



Twenty-year span of global acute pancreatitis trends: A bibliometric analysis



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ABSTRACT

Objective: This study aims to investigate the global research routine and trends of acute pancreatitis over the last twenty years based on the production, hotspots, and frontiers of published articles as well as to provide the global health system with a bibliometric reference.

Methods: The Web of Science core collection database was retrieved for acute pancreatitis original articles and review articles published from January 1, 1999 to May 17, 2020. Duplicates and discrete papers were excluded. Articles were evaluated for several characteristics including number of citations, publication time, country of origin, institution, journal and authorship.

Results: A total of 7001 articles originated from 94 countries and were published in 1263 journals. The China contributed most articles (1752) followed by USA (1214). The research was major published in specialized journals including the *Pancreas* (511) and *pancreatology* (351). Universities were the main institutions of science progress. High-impact articles focused on the fields of clinical medicine. A steady growth was observed in the last 20 years from 1999 to 2020.

Conclusion: This comprehensive bibliometric study indicates that severe acute pancreatitis and necrotizing pancreatitis are significant topic in the acute pancreatitis research. The structured information may be helpful in understanding research trends, and locating research hot spots and gaps in this domain.

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1. Introduction

Acute pancreatitis (AP), an inflammatory disorder of the pancreas, is the leading cause of admission to hospital for gastrointestinal disorders in the USA and many other countries. Gallstones and alcohol misuse are long-established risk factors, but several new causes have emerged that, together with new aspects of pathophysiology, improve understanding of the disorder. As incidence (and admission rates) of acute pancreatitis increase, so does the demand for effective management [1].

Bibliometrics uses mathematical and statistical methods to comprehensively analyze specific documents. The more commonly

used software is BibExcel, Bicom, CiteSpace and VOSviewer and other software. The growing availability of bibliometric methods and tools enables collection and analysis of appropriate literature resources to judge the development status of a discipline and predict its development prospects. Bibliometrics based on the mapping knowledge domain as a tool to evaluate the research outputs' characteristics has been widely adopted, and analysis results are capable of providing a comprehensive assessment of the quality and quantity of scientific yields [2]. Such research can not only describe the trends and distribution of publications including the impacts and citations but also reflect health policy decisions, the input of medical resources, and further social phenomena [3]. In order to assess the impact of AP research on global scientific research production and contribute to the prevention and control of AP, a bibliometric analysis was performed by utilizing the accessible data indexed at the Web of Science database.

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2. Materials and methods

2.1. Search strategy

A search query was built on the bibliometric database Web of Science for articles like this: TI = “acute pancreatitis”. The time frame for publication searching was set from January 1, 1999 to May 17, 2020, with no limitations on languages, the document types include original article and review article. Related data were listed in descending order according to their publication time. All of the citation information, bibliographical information, abstract and keywords, funding details, and others were exported with CSV format for analysis. Double-extraction method was used, with which two reviewers had extracted data and evaluated the study eligibility independently. The title and abstract for acceptable papers were screened respectively, and in the case that the title and abstract hit the inclusion criteria, the full publication will be included for retrieving and evaluation. The study contains the researches on AP and those which include AP in their main part. Publications on chronic pancreatitis and pancreatic cancer were excluded. In addition, all disagreements were settled through discussions under the verification of the third-party reviewer.

2.2. Data analysis

Microsoft Excel was applied to sort and to perform statistical procedures. Top prolific authors, countries, journals, institutions, and most cited papers were ranked according to the standard competition ranking (SCR). GraphPad Prism version 8.0 (San Diego, CA, USA) was used to draw bar charts. Data visualization was conducted using the VOSviewer (Version 1.6.6, The Centre for Science and Technology Studies of Leiden University, <https://www.vosviewer.com/>) technique to create scientific landscapes and networks based on the citation frequency, countries, journals, authors, and other information. Some bibliometric indicators were applied in the analysis. The strength of publications included was assessed by the impact factor (IF) obtained from the latest Journal Citation Report (2019) published by Thomson Reuters.

3. Results

3.1. Publications analysis based on language and yearly yields

Our search strategy yielded a total of 7,001 publications, include research articles (n = 6,347, 90.7%), review articles (n = 654, 9.3%). The retrieved papers were written in 14 different languages, mainly in English (n = 6689, 95.5%), followed by German (n = 91, 1.3%), French (n = 90, 1.3%), and Spanish (n = 70, 1.0%). An obviously growth of annual publication numbers was observed in the last several years from 2012 to 2019. The highest number of annual publications was seen in 2019, totaling 590 publications. The specific numbers of annual documents were shown in Fig. 1.

