



## Original article

# In-hospital mortality among electroconvulsive therapy recipients: A 17-year nationwide population-based retrospective study



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## ABSTRACT

**Background:** Electroconvulsive therapy (ECT) remains irreplaceable in the treatment of several psychiatric conditions. However, evidence derived using data from a national database to support its safety is limited. The aim of this study was to investigate in-hospital mortality among patients with psychiatric conditions treated with and without ECT.

**Methods:** Using data from the Taiwan National Health Insurance Research Database from 1997 to 2013, we identified 828,899 inpatients with psychiatric conditions, among whom 0.19% ( $n = 1571$ ) were treated with ECT.

**Results:** We found that ECT recipients were more frequently women, were younger and physically healthier, lived in more urbanized areas, were treated in medical centers, and had longer hospital stays. ECT recipients had lower odds of in-hospital mortality than did those who did not receive ECT. Moreover, no factor was identified as being able to predict mortality in patients who underwent ECT. Among all patients, ECT was not associated with in-hospital mortality after controlling for potential confounders.

**Conclusion:** ECT was indicated to be safe and did not increase the odds of in-hospital mortality. However, ECT appeared to be administered only on physically healthy but psychiatrically compromised patients, a pattern that is in opposition with the scientific evidence supporting its safety. Moreover, our data suggest that ECT is still used as a treatment of last resort in the era of modern psychiatry.

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## 1. Introduction

Over the past several decades, psychopharmacology has advanced dramatically. Although earlier discoveries of effective psychotropic drugs were based on serendipitous observations, significant breakthroughs in the development of effective psychotropic drugs have supplanted psychoanalytic therapy, once the central component of psychiatric treatment. In the era of modern psychiatric practice, pharmacotherapy has become the first-line

treatment for most psychiatric disorders. However, limitations still surround psychopharmacotherapy, rendering electroconvulsive therapy (ECT) irreplaceable in the treatment of severe psychiatric disorders [1].

No medical condition is an absolute contraindication for ECT [2,3]. However, ECT has been rarely used as a first-line treatment in clinical practice despite its unequivocal and documented efficacy in the treatment of certain life-threatening psychiatric conditions [1,4,5]. In fact, ECT has usually been considered as a last resort treatment modality, reserved only for patients who have failed to respond to other interventions [1]. Inaccurate Hollywood depictions have resulted in the perception of ECT as a brutal, harmful, and abusive treatment [6]. However, contrary to popular belief, evidence suggests that ECT is safe [1,2,4].

In California, the mortality rate among ECT recipients was identified to be only two deaths per 100,000 treatments from 1977 to 1983 [7]. In Texas, mandatory reporting of all deaths that

**Abbreviations:** ECT, electroconvulsive therapy; NHIRD, National Health Insurance Research Database; NHI, National Health Insurance; ICD-9-CM, International Classification of Diseases 9th Revision, Clinical Modification; CCI, Charlson Comorbidity Index; GEE, generalized estimating equations; OR, odds ratio.

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occurred within 14 days of ECT indicated a mortality rate of less than two deaths per 100,000 treatments from 1993 to 1998 [8]. Another study using data from a single hospital reported no deaths to have occurred in association with the more than 17,000 ECT treatments [9]. A registry-based cohort study reported that inpatients who underwent ECT had a lower overall mortality rate than did other inpatients with psychiatric conditions over a 25-year period [10]. Nevertheless, the authors reported that a selection bias might have contributed to the decreased risk of mortality observed in that study, as patients with poor physical health were less likely to receive ECT. Importantly, studies identified in the published literature have either included only a limited number of ECT recipients or been conducted over limited periods of time, and only two studies were identified that investigated this issue using data from a national database. The first study, based on data from the Veterans Affairs National Center for Patient Safety, reported less than one death to have occurred per 73,440 ECT treatments [11]. However, this database did not encompass the population of an entire nation. The second study covered all ECT treatments registered in the Danish National Patient Register from 2000 to 2007 (a total of 99,728 treatments) and concluded that death caused by ECT is an extremely rare event [12]. Importantly, research using databases that include entire national populations can eliminate selection bias and control for clinical characteristics, such as comorbidities and risk factors, and may provide valid insights into the association between mortality and ECT.

