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Research Paper

Trend of academic publication activity in anesthesiology: A 2-decade bibliographic perspective

Sy-Yuan Chen [1 †], Ling-Fang Wei [2 †], Chiu-Ming Ho [3 *]

[1] School of Medicine, College of Medicine, Chung Shan Medical University, Taichung, Taiwan
[2] Department of Library and Information Science, National Taiwan University, Taipei, Taiwan
[3] Department of Anesthesiology, Taipei Veterans General Hospital and National Yang-Ming University, Taipei, Taiwan

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ABSTRACT

Objectives: The publication of anesthesiology papers presents the importance of understanding the corresponding research activity. This research used the bibliographic method to investigate the publication trend in anesthesiology using Science Citation Index Expanded over the period 1995–2014.
Methods: The journals listed in the subject category of anesthesiology in the 2014 *Journal Citation Reports* were selected, and bibliographic information was collected from Science Citation Index Expanded, with 128,003 papers published from 1995 to 2014. Only the document type "article" was analyzed. The productivity and impact of various journals, countries, and institutions are discussed.
Results: A total of 64,199 articles published from 1995 to 2014, with 1,084,491 cited times, were examined. The total number of articles published by journals showed a slight increase in the 2nd decade. More than 45% of these articles were published by the top five journals, which have maintained their ranking over 2 decades. Most publications originated from North America and European countries, of which the United States had the highest number of publications and citations. Most of the institutions are academic universities and hospitals. More than half of the top 25 institutions (in rankings) are located in the United States, and Harvard University accounted the highest number of articles and citations among all institutions.
Conclusion: The results reported here may aid clinicians and researchers to better understand the worldwide contribution of anesthesiology research activities over 2 decades.

1. Introduction

Understanding the publication activity in the field of anesthesiology is incorporated in decisions that enhance academic advancement. To our best knowledge, the first study on this publication activity that evaluated the subject journals with citation analysis was published in 1987.[1] It is thus important to explore the current state of publications in anesthesiology.

A bibliometric method is the application of quantitative analysis to the publication of journals, articles, and their accompanying citation counts. A number of bibliometric studies looked at the publishing trends in anesthesiology, whereas others examined the state of journals. Robert et al[2] traced the evolution of the articles published on *Pain* from 1976 to 2007. Meanwhile, Szokol et al[3] reported that the number of basic science and clinical research papers contributed by American authors in core anesthesiology have decreased between 1980 and 2000. Other researchers went on to examine the geographical distribution of publications and identified some of the most cited institutions.[4–6] In addition, Bould et al[7] found that the researchers from United States had the highest number of original publications, whereas Swaminathan et al[8] demonstrated that the United States produced the largest amount of clinical research. However, Europe has a higher capita output of clinical research than that of the United States.[8] Li et al[9] reported the publication trends in East Asia and noted a significant decrease in the number of publications from Japan. On the contrary, this report observed modest increases in the number of publications in anesthesiology research from China and South Korea from 2000 to 2009.[9] Concerning the academic performance of institutions,

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* Corresponding author. Department of Anesthesiology, Taipei Veterans General Hospital, Number 201, Section 2, Shipai Road, Beitou District, Taipei City 11217, Taiwan.
E-mail address: cmho@vghtpe.gov.tw (C.-M. Ho).
† S.-Y. Chen and L.-F. Wei contributed equally to this study.

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Terajima and Aneman[5] identified the 67 institutions that produced the most cited articles in the pain and analgesia literature from 1986 to 1997.

Notably, previous bibliometric studies in anesthesiology were seldom conducted for global and long-term frame. Thus, the findings of these studies may not adequately cover the changing trends in the publication of anesthesiology articles over the past 2 decades. This study seeks to close this gap in research by conducting a thorough examination of journal articles listed under the subject category of "anesthesiology" in *Journal Citation Reports* (JCR) from 1995 to 2014. The aim of this study was to examine the distribution of journals, countries, and institutions for the period 1995–2014. The time trends of articles will be explored over 2 decades. The result reported here may aid clinicians and researchers in better understanding the worldwide contribution of anesthesiology research activities.