3.2. Publications analysis based on authors

A total of 27,109 authors contributed to the publication of all the 7001 papers included. The number of authors for a single document, also known as the transience index, was 21,432, accounting for 79.1% of all the authors. Among these, the first corresponding authors were from 94 different countries. There are 285 authors who published more than 10 articles in this field. Weiqin Li was the most productive author in this field with 78 publications, the following were Petrov, MS (72 publications) and Windsor, JA (53 publications). The top 10 most prolific authors were presented in Fig. 2A. Citation analysis of 60 authors with at least 20 publications

showed that 30 of them were interrelated. Weiqin Li was the most productive author with the publications number of 78. The top 10 most citation numbers authors was presented in Fig. 2B. Detailed citation analysis was presented in Fig. 3.

A total of 23,036 authors have been cited at least once, accounting for 85.0% of the total 27,109 authors, 12,741 authors had citation numbers at least 10 (55.3%), and 1,494 authors have been cited at least 100 times (6.5%). Banks, PA was the most influential author with the greatest citation number of 5,309, followed by Gooszen, HG (3,825), and Vege SS (3668); details of citation analysis are represented in Fig. 4. Among the top 20 most cited authors, Tsiotos, GG had the greatest citation numbers per publication (938), followed by Dervenis (493.25) and Baillie, J (278.6), more details were shown in Fig. 2C.

3.3. Publications analysis based on top cited articles

All of the retrieved 7,001 papers were cited 126,196 times. 171 (2.4%) articles had at least one hundred citation, while 997 (14.2%) articles had no citations. Among the top 10 highly cited papers, the USA had 5 articles. Top 20 cited papers are listed in Table 1. The highest citation number was 1,833 for the article entitled “Classification of acute pancreatitis-2012: revision of the Atlanta classification and definitions by international consensus” published in *The Gut* [4]. Among the top 20 highly cited papers, the *Gut*, *Lancet*, and *Gastroenterology* had 3 articles, respectively. As the first author, Banks, PA published 2 papers and participated 4 papers among the top 20 cited papers. Banks, PA was the most productive of the highest quality authors, participated in 47 articles.

3.4. Publications analysis based on countries/regions

The geographical distribution of publications involved 94 countries/regions over six Continents. There were 16 countries that just published only one article, and 65 countries that published at least five articles. The top 10 most productive countries are shown in Fig. 2D; the China ranked first with 1,752 publications, followed by USA (1,214 publications), Germany (457 publications), Japan (452 publications), and UK (401 publications).

Analysis of citation counts for countries showed that the USA had the most citations followed by China, UK, Germany and the Japan (Fig. 5). The international collaboration analysis based on 62 countries is shown in a network visualization map (Fig. 6). As is indicated in the collaboration analysis, the USA had collaborations with other 49 countries and followed by Italy (43 collaboration links), UK and Germany (both 42 collaboration links), China (37 collaboration links). For the USA, collaboration was mostly with China (relative link strength = 70) and Germany (relative link strength = 63).

3.5. Publications analysis based on institutions

Prolific institutions in publishing papers on acute pancreatitis were presented in Table 2. The most active institution was Sichuan University in China (162 publications), followed by Shanghai Jiaotong University in China (133 publications), and University of Pittsburgh in USA (122 publications). A total of 269 institutions published at least 10 articles. Among the top 10 most active institutions, 5 were in China, 3 were in USA. A total of 52 organizations have been cited at least 1,000 times, the citation analysis was shown in Fig. 7. The Harvard University obtained the highest citation number (7,251 citations), and followed by Mayo clinic (5,426 citations) and University of Pittsburgh (5,101 citations).

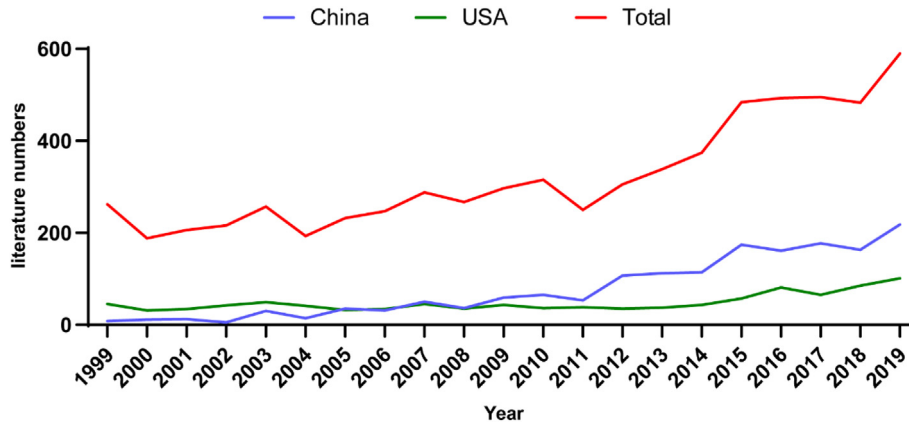


Fig. 1. Annual publications of acute pancreatitis.

