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ORIGINAL RESEARCH

The Effect of Seizures on Perinatal Outcomes in Pregnant Women with Epilepsy: A Single Center Retrospective Study

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Purpose: This study was conducted to evaluate the effects of epilepsy on pregnancy and delivery outcomes. It aimed to assess the relationship of seizure type, the presence of seizures during pregnancy, and the timing of the last seizure before conception on perinatal outcomes for pregnant women with epilepsy (WWE).

Methods: The research included 300 participants, comprising 100 pregnant WWE and a control group of 200 healthy pregnant women. The study analyzed demographic and clinical data for all subjects. Perinatal outcomes were evaluated according to seizure type, seizure status during pregnancy, and the last seizure before pregnancy.

Results: The results showed a high rate of cesarean sections in the epilepsy group, at 71%. The number of babies born small for gestational age (SGA) was also significantly higher among WWE ($p = 0.001$). While there was no significant difference in most maternal and fetal outcomes between women with generalized and non-generalized seizures, the study identified pre-conception presence of seizures as a critical factor. Women who had experienced a seizure within the year before becoming pregnant had babies born at an earlier gestational week ($p = 0.021$) and with a lower birth weight ($p = 0.018$) compared to those whose last seizure was more than a year ago. Furthermore, 45% of the WWE had seizures during their pregnancy.

Conclusion: The most important predictor of seizures during pregnancy is the presence of seizures before pregnancy. Presence of seizures during gestation is strongly associated with adverse perinatal outcomes, whereas the specific type of epilepsy is not.

Keywords: pregnancy, epilepsy, seizure, perinatal outcomes

Introduction

The neurological disorder epilepsy is particularly frequent during pregnancy. Epilepsy affects women of childbearing age and the prevalence of epilepsy during pregnancy is 0.3–0.7.[1] Although pregnant women with epilepsy (WWE) are considered high-risk, most pregnancies are uneventful. Epilepsy data are conflicting due to differences in study methodology. Literature has reported that the rate of cesarean sections and the risk of obstetric intervention have increased.[2] Apart from the discrepancy in reported data, ethnicity, geographic region, and socioeconomic status affect poor obstetric outcomes in WWE.[3]

In WWE pregnancies, a 10 times higher mortality rate and 2 to 3 times higher incidence of adverse perinatal outcomes were observed compared to healthy pregnant women.[4] There is an increased risk of anemia, premature rupture of membranes (PPROM), and hemorrhage after delivery in this group of patients.[4] To reduce maternal and neonatal complications and mortality in pregnant women, follow-up, a precise assessment of the gravity of the patient's illness, and effective treatment are needed.

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In addition to seizure type and presence of seizures during pregnancy, the use of antiseizure medications (ASM) is a major factor that can influence pregnancy and neonatal outcomes. Studies have demonstrated that older-generation ASM, such as valproate, are associated with increased risks of congenital malformations and neurodevelopmental disorders, whereas newer-generation ASM (eg, levetiracetam, lamotrigine) may pose lower risks. Therefore, understanding the medication profile in pregnant WWE is critical when evaluating perinatal outcomes.[5]

Seizures during pregnancy affect the pregnancy and delivery processes. Some studies say seizures should be managed before conception because the presence of seizures is expected to be the same before and throughout pregnancy.[6] However, the frequency of seizures may vary and may significantly affect the course of pregnancy and delivery.[7] Cesarean section(CS) rates increase in active epilepsy cases.[8,9] Concerns among physicians and patients about the risk of seizures during delivery and the potential negative consequences contribute to the rise in the rate of CS's.[10]

This study aims to examine the association between maternal epilepsy and adverse perinatal outcomes by comparing pregnant WWE and healthy pregnant women, and the secondary aim is to assess whether seizure types, presence of seizures during pregnancy, and time of last seizure before conception have an impact on perinatal outcomes. A novel contribution of this study is the stratification of WWE based on the timing of their last seizure before conception (≤1 year vs >1 year), which provides a unique clinical perspective on pre-pregnancy seizure control and its association with perinatal outcomes. These results will help control pre-pregnancy seizures, provide appropriate follow-up during pregnancy, and care for women after delivery.