2. Methods

This study retrieved data from Science Citation Index Expanded (SCI-E) over a period of 2 decades, (1995–2014) on August 18, 2015 at National Taiwan University. First, 30 source journals for the papers examined were selected in the subject category of "anesthesiology" in 2014 JCR. A total of 128,003 papers were published over this 20-year time frame. Only the document type "article" was analyzed in this study. A total of 64,199 articles with 1,084,491 citations were collected for further examined. Second, we captured the bibliographical record of each article in SCI-E and took note of its Institute for Scientific Information code, publication year, title, abstract, subject category, and references for further study. Finally, we used the following indicators to evaluate the productivity and impact of journals, countries, and institutions: total number of articles published by the journal to determine the importance or rank of the journal; total number of articles by countries and institutions was taken as a quantity indicator of research; total number of citations by countries and institutions was taken as the quality indicator of research.

There were several ways to determine the number of papers published. As in our previous study,[10] the whole counting method[11] was used in this study. Papers with multiple authors were counted more than once when the coauthorship was transnational or interinstitutional. The time trends of articles and the results will be presented by descriptive analysis divided into 2 decades.

3. Results

3.1. Distribution of journals

There were 30 journals that published anesthesiology articles in the 2014 JCR (Table 1). A total of 64,199 articles relating to anesthesiology were selected and divided for two decades. There were 30,507 articles published from 1995 to 2004 and 33,692 articles from 2005 to 2014, indicating an approximate 10% increase in the number of articles published. Overall, articles published from all journals showed only a slight increase, whereas journal titles increased from 18 in 1995 to 30 in 2014. *Anesthesia and Analgesia*, *Anesthesiology*, *Pain*, *British Journal of Anaesthesia*, and *Acta Anaesthesiologica Scandinavica*, which could be considered the core anesthesiology journals in terms of the number of articles published, contributed 45% of the total number of articles. However, it should be noted that the top five journals, which were ranked based on the number of articles in all journals, had shown a downtrend over 2 decades, with the exclusion of *Pain*. Moreover,

Table 1
Number of anesthesiology articles ranking over 2 decades.

Journal	Articles (rank)					
	1995–2004		2005–2014		Total[a]	
Anesthesia and Analgesia	5337	(1)	4174	(1)	9511	(1)
Anesthesiology	3730	(2)	2428	(3)	6158	(2)
Pain	2210	(5)	2646	(2)	4856	(3)
British Journal of Anaesthesia	2566	(3)	2119	(4)	4685	(4)
Acta Anaesthesiologica Scandinavica	2294	(4)	1687	(5)	3981	(5)
Anaesthesia	1751	(6)	1473	(7)	3224	(6)
Journal of Cardiothoracic and Vascular Anesthesia	1339	(8)	1614	(6)	2953	(7)
Canadian Journal of Anesthesia	1744	(7)	1007	(16)	2751	(8)
Annales Francaises d'Anesthesie et de Reanimation	1162	(9)	1267	(9)	2429	(9)
Anaesthesist	1160	(10)	1131	(12)	2291	(10)
European Journal of Anaesthesiology	1100	(11)	1122	(13)	2222	(11)
Anaesthesia and Intensive Care	1006	(13)	1135	(11)	2141	(12)
Journal of Clinical Anesthesia	1030	(12)	838	(18)	1868	(13)
Anasthesiologie Intensivmedizin Notfallmedizin Schmerztherapie	878	(14)	865	(17)	1743	(14)
Clinical Journal of Pain	470	(17)	1047	(14)	1517	(15)
Pediatric Anesthesia	140	(23)	1372	(8)	1512	(16)
European Journal of Pain	155	(22)	1245	(10)	1400	(17)
Regional Anesthesia and Pain Medicine	581	(15)	726	(20)	1307	(18)
Journal of Anesthesia	0	(25)	1028	(15)	1028	(19)
Anasthesiologie and Intensivmedizin	519	(16)	369	(26)	888	(20)
International Journal of Obstetric Anesthesia	328	(20)	525	(21)	853	(21)
Journal of Neurosurgical Anesthesiology	457	(18)	384	(25)	841	(22)
Der Schmerz	353	(19)	484	(22)	837	(23)
Minerva Anestesiologica	0	(25)	789	(19)	789	(24)
Journal of Clinical Monitoring and Computing	181	(21)	345	(28)	526	(25)
Pain Physician	0	(25)	467	(23)	467	(26)
Current Opinion in Anesthesiology	16	(24)	447	(24)	463	(27)
Pain Practice	0	(25)	365	(27)	365	(28)
Revista Brasileira de Anestesiologia	0	(25)	343	(29)	343	(29)
BMC Anesthesiology	0	(25)	250	(30)	250	(30)
Total	30,507		33,692		64,199	

