

# Neurodevelopmental Outcomes in Premature Neonates Diagnosed with Seizures

## Clinically vs. using Electroencephalogram

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### Introduction

Neonatal seizures can be associated with long-term sequelae, especially among preterm neonates. While there has been a reduction in mortality over the last decade, morbidity is still a problem. Seizures in preterm neonates are often diagnosed clinically and treatment is started prior to electroencephalogram (EEG) verification. By evaluating neurodevelopmental outcomes in preterm infants who experience seizures diagnosed by various methods, it may guide clinicians in the timing of starting treatment for seizures.

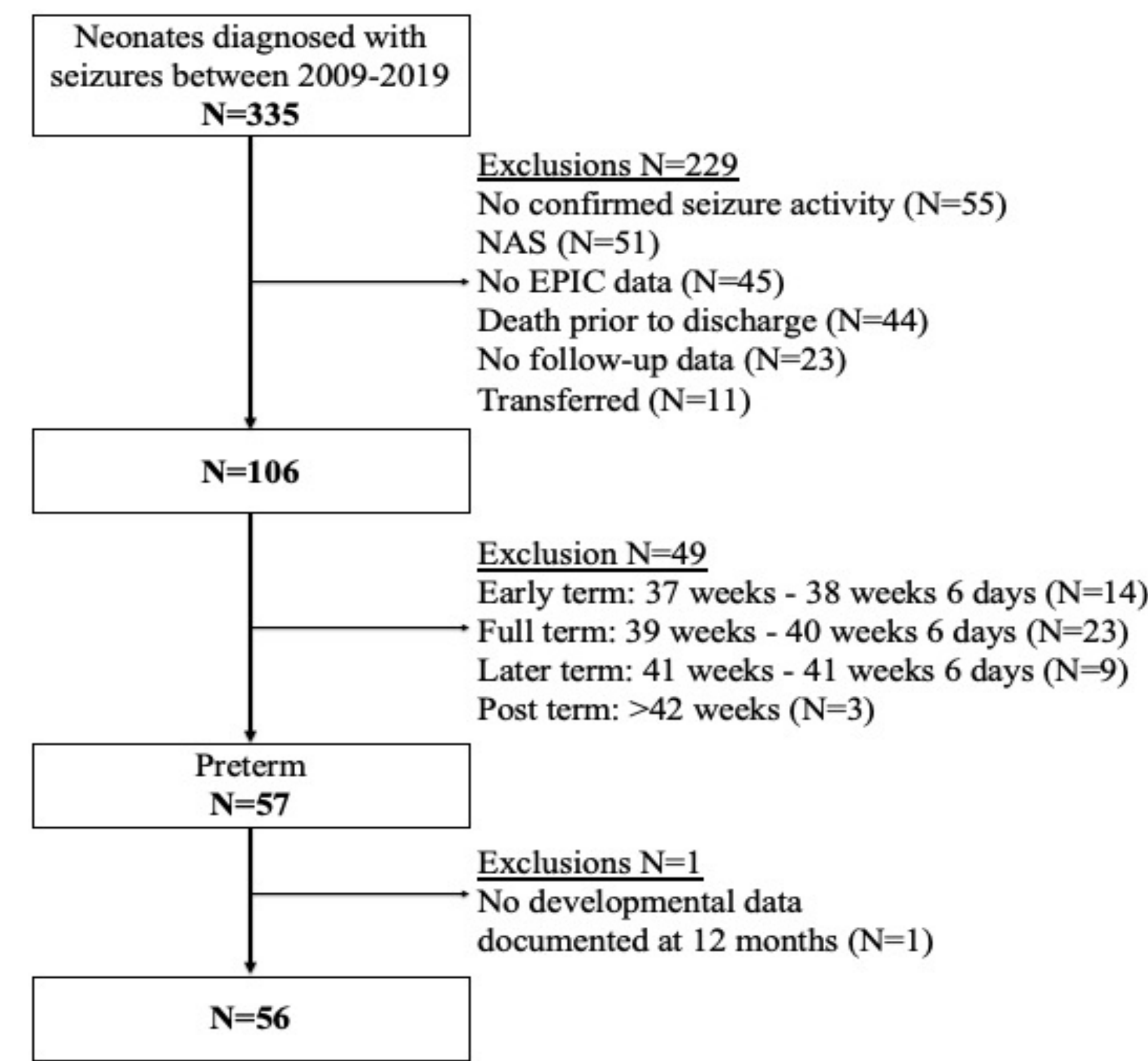
### Objective

Determine whether there is a difference in neurodevelopmental outcomes at 12-24 months corrected gestational age (CGA) among preterm neonates diagnosed with seizures clinically compared to using electroencephalogram (EEG).