Material Method

Study Design and Setting

This retrospective study included pregnant WWE and low-risk healthy pregnant women who were followed up at Necmettin Erbakan University Medical Faculty Hospital between January 2016 and October 2022. A retrospective single-center design was chosen to ensure consistency in patient management, reduce protocol variability, and allow access to comprehensive electronic records across a well-documented cohort. The study was approved by the Necmettin Erbakan University Faculty of Medicine ethics committee, and the principles of the Helsinki Declaration were followed throughout the study (2023/4141:12,646). Informed consent was obtained from all individuals included in this study. Patients whose data could not be reached in the epilepsy group or who did not give birth in our clinic were excluded.

Data Collection

The patient information was obtained from the electronic data registered in the outpatient clinic, delivery room, and operating room. Cases with fetal chromosomal or structural abnormalities detected during follow-up or multiple pregnancies were excluded from the study. The healthy control group consisted of low-risk pregnant women. Cases who used medical drugs due to chronic diseases, who used anti-psychiatric drugs, or who had a history of chronic hypertension, pregestational diabetes, or preeclampsia were excluded from the study. SPSS for Windows, version 21.0 The "random case sample" function was used to randomize the control group with a control-to-WWE case ratio of 2:1 (Figure 1). Although the control group was not individually age-matched, the mean maternal age between groups was statistically comparable ($p = 0.183$), minimizing confounding related to maternal age. All medical records of the cases with epilepsy, such as the type of seizure, the type and doses of ASM used, the seizure time before pregnancy, the history of seizures during pregnancy, and the drug changes during pregnancy, were accessed from the electronic recording system. Seizure data were collected retrospectively from electronic hospital records including outpatient prenatal visits, neurology consultations, and inpatient/emergency admissions. Thus, seizure reports included both hospital-attended episodes and patient-reported events documented during routine follow-up. Cases with major fetal anomalies were excluded to avoid confounding the relationship between maternal epilepsy and perinatal outcomes, since anomalies themselves can independently impact gestational age, birth weight, and delivery method. Subgroups were made based on the type of seizure (generalize vs nongeneralize), whether or not there was a seizure during pregnancy (whole pregnancy to delivery), and when the last seizure happened before pregnancy (less than 1 year or above 1 year). In ILAE-2017,[11] seizures were classified as focal, generalized, and unknown seizures. In our study, we included focal (nongeneralized)

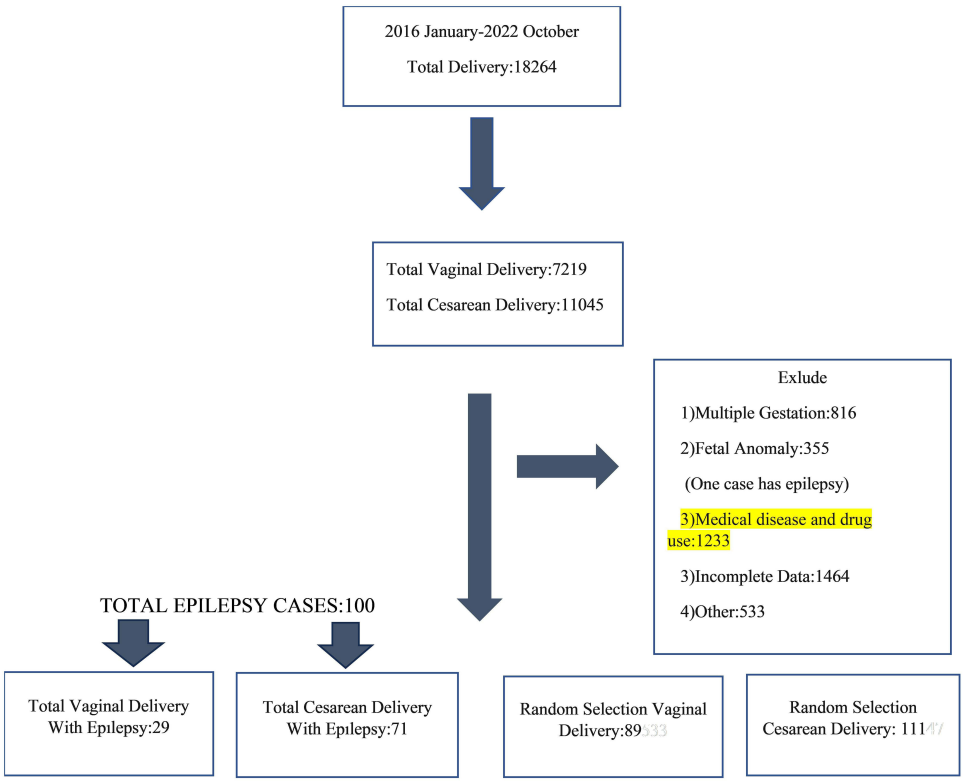

Figure 1 Selection of study group.

