	87.2	1.00	Ref
1	10	0.5	65	0.3	1.59	0.82-3.10
2+	359	16.5	2699	12.5	1.31	1.19-1.45
Months to 1st rehospitalization						
No rehospitalization	1799	83.0	18826	87.2	1.00	Ref
<6	103	4.8	515	2.4	2.02	1.64-2.49
6-<12	65	3.0	325	1.5	2.01	1.55-2.62
12-<24	201	9.2	1921	8.9	1.07	0.93-1.23
Death						
No	2163	99.8	21579	99.9	1.00	Ref
Yes	5	0.2	8	0.1	6.15	2.02-18.73

[a] RR estimated from Poisson regression with robust standard errors, adjusted for birth year and maternal age. In multinomial outcomes, outcomes dichotomized, and relative to those without the outcome.
[b] Restricted to 2132 women with epilepsy and 21400 comparison women without established diabetes.
[c] Restricted to 957 women with epilepsy and 9011 comparison women without prior deliveries.
[d] Restricted to 1310 women with epilepsy and 12979 comparison women with deliveries 2003 or later.
[e] Restricted to 1506 women with epilepsy and 16195 comparison women with vaginal deliveries.
[f] Restricted to 661 women with epilepsy and 5388 comparison women with cesarean deliveries.

Table 4 - Selected outcomes among singleton infants of women with and without epilepsy with deliveries in Washington State, 1987-2012.

	Women with Epilepsy (n=2168)	%	Comparison Women (n=21587)	%	RR[a]	95% CI
Malformation						
No	2010	92.7	20307	94.1	1.00	Ref
Yes	158	7.3	1280	5.9	1.25	1.07-1.47
Fetal distress						
No	1905	87.9	19063	88.3	1.00	Ref
Yes	263	12.1	2524	11.7	1.04	0.92-1.17
Meconium aspiration						
No	2158	99.5	21548	99.8	1.00	Ref
Yes	10	0.5	39	0.2	2.58	1.29-5.17
Birth weight <2500g						
No	1995	92.1	20553	95.4	1.00	Ref
Yes	171	7.9	994	4.6	1.70	1.45-1.99
Gestational age <37 weeks						
No	1946	90.5	20019	93.8	1.00	Ref
Yes	205	9.5	1330	6.2	1.53	1.33-1.76
Size for gestational age						
Small	254	13.4	1863	9.8	1.35	1.20-1.53
Appropriate	1491	78.3	15333	81.0	1.00	Ref
Large	158	8.3	1743	9.2	0.95	0.82-1.12
Apgar 5 minute [b]						
7-10	2110	97.8	21123	98.2	1.00	Ref
<7	48	2.2	399	1.8	1.21	0.90-1.63
Assisted ventilation >30 mins[c]						
No	1904	98.7	19018	99.3	1.00	Ref
Yes	26	1.3	135	0.7	1.93	1.27-2.94
Breastfed [d]						
No	988	77.8	11760	92.8	3.01	2.66-3.40
Yes	282	22.2	912	7.2	1.00	Ref
NICU admission [d]						
No	1165	90.4	12008	94.2	1.00	Ref
Yes	124	9.6	737	5.8	1.69	1.41-2.03
Hospital days - Vaginal [e]						
0-2	1232	85.6	13924	90.5	1.00	Ref
3-5	142	9.9	1034	6.7	1.47	1.25-1.74
6+	65	4.5	429	2.8	1.67	1.29-2.16
Hospital days - Cesarean[f]						
0-2	182	46.2	1780	55.1	1.00	Ref

3-5	164	41.6	1220	37.8	1.12	1.05-1.20
6+	48	12.2	229	7.1	1.69	1.36-2.11
<2 years after discharge						
Rehospitalized						
No	1956	90.2	19759	91.5	1.00	Ref
Yes	212	9.8	1828	8.5	1.14	1.00-1.31
No. of rehospitalizations						
0	1956	90.2	19759	91.5	1.00	Ref
1	17	0.8	124	0.6	1.37	0.83-2.27
2+	195	9.0	1704	7.9	1.13	0.98-1.30
Months to 1st rehospitalization						
No rehospitalization	1956	90.2	19759	91.5	1.00	Ref
<6	148	6.8	1241	5.8	1.18	1.00-1.39
6-<12	31	1.4	258	1.2	1.19	0.82-1.72
12-<24	33	1.5	329	1.5	1.01	0.71-1.44
Neonatal death <28 days						
No	2163	99.8	21516	99.7	1.00	Ref
Yes	5	0.2	71	0.3	0.74	0.30-1.84
Death <2 years						
No	2156	99.4	21475	99.5	1.00	Ref
Yes	12	0.6	112	0.5	1.11	0.61-2.01

[a] RR estimated from Poisson regression with robust standard errors, adjusted for birth year and maternal age. In multinomial outcomes, outcomes dichotomized, and relative to those without the outcome.

[b] Additionally adjusted for method of delivery.

[c] Restricted to 2016 women with epilepsy and 20065 women without epilepsy with deliveries 1989 or later.

[d] Restricted to 1310 women with epilepsy and 12979 women without epilepsy with deliveries 2003 or later.

[e] Restricted to 1506 women with epilepsy and 16195 women without epilepsy with vaginal deliveries.

[f] Restricted to 411 women with epilepsy and 3317 women without epilepsy with cesarean deliveries.

Table 5 - Pregnancy outcomes and complications among women with grand mal and petit mal status compared to women without epilepsy with singleton live birth deliveries in Washington State, 1987-2012.

	Grand Mal (n=29)	%	RR [a]	95% CI	Petit Mal (n=23)	%	RR [a]	95% CI
Preeclampsia/ Eclampsia								
No	23	82.1	1.00	Ref	21	91.3	1.00	Ref
Yes	5	17.9	3.85	1.74-8.52	2	8.7	2.06	0.55-7.74
Gestational Diabetes[b]								
No	26	92.9	1.00	Ref	22	100.0	1.00	Ref
Yes	2	7.1	2.11	0.66-6.79	1	0.0	1.28	0.19-8.74
Placental Abruption								
No	28	96.6	1.00	Ref	23	100.0	-	-
Yes	1	3.4	2.82	0.40-19.76	0	0.0	-	-
PPROM								
No	29	100.0	-	-	23	100.0	-	-
Yes	0	0.0	-	-	0	0.0	-	-
Labor Induction								
No	25	86.2	1.00	Ref	16	60.6	1.00	Ref
Yes	4	13.8	0.63	0.25-1.61	7	30.4	1.52	0.82-2.81
Breech/ Malpresentation								
No	28	96.6	1.00	Ref	21	91.3	1.00	Ref
Yes	1	3.4	087	0.13-5.94	2	8.7	2.01	0.54-7.48
Preterm Labor								
No	22	78.6	1.00	Ref	20	95.2	1.00	Ref
Yes	6	21.4	3.29	1.62-6.68	1	4.8	0.77	0.11-5.21
Delivery Method[c]								
Vaginal	8	66.7	1.00	Ref	6	85.7	1.00	Ref
C-section	4	33.3	1.69	0.81-3.55	1	14.3	0.58	0.11-3.17
Delivery Method								
Vaginal	18	62.1	1.00	Ref	20	87.0	1.00	Ref
C-section	11	37.9	1.85	1.18-2.88	3	13.0	0.62	0.22-1.79
Post-Partum Hemorrhage								
No	27	93.1	1.00	Ref	22	95.7	1.00	Ref
Yes	2	6.9	1.90	0.50-7.29	1	4.3	1.28	0.19-8.64
ICU admit[d]								
No	6	66.7	1.00	Ref	1	100.0	-	-
Yes	3	33.3	327.72	122.69-875.36	0	0.0	-	-
Hospital days Vaginal [e] (days)								
0-2	13	72.2	1.00	Ref	16	80.0	1.00	Ref
3-5	4	22.2	1.48	0.64-3.40	4	20.0	1.31	0.55-3.11
6+	1	5.6	4.44	1.71-11.55	0	0.0	-	-

