

# Epidemiology and Risk Factors of Convulsive Status Epilepticus Patients Admitted in the Emergency Department of Tertiary Hospital in Mogadishu, Somalia

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**Introduction:** Status epilepticus (SE) is one of the most common neurologic emergencies and is associated with significant morbidity and mortality. The underlying cause of SE varies between patients with epilepsy and those presenting without. The aim of this study was to evaluate the epidemiology, risk factors and outcomes of patients presenting with convulsive SE in the emergency department (ED) of a tertiary hospital in Mogadishu.

**Methods:** This was a cross-sectional study conducted between July 2021 and June 2022. The study included both patients with epilepsy and those without epilepsy presenting to the ED with SE. Risk factors and underlying etiologies were evaluated in the patients in both the pediatric group (0–18 years) and adult group (18 years and above). Clinical history, neurologic examinations, neuroimaging, electroencephalography findings, and laboratory investigations were all evaluated.

**Results:** The mean age for pediatric patients was 6 (SD±4.7), while the mean age for adult patients was 38 (SD±10.4). About 33 (36%) of the subjects had previous history of epilepsy, while 59 (64%) presented to the ED with their first seizure. About 80 (87%) had generalized seizure while 12 (13%) had focal seizure. Poor antiepileptic compliance was the most common risk factor for SE 20 (21.7%), followed by CNS infections 14 (15%), and prolonged febrile seizures 7 (7.6%). Poor antiepileptic drug compliance, cerebrovascular disorders, electrolyte imbalance, metabolic conditions, and drug abuse were the most common underlying etiologies of SE in patients older than 18 years. Prolonged febrile seizure, meningitis, encephalitis, systemic infections, and structural brain abnormalities were the most common underlying etiologies of SE in patients younger than 18 years.

**Conclusion:** CNS infections, CVDs, metabolic disturbances, electrolyte imbalances, and systemic infections are major etiological risk factors of SE in patients without prior history of epilepsy. Medication adherence was the major etiological risk factor for SE identified in patients with epilepsy.

**Keywords:** status epilepticus, emergency room, risk factors

## Introduction

Status epilepticus (SE) is defined as a seizure with 5 minutes or more of continuous clinical and/or electrographic seizure activity or recurrent seizure activity in which the patient does not regain consciousness in between. Previously, status epilepticus was defined as continuous seizure activity for duration of 30 minutes or a series of seizures in which the patient's consciousness is not regained in between seizures.<sup>1,2</sup> SE is a neurological emergency and life-threatening condition that needs immediate intervention and particular attention to prevent permanent cerebral damage.<sup>3</sup>

Status epilepticus is a life-threatening condition and is associated with significant rates of mortality and morbidity if not urgently managed. To prevent this catastrophe, rapid initiation of IV antiepileptic treatment is required to control such

a fatal condition and ensure the survival of the patients.<sup>4,17</sup> Adults with status epilepticus have a mortality rate of 15% to 20%, whereas children have a rate of 3% to 15%. Hyperthermia, pulmonary edema, cardiac arrhythmias, and cardiovascular collapse are all hallmarks of acute complications. Epilepsy (20% to 40%), encephalopathy (6% to 15%), and localized neurologic impairments are some of the long-term consequences (9 to 11%).<sup>5,6</sup>

The American Epilepsy Society Guidelines for the Evaluation and Management of Status Epilepticus from 2016 and the Neurocritical Care Guidelines from 2012 both describe status epilepticus (SE) as a seizure that lasts longer than 5 minutes. The guidelines additionally define refractory status epilepticus (RSE) as a seizure that persists despite treatment with an appropriate doses of a benzodiazepine (4-mg intravenous (IV) injection of lorazepam) plus the appropriate dose of one antiepileptic medication.<sup>25,26</sup>

The etiology of SE differs widely from patient groups. Underlying causes vary according to age and the epileptic history of patients. In people known to be epileptic, poor compliance and drug withdrawal are the commonest causes of SE. In contrast, patients with no epileptic history, metabolic causes, electrolyte imbalance, cerebrovascular disorders, head traumas, central nervous system (CNS) infections, cardiac arrests, and drug intoxications are the most common causes.<sup>7,8</sup>