[a] Rank by 1995–2014.

the number of articles published by *Anesthesia and Analgesia*, *Anesthesiology*, *British Journal of Anaesthesia*, and *Acta Anaesthesiologica Scandinavica* exhibited a decrease of 25%.

Table 2 shows the distribution of journals by cited times during the period 1995–2014. *Pain* had the largest cited times, followed by *Anesthesia and Analgesia*, *Anesthesiology*, *British Journal of Anaesthesia*, and *Acta Anaesthesiologica Scandinavica*, which also appeared in the list of top five most prolific journals. It was observed that the five journals had more productivity and higher impact than other journals. Moreover, *Clinical Journal of Pain*, which ranked 7th on the list, and 15th for number of articles published, was an example of a journal with low publication numbers and a high impact. Comparing the two decades, there were several journals with significant changes in ranking. *European Journal of Pain* rose in ranking (from 16th to 5th) as well as *Pediatric Anesthesia* (from 22nd to 9th), whereas *Canadian Journal of Anesthesia* fell to 10th from 7th place and *Journal of Cardiothoracic and Vascular Anesthesia* fell from 9th to 13th.

3.2. Distribution of countries

A total of 129 countries were identified from 64,199 articles for further investigation. Table 3 shows the top 20 countries according to the number of anesthesiology articles authored. The United States, Germany, the United Kingdom, France, and Japan were the top five countries in productivity, of which the United States accounted for the largest number of articles published. Most countries showed no significant difference in ranking over the 2 decades. Israel and Taiwan were both ranked in the top 20 in the 1st decade but fell off the list in the next, whereas Finland ranked 16th throughout the 20-year period but was not in the top 20 list in 2nd decade. It is noted that China and South Korea both showed a substantial increase in number of published articles published from 2005 to 2014. A centralized distribution of articles shows that the top three countries contributed 52% of the total number of articles, with the top five countries accounting for 66% and the top 10 countries accounting for more than 85%.

Table 3
Top 20 countries by number of articles over 2 decades.

Country	Articles (rank)					
	1995–2004		2005–2014		Total[a]	
USA	8,755	(1)	9,066	(1)	17,821	(1)
Germany	4,599	(2)	4,996	(2)	9,595	(2)
UK	3,518	(3)	2,817	(3)	6,335	(3)
France	2,177	(5)	2,491	(4)	4,668	(4)
Japan	2,380	(4)	1,949	(6)	4,329	(5)
Canada	1,669	(6)	2,192	(5)	3,861	(6)
Australia	1,233	(7)	1,633	(7)	2,866	(7)
Netherlands	621	(11)	1,217	(9)	1,838	(8)
Sweden	1,011	(8)	820	(13)	1,831	(9)
Italy	508	(14)	1,308	(8)	1,816	(10)
Switzerland	752	(10)	968	(10)	1,720	(11)
Austria	939	(9)	645	(17)	1,584	(12)
Denmark	569	(13)	766	(14)	1,335	(13)
Belgium	502	(15)	656	(16)	1,158	(14)
Turkey	344	(17)	739	(15)	1,083	(15)
Finland	610	(12)	459	—	1,069	(16)
Korea	154	—	836	(12)	990	(17)
China	93	—	840	(11)	933	(18)
India	278	(19)	600	(18)	878	(19)
Spain	299	(18)	518	(19)	817	(20)
Israel	368	(16)	351	—	719	—
Taiwan	257	(20)	357	—	614	—
Brazil	96	—	489	(20)	585	—

[a] Rank by 1995–2014.