Hospital days Cesarean [f] (days)								
0-2	1	9.1	1.00	Ref	0	0.0	1.00	Ref
3-5	8	72.7	1.17	0.88-1.57	3	100.0	1.14	1.03-1.26
6+	2	18.8	1.04	1.01-1.06	0	0.0	1.00	0.99-1.01
Death < 2 Years								
No	29	100.0	-	-	23	100.0	-	-
Yes	0	0.0	-	-	0	0.0	-	-

[a] RR estimated from Poisson regression with robust standard errors, adjusted for birth year and maternal age. In multinomial outcomes, outcomes dichotomized, and relative to those without the outcome.

[b] Restricted to 28 women with grand mal and 23 women with petit mal status without established diabetes.

[c] Restricted to 12 women with grand mal and 7 women with petit mal status without prior deliveries.

[d] Restricted to 9 women with grand mal and 1 woman with petit mal status deliveries in 2003 or later.

[e] Restricted to 18 women with grand mal status and 20 women with petit mal status with vaginal deliveries.

[f] Restricted to 11 women with grand mal status and 3 women with petit mal status with Cesarean deliveries.

Table 6 - Selected outcomes among singleton infants of women with grand mal and petit mal status compared to women without epilepsy with deliveries in Washington State, 1987-2012.

	Grand Mal (n=29)	%	RR [a]	95% CI	Petit Mal (n=23)	%	RR [a]	95% CI
Malformation								
No	26	89.7	1.00	Ref	22	95.7	1.00	Ref
Yes	3	10.3	1.81	0.62-5.30	1	4.3	0.76	0.11-5.17
Fetal Distress								
No	26	89.7	1.00	Ref	18	78.3	1.00	Ref
Yes	3	10.3	1.62	0.80-3.29	5	21.7	1.66	0.76-3.61
Meconium Aspiration								
No	29	100.0	-	-	23	100.0	-	-
Yes	0	0.0	-	-	0	0.0	-	-
Birth Weight <2500g								
No	23	79.3	1.00	Ref	22	95.7	1.00	Ref
Yes	6	20.7	4.59	2.24-9.43	1	4.3	1.04	0.15-7.17
Gestational Age <37 weeks								
No	22	78.6	1.00	Ref	20	95.2	1.00	Ref
Yes	6	21.4	4.05	2.03-8.07	1	4.8	0.99	0.14-6.83
Size for Gestational Age								
Small	2	8.3	0.72	0.20-2.68	3	14.3	1.30	0.45-3.75
Appropriate	21	87.5	1.00	Ref	17	80.9	1.00	Ref
Large	1	4.2	0.43	0.06-2.93	1	4.8	0.49	0.07-3.36
Apgar 5 Minute[b]								
7-10	27	93.1	1.00	Ref	23	100.0	-	-
<7	2	6.9	4.04	1.06-15.33	0	0.0	-	-
Assisted Ventilation >30 mins[c]								
No	20	87.0	1.00	Ref	19	100.0	-	-
Yes	3	13.0	22.9	8.06-64.91	0	0.0	-	-
Infant being Breastfed[d]								
No	2	25.0	3.29	0.95-11.33	0	0.0	-	-
Yes	6	75.0	1.00	Ref	1	100.0	-	-
NICU Admissions[d]								
No	6	66.7	1.00	Ref	1	100.0	-	-
Yes	3	33.3	5.76	2.28-14.54	0	0.0	-	-
Infant Length of Delivery Hosp. for Vaginal Deliveries[e] (days)								
0-2	13	81.3	1.00	Ref	18	100.0	1.00	Ref

3-5	3	18.8	2.11	0.77-5.77	0	0.0	-	-
6+	0	0.0	-	-	0	0.0	-	-
Infant Length of Delivery Hosp. for Cesarean Deliveries[f] (days)								
0-2	2	22.2	1.00	Ref	0	0.0	1.00	Ref
3-5	5	55.6	1.15	0.70-1.90	2	66.7	1.13	1.03-1.23
6+	2	22.2	2.53	0.90-7.13	1	33.3	4.64	3.76-5.73
Neonatal Death (<28 days)								
No	29	100.0	-	-	23	100.0	-	-
Yes	0	0.0	-	-	0	0.0	-	-
Infant Death (<2 years)								
No	29	100.0	-	-	23	100.0	-	-
Yes	0	0.0	-	-	0	0.0	-	-

[a] RR estimated from Poisson regression with robust standard errors, adjusted for birth year and maternal age. In multinomial outcomes, outcomes dichotomized, and relative to those without the outcome.

[b] Additionally adjusted for method of delivery.

[c] Restricted to 24 women with grand mal and 20 women with petit mal status with deliveries 1989 or later.

[d] Restricted to 9 women with grand mal and 1 women with petit mal status with deliveries in 2003 or later.

[e] Restricted to 16 women with grand mal and 18 women with petit mal status with vaginal deliveries.

[f] Restricted to 11 women with grand mal and 3 women with petit mal status with cesarean deliveries.

Table 7 - Pregnancy outcomes and complications among women with convulsive and non-convulsive seizure status compared to women without epilepsy with singleton live birth deliveries in Washington State, 1987-2012.