and generalized cases, and unknown seizures were excluded. The outcomes included the rates of small for gestational age (SGA; Birth weight below the 10th percentile for gestational age), preterm delivery (PTB; Birth under 37 weeks according to gestational age), PPROM, gestational diabetes mellitus, abruption placenta, uterine atony and preeclampsia, the rates of CS, postpartum hemorrhage, Apgar scores (Low Apgar scores were defined as <7 at 5 minutes, in accordance with standard clinical guidelines), blood transfusion, and fetal death rates.

Statistical Analysis

SPSS version 21 was used for statistical analysis. Initially, a graphical analysis of deviation from the normality of all data was performed using the Kolmogorov–Smirnov, Shapiro Wilk test, and histograms. To compare these groups, normally distributed data were presented as Mean ± SD. An Independent *t*-test was performed on parametric data. Mann–Whitney *U*-test was applied if the data were not parametric. The chi-square test was used to determine whether categorical variable distributions differed between groups. The p-significance value was taken as 0.05.

Results

Comparison of Sociodemographic and Clinic Data of WWE and Control Groups

A total of 300 patients were included in the study. 100 of them were pregnant WWE, and 200 were healthy control pregnancies. The demographic and clinical features of control and pregnant WWE are shown in Table 1. The mean age of the pregnant WWE was 28.81 ± 5.58 years. The rate of CS was 71% in the WWE group, while it was 55.5% in the control group (p=0.012). Newborn birth weight percentiles were significantly lower in the WWE group (44.32 ± 35.97 vs 52.86 ± 31.21; p=0.035). The SGA infant rate was significantly higher in the WWE group [28% (n = 28) vs 12% (n = 24); p = 0.001]. Pregnant WWE had longer hospital stays compared to the control group (p = 0.001). The rate of patients who had seizures during pregnancy was 45% (n = 45); single drug use was 74% (n = 74); and the rate of pregnant women whose medication and dosage did not change during pregnancy was 63% (n = 63).

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Table 1 Comparison of Sociodemographic and Clinical Data of WWE and Control Groups

Parameters		Epilepsy (n=100)	Controls (n=200)	p-value
Age(years)		28.81 ± 5.58	29.71 ± 5.51	0.183*
Gravida		2.53 ± 1.25	2.91 ± 1.30	**0.017***
Parity		1.05 ± 0.89	1.49 ± 1.02	**0.001***
Abortion		0(0–3)	0(0–5)	0.558**
Cesarean section history		0(0–3)	0(0–3)	0.499**
Body mass index		28.23±2.51	28.04±3.48	0.597*
Folate use		79(79%)	153(76.5%)	0.626***
Smoking		3(3%)	10(5%)	0.423
Delivery age(week)		37.84 ± 2.04	37.62 ± 2.22	0.408**
Newborn weight percentile		44.32 ± 35.97	52.86 ± 31.21	**0.035****
Birth weight (grams)		3036.28 ± 646.31	3134.05 ± 628.50	0.209**
SGA		28(28%)	24(12%)	**0.001*****
PPROM		6(6%)	14(7%)	**0.743*****
APGAR		6.44±1.10	6.31±0.98	**0.303***
İntrauterin fetal death		1(1%)	2(1%)	1.00***
Prepartum Hemoglobin (gr/dl)		12.49 ± 1.36	12.28 ± 1.34	0.216*
Postpartum Hemoglobin (gr/dl)		10.60 ± 1.43	11.64 ± 5.77	0.076**
Blood transfusion		5(5%)	6(3%)	0.385***
Maternal Hospitalization (days)		3(2–9)	2(1–23)	0.**001****
Type of delivery	Vaginal Cesarean	29(29%) 71(71%)	89(44.5%) 111(55.5%)	**0.012*****
Uterine atony		5(5%)	12(6%)	0.724***
Preeclampsia		5(5%)	9(4.5%)	0.847***
Abruption Placenta		1(1%)	2(1%)	1.00***
Placenta previa		0(0%)	5(2.5%)	0.111***
GDM		4(4%)	7(3.5%)	0.828***
Seizure Type	Generalized Non-generalized	49(49%) 51(51%)		
Seizure during pregnancy Presence of seizures in pregnancy		45(45%) 0(0–56)		
Time Between Last Seizure and Pregnancy(year)		2(0–15)		
Epilepsy diagnose Time(year)		11.10 ± 7.31		
Form of Treatment	Single Drug Two Drugs Three Drugs Without Medication Surgical	74(74%) 14(14%) 1(1%) 9(9%) 2(2%)		
Medication change during pregnancy	Same drug Increased the same drug dosage Changed the treatment	63(63%) 20(20%) 17(17%)		

