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Prevalence of patients with epilepsy unfit to drive

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Abstract:

BACKGROUND: There is no consensus among medical experts as to whether patients with epilepsy (PWEs) should be permitted to drive. PWEs who have had uncontrolled seizures in the past year are at an increased risk of road traffic accidents, often leading to the destruction of property, injury, or death. Currently, there is no clear policy on whether PWEs can drive in Saudi Arabia. Existing policies attempt to balance the potentially harmful and beneficial aspects of the issue. The purpose of this study was to measure the prevalence of PWEs who are unfit to drive.

MATERIALS AND METHODS: Data were collected by interviews, a structured validated questionnaire, and a review of the medical records of 140 PWEs, with a response rate of 84%.

RESULTS: Fifty four percent of PWEs were found unfit to drive. Of the 118 participants, 17.7% did not drive and 97 (82.3%) drove. Of the 21 patients who did not drive, 14 (11.8% of the total sample) never drove and 7 (5.9% of the total sample) stopped driving because of epilepsy. Of the 104 patients who drove, 45 (43.2% of the total sample) had a history of seizures while they drove. These incidents had resulted in the involvement of 28 patients (26.9% of the total sample) in motor vehicle accidents and 17 (16.3% of the total sample) patients being admitted to the emergency room.

CONCLUSION: Structured regulation and licensing procedures are necessary for PWEs to drive safely. Regulations in other countries demand that seizures be controlled for 1 year before epileptic patients are allowed unrestricted driving. Such regulations would improve road safety in Saudi Arabia.

Keywords:

Driver's license, epilepsy, motor vehicle accident, seizure, traffic

Introduction

Patients with epilepsy (PWEs) who have uncontrolled seizures are at the risk of road traffic accidents (RTAs).^[1] The World Health Organization (WHO) estimates that there are 50 million PWEs worldwide.^[2] Epilepsy is one of the most common chronic neurological disorders, ranking the 1st of the three most frequently encountered neurological diseases in primary health-care settings in almost all Eastern Mediterranean countries.^[2] In the Kingdom of Saudi Arabia, there is an estimated 23,700 PWEs, i.e., there are 6.5 PWEs of every 1000 persons.^[3] The universal burden of epilepsy as determined by estimating the number of productive life

years lost owing to disability or premature death resulting from the disease is high.^[4]

In the late 1800s, recognized medical conditions, including epilepsy, were documented to make the public aware of the risks when motor vehicles were first introduced.^[5] Therefore, PWEs were not discussed when licenses became obligatory.^[5] By 1940s, it had become apparent that for many PWEs, the seizures would stop, or that the condition could be controlled with medications, and consequently, these patients would be considered fit to drive. The purpose of seizure control considered adequate to grant PWEs fitness to drive has been based mainly on a seizure-free interval (SFI).^[5]

The WHO describes RTAs as "a cost of modernization." As such, RTAs have

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become an internationally recognized concern.^[6] RTAs, which include accidents involving a motor vehicle and another vehicle, animal, or pedestrian, have become increasingly common in Saudi Arabia.^[6] Motor vehicles are the primary means of transportation in Saudi Arabia and RTAs were responsible for 3.5% of total deaths and injuries between 1971 and 1997. On average, one person was killed and four were injured every hour during this period.^[6] The Saudi Traffic System Regulation Article (5/36) states “to prove medical fitness, safety of the body... is required.”^[7] However, in Saudi Arabia, PWEs are not legally obliged to inform authorities of their condition.^[7] In a case-control study in Maryland, USA, 50 PWEs involved in RTAs were compared to 50 PWEs who were not involved in RTAs.^[1] The duration of SFI was the strongest predictor of RTAs.^[1] This was shown to be associated with a reduced odds ratio for RTAs (0.075 for >12 months, 0.147 for >6 months, and 0.428, which was not statistically significant, for >3 months).^[1] The 2005 Symposium of European Union Regulators of Clinicians and Driving put forward a proposal that required a 1-year SFI before driving was permitted.^[1] SFI has also been proven to be valuable in determining the timing of the discontinuation of antiepileptic drugs.^[1]

Only one similar previous study has been conducted in Saudi Arabia.^[8] That study was conducted 14 years ago, which underlines the need for the current study.^[8] Interviewer-administered questionnaires were used.^[8] Our conclusions counter the current regulations of the Saudi traffic system on epilepsy and driving.^[6]