	Convulsive Seizures (n=234)	%	Poisson Regression [a]	95% CI	Non Convulsive Seizures (n=178)	%	RR [a]	95% CI
Preeclampsia/ Eclampsia								
No	203	95.0	1.00	Ref	167	96.0	1.00	Ref
Yes	18	5.0	1.72	1.10-2.69	7	4.0	0.84	0.41-1.75
Gestational Diabetes[b]								
No	221	95.3	1.00	Ref	168	96.6	1.00	Ref
Yes	11	4.7	1.20	0.68-2.14	6	3.4	0.76	0.34-1.70
Placental Abruption								
No	229	97.9	1.00	Ref	176	98.9	1.00	Ref
Yes	5	2.1	1.76	0.73-4.27	2	1.1	0.92	0.23-3.66
PPROM								
No	230	98.3	1.00	Ref	174	97.8	1.00	Ref
Yes	4	1.7	1.50	0.56-4.03	4	2.2	1.91	0.72-5.07
Labor Induction								
No	179	76.5	1.00	Ref	118	66.3	1.00	Ref
Yes	55	23.5	1.04	0.83-1.31	60	33.7	1.46	1.17-1.78
Breech/ Malpresentation								
No	222	94.9	1.00	Ref	169	94.9	1.00	Ref
Yes	12	5.1	1.28	0.73-2.22	9	5.1	1.24	0.65-2.34
Preterm Labor								
No	209	90.5	1.00	Ref	157	89.7	1.00	Ref
Yes	22	9.5	1.45	0.97-2.17	18	10.3	1.55	1.00-2.41
Delivery Method[c]								
Vaginal	79	69.3	1.00	Ref	61	70.1	1.00	Ref
C-section	35	30.7	1.30	1.00-1.70	26	29.9	1.18	0.86-1.63
Delivery Method								
Vaginal	162	69.2	1.00	Ref	128	71.9	1.00	Ref
C-section	72	30.8	1.42	1.18-1.72	50	28.1	1.22	0.97-1.54
Post-Partum Hemorrhage								
No	224	95.7	1.00	Ref	169	94.9	1.00	Ref
Yes	10	4.3	1.17	0.64-2.16	9	5.1	1.40	0.74-2.65
ICU admit[d]								
No	83	95.4	1.00	Ref	71	100.0	-	-
Yes	4	4.6	45.4	15.6-132	0	0.0	-	-
Hospital days-vaginal delivery [e]								
0-2	117	72.2	1.00	Ref	94	73.5	1.00	Ref
3-5	36	22	1.52	1.14-2.02	31	24.2	1.66	1.22-2.26
6+	9	5.6	2.53	1.62-3.96	3	2.3	2.68	1.64-4.39
Hospital days-cesarean[f]								

0-2	15	20.8	1.00	Ref	8	16.0	1.00	Ref
3-5	50	69.4	1.03	0.90-1.17	38	76.0	1.16	1.01-1.33
6+	7	9.7	1.03	1.02-1.04	4	8.0	1.03	1.01-1.05
Death < 2 Years								
No	232	99.2	1.00	Ref	178	100.0	-	-
Yes	2	0.9	13.5	3.00-60.60	0	0.0	-	-

[a] RR estimated from Poisson regression with robust standard errors, adjusted for birth year and maternal age. In multinomial outcomes, outcomes dichotomized, and relative to those without the outcome.

[b] Restricted to 232 women with convulsive and 174 women with non-convulsive seizures without established diabetes.

[c] Restricted to 114 women with convulsive and 87 women with non-convulsive seizures without prior deliveries.

[d] Restricted to 88 women with convulsive and 71 women with non-convulsive seizures with deliveries in 2003 or later.

[e] Restricted to 162 women with convulsive and 128 women with non-convulsive seizures with vaginal deliveries.

[f] Restricted to 72 women with convulsive and 50 women with non-convulsive seizures with cesarean deliveries.

Table 8 - Selected outcomes among singleton infants of women with convulsive and non-convulsive seizure status compared to women without epilepsy with deliveries in Washington State, 1987-2012.

	Convulsive Seizures (n=234)	%	Poisson Regression [a]	95% CI	Non Convulsive Seizures (n=178)	%	RR [a]	95% CI
Malformation								
No	207	88.5	1.00	Ref	169	94.9	1.00	Ref
Yes	27	11.5	2.00	1.40-2.87	9	5.1	0.87	0.46-1.64
Fetal Distress								
No	196	83.8	1.00	Ref	156	87.6	1.00	Ref
Yes	38	16.2	1.30	0.97-1.74	22	12.4	1.02	0.69-1.51
Meconium Aspiration								
No	234	100.0	-	-	177	99.4	1.00	Ref
Yes	0	0.0	-	-	1	0.6	3.50	0.48-25.7
Birth Weight <2500g								
No	217	92.7	1.00	Ref	163	91.6	1.00	Ref
Yes	17	7.3	1.60	1.01-2.55	15	8.4	1.86	1.14-3.03
Gestational Age <37 weeks								
No	209	90.5	1.00	Ref	157	89.7	1.00	Ref
Yes	22	9.5	1.45	0.97-2.17	18	10.3	1.55	1.00-2.41
Size for Gestational Age								
Small	21	9.9	0.89	0.60-1.34	16	10.1	1.01	0.63-1.60
Appropriate	180	84.5	1.00	Ref	125	79.1	1.00	Ref
Large	12	5.6	0.61	0.35-1.05	17	10.8	1.17	0.75-1.82
Apgar 5 Minute								
7-10	232	99.2	1.00	Ref	172	97.2	1.00	Ref
<7	2	0.8	0.49	0.12-1.83	5	2.8	1.59	0.67-3.79
Apgar 5 Minute[b]								
7-10	232	99.2	1.00	Ref	172	97.2	1.00	Ref
<7	2	0.8	0.46	0.12-1.83	5	2.8	1.54	0.65-3.64
Assisted Ventilation >30 mins[c]								
No	181	97.3	1.00	Ref	161	100.0	-	-
Yes	5	2.7	4.42	1.82-10.75	0	0.0	-	-
Infant being Breastfed[d]								
No	18	20.9	2.61	1.71-3.97	9	13.2	1.80	0.97-3.33
Yes	68	79.1	1.00	Ref	59	86.8	1.00	Ref
NICU Admissions[d]								
No	75	83.0	1.00	Ref	68	95.8	1.00	Ref
Yes	13	17.1	2.95	1.85-4.70	3	4.2	0.73	0.24-2.21

Infant Length of Delivery Hosp. For Vaginal Deliveries[e] (days)								
0-2	117	75.5	1.00	Ref	105	86.1	1.00	Ref
3-5	28	18.1	2.33	1.67-3.26	15	12.3	1.66	1.03-2.68
6+	10	6.5	2.72	1.48-5.00	2	1.6	0.64	0.16-2.52
Infant Length of Delivery Hosp. for Cesarean Deliveries[f] (days)								
0-2	22	31.9	1.00	Ref	12	25.0	1.00	Ref
3-5	41	59.4	1.01	0.85-1.20	33	68.8	1.26	1.05-1.51
6+	6	8.7	1.20	0.56-2.56	3	6.2	1.01	0.43-2.41
Neonatal Death (<28 days)								
No	234	100.0	-	-	177	99.4	1.00	Ref
Yes	0	0.0	-	-	1	0.6	1.68	0.23-1.96
Infant Death (<2 years)								
No	233	99.6	1.00	Ref	176	98.9	1.00	Ref
Yes	1	0.4	0.73	0.10-5.28	2	1.1	2.04	0.51-8.24

[a] RR estimated from Poisson regression with robust standard errors, adjusted for birth year and maternal age. In multinomial outcomes, outcomes dichotomized, and relative to those without the outcome.

[b] Additionally adjusted for method of delivery.

[c] Restricted to 204 women with convulsive and 166 women with non-convulsive seizures with deliveries 1989 or later.

[d] Restricted to 88 women with convulsive and 71 women with non-convulsive seizures with deliveries in 2003 or later.

[e] Restricted to 162 women with convulsive and 128 women with non-convulsive seizures with vaginal deliveries.

