Journal of Plastic, Reconstructive & Aesthetic Surgery (2015) 68, 1304—1308

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

A worldwide bibliometric analysis of published literature in plastic and reconstructive surgery

B.C. Rymer*, **R.M. Choa**

Department of Plastic Surgery, Royal Stoke University Hospital, Newcastle Road, Stoke-on-Trent, Staffordshire, ST4 6QG, UK

Received 26 February 2015; accepted 18 May 2015

KEYWORDS
Bibliometrics;
Plastic surgery;
Global research;
Publications;
Impact factor

Summary *Background:* Bibliometrics is the analysis of the content and citations of journal articles to quantify trends in published data. In this study, we aimed to use bibliometric analysis to identify the contribution of various countries to the plastic surgical literature over a 5-year period.
Methods: In this study, the top 20 countries publishing articles on surgery and 10 plastic surgical journals with the highest impact factors (IFs) were included. The number of scientific articles published in each journal per year (2009—2013) in each country was found using PubMed. As a marker of quality, the mean IF for each country was calculated using the number of articles and journal IF. These data were compared with population, gross domestic product (GDP) and dollars spent on research.
Results: A total of 10,051 articles were included. The USA was the largest contributor, with 4008 articles published over 5 years, followed by the UK (1163 articles). The USA's mean IF was 2.084, closely followed by Canada (2.037). The UK had the highest number of publications per million population (PMP; 18.14 publications PMP). When considering the overall research spending per country, Turkey had the most cost-effective publication output. The least cost-effective country was South Korea. Sweden, the Netherlands and Canada had the greatest increase in publication quality.
Conclusions: Bibliometric analysis can be used to identify not only major centres of plastic surgical research, such as the USA and UK, but also centres that produce high-quality data, such as Canada, and cost-effective research, such as Turkey. It can also highlight the areas of increasing success in plastic surgical research.

* Corresponding author.
E-mail address: ben.rymer@doctors.org.uk (B.C. Rymer).

http://dx.doi.org/10.1016/j.bjps.2015.05.024

Introduction

Bibliometrics is the process of analysing the content and citations of journal articles to quantify trends in publication type, topic area, institutions of origin and dissemination of published data.[1] The most frequently encountered use of bibliometric analysis is to find a journal's impact factor (IF), which indicates the number of times an article is likely to be cited in 1 year once published in a particular journal.[1] This is only a relatively simple example of the use of this form of statistical analysis, and more in-depth analyses are used globally by research institutions, governments and universities to evaluate and direct research efforts.[1]

Bibliometric analysis has been used previously by other authors to investigate the impact of historical papers on a field and hence determine a list of influential papers,[2,3] thus creating guides of recommended reading within specialities. It has also highlighted deficiencies in the currently available literature and guided future research.

In this study, we aimed to use bibliometric analysis to identify the contribution of various countries to the plastic surgical literature over a 5-year period. Although this has been done in other surgical specialities,[4] a study of the same size is yet to be completed for plastic and reconstructive surgery.

Methods

The top 20 countries based on the number of articles published in the field of surgery, as per the SCImago Country Rank, were included in this study.[5] Ten plastic and reconstructive surgical journals with the highest IFs between 2009 and 2013 were included in this study. Journals without an IF for each of the 5 years were excluded. Historical IFs were gathered from the Bioxbio Impact Factor Search website.[6]

A search phrase was constructed on PubMed using country of affiliation, year of publication and journal title. Comment articles, editorials, letters and congress proceedings were excluded. The number of scientific articles published per year, between 2009 and 2013, in each country was gathered for each journal. Population and gross domestic product (GDP) data were gathered from the World Data Bank website.[7]

The total IF for each country per year was calculated by multiplying the journal's IF for that year by the number of articles published. These were added across years and journals to get the total IF for that country. The total IF was subsequently divided by the total number of articles published to find the overall mean IF for the 5-year period.

The analysis involved the comparison of total number of articles published and the mean 5-year IF with population, percentage of GDP spent on health, percentage of GDP spent on research, total dollars spent on research and total dollars spent on health. Trends across the 5-year period were also analysed.

Results

Journals included

IF data between 2009 and 2013 showed that the leading journals on the basis of IF were the Journal of Plastic, Reconstructive and Aesthetic Surgery; Plastic and Reconstructive Surgery; Burns; Annals of Plastic Surgery; Journal of Burn Care and Research; Clinics in Plastic Surgery; Journal of Reconstructive Microsurgery; Facial Plastic Surgery; Archives of Facial Plastic Surgery; and Aesthetic Plastic Surgery.

