



## Review article

## Top 100 cited articles on epilepsy and status epilepticus: A bibliometric analysis



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## ABSTRACT

The purpose of this study is to identify the top 100-cited articles dedicated to epilepsy and status epilepticus published in journals from January, 1950 through February, 2016 that have made key contributions in the field. We performed a search of journals and selected the top 100-cited articles on epilepsy and status epilepticus, respectively, by utilizing the Institute for Scientific Information database available under the banner of the Web of Science. The top-cited articles on epilepsy and status epilepticus were all published in 24 journals, respectively. In both fields of epilepsy and status epilepticus, the most frequently cited journal was *Epilepsia* (26 articles on epilepsy and 19 articles on status epilepticus). The 100 most-cited articles in the field of both epilepsy and status epilepticus mainly originated from institutions in the United States of America. The articles on epilepsy included 25 laboratory studies, 15 pharmacotherapy studies, 13 general review studies, 12 surgery studies, 11 neuroimaging studies, eight epidemiology studies, eight neuropsychiatry studies, six genetic studies, and two electrophysiology studies, whereas 41 laboratory studies, 21 epidemiology studies, 16 pharmacotherapy studies, nine electrophysiology studies, nine general review studies, and four neuroimaging studies were included in the field of status epilepticus. We demonstrate that neuroimaging, genetics, and surgery are emerging topics in the field of epilepsy over the past decades. Moreover, we found that the majority of top-cited articles on epilepsy and status epilepticus originated from institutions in the United States of America and most were published in *Epilepsia*.

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## 1. Introduction

Epilepsy is a disease that is as old as human existence. It was first described in a text from 2000 B.C written in the Akkadian language [1]. Currently, epilepsy is one of the most common chronic neurological diseases and affects approximately 50 million people worldwide [2]. In addition, status epilepticus is a relatively common medical and neurologic emergency that requires prompt evaluation and treatment [3]. Over a lifetime, up to 10 percent of adults with epilepsy and 20 percent of children with epilepsy will go on to have status epilepticus [3,4]. The research in the field of epilepsy and status epilepticus has shown impressive development over

the past 50 years and research articles published in this field reflect its evolution.

In 1962, the Science Citations Index was initiated at the Institute for Scientific Information (ISI) by Eugene Garfield, which is now owned by the Thomson Corporation of Toronto. The purpose was to maintain a systematic ongoing measurement of the citation counts for scientific journals [5]. The ISI database, via the Science Citation Index Expanded and the Journal Citation Reports, contains more than 11,000 international journals and provides the complete bibliographical information of these indexed publications [5]. It is a multidisciplinary index to the journal literature of the science. The number of citations of previously published work is an indicator of its subsequent recognition and impact in an area of study [6–8]. Reviewing articles that are frequently cited can provide information about the dominant areas of a discipline, as well as highlight the growth of particular fields. Furthermore, top-cited articles are often written by recognized experts who can offer insight into the future directions of the discipline. The study and analysis of

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citation indexes have resulted in the development of various metrics to assess the impact of scientific journals or individual investigators based on the number of citations to their respective works [6–8].

Several recent studies have identified and analyzed citation classics and top-cited articles in various medical fields including general surgery [9], anesthesiology [10], emergency medicine [11], plastic surgery [12], dermatology [13], obstetrics and gynecology [14], orthopedic surgery [15], critical care medicine [16], and essential tremor [17]. However, to the best of our knowledge, no comprehensive study of the top-cited articles in the field of epilepsy or status epilepticus has been available to date, especially using the ISI database. The purpose of this study was to identify the 100 most-cited articles published in journals from January, 1950 through February, 2016 dedicated to epilepsy and status epilepticus that have made key contributions in the field. Identifying a reliable and unified set of core journals in the field of epilepsy and status epilepticus may be of interest to investigators in the field.

## 2. Methods

We did a citation analysis in the field of epilepsy and status epilepticus, respectively. The citation analysis is a bibliometric method that examines the frequency and patterns of citations in articles.

First, we performed a search of journals and selected the most cited articles by utilizing the ISI database available under the banner of the Web of Science, providing the most relevant bibliometric information from published scientific articles since 1950. Based on the Journal Citation Reports Science Edition 2014, the following three subject categories of journals were included: 192 journals on “clinical neurology”, 252 journals on “neuroscience”, and 110 journals on “medicine, general & internal”. For each included journal, we retrieved all articles that were cited more than 100 times at the time of search (February, 2016) using the “cited reference search” facility of the Science Citation Index Expanded of the ISI Web of Science. In general, an article that has been cited more than 100 times is considered a “classic”. Classic articles tend to represent historical landmarks in the evolution of a specific area.

