

**ADDIS ABABA UNIVERSITY**  
**COLLEGE OF HEALTH SCIENCES**  
**SCHOOL OF MEDICINE**  
**DEPARTMENT OF NEUROLOGY**



**NEONATAL SEIZURE PATTERN,SHORT-TERM OUTCOMES AND  
PREDICTORS AMONG NICU ADMISSIONS IN ETHIOPIA :A  
MULTICENTER CROSS SECTIONAL PROSPECTIVE STUDY 2025.**

**By: TAZEBEW TILAHUN (Pediatrician, Pediatrics Neurology Fellow)**

**A THESIS TO BE SUBMITTED TO TASH, NEUROLOGY DEPARTMENT  
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**September, 2025**

**Addis Ababa, Ethiopia**

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Full title of research work	Neonatal seizure pattern,short term outcome and its predictors among newborns with seizure admitted to NICU(TASH, Yekatit12,Gandhi Memorial hospital)
Study area	( TASH, Yekatit 12,Gandhi) NICUs

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## **Abbreviations and acronyms**

ASM	Anti-seizure Medication
CPD	Cephalopelvic disproportion
AKI	Acute Kidney Injury
EEG	Electroencephalogram
EMDHS	Ethiopia Mini Demography and Health Survey
GA	Gestational age
HC	Head circumference
PROM	Premature rupture of membranes
NICU	Neonatal Intensive Care Unit
NS	Neonatal Seizure
SDG	Sustainable Development Goals
TASH	Tikur Anbessa Specialized Hospital
TORCH	Toxoplasmosis, Others, Rubella, Congenital CMV, Herpes Simplex Virus
HIE	Hypoxic ischemic encephalopathy
APGAR	A=Appearance,P=Pulse,G=Grimace,A=Activity ,R= Respiration

## Abstract

### **Background:**

During neonatal period seizure is one most common presentation .Presentation and type is different from elder children.It have high risk of mortality as well as morbidity with high risk of neurological impairment or future epilepsy. Hypoxic-ischemic encephalopathy, meningitis,hypoglycemia,and hypocalcaemia account the majority causes of neonatal seizure .However little is investigated about outcomes of neonatal seizure in Ethiopia .

**Objective:** To describe neonatal seizure pattern, short term outcomes and its predictors among neonates with seizure admitted to NICU's of Tikur Anbessa Specialized Hospital, Yekatit 12 and Gandhi memorial hospital, AddisAbaba,Ethiopia.

**Methodology:**A Multicenterinstitutional-based cross sectional prospective study was done among newborns with neonatal seizure admitted to Tikur Anbessa Specialized Hospital, Yekatit 12, and Gandhi Hospital from January 1 ,2025toSeptember 1, 2025.Data were collected using an adopted form of standard with pretested, structuredquestionnaires. Data were entered using SPSS version 27 and analayed with SPSS 27 after checking for missing values .Descriptive statistics like mean, median and mode were used to summarize descriptive data. Bivariate and multivariate logistic regression analysis were performed and variables with p-value of  $< 0.25$  were included for multivariate logistic regression. Adjusted Odds Ratios (AOR) with 95% confidence interval were estimated to identify the strength of association. Statistical significance was declared at a p-value  $< 0.05$ .

**Results:**All of neonates with neonatal seizure were included with 100% response rate .The study found that 30 (27.8%) (95% CI: 22.2, 36.9) had poor neonatal seizure short-term outcomes. The study revealed that low 5<sup>th</sup> minute APGAR score (AOR=15.8, [95% CI: 1.06, 23.6]), history of neonatal resuscitation (AOR=6.58 [95% CI: 1.25, 34.6]), presence of prolonged labor (AOR=5.92, [95% CI: 1.13, 30.8]), and multiple episodes of seizure attacks (AOR= 11.3 [95% CI :1.73, 47.9]) were predictors of poor neonatal seizure outcomes.

**Conclusion:**More than one-fourth of neonates with seizures experienced poor neonatal seizure outcomes. Low5<sup>th</sup> minute APGAR scores, a history of neonatal resuscitation, prolonged labor, and multiple episodes of seizure were predictors of poor neonatal seizure outcomes. This finding emphasizes the critical need for correcting these risk factors. A coordinated effort by various stakeholders is essential to implement strategies that improve neonatal seizure outcomes.

**Keywords:** *Neontal seizure,Newborn,short-term outcomes, Pattern*

## 1. Introduction

### 1.1. Background

During neonatal period seizure is one most common presentation .Neonatal seizures are due to paroxysmal alterations which manifest with either motor ,behavior or autonomic disturbance .They are clue to underlying neurologic dysfunction which demands immediate evaluation and targeted interventions(1,2).They can occur at any age with terms up to 4weeks postnatal and preterm's up to 44 weeks corrected gestational age .The commonest time is during the first 10 days of postnatal life (3).

Neonatal period is highest time for seizure occurrence with directly proportional to birth weight :57.5 per 1,000 with birth weight <1,500g and 2.8 per 1,000 with birth weight between 2,500gm and 3,999gm (1,4). The greatest susceptible to seizures during neonatal period is due to two principal reasons : enhanced excitability and low levels of the inhibitory neurotransmitter gamma-aminobutyric acid (GABA) (5).

Mortality and morbidity of neonatal seizures remain high despite advanced perinatal care . Moreover,there are numerous problems in the diagnosis and proper management highlighting the need to study the neonatal seizure (6).Preterm infants presents unique challenge with their wide spectrum of uncoordinated movements, especially in sick pre-term neonates, considering the frequently subtle seizure semiology which needs Video EEG confirmation. This important diagnostic test helps to avoid misdiagnosis despite its crucial role past studies lack the video confirmation during there study(7).Classification of neonatal seizure is very crucial

According description by Volpe ,neonatal seizure includes tonic,clonic ,myoclonic ,subtle each either focal or generalized . There are classified as electro clinical or electrographic only during EEG Era (8).Phenobarbital remains the drug of choice compared to treatment in older children .Particularly in resource-poor settings (while in developed countries, neurocritical care for neonates is a growing multidisciplinary subspecialty, for example, therapeutic hypothermia may reduce morbidity and mortality in neonates with HIE) little has changed(9).

## 1.2. Statement of the problem

About 2.6 million neonates die every year worldwide .Eventhough all preventive measures were taken to reduce neonatal mortality more than 60 countries are not likely to meet the target of Sustainable Development Goal (SDG) (10).Seizures are major presentations in the neonate incidence proportional to gestational age :1.5–3.5/1000 for term infants and 10– 130/1000 for preterms(11).

According to the 2019 EMDHS(R), the neonatal, infant, and under-5 mortality rates for the 5 years before the survey were 33, 47, and 59 deaths per 1,000 live births, respectively. In other words, 1 in every 30 children in Ethiopia dies within the first month, 1 in every 21 dies before their first birthday, and 1 in every 17 dies before their fifth birthday(14).

According to study done in Babylon teaching hospital subtle was the commonest seizure type 46 (37.7%) with tonic type 35 (28.7%), clonic 32 (26.2%), and myoclonic type 9 (7.4%) account the remaining seizure types (6).According to study in Ayder comprehensive hospital neonatal seizure occurred in 9.6%. Of whom about 30% were having poor outcome(neurological impairment, left medical advice ,lack of improvement) (12).Mortality from neonatal seizure ranges 10-30% which signifies major public health issue .Major morbidity and sequela following neonatal seizure includes later epilepsy which is close to 25% (12).

### **1.3. Significance of the study**

The aim of this study was to investigate the factors affecting the adverse outcome of neonates admitted with seizures in the neonatal Intensive Care Unit (NICU). To provide targeted and advanced care for better outcome it is crucial to identify factors associated with poor neonatal seizure outcome.

Though multiple studies are conducted so far ,there is limited study conducted on neonatal seizure out come .The mere rely on clinical diagnosis without EEG further contribute for under diagnosis .