Absolute figures

A total of 10,051 articles were included. The largest contributor was the USA, with 4008 articles published over 5 years, followed by the UK (1163 articles). The total number of articles published by each country is shown in Table 1. The mean 5-year IF was highest for the USA (2.084), followed by Canada (2.037). Full rankings by total publications and mean 5-year IF are shown in Table 1.

Adjusted for demographics

Adjustment of the data for population revealed that the UK had the highest rate of publication per million population (PMP), with 18.14 publications PMP. This adjustment moved the ranking of the USA to sixth, with Australia, the Netherlands, Taiwan and Austria producing more publications per million population. With regard to its population,

Table 1 Total publications and mean 5-year impact factor per country, with each country's associated rank for these findings.

Rank by total publications	Country	Total publications	Mean 5-Year IF	Rank by mean IF
1	USA	4008	2.084	1
2	UK	1163	1.707	16
3	China	768	1.722	13
4	Japan	529	1.728	12
5	Germany	416	1.713	15
6	Turkey	406	1.521	20
7	Australia	391	1.869	3
8	Italy	366	1.822	6
9	Canada	328	2.037	2
10	Taiwan	311	1.845	5
11	Netherlands	247	1.813	8
12	Brazil	238	1.752	11
13	France	195	1.820	7
14	Spain	138	1.644	18
15	India	123	1.717	14
16	Austria	112	1.868	4
17	Sweden	99	1.781	10
18	Switzerland	99	1.692	17
19	South Korea	66	1.806	9
20	Greece	48	1.636	19

India's production was the least. Full data for each country are shown in Table 2.

The USA produced the highest number of publications per percentage of GDP spent on health and research (1437 and 224 publications, respectively).

When the absolute value of the total research dollars spent per publication was calculated, it was found that Turkey spent the lowest amount of money, averaging $17,370,000 for every publication in plastic surgery. The least cost-effective country in terms of research spending was South Korea, which spent $798,550,000 per plastic surgery article published. It is acknowledged that this analysis is limited by the variable proportions of total research spending that actually go into plastic surgical research in each country. Table 2 shows each country's figure for total dollars spent on research and health per publication.

Trends over time

Globally, there was a decline in the number of published articles every year, with a total of 2140 articles published in 2009 and 1889 published in 2013. No single country was identified as particularly contributing to this overall decline. The majority of the included countries kept a relatively constant mean IF year on year. However, Sweden, the Netherlands and Canada displayed considerable growth between 2009 and 2013. Sweden's mean IF increased from 1.390 in 2009 to 2.102 in 2013, the Netherlands' from 1.566 to 1.923 and Canada's from 1.763 to 2.133. Globally, Canada had the highest mean IF in 2010. Graph 1 shows the mean IF by year of these three countries compared with the UK and USA.

The mean IF of Greece displayed the largest decline over the study period, from 1.927 in 2009 to 1.389 in 2013. This represents a 28% decline. It is, however, acknowledged that this period encompasses a difficult financial period for Greece with regard to the global recession.

The contribution of the UK

The UK produced the second largest number of overall publications during the study period (1163), with the highest number when adjusted for population (18.14 publications PMP). When considering cost-effectiveness, the UK had the third lowest GDP expenditure on both overall health and overall research per publication produced (£203,790,000 and £37,290,000 respectively). In an area of poorer performance, the UK's mean 5-year IF ranking changed to 16 globally and displayed little progression over the 5-year study period.