Table 2
Cited times in anesthesiology ranking over 2 decades.

Journal	Cited times (rank)					
	1995–2004		2005–2014		Total[a]	
Pain	149,796	(1)	78,331	(1)	228,127	(1)
Anesthesia and Analgesia	135,233	(3)	60,450	(2)	195,683	(2)
Anesthesiology	139,449	(2)	55,423	(3)	194,872	(3)
British Journal of Anaesthesia	61,161	(4)	35,437	(4)	96,598	(4)
Acta Anaesthesiologica Scandinavica	33,817	(5)	16,950	(6)	50,767	(5)
Anaesthesia	28,841	(6)	16,299	(7)	45,140	(6)
Clinical Journal of Pain	19,569	(8)	15,641	(8)	35,210	(7)
Canadian Journal of Anesthesia	25,515	(7)	9,295	(10)	34,810	(8)
Journal of Cardiothoracic and Vascular Anesthesia	15,198	(9)	8,746	(13)	23,944	(9)
European Journal of Pain	5,345	(16)	18,533	(5)	23,878	(10)
European Journal of Anaesthesiology	11,264	(11)	9,168	(11)	20,432	(11)
Regional Anesthesia and Pain Medicine	11,027	(12)	9,074	(12)	20,101	(12)
Journal of Clinical Anesthesia	12,770	(10)	4,360	(18)	17,130	(13)
Anaesthesia and Intensive Care	10,179	(13)	5,714	(15)	15,893	(14)
Pediatric Anesthesia	1,945	(22)	11,131	(9)	13,076	(15)
Anaesthesist	7,498	(14)	4,100	(19)	11,598	(16)
Journal of Neurosurgical Anesthesiology	6,045	(15)	3,242	(20)	9,287	(17)
Annales Francaises d'Anesthesie et de Reanimation	4,583	(17)	2,786	(23)	7,369	(18)
International Journal of Obstetric Anesthesia	2,861	(18)	3,184	(21)	6,045	(19)
Pain Physician	0	(25)	5,741	(14)	5,741	(20)
Current Opinion in Anesthesiology	126	(24)	4,941	(17)	5,067	(21)
Minerva Anestesiologica	0	(25)	4,982	(16)	4,982	(22)
Der Schmerz	2,452	(20)	1,838	(25)	4,290	(23)
Journal of Clinical Monitoring and Computing	2,465	(19)	1,161	(26)	3,626	(24)
Anasthesiologie Intensivmedizin Notfallmedizin Schmerztherapie	2,367	(21)	1,054	(27)	3,421	(25)
Journal of Anesthesia	0	(25)	3,157	(22)	3,157	(26)
Pain Practice	0	(25)	1,898	(24)	1,898	(27)
Anasthesiologie & Intensivmedizin	982	(23)	506	(29)	1,488	(28)
BMC Anesthesiology	0	(25)	536	(28)	536	(29)
Revista Brasileira de Anestesiologia	0	(25)	325	(30)	325	(30)
Total	690,488		394,003		1,084,491	

[a] Rank by 1995–2014.

Table 4
Top 20 countries by cited times over 2 decades.