Notes: The data was given as Mean + SD and n (%). * independent *t* test, ** Mann–Whitney *U*-test, *** chi-square test. Bold values denote statistical significance at the $p < 0.05$ level.

Abbreviations: GDM, gestational diabetes mellitus; SGA, small gestational age; NICU, neonatal intensive care unit; PPROM, preterm premature rupture of membrane.

Pregnant WWE Classified by Type, Frequency of Seizures

When the outcomes for both the fetus (birth weight, delivery week, Apgar score) and the mother (atony, preeclampsia, hemoglobin value, PPROM, abruption placenta) were compared between women who had seizures and those who did

not, there was no statistically significant difference. While the rate of CS was 91.1% in those who had seizures during pregnancy, it was 54.5% in those who did not (p=0.0001). However, it was observed that those with pre-conceptional seizures of less than 1 year and those with generalized seizures had more frequent seizures during pregnancy (p = 0.0001 and 0.005, respectively). Treatment was started for the patient who had a seizure without taking medication (Table 2). Fetal and maternal outcomes of cases with generalized and non-generalized seizures were not significantly different except for the mean birth weight percentile (Table 3).

Evaluation of Pregnant WWE According to Their Pre-Pregnancy Epilepsy Experience

Comparing those who had a seizure in the pre conceptional year with those who had a seizure more than 1 year ago, the birth week (37.29 ± 2.51 weeks vs 38.24 ± 1.54 weeks; p = 0.021) and birth weight (2587.84 ± 730.61 g vs 3165.69 ± 548.63 g; p = 0.018) were observed to be significantly low. Fetal Apgar score, hospitalization, SGA, and fetal death rates were not different in this group. Maternal hospitalization, postpartum bleeding, uterine atony, PPROM and preeclampsia rates were not different. The rate of CS was significantly higher in those who had seizures within 1 year before pregnancy (p=0.0001) (Table 4). In our series, the content of the drug was not found to be

Table 2 Demographic and Clinical Data of Patients with Epilepsy are Classified According to the Presence or Absence of Seizures During Pregnancy