It will also be invaluable for clinicians for tailoring interventions, providing accurate prognostic information to the families, and ultimately improving the quality of care for this vulnerable population. It will create a foundation for understanding potential short-term outcomes that predict later neurodevelopmental consequences. This research will serve as a stepping stone towards developing evidence-based treatment protocol for the management of neonatal seizures and contribute to reducing the burden of neurological morbidity in newborns.

## 2. Literature review

Seizures, as the most common symptom of neurological dysfunction in neonates, occur in the first month of life (a time of increased risk). Its incidence in the NICU is as high as 10-25%, where 15% ones die and 35-40% of them have prominent neurological disability(13). A study done on Iran, West Asia, Amirkola Children's Hospital shows that preterm and term neonates with seizures, the main diagnoses in neonates with seizures were idiopathic (38.1%) and hypoxic-ischemic encephalopathy (HIE) (14.3%), hypoglycemia (9.5 %), hypomagnesaemia (7.1%), and opiate withdrawal (4.8%). Seizure control with antiepileptics, inborn errors of metabolism, and time of drug discontinuation were significantly associated with adverse neurodevelopmental outcomes. The most common neurologic complication was a swallowing problem (13).

A study done in Bosnia and Herzegovina on Predictors of mortality in neonates with seizures shows that the most common cause of seizures was birth asphyxia and intra-periventricular haemorrhage for full-term infants and for preterm infants respectively .About 23% of infants with seizures died in the first years of life. There was more preterm death than term infants. Resuscitation, mechanical ventilation, and asphyxia were significantly associated with mortality according to the study (14).

According to a study done in an Iraqi teaching hospital, 3.9% neonates developed neonatal seizures during the study period. The most common cause identified was HIE (33.6%), followed by metabolic disturbances collectively constituting (29.5%), and infections, found in 16.4% of neonates. Subtle type seizure was the most common 46 (37.7%) in neonates, followed by tonic type (28.7%), clonic (26.2%), and the myoclonic type (7.4%). According to short-term outcome finding, 17.2% of neonates were died, about 26.2% neonates were discharged with neurologic complications, and the remaining 56.6% of neonates were discharged with no complications. Hypoxic ischemic encephalopathy and sepsis were significantly associated with mortality and worse neurological complications.

Another study done in India, Kuppam, a tertiary care hospital shows that the most seizures occur within 72 hours, which accounts for 82.85%. Subtle seizure was the most common seizure type seen in 64.2%, followed by tonic seizures in 22.4 %, clonic seizures (16.9%) and myoclonic seizures (3%). According to the outcome analysis of neonates with seizures, 11.94% died, about 17.96% survived with sequelae, and 70.1% survived with no sequelae(15).

Another study done in Rajasthan, India, a prospective cross-sectional study result shows majority of neonates had onset of seizure (<72 hours) and the remaining neonates had onset of seizure (>72 hours). The most common type of neonatal seizure was subtle (75%), tonic seizure (17.3%), clonic seizure (5.1%) and the least common type was myoclonic (2.5%). The most common cause of neonate's seizure noted was PNA (73%), followed by meningitis and hypoglycemia. The most common cause of neonatal seizure, both in full-term and preterm is PNA followed by meningitis (in full term) and in preterm is meningitis and hypoglycemia (15).

Another study done in India shows that the commonest seizure type is followed by clonic seizures. In neonates with seizures, the mortality rate was 28.4%. There was a significant increase in duration of hospital stay and delay in commencement of oral feeds without an increase in mortality, need for ventilator support or inotrope support in such neonates as compared to term neonates without seizures (16).

Another study done in India, shows that neonates with seizures (34.5%) had adverse outcomes. APGAR score  $\leq 3$  at 5 minutes, very low birth weight babies, septicemia, seizure onset within 24 hours, meningitis, microcephaly and abnormal cranial ultrasound were significant predictors of adverse outcomes in neonates with seizures (14).

A retrospective study done in Patan, Nepal, shows that the cause of seizure was hypoxic ischemic encephalopathy in 25% of cases, and no cause was found in 15% of cases. The mortality rate was 9.3% with hypoxic ischemic encephalopathy being the most common cause. Mortality was significantly associated with Hypoxic-Ischemic Encephalopathy and congenital brain anomalies (17).

Another study done in Benghazi, a prospective cross-sectional study, shows that the most common type of seizure was subtle (48%), followed by clonic, tonic, and myoclonic (3).

A study done in Parma, Italy, found that a 5-minute Apgar score of 0 - 7 and etiology with increased mortality and between female gender and status epilepticus with epilepsy (18). Another study done in a rural Kenyan District Hospital shows that Seizure was reported in 9.0% of neonatal admissions. The main presentations in neonates with seizures were sepsis in 60%, neonatal encephalopathy in 21% and meningitis in 15%, but only neonatal encephalopathy and bacterial meningitis were independently associated with seizures. Neonates with seizures had a longer hospital stay than those without neonatal seizures. Up to 13% of the surviving newborns with seizures had neurological complications during discharge (19).

Another study done in Egypt shows that hypoxic-Ischemic Encephalopathy (34.2%) was the most common aetiology for neonatal seizures, followed by intracranial haemorrhage (25.8%). The predominant seizure type was subtle (57.5%), preceded by a clonic seizure (16.7%). Moreover, 72 neonates had a normal outcome, 60% of cases had minor functional disabilities, and 22.5% newborns survived with one or more neurodevelopmental complications, with 17.5% of deaths. Based on outcome analysis, metabolic acidosis, abnormal cranial ultrasonography findings, and the presence of congenital heart disease were significant predictors of poor neonatal seizure outcomes (20).

Another prospective study done in Sudan, Khartoum shows that 7.7% had seizures as a major presenting symptom. About 41.4% had hypoxic-ischaemic encephalopathy, 22.4% had evidence of septicemia/meningitis, and primary biochemical abnormalities accounted for 27.6%. The most common seizure type was generalised tonic clonic in 44% followed by 25.9% had focal clonic. 76.7% were well controlled, 22.4% were partially controlled, and 0.9% neonates had poorly controlled seizures. Neonates whose mothers had illnesses related to pregnancy, neonates with generalised seizures, preterm delivery, seizures started in the first 24 hours of life and neonates with abnormal brain imaging, had poorly controlled seizures (21).

