Received 08 October 2023 | Accepted 05 December 2023
DOI: https://doi.org/10.4038/sljon.v10i2.148

SLJoN

ORIGINAL ARTICLE

Epilepsy and driving; Impact on the patient and the society

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Abstract

Road traffic accidents are a leading cause of morbidity and mortality in Sri Lanka. Although it is a statutory requirement to declare epilepsy before applying for a driving licence in Sri Lanka, the regulations are not well-defined.

This study aimed to identify the clinical and demographic characteristics of patients with epilepsy who continue to drive and to determine factors that contribute to road traffic accidents in them.

Methods: This is a descriptive cross-sectional study. All epilepsy patients followed up at the National Epilepsy Centre at the National Hospital of Sri Lanka and having a valid driving licence were included into the study.

Results: One hundred and forty-two patients were included. The majority were males (98%). The majority were on at least two anti-seizure medications. Only 68 (47.9%) of them were seizure free for more than 2 years. Forty-one (28.9%) had experienced at least one road traffic accident as a driver. Out of the 54 road traffic accidents reported by these participants, 13 (24%) were due to either development of a seizure or an aura. Seizure freedom for more than two years was associated with a reduced incidence of road traffic accidents.

Conclusion: This study indicates that many patients with epilepsy continue to drive with inadequate control of their epilepsy. Formal guidelines on driving with epilepsy for Sri Lanka need to be developed.

KEYWORDS
Driving, road traffic accidents, Sri Lanka

INTRODUCTION

Driving is a critical skill required for employment, socialization, and self-esteem. It requires a combination of skills including attention, concentration, perception, coordination, judgment, and motor skills. Driving is therefore considered a complex cognitive and motor task[1].

In the early 19th century when motor vehicles were first introduced, certain medical conditions including epilepsy, were recognized as risk factors for driving.[2] The incidence rate of fatal motor vehicle accidents in patients with epilepsy was 2.3 times the rate in cardiovascular and hypertensive disease and 4.6 times the rate in diabetes[9]. Compared to the number of accidents under the influence of alcohol, fatality rates of epilepsy-related road traffic accidents (RTA) were low[9]. However, by the mid-20th century, it was recognized that some patients with epilepsy became seizure free with time and could be considered as safe drivers.[2]

Over the years, many studies have confirmed that epilepsy poses several risks while driving. In a multi-centre prospective study in the United States in 2000 on 367 patients with refractory localization related epilepsy, one third had driven despite restrictions. One hundred and forty-four (39.3%) developed one or more seizures while driving, and 98 (26.7%) encountered at least one RTA due to seizures.[3] The severity of accidents for serious injuries increased by 40% and non-driver fatalities by two-fold in drivers with epilepsy.[4] Driving by those with epilepsy is reported from many non-Western countries as well. These include Saudi-Arabia[5], China[6], and India[7], where the rates of RTAs are 27%, 7.5% and 7.8% respectively. A single previous study from Sri Lanka reported an accident rate of 15%.[8]

Anti-seizure medication (ASM) may also contribute to the risks in driving. Many ASMs carry undesirable adverse effects such as ataxia, blurred vision, dizziness, and confusion.[10, 11] Although tolerance develops over time for most of these medications, they may still impair driving skills.[11]

The regulations to permit licensure for persons with epilepsy, in many countries are based on the seizure free interval. In a study comparing international regulations on automobile driving and epilepsy, it was found that, out of ninety-six countries, 16 countries had a permanent ban on driving after the diagnosis of epilepsy.[12] Other countries required a variable seizure- free period from 6 months to 3 years before recommencement of driving. Few countries did not have specific laws to regulate driving in patients with epilepsy.[12] In Sri Lanka, a 36-month seizure free interval before commencing driving is recommended.[12] Most rules and restrictions are mainly based upon practical experience, expert opinion, and political requirements rather than strong validated scientific evidence.[13] This accounts for the wide variations in specific rules and restrictions on driving in different countries.

The financial requirements, and employment demands in Asian countries are different from that of European countries.[14] Therefore, a larger population of Asian patients with refractory epilepsy continue to drive.[14]

This study was conducted to identify the individual and societal impact of driving with epilepsy in Sri Lanka. Ethical approval was granted by the Ethics Review Committee of the National Hospital of Sri Lanka.

METHODS

A descriptive, cross-sectional study was performed. All patients who fulfill the International League Against Epilepsy (ILAE) operational definition of epilepsy and followed up at the National Epilepsy Centre at the National Hospital of Sri Lanka having a valid Sri Lankan driving licence for at least three months duration were included. Patients with medical conditions which may have an additional impact on driving, such as diabetes mellitus with autonomic dysfunction/ peripheral neuropathy, recurrent hypoglycemia, sleep apnoea, stroke with residual disability and patients using psychoactive substances were also excluded from the study.