### Methods

- IRB approved retrospective chart review of preterm neonates born between 2009 and 2019, data collected from EHR (EPIC)
- Inclusion criteria:
  - premature neonates (<37 weeks)
  - admitted to the neonatal intensive care unit (NICU)
  - diagnosed with seizures clinically and/or via EEG
- Exclusion criteria:
  - passed away prior to discharge
  - had no confirmed seizure activity at discharge from the NICU
  - diagnosed with Neonatal Abstinence Syndrome
  - transferred to another hospital
  - had insufficient follow-up data recorded in EHR
- Presence or absence of any neurodevelopmental impairment (answered in a yes/no format) at 12 months and 18-24 months was recorded.
- Developmental milestones (12, 18, and 24 months CGA) and the Bayley Scale of Infant Development III (BSID III) were recorded and compared.
- Chi-square and Mann-Whitney U tests were used for analyses.

**Figure 1. Inclusion and Exclusion Criteria**



**Table 1. Baseline Characteristics**

	N	n	Percent	Mean (SD)
Sex	56			
<i>Male</i>		29	51.8%	
Race	56			
<i>White</i>		8	14.3%	
<i>Black</i>		32	57.1%	
<i>Hispanic</i>		12	21.4%	
<i>Asian</i>		0	0.0%	
<i>Other Races</i>		4	7.1%	
GA Category	56			
<i>Extremely Preterm</i>		38	67.9%	
<i>Very Preterm</i>		8	14.3%	
<i>Moderate/Late Preterm</i>		10	17.9%	
EEG Seizure Detected	56	12	21.4%	
Neurological Impairment (12 months)	56	27	48.2%	
Neurological Impairment (18-24 months)	47	25	53.2%	
Bayley Scale (BSID III) completed	56	17	30.4%	
Birthweight (grams)	56			1087.9 (815.9)

**Table 2. EEG Seizure vs. Clinical Seizure Descriptive**

	Clinical Seizure				EEG Seizure				P value
	N	n	Percent	Mean (SD)	N	n	Percent	Mean (SD)	
Sex	44				12				0.244
<i>Male</i>		21	47.7%			8	66.7%		
<i>Female</i>		23	52.3%			4	33.3%		
Race	44				12				<0.001
<i>White</i>		5	11.4%			3	25.0%		
<i>Black</i>		31	70.5%			1	8.3%		
<i>Hispanic</i>		7	15.9%			5	41.7%		
<i>Other Races</i>		1	2.3%			3	25.0%		
GA Category	44				12				0.704
<i>Extremely Preterm</i>		31	70.5%			7	58.3%		
<i>Very Preterm</i>		6	13.6%			2	16.7%		
<i>Moderate/Late Preterm</i>		7	15.9%			3	25.0%		
Birthweight (grams)	44			1012.1 (717.6)	12			1365.8 (1099.1)	0.186

**Table 3. EEG Seizure vs. Clinical Seizure Developmental**

	Clinical Seizure			EEG Seizure			P value
	N	n	Percent	N	n	Percent	
Neurological Impairment at 12 Months	44	21	47.7%	12	6	50.0%	0.889
Neurological Impairment at 18-24 Months	40	22	55.0%	7	3	42.9%	0.553
24 Month Developmental Milestones							
<i>Runs/kicks and throws ball</i>	17	14	82.4%	3	1	33.3%	0.140
<i>Walks up and down stairs</i>	17	13	76.5%	3	1	33.3%	0.202
<i>Uses spoon or fork/imitates strokes</i>	17	12	70.6%	3	2	66.7%	1.000
<i>Stacks 6 blocks/opens a door</i>	17	13	76.5%	3	0	0.0%	0.031
<i>50 word vocabulary/2-3 word phrases</i>	17	5	29.4%	3	0	0.0%	0.539
<i>Use of pronouns/names pictures</i>	16	6	37.5%	3	0	0.0%	0.517
<i>Listens to stories/problem solves</i>	17	9	52.9%	3	1	33.3%	1.000
<i>Paralleled play with other children</i>	17	13	76.5%	3	0	0.0%	0.031
<i>Imitates adults/pretend play</i>	16	13	81.3%	3	1	33.3%	0.155

### Results

- Of 335 patients, 56 were included with a mean birth weight of 1087.9 grams (SD=815.9).
- Seizure diagnosis confirmed via EEG in 12 (21.4%) patients.
- Overall, neurodevelopmental impairment was present in 27/56 (48.2%) at 12-months and 25/47 (53.2%) at 18-24 months.
- There was no statistical difference in the presence of neurodevelopmental impairment between preterm neonates diagnosed with seizures clinically and via EEG, 48% vs. 50% at 12 months (p=0.89) and 55% vs. 43% at 18-24 months (p=0.55).
- There was no statistical differences in BSID III, 12-month milestones, and 18-month milestones between the EEG seizure vs. clinical seizure groups.
- At 24-months, developmental milestones “stacks 6 blocks/opens a door” (p<0.05) and “paralleled play with other children” (p<0.05) were statistically documented more often in those diagnosed clinically.

### Conclusion

- There were no differences in presence of a neurodevelopmental impairment among preterm neonates diagnosed with seizures clinically versus by EEG.
- No significant differences in developmental milestones (12, 18 months CGA) or BSID III were found. Two out of nine 24-month milestones show statistically significant differences between groups.
- Due to low follow up and Bayley completion rate these scores may be biased.
- Overall rate of disability was high in this sample, but it may indicate that regardless of the mode of diagnosis, early therapies and intervention may be necessary for these patients.

### References

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