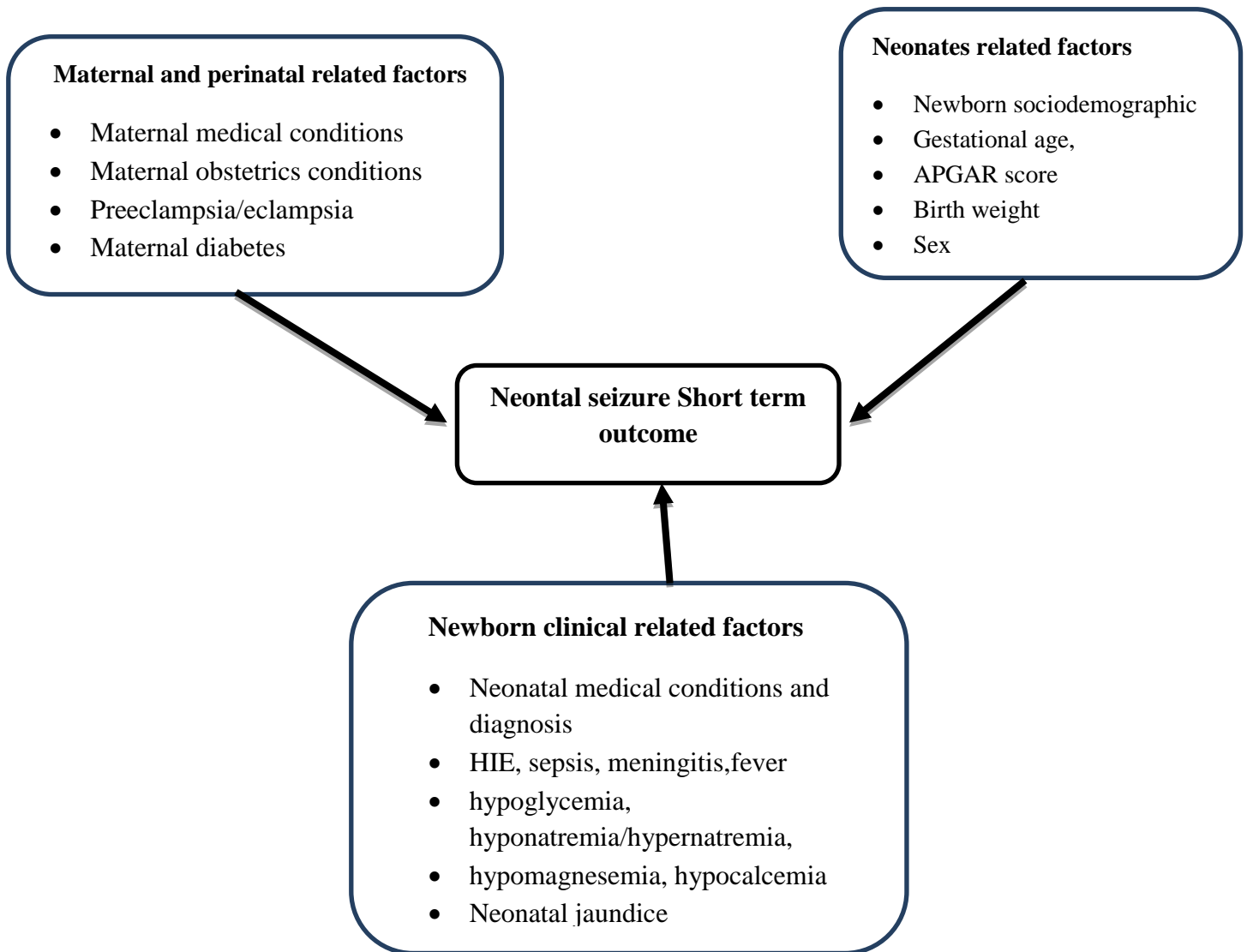
Another retrospective study done shows that 29.7% neonates with seizures died within the first year, while 70.3% survived. The leading causes of death were developmental brain malformation (31.4%), metabolic (20%), Hypoxic-Ischemic Encephalopathy (20%), intracranial haemorrhage (11.4%) and infections (11.4%). Use of more than one antiepileptic medication and multiorgan failure were significant factors that predicted neonatal death (22).

A study done at Ayder Hospital, Mekelle, Tigray, Ethiopia, shows that 9.6% were cases of neonatal seizure. The most frequent types of seizure were subtle 45.1% and tonic 31.6% respectively. At the end of hospitalisation, 70.3% of neonates with seizures were improved, 21.3% of neonates with seizures died, and 8.4% of neonates with seizures had severe neurologic deficits. Poorly controlled seizures, prolonged duration of labor and seizure onset <72 hours, respectively, were factors associated with poor neonatal seizure outcomes (12).

Another study done in Gondar, Ethiopia, shows that 19.7% of neonates with seizures died during the acute neonatal illness. The most common cause of death was perinatal asphyxia with Hypoxic-ischaemic encephalopathy, accounting for 73.9% of the deaths. Among the surviving

newborns with seizure, 10.6% had neurodevelopmental deficits during discharge. Being a multiparous mother, being female, and having tonic and myoclonic seizures were significantly associated with poor short-term outcome (23).

### 3. Conceptual framework



**Figure 1: A developed conceptual framework for assessing predictors of neonatal seizure outcomes among neonates admitted to TASH, Yekatit 12, and Gandhi Memorial Hospital, Ethiopia,2025**

## **4. Objectives**

### **4.1. General Objective**

To identify and describe the seizure patterns and short –term neurological outcomes among neonates admitted with seizures at NICU(TASH,Yekatit 12 and Gandhi Memorial Hospital ) and to determine the influencing factors

### **4.2. Specific objectives**

- ✚ To determine the seizure patterns among newborns with seizure admitted to TASH ,Yekatit 12 and Gandhi Memorial Hospital in 2025
- ✚ To asses the short term outcomes of neonatal seizures in these newborns
- ✚ To identify predictors of neonatal seizure outcomes among newborns admitted to these hospitals

## 5. Methods

### 5.1. Study area and period

The study was done in Tikur Anbessa Specialized Hospital, Yekatit 12, and Gandhi Memorial Hospital, Addis Ababa, Ethiopia. Addis Ababa is the capital city of Ethiopia, which is located at an altitude of 2355 meters above sea level. About 5,461,000 people are expected to live in the city. TASH, which is located in Addis Ababa, is one of the study areas. TASH is the biggest governmental hospital in the country. It started to provide service since 1972. It has almost all departments and pediatrics and child health was established in 1964. Almost half million people got all inclusive service inpatient and outpatient departments. It has about 700 beds divided into inpatient wards and emergency units including ICU. The NICU unit has a sub-division on it for admitting critical patients, term, and preterm, in separate, defined resuscitation rooms, which are equipped with different emergency fluids, medication, and instruments with specifically assigned nurses and physicians. The ward has a total of 41 beds (11 incubators for preterms), and there is also a separate room with one neonatal EEG machine. On average, monthly, about 100 neonates are admitted to the NICU. It is staffed with 1 consultant neonatologist, 1 neonatology fellow, 12 residents, and 38 fully functioning nurses. There are 02 full-time pediatric neurologists involved in a variety of neurological cases. The second study area is Yekatit 12 Hospital. It is established in 1963 in Addis Ababa, specifically Abebech Gobena which is also located in Addis Ababa. The hospital started to provide services in 2013. The neonatal unit is divided into term, preterm, critical, stable, and ICU and has a total of 60 beds. There are around 40 nurses, 11 residents, 06 pediatricians, and 1 neonatologist working there. It is equipped with 10 incubators and 6 phototherapy machines. On an average monthly basis, there are about 200 neonatal admissions. Another study area is Gandhi Memorial Hospital, which is also located in Addis Ababa, nearly in 1km from black lion hospital. It is one of the MCH centers in Addis Ababa serving maternity and neonates. The neonatal unit has a total of 47 beds divided into term, preterm, critical, KMC, stable, and phototherapy rooms. There are about 11 incubators and 04 phototherapy machines. There are about 32 nurses, 05 residents, and 02 full-time working pediatricians. It has, on average, 120 neonates' monthly admissions.

### 5.3. Study design

A multicenter institutional-based, descriptive, prospective observational cohort study was used to study neonatal seizure patterns, short-term outcomes, and its predictors.

### 5.4. Target and Study population

#### 5.1.1. Source Population

All NICU admissions of TASH, Yekatit 12, and Gandhi Memorial Hospital, during the study period.

#### 5.1.2. Study population

All neonates with the diagnosis of neonatal seizure.

### 5.5. Inclusion and Exclusion criteria

#### 5.4.1. Inclusion Criteria

All neonates diagnosed with neonatal seizures, either through clinical assessment, electroencephalography (EEG), or both.