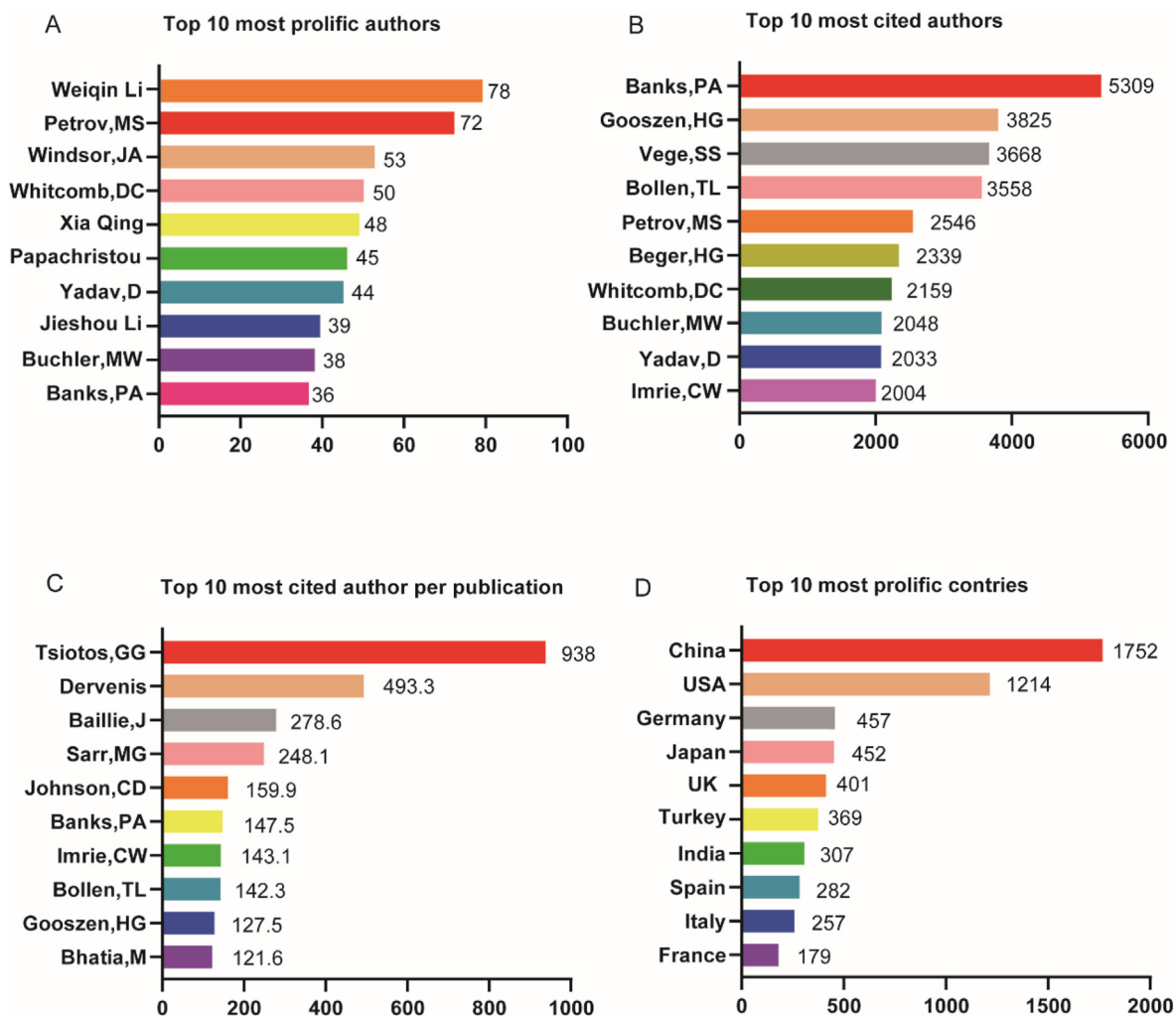


Fig. 2. (A) Top 10 most prolific authors. (B) Top 10 most citation numbers authors. (C) Top 10 authors with the highest citation numbers per publication. (D) Top 10 most prolific countries/regions according to publication numbers.