Country	Cited Times(rank)					
	1995–2004		2005–2014		Total[a]	
USA	266,073	(1)	132,938	(1)	399,011	(1)
UK	85,748	(2)	45,562	(3)	131,310	(2)
Germany	69,596	(3)	47,222	(2)	116,818	(3)
Canada	49,063	(4)	32,057	(4)	81,120	(4)
France	37,905	(5)	25,563	(5)	63,468	(5)
Japan	37,094	(6)	15,310	(9)	52,404	(6)
Australia	28,676	(7)	18,641	(7)	47,317	(7)
Netherlands	22,154	(9)	18,823	(6)	40,977	(8)
Sweden	28,390	(8)	11,471	(12)	39,861	(9)
Denmark	20,844	(10)	14,155	(10)	34,999	(10)
Switzerland	19,292	(11)	12,766	(11)	32,058	(11)
Italy	13,833	(15)	17,027	(8)	30,860	(12)
Austria	17,744	(12)	8,869	(14)	26,613	(13)
Belgium	15,202	(14)	10,740	(13)	25,942	(14)
Finland	16,730	(13)	6,597	(18)	23,327	(15)
Israel	9,607	(16)	5,553	—	15,160	(16)
Norway	7,160	(17)	7,702	(16)	14,862	(17)
Spain	6,795	(18)	7,188	(17)	13,983	(18)
Turkey	5,433	(20)	6,063	(19)	11,496	(19)
China	2,584	—	7,709	(15)	10,293	(20)
Taiwan	6,118	(19)	4,135	—	10,253	—
Korea	2,828	—	6,040	(20)	8,868	—

[a] Rank by 1995–2014.

Table 5
Top 25 institutions by number of articles over 2 decades.

Institution	Country	Articles (rank)					
		1995–2004		2005–2014		Total[a]	
Harvard University	USA	462	(2)	730	(1)	1192	(1)
University of Toronto	CA	381	(3)	571	(2)	952	(2)
University of California–San Francisco	USA	511	(1)	364	(6)	875	(3)
University of Washington–Seattle	USA	373	(4)	377	(5)	750	(4)
Duke University	USA	366	(5)	340	(7)	706	(5)
Ruprecht Karl University of Heidelberg	DE	320	(7)	380	(4)	700	(6)
Stanford University	USA	306	(8)	324	(8)	630	(7)
Massachusetts General Hospital	USA	175	—	419	(3)	594	(8)
Johns Hopkins University	USA	250	(12)	311	(11)	561	(9)
Brigham & Women's Hospital	USA	233	(14)	290	(13)	523	(10)
McGill University	CA	202	(20)	309	(12)	511	(11)
Ludwig Maximilian University of Munich	DE	249	(13)	225	(25)	474	(12)
University of Copenhagen	DK	185	(23)	288	(15)	473	(13)
University of Pennsylvania	USA	176	—	290	(14)	466	(14)
University of Helsinki	FI	259	(9)	190	—	449	(15)
Karolinska Institutet	SE	180	—	266	(17)	446	(16)
University of Munster	DE	225	(15)	217	—	442	(17)
Columbia University	USA	186	(22)	248	(18)	434	(18)
Humboldt University of Berlin	DE	116	—	317	(9)	433	(19)
University of Florida	USA	217	(17)	208	—	425	(21)
Free University of Berlin	DE	111	—	314	(10)	425	(20)
University College London	UK	168	—	239	(20)	407	(22)
University of Pittsburgh	USA	161	—	230	(22)	391	(23)
Wake Forest University	USA	253	(10)	132	—	385	(24)
University of Zurich	CH	179	—	203	—	382	(25)
University of California–San Diego	USA	190	(21)	189	—	379	—
Medical College of Wisconsin	USA	205	(19)	169	—	374	—
Yale University	USA	185	(24)	188	—	373	—
Mayo Clinic College of Medicine	USA	93	—	271	(16)	364	—
Aarhus University	DK	123	—	238	(21)	361	—
University of Vienna	AT	340	(6)	19	—	359	—
French Institute of Health and Medical Research	FR	92	—	247	(19)	339	—
Northwestern University	USA	109	—	229	(24)	338	—
University of Hamburg	DE	218	(16)	113	—	331	—
Cleveland Clinic Foundation	USA	213	(18)	107	—	320	—
University of Innsbruck	AT	253	(11)	22	—	275	—
University of Melbourne	AU	42	—	230	(23)	272	—
University of Ulm	DE	184	(25)	71	—	255	—

[a] Rank by 1995–2014.