#### 5.4.2. Exclusion criterion

- Neonates with doubtful motor movements like jitteriness, tetanic spasms
- Newborns with complex and severe congenital disorders
- Newborns whose hospital stay is less than 24 hours
- Neonates beyond 28 days of age

### 5.5. Sampling size and sampling technique

The Sample size were calculated using single population proportion formula with 95% confidence and Z value of 1.96. Uing Study in Mekelle p value is 0.095 from 1622 neonates with 155 neonatal seizure .Precision(d) 5% was taken with value of 0.05

$$N = \frac{z^2 p(1-p)}{d^2} = \frac{(1.96)^2 \times (0.095) \times (1-0.095)}{0.05 \times 0.05} = 132$$

The final sample size n was obtained by deduction, considering a finite source population, as our source population is less than 10,000

$$n = \frac{no}{1 + no/N} = \frac{132}{1 + 132/600} = 108$$

So, our final sample size was 108 neonates with seizures. Finally, based on the proportion allocation among the three (TASH, Yekatit 12, and Gandhi Memorial Hospital) study areas, the following results were obtained.

$$\text{TASH} = (600/600+720+900) \times 108 = 29$$

$$\text{Yekatit 12 hospital} = (900/900+600+720) \times 108 = 44$$

$$\text{Gandhi memorial hospital} = (720/720+600+900) \times 108 = 35$$

## 5.6. Data collection and procedure

### 5.6.1. Data collection instrument

Structured and pretested questionnaires were utilized for data collection. The questionnaire was prepared and organized from past studies, with the addition of some important parameters. In case of a dilemma of being seizure, it was confirmed by Pediatric Neurologist /Neonatologist working in the ward.

### 5.6.2. Data collection method

An organized checklist, which incorporates all parameters were utilized. The pre-structured questionnaires were developed from previous studies, which included neonatal sociodemographic characteristics. It also included a basic clinical profile, laboratory investigations, including EEG and neuroimaging if done. Maternal medical conditions were also incorporated. Before actual data collection a pilot trial was done in one of NICUs and modified and corrected. Data were collected by residents working there after given a half-day training. The training was about elaborating the inclusion, exclusion criteria, questionnaires, and demonstration of the different seizure types.

To ascertain the quality of data and trustworthiness the principal investigator was monitoring throughout the data collection period. This data was finalized after being filled out during discharge and categorizing its outcome. Neonates with diagnosis of seizure were followed prospectively throughout the hospital stay.

## 5.7. Study Variables

### 5.7.1. Dependent variables

- Short-term outcome of neonatal seizure

### 5.7.2. Independent Variables

- Apgar Score
- Age
- Birthweight
- Sex
- Gestational age
- Neonatal HIE
- Hypoglycemia, electrolyte disturbances
- Neonatal sepsis/meningitis
- Maternal medical/obstetric conditions

## 5.8. Operational definitions

**Seizure**—An abnormal clinical/Electrical event manifested by a neonate and confirmed by Pediatric Neurologist /Neonatologist working in the ward.

**Short-term outcome** in this study was defined as an outcome at the time of discharge, which can be death, discharge without sequela, and with sequela(hypotonia, hypertonia,microcephaly, macrocephaly, incomplete/absent primitive reflexes, feeding difficulties, lethargy), and left against medical advice.

**Birth asphyxia** :was defined as mild, moderate, and severe based on APGAR scores (6–7, 4–5, and 0–3, respectively). A history of delayed cry at birth, a history of resuscitation, or evidence of postnatal neurological abnormality (axial hypotonia, shoulder tone hypotonia, differential hypotonia, and multi-organ dysfunction) was considered as evidence of birth asphyxia in case of absent APGAR score documentation .

**Poorly controlled seizure**; Neonates who have more than 1 seizure attacks per week

**Sepsis** : diagnosis based on clinical or blood culture as to the treating physician

## **5.9. Data analysis**

The collected data was entered into SPSS version 27 and analyzed after checking for completeness. Frequency, Mean, and median were used to describe the descriptive data. Bivariate and multivariate logistic regression method was done to identify factors associated with the short-term outcome of neonatal seizure among neonates with a diagnosis of seizure admitted to TASH, Yekatit 12, and Gandhi Memorial Hospital. A 95% odds ratio confidence interval was estimated to determine the strength of association. Variables with an Odds ratio having a p-value <0.05 in multivariate analysis were considered to be an independent predictor of poor seizure outcome. Model fitness was ascertained with Hosmer's and Lemeshow's fitness test with p value of 0.862

## **5.10. Ethical considerations**

The Department of Pediatrics and Child Health research publication committee (DPCH-REC), Department of Neurology, CHS TASH and Addis Ababa regional Health Bureau were requested for ethical approval and obtained before undertaking data collection. Informed verbal consent was taken from the mother of neonates /caregivers before data collection

The confidentiality of patients' clinical findings, including video records and results, was maintained, and the data collected was used primarily for the intended purposes. Identifiers like names, medical record numbers, and cell phone numbers of parents/caretakers were not included in the questionnaire and coding was used. The principal investigator was doing for safely storing the collected data.

## **5.11. Dissemination of the results**

Finally, the result of the study will be subjected to an open thesis defense. After approval, it will be submitted to the department of pediatrics and child health and the neurology department, and its copy will be sent to the research center of Addis Ababa University, College of Medicine and Health Science. The result will also be disseminated to various organizations which can be governmental or non governmental. The findings will also be presented in different professional forums and to the hospital staff members. We will use our maximum effort to publish in peer-reviewed scientific journals.

## 6. Results

### 6.1. Newborn socio-demographic and birth related characteristics

In our study all of 108 neonates were participated with 100% response rate. The majority of study participants, 67 (62.2%), were <24 hours at admission with mean admission age of 27.2 hour. Regarding the sex of neonates, the majority of neonates, 73 (67.6%), were male. The majority of study participants, 65 (60.2%), had an APGAR score (5<sup>th</sup>) between 3 and 6. The majority of neonates, 56 (51.9%), were having history of crying after birth. About three-fourths, 88 (81.5%) of neonates had birth weight between 2500-4000 grams (Table 1).

**Table 1: Socio-demographic characteristics of neonates admitted to NICU of three selected Hospitals, Addis Ababa, Ethiopia (n=108).**

Variables	Categories	Frequency	Percentage (%)
Neonate age	<24 hours	88	81.5
	24-48 hours	5	4.6
	>48 hours	15	13.9
Sex of neonates	Male	73	67.6
	Female	35	32.4
1 <sup>st</sup> minute apgar score	>7	29	26.8
	3-6	72	66.6
	<3	7	6.5
5 <sup>th</sup> minute APGAR Score	>7	38	35.2
	3-6	65	60.2
	<3	5	4.6
Cry after birth	Yes	56	51.9
	No	52	48.1
Neonatal resuscitation	Yes	42	38.9
	No	66	61.1
Resuscitation duration (n=42)	<5 minutes	9	8.3
	5-10 minutes	12	11.1
	11-20 mites	21	19.4
Birth weight in grams	<2500g	15	13.9
	2500-4000g	88	81.5
	>4000g	5	4.6
Gestational age	<37 weeks	17	15.7
	37-42 weeks	76	70.4
	>42 weeks	15	13.9
Weight for gestation	AGA	101	93.5
	SGA	7	6.5
Number of fetus	Single	106	8.1
	Twin	2	1.9

## **6.2. Maternal socio-demographic, reproductive, and obstetric characteristics**

The majority of study participants, 102 (94.4%), were urban area residents. More than one-third, 52 (48.1%), were between the ages of 25 and 35, followed by 49 (45.4%) who were ages less than 25 years, with a mean age of 26.9 years and a standard deviation (SD) of 4.78. More than half of the study participants, 57 (52.8%), were primigravida, while 50 (46.3%) were multigravida. Regarding the duration of labor, more than three-fourths, 85 (78.7%) of neonates had a normal duration of labor. Furthermore, only 21 (19.5%) experienced an obstetric complication during pregnancy. The majority of deliveries, 71 (65.7%) were at the hospital level (**Table 2**).