Status epilepticus is a common neurologic emergency we frequently see in the emergency department of our hospital. There are different etiologies for SE seen in the evaluation of these patients. One major risk factor for SE in these patients, especially in adults, is lack of compliance with antiepileptic medications. Since there was no previous study evaluating the epidemiological profile and risk factors of SE in the country, we aimed to assess the epidemiology and risk factors of convulsive SE among patients admitted to the emergency department of our hospital; we also assessed the outcomes (intra-hospital mortality) of these patients so that patients who are at risk can be diagnosed and treated early in the course of the disease to reduce mortality.

## Methods and Materials

This was a cross-sectional study conducted at Mogadishu Somali Turkish Training and Research Hospital between July 2021 and June 2022. All patients who presented to the emergency department with convulsive status epilepticus who were eligible to the inclusion criteria were evaluated. The participants of the study were both patients with a history of epilepsy and those without epilepsy, of all ages, presenting to the ER with status epilepticus. Patients with psychogenic non-epileptic seizures and patients with epileptic seizures but did not the the definition of SE were excluded from the study. Risk factors and underlying risk factors were evaluated in the patients. Clinical history, neurologic examinations, cerebral imaging, electroencephalographic findings and laboratory investigations (including complete blood count, full biochemistry profile) were all assessed by a team of neurologists, pediatricians and emergency physicians. The data related to seizure onset, nature, and length was collected by a team of neurologists and emergency physicians at the emergency visit and following hospital admission. The neurological examinations were made by neurologists both at the emergency visit and after the patient's recovery from the seizure (this was made to clearly define that the neurological deficit was not due to the seizure itself). The EEG recordings were made within the first 20 hours of patients' admission to the emergency room and were interpreted by consultant neurologists at our hospital.

The data were collected by 4 researchers, and other researchers reviewed the appropriateness of all patients included and excluded. The patients' medical records were partially obtained from the hospital database (FONET system), while some other data were given by the patients/relatives. The collected data included patients' demographics (age, gender), laboratory tests (albumin, sodium, potassium, calcium, magnesium, glucose, aspartate aminotransferase, alanine aminotransferase), past medical history (ischemic stroke, hemorrhagic stroke, previous history of epilepsy, diabetes mellitus, coronary artery disease, traumatic brain injury), seizure classification (generalized convulsive, and focal motor). Patients' brain imaging (CT/MRI) and EEG were performed within 20 hours of admission. Since we could not measure antiepileptic drug levels, interruption or discontinuation of anticonvulsive medication as a trigger of SE was considered as a poor/lack of compliance of AEDs. All patients had neuroimaging studies (CT/MRI) and EEG recordings. The neuroimaging was assessed by neurologists and radiologists in the hospital, and based on the analysis; it was classified into normal and abnormal imaging findings. The EEG recordings were interpreted by consultant neurologists and classified into normal, generalized epileptic discharges, focal epileptic discharges, focal slowing, and generalized slowing

patterns. The outcome (mortality) of patients was assessed in both pediatric and adult patients, and comparisons were made in both groups to identify if there was a statistically significant difference in mortality rates.

## Case Definition

SE was defined as a seizure with 5 minutes or more of continuous seizure activity or recurrent seizure activity without recovery between seizures. We enrolled all patients who met the definition of status epilepticus regardless of age, seizure type, or epileptic history. Furthermore, 10 patients were excluded from the study due to psychogenic non-epileptic seizures (PNES).

## Statistical Analysis

Continuous variables are represented by means and standard deviations; frequencies and percentages were used to illustrate categorical variables. Pearson's chi-square test was used to determine the etiological and risk factors distribution by age group of the patients.  $P < 0.05$  was considered statistically significant. SPSS software version 26 was used to conduct the statistical analysis.