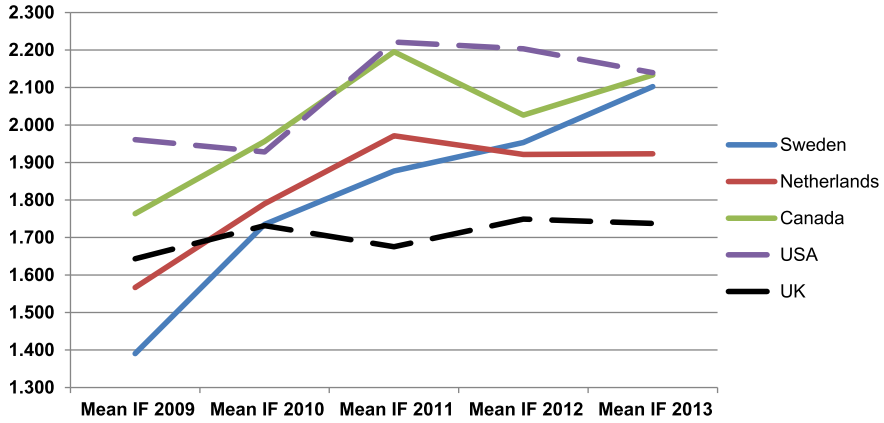
Discussion

World leaders

The principal finding of this study is that in absolute terms of numbers of articles published within the plastic and reconstructive surgery literature, the USA is by far the largest contributor. This finding agrees with a similar, smaller study conducted by Zhang et al. between 2005 and

Table 2 Number of publications per country adjusted for population, percentage of gross domestic product (GDP) and total dollars spent on research, and percentage of GDP and total dollars spent on health. Rank of country is as per number of publications per million population.

Rank	Country	Publications per million population	Publications per %GDP spent on research	Publications per %GDP spent on health	Total dollars spent on research per publication (millions)	Total dollars spent on health per publication (millions)
1	UK	18.14	676.16 (2)	123.72 (3)	37.29 (3)	203.79 (3)
2	Australia	16.90	163.60 (8)	42.97 (7)	95.39 (7)	363.21 (4)
3	Netherlands	14.70	114.35 (12)	19.92 (13)	69.97 (5)	401.71 (5)
4	Taiwan	13.32	102.98 (14)	47.12 (6)	46.16 (4)	100.87 (1)
5	Austria	13.22	39.44 (18)	9.74 (17)	105.40 (9)	426.81 (6)
6	USA	12.68	1436.56 (1)	223.91 (1)	116.95 (11)	750.30 (14)
7	Switzerland	12.25	43.04 (17)	8.76 (19)	151.10 (14)	742.35 (13)
8	Sweden	10.32	29.03 (19)	10.31 (16)	192.53 (15)	542.01 (9)
9	Canada	9.33	189.60 (7)	30.09 (11)	96.35 (8)	607.07 (10)
10	Italy	6.12	288.19 (5)	39.78 (8)	71.87 (6)	520.66 (8)
11	Turkey	5.42	472.09 (3)	64.44 (4)	17.37 (1)	127.27 (2)
12	Germany	5.16	142.47 (11)	36.81 (9)	255.14 (17)	987.34 (18)
13	Greece	4.35	69.57 (16)	5.16 (20)	34.75 (2)	468.33 (7)
14	Japan	4.15	156.06 (9)	52.38 (5)	314.11 (18)	935.83 (16)
15	Spain	2.96	106.15 (13)	14.38 (15)	127.95 (13)	944.88 (17)
16	France	2.95	86.28 (15)	16.67 (14)	316.97 (19)	1640.97 (20)
17	South Korea	1.31	16.34 (20)	8.80 (18)	798.55 (20)	1482.45 (19)
18	Brazil	1.19	196.69 (6)	25.59 (12)	114.17 (10)	877.51 (15)
19	China	0.57	387.88 (4)	142.22 (2)	238.23 (16)	649.71 (12)
20	India	0.10	151.85 (10)	30.75 (10)	123.59 (12)	610.34 (11)



Graph 1 Progression of the mean impact factor of the Netherlands, Canada and Sweden in comparison with the UK's and USA's progression over the 5-year study period.

2009.[8] When adjusted for population, the UK was the largest contributor of publications per million population, in contrast to the findings of the Zhang et al. study, which showed Sweden as the largest contributor of publications per capita.[8] This suggests that although prolific in the field, some of the USA's success within this analysis is because of its expansive population. However, the USA's credit cannot be solely taken away on this point as nations with large populations, such as India, Brazil and China, are seen to produce far fewer publications. Although journals were chosen based on a predefined and global standard (IF), a limitation of our study is the potential for selection bias within the choices as there is a predominance of North American and Western European journals, with none of the journals being produced by the Asian nations, which seem under-represented in this analysis.

Quality

In this study, we aimed to provide an assessment of not just the quantity of publications but also their quality. To this end, we calculated the mean 5-year IF, as produced in other articles of this nature. This demonstrated that the USA retained its first-place ranking for quality as well as for overall quantity. Again, this is in accordance with findings from previous bibliometric studies.[8] Surprisingly, the UK suffered from this analysis, ranking 16th, indicating that while the UK produces a good quantity of publications, their quality is outranked on the world stage. Canada, Australia, Austria and Taiwan were all highlighted as producing particularly high-quality research. Countries with lower mean IFs can aim to improve their ranking by either producing a greater volume of work or aiming to publish high-quality original research articles in high-ranking journals. Both tactics are seen within this cohort of top 20 countries.