**Table 2: Maternal socio-demographic, reproductive, and obstetrics characteristics of the neonates , Addis Ababa, Ethiopia (n=108)**

<b>Variables</b>	<b>Categories</b>	<b>Frequency</b>	<b>Percentage (%)</b>
Residency	Urban	102	94.4
	Rural	6	5.6
Mothers age	<25	49	45.4
	25-35	52	48.1
	>35	7	6.5
Mother's educational level	Illiterate	7	6.5
	Upto grade 8	36	33.3
	Uptograde 12	44	40.7
	Degree and above	21	19.4
Gravida status	Primigravida	57	52.8
	Multi gravida	50	46.3
	Grand multipara	1	0.9
Maternal iron and folate intake	Yes	107	99.1
	No	1	0.1
Onset of labor	Spontaneous	107	99.1
	Induced	1	0.1
Duration of labor	Normal	85	78.7
	Precipitate	6	5.6
	Prolonged	17	15.7
Obstetric complications	Yes	21	19.5
	No	87	80.5
Type of obstetric complications (n=21)	APH	1	4.76
	Breech presentation	5	23.8
	CPD	7	33.3
	IUFD	1	4.76
	Preeclampsia	3	14.2
	PROM	4	19.0
Maternal chronic medical illness	Yes	7	93.5
	No	101	6.5
Type of Maternal chronic medical illness (N=7)	Anemia	2	28.5
	DM	2	28.5
	HTN	3	42.9
Maternal drug use during pregnancy	Yes	1	0.9
	No	107	99.1
History of abortion	Yes	13	12
	No	95	88
Place of delivery	Home	3	2.8
	Health center	34	31.5
	Hospital	71	65.7
Mode of delivery	SVD	63	58.3
	Instrumental	8	7.4
	CS	37	34.3

### 6.3. Clinical-related characteristics of newborns with seizures

Based admission medical diagnosis as etiology for seizure PNA accounts the majority (57;52.8%) followed by sepsis (16;14.8%) ,hypoglycemia(6;5.55%) , jaundice (5;4.6%) and pyogenic meningitis (4;3.7%). The majority of study participants, 73 (67.8%), had a 120-160 beats per minute pulse rate at admission. More than one-third, 49 (45.4%), of study participants had a 30-60 respiratory rate at admission. About two-thirds, 72 (66.7%) of study participants were having depressed mental status at admission. Regarding the tone of the newborn at admission, about 81 (75%) of study participants were normotonic. Furthermore, 82 (75.9%) of study participants had abnormal reflexes at admission (**Table 3**).

**Table 3: clinical characteristics of neonates admitted to NICUs in three selected Hospitals, Addis Ababa, Ethiopia (n=108)**

Variables	Category	Frequency	Percentage (%)
Neonatal medical diagnosis	PNA	57	52.7
	Sepsis	16	14.8
	Hypoglycemia	6	5.55
	Jaundice	5	4.6
	Meningitis	4	3.7
	Others	20	18.5
Neonatal pulse rate at admission	<120	16	14.8
	120-160	73	67.8
	>160	19	17.6
Neonatal respiratory rate at admission	<30	8	7.4
	30-60	49	45.4
	>60	51	47.2
Neonatal oxygen saturation at admission	<85	30	27.8
	85-90	20	18.5
	90-95	26	24.1
	>95	32	29.6
Newborn's mental status at admission	Alert	36	33.3
	Depressed	72	66.7
Tone of the newborn at admission	Normotonic	81	75
	Hypotonic	18	16.7
	Hypertonic	9	8.3
Neonatal reflex at admission	Normal	26	24.1
	Abnormal	82	75.9

#### **6.4. Neonatal admission laboratory, imaging-related characteristics**

Complete blood count (CBC), random blood sugar, serum electrolyte and brain imaging were done as part of diagnostic work up. CBC was performed in all of them which reveals normal WBC (9000-34000 cell/ $\mu$ L) in 95 (88%) %, Sepsis ( $>34000$  cell/ $\mu$ L) in 3 (2.8%), and anemia in 24 (22.2%) of neonates. Lumbar puncture were performed in 5 (4.6%) neonates and CSF examination shows meningitis in 4 of them. None of the neonates had brain scanning (MRI and CT scan), and EEG. Low blood sugar was found in 6 (5.6%) of neonates; in the majority of them, 90 (83.3%), it was within the normal range. Furthermore, Serum total bilirubin was performed in 35 (32.4%) of neonates, and the result shows that 32 (29.6%) of neonates had normal serum bilirubin (**Table 4**).

**Table 4: Laboratory findings OF neonate with seizures admitted to NICUs in three selected Hospitals, Addis Ababa, Ethiopia (n=108)**

Variables	Results	Frequency	Percentage (%)
Serum sugar	Hypoglycemia	6	5.6
	Euglycemia	90	83.3
	Hyperglycemia	12	11.1
WBC at admission	<9000 cell/ $\mu$ L	10	9.3
	9000-34000 cell/ $\mu$ L	95	88
	>34000 cell/ $\mu$ L	3	2.8
Hgb at admission	<15	24	22.2
	15-18	32	29.6
	$\geq$ 18	52	48.1
Platelets at admission	Thrombocytopenia	15	13.9
	Normal	93	86.1
Serum Sodium at admission	Normal	67	62
	Hyponatremia	8	7.4
	Hypernatremia	12	11.1
	Not done	21	19.4
Serum calcium at admission	Hypocalcemia	2	1.9
	Normal	53	49.1
	hypercalcemia	2	1.9
	not done	51	47.2
Serum magnesium at admission	Normal	3	2.8
	Not done	105	97.2
CSF analysis	Done	5	4.6
	Not done	103	95.4
CSF cell count (n=5)	2	1	20
	25	1	20
	29	1	20
	35	1	20
	24900	1	20
CSF protein (n=5)	35	1	20
	40	1	20
	60	1	20
	78	1	20
	279	1	20
CSF glucose (n=5)	42	1	20
	32	1	20
	42	1	20
	45	1	20
	57	1	20
Serum total bilirubin	Normal	32	29.6
	High	3	2.8
	Not done	73	67.6
Trans fontanel US	Normal	31	28.7
	Abnormal	14	13
	Not done	63	58.3

## **6.5. Newborn discharge clinical and laboratory characteristics**

More than three-fourths, 82 (75.9%) of study participants were alert at discharge. Regarding the tone of newborns at discharge, about 81 (75%) of study participants were normotonic. Furthermore, 82 (75.9%) of study participants had normal reflexes at discharge. More than three-fourths, 88 (81.5%) of neonates were discharged with birth weight between 2500 and 4000 grams. Discharge Hgb results show that more than one-third, 38(35.2%) of neonates had anemia at discharge. Furthermore, discharge WBC findings show that more than three-fourths, 74(68.5%) of neonates have normal WBC at discharge (**Table 5**).

**Table 5: Discharge summary clinical and laboratory findings of neonates with seizures admitted to NICUs in three selected Hospitals, Addis Ababa, Ethiopia (n=108)**

<b>Variables</b>	<b>Categories</b>	<b>Frequency</b>	<b>Percentage</b>
Neonatal reflex at discharge	Normal	82	75.9
	Abnormal	26	24.1
Mental status at discharge	Alert	82	75.9
	Depressed	26	24.1
Tone at discharge	Normotonic	81	75
	Hypotonic	18	16.7
	Hypertonic	9	8.3
Discharge weight in grams	<2500g	20	18.5
	2500-4000g	85	78.7
	>4000g	3	2.77
Duration of hospital stay	<7 days	32	29.6
	7-13 days	60	55.6
	14-21days	11	10.2
	>21 days	5	4.6
Discharge serum sodium	Hyponatremia	9	8.3
	Normal	31	28.7
	Hypernatremia	1	0.9
	Not done	67	62
Discharge serum calcium	Hypocalcemia	1	0.9
	Normal	13	12
	Not done	94	87
Discharge serum magnesium	Hypomagnesemia	2	1.9
	Normal	4	3.7
	Hypermagnesemia	1	0.9
	Not done	101	93.5
Discharge Hgb	Anemia	38	35.2
	Normal	42	38.9
	Polycythemia	20	18.5
	Not done	8	7.4
WBC at discharge	Low WBC	26	24.1
	Normal	74	68.5
	Not done	8	7.4
Discharge platelets	Normal	100	92.6
	Not done	8	7.4

## 6.6. Patterns of neonatal seizure, episodes of attacks, and related characteristics

Based on the time onset, half 54 (50%) newborns manifest their first seizure before 24 hours of delivery, and 35 (32.4%) had seizure onset between 24 and 48 hours of age. The majority of neonates, 63(58.3%), had more than one episode of seizure in comparison to those having single episodes (45; 41.7%). In this study more than of neonates had experienced subtle type seizure (38; 35.2%), tonic seizure (24; 22.2%), mixed seizure (19; 17.6%), clonic (17;15.7%), myoclonic (9;8.3%) and the least type of seizure is spasm (1;0.3%) (**Table 6**).

