Original Article

Incidence of Seizure-Related Injury: Traffic Accident, Falling and Drowning in Epileptic Patients

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Background: People with epilepsy (PWE) are high risk of accidents and injuries more than normal population. There has been no national data study on the traffic accident, falling and drowning in hospitalized epileptic patients in Thailand.

Objective: To determine the incidence of traffic accident, falling and drowning of PWE in Thailand.

Materials and Methods: The authors retrospectively explored national data in Thailand for reimbursement of seizure-related injuries (SRI) focus on traffic accident ICD 10 (V20 to V99), falling ICD 10 (W00 to W19) and drowning ICD 10 (W65 to W74) of epilepsy patients' age of 18 or over who admitted in the fiscal year 2004 to 2012. PWE were diagnosed and searched based on ICD 10 (G40, G41) from the national database with Universal Health Coverage Insurance office.

Results: There were 86,531 PWEs in the present study; most were males 57,653 cases (66.63%). PWE had traffic accident 312 cases (Incidence rate 361 per 100,000). The most of motor vehicle crashes traffic accidents were motorcycles 283 cases (90.7%), followed by cars 15 cases (4.8%) pickup 11 cases (3.5%) bus 2 cases (0.6%) and truck 1 case (0.3%) respectively. Seizure-related falls were 3,265 cases (incidence 3,750 per 100,000) and drownings were 42 cases (incidence 50 per 100,000). At discharge, 90.75% of patients were improved, while 7.31% were not improved, and in-hospital mortality rate was 1.94%. drownings were 42 cases (incidence 50 per 100,000).

Conclusion: This finding supports the public policy for consider issue legal driving license for PWE in Thailand. In addition, seizure-related falls especially fall from working at heights or among construction workers must be considered.

Keywords: Seizure-related injuries, Traffic accident, Falling, Drowning, Epilepsy

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Current studies regarding accidents have found that seizures related injury are likely to increase because epileptic patients have a higher risk of accidents and deaths than normal people.This is especially true in patients with epilepsy who have uncontrolled seizures, patients with generalized Tonic-Clonic seizures (GTCs), patients with symptoms of unconsciousness and immediate fall (atonic seizures) without warning signs, or in patients with complex partial seizures (CPS), which causes patients to be unable to prevent plausible dangers[1,2].

In addition, the side-effects from anti-epileptic drugs can cause tremor hands, unbalanced walking, and double vision, all of which can cause patients to be more vulnerable to accidents. The accidents, which can cause severe consequences of disability or death due to seizures, are traffic accidents, which are one of the most common causes of death in Thailand.

Epilepsy patients have a higher risk of accidents and deaths than the normal population, especially those epilepsy patients who had uncontrolled seizures. According to the study by Lings, it was found that epileptic patients have a 7 times greater risk of traffic accidents[3]. Regarding the factors of accidents for epileptic patients, generalized Tonic-Clonic seizures (GTCs) have been found to be one of the factors[4-8].

In addition, it has been revealed that Myoclonic seizures and Atonic seizures are also risk factors[9,10] based on the fact that the symptoms of such seizures often do not show any auras. Patients, therefore, cannot plausibly prevent accidents. At times, the accidents can causeserious injuries, other accidents, or even disability or death, especially when accidents are caused by seizures that occur when the patients are driving a motorcycle. Not only do epilepsy patients get injured, but the public may also be affected by these unpredictable and uncontrollable accidents as well.

In regard to the interviews carried out with adult epilepsy patients at 15 years of age and above, it was found

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that nearly 75 percent of epilepsy patients had been driving and that 30 percent of them had had seizures while driving. Moreover, 60 percent of their seizures had caused accidents and 20 percent of the accidents had resulted in the patients and the affected travelers being admitted to the hospital[6]. Yusuf Ali Altunc et al[11] conducted a study and discovered that the most common injuries in patients with epilepsy had been soft tissue contusions (21.5%), brain injuries (19.8%), torn wounds (14.2%), and dental injuries (13.3%), respectively. Mostly the accidents had caused minor injuries. This is consistent with the findings from a study by Somsak Tiamkao et al[4] in which it was revealed that the most common injuries in patients with epilepsy were soft tissue contusions (61%), burn wounds and scalds (17%), head injuries (14%), bone injuries (5%), and drowning (3%), respectively.