Progression

The inclusion of 5 years' worth of data allowed a dynamic overview of fluctuating patterns, something that lacked in previous studies of this kind. Despite plastic surgery being an expanding speciality globally, the absolute numbers of publications decreased between 2009 and 2013 from 2140 articles to 1889. The responsible cause for this decline is unknown; however, we postulate that this may be attributed to stricter peer-review processes or a reduction in the plastic surgery research spending during the global recession. Although the quality of published work, as represented by the mean 5-year IF, remained fairly uniform across study years, Sweden, the Netherlands and Canada showed considerable progression, increasing their mean IFs by 51.2%, 22.8% and 21.0%, respectively. These countries consistently improved their mean IF year on year. Canada also increased its absolute output of articles by 88% within the 5 years. This compares starkly with the global leaders, the USA and UK, who showed only minimal increases in their mean IF across the study period (9.1% and 5.7%, respectively). This comparison is well illustrated in Graph 1. The poorest performer in this area was Greece, which decreased its mean IF by 28% over the 5-year period, possibly as a result of the enacted stringent austerity measures. A repeat study when global recession is not a potential influencing factor should be considered in order to investigate the role of financial burden in these conclusions.

Cost efficiency

On the basis of total dollars spent on research, an analysis was performed to find the most cost-effective nation for plastic surgical research publications, which demonstrated that Turkey produced plastic surgery articles at the lowest cost. Quality was lost as a result of reduced expenditure, with Turkey ranking lowest for mean 5-year IF (1.521).

This analysis is limited by the fact that the overall health and research budget of each country was taken into account, including spending across all research fields and areas of health-care at the national level. Further detailed data regarding spending, specifically, on plastic surgery were unavailable. The authors believe this assessment is still useful as spending on plastic surgery is likely to represent a relatively uniform fraction of the total national research spending.

Conclusions

Although bibliometric analyses have been conducted across several fields of surgery, we believe this to be the largest study on plastic and reconstructive surgery. Using these tools, our analysis has confirmed the USA to be the forerunner in producing research publications in plastic surgery. However, we have highlighted other centres, such as Canada, the Netherlands and Sweden, as producers of high-quality and rapidly progressive research within our study period. Knowledge of these countries as major contributors is hopefully useful to readers when reviewing a vast and broad speciality area. As authors, we believe that bibliometric analysis is an incredibly useful tool for trainees looking for both research direction and potential destinations for specialist fellowships.

Conflict of interest statement

The authors have neither financial nor personal conflicts of interest to declare.

Funding

No sources of funding were utilised for this study by either author. The authors did not have any financial interests in this study or associated commercial associations. No products, devices or drugs were used in this study.

References

1. Reuters Thomson. *Using bibliometrics: a guide to evaluating research performance with citation data*. Philadelphia: Thomson Reuters; 2008.
2. Loonen M, Hage J, Kon M. Plastic surgery classics: characteristics of 50 top-cited articles in four plastic surgery journals since 1946. *Plast Reconstr Surg* 2008;**121**(5):320—7.
3. O'Sullivan K, Kelly J, Hurley J. The 100 most cited publications in cardiac surgery: a bibliometric analysis. *Ir J Med Sci* 2015; **184**(1):91—9.
4. Kennedy C, O Sullivan P, Bilal M, Walsh A. Ireland's contribution to orthopaedic literature: a bibliometric analysis. *Surgeon* 2013;**11**(5):267—71.
5. SCImago Journal and Country Rank. Country rankings: medicine, surgery, 1996—2013. Available at: http://www.scimagojr.com/countryrank.php?area=2700&category=2746&region=all&year=all&order=it&min=0&min_type=it. [accessed 12.12.14].
6. Impact Factor Search. Available at: http://www.bioxbio.com/if/. [accessed 12.12.14].
7. The World Bank. Data by country. Available at: http://data.worldbank.org/indicator/SP.POP.TOTL. [accessed 12.12.14].
8. Zhang WJ, Ding W, Jiang H, Zhang YF, Zhang JL. National representation in the plastic and reconstructive surgery literature: a bibliometric analysis of highly cited journals. *Ann Plast Surg* 2013;**70**(2):231—4.