[f] Restricted to 72 women with convulsive and 50 women with non-convulsive seizures with cesarean deliveries.

Table 9 - Pregnancy outcomes and complications among women with intractable and tractable epilepsy compared to women without epilepsy with singleton live birth deliveries in Washington State, 1987-2012.

	Intractable Epilepsy (n=27)	%	RR [a]	95 % CI	Tractable Epilepsy (n=1852)	%	RR[a]	95% CI
Preeclampsia/ Eclampsia								
No	27	100.0	-	-	1683	93.5	1.00	Ref
Yes	0	0.0	-	-	117	6.5	1.27	1.06-1.53
Gestational Diabetes[b]								
No	27	100.0	-	-	1692	92.7	1.00	Ref
Yes	0	0.0	-	-	133	7.3	1.27	1.07-1.51
Placental Abruption								
No	26	96.3	1.00	Ref	1828	98.7	1.00	Ref
Yes	1	3.7	3.06	0.45-21.0	24	1.3	1.12	0.74-1.69
PPROM								
No	26	96.3	1.00	Ref	1815	98.0	1.00	Ref
Yes	1	3.7	3.04	0.45-20.8	37	2.0	1.63	1.16-2.29
Labor Induction								
No	17	63.0	1.00	Ref	1286	69.4	1.00	Ref
Yes	10	37.0	1.49	0.91-2.43	566	30.6	1.19	1.11-1.28
Breech/ Malpresentation								
No	26	96.3	1.00	Ref	1757	94.9	1.00	Ref
Yes	1	3.7	0.89	0.13-6.11	95	5.1	1.27	1.04-1.57
Preterm Labor								
No	22	81.5	1.00	Ref	1663	90.2	1.00	Ref
Yes	5	18.5	2.74	1.25-6.01	181	9.8	1.43	1.23-1.65
Delivery Method[c]								
Vaginal	6	40.0	1.00	Ref	564	68.5	1.00	Ref
C-section	9	60.0	2.08	1.44-3.00	259	31.5	1.19	1.07-1.32
Delivery Method								
Vaginal	15	55.6	1.00	Ref	1279	69.1	1.00	Ref
C-section	12	44.4	1.74	1.17-2.58	572	30.9	1.22	1.14-1.31
Post-Partum Hemorrhage								
No	26	96.3	1.00	Ref	1769	95.5	1.00	Ref
Yes	1	3.7	1.02	0.15-6.98	83	4.5	1.21	0.97-1.51
ICU admit[d]								
No	15	100.0	-	-	1216	99.6	1.00	Ref
Yes	0	0.0	-	-	5	0.4	4.37	1.55-12.36
Maternal Length of Delivery Hosp. for Vaginal Deliveries (days)[e]								
0-2	13	86.7	1.00	Ref	990	77.4	1.00	Ref

3-5	2	13.0	0.91	0.25-3.35	255	19.9	1.42	1.27-1.60
6+	0	0.0	-	-	34	2.7	2.20	1.78-2.70
Maternal Length of Delivery Hosp. for Cesarean Deliveries (days)[f]								
0-2	4	33.3	1.00	Ref	171	29.9	1.00	Ref
3-5	5	41.7	0.85	0.48-1.52	366	64.0	1.07	1.01-1.14
6+	3	25.0	1.06	1.03-1.09	35	6.1	1.03	1.01-1.06
Death < 2 Years								
No	27	100.0	-	-	1849	99.8	1.00	Ref
Yes	0	0.0	-	-	3	0.2	5.28	1.58-17.62

[a] RR estimated from Poisson regression with robust standard errors, adjusted for birth year and maternal age. In multinomial outcomes, outcomes dichotomized, and relative to those without the outcome.

[b] Restricted to 27 women with intractable and 1825 women with tractable epilepsy without established diabetes.

[c] Restricted to 15 women with intractable and 823 women with tractable epilepsy without prior deliveries.

[d] Restricted to 15 women with intractable and 1242 women with tractable epilepsy with deliveries in 2003 or later.

[e] Restricted to 15 women with intractable and 1279 women with tractable epilepsy with vaginal deliveries.

[f] Restricted to 12 women with intractable and 572 women with tractable epilepsy with cesarean deliveries.

Table 10 - Selected outcomes among singleton infants of women with intractable and tractable epilepsy compared to women without epilepsy with deliveries in Washington State, 1987-2012.

	Intractable Epilepsy (n=27)	%	RR [a]	95 % CI	Tractable Epilepsy (n=1852)	%	RR [a]	95% CI
Malformation								
No	25	92.6	1.00	Ref	1715	92.6	1.00	Ref
Yes	2	7.4	1.24	0.33-4.73	137	7.4	1.24	1.05-1.47
Fetal Distress								
No	23	85.2	1.00	Ref	1642	88.7	1.00	Ref
Yes	4	14.8	1.28	0.52-3.13	210	11.3	0.99	0.87-1.14
Meconium Aspiration								
No	26	96.3	1.00	Ref	1844	99.6	1.00	Ref
Yes	1	3.7	20.26	2.97-138.14	8	0.4	2.23	1.04-4.78
Birth Weight <2500g								
No	25	92.6	1.00	Ref	1710	92.4	1.00	Ref
Yes	2	7.4	1.62	0.43-6.15	140	7.6	1.60	1.35-1.90
Gestational Age <37 weeks								
No	25	92.6	1.00	Ref	1657	90.2	1.00	Ref
Yes	2	7.4	2.95	1.36-6.37	180	9.8	1.51	1.30-1.75
Size for Gestational Age								
Small	1	4.4	0.43	0.06-2.97	206	12.7	1.30	1.14-1.49
Appropriate	21	91.3	1.00	Ref	1279	78.9	1.00	Ref
Large	1	4.3	0.42	0.06-2.82	137	8.4	0.99	0.84-1.17
Apgar 5 Minute[b]								
7-10	26	96.3	1.00	Ref	1803	97.9	1.00	Ref
<7	1	3.7	1.78	0.27-11.80	39	2.1	1.07	0.77-1.49
Assisted Ventilation >30 mins[c]								
No	25	100.0	-	-	1755	98.8	1.00	Ref
Yes	0	0.0	-	-	22	1.2	1.74	1.11-2.72
Infant being Breastfed[d]								
No	2	13.3	2.04	0.56-7.42	264	21.9	2.98	2.63-3.37
Yes	13	86.7	1.00	Ref	939	78.1	1.00	Ref
NICU Admissions[d]								
No	13	86.7	1.00	Ref	1112	91.1	1.00	Ref
Yes	2	13.3	2.30	0.63-8.36	109	8.9	1.54	1.27-1.87
Infant Length of Delivery Hosp.								

for Vaginal Deliveries (days) [e]								
0-2	13	86.7	1.00	Ref	1062	86.7	1.00	Ref
3-5	2	13.3	1.83	0.50-6.76	109	8.9	1.43	1.19-1.73
6+	0	0.0	-	-	54	4.4	1.58	1.20-2.09
Infant Length of Delivery Hosp. for Cesarean Deliveries (days) [f]								
0-2	3	25.0	1.00	Ref	213	38.7	1.00	Ref
3-5	8	66.7	1.44	0.94-2.21	280	50.8	1.14	1.05-1.23
6+	1	8.3	1.65	0.24-11.3	58	10.5	1.54	1.20-1.97
Neonatal Death (<28 days)								
No	27	100.0	-	-	1847	99.7	1.00	Ref
Yes	0	0.0	-	-	5	0.3	0.83	0.33-2.06
Infant Death (<2 years)								
No	27	100.0	-	-	1841	99.4	1.00	Ref
Yes	0	0.0	-	-	11	0.6	1.17	0.63-2.18

[a] RR estimated from Poisson regression with robust standard errors, adjusted for birth year and maternal age. In multinomial outcomes, outcomes dichotomized, and relative to those without the outcome.