The details of an accident, which occurred on 11 June 2014 in Nong Bua Lam Phu Province, showed that a patient with epilepsy had experienced seizures while driving, which resulted in an accident that killed 4 students and caused many injuries. Events such as this have caused the public to raise the question as to whether or not epilepsy patients should be allowed to drive. Subsequently, the Department of Land Transport, the Ministry of Transport, and the Medical Council of Thailand have all suggested that the drivers' licenses of those individuals with epilepsy, severe diabetes, and heart disease should be controlled in order to appropriately provide empirical evidence of the regulation of driving licenses to epileptic patients.

Based on the aforementioned information, this study has been conducted in order to examine the accidents caused by seizures in Thailand.

Research objectives

To study the incidences of accidents caused by seizures (i.e., traffic accidents, falling, and drowning) found in the epileptic patients in Thailand.

Type of research

The present study is a descriptive retrospective study.

Population and sample

The population used in this research was entirely composed of epileptic patients, who had been admitted to hospital (as in-patients) as a result of accidents arising from seizures, based on the database of Thailand medical records used in disbursement of medical expenses from the National Health Security Office (NHSO) according to the ICD 10 during the period of 1 October 2004 to 30 September 2013.

Terms and definitions

- Epilepsy is based on the diagnostic criteria of the International League Against.

- Epilepsy (ILAE) classification 1981 and the database of medical records G40 (Epilepsy) and G41 (Status Epilepticus).

- Traffic accidents refer to ICD 10 Thailand. In this study, the data was collected using the following codes:

(V20-V29) Motorcycle users injured in transportation accidents

(V30-V39) Three-wheeled-motor vehicle users injured in transportation accidents

(V40-V49) Car users injured in transportation accidents

(V50-V59) Users of small trucks or vans injured in transportation accidents

(V60-V69) Heavy truck users injured in transportation accidents

(V70-V79) Bus users injured in transportation accidents

(V98-V99) Other transport or unspecified accidents

- Intracranial injury is based on ICD 10 Thailand. In this study, the data were collected using the following codes:

(S06.0) Concussion is a severe brain injury. Patients have a history of unconsciousness or when the brain is CT-scanned, no abnormality, such as bleeding in the brain, is found.

(S06.1) Traumatic cerebral edema

(S06.2) Diffuse traumatic brain injury

(S06.3) Focal traumatic brain injury

(S06.4) Epidural hemorrhage

(S06.5) Bleeding under the cortex of the traumatic sub-arachnoid hemorrhage

(S06.6) Traumatic sub-arachnoid hemorrhage Chest injuries are based on ICD 10 as follows:

(S27.0) Traumatic pneumothorax

(S27.1) Traumatic hemothorax

(S27.2) Traumatic pneumohemothorax

(S27.7) Multiple injuries of the intra-thoracic organs

(S27.8) Injuries in other organs specified in the chest cavity

(S27.9) Injuries in organs that are not specified in the chest cavity

- Injuries of intra-abdominal organs and traumatic haemoperitoneum are based on ICD 10 as follows:

S36.0 Injuries of the spleen

S36.1 Injuries of the liver or gallbladder

S36.2 Injuries of the pancreas

S36.3 Injuries of the stomach

S36.4 Injuries of the small intestine

S36.5 Injuries of the colon

S36.6 Injuries of the rectum

S36.7-8 Injuries of multiple intra-abdominal organs

- Fracture injuries in this research refer to the following:

(S42) Fracture of the shoulder and upper arm bones

(S52) Fracture of the elbows and forearms

(S72) Fractureof the thigh bone

(S82) Fracture of the tibia including ankle (Excluding the hand bones, fingers, feet, and broken toes)