3.6. Publications analysis based on journals

All the retrieved documents were published in 1263 different journals. The top 20 active journals in publishing articles on acute pancreatitis were shown in Table 3. The most prolific journal in this

field was *Pancreas* (511 publications), followed by *Pancreatology* (351 publications), and *World Journal of Gastroenterology* (312 publications). The total number of articles published in top 20 journals was 2,254, accounting for 32.2% of total retrieved documents. Citations analysis of the included 274 journals with at least

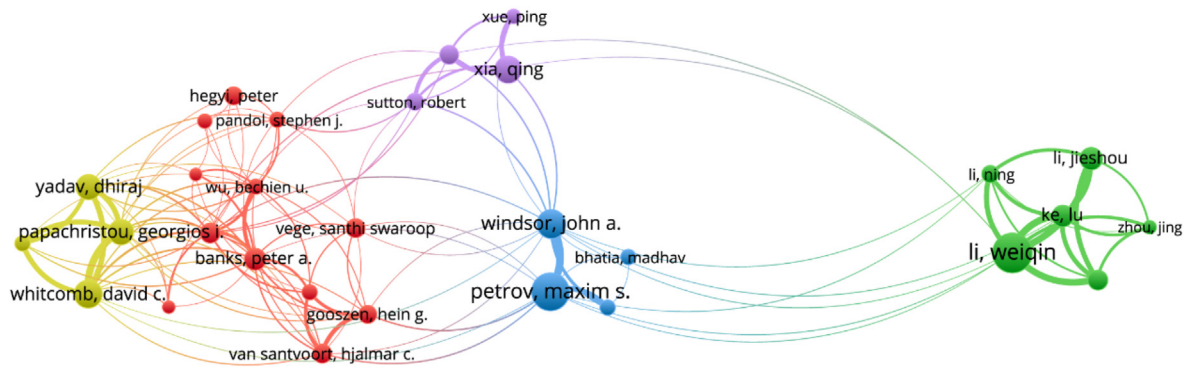


Fig. 3. Citation analysis of 30 authors with at least 20 publications. Thicker lines indicate stronger collaborations. Authors represented with larger circle size or font size had relatively more publications.

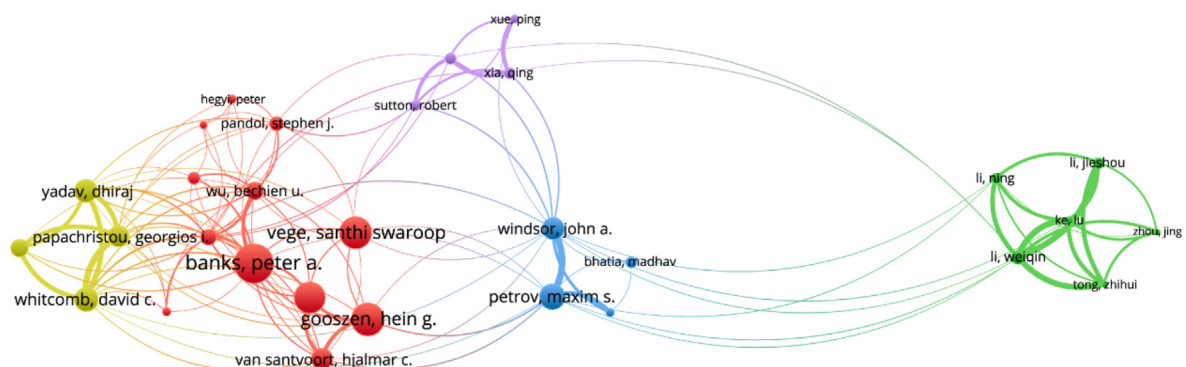


Fig. 4. Citation analysis of 30 authors with at least 20 publications. Thicker lines indicate stronger collaborations. Authors represented with larger circle size or font size had relatively more citations.

five publications indicated that *Pancreas* has the highest citation numbers (N = 10,537), followed by *Pancreatology* (N = 7,191), and *World Journal of Gastroenterology* (N = 6,305). Density map of journals citation analysis were show in Fig. 8.

3.7. Publications analysis based on terms frequency

A density visualization map of most frequently encountered terms is shown in Fig. 9. This analysis was performed based on the terms extracted from the title and abstract fields of retrieved publications, a number of 367 terms met the threshold with a minimum number of occurrences as 100. The term with the highest frequency was acute pancreatitis (N = 5,561), followed by patient (N = 4,073), study (N = 3,355), treatment (N = 2,162), severe acute pancreatitis (N = 1,779), and complication (N = 1,428). In addition, the mechanism appeared 803 times, etiology appeared 497 times.

