



# Mortality-specific comorbidity among inpatients with epilepsy: A preliminary cross-sectional study in West China

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## ABSTRACT

**Purpose:** The purpose of this study was to investigate the current condition of mortality-specific comorbidity among hospitalized patients with epilepsy (PWE).

**Methods:** The discharge abstract records of PWE from over 730,000 admissions were extracted from the hospital medical database. Fourteen mortality-related comorbidities from an epilepsy-specific index (ESI) were selected for the present assessment. The hospital-based prevalence of these comorbidities was estimated. The distributions of PWE with an ESI-based prognostic score were calculated.

**Results:** A cohort of 11,422 PWE (male 58.5%) was included in the present study. The order of comorbidities in terms of high to low prevalence ranking was as follows: hypertension (19.6%), peripheral vascular disease (8.1%), cardiac arrhythmias (5.8%), dementia (4.6%), renal disease (4.1%), congestive heart failure (3.8%), metastatic cancer (3.4%), brain tumor (2.4%), paraplegia and hemiplegia (2.0%), solid tumor without metastasis (1.7%), anoxic brain injury (1.4%), pulmonary circulation disorders (1.3%), moderate or severe liver disease (1.1%), and aspiration pneumonia (0.2%). High rates of comorbidities in the elderly were also noted. Spearman correlation analysis showed a moderate correlation between the changes in ages and prognostic score with a rho of 0.6 ( $p < 0.001$ ). The percentage of females with a score of 0 was higher than that of males ( $p < 0.001$ ), indicating that the prognostic survival of the majority of females was relatively longer than that of males.

**Conclusion:** Our study demonstrated that the comorbidity burden of female PWE was relatively lower than that of male PWE. High prevalence of cardiac and vascular diseases was found in PWE, thereby affecting the long-term survival rate. Considering that the propensity of increased comorbidity was prevalent with age, we should implement early preventive measures to manage the potential comorbidities associated with mortality, reduce disease burden, and prolong the survival of PWE.

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## 1. Introduction

Epilepsy is one of the most common chronic neurologic diseases affecting more than 70 million individuals worldwide [1]. Patients with epilepsy (PWE) carry an increased risk of morbidity and mortality compared with the general population [2]. Our previous study suggested that the risk of premature death is nearly five times higher in patients with convulsive epilepsy than in the general Chinese population [3]. The comorbidities of index disease in broad terms include distinct clinical diseases and syndromes, which are known as cooccurrent medical morbid conditions [4]. Comorbidities in epilepsy are common, and nearly half of adults with active epilepsy have at least one comorbid medical disorder [5]. Psychiatric comorbidity is found to play an

important part in premature mortality [6]. However, somatic comorbidities still remarkably contribute to this condition. Certain comorbidities affecting the survival rate of patients have a prognostic-predicting value. Treating comorbidities may also affect seizure control and reduce premature death [7]. Comorbidity indices are useful instruments to measure the overall comorbidity burden of an individual [7]. An epilepsy-specific index (ESI) has been developed specifically for epilepsy mortality research and validated in the administrative and clinical cohorts of PWE [8,9]. This preliminary study on mortality-specific comorbidities aimed to describe the distribution of mortality-specific comorbidities on a large cohort of PWE in a hospital by using ESI.

## 2. Methods

### 2.1. Data sources and study population

The Institutional Ethics Committee of Sichuan Academy of Medical Sciences and Sichuan Provincial People's Hospital provided ethical

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approval on data use. Data were extracted from the inpatient discharge abstract database of Sichuan Provincial People's Hospital from November 1, 2007 to July 31, 2017. The discharge diagnoses in the database were based on the International Classification of Diseases (ICD)-10. The inpatients included in the present study were from all medical departments except outpatient clinics. All of the discharge diagnoses of the identified patients with epilepsy were primarily responsible for resource use.

All inpatients of any age, confirmed with epilepsy, and admitted to the Sichuan Provincial People's Hospital, which is one of the largest tertiary hospitals in Chengdu, China, with 3277 beds for clinical use, were recruited. It has been validated that administrative data can reasonably accurately identify patients who have ever had epilepsy [10]. Epilepsy diagnosis was based on the 1981 and the 2005 classifications [11,12]. The ICD-10-CA codes G40–G41 were used to find epilepsy in any discharge diagnostic field combined with text-based retrieval if necessary. Exclusion criteria were those with seizures/status epilepticus (SE) without an established epilepsy diagnosis and those with reflex epilepsy. As regards to patients with multiple admissions, the latest discharge record was used to collect information.

Before the entire screening and data extraction were performed, 150 medical records were randomly selected to test the diagnostic accuracy of epilepsy in the database. The diagnostic accuracy of the selected patients labeled with "epilepsy" in the discharge diagnosis field was tested to avoid reviewing a large number of medical records and to detect the underlying misdiagnoses and missed diagnoses. Two experts on epilepsy were involved in independently reading all of the charts of 150 selected records and in reviewing all notes, including physician history, physical examination, laboratory tests, imaging reports (if available), and any other pertinent investigations. Afterward, the two reviewers reached a consensus and assigned the presence, absence, or suspicion of epilepsy. Depending on whether the epilepsy is confirmed or not (or suspected), we compared this information with the original discharge diagnosis. The diagnostic concordance rate of the discharge diagnosis in ICD-10 was 95.3%. However, the classification of epilepsy was not considered in the present study. Of note, misclassification of the epilepsy was not taken into account of the diagnostic concordance. Additionally, an age-and-sex matched cohort of patients without epilepsy was randomly selected from the database for comparison.