ECT remains one of the most clinically underutilized treatments in psychiatry [4]. The device that is used to administer ECT is a class III medical device, indicating high risk and a lack of sufficient information to assure safety [13]. A recent study evaluating data collected from 1993 to 2009 reported a sharp decline in the availability and use of ECT in general hospitals across the United States [14]. Undoubtedly, if research provides evidence of the safety of ECT at the national level, this treatment modality may become an increasingly important option in psychiatric practice. The aim of this study was to investigate the mortality rate in inpatients with psychiatric conditions that were treated with ECT based on one of the largest nationwide population databases in the world.

## 2. Materials and methods

### 2.1. Data source

The Institutional Review Board for the Protection of Human Subjects at the Tri-Service General Hospital approved the protocol. Data were collected from the National Health Insurance Research Database (NHIRD), which was derived from the claims data of the National Health Insurance (NHI) program of Taiwan. The NHI program was established in 1995 and delivers universal coverage provided by a government-run, single-payer compulsory insurance plan to centralize the disbursement of health care funding. By 2010, it covered 99.5% of the Taiwanese population [15]. As the NHI program covers approximately 23 million residents in Taiwan, it is one of the largest and most comprehensive, nationwide population databases in the world.

The NHIRD provides encrypted patient identification numbers, gender, birthdays, dates of admission and discharge, medical institutions providing the services, ICD-9-CM (International Classification of Diseases, 9th Revision, Clinical Modification) diagnostic and procedure codes (up to five each), outcome at hospital discharge (recovered, died or transferred out), order codes, and fees charged for the associated medical services. Data are updated biannually. Researchers who seek to use the NHIRD and its

data subsets are required to sign a written agreement declaring that they do not intend to gather information that could potentially violate the privacy of patients or care providers.

### 2.2. Study population

A retrospective study design was used. Data from the “details documents of hospitalization medical expenses” and “registry for contracted medical facilities” fields were extracted from the NHIRD. Between 1 January 1997 and 31 December 2013, there were 46,175,208 hospital admissions. Eliminating duplicate cases, we identified 15,246,712 hospitalized patients, among whom 831,174 were diagnosed with psychiatric disorders (ICD-9-CM: 290–319). Patients who underwent ECT were identified by the ICD-9-CM procedure codes 94.26 and 94.27.

### 2.3. Variable definition

Catastrophic illness was defined, according to the NHIRD, as indicating several diseases or injuries, such as malignant neoplasms, systemic lupus erythematosus, and burns involving > 20% of the total body surface [16]. The level of urbanization of the Taiwanese townships was defined according to population density, ratio of the population with a college education or above, ratio of the population that was elderly (aged 65+ years), ratio of the population employed in agriculture, and number of physicians per 100,000 people [17]. Low-income household status was defined as a household with an average per capita monthly family income less than the monthly minimum living expense standard for a household in the region of residence. The minimum living expense standard was defined as 60% of the average monthly disposable income for each region [18]. Residence location was categorized as northern Taiwan, central Taiwan, southern Taiwan, eastern Taiwan, or the outer islands. Level of hospital was defined as medical center, regional hospital, and local hospital. The presence of comorbidities was determined using the Charlson Comorbidity Index (CCI) [19].

### 2.4. Statistical analysis

Group differences in continuous variables were analyzed using independent samples *t*-tests. Pearson's  $\chi^2$  tests were used to compare the distributions of categorical variables between the ECT group and non-ECT group.

Generalized estimating equations (GEE) were employed for modelling. Several GEE models were used to measure the strength of the associations between predictor variables and dichotomous outcome variables. The outcome variables assessed were in-hospital mortality and ECT application. Crude odds ratios (ORs) represented the influence of a single variable on the odds of outcome occurrence, and adjusted ORs indicated the influence of a variable after controlling for confounders. All tests were two-sided, and  $P < 0.05$  was considered significant. All statistical analyses were performed using IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY, USA).

## 3. Results

The final study population consisted of 828,899 inpatients with psychiatric disorders after excluding 2275 patients with missing gender data. The study population was predominantly men (54.47%), and the mean age of patients was  $54.4 \pm 21.6$  years. Between 1997 and 2013, there were 16,075 in-hospital mortality (1.94%). The study population was divided into the ECT group ( $n = 1571$ ) and non-ECT group ( $n = 827,328$ ). Only 0.19% of inpatients

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