- Fallsare based on the ICD 10 Thailand. In this

study, the data was collected using the following codes:

(W00-W19) Falls
(W10) Fallsfrom stairs
(W11) Falls from ladders
(W12) Falls from scaffolding
(W13) Fallsfrom buildings
(W14) Falls from trees
(W19) Unspecified falls

Drowning deaths and unintentional drowning were in accordance with the ICD 10, Thailand. In this research, data was collected using the codes (W65-W74) Drowning Deaths and Unintentional Drowning.

Data analysis

Descriptive statistics

Categorical variables were calculated using descriptive statistics for the percentages.

Continuous variables were calculated using descriptive statistics for the mean values.

Results

The incidences of traffic accidents, fall accidents, and drownings, which had occurred with epileptic patients in Thailand were examined. The data were derived from the database of Thailand medical records, which is used in the disbursement of medical expenses from the National Health Security Office (NHSO) according to ICD 10, and the time period ranged from 1 October 2004 to 30 September 2013. There was a total of 86,351 participants, who were patients with age ranges of 15 to 46 years of age (64%). Males constituted 66 percent of the participants. Moreover, 78,341 participants had been diagnosed with G40 and 8,010 patients had been diagnosed with G41 (9.28%). Of the participants, 32.05 percent were from the Northeast, followed by 29.07 percent from Central Thailand, 26.54 percent from the North, and 12.34 percent from the South, as shown in Table 1.

Regarding the traffic accidents caused by the 312 epileptic patients, it was found that the highest number had been from motorcycle accidents with 283 cases (90.7 %), followed by car accidents with 15 cases (4.8%), truck accidents with 11 cases (3.5%), bus accidents with 2 cases (0.6%), and 1 incident of a lorry accident (0.3%), respectively.

Considering the population of epileptic patients examined in this study (a total of 86,351 people), it was found that the incidence of traffic accidents is 361 per 100,000 epilepsy patients, as shown in Table 2.

Moreover, there were 42 cases of drowning due to seizures, which indicates that the incidence of drowning was 50 cases per 100,000 epilepsy patients.

Regarding the cases of falls, there were 3,265 cases or 3,770 cases per 100,000 epilepsy patients. The majority of the falls, which involved 138 people, had been from stairs

Table 1. Demographic data

General information	Number (cases)	Percent
Gender		
Male	57,653	66.63
Female	28,878	33.37
Age (years)		
15 to 29	19,344	22.35
30 to 39	18,469	21.34
40 to 49	18,002	20.80
50 to 59	12,500	14.45
60 to 69	8,916	10.30
70 to 79	6,653	7.70
>80	2,647	3.06
Regions		
Central	25,155	29.07
Northern	22,967	26.54
Northeastern	27,733	32.05
Southern	10,676	12.34

Table 2. The details of the accidents

Details	Number		Percentages (from all epilepsy patients)	The incidence per 100,000
	Cases	Percent		
Traffic accidents	312	100	0.35	361
Motorcycles	283	90.7	0.32	320
Cars	15	4.8	0.02	20
Trucks	11	3.5	0.01	18
Lorries	1	0.3	0.001	1
Buses	2	0.7	0.002	2
Accidental downing	42		0.05	50
Falls	3,265	100	3.77	3,750
Falls from steps/stairs	138	4.22	0.16	160
Falls from ladder	10	0.31	0.01	10
Falls from scaffolding	18	0.56	0.02	20
Falls from building	62	1.89	0.07	70
Falls from tree	17	0.53	0.02	20
Falls: unspecified	3,020	92.49	3.46	3,490