3.8. Publications analysis based on key words

A density visualization map of most frequently key words is shown in Fig. 10. This analysis was performed based on the key words fields of retrieved publications, a number of 93 key words met the threshold with a minimum number of occurrences as 100. The key words with the highest frequency was acute pancreatitis (N = 2,758), followed by pancreatitis (N = 1,097), management (N = 998), severity (N = 937), mortality (N = 785), and acute necrotizing pancreatitis (N = 677). In addition, the severe acute pancreatitis appeared 616 times, necrosis appeared 611 times, necrotizing pancreatitis appeared 441 times. It can be seen that the keywords related to necrosis were at least 1,729 times.

4. Discussion

Bibliometric analysis can helps us recognize important advances in research about AP and adds useful perspective on historical developments in our specialty. It can also supply quantitative information about authors, institutions, and journals that is helpful to identify classic works and high-impact journals. To the best of our knowledge, this is the first comprehensive bibliometric analysis to reveal the research trends of AP.

These articles reflected major advances and annual publications' trend about AP during the last 20 years. Over the past 20 years as the research progress of AP and imaging technology progress, the classification and definition in the controversial. 2012 international acute pancreatitis revised working group published a new revision of the Atlanta classification standard, the concise clinical and radiological criteria for the classification of AP were clearly defined, the related research to standardization, the academic exchanges between help clinicians. Our results showed that there has been a steady increase in the number of articles about AP each year since 1999, especially since 2012. However, it deserves further analysis whether AP publication rising as a percentage of total biomedical publication year on year.

The USA and China are the most productive countries, contributing over 2800 articles to AP research. Chinese scholars' publications occupied the leading position, which showed that Chinese medical research has made great progress in recent years. The results showed that the contribution of many of the developed country such as US, European and Japanese individuals and centers is historical and that the contribution from China (and others developing country) is more recent. These articles include many

Table 1
Top 20 cited articles on acute pancreatitis from 1999 to 2019.

SCR	Author	Title	Year	Source title	Cited by	IF
1st	Banks et al.	Classification of acute pancreatitis-2012: revision of the Atlanta classification and definitions by international consensus	2013	Gut	1833	13.319
2nd	Banks et al.	Practice guidelines in acute pancreatitis	2006	American Journal of Gastroenterology	967	5.608
3rd	Tenner et al.	American College of Gastroenterology Guideline: Management of Acute Pancreatitis	2013	American Journal of Gastroenterology	714	9.213
4th	Besselink et al.	Probiotic prophylaxis in predicted severe acute pancreatitis: a randomised, double-blind, placebo-controlled trial	2008	Lancet	726	28.409
5th	Besselink et al.	IAP/APA evidence-based guidelines for the management of acute pancreatitis	2013	Pancreatology	588	2.504
6th	Buchler et al.	Acute necrotizing pancreatitis: Treatment strategy according to the status of infection	2000	Annals of Surgery	503	5.987
7th	Frossard et al.	Acute pancreatitis	2008	Lancet	470	28.409
8th	Whitcomb et al.	Acute pancreatitis	2006	New England Journal of Medicine	444	51.296
9th	Johnson et al.	UK guidelines for the management of acute pancreatitis	2005	Gut	460	7.692
10th	Forsmark et al.	AGA institute technical review on acute pancreatitis	2007	Gastroenterology	434	11.673
11th	Balthazar et al.	Acute pancreatitis: Assessment of severity with clinical and CT evaluation	2002	Radiology	392	4.844
12th	Bhatia et al.	Inflammatory mediators in acute pancreatitis	2000	Journal of Pathology	359	4.137
13th	Petrov et al.	Organ Failure and Infection of Pancreatic Necrosis as Determinants of Mortality in Patients With Acute Pancreatitis	2010	Gastroenterology	358	12.032
14th	Pandol et al.	Acute pancreatitis: Bench to the bedside	2007	Gastroenterology	364	11.673
15th	Halangk et al.	Role of cathepsin B in intracellular trypsinogen activation and the onset of acute pancreatitis	2000	Journal of Clinical Investigation	361	12.015
16th	Yadav et al.	Trends in the epidemiology of the first attack of acute pancreatitis - A systematic review	2006	Pancreas	356	2.121
17th	Johnson et al.	Persistent organ failure during the first week as a marker of fatal outcome in acute pancreatitis	2004	Gut	345	6.601
18th	Bhatia et al.	Pathophysiology of acute pancreatitis	2005	Pancreatology	319	1.564
19th	Buter et al.	Dynamic nature of early organ dysfunction determines outcome in acute pancreatitis	2002	British Journal of Surgery	320	3.444
20th	Lankisch et al.	Acute pancreatitis	2015	Lancet	302	44.002

SCR, standard competition ranking. Equal items were given the same ranking number, and then a gap is left in the ranking numbers; IF, impact factor.