Materials and Methods

A descriptive cross-sectional patient-based study was conducted of patients being treated at King Fahad Specialist Hospital in Dammam, Saudi Arabia ($n = 118$). All PWEs attending King Fahad Specialist Hospital were identified with the help of the Health Informatics Department. Using the Medicaplus system and patient log books in the clinics, we identified patients diagnosed with epilepsy or seizure disorder of specific subtypes and other nonspecific subtypes. Information on the patients' names, ages, contact numbers, and the date of the last visit was collected. A sample size of 105 was calculated as adequate to detect differences in the reported seizure rate with an alpha level of 0.05 and a power of 90%. The participants were all Saudi citizens who had been diagnosed with epilepsy at least 1 year previously and were at least 17 years of age. The exclusion criteria were as follows: critical illness, current hospital admission, intellectual disability, plegia, being bedridden, impaired cognitive function, or any other concurrent illness that prevented the respondent from driving. After excluding 21 patients currently admitted for a critical illness, 7 patients were with intellectual

disability and 52 were with cognitive impairments; the response rate was 84%.

Ethical approval from the institutional review board (IRB)/ethics committee was obtained, and informed written consent was taken from all the study participants. The Collaborative Institutional Training Initiative and the National Institutes of Health certifications were also acquired. All participants provided signed written informed consent after being apprised of the purpose of the study and assured of confidentiality. All participants had the right to object to participation and withdraw at any time. The Health Informatics Department was authorized to review medical records after the respondents' medical record numbers had been submitted and IRB approval received.

The variables studied included the following: age, marital status, number of children, education level, occupation, comorbidities, number of seizures while driving, RTAs caused by seizures while driving, and emergency room visits as a result of the RTAs. The dependent variables were the number of seizures in the last year (i.e., the SFI) and whether PWEs were currently driving (driving status).

A pilot study was conducted in Al Qatif Central Hospital. In the pilot study, we assessed 30 PWEs with similar characteristics to those in the larger study to determine whether changes to the questionnaire were necessary. The results indicated that the questionnaires were easily understood and comprehensive. As such, no changes were needed.

In the main study, 140 participants were interviewed using an interviewer-administrated questionnaire in Arabic. The questionnaire and consent form together with the pilot study performed earlier were independently validated and approved by two consultants. Hard copies were produced, and the data were double-checked and corrected by reviewing the medical records. Medical records were used to confirm seizure type, medication use, compliance, frequency of seizures or absence of seizures in patients in remission, and the dates of seizures.

The data were coded, checked for completeness, sorted, and verified to eliminate inconsistencies or outliers. They were then computerized, processed, and analyzed by the principal investigator with the help of a biostatistician, using the Statistical Package for the Social Sciences (SPSS) version 16 (Chicago, IL, USA). Cronbach's alpha was used to assess reliability; a value of 80.9% indicated high reliability. Cross-tabulation, the Chi-squared test, and other alternatives were used to compare PWEs who drove with those who did not. Statistical associations

were determined using tests of proportion, Pearson's correlation, *t*-tests, and linear correlation between categorical variables as indicated. Differences with $P < 0.05$ were considered statistically significant and 95% confidence intervals were used to assess data accuracy.

Results

The 118 PWEs were 17–57 years of age, with a mean age of 31.22 years (standard deviation [SD] = 9.94). All participants were men, as women were not allowed to drive in Saudi Arabia at the time of the study. Fifty-nine (50%) of the respondents were married, 58 (49.2%) were single, and 1 (0.8%) of the respondents was divorced. Of the married PWEs, 46 (76.6%) of 59 had children, with a mean of 2.42 (SD = 2.29) children, a range of 0–10, and a median of 2.

Since comorbidities could contribute to patients' ability to drive, the presence of other medical conditions was examined; 50.8% of the participants did not have any coexisting diseases. With respect to comorbidities, 13.4% of the total sample had hypertension, 9.3% had an operated space-occupying lesion, and 8.4% had diabetes and used oral hypoglycemic agents. Other comorbidities included hematological diseases, neurological diseases, dyslipidemia, diabetes requiring insulin, cerebrovascular accidents, renal diseases, treated cancer, psychiatric illnesses, cardiovascular diseases, and peptic ulcer disease.