[b] Additionally adjusted for method of delivery.

[c] Restricted to 27 women with intractable and 1852 women with tractable epilepsy with deliveries 1989 or later.

[d] Restricted to 15 women with intractable and 1242 women with tractable epilepsy with deliveries in 2003 or later.

[e] Restricted to 15 women with intractable and 1279 women with tractable epilepsy with vaginal deliveries.

[f] Restricted to 12 women with intractable and 572 women with tractable epilepsy with cesarean deliveries.

Table 11 - Pregnancy outcomes and complications among women with primary generalized and focal epilepsy compared to women without epilepsy with singleton live birth deliveries in Washington State, 1987-2012.

	Primary Generalized Epilepsy (n=322)	%	RR [a]	95% CI	Focal Epilepsy (n=63)	%	RR[a]	95% CI
Preeclampsia/ Eclampsia								
No	289	94.1	1.00	Ref	60	96.7	1.00	Ref
Yes	18	5.9	1.24	0.79-1.95	2	3.2	0.66	0.17-2.59
Gestational Diabetes[b]								
No	305	95.6	1.00	Ref	60	98.4	1.00	Ref
Yes	14	4.4	1.11	0.66-1.86	1	1.6	0.28	0.04-1.96
Placental Abruption								
No	317	98.5	1.00	Ref	62	98.4	1.00	Ref
Yes	5	1.5	1.27	0.53-3.09	1	1.6	1.31	0.19-9.13
PPROM								
No	317	98.5	1.00	Ref	60	95.2	1.00	Ref
Yes	5	1.5	1.36	0.56-3.28	3	4.8	3.90	1.28-11.90
Labor Induction								
No	234	72.7	1.00	Ref	40	63.5	1.00	Ref
Yes	88	27.3	1.21	1.01-1.45	23	36.5	1.47	1.05-2.05
Breech/ Malpresentation								
No	306	95.0	1.00	Ref	59	93.7	1.00	Ref
Yes	16	5.0	1.23	0.76-2.00	4	6.3	1.52	0.59-3.91
Preterm Labor								
No	288	90.9	1.00	Ref	57	90.5	1.00	Ref
Yes	29	9.1	1.39	0.98-1.98	6	9.5	1.41	0.66-3.03
Delivery Method[c]								
Vaginal	113	71.5	1.00	Ref	19	61.3	1.00	Ref
C-section	45	28.5	1.19	0.93-1.52	12	38.7	1.38	0.89-2.15
Delivery Method								
Vaginal	231	71.7	1.00	Ref	42	66.7	1.00	Ref
C-section	91	28.3	1.30	1.09-1.55	21	33.3	1.29	0.92-1.83
Delivery Method								
Vaginal	231	71.7	1.00	Ref	42	66.7	1.00	Ref
C-section	91	28.3	1.30	1.09-1.55	21	33.3	1.29	0.92-1.83
Post-Partum Hemorrhage								
No	308	95.6	1.00	Ref	60	95.2	1.00	Ref
Yes	14	4.4	1.19	0.71-2.00	3	4.8	1.32	0.44-4.00
ICU admit[d]								
No	109	99.1	1.00	Ref	40	100.0	-	-
Yes	1	0.9	9.69	1.30-72.4	0	0.0	-	-
Hospital days Vaginal Deliveries[e]								

(days)								
0-2	168	72.7	1.00	Ref	31	73.8	1.00	Ref
3-5	54	23.4	1.59	1.25-2.01	9	21.4	1.56	0.88-2.79
6+	9	3.9	2.28	1.54-3.36	2	4.8	4.32	2.00-9.32
Hospital days Cesarean Deliveries[f]								
(days)								
0-2	18	19.8	1.00	Ref	4	19.1	1.00	Ref
3-5	66	72.5	1.04	0.93-1.16	15	71.4	1.23	0.98-1.56
6+	7	7.7	1.03	1.01-1.04	2	9.5	1.05	1.02-1.07
Death < 2 Years								
No	320	99.4	1.00	Ref	63	100.0	-	-
Yes	2	0.6	10.54	2.33-47.7	0	0.0	-	-

[a] RR estimated from Poisson regression with robust standard errors, adjusted for birth year and maternal age. In multinomial outcomes, outcomes dichotomized, and relative to those without the outcome.

[b] Restricted to 319 women with primary generalized and 61 women with focal epilepsy without established diabetes.

[c] Restricted to 158 women with primary generalized and 31 women with focal epilepsy with no prior deliveries.

[d] Restricted to 111 women with primary generalized and 40 women with focal epilepsy with deliveries in 2003 or later.

[e] Restricted to 231 women with primary generalized and 42 women with focal epilepsy with vaginal deliveries.

[f] Restricted to 91 women with primary generalized and 21 women with focal epilepsy with cesarean deliveries.

Table 12 - Selected outcomes among singleton infants of women with primary generalized and focal epilepsy compared to women without epilepsy with deliveries in Washington State, 1987-2012.

	Primary Generalized Epilepsy (n=322)	%	Poisson Regression[a]	95% CI	Focal Epilepsy (n=63)	%	RR[a]	95% CI
Malformation								
No	290	90.1	1.00	Ref	62	98.4	1.00	Ref
Yes	32	9.9	1.73	1.23-2.41	1	1.6	0.27	0.04-1.87
Fetal Distress								
No	273	84.8	1.00	Ref	58	92.1	1.00	Ref
Yes	49	15.2	1.22	0.94-1.59	5	7.9	0.69	0.30-1.59
Meconium Aspiration								
No	322	100.0	-	-	62	98.4	1.00	Ref
Yes	0	0.0	-	-	1	1.6	8.92	1.26-63.2
Birth Weight <2500g								
No	300	93.2	1.00	Ref	59	93.7	1.00	Ref
Yes	22	6.8	1.51	1.00-2.27	4	6.3	1.39	0.54-3.61
Gestational Age <37 weeks								
No	296	92.8	1.00	Ref	57	90.5	1.00	Ref
Yes	23	7.2	1.31	0.88-1.94	6	9.5	1.52	0.71-3.26
Size for Gestational Age								
Small	32	10.9	1.02	0.73-1.41	3	5.5	0.56	0.19-1.69
Appropriate	239	81.3	1.00	Ref	47	85.5	1.00	Ref
Large	23	7.8	0.86	0.58-1.27	5	9.1	0.93	0.41-2.12
Apgar 5 Minute[b]								
7-10	319	99.1	1.00	Ref	60	97.7	1.00	Ref
<7	3	0.9	0.51	017-1.57	2	3.3	1.66	0.43-6.36
Assisted Ventilation >30 mins[c]								
No	261	99.2	1.00	Ref	63	100.0	-	-
Yes	2	0.8	1.26	0.31-5.15	0	0.0	-	-
Infant being Breastfed[d]								
No	21	19.4	2.44	1.65-3.60	3	10.3	1.46	0.57-3.73
Yes	87	80.6	1.00	Ref	35	89.7	1.00	Ref
NICU Admissions[d]								