## Ethical Approval and Consideration

This study was performed in line with the principles of the Declaration of Helsinki. The study was reviewed and accepted by the ethics committee of Mogadishu Somali Turkish Training and Research Hospital (Ethics Protocol No: MSTH/7418). All patients and caregivers were informed of the purpose of this study. Written informed consent was obtained from the adult patients who were able to give consent for the study. For children and adult patients (who are unable to give consent for their medical condition), the consent was obtained from their relatives or caregivers. We declare that we have followed the protocols of our work center. Patients' data confidentiality was respected.

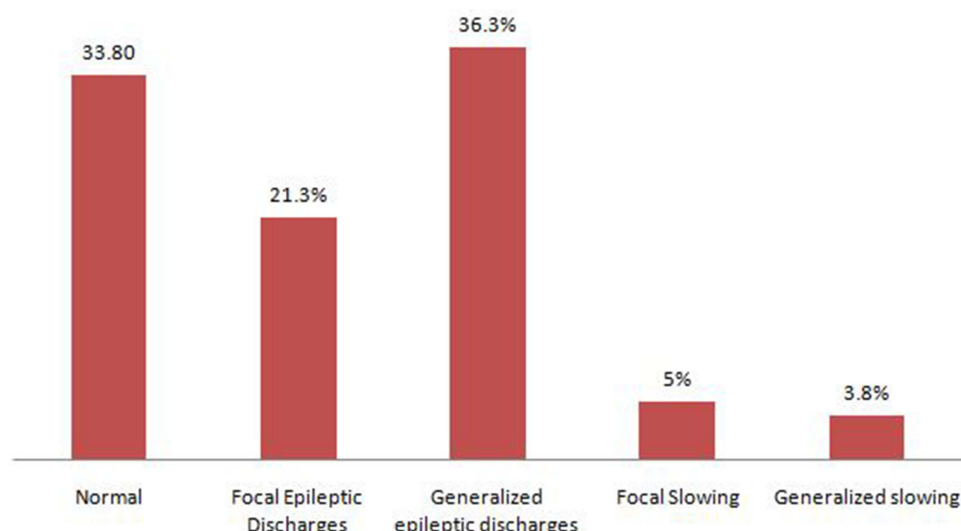
## Results

Of the 92 patients included in this study, 52 were adults and the other 40 were less than 18 years old. The mean age for pediatric patients was 6 ( $SD \pm 4.7$ ), while the mean age for adult patients was 38 ( $SD \pm 10.4$ ). 50 (54.3%) of patients were male, while 42 (45.7%) were female. Comorbidity was present in 38 (41%) of the subjects. 33 (36%) of the subjects had a previous history of epilepsy, while 59 (64%) presented to the emergency room with status epilepticus for the first time in their lives. Of those with epilepsy history, 11 (33%) had 1–5 years of epilepsy history, 10 (30%) had epilepsy between 5–10 years, 8 (24%) had epilepsy between 10–15 years, 3 (9%) had epilepsy between 15–20 years, while 1 (3%) had epilepsy for more than 20 years. In terms of seizure type, 80 (87%) had generalized seizures, while 12 (13%) had focal seizures. Generalized seizures were slightly higher in male patients and those above 18 years of age (see Table 1). Thirty-two (32.6%) of the patients had a family history of epilepsy.

Following a neurologic examination, 28 (30%) of the patients had neurologic deficits, whereas 64 (70%) had a normal neurologic examination. 23 (25%) had abnormal brain imaging, while 69 (75%) had normal brain imaging. Abnormal imaging findings were more common in adult patients than in pediatric patients. This was statistically significant ( $P = 0.028$ ). The most common EEG abnormality seen in 34 patients (37%), was generalized epileptic discharges; 19 patients (20.7%) had focal epileptic discharges, and 31 patients (33.7%) had normal EEG findings (Figure 1 shows the EEG

**Table 1** Seizure Type by Gender and Age of Patients

Variables	Type of Seizures	
	Generalized	Focal
Male	45(56.3%)	5(41.7%)
Female	35(43.8%)	7(58.3%)
Below 18 years	31(38.8%)	4(33.3%)
18 years and above	49(61.3%)	8(66.7%)



**Figure 1** Shows EEG findings of patients.

findings of patients). Patients with a past history of epilepsy were more likely to have EEG pathologic findings compared to those with no past history of epilepsy. This was statistically significant ( $P=0.001$ ). Regarding antiepileptic medication history, 31 (33.7%) of the patients were on antiepileptic medications. Of these, 9 (29%) were on monotherapy, while 22 (71%) were on polytherapy.