The majority of PWEs had a high school certificate (54 participants, 45.4%), while a minority had a diploma (27 participants, 22.6%) or a bachelor's degree (20 participants, 16.8%). One (0.8%) participant had a PhD. The remainder of the participants had elementary (12 participants, 10%) or middle school (4 participants, 3.3%) levels of education.

Table 1 presents data, indicating that 97 (82.2%) PWEs in this study drove and 21 (17.8%) did not drive. Of those who did not drive, 14 had never driven, and the remaining 7 (28.6%) had stopped driving because of their epilepsy. Six (6.1%) of the 97 PWEs who were currently driving had previously stopped because of their condition and had resumed driving after a mean of 35.5 weeks (range, 8–107 weeks).

Most PWEs drove their own cars to work (37, 31.1%), and 6 (5%) used their cars to perform duties. Twenty-seven (22.7%) PWEs were unemployed, 18 (15.1%) did not use their cars or drive to work, 16 (13.4%) drove their company car as part of their work, 7 (5.9%) drove to school, and 7 (5.9%) were retired.

The mean period since diagnosis was 11.31 years (SD = 8.5, range = 1–40 years). Most

Table 1: History of seizures while driving

	Driving status		Total N (%)
	No N (%)	Yes N (%)	
Seizure while driving			
Yes, with accident	3 (14.3)	25 (25.8)	28 (23.7)
Yes, without accident	2 (9.5)	15 (15.5)	17 (14.4)
No	2 (9.5)	57 (58.8)	59 (50.0)
Never drove	14 (66.7)	0 (.0)	14 (11.9)
Total	21	97	118

respondents had primary epilepsy (71 PWEs, 59.7%). The remaining cases were due to secondary causes, including head injury (17 PWEs, 14.3%), stroke (10 PWEs, 8.4%), space-occupying lesions (9 PWEs, 7.6%), brain manipulations (5 PWEs, 4.2%), arteriovenous malformations (5 PWEs, 4.2%), and encephalitis (2 PWEs, 1.7%).

Generalized tonic-clonic and complex partial seizures with secondary generalization were the first and second most common subtypes in this study (70 PWEs, 59.7%, and 23 PWEs, 19.5%, respectively). Other seizure subtypes included complex partial (17 PWEs, 14.4%), nocturnal (3 PWEs, 2.5%), mixed (3 PWEs, 2.5%), absence (1 PWE, 0.8%), and myoclonic jerks (1 PWE, 0.8%).

Medications used to control epilepsy are widely available, and 30.5% of the participants took a combination of two different medications: 19.2% took levetiracetam, 19.1% took sodium valproate, and 12.7% were on three or more medications. The remaining participants took carbamazepine, phenytoin, or lamotrigine (11%, 5%, and 0.8%, respectively). Nine (7.6%) PWEs were not on any medications. Ninety-seven (81.5%) PWEs were compliant with medications and 86 (72.3%) PWEs were regularly followed up.

The mean duration since the last seizure was 61.21 weeks, ranging from 1 to 312 weeks (SD = 78.5), with a median of 26.21 weeks. Participants were categorized into two groups based on an SFI of 52 weeks. Those who had their last seizure ≤ 52 weeks before the study were considered to have uncontrolled PWEs (70, 59.3%), while those who had had their last seizure ≥ 53 weeks before the study were considered to have controlled PWEs (48, 40.6%). The mean number of seizures during the year preceding the study was 19.3 (SD = 65.5).

The PWEs were asked to document when their last seizure occurred, and the information given was used to determine SFI. The two groups were formed accordingly. Group 1 (uncontrolled PWEs) comprised 82 (69.5%) PWEs who had had attacks within the last 52 weeks

or less, while Group 2 (controlled PWEs) consisted of 36 (30.5%) PWEs whose last attack was 53 weeks or more before [Table 2].

Seizures that occurred while driving were recorded for both controlled and uncontrolled PWEs, excluding the 14 participants who never drove [Table 1]. Fifty-nine (50%) participants had no history of seizures while driving, 28 (23.7%) had seizures while driving that had resulted in RTAs, and the remaining 17 (14.4%) had had seizures while driving that did not result in RTAs. Of the 28 participants who had RTAs due to seizures while driving, 15 (53.5%) got injured and had been admitted to the emergency room, 11 (39.2%) did not cause any harm to themselves or others, 1 (3.5%) had caused harm to another person that had resulted in an emergency room admission, and 1 (3.5%) injured himself and another individual that resulted in the admission of both to the emergency room.