No	98	88.3	1.00	Ref	38	95.0	1.00	Ref
Yes	13	11.7	2.02	1.21-3.39	2	5.0	0.87	0.22-3.35
Infant Length of Delivery Hosp. for Vaginal Deliveries (days) [e]								
0-2	177	80.5	1.00	Ref	32	78.1	1.00	Ref
3-5	32	14.6	1.89	1.37-2.61	8	19.5	2.94	1.56-5.56
6+	11	5.0	2.01	1.12-3.61	1	2.4	1.03	0.15-7.18
Infant Length of Delivery Hosp. for Cesarean Deliveries (days) [f]								
0-2	27	30.7	1.00	Ref	5	25.0	1.00	Ref
3-5	54	61.4	1.03	0.89-1.19	15	75.0	1.49	1.14-1.95
6+	7	8.0	1.09	0.56-2.11	0	0.0	-	-
Neonatal Death (<28 days)								
No	321	99.7	1.00	Ref	63	100.0	-	-
Yes	1	0.3	0.91	0.13-6.55	0	0.0	-	-
Infant Death (<2 years)								
No	319	99.1	1.00	Ref	63	100.0	-	-
Yes	3	0.9	1.61	0.51-5.14	0	0.0	-	-

[a] RR estimated from Poisson regression with robust standard errors, adjusted for birth year and maternal age. In multinomial outcomes, outcomes dichotomized, and relative to those without the outcome.
[b] Additionally adjusted for method of delivery.
[c] Restricted to 285 women with generalized and 63 women with focal epilepsy with deliveries 1989 or later.
[d] Restricted to 111 women with generalized and 40 women with focal epilepsy with deliveries in 2003 or later.
[e] Restricted to 231 women with generalized and 42 women with focal epilepsy with vaginal deliveries.
[f] Restricted to 91 women with generalized and 21 women with focal epilepsy with cesarean deliveries.

Supplementary Table 1 - Pregnancy outcomes and complications among women with and without epilepsy with singleton live birth deliveries in Washington State, 1987-1996.

	Women with Epilepsy (n=649)	%	Comparison Women (n=6518)	%	RR[a]	95% CI
Preeclampsia/ Eclampsia						
No	595	96.3	5778	96.0	1.00	Ref
Yes	23	3.7	239	4.0	0.92	0.61-1.39
Gestational Diabetes[b]						
No	621	96.4	6322	97.5	1.00	Ref
Yes	23	3.6	165	2.5	1.48	0.96-2.62
Placental Abruption						
No	640	98.6	6427	98.6	1.00	Ref
Yes	9	1.4	91	1.4	1.03	0.52-2.02
PPROM						
No	644	99.2	6445	98.9	1.00	Ref
Yes	5	0.8	73	1.1	0.69	0.28-1.70
Labor Induction						
No	523	80.6	5376	82.5	1.00	Ref
Yes	126	19.4	1142	17.5	1.11	0.93-1.30
Breech/ Malpresentation						
No	621	95.7	6238	95.7	1.00	Ref
Yes	28	4.3	280	4.3	1.02	0.69-1.49
Preterm Labor						
No	588	93.3	5963	94.0	1.00	Ref
Yes	42	6.7	384	6.0	1.09	0.80-1.48
Delivery Method[c]						
Vaginal	228	78.4	2188	80.2	1.00	Ref
C-section	63	21.6	539	19.8	1.11	0.88-1.39
Delivery Method						
Vaginal	512	78.9	5311	81.5	1.00	Ref
C-section	137	21.1	1206	18.5	1.16	0.99-1.35
Post-Partum Hemorrhage						
No	628	96.8	6292	96.5	1.00	Ref
Yes	21	3.2	226	3.5	0.93	0.60-1.44
Hospital days - vaginal [d]						
0-2	384	75.0	4407	83.0	1.00	Ref

3-5	117	22.9	854	16.1	1.43	1.21-1.70
6+	11	2.1	50	0.9	1.77	1.32-2.37
Hospital days - Cesarean [e]						
0-2	13	9.5	108	9.0	1.00	Ref
3-5	113	82.5	1009	83.7	1.00	0.94-1.06
6+	11	8.0	89	7.3	1.05	0.67-1.66
Death < 2 Years						
No	647	99.7	6512	99.9	1.00	Ref
Yes	2	0.3	6	0.1	3.34	0.68-16.47

[a] RR estimated from Poisson regression with robust standard errors, adjusted for birth year and maternal age. In multinomial outcomes, outcomes dichotomized, and relative to those without the outcome.
[b] Restricted to 644 women with epilepsy and 6487 women without epilepsy without established diabetes.
[c] Restricted to 291 women with epilepsy and 2727 women without epilepsy with no prior deliveries.
[d] Restricted to 512 women with epilepsy and 5311 women without epilepsy with vaginal deliveries.
[e] Restricted to 137 women with epilepsy and 1206 women without epilepsy with cesarean deliveries.

Supplementary Table 2 - Pregnancy outcomes and complications among women with and without epilepsy with singleton live birth deliveries in Washington State, 1997-2006.

	Women with Epilepsy (n=369)	%	Comparison Women (n=3666)	%	RR[a]	95% CI
Preeclampsia/ Eclampsia						
No	315	91.6	3195	94.8	1.00	Ref
Yes	29	8.4	176	5.2	1.62	1.11-2.35
Gestational Diabetes[b]						
No	340	92.9	3441	95.0	1.00	Ref
Yes	26	7.1	183	5.0	1.45	0.98-2.16
Placental Abruption						
No	365	98.9	3627	98.9	1.00	Ref
Yes	4	1.1	39	1.1	1.04	0.38-2.91
PPROM						
No	361	97.8	3626	98.9	1.00	Ref
Yes	8	2.2	40	1.1	2.02	0.86-4.28
Labor Induction						
No	243	65.9	2596	70.8	1.00	Ref
Yes	126	34.1	1070	29.2	1.17	1.01-1.36
Breech/ Malpresentation						
No	349	94.6	3516	95.9	1.00	Ref
Yes	20	5.4	150	4.1	1.33	0.85-2.10
Preterm Labor						
No	328	89.1	3396	93.5	1.00	Ref
Yes	40	10.9	237	6.5	1.67	1.22-2.30
Delivery Method[c]						
Vaginal	111	67.3	1096	73.4	1.00	Ref
C-section	54	32.7	398	26.6	1.23	0.97-1.55
Delivery Method						
Vaginal	255	69.3	2798	76.4	1.00	Ref
C-section	113	30.7	865	23.6	1.31	1.12-1.55
Post-Partum Hemorrhage						
No	351	95.1	3532	96.3	1.00	Ref
Yes	18	4.9	134	3.7	1.33	0.82-2.15
Hospital days - vaginal [d]						
0-2	206	80.8	2484	88.8	1.00	Ref