Regarding the underlying causes of the status epilepticus of the subjects, 20 (20.7%) were due to poor AED compliance, 8 (8.7%) were due to systemic infection, 7 (7.6%) were due to prolonged febrile seizures, 7 (7.6%) were due to electrolyte imbalance (Table 2 lists the different etiologies of status epilepticus among the patients). Among the 92 patients admitted, 18 (19.6%) died during hospitalization, while 74 (80.4%) were discharged from the hospital following successful management.

**Table 2** Underlying Causes of Status Epilepticus Among Patients

Etiology	Frequency	Percent
Hyponatremia	6	6.5%
Poor AED compliance	20	21.8%
Meningitis	8	8.7%
Drug abuse	3	3.3%
Ischemic stroke	4	4.3%
Head trauma	3	3.3%
Structural brain abnormality	6	6.5%
Underlying cause is unknown	4	4.3%
Systemic infection	8	8.7%
Hyperglycemia	2	2.1%
Hypoglycemia	4	4.3%
Brain abscess	1	1.1%

(Continued)

**Table 2** (Continued).

<b>Etiology</b>	<b>Frequency</b>	<b>Percent</b>
CVT	2	2.1%
Uremic encephalopathy	3	3.3%
Subdural hematoma	2	2.1%
Febrile seizure	7	7.7%
Hemorrhagic stroke	3	3.3%
Encephalitis	5	5.5%
Hypocalcemia	1	1.1%
<b>Total</b>	<b>92</b>	<b>100%</b>

**Abbreviations:** AED, antiepileptic drug; CVT, cerebral venous thrombosis.

3% of the subjects became refractory status epileptics. Mortality was somewhat higher in adult patients with abnormal neuroimaging findings compared pediatric patients. This was not statistically significant ( $P = 0.602$ ).

The study showed variation in the etiology of status epilepticus among different age groups. Poor antiepileptic drug compliance, cerebrovascular disorders, electrolyte imbalance, metabolic conditions, and drug abuse were the most common underlying etiologies of status epilepticus in patients older than 18 years. Prolonged febrile seizures, meningitis, encephalitis, systemic infection, and structural brain abnormalities were the most common underlying etiologies of status epilepticus in patients younger than 18 years (see Table 3). In this study, there was statistical significance between the type of seizure and the outcome of the patients. Patients with generalized status epilepticus died at a higher rate than those with focal status epilepticus ( $P = 0.016$ ).

**Table 3** Distribution of Etiologies of SE Among Different Age Groups

		<b>Age of Patients</b>		<b>P-value</b>
		<b>Below 18 Years</b>	<b>Above 18 Years</b>	
Underlying cause of status Epilepticus	Hyponatremia	1(2.9%)	5(8%)	0.034
	Poor antiepileptic drug compliance	5(14.3%)	15(26.3%)	0.016
	Meningitis	5(14.3%)	3(5.3%)	0.016
	Drug abuse	0(0.0%)	3(5.3%)	0.026
	Ischemic stroke	1(2.9%)	3(5.3%)	0.341
	Head trauma	2(5.7%)	1(1.8%)	0.562
	Structural brain abnormality	5(14.3%)	1(1.8%)	0.025
	Systemic infection	5(14.3%)	3(5.3%)	0.016
	Hyperglycemia	0(0.0%)	2(3.5%)	0.026
	Hypoglycemia	1(2.9%)	3(5.3%)	0.043
	Brain abscess	0(0.0%)	1(1.8%)	0.368