Parameters		**Seizures (n = 45)**	**No Seizures (n = 55)**	**p-value**
Age(years)		28.51 ± 5.28	29.05 ± 5.85	0.630**
Delivery age(week)		37.53 ± 2.28	38.09 ± 1.82	0.177**
Cesarean section		41(91.1%)	30(54.5%)	**0.0001*****
Newborn weight percentile		43.20 ± 38.12	45.24 ± 34.45	0.780**
Birth weight (grams)		2962.84 ± 728.02	3096.36 ± 570.79	0.306*
Apgar Score 5'min		6.42 ± 1.29	6.45 ± 0.94	0.889**
SGA		14(31.1%)	14(25.5%)	0.343***
PPROM		1(2.2%)	5(9.1%)	0.219
APGAR		6.42±1.28	6.45±0.93	0.889
NICU admission		8(17.8%)	7(12.7%)	0.335***
İntrauterin fetal death		1(2.2%)	0(0%)	0.450***
Prepartum Hemoglobin (gr/dl)		12.65 ± 1.50	12.36 ± 1.23	0.296*
Postpartum Hemoglobin (gr/dl)		10.89 ± 1.69	10.37 ± 1.15	0.087*
Maternal Hospitalization (days)		3.31 ± 1.86	3.16 ± 1.68	0.677**
Time Between Last Seizure And Pregnancy(years)		1(0–11)	2(0–15)	**0.0001****
Uterine atony		3(6.7%)	2(3.6%)	0.405***
Preeclampsia		3(6.7%)	2(3.6%)	0.405***
Abruption Placenta		0(0%)	1(1.8%)	0.550***
GDM		1(2.2%)	3(5.5%)	0.388***
Medication change during pregnancy	Same drug	22(48.9%)	41(74.5%)	**0.001**
	Increased the same drug dosage	17(37.8%)	3(5.5%)	
	Changed the treatment	6(13.3%)	11(20%)	
Seizure Type	Generalized	29(64.4%)	20(36.4%)	**0.005*****
	Non-generalized	16(35.6%)	35(63.6%)	
Form Of Treatment	Single Drug	35(77.8%)	39(70.9%)	0.255***
	Two Drugs	8(17.8%)	6(10.9%)	
	Three Drugs	0	1(1.8%)	
	Without Medication	2 (4.4%)	7(12.7%)	
	Surgical	0	2(3.6%)	

Notes: The data was given as Mean + SD and n(%). * independent *t* test, ** Mann–Whitney *U*-test, *** chi-square test. Bold values denote statistical significance at the p < 0.05 level.

Abbreviations: GDM, gestational diabetes mellitus; SGA, small gestational age; NICU, neonatal intensive care unit; PPROM, preterm premature rupture of membrane.

Table 3 Demographic and Clinical Data of Pregnant Women with Epilepsy Grouped by Seizure Type

Parameters	Generalized Seizures (n = 49)	Non-Generalized Seizures (n = 51)	p-value
Delivery age(week)	37.98 ± 2.30	37.71 ± 1.78	0.507**
Cesarian section	35(71.4%)	36(70.6%)	0.926***
Newborn weight percentile	36.53 ± 35.10	51.80 ± 35.54	**0.033****
Birth weight (grams)	2931.84 ± 669.84	3136.63 ± 612.70	0.114*
Apgar Score 5'min	6.29 ± 1.17	6.59 ± 1.02	0.172**
SGA	17(34.7%)	11(21.6%)	0.108***
NICU admission	10(20.4%)	5(9.8%)	0.114***
PPROM	1(2%)	5(9.8%)	0.205
APGAR	6.28±1.17	6.58±1.02	0.172
Intrauterin fetal death	1(2.04%)	0(0%)	0.490***
Prepartum Hemoglobin (gr/dl)	12.48 ± 1.50	12.51 ± 1.23	0.924*
Postpartum Hemoglobin (gr/dl)	10.63 ± 1.55	10.58 ± 1.33	0.884*
Maternal Hospitalization (days)	3.43 ± 1.94	3.04 ± 1.55	0.269**
Time Between Last Seizure And Pregnancy(year)	1.5(0–15)	2(0–11)	0.280**
Uterine atony	2(4.1%)	3(5.9%)	0.519***
Preeclampsia	3(6.1%)	2(3.9%)	0.481***
Abruption Placenta	1(2.04%)	0(0%)	0.490***
GDM	0(0%)	4(7.8%)	0.064***

Notes: The data was given as Mean + SD and n(%). * independent *t* test, ** Mann–Whitney *U*-test, *** chi-square test. Bold values denote statistical significance at the $p < 0.05$ level.

Abbreviations: GDM, gestational diabetes mellitus; SGA, small gestational age; NICU, neonatal intensive care unit; PPROM, preterm premature rupture of membrane.