3-5	41	16.1	301	10.8	1.53	1.13-2.06
6+	8	3.1	13	0.4	3.32	2.09-5.26
Hospital days - Cesarean [e]						
0-2	27	23.9	251	29.0	1.00	Ref
3-5	78	69.0	580	67.1	1.07	0.95-1.20
6+	8	7.1	34	3.9	1.02	0.96-1.08
Death < 2 Years						
No	368	99.7	3664	99.9	1.00	Ref
Yes	1	0.3	2	0.1	5.14	0.47-56.12

[a] RR estimated from Poisson regression with robust standard errors, adjusted for birth year and maternal age. In multinomial outcomes, outcomes dichotomized, and relative to those without the outcome.
[b] Restricted to 366 women with epilepsy and 3624 women without epilepsy without established diabetes.
[c] Restricted to 165 women with epilepsy and 1496 women without epilepsy with no prior deliveries.
[d] Restricted to 255 women with epilepsy and 2798 women without epilepsy with vaginal deliveries.
[e] Restricted to 113 women with epilepsy and 865 women without epilepsy with cesarean deliveries.

Supplementary Table 3 - Pregnancy outcomes and complications among women with and without epilepsy with singleton live birth deliveries in Washington State, 2007-2012.

	Women with Epilepsy (n=1150)	%	Comparison Women (n=11403)	%	RR[a]	95% CI
Preeclampsia/ Eclampsia						
No	1060	92.9	10695	94.6	1.00	Ref
Yes	81	7.1	611	5.4	1.30	1.04-1.63
Gestational Diabetes[b]						
No	1025	91.4	10419	92.3	1.00	Ref
Yes	97	8.6	870	7.7	1.19	0.97-1.45
Placental Abruption						
No	1132	98.4	11274	98.9	1.00	Ref
Yes	18	1.6	129	1.1	1.05	0.38-2.91
PPROM						
No	1123	97.7	11255	98.7	1.00	Ref
Yes	27	2.3	148	1.3	1.81	1.20-2.72
Labor Induction						
No	777	67.6	8280	72.6	1.00	Ref
Yes	373	32.4	3123	27.4	1.18	1.08-1.29
Breech/ Malpresentation						
No	1089	94.7	10945	96.0	1.00	Ref
Yes	61	5.3	458	4.0	1.35	1.04-1.75
Preterm Labor						
No	1013	88.1	10571	92.8	1.00	Ref
Yes	137	11.9	825	7.2	1.64	1.38-1.95
Delivery Method[c]						
Vaginal	318	63.5	3374	70.5	1.00	Ref
C-section	183	36.5	1414	29.5	1.23	1.11-1.42
Delivery Method						
Vaginal	739	64.3	8086	70.9	1.00	Ref
C-section	411	35.7	3317	29.1	1.25	1.15-1.36
Post-Partum Hemorrhage						
No	1097	95.4	10975	96.3	1.00	Ref
Yes	53	4.6	428	3.7	1.22	0.92-1.61
ICU admit						
No	1130	99.4	11253	99.9	1.00	Ref

Yes	7	0.6	10	0.1	6.86	2.63-17.91
Hospital days - vaginal [d]						
0-2	564	76.3	6851	84.7	1.00	Ref
3-5	155	30.0	1175	14.5	1.44	1.24-1.68
6+	20	2.7	60	0.8	2.47	1.87-3.27
Hospital days - Cesarean [e]						
0-2	144	35.0	1407	42.4	1.00	Ref
3-5	237	57.7	1800	54.3	1.10	1.01-1.20
6+	30	7.3	110	3.3	1.05	1.02-1.09
Death < 2 Years						
No	1148	99.8	11403	100.0	-	-
Yes	2	0.2	0	0.0	-	-

[a] RR estimated from Poisson regression with robust standard errors, adjusted for birth year and maternal age. In multinomial outcomes, outcomes dichotomized, and relative to those without the outcome.
[b] Restricted to 1122 women with epilepsy and 11289 women without epilepsy without established diabetes.
[c] Restricted to 501 women with epilepsy and 4788 women without epilepsy with no prior deliveries.
[d] Restricted to 739 women with epilepsy and 8086 women without epilepsy with vaginal deliveries.
[e] Restricted to 411 women with epilepsy and 3317 women without epilepsy with cesarean deliveries.

Supplementary Table 4- Selected outcomes among singleton infants of women with and without epilepsy with deliveries in Washington State, 1987-1996.

	Women with Epilepsy (n=649)	%	Comparison Women (n=6518)	%	RR [a]	95% CI
Malformation						
No	598	92.1	6518	94.5	1.00	Ref
Yes	51	7.9	360	5.5	1.42	1.07-1.88
Fetal Distress						
No	551	84.9	5589	85.8	1.00	Ref
Yes	98	15.1	929	14.2	1.06	0.88-1.29
Meconium Aspiration						
No	647	99.7	6511	99.9	1.00	Ref
Yes	2	0.3	7	0.1	2.81	0.59-13.35
Birth Weight <2500g						
No	610	94.1	6228	95.8	1.00	Ref
Yes	38	5.9	276	4.2	1.36	0.98-1.90
Gestational Age <37 weeks						
No	607	95.4	6094	95.7	1.00	Ref
Yes	29	4.6	273	4.3	1.06	0.73-1.53
Size for Gestational Age						
Small	96	15.4	718	11.4	1.33	1.09-1.61
Appropriate	471	75.6	4951	78.8	1.00	Ref
Large	56	9.0	618	9.8	0.97	0.75-1.26
Apgar 5 Minute[b]						
7-10	643	99.2	6386	98.5	1.00	Ref
<7	5	0.8	100	1.5	0.49	0.20-1.18
Assisted Ventilation >30 mins[c]						
No	455	99.3	4569	99.6	1.00	Ref
Yes	3	0.7	18	0.4	1.62	0.48-5.46
Infant Length of Delivery Hosp. for Vaginal Deliveries (days) [d]						

0-2	399	83.3	4240	87.6	1.00	Ref
3-5	63	13.2	481	9.9	1.33	1.04-1.69
6+	17	3.5	118	2.5	1.49	0.90-2.46
Infant Length of Delivery Hosp. for Cesarean Deliveries (days) [e]						
0-2	15	11.6	157	14.7	1.00	Ref
3-5	103	79.9	838	78.7	1.04	0.96-1.12
6+	11	8.5	70	6.6	1.29	0.79-2.09
Neonatal Death (<28 days)						
No	647	99.7	6496	99.7	1.00	Ref
Yes	2	0.3	22	0.3	0.92	0.22-3.86
Infant Death (<2 years)						
No	645	99.4	6476	99.4	1.00	Ref
Yes	4	0.6	42	0.6	0.94	0.34-2.60

[a] RR estimated from Poisson regression with robust standard errors, adjusted for birth year and maternal age. In multinomial outcomes, outcomes dichotomized, and relative to those without the outcome.
[b] Additionally adjusted for method of delivery.
[c] Restricted to 497 women with epilepsy and 4996 women without epilepsy with deliveries 1989 or later.
[d] Restricted to 512 women with epilepsy and 5311 women without epilepsy with vaginal deliveries.
[e] Restricted to 137 women with epilepsy and 1206 women without epilepsy with cesarean deliveries.