Table 3. The results of the injuries

Results of Injuries	Number		Percentages (from all epilepsy patients)	Incidence per 100,000
	Cases	Percent		
Brain injury	140	100.00	0.162	162
Diffuse brain injury	56	40.00	0.06	60
Subdural hematoma	43	30.70	0.05	50
Focal brain injury	19	13.60	0.02	20
Epidural hematoma	15	10.70	0.02	20
Subarachnoid hemorrhage	5	3.58	0.01	10
Traumatic cerebral edema	2	1.42	0.002	2
Traumatic pneumothorax	2		0.002	2
Fractures and Dislocations	174	100.00	0.20	200
Fracture of the shoulder/upper arm	94	54.00	0.11	110
Fracture of the forearm	42	24.10	0.05	50
Fracture of the femur	27	15.50	0.03	30
Fracture of the lower leg/ankle	11	6.40	0.01	10

(3.06%). This was followed by falls from construction sites involving 62 people (1.89%), and falls from scaffolding, which involved 18 people (0.55%). Finally, unspecified falls were as high as 3,020 times (92.49%) as shown in Table 2.

Patients with epilepsy had been in accidents, which had affected various important organs. In this study, epileptic patients comprised a total of 86,351 people. Of those, a total of 140 people had experienced brain injuries (an incidence of 162 per 100,000 epilepsy patients). In the majority of cases, 56 patients (40.0%) had experienced diffuse brain injuries, followed by 43 cases (30.7%) of subdural hematoma, 19 cases (13.5%) of focal brain injuries, and 15 cases (10.7%) of epidural hematoma, respectively. Regarding Traumatic pneumothorax, the incidence was 2 cases per 100,000 epilepsy patients as shown in Table 3.

There were 170 epilepsy patients suffering from fracture and dislocation accidents, which accounted for 200 incidents per 100,000 epilepsy patients. Fractures of the shoulder or upper arm were found to be the highest number or 94 cases (54%), followed by 42 cases (24.1%) of fractured forearms, and 27 cases (15.5%) of fractured femurs, respectively. The data is shown in Table 3.

Prior to discharge, the symptomatic conditions of the epilepsy patients were found to be as follows: in better condition in 79,054 cases (90.16%), unimproved in 6,407 cases (7.3%), and death in 1,699 cases (1.94%) as shown in Table 4.

Table 4. Discharge status

Discharge status	Number	Percentage
Complete recovery	523	0.60
Improved	79,054	90.16
Not improved	6,407	7.30
Dead	1,699	1.94

Discussion

The incidences of traffic accidents, fall accidents, and drownings, involving epileptic patients in Thailand were examined by utilizing the database of Thailand medical records used in the disbursement of medical expenses from the National Health Security Office (NHSO) according to ICD 10. The studied time period was from 1 October 2004 to 30 September 2013. The data revealed that the types of vehicles, driven by the epileptic patients, which had been involved in the most traffic accidents, had been motorcycles (90.70%), followed by cars (4.8%), and pickup trucks (3.5%), respectively. These findings corresponded to results from a study by Jiamjit Saengsuwan, et al[12] on Traffic Accidents Epilepsy Patients in the Northeast. The study's findings revealed that motorcycles had caused the majority of accidents at 81.8 percent, followed by cars at 25 percent. This constitutes an area of great concern. When laws are being made, which are concerned with driving and epileptic patients, there is a need to focus upon those epileptic patients, who are presently driving motorcycles and cars. In particular, this study found that the incidence of traffic accidents arising from epileptic drivers, who drive trucks and buses, was in 3 cases per 100,000 patients. Despite this small number, a many losses result from the accidents that take place. In addition, patients with epilepsy should not drive cars, and this is especially true if they are unable to control their seizures.

This can be seen in some Western countries, such as the United States, Canada, England, and many other countries in Europe, which have created legislation that requires epileptic patients to be seizure-free for at least 3 to 12 months before they are allowed to legally drive[13]. In England, the law states that epilepsy patients must not have had seizures (to be seizure-free) for at least 12 months or at best, for 2 years[14].