Second, to identify frequently cited epilepsy- and status epilepticus-specific articles, we searched the following terms in the selected articles that have been cited more than 100 times: “epilepsy” and “status epilepticus”, respectively.

Third, we identified the 100 top-cited articles in the field of epilepsy and status epilepticus, respectively, and we manually reviewed the contents of these articles. We examined the characteristics of the articles, such as number of citations, ranking, authorship, article title, year of publication, publishing journal, publication type, and topic categories. The publication types were categorized into original article, case series, and systemic review/guidelines, and the topic types were sub-typed as epidemiology, pharmacotherapy, surgery, laboratory, electrophysiology, neuroimaging, genetics, neuropsychiatry, and general review. When the authors of an article had more than one affiliation, the department, institution, and country of origin were defined by the affiliation of the first author. Data are presented using descriptive statistics, and no tests of statistical significance were performed. This study did not need to be reviewed by an ethics committee because it performed a bibliometric analysis of existing published studies and did not involve human subjects.

## 3. Results

Nine hundred eighty-eight articles on epilepsy and 117 articles on status epilepticus that were cited more than 100 times in the ISI

database retrieved. Of the 988 articles and 117 articles, we selected the 100 most frequently cited articles for further analysis and ranked them according to the number of citations, respectively (Table 1, Supplementary Tables 1 and 2). The most cited article on epilepsy received 1,711 citations, and the least cited article received 271 citations. The majority of articles (77 articles) received more than 300 citations. The most cited article on status epilepticus received 611 citations, and the least cited article received 108 citations.

The top-cited articles on epilepsy were all published in 24 journals (Table 2). Of the 24 journals, the most frequently cited journal was *Epilepsia* (26 articles), followed by *Annals of Neurology* (16 articles) and *Brain* (12 articles). More than half of the articles (54 articles) were retrieved from these three journals. In addition, half of the 10 top-cited articles were published in *Epilepsia*. The top-cited articles on status epilepticus were also all published in 24 journals (Table 2). Of the 24 journals, the most frequently cited journal was *Epilepsia* (19 articles), followed by *Neurology* (18 articles) and *The Journal of Neuroscience* (11 articles). About half of the articles (48 articles) were retrieved from these three journals.

The top 100-cited articles on epilepsy originated from institutions in 14 countries, with the United States of America contributing 46 articles, followed by the United Kingdom (19 articles), Canada (13 articles), and France (5 articles) (Table 3). Fifty-nine of the articles originated from the North American continent, including the United States of America and Canada, 37 articles originated from the countries of Europe, including the United Kingdom, France, Finland, Italy, Germany, Switzerland, Denmark, Netherlands, and Sweden, and only four articles originated from the countries on Asia and Oceania, including Australia, China, and Japan. The top 100-cited articles on status epilepticus originated from institutions in 16 countries, with the United States of America contributing 62 articles, followed by France (6 articles), Germany (6 articles), and the United Kingdom (6 articles) (Table 3). More than two-thirds (69 articles) of the articles originated from the American continent, including the United States of America, Canada, and Brazil, 28 articles originated from the countries of Europe, including France, Germany, the United Kingdom, Sweden, Switzerland, Austria, Czech Republic, Finland, Italy, and Netherlands, and only three articles originated from the countries on Asia and Oceania, including India, Israel, and New Zealand.

Tables 4 and 5 list the top-ranked institutions and authors for the published epilepsy and status epilepticus citation classics associated with two or more articles. The 19 institutions provided two or more top-cited articles on epilepsy. The institution associated with the largest number of epilepsy citation classics was McGill University in Canada (8 articles), followed by the University of California, Los Angeles in the United States of America (5 articles), and University College of London in the United Kingdom (5 articles). J. Engel, Jr, who was the first author of 6 articles, was listed most frequently in the epilepsy citation classics. The decade of publication with the most relevant articles identified is listed in Table 6. The publication years were concentrated in the 1990s, where 40 of the citation classics were published. Further, 68 of the 100 top-cited articles were published throughout the 1990s and 2000s. The earliest recorded article was published in 1964, and the most recent article was in 2014. The 15 institutions provided two or more top-cited articles on status epilepticus. The institution associated with the largest number of status epilepticus citation classics was University of California, Los Angeles in the United States of America (15 articles), followed by Columbia University in the United States of America (8 articles), University of California, San Francisco in the United States of America (6 articles), University of Virginia in the United States of America (6 articles), and Virginia Commonwealth University in the United States of America (6 articles). Lowenstein DH, who was the first

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