Table 4 shows the top 20 countries by cited times. The United States owns the top position both in published articles and cited times, followed by the United Kingdom and Germany. Comparison of the two decades shows that the Netherlands, Italy, China, and South Korea exhibited growth rates (in ranking) superior to those of other countries. The Netherlands ranked 9th in the 1st decade and 6th in the 2nd decade, whereas Italy ranked 15th and 8th, respectively. China and South Korea, which fell off the list in the 1st decade, ranked 15th and 20th in the 2nd decade, respectively. Moreover, Israel and Taiwan declined in impact ranking. In brief, this result of ranking is similar with the ranking of distribution of number of articles.

3.3. Institutional distribution

A total of 1692 institutions were identified from 64,199 articles for further study. Table 5 shows the output of the top 25 institutions. Among the institutions, 13 are located in the United States, followed by Germany with five institutions and Canada with two institutions. Apart from Massachusetts General Hospital and Brigham & Women's Hospital, all institutions on the list were universities over this 2-decade period. Harvard University had the highest number of articles among all the institutions.

The ranking of institutions showed considerably higher variation compared with the ranking of countries. Some institutions fell from and subsequently reappeared on the list at various points. Several institutions, such as Massachusetts General Hospital, University of Pennsylvania, Karolinska Institutet, Humboldt University of Berlin, Free University of Berlin, University College London, and University of Pittsburgh, first appeared on the list only in the 2nd decade. By contrast, University of Helsinki, University of Munster, University of Florida, and Wake Forest University, all fell off the list in the 2nd decade, whereas University of Helsinki and Wake Forest University ranked in the top 10 in the 1st decade. Overall, U.S. institutions have dominated the rankings for 2 decades.

Table 6 indicates the impact of various institutions ranked by cited times. This ranking was similar to that of the number of articles published. Harvard University ranked first in both rankings (Tables 5 and 6). Again, most of the institutions were located in the United States. It was noted that Massachusetts General Hospital achieved an impressive feat in the 2nd decade in both rankings. Only a few of institutions did not appear on the top 25 list in terms of paper counts (Table 5), such as University of California–San Diego, Aarhus University, Maastricht University, Medical College of Wisconsin, University of Iowa, and University of Michigan–Dearborn. Some institutions fell off the list in the 2nd decade, such as University of California–San Diego, Medical College of Wisconsin, University of Iowa, University of Helsinki, and Wake Forest University.

4. Discussion

This study attempted to examine the distribution of journals, countries, and institutions concerning publication of papers in anesthesiology over 2 decades. Based on our results, we identified a total of 64,199 articles with 1,084,491 citations in the subject

Table 6
Top 25 institutions by cited times over 2 decades.

Institution	Country	Cited times (rank)					
		1995–2004		2005–2014		Total[a]	
Harvard University	USA	15,757	(3)	12,324	(1)	28,081	(1)
University of California–San Francisco	USA	18,989	(1)	6,698	(4)	25,687	(2)
University of Washington–Seattle	USA	16,523	(2)	7,222	(3)	23,745	(3)
University of Toronto	CA	13,547	(5)	9,323	(2)	22,870	(4)
Duke University	USA	13,589	(4)	5,387	(7)	18,976	(5)
Stanford University	USA	11,243	(6)	4,489	(13)	15,732	(6)
Johns Hopkins University	USA	9,224	(8)	5,650	(6)	14,874	(7)
Massachusetts General Hospital	USA	6,252	(22)	6,138	(5)	12,390	(8)
University of California–San Diego	USA	9,411	(7)	2,885	—	12,296	(9)
Brigham & Women's Hospital	USA	7,413	(9)	4,677	(9)	12,090	(10)
University of Florida	USA	7,304	(10)	4,501	(12)	11,805	(11)
University College London	UK	7,160	(13)	4,507	(11)	11,667	(12)
McGill University	CA	7,185	(12)	4,368	(15)	11,553	(13)
Karolinska Institutet	SE	6,650	(18)	4,165	(16)	10,815	(14)
University of Copenhagen	DK	6,121	(23)	4,595	(10)	10,716	(15)
Aarhus University	DK	6,429	(20)	4,132	(17)	10,561	(16)
Ruprecht Karl University of Heidelberg	DE	5,452	—	5,048	(8)	10,500	(17)
University of Pennsylvania	USA	6,832	(16)	3,634	(23)	10,466	(18)
Maastricht University	NL	6,331	(21)	3,752	(19)	10,083	(19)
Medical College of Wisconsin	USA	6,890	(14)	3,023	—	9,913	(20)
University of Iowa	USA	6,623	(19)	3,230	—	9,853	(21)
University of Helsinki	FI	6,883	(15)	2,875	—	9,758	(22)
Wake Forest University	USA	7,300	(11)	1,903	—	9,203	(23)
University of Pittsburgh	USA	5,556	—	2,992	—	8,548	(24)
University of Michigan–Dearborn	USA	5,225	—	3,319	—	8,544	(25)
Columbia University	USA	4,503	—	4,008	(18)	8,511	—
Ludwig Maximilian University of Munich	DE	4,826	—	3,520	(24)	8,346	—
Emory University	USA	5,738	(24)	2,065	—	7,803	—
University of Zurich	CH	3,923	—	3,332	(25)	7,255	—
Health Science Center	CA	5,656	(25)	1,532	—	7,188	—
University of Louisville	USA	3,512	—	3,646	(22)	7,158	—
University of Oslo	NO	2,650	—	4,396	(14)	7,046	—
University of Vienna	AT	6,689	(17)	195	—	6,884	—
French Institute of Health and Medical Research	FR	2,964	—	3,668	(20)	6,632	—
Technical University of Munich	DE	2,518	—	3,667	(21)	6,185	—