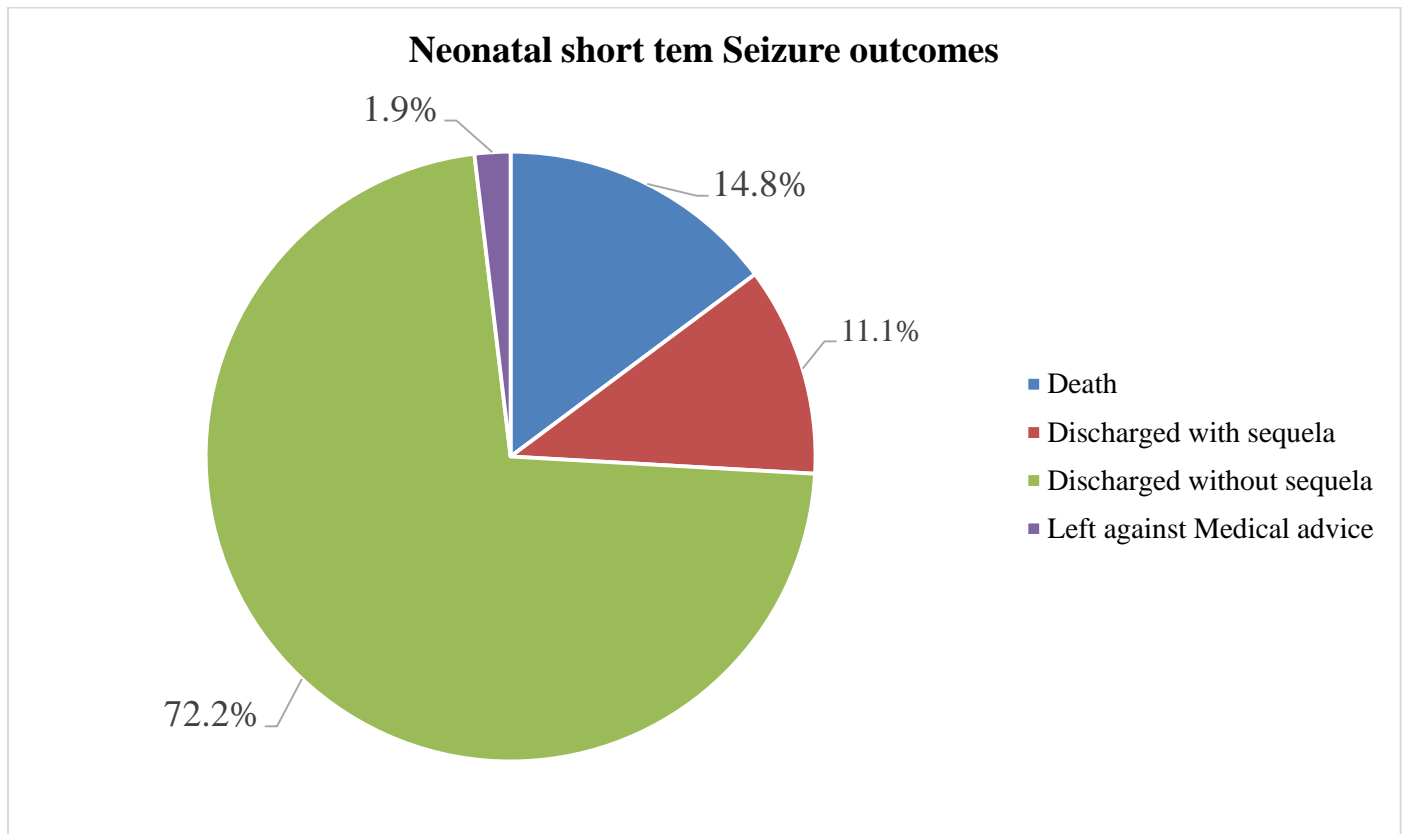
**Table 6: Patterns of Neonatal Seizure of neonates admitted to NICUs in three selected Hospitals, Addis Ababa, Ethiopia (n=108)**

Variables	Categories	Frequency	Percentage
Seizure type	Subtle	38	35.2
	Tonic	24	22.2
	Clonic	17	15.7
	Myoclonic	9	8.3
	Spasm	1	0.3
	Mixed	19	17.6
Duration of seizure	<60 seconds	49	45.4
	60-119 seconds	19	17.6
	≥120 seconds	40	37
Onset of seizures	Before 24 hours	54	50
	Between 24 and 48 hours	35	32.4
	After 48 hours	19	17.6
Episode of seizure before ASM	Single	45	41.7
	Multiple	63	58.3
Seizure frequency in a week	1	18	16.7
	2	37	34.3
	3	11	10.2
	4	19	17.6
	5	21	19.4

	7	2	1.9
Started ASM	Yes	108	100
	No	0	0
Type of started ASM	Calcium gluconate	4	3.7
	Phenobarbitone	23	21
	Phenytoin	2	1.2
	Calcium gluconate+phenobarbitone	45	42
	Calcium gluconate+Phenytoin+phenobarbitone	16	18.8
	Phenytoin + Phenobarbitone	6	5.5
	Calcium gluconate	5	4.6
	gluconate+Phenytoin+phenobarbitone+levetiracetam	4	3.7
	Phenytoin+phenobarbitone+levetiracetam	3	2.7
Calcium gluconate+phenytoin			
Number of ASM	1	29	26.8
	2	54	50
	3	20	18.5
	4	5	4.6
Discharge with ASM (92)	Yes	75	81.5
	No	17	18.5

### 6.7. Neonatal seizure clinical outcome at the end of hospitalization

Out come of neonatal seizure at the end of hospital stay were: 78 (72.2%) neonates discharged with no sequela, 16 (14.8%) neonates died, 12 (11.1%) neonates were discharged with sequela, and 2 (1.9%) neonates left against medical advice. Furthermore, more than one-fourth of study participants, 30 (27.8%) (95% CI:22.2,36.9) had poor neonatal seizure short-term outcomes (**Figure 2**).



**Figure 2: Neonatal seizuershort-term outcomeadmitted in three selected Hospitals, Addis Ababa, Ethiopia (n=108)**

### **Factors associated with neonatal seizure outcomes**

In this study, 5<sup>th</sup> minute APGAR Score, neonate crying after birth, history of neonatal resuscitation, duration of labor, history of abortion, admission mental status, tone of newborn, neonatal reflex, episode of seizures, and sodium at admission were considered as candidate variables for multivariate logistic regression analysis. Low 5<sup>th</sup> minute APGAR Score, history of

neonatal resuscitation, presence of prolonged labor, and multiple episodes of seizure attacks were associated with poor neonatal seizure outcomes.

In this study, neonates who were delivered with prolonged labor were nearly 6 times higher to have poor neonatal seizure outcomes than neonates who were delivered with a normal labor duration (AOR= 5.92, [ 95% CI: 1.13 – 30.8]). Neonates who had moderate Asphyxia (APGAR Score= 3–6) and severe birth asphyxia (APGAR Score <3) during delivery were nearly 6 times (AOR= 6.21, [ 95% CI: 1.02 – 37.5]) and 16 times (AOR= 15.8, [ 95% CI: 1.06 – 23.6]) more likely, respectively, to have poor neonatal seizure outcomes than neonates who delivered with normal APGAR Scores. Neonates who had a history of resuscitation were 6 times more likely to have poor neonatal seizure outcomes than neonates who had no history of resuscitation (AOR= 6.58, [ 95% CI: 1.25 – 34.6]).