Table 4 Comparison of the Data of Pregnant Women with Epilepsy Whose Duration Between Their Last Seizure and Pregnancy Was Less Than 1 year and Above 1 year

Parameters	≤1 year (n=42)	> 1 year (n=58)	p-value
Age(years)	29.45 ± 6.17	28.34 ± 5.11	0.330*
Delivery week	37.29 ± 2.51	38.24 ± 1.54	**0.021****
Cesarian section	38(90.5%)	33(56.9%)	0.**0001*****
Newborn weight percentile	36.24 ± 33.56	50.17 ± 36.81	0.055**
Birth weight (grams)	2587.84 ± 730.61	3165.69 ± 548.63	**0.018***
Apgar Score 5'min	6.40 ± 1.21	6.47 ± 1.03	0.787**
SGA	15(35.7%)	13(22.4%)	0.108***
PPROM	3(7.1%)	5(3.2%)	0.694
APGAR	6.40±1.21	6.46±1.02	0.787
NICU admission	9(21.4%)	6(10.3%)	0.107***
İntrauterin fetal death	1(2.4%)	0(0%)	0.420***
Prepartum Hemoglobin (gr/dl)	12.62 ± 1.44	12.40 ± 1.31	0.434*
Postpartum Hemoglobin (gr/dl)	10.80 ± 1.58	10.47 ± 1.32	0.261*
Maternal Hospitalization (days)	3.38 ± 1.72	3.12 ± 1.78	0.466**
Uterine atony	2(4.8%)	3(5.2%)	0.650***
Preeclampsia	2(4.8%)	3(5.2%)	0.650***
Abruption Placenta	0(0%)	1(1.7%)	0.580***
Presence of seizures in pregnancy	1(0–56)	0(0–20)	**0.0001****

Notes: The data was given as Mean + SD and n(%). * independent *t* test, ** Mann–Whitney *U*-test, *** chi-square test. Bold values denote statistical significance at the $p < 0.05$ level.

Abbreviations: GDM, gestational diabetes mellitus; SGA, small gestational age; NICU, neonatal intensive care unit; PPROM, preterm premature rupture of membrane.

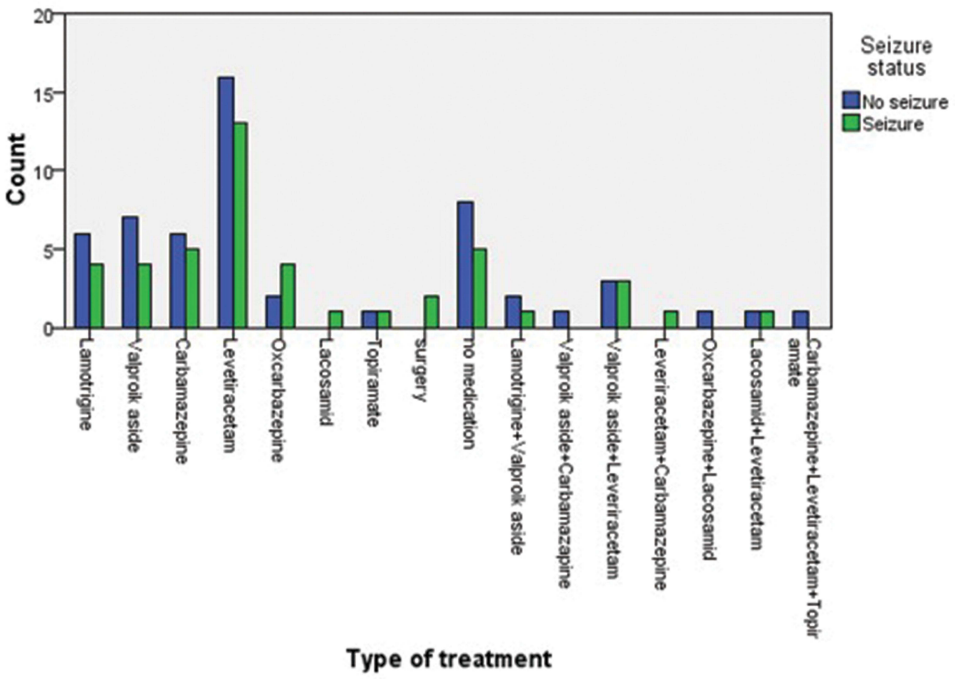

Figure 2 Drug distribution and seizure status of pregnant women with epilepsy.

statistically significant in presence of seizures during pregnancy (p=0.855). Figure 1 illustrates the randomization process for control group selection, and Figure 2 displays the relationship between ASM regimen and presence of seizures.

