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Stroke-associated pneumonia

A bibliometric analysis of worldwide trends from 2003 to 2020

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Abstract

Stroke-associated pneumonia (SAP) is a spectrum of pulmonary infections in patients within 7 days of stroke. Which is one of the most common complications after stroke and is significantly associated with a poor prognosis of stroke. To the best of our knowledge, a bibliometric method was not previously used to analyze the topic of SAP; we aim to describe the situation and evolution of SAP from 2003 to 2020, and to discuss the research hotspots and frontiers.

A total of 151 articles were retrieved from the Scopus database. Bibliometric analysis was used to explore the dynamic trends of articles and the top subject areas, journals, institutes, citations, and co-keywords. VOS viewer software (version 1.6.15) was used to graphically map the hot topics of SAP based on the co-keywords.

A total of 151 articles were identified. Articles have increased over the recent years and faster in the last 2 years (55 articles, 36.4%), the majority of subject areas are medicine (124 articles, 82.1%) and neuroscience (38 articles, 25.2%). The "Journal Of Stroke And Cerebrovascular Diseases" with 15 articles has been scored as the first rank followed by "Plos One." Regarding the geographical distribution of articles, China is the most productive country with 50 articles (33.1%), others are more prominent in Europe, and most institutes are universities. Citations have increased over time, the main country of the top five highly cited published articles are Germany and before 2008. The co-keywords are mainly divided into four aspects: risk factors, predictive scores, preventions, and outcomes.

This study could provide practical sources for researchers to find the top subject areas, journals, institutes, citations, and co-keywords. Moreover, the study could pave the way for researchers to be engaged in studies potentially lead to more articles in this field.

Abbreviations: IF = impact factors, SAP = Stroke-associated pneumonia, SIDS = stroke-induced immunosuppression, UK = United Kingdom.

Keywords: acute stroke, bibliometric analysis, stroke-associated pneumonia, worldwide trends

1. Introduction

Stroke is a frequent focus of chronic disease in China.[1] Pneumonia is a frequent clinical complication after stroke, occurring most often within the first week (stroke-associated pneumonia, SAP). The term "stroke-associated pneumonia" has been used for the first time by Hilker et al,[2] and the incidence of SAP varies from 8.6%[3] to 14.3%.[4] SAP increases the risk of mortality, prolonged hospitalization and has been associated with poor functional outcome.[5–6] Additionally, SAP has a large economic burden on medical systems with the cost of each case estimated to be £14,371 in the United Kingdom.[7]

To reduce the burden of SAP, the factors, mechanisms, and interventions had been explored. Stroke severity is a major independent risk factor for SAP, dysphagia and aspiration are other important risk factors, which have frequently been reported in multiple studies, as well as old age.[8,9] Significant development has been made in the pathophysiological mechanism, as the stroke-induced immunodepression has been improved understanding.[10] So interventions to reduce SAP are also significant topics worthy of further attention. A systematic review showed that screening for stroke-induced immunodepression, use of medication and nasogastric tubes, multidisciplinary team approach to swallowing can reduce SAP.[8] In recent years, SAP is experiencing unprecedented development. But, the global research trend in SAP has not been well studied yet. Therefore, it is necessary to investigate the global status of SAP.

Publications can represent the importance of a certain field which are critical indicators of research trends. Bibliometric analysis is a method to predict the developing trends of the research, by comparing the main authors, institutes, nations, and keywords.[11] This technology allows people to quickly acquire information concerning the scientific. It can also make contributions to clinical-making and guidelines regulation.

To the authors' knowledge, there are no bibliometric analyses regarding SAP research. This study used bibliometric tools to

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The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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analyze SAP-related articles retrieved from the Scopus database. The aim was to provide a retrospective and contemporary view of the current status and mainstream research on SAP from 2003 to 2020.

2. Methods

2.1. Data source

A descriptive bibliometric study of articles covering the role of SAP was conducted in the Scopus database available at http://www.scopus.com. Scopus database had an all-embracing coverage in health and biomedical fields, which has high coverage of citation reports than Web of Science and Google Scholar.[12] It is also easy to access various valid analytical tools made it a suitable choice for our study.[13]

2.2. Search strategies

Articles were searched in the Scopus database across title, abstract, and keywords. The online literature search was done on December 31, 2020, using the Scopus database with no language limitation. Terms used during the search were: TI = Stroke-associated pneumonia AND publishing year = (2003–2020). Only articles defined as "articles" were included in the analysis others, such as reviews, letters, or editorials were excluded.

2.3. Ethical approval

There was no need for ethical approval for this review because all the data were extracted from previously published articles.