[a] Rank by 1995–2014.

category of anesthesiology from SCI-E. The top five journals remained on the top lists, as shown in Tables 1 and 2, indicating that their core places remained unchanged even as the total number of articles decreased by 19% during this period. Declining to publish certain articles may be partly attributed to the desire of various editorial boards to improve their journal impact factor.[12] The impact factor is the average number of citations received per paper published in that journal during the 2 preceding years. Improvement of the impact factor could easily be based on the decrease in the previous year's number of articles alone.[13,14] This may explain why there was a decreasing pattern of publication in top journals over the past 20 years.

North America and European countries contributed large amounts of papers and highly cited articles, as shown in Tables 3 and 4, indicating a centralized distribution worldwide. The top seven countries contributed approximately 77% of the number of total articles. These top seven countries in our 2-decade study were in agreement with the findings of previous studies,[15,16] although the studied periods were different. It appears that the United States still accounts for the largest amount of research with high impact all over the world. Certain studies have shown that the numbers for the United States[17] and the United Kingdom[18] have recently decreased. Comparison the two studied decades indicates that the numbers did substantially decline in the United Kingdom (approximately 20%), whereas those in the United States increased by approximately 4% (papers). This inconsistent trend in the data for the United States may be attributable to the different data sets used. Our data set included a total of 30 journal titles, whereas the other study only included the top three journal titles (*Anesthesia and Analgesia*, *Anesthesiology*, and *Pain*), showing a decrease in the number of publications in the United States.[17] The total number of articles of the top three journals decreased by 18%, whereas the total number of articles of these 30 journals increased by 10% in the past decade, as shown in Table 1. In fact, there is no downtrend in publication in the United States. In addition, China and South Korea achieved impressive growth in productivity and impact in the 2nd decade, although Japan managed to retain its lead on the rankings. This suggests that both countries in East Asia have advanced substantially in anesthesiology studies in recent years.[9,19]

Most of the institutions consisted of leading universities and hospitals, as shown in Tables 5 and 6, indicating the research is mostly based on academic institutions. Harvard University (USA) ranked first in terms of productivity and impact; moreover, more than half of the top 25 institutions are located in the United States. It was likewise significant that the United States also had the largest number of articles published (Table 3) and citations (Table 4) over 2 decades, indicating that U.S. institutions played a crucial role in the anesthesiology field.