Discussion

The demographic and clinical features, the perinatal outcomes of pregnant WWE were compared to those of healthy pregnant women in this study. It was observed that the rates of cesarean sections and SGA babies were higher in pregnant WWE, and the length of hospital stay was longer due to delivery. While 45% of pregnant WWE had seizures during pregnancy, 74% had a single drug, and 63% did not change their drug. Earlier delivery and lower birth weight were observed in pregnant women who experienced seizures in the year before pregnancy.

Researchers have found that pregnant WWE are more likely to have pregnancy-induced hypertension, placental abruption, postpartum bleeding, and death than pregnant women without epilepsy[12,13] This study found a statistically significant difference in the increased risk of CS and SGA fetus between women with pregnancy-related epilepsy and controls. G-Bannerman et al found that while maternal mortality did not increase in pregnant WWE, adverse maternal outcomes were moderate in antiepileptic drug patients.[14] While several studies have found that maternal epilepsy is associated with an increased risk of preterm birth, preeclampsia, postpartum hemorrhage, cesarean delivery, and SGA,[4,15] Salman et al observed increased placental abruption, long-term hospital stays, and high perinatal morbidity in pregnant WWE.[16] The current study has shown that pregnant WWEs have longer hospital stays than healthy pregnant women. Some studies have reported that there are no adverse outcomes in pregnant WWE.[17] Differences in studies may be due to exclusion criteria such as structural anomalies and multiple pregnancies, which were not included in the study.

Recent research indicates that individuals with epilepsy are at an elevated risk of severe maternal morbidity and hospital readmission during the peri-partum and postpartum period. Close monitoring of individuals with epilepsy during pregnancy is necessary, as well as considerations regarding the administration of antiseizure medications.[18] Based on data from India from 1998 to 2017, Keni et al discovered that fewer people (12.7%) stopped using ASMs in recent years, and the percentage of people using monotherapy and polytherapy stayed the same at 61.5% and 25.8%, respectively. During this time, the use of older ASMs like phenobarbitone, phenytoin, and valproate dropped a lot, while the use of newer

ASMs like clobazam, levetiracetam, lamotrigine, and oxcarbazepine rose from about 0% to 4.7% to 5.5% to 40.5%. This suggests that the newer ASMs may work better and be easier for patients to handle.[19]

In addition to studies that show adverse perinatal outcomes [NICU (neonatal intensive care unit) admission, breathing problems, and seizures in newborns] in pregnant WWE,[20] in a study done in Sweden, it was found that pregnant women who took antiseizure drug did not have any perinatal adverse outcomes.[21] Epileptic seizures during pregnancy were marginally associated with SGA infants in a Taiwanese population-based data set compared to women with epilepsy who did not have seizures during pregnancy.[22] In their study, Van Marter et al reported that there was no difference in the rates of SGA between babies born to pregnant women with epilepsy and healthy pregnant women and that SGA rates were high only in cases using topiramate.[23] Maternal seizures pose risks to the fetus. Generalized tonic-clonic seizures, in particular, can cause hypoxia and lactic acidosis, which can harm the fetüs.[24] Although the frequency of seizures during pregnancy was high in the generalized group in our series, maternal (excluding cesarean delivery) and perinatal adverse outcomes were not different. Even though the birth weight percentile was statistically lower in the generalized seizure group, it did not correspond to an increased incidence of SGA or NICU admissions, limiting the clinical impact of this finding. In addition to seizure timing and delivery outcomes, other important factors such as seizure severity, ASM type, and the potential link between epilepsy and fetal anomalies should also be considered. Previous studies have reported that generalized tonic-clonic seizures may pose risks such as hypoxia or fetal acidosis, especially in uncontrolled epilepsy.[5,25] While some ASMs like valproate are associated with increased teratogenic risk, newer-generation ASMs may offer safer profiles. However, due to the exclusion of anomalous fetuses and limited granularity in our retrospective dataset, we were unable to explore these relationships in detail. This represents a limitation of our study but also highlights a need for future prospective research focused on ASM-specific outcomes and seizure severity classification. In this study, we found that, compared to controls, the SGA ratio was high and the mean birth weight percentile was low. We think that the low rates of perinatal adverse outcomes are due to the increase in patient and physician awareness and our being a tertiary center. While we hypothesize that tertiary center management and heightened awareness may contribute to favorable outcomes, objective parameters such as ASM level monitoring were not consistently recorded and thus could not be analyzed.