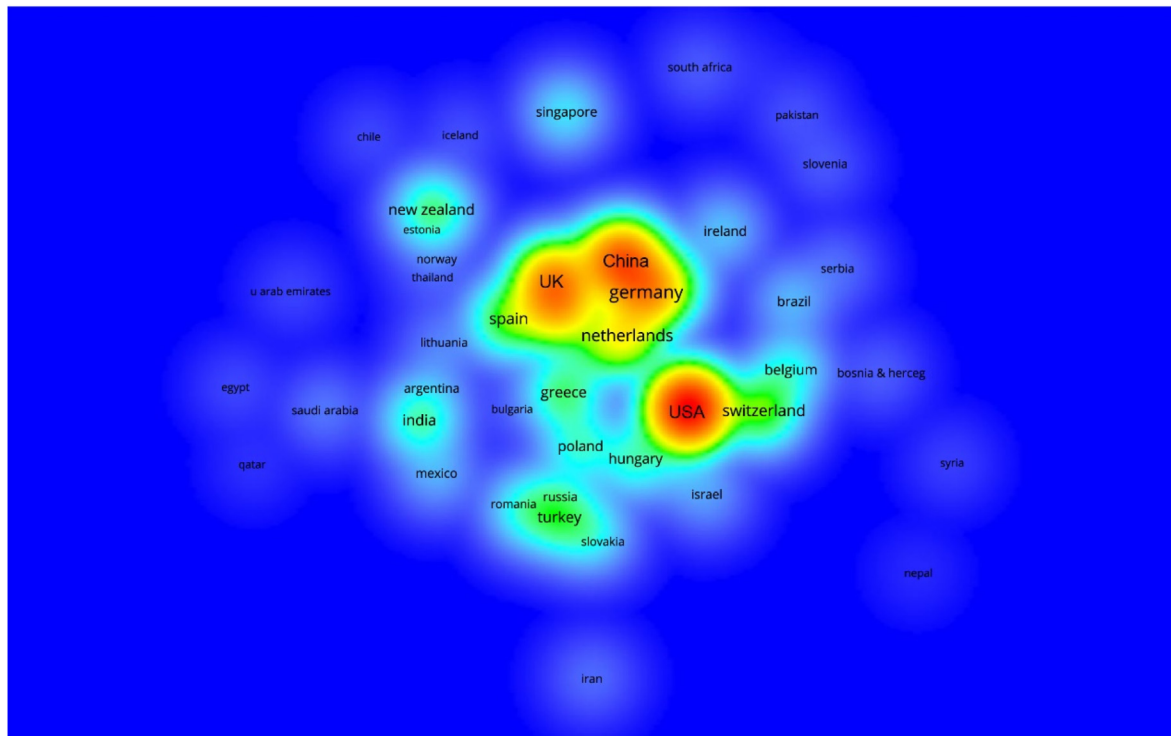


Fig. 5. Density visualization of citation analysis for countries with a minimum productivity of 5 documents, a total of 65 countries and regions meet the threshold. Countries with the higher number of citations have darker spots.