Supplementary Table 5 - Selected outcomes among singleton infants of women with and without epilepsy with deliveries in Washington State, 1997-2006.

	Women with Epilepsy (n=369)	%	Comparison Women (n=3666)	%	Poisson Regression[a]	95% CI
Malformation						
No	340	92.4	3440	93.8	1.00	Ref
Yes	29	7.8	226	6.2	1.28	0.88-1.86
Fetal Distress						
No	331	89.7	3268	89.1	1.00	Ref
Yes	38	10.3	398	10.9	0.95	069-1.30
Meconium Aspiration						
No	368	99.7	3662	99.9	1.00	Ref
Yes	1	0.3	4	0.1	2.55	0.28-23.44
Birth Weight <2500g						
No	333	99.9	3508	96.0	1.00	Ref
Yes	36	0.1	148	4.0	2.41	1.70-3.42
Gestational Age <37 weeks						
No	328	89.4	3378	93.5	1.00	Ref
Yes	39	10.6	234	6.5	1.65	1.19-2.27
Size for Gestational Age						
Small	42	11.4	317	8.7	1.32	0.97-1.78
Appropriate	287	78.0	2950	81.4	1.00	Ref
Large	39	10.6	359	9.9	1.12	0.82-1.53
Apgar 5 Minute[b]						
7-10	357	97.5	3590	98.3	1.00	Ref
<7	9	2.5	62	1.7	1.40	0.70-2.83
Assisted Ventilation >30 mins						
No	339	99.4	3329	99.3	1.00	Ref
Yes	2	0.6	22	0.7	0.92	0.21-3.92
Infant Being Breastfed[c]						
No	30	20.7	130	9.0	2.24	1.56-3.20
Yes	115	79.3	1313	91.0	1.00	Ref
NICU Admission[c]						

No	146	92.4	1432	93.6	1.00	Ref
Yes	12	7.6	98	6.4	1.22	0.68-2.17
Infant Length of Delivery Hosp. for Vaginal Deliveries (days)[d]						
0-2	221	88.8	2511	92.8	1.00	Ref
3-5	16	6.4	122	4.5	1.46	0.88-2.41
6+	12	4.8	73	2.7	1.83	1.01-3.32
Infant Length of Delivery Hosp. for Cesarean Deliveries (days)[e]						
0-2	31	27.7	313	37.9	1.00	Ref
3-5	67	59.8	444	53.8	1.18	1.02-1.36
6+	14	12.5	69	8.4	1.72	1.05-2.82
Neonatal Death (<28 days)						
No	368	99.7	3655	99.7	1.00	Ref
Yes	1	0.3	11	0.3	0.90	0.12-6.91
Infant Death (<2 years)						
No	366	99.2	3648	99.5	1.00	Ref
Yes	3	0.8	18	0.5	1.64	0.49-5.55

[a] RR estimated from Poisson regression with robust standard errors, adjusted for birth year and maternal age. In multinomial outcomes, outcomes dichotomized, and relative to those without the outcome.
[b] Additionally adjusted for method of delivery.
[c] Restricted to 160 women with epilepsy and 1576 women without epilepsy with deliveries in 2003 or later.
[d] Restricted to 767 women with epilepsy and 8109 women without epilepsy with vaginal deliveries.
[e] Restricted to 250 women with epilepsy and 2071 women without epilepsy with cesarean deliveries.

Supplementary Table 6 - Selected outcomes among singleton infants of women with and without epilepsy with deliveries in Washington State, 2007-2012.

	Women with Epilepsy (n=1150)	%	Comparison Women (n=11403)	%	RR [a]	95% CI
Malformation						
No	1072	93.2	10709	93.9	1.00	Ref
Yes	78	6.8	694	6.1	1.12	0.89-1.40
Fetal Distress						
No	1023	89.0	10206	89.5	1.00	Ref
Yes	127	11.0	1197	10.5	1.05	0.88-1.25
Meconium Aspiration						
No	1143	99.4	11375	99.8	1.00	Ref
Yes	7	0.6	28	0.2	2.43	1.06-5.55
Birth Weight <2500g						
No	1052	91.6	10871	95.0	1.00	Ref
Yes	97	8.4	570	5.0	1.68	1.36-2.06
Gestational Age <37 weeks						
No	1011	88.1	10547	92.8	1.00	Ref
Yes	137	11.9	823	7.2	1.65	1.39-1.95
Size for Gestational Age						
Small	116	12.7	828	9.2	1.35	1.13-1.62
Appropriate	733	80.4	7432	82.3	1.00	Ref
Large	63	6.9	755	8.5	0.87	0.68-1.11
Apgar 5 Minute[b]						
7-10	1110	97.0	11147	97.9	1.00	Ref
<7	34	3.0	237	2.1	1.37	0.96-1.96
Assisted Ventilation >30 mins						
No	1110	98.1	11120	99.2	1.00	Ref
Yes	21	1.9	95	0.8	2.20	1.37-3.52
Infant Being Breastfed						
No	873	77.6	10447	93.0	3.16	2.78-3.59
Yes	252	22.4	782	7.0	1.00	Ref
NICU Admission						

No	1019	90.1	10576	94.3	1.00	Ref
Yes	112	9.9	188	5.7	1.73	1.43-2.10
Infant Length of Delivery Hosp. for Vaginal Deliveries (days)[d]						
0-2	794	71.9	8953	80.9	1.00	Ref
3-5	227	20.5	1651	14.9	1.61	1.25-2.07
6+	84	7.6	467	4.2	1.71	1.22-2.41
Infant Length of Delivery Hosp. for Cesarean Deliveries (days)[e]						
0-2	182	46.2	1780	55.1	1.00	Ref
3-5	164	41.6	1220	37.8	1.15	1.02-1.30
6+	48	12.2	229	7.1	1.81	1.36-2.39
Neonatal Death (<28 days)						
No	1148	99.8	11365	99.7	1.00	Ref
Yes	2	0.2	38	0.3	0.52	0.13-2.18
Infant Death (<2 years)						
No	1145	99.6	11351	99.5	1.00	Ref
Yes	5	0.4	52	0.5	0.95	0.38-2.38

[a] RR estimated from Poisson regression with robust standard errors, adjusted for birth year and maternal age. In multinomial outcomes, outcomes dichotomized, and relative to those without the outcome.
[b] Additionally adjusted for method of delivery.
[c] Restricted to 1150 women with epilepsy and 11403 women without epilepsy with vaginal deliveries.
[d] Restricted to 411 women with epilepsy and 3317 women without epilepsy with cesarean deliveries.