The number and features of seizures in pregnant WWE can differ during pregnancy. Pregnancy was associated with a 14–62% rise in the presence of seizures.[26] In this study, 45% of pregnant WWE have seizures during pregnancy. In the study of Huang et al, It was reported that 54.67% of pregnant WWE had seizures throughout pregnancy, Moreover, the type of seizure remained the same in 60.98% of these women. In another study, it was reported that only 47.5% of these women had a seizure-free pregnancy.[12,27] According to one study, WWE who were seizure-free in the nine months prior to pregnancy had an 84–92% chance of not having a seizure throughout their pregnancy if they did not alter their current antiepileptic regimen.[28] The presence of seizures before pregnancy is the best indicator of seizures during pregnancy. In current study, the presence of seizures during pregnancy was significantly higher in those who had a seizure one year before pregnancy. When those who had a seizure one year before pregnancy were compared with those who had their last seizure more than a year ago, it was seen that the week of birth and newborn birth weight were low. This supports the consideration of a seizure-free interval of at least one year before conception as a potential clinical goal when managing WWE of child-bearing age.

The presence of epilepsy during pregnancy is not an absolute indication for a CS. There are many reasons for the high number of cesarean deliveries in the WWE. Due to the risk of having a seizure during delivery, epileptic pregnant women who do not take their medicines regularly may choose to have an elective CS. Epileptic seizures during vaginal delivery may be exacerbated by sleep deprivation, fatigue, and labor pain. According to previous research, the incidence of epileptic seizures during labor is approximately 2%.[27] Parallel to the increasing CS rates in Turkey, the rate of CS in our study group was 71%. In the Poland study, this rate was 47.1%.[2] Research studies in the United States found that WWE were more likely to have a cesarean delivery than those without (40.5% vs 33.1%).[15] In contrast to our findings, European studies found lower cesarean delivery rates in WWE (18.8% vs 34%).[29] However, the overall cesarean section rate in Turkey has consistently remained above 50% in recent years, independent of epilepsy status. This likely contributes to the higher CS rate observed in both our WWE and control groups and

reflects broader regional clinical practice patterns. In the MONEAD study, it was observed that there was no difference in CS rates between pregnant WWE and controls.[30] Furthermore, some studies found a higher rate of vaginal deliveries.[31] Studies show that the type of seizure affects the number of CS's. It was found that pre-pregnancy generalized epilepsy affects the number of CS's.[2] The rate of CS was the same in the generalized and non-generalized groups in our study group. SGA pregnancies and associated presentation anomalies may be cofactors for cesarean deliveries.[32]

Strengths and Limitations

The limitations of this study are that it is a retrospective, single-center study. The tertiary nature of the NEU and relatively small sample size may limit the generalizability of the findings. The effects of the drugs and multidrug treatments used in this study on perinatal morbidity and mortality were not evaluated. On the other hand, the data reflect both seizures reported by patients during routine obstetric follow-up, neurology consultations and those requiring emergency visits, or hospitalization. However, we recognize that mild or unreported seizures may not have been captured. Seizure changes during pregnancy and presence of seizures according to trimesters could not be evaluated. No evaluation could be made about the long-term outcomes of the neonates of epileptic mothers. The study's exclusion of fetuses with anomalies and pregnant education levels is another limitation.

The strength of this study is that all fetal and maternal outcomes can be obtained according to seizure types, presence of seizures during pregnancy, and how long before conception the seizure occurs. Another strength of the study is that seizure-based subgroup analyses were performed to investigate the importance of disease characteristics.

Conclusion

This study showed that the rates of SGA and cesarean births are higher in pregnant WWE than in pregnant women without epilepsy. The most important predictor of seizures during pregnancy is the presence of seizures prior to pregnancy. Presence of seizures during pregnancy is associated with adverse perinatal outcomes. Types of epilepsy were not associated with adverse outcomes. These findings highlight the importance of multidisciplinary care for pregnant WWE. However, due to the retrospective single-center design and the lack of detailed ASM specific data, caution is advised when generalizing these findings to broader populations. Future prospective studies with ASM level monitoring are warranted.

Data Sharing Statement

The datasets generated and analyzed during the present study are available from the corresponding author on reasonable request.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no conflict of interest.

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