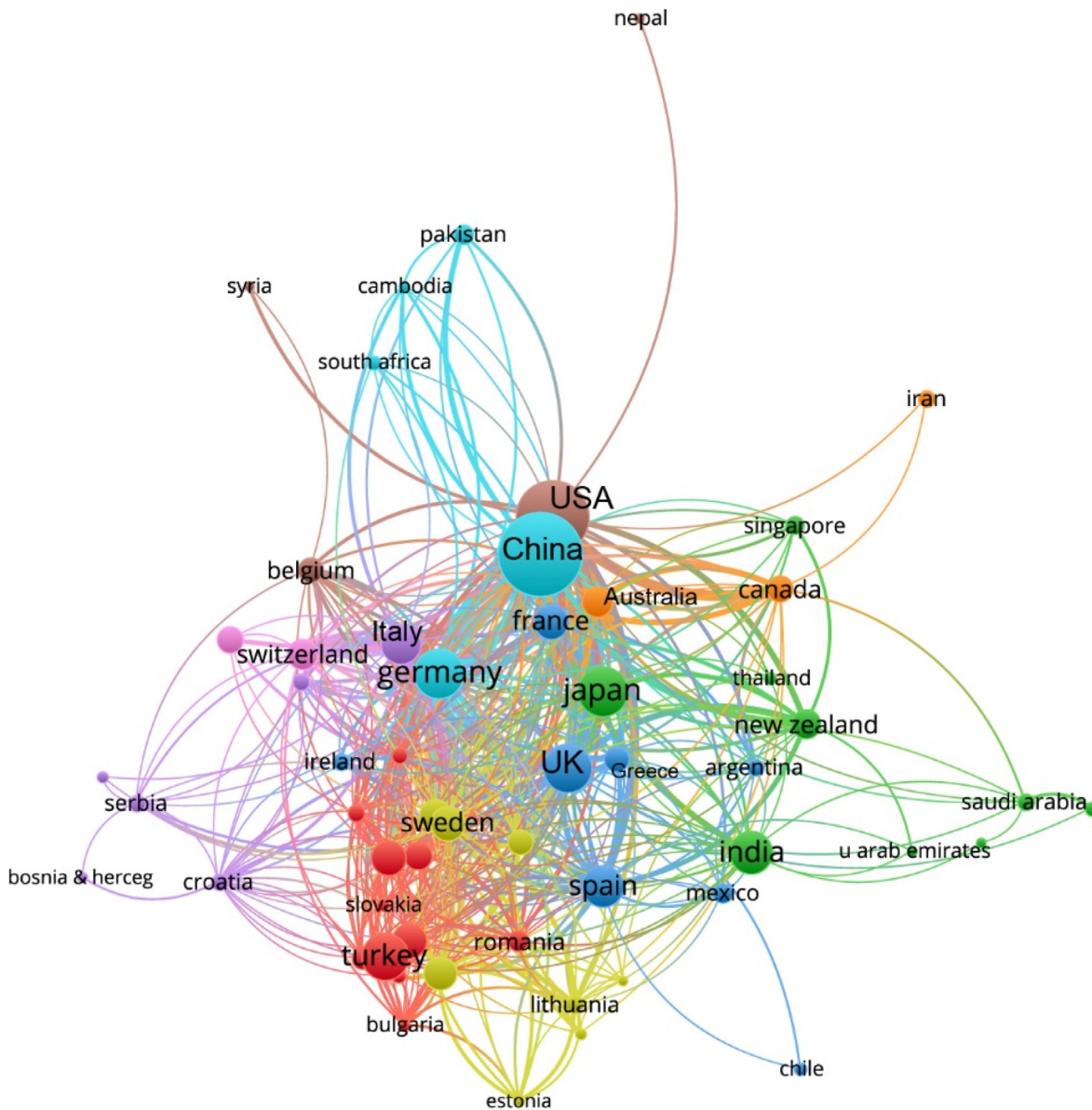


Fig. 6. Citation analysis of 62 countries with at least 5 publications. Thicker lines indicate stronger collaborations. Countries represented with larger circle size or font size had relatively more publications.

Table 2
Top 10 prolific institutions in publishing papers on acute pancreatitis.

SCR	Institution	Country	Documents
1st	Sichuan University	China	162
2nd	Shanghai Jiaotong University	China	133
3rd	University of Pittsburgh	USA	122
4th	Nanjing University	China	101
5th	University of Auckland	New Zealand	98
6th	University of Helsinki	Finland	86
7th	Mayo clinic	USA	84
8th	Zhejiang University	China	75
9th	China Medical University	China	71
10th	Harvard University	USA	68

clinical studies about AP [5,6]. However, our results showed that there were no Chinese among the top ten cited authors. We should pay attention to the quality of the paper rather than the quantity, and pay more attention to academic innovation.

The number of times that an article is cited is widely used to measure its impact and to assess its quality by authors and can help doctors quickly search those needed articles. As expected, most of the 20 most frequently cited articles came from the United States in the fields of AP research and 3 of the top 10 institutions were located in the United States, which is in keeping with the origins of the top 100 citation classics in the fields of digestive system disease [7], colorectal cancer [8], and others. Harvard University and Mayo Clinic are the two most cited institutions. These findings prove the USA's overwhelming impact on medical science research not only its large population and the abundant financial resources available to the scientific community, but also Innovative cultural features is more important factor. It is also reported that American authors tend to be biased in their citation process toward local articles and that US reviewers prefer US papers [9,10]. In addition, the most critical reason was because the USA has been crucial in fostering and engaging in international collaborations on AP research regarding prevention, control, diagnosis, and treatment [11].

Table 3
Top 20 prolific journals in publishing papers on AP.

SCR	Journals	Documents	IF(2019)
1st	Pancreas	511	2.92
2nd	Pancreatology	351	3.629
3rd	World Journal of Gastroenterology	312	3.665
4th	Digestive Diseases and Sciences	129	2.751
5th	Hepato-gastroenterology	92	NA
6th	American Journal of Gastroenterology	87	10.171
7th	Scandinavian Journal of Gastroenterology	81	2.13
8th	Plos One	76	2.74
9th	Gastroenterology	60	17.373
10th	Medicine	59	1.552
11th	Journal of Clinical Gastroenterology	57	2.973
12th	Journal of Gastroenterology and Hepatology	55	3.437
13th	Gut	53	19.819
14th	British Journal of Surgery	50	5.676
15th	Hepatobiliary & Pancreatic Diseases International	49	2.428
16th	Journal of Gastrointestinal Surgery	48	2.573
16th	Journal of the Pancreas	48	NA
18th	American Journal of Physiology-gastrointestinal and Liver Physiology	47	3.725
18th	European Journal of Gastroenterology & Hepatology	47	2.251
20th	International Journal of Clinical and Experimental Medicine	42	0.166

