



## Driving among patients with epilepsy in West China

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### ABSTRACT

**Purpose:** This study was conducted to survey the driving status of PWE in West China and to explore the sociodemographic and clinical factors associated with driving.

**Methods:** Between October 2012 and October 2013, all adult patients who came to our epilepsy clinic in the West China Hospital were invited to participate. Logistic regression was used to detect the patient factors associated with driving.

**Results:** A total of 657 patients completed this study. We found that 128 (19.5%) of these patients had driven recently (during the past year); among them, 80 (62.5%) experienced at least one seizure in the previous year. A logistic regression suggested that age, being male, being married, having a higher personal income, experiencing no seizure while awake, and taking fewer antiepileptic drugs were independently associated with recent driving.

**Conclusion:** This study showed that a considerable proportion of patients continue driving despite uncontrolled seizures. More detailed and operational driving restrictions may be needed for patients in China in order to strike a better balance between patients' quality of life and public safety.

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### 1. Introduction

Epilepsy is characterized by its often unpredictable seizures. Seizures such as complex partial and major motor seizures, which result in an altered state of consciousness, may affect the driving ability of patients with epilepsy (PWE) and lead to motor vehicle collisions [1]. However, driving is important for patients' work, social activities, and quality of life. It is necessary to make a specific law to strike a balance between patients' quality of life and the safety of patients and the general population [2]. Laws regulating driving for PWE vary from country to country and from state to state. In the U.S., most states require that patients have a specific duration of freedom from seizures (ranging from 3 to 12 months) in order to drive [3]. In Japan, patients can be granted a driver's license after a seizure-free period of two years [4]. In Brazil, a one-year seizure-free period is required [5]. In China, regardless of whether their epilepsy is active or not, PWE have not been allowed to drive a motor vehicle since 1988 according to the *Regulations of the People's Republic of China on Road Traffic* [6]. *Provisions on the Application for and Use of Driving Licenses* came into effect in 2004 [7], which banned all patients with epilepsy from obtaining a driver's license. However, previous studies from other countries showed that approximately 20–42% of PWE drove illegally, regardless of the presence of

uncontrolled seizures [5,8,9]. There are approximately 9 million PWE in China, and motor vehicle usage is soaring [10,11]. According to data released by the Ministry of Public Security, China had 260 million motor vehicle drivers by the end of 2012, with an annual growth rate of over 10% [12]. However, to the best of our knowledge, there is currently no survey of the driving prevalence of PWE in China. Thus, we conducted this study to survey the driving status and motor vehicle crashes of PWE and to explore the sociodemographic and clinical factors associated with driving and seizure-related crashes in order to provide information to legislators, the Public Transportation Management Department, and doctors in China.

### 2. Material and methods

#### 2.1. Study setting and procedures

Between October 2012 and October 2013, all adult patients who came to our epilepsy clinic in the West China Hospital, a tertiary referral center in Chengdu, a city with over 14 million people, were invited to participate in our study.

Patients were included if they met the following inclusion criteria:

1. They had a validated diagnosis of epilepsy.
2. They were over 18 years of age (the legal age for driving in China).
3. They had been diagnosed with epilepsy for at least 1 year.

Patients were excluded if they had a known condition other than epilepsy that made them forbidden from driving a motor vehicle according

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to the *Provisions on the Application for and Use of Driving Licenses*, such as heart disease, Meniere's disease, conversion disorder, paralysis agitans, psychosis, dementia, drug abuse, and other diseases that may affect physical activity [7].

The study was approved by the Ethics Committee of the West China Hospital, Sichuan University. We informed all participants of the purpose of the study and obtained their written informed consent. The participants' anonymity was guaranteed. Informed consent forms and questionnaires were separated into two envelopes. After the participants signed the informed consent, the eligible ones were brought to a quiet room for a semistructured interview.

## 2.2. Sociodemographic status, clinical information, and driving information

During the structured interview, the following information was gathered:

**Sociodemographic status:** age, gender, occupational status, personal income, educational levels, marital status, location (rural/suburban/urban), and region (Chengdu/other regions in Sichuan/other provinces).

**Clinical information:** seizure type, epilepsy syndrome, seizure frequency, age at seizure onset, whether the patient experienced seizures while awake, whether the patient had a reliable aura, number of antiepileptic drugs (AEDs) taken, and length of time that they were seizure-free.

**Driving information:** whether the patient received a driver's license, the type of motor vehicle, number of years of driving, number of years of driving after diagnosis, mileage, purpose of driving, seizures during driving, motor vehicle crashes, knowledge of Chinese driving restrictions, whether the patient reported their condition to the driving management department, and whether the patient discussed their driving with doctors or their driving school.