Furthermore, neonates who experienced multiple seizure episodes were eleven times higher to have poor outcomes in comparison to those with a single seizure episode (AOR= 11.3, [ 95% CI: 1.73 – 47.9]) (**Table 7**).

**Table 7: predictors of neonatal seizure outcomes among neonates admitted to NICUs in TikurAnbessa Specialized Hospital, Yekatit 12, and Gandhi Memorial Hospital, Addis Ababa, Ethiopia (n=108)**

Variables	Categories	Neonatal seizure outcomes		COR (95% CI)	AOR (95%CI)	P Value
		Poor	Good			
APGAR Score	>7	5	51	1	1	<b>0.047</b> <b>0.045</b>
	3-6	20	25	8.16 (2.74,	6.21 (1.02,	
	<3	5	2	24.2)	37.5)	
				25.5 (3.89,	15.8 (1.06,	
				67.0)	23.6)	
Neonate cries after birth	Yes	9	47	1	1	0.419
	No	21	31	3.53 (1.43,	1.88 (0.40,	
				8.72)	8.70)	
Neonatal resuscitation	Yes	22	20	7.97 (3.06,	6.58 (1.25,	<b>0.026</b>
	No	8	58	20.7)	34.6)	
				1	1	
Duration of labor	Normal	16	69	1	1	0.187 <b>0.035</b>
	Precipitate	3	3	4.31 (0.79,	5.09 (0.45,	
	Prolonged	11	6	23.3)	57.3)	
				7.90 (2.54,	5.92 (1.13,	
				24.5)	30.8)	
History of abortion	Yes	5	8	1.75 (0.52,	5.70 (0.71,	0.099
	No	25	70	5.85)	45.3)	
				1	1	
Admission mental status	Alert	5	31	1	1	0.972
	Depressed	25	47	3.29 (1.14,	0.95 (0.08,	
				9.53)	11.3)	
Tone of the newborn	Normotonic	8	39	1	1	0.145 0.227
	Hypotonic	21	36	2.84 (1.12,	0.15 (0.01,	
	Hypertonic	1	3	7.22)	1.8)	
				1.62 (0.14,	6.88 (0.30,	

				17.6)	15.7)	
Neonatal reflex	Normal	2	24	1	1	0.870
	Abnormal	28	54	6.22 (1.37, 28.5)	1.18 (0.14, 9.48)	
Episode of seizures	Single	2	39	1	1	<b>0.011</b>
	Multiple	28	39	14.0 (3.11, 26.8)	11.3 (1.73, 47.9)	
Sodium at admission	Normal	13	53	1	1	0.452 0.319
	Hyponatremia	11	15	2.99 (1.11, 8.01)	1.80 (0.39, 8.31)	
	Hypernatremia	6	10	2.44 (0.72, 7.96)	2.37 (0.43, 13.0)	

## 6. Discussions

The aim of this study was to assess neonatal seizure patterns, short-term outcomes, and their predictors among neonates admitted to Neonatal Intensive Care Units, a multicenter, prospective observational cohort study, Ethiopia. The present study reveals that the magnitude of poor neonatal seizure outcomes was 27.8% (95% CI:22.2 – 36.9), which was comparable with the study done in Ayder Hospital, Tigray, Ethiopia (29.7%) (12), Khartoum, Sudan (22.4%)(21), North India (24), Kuppam, Andhra Pradesh (29.9%)(2), Guru Teg Bahadur Hospital, Delhi, India (34.5%)(25), Kerala, India (33.4%)(26), Baghdad city, the Iraq (32.51%)(27), Patna, India (28.4%) (16)but higher than studies conducted from Patan Hospital, Nepal (18.75%)(17), University Of Gondar Hospital, Ethiopia (16.2%)(23), Kilifi District Hospital, Kenya (19.1%)(19), Benghazi, Libya (15%)(3), Hamadan, Iran (14.7%)(28).This study is lower than studies done from Babylon Hospital, Iraq (43.4%)(29), Benham University Hospital, Egypt (40%)(20), Benghazi, Libya (48%)(3), Bosnia and Herzegovina, Southeast Europe (37.2%)(11). The differences could be attributed to variations in healthcare quality, study design (prospective vs. retrospective), patient populations (including maternal and neonatal health factors), access to treatment, and healthcare-seeking behaviors across settings.

In the current finding, prolonged labor was highly correlated with poor neonatal seizure outcomes. Neonates who were delivered with prolonged labor were nearly 6 times higher to have poor neonatal seizure outcomes than neonates who were delivered with a normal labor duration. This study was consistent with a study from Ayder Hospital, Tigray, Ethiopia(12). A possible explanation for this association is that prolonged labor increases the risk of birth asphyxia due to compromised placental blood flow and reduced oxygen delivery to the fetus. This can result in hypoxic-ischemic brain injury, which is a major contributor to neonatal seizures and adverse neurological outcomes. Additionally, prolonged labor may also be associated with increased risks of infection and traumatic delivery, further compounding the risk of poor outcomes in affected neonates.

Neonates who had moderate Asphyxia (APGAR Score between 3 and 6) and severe birth asphyxia (APGAR Score less than 3) during delivery were nearly 6 times and 16 times more likely to have poor neonatal seizure outcomes than neonates who delivered with a normal APGAR Score. This study was in line with a study from Jaipur, India (15), Delhi, India (25), Bosnia and Herzegovina (30), Kerala, India (26), Uyo, Nigeria, West Africa (31), King Abdulaziz University Hospital, Jeddah City, Saudi Arabia (32), Banha University Hospital and Benha Children Hospital, Benha, Egypt(33), North India(24), and Bareilly, India(34), Emek Medical Center, Afula, Israel(35). The possible explanation may be that birth asphyxia can cause hypoxic-ischemic brain injury, leading to seizures and neurological damage. More severe asphyxia results in greater brain injury, likely explaining the higher prediction of poor outcomes in neonates with low APGAR scores.

Neonates who had multiple episodes of seizure attacks were 11 times higher to have poor neonatal seizure outcomes than neonates who had single episodes of seizure attacks. This study was consistent with a study from selected Amhara region hospitals, Ethiopia(33), Babol, Northern Iran (13), Neonatal Seizure Registry (NSR cohort study), US (36) and Massachusetts, USA(37). The possible explanation is that recurrent seizures indicate more severe underlying brain injury or dysfunction, which can worsen neurological prognosis. Multiple seizures may also lead to increased neuronal excitability and metabolic demand, exacerbating brain damage and reducing the effectiveness of treatment(38).

Neonates who had a history of resuscitation were 6 times higher to have poor neonatal seizure outcomes than neonates who had no history of resuscitation. This study was in line with a study from UCC Sarajevo, Bosnia and Herzegovina, Southeast Europe (30). The possible explanation is that the need for resuscitation often indicates perinatal distress or hypoxia, leading to hypoxic-ischemic brain injury. This injury increases the risk of seizures and contributes to poorer neurological outcomes, making neonates who require resuscitation more likely to experience adverse seizure outcomes(39).

## **7. Strengths and Limitations of the Study**

### **7.1. Strength of the study**

The main strength of the study is being cross sectional prospective which allowed real and complete data collection and decreasing recall bias

This study also finds that some neonates are discharged with no ASM which is in line with ILAE recommendation that all ASM should be tapered and discontinued prior to discharge unless the diagnosis of Neonatal epilepsy syndrome.

### **7.2. Limitations of the study**

The small sample size of our study reduced statistical power and resulted in wide confidence intervals is one limitation .Because of this, the findings may not be generalizable to all neonates with seizures in other settings. In addition, the follow-up period was short, and long-term neurodevelopmental outcomes were not assessed.Lack of EEG and genetics work up in the study setup is an other limitation of the study .