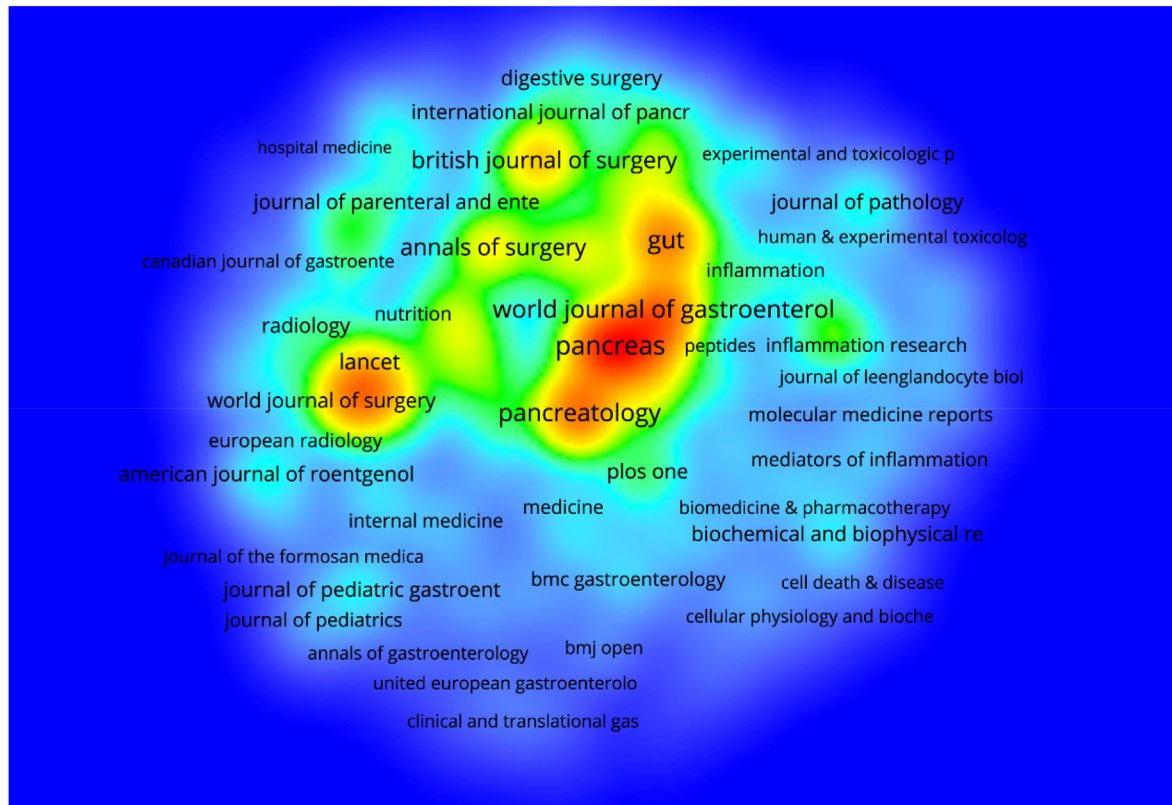


Fig. 8. 274 journals were included in this analysis with a minimum productivity of five publications in this field. Journals with the higher number of citations have darker spots.

pathophysiology of pancreatitis. Various guidelines about severe acute pancreatitis have been published in recent years, covering early diagnosis, antibiotic treatment, management of intensive care units, surgical management, enteral nutrition, and abdominal cavity [16,17]. In addition, our research shows that necrotizing pancreatitis is a research hotspot in the past 20 years. Infectious pancreatic necrosis is still one of the clinical problems, and the fatality rate is as high as 20%–30%. The American Gastroenterology Association and many other guidelines clearly point out that once pancreatic necrosis is infected, puncture and drainage should be

done immediately [18,19]. Minimally invasive interventions for ascending steps of infectious pancreatic necrosis have been widely accepted and gradually show advantages. Ascending the stairs first consider percutaneous or transgastric puncture drainage. Randomized controlled trials (RCT) have compared minimally invasive medical and surgical treatments, and the results show that there is no significant difference in mortality. However, the incidence of major complications in endoscopic transgastroduodenal debridement is significantly lower than that of surgical debridement [20,21]. Therefore, it is currently considered that the placement of a

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