There are several limitations in our study. The number of articles and citations were just two indicators of the bibliometric method selected to describe the trend of publications. Impact factors, average cited times per papers, *h* index, and others are additional options for every kind purpose of study to use, even the counting methods adopted. In addition, several factors were not taken into consideration in our study, such as population, gross domestic product, and other economic or cultural factors. Moreover, we only included articles published in anesthesiology journals from the SCI-E. Not all anesthesiology papers published in journals could be collected.

In conclusion, we could clarify the trend of publication-related anesthesiology from the distribution of journals, countries, and institutions to capture an image of the subject field development over the past 2 decades. The results of this study may be of interest to clinicians and researchers attempting to present the global, long-term research activities for the anesthesiology community.

References

1. Bottcher S, Schuh FT. Evaluation of anesthesiology journals using citation analysis. *Anaesthesist*. 1987;36:187–189.
2. Robert C, Wilson CS, Donnadieu S, Gaudy JF, Arreto CD. Evolution of the scientific literature on pain from 1976 to 2007. *Pain Med*. 2010;11:670–684.
3. Szokol JW, Murphy GS, Avram MJ, Nitsun M, Wynnychenko TM, Vender JS. Declining proportion of publications by American authors in major anesthesiology journals. *Anesth Analg*. 2003;96:513–517.
4. Cason BA, Avery EG, Slocum R, Hickey RF. Publication output of the world's anesthesiology departments, 1981–1994: a citation analysis. *Anesthesiology*. 1996;85:A1035.
5. Terajima K, Aneman A. Citation classics in anaesthesia and pain journals: a literature review in the era of the internet. *Acta Anaesthesiol Scand*. 2003;47:655–663.
6. Moppett IK, Hardman JG. Bibliometrics of anaesthesia researchers in the UK. *Br J Anaesth*. 2011;107:351–356.
7. Bould MD, Boet S, Riem N, Kasanda C, Sossou A, Bruppacher HR. National representation in the anaesthesia literature: a bibliometric analysis of highly cited anaesthesia journals. *Anaesthesia*. 2010;65:799–804.
8. Swaminathan M, Phillips-Bute BG, Grichnik KP. A bibliometric analysis of global clinical research by anesthesia departments. *Anesth Analg*. 2007;105:1741–1746.
9. Li Z, Qiu LX, Wu FX, Yang LQ, Sun YM, Yu WF. Scientific publications in anesthesiology journals from East Asia: a 10-year survey of the literature. *J Anesth*. 2011;25:257–262.
10. Chen SY, Wu JT. Global productivity of dermatological research: a bibliometric analysis from 1985 to 2014. *Br J Dermatol*. 2016. in press.
11. Huang MH, Lin CS, Chen DZ. Counting methods, country rank changes, and counting inflation in the assessment of national research productivity and impact. *J Am Soc Inf Sci Technol*. 2011;62:2427–2436.
12. Garfield E. How can impact factors be improved? *Br Med J*. 1996;313:411–413.
13. Garfield E. Journal impact factor: a brief review. *Can Med Assoc J*. 1999;161:979–980.
14. Garfield E. The history and meaning of the journal impact factor. *JAMA J Am Med Assoc*. 2006;295:90–93.
15. Figueredo E, Sanchez Perales G, Munoz Blanco F. International publishing in anaesthesia — how do different countries contribute? *Acta Anaesthesiol Scand*. 2003;47:378–382.
16. Li Z, Qiu LX, Wu FX, Yang LQ, Sun S, Yu WF. Scientific publications in international anaesthesiology journals: a 10-year survey. *Anaesth Intens Care*. 2011;39:268–273.
17. Pagel PS, Hudetz JA. Recent trends in publication of basic science and clinical research by United States investigators in anesthesia journals. *BMC Anesthesiol*. 2012;12:5.
18. Feneck RO, Natarajan N, Sebastian R, Naughton C. Decline in research publications from the United Kingdom in anaesthesia journals from 1997 to 2006. *Anaesthesia*. 2008;63:270–275.
19. Wang JO, Chen TJ, Kao SY, Yeh TC, Chou LF, Ho ST. Scientific publications by anesthesia departments in East Asia. *Scientometrics*. 2012;92:135–143.