Data collection and analysis

The patients were interviewed using a pre-tested interviewer administered questionnaire. Data on (a) demographic characteristics (b) epilepsy details (c) practices of driving, (d) details of encountered RTAs (e) attitudes regarding rules and regulations on driving with epilepsy (f) ASMs used and medication-related adverse effects impairing driving skills were gathered. Patient clinical records and seizure diaries were also used for data gathering. The injuries due to RTAs were classified as fatal, grievous (according to the medico-legal classification of injuries), and minor injuries.

Data analysis was completed using SPSS software version 23. Frequency analysis and multinomial logistic regression were the statistical methods used in data analysis.

RESULTS

A total of 142 patients were eligible for the study. Table 1 summarizes the demographic and clinical characteristics of the study population.

The mean age of the study population was 36 years (range 18 to 67 years). Medical comorbidities were seen in 14, including type 2 diabetes mellitus (n=4), hypertension (n=6), ischemic heart disease (n=1) and stroke without residual disability (n=3).

The average age at diagnosis of epilepsy was 25 years (3 months to 52 years). Twenty five percent had (n=35) magnetic resonance imaging (MRI) abnormalities including mesial-temporal sclerosis (13.4%), focal cortical dysplasia (2.1%), post stroke gliosis (6.3 %) and intracranial benign tumors or cystic lesions (2.8 %). Eighteen patients (12.7%) had an abnormal electroencephalogram (EEG) on diagnosis of epilepsy.

Most patients used polytherapy. Among the medications used, sodium valproate was the most frequently used by 61 patients (43%). The others were clobazam (n=49), levetiracetam (n=46), carbamazepine (n=38), oxcarbazepine (n=32), topiramate (n=22) lamotrigine (n=16), phenytoin (n=8), phenobarbitone (n=2) and vigabatrin (n=1)

Forty five percent of participants experienced adverse effects due to ASMs. The adverse effects with a significant impact on driving skills included increased sedation in 49 (34.5%), vertigo and unsteadiness in 11 (7.7%), slower processing in 20 (14.1%), tremors in 11 (7.7%), low mood in 15 (10.6%) and double vision in 2 (1.4%),

The majority reported good adherence to ASMs (n=79, 55.6%). Others missed medication 1-2 times a month (n=43, 30.3%), 3-5 times a month (n=15, 10.6%), 5-10 times a month (n=1, 0.7%) and more than 10 times a month (n=4, 2.8%).

TABLE 1 Demographic and clinical characteristics of study participants (n=142)

Characteristic		Frequency	Percentage
Age	less than 20	7	4.9
	21 - 40	82	57.8
	41 - 60	50	35.2
	Above 60	3	2.1
Gender	Male	139	97.9
	Female	3	2.1
Province of residence	Western	117	82.4
	Eastern	1	0.7
	Southern	7	4.9
	Central	2	1.4
	Northcentral	6	4.2
	Northwestern	4	2.8
	Sabaragamuwa	2	1.4
	Uva	3	2.1
Comorbidities	Present	14	9.9
	Absent	128	90.1
Onset	Focal motor	20	14
	Focal non-motor	62	43.4
	Generalized motor	59	41.3
	Unknown	1	0.7
Identified lesion on MRI	Present	36	25.4
	Absent	94	66.2
	Data not available	12	8.5
EEG	Normal	76	53.5
	Abnormal	18	12.7
	Unavailable	48	33.8
Number of ASMs taken by patient	1	52	36.6
	2	62	43.7
	3	20	14.1
	4	5	3.5
	5	3	2.1
Adverse effects for ASMs	Present	65	45.8
	Absent	77	54.2
Seizure frequency	seizure free > 2 years	68	47.9
	seizure free 1-2 years	16	11.3
	seizure free 6-12 months	19	13.4
	1-3 seizures/ year	15	10.6
	4-11 seizures/ year	4	2.8
	Several seizures per month	18	12.6
	Daily seizures	2	1.4

ASM – anti-seizure medication, MRI – magnetic resonance imaging, EEG – electroencephalogram

TABLE 2 Driving practices among persons with epilepsy

Characteristic		Frequency	Percentage
Started driving before diagnosis of epilepsy	Yes	60	42.3
	No	70	49.3
	Unable to recall	12	8.6
Purpose of driving	Employment	76	53.5
	Traveling	124	87.3
	Hobby	18	12.7
Number of vehicles driven by patient	1	61	43.0
	2	68	47.9
	3	9	6.3
	4	4	2.8
Types of vehicles driven	Motorcycle	108	76.1
	Car	36	25.4
	Van	21	14.8
	Bus	3	2.1
	Lorry	2	1.4
	Three-wheeler	69	48.6
Driving to transport others	Yes	127	89.4
	No	15	10.6
Employment as a driver	Yes	11	7.7
	No	131	92.3
Experienced a road traffic accident as a driver	Yes	41	28.9
	No	101	71.1

Out of the 127 study participants who stated that they transport other people, 123 (86.8%) transported family members and friends. School children (n=4, 2.8%), local and foreign tourists (n=4, 2.8%) and vehicle-hire passengers (n=6, 4.2%) were among the other groups that were being transported. Eleven (7.7%) were enrolled by employment agencies.