(Continued)

**Table 3** (Continued).

		Age of Patients		P-value
		Below 18 Years	Above 18 Years	
	Cerebral venous thrombosis	1(2.9%)	1(1.8%)	0.628
	Uremic encephalopathy	0(0.0%)	3(5.3%)	0.261
	Subdural hematoma	0(0.0%)	2(3.5%)	0.256
	Prolonged febrile seizure	6(17.1%)	1(1.8%)	0.001
	Hemorrhagic stroke	0(0.0%)	3(5.3%)	0.562
	Encephalitis	3(8.6%)	2(3.5%)	0.002
	Hypocalcemia	0(0.0%)	1(1.8%)	0.542
	Underlying cause is unknown	0(0.0%)	4(7%)	0.016

## Discussion

Status epilepticus (SE) is defined as a seizure that lasts longer than 5 minutes, or having more than 1 seizure within a 5-minute period, without returning to a normal level of consciousness between episodes.<sup>1</sup> Status epilepticus is one of the most common neurologic emergencies seen in the ER. It can have life-threatening complications and long-term consequences if it lasts longer than 30 minutes.<sup>9</sup> We included 92 patients (52 adult and 40 pediatric patients) who presented with status epilepticus to the emergency department of our hospital. Etiological factors such as poor AED compliance, structural CNS insult, electrolyte imbalance, metabolic disturbances, prolonged febrile seizures, central nervous system infections, neoplastic lesions, hydrocephalus, head trauma, and other factors that are associated with SE among patients were all evaluated. The scope of etiological factors in the development of SE varies according to demographic history and clinical history.

Risk factors for first time SE include head trauma, fever, stroke, alcohol use, metabolic abnormalities, anoxia/hypoxia, tumors, and drug overdose. Poor compliance of AEDs and low epileptic drug levels are the major risk factors for SE in patients with known epilepsy history.<sup>10,11,18</sup> In this study, 64% of the patients presented to the emergency room with status epilepticus for the first time in their lives, indicating a high potential for underlying secondary causes. Risk factors for status epilepticus were different among patients with epilepsy and those presenting with status epilepticus for the first time, as well as between different age groups of patients. In our study, poor AED compliance, cerebrovascular disorders, electrolyte imbalance, metabolic conditions, and drug abuse were the most common underlying etiologies of status epilepticus in patients older than 18 years. The most common underlying etiologies of status epilepticus in patients under the age of 18 were febrile seizures, meningitis, encephalitis, systemic infection, and structural brain abnormalities.

Status epilepticus is associated with a high rate of mortality. It affects about 50/100,000 people each year and recurs in more than 13% of cases. The strongest single risk factor for generalized convulsive status epilepticus is a history of epilepsy.<sup>19</sup> Mortality rates are 15% to 20% in adults<sup>12</sup> and 3% to 15% in children.<sup>14</sup> In our study, 18 (19.6%) of 92 patients admitted died during hospitalization, while 74 (80.4%) were discharged from the hospital following successful management. 3% of the subjects became refractory status epileptics. Mortality was higher in adult patients with abnormal neuroimaging findings compared pediatric patients. This was not statistically significant ( $P=0.602$ ). The mortality of our patients was related to SE and their underlying etiologies.

Acute complications resulting from hyperthermia, pulmonary edema, cardiac arrhythmias, and cardiovascular collapse are the responsible causes of death in status epilepticus patients.<sup>10</sup> In pediatric patients, SE has been associated with CNS damage, fever, poisoning, systemic infection, low anticonvulsant levels, anatomical brain abnormalities, electrolyte imbalances, and inborn metabolic errors in children.<sup>13,14</sup> In our study, prolonged febrile seizures, meningitis, encephalitis,



systemic infection, structural brain abnormalities, and poor antiepileptic compliance were the most common underlying etiologies of status epilepticus in pediatric patients. As per a study by Coeytaux et al, cerebrovascular accidents were the most frequent risk factors in non-epileptic patients (30%). Antiepileptic drug noncompliance was the most common risk factor in epileptic patients (18.9%).<sup>15</sup> In this study, cerebrovascular disorders accounted for 8% of the underlying etiologies in non-epileptic patients. CVD was more common in adult patients than in the pediatric group.