## **8. Conclusion and recommendations**

### **8.1. Conclusions**

In this study, more than one-fourth of neonates with seizures had poor neonatal seizure outcomes. Low 5<sup>th</sup> minute APGAR Score, history of neonatal resuscitation, presence of prolonged labor, and multiple episodes of seizure attacks were predictors of poor neonatal seizure outcomes.

### **8.2. Recommendations**

#### **8.2.1. For healthcare providers**

- Strengthen intrapartum care to prevent prolonged labor and reduce the risk of birth asphyxia.
- Ensure timely and effective neonatal resuscitation through regular training of health professionals and availability of essential equipment.
- Close monitoring and early management of high-risk neonates, particularly those with low APGAR scores, a history of resuscitation, or multiple seizures.
- Establish structured follow-up programs to monitor neurodevelopmental outcomes beyond NICU discharge.

#### **8.2.2. For policy makers / Ministry of Health**

Integrate neonatal seizure prevention, early detection, and management into national newborn and child health strategies, with emphasis on strengthening intrapartum care, ensuring availability of neonatal resuscitation resources, and establishing follow-up systems for high-risk neonates.

#### **8.2.3. For researchers**

Conduct further prospective studies with a large sample size that focus on the longer follow up period to assess neurological-developmental outcome following neonatal seizures, and assess the effectiveness of interventions aimed at preventing seizures, reducing seizure recurrence, and improving short and long-term outcomes following neonatal seizures.

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**Consent form**

Addis Ababa university, health science and school of medicine ,Yekatit 12 hospital and Gandhi Memorial hospital

This questionnaire is developed to identify neonatal seizure patten,short-term outcomes and its predictors among neontates admitted with neonatal seizure at TASH,Yekatit 12 and Gandhi memorial hospital.My name isTazebewTilahun Pediatrician and pediatrics neurology fellow in the department of Neurology at TASH,AddisAbaba.I am doing this research as partial fulfilment of the requirements of subspeciality in pediatric neurology Addis Ababa .Data will be collected from mothers of neonates .I am going to ask some questions that are very relevant to my study .The identifiers including your names ,medical records will be kept confidential besides me and there is no harm to the neonates .if you don't want to participate or answers questions you have the right to do so.However ,your willingness to answer all the questions is highly appreciated .

Would you like to participate in responding questions in this questionarie?Yes\_\_\_\_\_ No \_\_\_\_\_

Date \_\_\_\_\_

## Questionaries

### 1. Neonatal socio demographic characteristics

Patient MRN	_____		
S/N	Questions	Coding category	Code
1.	Age of new born at presentation /admission	In Hrs(if<72hrs) and In days(if>72hrs)	_____
2.	Sex of the neonate	1.male 2.female 3.Unclassified	
3.	Apgar score	1 <sup>st</sup> minute____5 <sup>th</sup> minute_____	
4.	Cry immediately after delivery	1.yes 2.no	
5.	Neonatal resuscitation done	1.yes----if yes how long and mention if medications used 2.no	_____ _____
6.	Birth weight	In grams _____	
7.	Gestational age	In weeks _____	
8.	Weight for gestational age	1.AGA 2.SGA-----a) symmetricb) asymmetric 3.LGA	
9.	Place of delivery	1.home 2.health center 3.hospital	
10.	Mode of delivery	1.SVD 2.intrumental 3.C/S	
11.	No of fetuses in the current pregnancy	1.singleton 2.tiwns 3.tripletes and above if	

### 2. Maternal medical conditions and sociodemographic characteristics

1.	Maternal age	In years _____	
2.	Residence	1.rural 2.urban	
3.	Educational status	1.iliterate 2.upto grade 8 3.up to grade 12 3.college and above	
4.	Maternal ANC follow up	1.yes ,No of ANC visit____ 2.no	
5.	Gravidity status	1.primigravida 2.multigravida 3.grand multipara 4.Great grand multipara	
6.	Maternal iron and folic intake	1.yes 2.no	
7.	Onset of labor	1.spontaneous 2.induced ( indication)_____	

8.	Duration of labor	In hours _____	
9.	Obstetrical complications during pregnancy	1.yes( mention) _____ 2..no	
10	Any Maternal chronic medical illness	HypertensionyesNO DiabetesYesno Asthmayesno Thyroid diseaseyesno Cardiac illnessyesno Chronic kidney disease yesno Others_____	
11.	Maternal drug use during pregnancy other than iron and folic acid	1.yes---mention if any----- 2.no	
12	Any maternal history of abortion	1.yesA) 1 <sup>st</sup> trimensterB) second trimenster C) 3 <sup>rd</sup> trimerter 2 No	

### 3.Neonatal Medical conditions

1	Neonatal medical diagnosis	1.PNA 2.sepsis 3.menigitis 4.jaundice 5.hypoglycemia 6.electrolyte abnormality ---specify 7.Others ---specify _____	
2	Neonatal physical exam findings	Vital sign PR-RR= T0=spO2- AnthropometryHC= length= Chest 1.normal2.Abnormal MSS 1.normal2.abnormal IS 1.normal2.Abnormal CVS -1-normal 2.Abnormal Abdomen -any hepatosplenomegaly 1-yes 2.no Mentation 1-alert 2.lethargic 3.comatose Tone 1-normotonic 2.hypotonic 3.hypertonic Neonatal reflexes Moro 1-complete 2.incomptete 3.absent Sucking 1-sustained 2.non sustained Grasp 1-strong 2.weak	Specify if abnormal
3	Seizure type	1.subtle	

		2.tonic 3.clonic 4.myoclonic 5.multiple/Mixed...6.others	
4	Duration of seizure	_____	
5	Time of onset of seizure	1.before 24 hour 2.between 24-48 hour 3.after 48 hour	
6	Episodes of seizure attack	1.single 2.multiple	
7	Was anticonvulsant therapy started	1.yes 2.no	
8	What was the medication used	1.calcium gluconate 2.phenytoin 3.phenobarbitone 4.Levetiracetam 5.Diazepam 6.other	
9	How many drugs used	1.one 2,two 3.three and more	
10	Seizure frequency in a week	1.one 2.two 3.three and above	

**Neonatal laboratory ,imaging and EEG characteristics**

1.	Serum sugar level(most lowest record)	_____mg/dl	
1	Cbc at admission	Wbc____Hb____HCT____PLT_____	
2	Sodium	1.highest record____ 2.lowest record____ 3.not done	
3	Calcium (lowest record)	_____	
4	Magnesium	1.normal 2.abnormal 3.not done	
5	CSF	1.Cell count ___protein ___ glucose ___gram reaction ___culture 2.not done	
6	Bilirubin (highest record)	Total____In mg/dl Direct____in mg/dl	
7	Transfontanel us	1.normal 2.abnormal ---specify 3.Not done	
8	Brain CT scan	1-normal 2.abnormal ---specify 3.Not done	
9	Brain MRI	1.normal 2.abnormal –a) ICH B) hydrocephalus C) extracranial hematoma 3.not done	
9	EEG	1.normal 2.abnormal—write 3.Not done	

**New born characteristics todischge /outcome assessment variables**

1.	Head circumference	_____cm	
2	Weight	_____gm	
3.	Moro reflex	1.complete 2.incomplete 3.Absent	
4.	Grasp reflex	1.strong 2.weak	
5.	Sucking reflex	1.sustained 2.non sustained ( with ng tube )	
6.	Tone	1.normotonic 2.spastic 3.hypotonic	
7.	Mentation	1.alert 2.depressed	
8.	Total duration of hospital stay	In days _____	
9.	Discharge with NG tube	1.yes 2.no	
10.	Last/discharge CBC	WBC__Hb__HCT__plt__	
11.	Discharge medication if any	-----	
12.	Outcome	1.death 2.Discharge with sequela 3.Discharge with no sequela 4.Went against medical advice/LAMA	