## 2.2. Comorbidity classification and selection

Comorbidity ICD codes are all from the epilepsy specific index. Consisting the ESI are 14 comorbidities significantly associated with mortality, and each comorbidity was assigned a weighed value of prognostic scores 1–6 [8]. The present study retained all of the 14 comorbidities as follows: pulmonary circulation disorders, hypertension, and cardiac arrhythmias (prognostic score 1); congestive heart failure, peripheral vascular disease, renal disease, solid tumor without metastasis, paraplegia and hemiplegia, aspiration pneumonia, and dementia (prognostic score 2); brain tumor, anoxic brain injury, and moderate or severe liver disease (prognostic score 3); and metastatic cancer (prognostic score 6). Comorbid conditions were defined using clinical diagnosis at discharge. The ICD-10 codes for each comorbid category were referenced [8]. We assigned scores 0, 1–5 (low), 6–10 (moderate), and >10 (high) as groups based on the distinct discrimination of crude mortality (per person year), which was preferred in a previous study [8].

## 2.3. Data processing and statistical analysis

Matlab (R2009b) was used to process the large number of discharge abstract data. In detail, we programmed the discharge diagnosis to be automatically categorized into the listed comorbidity by matching the

ICD-10 code of such diagnosis with all of the codes representing a given comorbidity category.

Data were analyzed using SPSS 17.0 (Chicago, IL, U.S.A.), and a 5% level of significance was assumed (two-sided p-value). Descriptive approaches were applied to represent the baseline demographics. The prevalence of comorbidities was calculated among different age groups (<18, 18–34, 35–64, and ≥65 years). A total prognostic score from the ESI was calculated for each patient, and the proportions of those with score 0, 1–5, 6–10, and >10 were counted. Chi-square was conducted to statistically compare categorical variables. For bivariate analyses, Spearman's rank correlation was performed to analyze the correlation between the changes in age and ESI scores.

## 3. Results

### 3.1. Demographical information

A cohort of 11,422 PWE (58.5% male) from over 730,000 admissions (from November 1, 2006 to July 31, 2017) in Sichuan Provincial People's Hospital satisfied our inclusion criteria. The mean age of the patients was 40.2 years with standard deviation (SD) of 25.9 years. The prevalence by age distribution was as follows: 2851 patients (25.0%) were younger than 18 years; 2446 patients (21.4%) were 18–34 years; 3517 patients (30.8%) were 35–64 years, and 2608 patients (22.8%) were equal to or more than 65 years. The median length of stay was 6 days (interquartile range [IQR]: 1–14). The distribution of the patients from different departments was as follows: 7469 (65.4%) patients from the Neurology Department; 998 (8.7%) patients from pediatric wards; 799 (6.9%) patients from the Neurosurgery Department; 386 (3.4%) patients from the Geriatric Department, and 1770 (15.5%) patients from other departments.

### 3.2. Prevalence of the mortality-specific morbidities

Fourteen mortality-specific morbid conditions were selected according to the ESI (Table 1). The order of comorbidities in terms of high to low prevalence ranking was as follows: hypertension (19.6%), peripheral vascular disease (8.1%), cardiac arrhythmias (5.8%), dementia (4.6%), renal disease (4.1%), congestive heart failure (3.8%), metastatic cancer (3.4%), brain tumor (2.4%), paraplegia and hemiplegia (2.0%), solid tumor without metastasis (1.7%), anoxic brain injury (1.4%), pulmonary circulation disorders (1.3%), moderate or severe liver disease (1.1%), and aspiration pneumonia (0.2%). The prevalence of mortality-specific morbidities grouped by age is presented in Table 2. The high prevalence of comorbidities in the elderly was noted.

**Table 1**  
Prevalence of comorbidities in cohorts with epilepsy and without epilepsy.

	With epilepsy (11422)	Without epilepsy (11422)
<i>Comorbidities (n, %)</i>		
Pulmonary circulation disorders	146 (1.3)	351 (3.1)
Hypertension	2244 (19.6)	2656 (23.3)
Cardiac arrhythmias	661 (5.8)	750 (6.6)
Congestive heart failure	431 (3.8)	630 (5.5)
Peripheral vascular disease	928 (8.1)	1014 (8.9)
Renal disease	470 (4.1)	562 (4.9)
Solid tumor without metastasis	195 (1.7)	655 (5.7)
Paraplegia and hemiplegia	223 (2.0)	50 (0.4)
Aspiration pneumonia	26 (0.2)	24 (0.2)
Dementia	521 (4.6)	218 (1.9)
Brain tumor	271 (2.4)	82 (0.7)
Anoxic brain injury	160 (1.4)	51 (0.4)
Moderate or severe liver disease	123 (1.1)	218 (1.9)
Metastatic cancer	388 (3.4)	449 (3.9)

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