Fourteen participants had never driven, 42 (35.5%) had never stopped driving because of their condition, 40 (34.2%) reported feeling an aura before a seizure which provided sufficient time to park, 9 (7.6%) only drove to work or to places nearby, 7 (6%) had decided to stop driving, and 6 (4.3%) stopped driving at some point but had resumed after a mean of 35.5 weeks (SD = 37.2, range = 8–104 weeks).

Regardless of the current SFI, 104 participants drove at some point though when they had uncontrolled seizures. Specifically, 45 PWEs had histories of seizures while driving, and 28 of these participants had RTAs as a result; 17 incidents had resulted in emergency room admissions.

The mean ages of those who drove and those who did not drive were 30.1 (SD = 8.1) and 31.3 (SD = 10.3) years, respectively. PWEs who drove had a mean of 2.69 children (SD = 2.2), while PWEs who did not drive had a mean of 0.62 children (SD = 1.4); the difference was statistically significant ($P = 0.016$).

Table 2 shows that a significant number (66%) of PWEs with uncontrolled seizures drove. The driving status and SFI were not significantly associated ($P = 0.059$) [Figure 1]. There was a highly

significant relationship between driving status and driving to work in both groups ($P = 0.000$ and $P = 0.016$ for Groups 1 and 2, respectively). The majority of PWEs who did not drive were either unemployed or used an alternative method of transportation to work, in both the uncontrolled and controlled groups. PWEs who drove did so in a variety of conditions and used their car to go to work regardless of the status of their epilepsy control

There was a wide but statistically non-significant variation in the types of seizure and driving status in both uncontrolled and controlled groups. Although the differences were not statistically significant, almost 80% of PWEs had either primary or secondary generalized seizures. There was a highly significant relationship between the driving status and the history of seizures while driving ($P = <0.001$), as shown in Table 1.

Forty-five (38.1%) of the 118 respondents had a history of one or more seizures while driving, and 28 (62.2%) of the 45 had a history of at least one accident as a result of a seizure. Of the 118 respondents, 59 denied any history of seizures while driving. Participants were not categorized by current control status.

There was a highly significant relationship between the decisions of PWEs to stop driving because of their current condition and driving status ($P = <0.001$). Table 3 presents data on PWEs who were driving at the time of the study and had never stopped doing so (43.3%). Of those participants who continued to drive, 41.2% reported that they felt an aura before a seizure, thereby allowing them enough time to park their vehicle before the seizure occurred. Of those who did not drive, 14 (66.7%) participants had never driven even before experiencing seizures.

Discussion

Families are traditionally patriarchal in Saudi Arabia. A man has obligations outside the home besides providing for his family. Furthermore, women were not allowed to drive in Saudi Arabia at the time of the study. Most participants were in very active phases of life (20–49 years of age), with a mean age of 31 years. Our participants included students, professionals, and other employed people, who required independence to perform their daily tasks. Many participants also had children and, therefore, had associated responsibilities. A previous study investigated epilepsy and driving in a similar group of participants.^[8]

Driving status and driving to work were highly associated in this study. The majority of PWEs who did not drive were either unemployed or used public transportation to go to work. PWEs who drove did so in a variety of conditions.

Table 2: Seizure-free intervals and driving status

Group	Driving status		Total N (%)
	No N (%)	Yes N (%)	
SFI (weeks)			
≤ 52	18 (85.7)	64 (66.0)	82 (69.5)
≥ 53	3 (14.3)	33 (34.0)	36 (30.5)
Total	21 (100.0)	97 (100.0)	118 (100.0)

SFI=Seizure-free interval

Therefore, PWEs drove to work and performed a variety of tasks that contributed to their independence and the quality of life for themselves and their family members.^[9] A previous study investigated the quality of life of PWEs in Thailand. Patients who had had epileptic seizures while driving had a significantly lower quality of life than those who had not had seizures while they drove.^[10]

In this study, we found a higher frequency of participants having seizures while they drove compared to other countries. A study conducted in Thailand^[10] found that 28% of participants had seizures while driving. Furthermore, 57% of the participants had had seizure-related accidents, most of which were minor, but approximately 20% of the incidents had resulted in hospitalization. A study of PWEs in Finland revealed an accident rate that was twice that of matched controls.^[8] One study reported a higher risk of RTAs in PWEs in Washington state,^[8] and another group reported a 1.57-fold higher risk of RTAs in PWEs.^[8]