As Maldonado et al revealed in their study, 56.1% of the patients had abruptly interrupted or discontinued their antiepileptic medication, which was the underlying cause of their status epilepticus.<sup>16</sup> According to a Colombian study,<sup>20</sup> noncompliance with medication is the leading cause of SE. Non-compliance is common in Somalia, although it has not been studied. There was no single previous study evaluating antiepileptic drug compliance. In this study, the most common risk factor identified in patients with epilepsy was non- or poor compliance with AEDs (21%). Among the 33% of epileptic patients in this study, 60% of these epileptic patients came with status epilepticus to the ER due to medication noncompliance. Moreover, poor AED compliance was more common in adult patients compared to children. Poor compliance with antiepileptic medications is significantly higher in Sub-Saharan African countries, with 67% in Nigeria, 54% in Kenya, and 37% in Ethiopia, and economic factors were the primary determinants of poor compliance.<sup>21–23</sup> The main causes of treatment failure and emergency department visits among epileptic patients are poor adherence to antiepileptic medications. Repeated seizures lead to a low quality of life, diminished productivity, and a social and economic problem associated with seizures.<sup>24</sup>

In developing countries, central nervous system infections are one of the major causes of SE in patients presenting with first-time seizures in the ER (contributing to 15% of the cases).<sup>25</sup> Among CNS infections, encephalitis, meningitis, and brain abscess were observed in the study. Systemic infections were also responsible for almost 10% of cases of SE (including those with a history of epilepsy and those without). Therefore, in patients presenting with first-time seizures, infectious causes should be given great consideration in the differential diagnosis by performing extensive laboratory investigations and cranial imaging and CSF analysis in certain circumstances.

According to research by Chin et al, 17% of the total included SE cases were caused either by metabolic disorders or electrolyte disturbances.<sup>6</sup> In our study, metabolic and electrolyte imbalances were also common etiologies of SE (15%). Among the recorded etiologies are hypoglycemia, hyperglycemia, uremic encephalopathy, hyponatremia, and hypocalcemia. The differential diagnosis of patients with first-time SE should be broad and metabolic and electrolyte imbalances should be evaluated as possible etiologies for the status epilepticus.

## Study Limitations

The main limitation faced during this study was the lack of sufficient previous information related to status epilepticus in its various forms in our country, as well as the associated risk factors (because there was not a single study related to status epilepticus conducted in the country before, thus this becomes the first of its kind). Another limitation was the lack of measurement of the serum levels of medications used for epileptic control because either the test could not be performed (lack of availability of the test) or patients did not usually have money to pay for such measurements. Cross-sectional study is not the best research design to measure risk factors related to a specific outcome, but it gives an overview of risk factors related to a particular outcome at a specific point of time. To reduce the possible confounding factors, we used a strict systematic approach for data collection and a consistent definition for our cases. This minimized the level of data bias and misclassification that could be present in our investigation. At this point, we think it provides useful insight into risk factors for status epilepticus in both pediatric and adult patients. We recommend further prospectively designed multicenter studies be conducted in the country.

## Conclusion

This study is the first of its kind to be conducted in Somalia to determine the etiological and risk factors of status epilepticus. The findings of the study will be useful for clinicians in the management of status epilepticus. To fully understand the risk factors related to SE, further research is needed to be conducted in Mogadishu and other cities in the country.

## Abbreviations

ER, Emergency Room; CVD, Cerebrovascular disorders; AED, Antiepileptic drugs; CNS, Central Nervous System; SE, Status Epilepticus.

## Ethical Approval

This study was performed in line with the principles of the Declaration of Helsinki. The study was reviewed and accepted by the ethics committee of Mogadishu Somali Turkish Training and Research Hospital (Ethics Protocol No: MSTH/7418).

## 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 no conflicts of interest in this work.

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