Based on a total of 316 injuries, the results of this study showed that the highest number of injuries was found to be from fractures and dislocations consisting of 174 injuries

(55%), followed by 140 brain injuries (44.3%) and 2 incidences of traumatic pneumothorax (0.63%). In contrast, the research conducted by Neufeld MY, et al[15] found that head injuries were the highest at 55 percent, followed by blunt injuries at 40 percent, and fractures at 17 percent, respectively. This is inconsistent with the results of a study conducted by Yusuf Ali Altunci, et al[11] in Turkey, in which it was found that soft tissue contusions comprised the majority of injuries found in epileptic patients (21.5%), followed by brain injuries (19.8%), and torn wounds (14.2%), respectively. However, if the soft tissue injuries were to be excluded, the results were somewhat similar to the findings from the study by Neufeld MY, et al and the study by Yusuf Ali Altunci, et al. In both studies, brain injuries were shown to have the highest incidence (Table 4).

For the purposes of this study, the researchers did not collect data on soft tissue injuries and dental injuries given that the study's purpose was to collect data on serious incidents that occur in patients with epilepsy. Regarding blunt injuries (S36), no diagnosis was found for epileptic patients in the study done by the researcher. This was most likely due to the fact that no history of such cases had been recorded in the medical records.

Based on this research with a total of 86,351 participants, the results indicated that falls by epileptic patients showed an incidence of 3,770 cases per 100,000 patients. This number was higher when compared to traffic accidents and drowning with incidence rates of 361 and 50 people per 100,000 epileptic patients, respectively. In addition to quelling car accidents, the results indicated that for epileptic patients, focusing on the risk of falls, such as when working in high places or performing construction work, is also required.

According to the findings of this study, epileptic patients, who had experienced accidents before they were discharged, exhibited a better recovery at 90 percent, had become disable at 7.3 percent, and had been found dead at 1.94 percent, which indicates a loss of life.

Regarding the risk factors for accidents in epileptic patients from other research, it was found that Generalized Tonic-Clonic seizures (GTCs) had been a risk factor for accidents in epileptic patients[4-8]. In addition, myoclonic seizures and atonic seizures had also been identified as risk factors[9,10].

Based on the fact that the symptoms of such seizures do not always have any auras, the patients, as a consequence, cannot prevent accidents. At times, these seizures can cause serious injuries or accidents, which can cause disabilities or even death.

Therefore, for ease of access, the Accidental Opportunity Assessment Form for Epilepsy Patients, created by Somsak Tiamkao, et al[16] is available on the website. It is recommended for epileptic patients, people without epilepsy, or even for physicians, who may be seeking to give advice to their patients.

For this research study, with a population of 86,351 people, the database is somewhat large because it constitutes a collection of data throughout the country without data randomization. Although the present study should provide a respectable overview of accidents among epileptic patients in Thailand, there is a limitation, which arises from the fact that it is a retrospective research study. As such, it may provide incomplete information, making it impossible to get some details, such as details relating to the intensity of the seizures. In addition, the obtained data may be lower than expected due to incomplete medical records. Moreover, the data derived from the medical records were mixed up in this study, making it impossible to separate the accidents that happened to patients with G40 and G41, which represents a limitation to this study. Therefore, a suggestion for further studies is that in order to collect data through a prospective study, more complete and accurate information needs to be provided.

Conclusion

The accidents that had happened to most of the adult epileptic patients had been falls. In regard to traffic accidents, it was found that the vehicles that had caused the most accidents were motorcycles. The present study is likely to help support legislative policies focused upon the operation of vehicles by epileptic patients. Furthermore, in order to prevent accidents due to seizures, concerns regarding epilepsy patients, who work in high-rises or in construction work, should be addressed.

What is already known on this topic?

People with epilepsy are high risk of accidents and injuries more than normal population.

What this study adds?

This finding supports the public policy for consider issue legal driving license for PWE in Thailand. In addition, seizure-related falls especially fall from working on height or construction worker must be considered.

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Potential conflicts of interest

The authors declare no conflict of interest.

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