In this study, 43.3% of PWEs who drove had never stopped. Consistent with this study, a study in China found that many PWEs continued driving despite their uncontrolled seizures.^[11] In 2012, Tatum *et al.* interviewed 287 PWEs in Florida to assess illegal and unauthorized

driving practices and found that 35.2% of PWEs were fit to drive, while 62.3% were unfit, since they had had seizures within the past 6 months.^[12]

Almost 80% of PWEs in this study had either primary or secondary generalized seizures, which include loss of consciousness and a resultant loss of control of the vehicle they were driving. Such events greatly increase the possibility of RTAs. It was reported that 55% of seizures that occurred while driving resulted in accidents and an accident rate of 17% in individuals with partial complex seizures.^[8] Furthermore, Shareef *et al.* studied 267 patients, 27 (10.1%) of whom had been counseled on driving. PWEs were more likely to be counseled on driving than patients with other conditions that led to loss of consciousness.^[13]

The main limitation of this study was the use of a self-report questionnaire to collect data. As such, recall bias may have affected the study results. This study was conducted in only one tertiary center, so additional research in primary and secondary centers would provide a larger sample and wider coverage.

Most drivers with epilepsy had not been made aware of the risks of driving. Owing to the unpredictability of seizures, it is advisable to provide accurate information on the driving laws to health-care workers and PWEs. This strategy will improve public safety and quality of care. Furthermore, Saudi traffic regulations should be clarified and simplified to include relevant policies stipulating that epileptic seizures must be controlled for at least 1 year before unrestricted permission is given to PWEs to drive. Support groups and social services should acknowledge the quality of life for PWEs in relation to driving by mitigating the negative effects of the suspension of the driver's license.

In conclusion, we found that only 30% of PWEs were adequately informed about the risks of driving with their condition. The prevalence of unfit drivers among PWEs treated at King Fahad Specialist Hospital was 54%. The paucity of evidence on driving and the quality of life in Saudi PWEs makes a determination of driving restrictions challenging. These decisions should continue to be individualized based on specific patient factors. However, there is a need to generate structured regulations and supporting materials for taking decisions on permits to drive for PWEs. Consistent with standards in other countries, it would be safer to direct that seizures be controlled for approximately 1 year before unrestricted driving authorization is given. The results of this study contribute to knowledge that can be used to balance the risks and benefits of PWEs in Saudi Arabia driving.

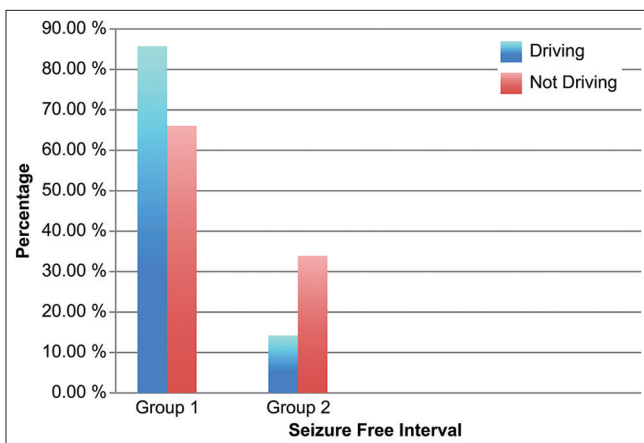


Figure 1: Seizure-free intervals and driving status

Table 3: Stopped driving due to epilepsy

	Driving status		Total N (%)
	No N (%)	Yes N (%)	
Decision to stop driving			
No	0 (0.0)	42 (43.3)	42 (35.6)
Yes (still not driving)	7 (33.3)	0 (0.0)	7 (5.9)
Stopped previously but currently driving	0 (0.0)	6 (6.2)	6 (5.1)
Never drove	14 (66.7)	0 (0.0)	14 (11.9)
Only driving to work	0 (0.0)	9 (9.3)	9 (7.6)
Aura prior to a fit (able to park)	0 (0.0)	40 (41.2)	40 (33.9)
Total	21	97	118

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Conflicts of interest

There are no conflicts of interest.

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