The most common mode of transportation was the motorcycle (n=108, 76%), followed by the three-wheeler.

Among the 41(28.9%) individuals who faced RTAs as the driver, the majority (n=30, 75.6%) had faced only a single RTA. Seven had faced two, two had faced three and one had faced four accidents respectively.

One of the study participants developed seizures with sensory aura on two occasions while driving but was able to stop the vehicle in time to avoid an accident.

The pattern of seizure (generalized vs focal), preservation of awareness, number of ASMs and presence of adverse events due to ASMs did not appear to have a significant effect on road traffic accidents. Seizure freedom of more than 2 years was independently associated with a significant probability of not experiencing a RTA.

When knowledge, and attitudes regarding driving with epilepsy was assessed, 114 (80.3%) were aware that epilepsy is a condition that needs to be disclosed to the driving license authorities. When inquired as to whether they thought the driving restrictions were necessary, 50 (35.2%) intimated that restrictions were not necessary. Thirty-two (22.5%) affirmed that restrictions were necessary, while the majority (n=60, 42.3%) believed that imposing restrictions should be guided by individual patient circumstances.

When asked how long they think that a patient with epilepsy should avoid driving after a seizure, the single most frequent response was 3-6 months (n=41, 28.9%). Other responses include 6 months to one year indicated by 26% and 2- 5 years by 12%. Forty (28.2%) believed that driving restrictions were not necessary or 2-3 days of avoiding driving after a seizure should be sufficient. Seven (4.9%) refrained from answering.

TABLE 3 **Patient characteristics in those who experienced road traffic accidents**

Characteristics related to road traffic accident (RTA)		Frequency	Percentage
Age at the time of RTA	21-40	28	51.9
	41-60	25	46.3
	Above 60	1	1.9
Number of ASMs at the time of RTA	1	18	33.3
	2	18	33.3
	3	10	18.5
	4	7	13
	5	1	1.9
Adverse effects related to ASMs at the time of RTA	Yes	35	64.8
	No	19	35.2
Seizure freedom at time of RTA	More than 2 years	29	53.7
	6 months to 2 years	5	9.3
	Ongoing seizures within last 6 months	24	37.0
Type of vehicle driven at time of RTA	Car	7	13
	Three-wheeler	8	14.8
	Motorcycle	36	66.7
	Van	2	3.7
	Lorry	1	1.9
Cause of the RTA as reported by the participant	Development of a seizure	13	24.1
	Sleepiness	11	20.4
	Over speeding	2	3.7
	Alcohol/ Other	3	5.5
	Fault of the other party	25	46.3
Bodily injuries to the driver	Grievous injuries	5	9.3
	Minor injuries	22	40.7
	No injuries	27	50.0
Bodily injuries to the passengers	Fatal	1	1.9
	Grievous injuries	1	1.9
	Minor injuries	13	24.1
	No injuries	17	32.3

TABLE 4 Risk factors for developing RTAs in patients with epilepsy

Characteristic		Faced RTA (%)	Not faced RTA (%)	Likelihood ratio		Odds ratio (95% CI)
				χ^2(df)	Significance (p)	
Seizure onset	**Generalized**	15 (10.56)	44 (30.98)	1.38(2)	0.51	0.49 (0.22-0.99)
	Focal	26 (18.3)	56 (39.43)			
Awareness	**Preserved**	6 (4.22)	26 (18.30)	2.19 (1)	0.14	2.02 (0.76 -5.36)
	Absent	35 (24.64)	75 (52.82)			
Number of ASMs	**1**	15 (10.56)	37 (26.05)	0.00 (1)	0.99	0.99 (0.47-2.12)
	> 1	26 (18.30)	64 (45.07)			
Adverse effects	**Yes**	23 (16.19)	42 (29.57)	2.47 (1)	0.12	0.57 (0.27-1.16)
	No	18 (12.67)	59 (41.55)			
Seizure freedom > 2 years	**Yes**	25 (17.60)	43 (30.28)	3.97 (1)	0.05	0.48 (0.23 -0.99)
	No	16 (11.26)	58 (40.84)			

(χ^2Chi-square, df – degree of freedom, 95% CI = 95% confidence interval, ASM – Anti-seizure medication, RTA – Road traffic accident)

DISCUSSION

Our study shows that many individuals continue to drive with the diagnosis of epilepsy and more than 80% of them were in the productive working age. A large proportion (52.1%) had not reached seizure freedom of two years and more than 60% were on two or more ASMs. Thirty percent of the study population have faced road traffic accidents as the driver of the vehicle. Seizure freedom of more than two years was associated with a statistically significant reduction in the number of road traffic accidents.