## 2.3. Data analysis

The sociodemographic status, clinical information, and driving information of all responders were described. Means and percentages were used to describe the distribution of continuous and categorical variables, respectively. Univariate binary logistic regression was performed to detect the possible association between clinical and sociodemographic variables and recent driving experiences. To detect the independent association with recent driving experiences, variables that yielded  $p < 0.2$  in the univariate binary logistic regression and clinical factors that were associated with driving in a previous study (such as seizure type, seizure frequency, aura, length of time in which the patient was seizure-free, age at onset, number of AEDs taken, and whether the patient experienced seizures while awake) were entered into a model of multiple logistic regression [5,13–15]. Multicollinearity test was performed before those variables were entered into the regression model. If a tolerance for a variable was 0.1 or less, this variable would not enter the regression model. After that, we described the traffic accidents caused by seizures. To explore the factors among the driving patients that may be related with seizure-related crashes, we compared age, gender, seizure type, aura, seizure frequency, awake seizures, and vehicle type between drivers who were involved in seizure-related crashes and who were not. Student's *t*-test and chi-squared test were used to compare continuous and categorical variables, respectively.

Statistical Product and Service Solutions 15.0 (SPSS Inc., Chicago, Illinois) was used to perform all analyses.

All *p*-values were two-sided, with  $p < 0.05$  considered statistically significant.

## 3. Results

### 3.1. Clinical and demographic data of the participants

A total of 693 patients who came to our epilepsy clinic between October 2012 and October 2013 were invited to participate in our study. A total of 678 patients agreed to participate. Among them, seven were newly diagnosed, eight had a physical disability, and six had a significant intellectual disability; these patients were excluded. A total of 657 patients completed this study.

Among the 657 patients, 382 (58.1%) were male and 275 (41.9%) were female. The average age of the patients was  $32.8 \pm 11.8$  years. The median personal income (interquartile range: 25th–75th) was 2000 (500–4000) Yuan per month. The mean age at the time of seizure onset was  $21.8 \pm 12.8$  years. Regarding the seizure type, 29 (4.4%) patients experienced simple partial seizures without evolving to convulsive seizures, 136 (20.7%) experienced complex partial seizures without evolving to convulsive seizures, 492 (74.9%) had experienced convulsive seizures, 9 (1.4%) experienced both simple partial seizures and convulsive seizures, and 44 (6.7%) experienced both simple partial seizures and convulsive seizures. With respect to the epileptic syndromes, 281 (42.8%) were diagnosed with idiopathic epilepsy, 216 (32.9%) were diagnosed with cryptogenic epilepsy, and 160 (24.3%) were diagnosed with symptomatic epilepsy. Among the patients with epilepsy, 80 (12.2%) were diagnosed with temporal lobe epilepsy, 52 (7.9%) were diagnosed with frontal lobe epilepsy, and 5 (0.8%) were diagnosed with occipital lobe epilepsy. As for the seizure frequency, 20 (3.0%) experienced seizures on a daily basis, 42 (6.4%) experienced seizures on a weekly basis, 143 (21.8%) experienced seizures on a monthly basis, 240 (36.5%) experienced seizures on a yearly basis, and 212 patients (32.3%) had not experienced a seizure during the past year. In terms of treatment, 322 (49.0%) patients were on monotherapy, and 272 (41.4%) were on polytherapy.

### 3.2. Driving status in patients with epilepsy

In this sample, 176 (26.8%) individuals said that they had possessed a driver's license at some point, and 174 (26.5%) said they held currently valid licenses; among these latter patients, 81 (46.6%) received a driver's licenses after disease onset.

According to the data of the 2010 population census and the data from the Ministry of Public Security of the People's Republic of China, the rate of license holders was proximately 24.7% among adult Chinese. Comparing with the rate of license holders in our sample, there was no statistically significant difference (26.8% vs 24.7%  $p = 0.207$ ).

Among all 172 responders (26.2%) who indicated that they had driven once and 128 (19.5%) who had driven recently (during the past year), 80 (62.5%) had experienced at least one seizure in the previous year. Table 1 shows the driving characteristics of patients who had driven recently. Among the patients who had driven recently, 86 (67.2%) drove to go to work, 41 (32.0%) knew of the driving restriction, 49 (38.3%) had consulted their doctor about driving, and only one patient (0.8%) had consulted their driving school. None reported their disease to the police or to the transportation management department.

### 3.3. Factors associated with driving in patients with epilepsy

Univariate binary regression was used to detect the association between clinical and sociodemographic variables and recent driving experiences (Table 2). Univariate binary regression showed that age ( $p = 0.002$ ), gender ( $p < 0.001$ ), occupational status ( $p < 0.001$ ), marital status ( $p = 0.001$ ), personal income ( $p < 0.001$ ), and educational levels ( $p = 0.005$ ) were associated with recent driving. For clinical variables, not having seizures while awake ( $p = 0.001$ ), adult onset ( $p = 0.010$ ), and number of AEDs taken ( $p = 0.001$ ) were associated with recent driving.

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