2.4. Data analysis

The collected data were publication year, subject area, characteristics of the main journals, citation number, geographical distribution, and institutes' characteristics of articles. The impact factors (IF) of the journals were available at http://www.greensci.net/. Data entry and collecting were verified by two authors. The txt data downloaded from the Scopus database were imported into Microsoft Excel 2016 and VOS viewer 1.6.15 for bibliometric analysis.

3. Results

3.1. Time trend in publications

Overall, 151 articles, published from January 2003 to December 2020 were analyzed. The time-trend distribution of articles is shown in Figure 1. Articles in the field of SAP have increased over the recent years and faster in the last 2 years (55 articles, 36.4%).

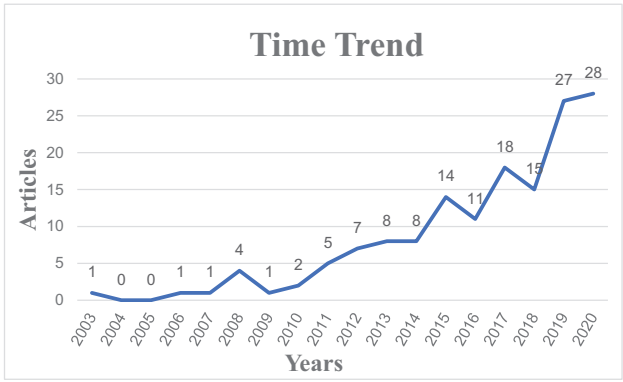

Figure 1. Time-trend distribution of articles in the field of SAP.

3.2. Subject area and main journals

Among the subject area of the articles, the top five are medicine (124 articles, 82.1%), neuroscience (38 articles, 25.2%), biochemistry, genetics and molecular biology (21 articles, 13.9%), nursing (16 articles, 10.6%), and agricultural and biological sciences (7 articles, 4.6%).

Table 1 shows the characteristics of the main journals. The "Journal Of Stroke And Cerebrovascular Diseases" with 15 articles has been scored as the first rank followed by "Plos One," "Stroke," "BMC Neurology," and "Frontiers In Neurology," respectively. The impact factor of all the top five journals is remarkable.

3.3. Geographical distribution

Regarding the geographical distribution of articles, China is the most productive country with 50 articles (33.1%). Germany is ranked second (19.2%), and the United Kingdom, the United States, Spain are ranked subsequently as the top five countries with a high number of published articles (129 articles, 85.4%).

3.4. Institutes' characteristics of articles

The first ranked institute for articles in the field of SAP is "Charité—Universitätsmedizin Berlin," followed by "The University of Manchester," "Salford Royal NHS Foundation Trust," "King's College London," and "Vall d'Hebron Institut de Recerca." The details of findings are shown in Table 2.

3.5. Citation number

The trend of citation numbers is shown in Figure 2. The total citation number of 151 articles is 2033 times until December 31, 2020. Therefore, the average number of citations per article is

Table 1

Characteristics of top five journals of articles in field of SAP.

Journals	IF	Articles	Total citations to articles	Citations per article	Citations to highest cited articles
Journal of Stroke and Cerebrovascular Diseases	1.787	15	108	7.2	22
Plos One	2.74	7	282	40.3	175
Stroke	4.882	7	552	78.9	288
BMC Neurology	2.356	6	47	7.8	19
Frontiers In Neurology	2.889	6	32	5.3	19

Table 2

Characteristics of top five institutes of articles in field of SAP.

Rank	Name of institute	Articles	Country
1	Charité-Universitätsmedizin Berlin	20	Germany
2	The University of Manchester	10	the United Kingdom
3	Salford Royal NHS Foundation Trust	9	the United Kingdom
4	King's College London	8	the United Kingdom
5	Vall d'Hebron Institut de Recerca	7	Spain

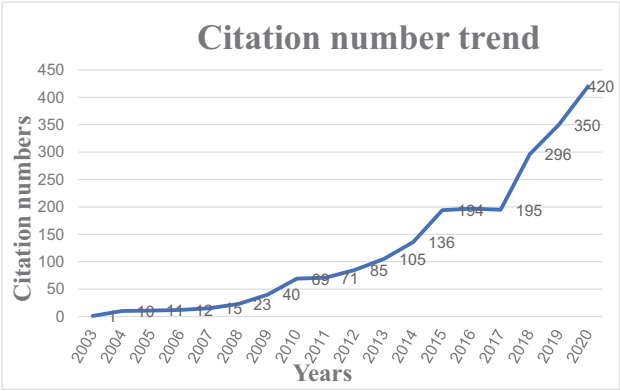

Figure 2. Chart of citation of articles in the field of SAP.