According to the World Bank report on Sri Lankan road safety[16], an average of 38,000 RTAs occur annually, resulting in around 3000 deaths and 8000 serious injuries. The estimated annual road traffic deaths per capita in Sri Lanka is highest among other South Asian countries. Over two thirds of victims are in the productive working age of 15-64 years. The rapid growth of vehicle ownership between the 2011-2018 period, estimated to be a 67% increase,[16] was one dominant reason for the increase in numbers of RTA.

The lack of a robust driving licence system accessible to law enforcement authorities was pointed out as a major contributor to the increasing number of RTAs in the World Bank report [16]. While most countries practice stringent regulations on driving with epilepsy[12], Sri Lanka does not have such clearly formulated regulations. The findings from our study highlights the need for a formal assessment of driving practices among patients with epilepsy.

A considerable number of individuals in the epilepsy clinic, at the National Epilepsy Centre, were driving a vehicle despite inadequate control of their epilepsies. Although excluded from our study, twelve stated that they were continuing to drive without a driving license. Most participants were in the 21-60 age group, reflecting the workforce. Only 2.1% of the license holders were females. This is in comparison to the 1% female drivers in the previous study conducted in 1998.[8]

The most common vehicle driven by the participants in our study was the motorcycle, followed by the three-wheeler. This reflected the usual modes of transport among the general population in Sri Lanka. In year 2017, motorized 2 to 3 wheelers accounted for 71% of the vehicle population in Sri Lanka and contributed to 40% of RTAs.[16]

Our study showed that seizure freedom for more than 2 years was associated with a statistically significant reduction in motor vehicle accidents in those with epilepsy. This was comparable to a Chinese study in 2019, where seizure freedom of more than 2 years was associated with an 89% reduced chance of a RTA.[6]

Attempts have been made in the past to stratify driving risk based on levels of seizure related impairments. The common

belief was that aura provided sufficient warning of a seizure.[17] Some studies based on self-reporting, indicated that patients with epilepsy who experience aura or have preserved awareness may be less likely to face an RTA.[12] However, self-reporting of level of impairment during a seizure can be unreliable. In our study, the group with impaired awareness at the onset of seizures did not show a significant increase in the number of RTAs compared to the group with preserved awareness. Focal onset compared to generalized onset of seizures also did not have a statistically significant impact on the number of road traffic accidents.

Regarding the effects of ASMs on RTAs, a Swedish study which followed 29,220 patients with epilepsy from 2006 to 2013[18] found no significant differences in the rates of RTAs. A Chinese study of 519 patients identified that the number of ASMs was independently associated with increased motor vehicle accidents[6].

In our study, the number of ASMs or the presence of patient reported adverse events did not have a statistically significant impact on the number of RTAs. Most of our study population (63%) were on 2 or more ASMs compared to the above studies where the patients were either on a single medication or none.

Nearly half of our study participants experienced adverse effects that are known to influence driving; namely disorders of balance, memory, attention, and reaction.[18] However, further analysis was confounded by the fact that many participants were on two or more anti-seizure medications with potential interactions and cumulative adverse effect profiles.

When knowledge regarding legislations on epilepsy and driving was assessed, the majority were aware that it is a condition that needs to be declared on obtaining a licence, but most were unclear on how long to avoid driving after experiencing a seizure. Two to three days of avoidance of driving following a seizure was considered adequate by the majority. This finding is overly concerning as it reflects the lack of education regarding risks related to driving with epilepsy. It further emphasizes the need for a formal education program regarding driving and epilepsy.

LIMITATIONS

Our study was conducted in a tertiary epilepsy centre and may not be representative of the status in the general population and therefore the results may not be generalisable. Data on driving and clinical information was based on self-report and is prone to response bias. Under-reporting of seizures and road traffic accidents is a possibility, with the fear of losing driving privileges. The sample sizes may be too small to provide precise estimates.

CONCLUSION

Our study indicates that many patients with epilepsy continue to drive despite having inadequate control of seizures. This finding highlights the need for formal guidelines on driving with epilepsy, for Sri Lanka.

Ongoing health education regarding the risks of driving with epilepsy is of utmost importance. Less restrictive solutions that enable medically disabled persons to drive while ensuring road safety will need to be explored in future studies.

Conflicts of interest

There are no known conflicts of interest associated with this publication and the author(s) received no financial support for the research, authorship, and/or publication of this article.

ACKNOWLEDGMENTS

We are incredibly grateful to all the patients who participated in our study.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author, (W.M.M.B). The data are not publicly available due to their containing information that could compromise the privacy of research participants.

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