13.5. Citations in the field of SAP have increased over time with the highest citations are 420 times in 2020. 25.2% of articles (38 articles) do not receive any citation. The h-index for articles is 22, which means that 22 articles have been cited at least 22 times. Characteristics of the top five highly cited published articles in the field of SAP are summarized in Table 3.

3.6. Analysis of the occurrences of keywords

VOS viewer software is used to assess the occurrences of keywords. In order to map this network, the minimum number of occurrences of a keyword is 2. Out of 309 keywords, 66 keywords meet this threshold. The density views of the occurrences of keywords in the field of SAP are shown in Figure 3. The top five co-keywords in the field are stroke, pneumonia, stroke-associated pneumonia, dysphagia, and acute ischemic stroke.

4. Discussion

In this study, we use a bibliometric analysis method to assess the research trend of SAP. We found that:

1. articles have increased over the recent years and faster in the last 2 years;
2. the majority of subject areas are medicine and neuroscience, more frequently published in stroke or neurology journals;
3. this field is more prominent in Europe, most of the institutes are university;
4. citations have increased over the time, the main country of the top five highly cited published articles are Germany and before 2008;
5. the co-keywords mainly divided into four aspects: risk factors, predictive scores, preventions, and outcomes.

The number of articles in this field showed an increasing trend over the years. This progressive increase indicated more attention on this topic. Since the concept of SAP was first proposed in 2003,[2] researchers were beginning to realize that there is a difference between SAP and pneumonia. SAP is one type of pneumonia, also the important risk factor for death after stroke, will increase the length of hospital stay and medical costs, bring heavy burden to the family and society.[14,15] Furthermore, stroke-induced immunosuppression (SIDS) as a factor of SAP has become the hot spot of research led to significant growth in the number of articles in the field.[16] Especially in this period of a pandemic, the number of articles had almost doubled.

The majority of articles were published in high impact and quality international journals in the field of stroke, indicated the high attention among the stroke researchers. In the top five journals, "Stroke" with an IF of 4.882 was shown to present the

Table 3

Characteristics of top five highly cited published articles in field of SAP.

Rank	Name of article	Number of citations	Year	Country	Journal	IF
1	Nosocomial pneumonia after acute stroke: Implications for neurological intensive care medicine	288	2003	Germany	Stroke	4.882
2	Risk factors, inpatient care, and outcomes of pneumonia after ischemic stroke	180	2011	Canada	Neurology	8.77
3	Preventive antibacterial therapy in acute ischemic stroke: A randomized controlled trial	175	2008	Germany	Plos One	2.74
4	Stroke-associated infection is an independent risk factor for poor outcome after acute ischemic stroke: Data from the netherlands stroke survey	142	2009	Netherlands	Cerebrovascular Diseases	2.698
5	Predictors of pneumonia in acute stroke patients admitted to a neurological intensive care unit	112	2007	Germany	Journal of Neurology	3.956

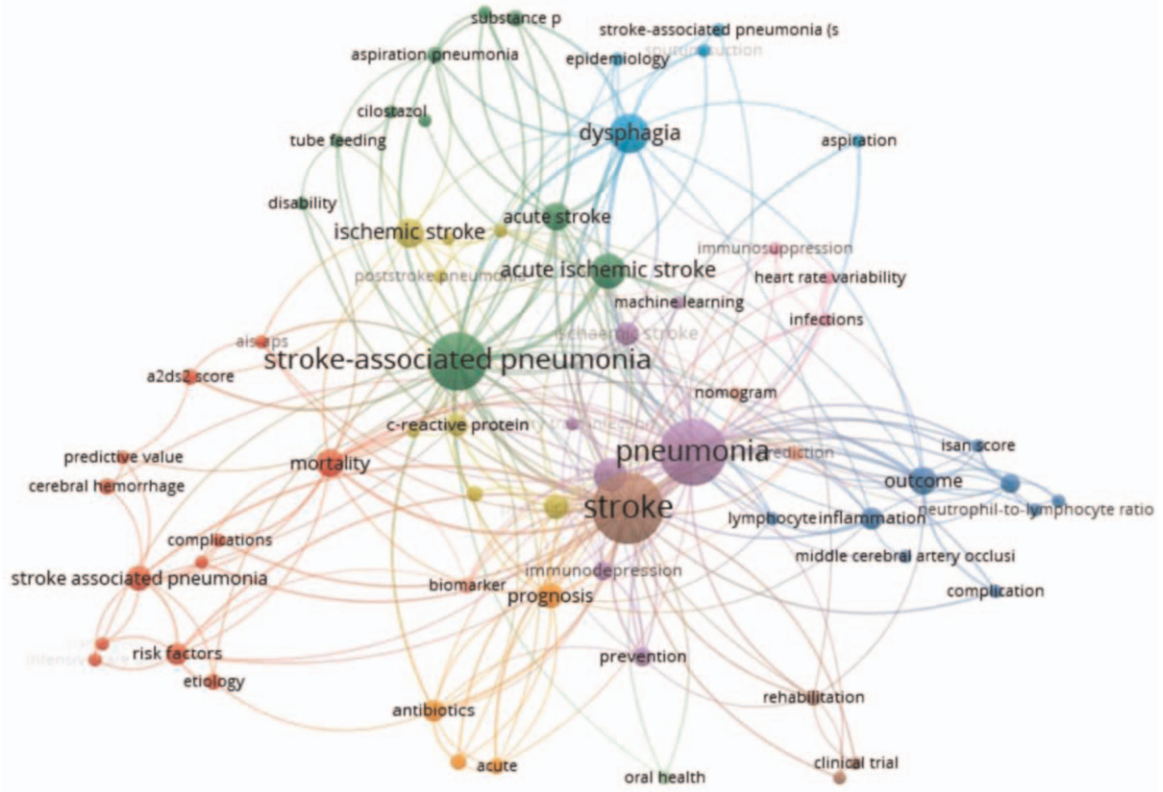

Figure 3. Map of co-keywords of articles in the field of SAP.

importance of new findings of SAP. The "Journal of Stroke and Cerebrovascular Diseases" with the highest number of articles in the field was indexed in many of the important citation databases, like PubMed, Web of Science, Scopus, and Medline.

China as the leading country published the most articles and Germany ranked second. It should be noted that although China was published one-third of articles in this field, "Charité-Universitätsmedizin Berlin" from Germany was found as the top institute focused on this topic. Some institutions in the United Kingdom also work in the field. This could be explained that the research on the concept, diagnostic criteria, and factors of SAP mainly comes from these institutions.[17,18] The main institutions were universities, but SAP was a clinical issue, this reminds us to strengthen the cooperation between universities and hospitals.

Citations in this field of SAP had increased over time, especially rapid growth in the recent 3 years. That may be because of the increased number of articles, and more researchers on this topic. The top five highly cited articles were published from 2003 to 2011. Germany had three high cited articles was ranked as the first, indicating the German researchers focused on SAP again. The highest cited article (288 times) was published by Hilker et al from Germany in 2003, entitled "Nosocomial pneumonia after acute stroke: Implications for neurological intensive care medicine."[2] This article was the first study of SAP published in "stroke," which brought a new perspective for pneumonia after stroke.

The high-frequency keywords represent the focus in this field.[19] The co-keywords networks showed the researchers' interest topics in this field, such as the risk factors, predictive scores, preventions, and outcomes. Since more and more research had shown that SAP was associated with poor outcomes, like increased risk of in hospital mortality,[20] prolonged length of hospital stay,[21] and has a considerable economic impact on healthcare resources.[7] Exploring the risk factors had become a hot topic of research. Dysphagia and stroke-induced immunodeficiency were the major risk factors that predispose patients to SAP.[22,23] Besides, age, stroke severity, level of consciousness, chronic obstructive pulmonary disease, and coronary artery disease may be associated with SAP.[24] Furthermore, a range of research developed some predictive scores based on the risk factors to predictive SAP.[17] To prevent SAP, the research of clinical and nursing prophylactic measures also became a hot topic. Some articles had to find medical interventions and care processes that may impact the development of SAP. However, there were insufficient data to determine which interventions were more effective. Which indicated to us that further research should be needed in the field.

5. Strengths and limitations

Our study had some strengths and limitations. First, we focused on the hot topic in the field of stroke and pneumonia. Second, we used Scopus database which has a high multidisciplinary coverage in science. Third, we analyzed the research status and trends in this field from the perspectives of subject areas, journals, institutes, citations, and co-keywords networks. Finally,

the potential limitation of this study was the number of articles maybe not enough, the database may not represent all the articles in this field.

6. Conclusion

The results of this study showed an ascending trend in global articles in the field over years. The trend was in line with the development of risk factors and measures to improve the patients' outcomes. Through the bibliometric analysis could evaluate the development of SAP, and explore the research trend of SAP. Overall, this study could provide practical sources for researchers to find the top subject areas, journals, institutes, citations, and co-keywords. Additionally, the study could pave the way for researchers to be engaged in studies potentially lead to more articles in this field.

Author contributions

Data curation: Yuanyuan Chen, Hongyan Yang.
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