PERGAMON

European Journal of Cancer 38 (2002) 1121–1125

European Journal of Cancer

www.ejconline.com

Assessing oncological productivity: is one method sufficient?

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Received 17 July 2001; received in revised form 2 November 2001; accepted 29 December 2001

Abstract

This work analyses the distribution of oncological papers published in 1995 by authors from the European Union (EU) in any journal of all the Subject Categories of the Science Citation Index compiled by ISI (Institute for Scientific Information, Philadelphia, USA) and is based on the country of origin of all of the contributors. The study compares the results with those of a previous study dealing with publications in journals of the ISI Oncology Category based on the country of origin of the corresponding author. The aim of the study was to compare two different methods used to evaluate research productivity in order to understand the extent to which the results are influenced by the methodology adopted. Data on the number of published papers for each country, ratio between the number of occurrences of papers and country population and gross domestic product (GDP), and mean Impact Factors (IF) were compared. While findings on the number of published papers (United Kingdom (UK), Germany and France ranking best), source country population (Sweden, Denmark and the Netherlands ranking best) and gross domestic product (Sweden, Finland and the Netherlands ranking best) showed no important changes, the mean IF value result was, for some countries, very different from the previous study. In particular, while Germany, Belgium, Portugal and France fared well, Norway, Sweden, Austria and Spain showed poorer results. Some hypotheses are advanced, and care in the scientometric interpretation of data is urged. An analysis of the journals in which EU authors published their articles was also carried out and the main SCI categories to which the journals belong are reported. As was expected, many categories other than oncology were represented (biochemistry, haematology, pathology, etc.).

Keywords: Neoplasms, Bibliometrics, Europe

1. Introduction

The main purpose of the paper was to compare two different methods used to extract data for evaluation of the research performance of a country and to establish if different methods yield different results.

The impact of oncology research in 1995 in the European Union (EU) was assessed through a bibliometrics-based study that correlated the number of publications with the relative mean Impact Factor (IF) [1]. Socioeconomic variables such as country population and its gross domestic product (GDP) were also taken into account. IF is the average number of times articles published in a specific journal in the 2 previous years were cited in a particular year. Clearly, this index does not score a single paper, but the average weight of a journal, and it is heavily conditioned by trends and the current interests of scientists. Several other indicators can estimate the scientific audience of a journal and/or of a paper [3–6]. However, we used this parameter since it is easily accessible, is well-known and is used on a worldwide basis by researchers. It also allows comparison with previously published papers on this topic.

The method used in the study, however, was based on only those articles published in oncological journals, as indexed by the Oncology Category of the Science Citation Index (SCI), Institute for Scientific Information (ISI), Philadelphia, USA [2]. However, because many basic cancer research articles are published in basic discipline journals (e.g. biochemistry, immunology), and cancer clinical studies may appear in categories covering general subjects (e.g. medicine, pharmacology) or deal

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0959-8049/02/$ - see front matter
PII: S0959-8049(02)00025-4

with systems or organs (e.g. respiratory or digestive tracts), we re-examined the study data from the same year of 1995 by including all of the literature published in any journal of all the Subject Categories of the SCI.

Moreover, while the previous analysis considered the country of the corresponding author as the country of origin of the article, this study used the standard count procedure to guarantee that equal credit was given to all of the contributors. Productivity of a country corresponded to the total number of publications in which an author belonging to a given country appeared; thus a single paper may be counted as an entry many times for many countries. For this reason, we refer in this study to the number of occurrences rather than the number of papers.

Finally, the previous analysis took into consideration only peer-reviewed papers, editorials, reviews, technical notes and letters to the editor. Journal supplements with abstracts or meeting reports were excluded. This study, by contrast, takes into account all types of publications comprised in the database indexing process, abstracts not subject to peer review were included.

This different approach has allowed us to analyse those journals preferred by European scientists.

2. Methods

The analysis was based on data retrieved from the SCI via the SciSearch database. This database, established by the ISI in 1974, covers multidisciplinary scientific research literature from over 80 countries on all areas of the natural sciences, medicine, applied sciences and technology. More than 5000 journals are indexed, spanning more than 150 scientific disciplines. The search was performed on the DIMDI Host Computer (Deutsches Institut für Medizinische Dokumentation und Information, Cologne, Germany: http://www.dimdi.de) using some specific tools available from the Host, and was processed as follows.

The Preprocessed Searches (PPS), one of the above tools, which permits enucleating articles dealing with a specific subject, was used to allow the retrieval of all articles published in oncology in the broad sense. The search profile 'PPS = neoplasms' was created by Dimdi Host Computer staff to exploit the specific vocabulary and relevant text-words in the database.

The Corporate Country (CCO), a field of the SciSearch database, was used in order to retrieve articles published by a specific country (e.g. PPS = neoplasms and CCO = Greece).

Analysis of each country's data was performed through the REPORT = STAT command, a tool of the Dimdi Host Computer that permits a simple statistical survey of the search result. The field under evaluation was the journal title. The system creates a country-specific output of journal titles with the number of articles published. The values found in the analysis are displayed, together with the absolute frequency (occurrences) and the relative frequency (%) of each journal of the search set. Since the system analyses a search set of up to 2000 records, for countries with a higher number of records, an artifice was created in order to divide the search set into smaller samples (smaller than 2000). Each result was then summed in order to obtain a unique result. Data of each country were translated into a table using Excel.

Each journal title was hand matched with the Journal Citation Report (JCR) list in order to attribute the IF value. For major journals diversified into specialised categories but retaining the parent journal's title as part of its name, e.g. Mutation Research and its sections, Genetic Toxicology, DNA repair, etc., the same IF was attributed since ISI combines the data of all category titles and presents them as one listing under the parent title in the JCR. It was not possible to assign an IF for less than 1.5% of journals.

Journals with a number of occurrences higher than 100 were retrieved and the ISI main Category was attributed. For purposes of the study, 'Category' was defined as the major scientific field to which the journal belongs, according to the SCI JCR.

As for the previous study, the EU was defined as the 15 official Member States plus Norway, given its inclusion in the European Economic Area (EEA) and in all calculations concerning the EU issued by the Statistical Office of the European Communities (Eurostat). Papers originating from England, Scotland, Northern Ireland and Wales were grouped under the United Kingdom (UK). The resident population (expressed in millions of inhabitants) and GDP (expressed in billions of US dollars) for each country were retrieved from Eurostat annual statistical reviews.

3. Results

A worldwide total of 84 837 papers were published in the oncological literature during 1995, with 35 962 occurrences originating from the EU (Table 1, column B). All EU countries were represented. The countries with highest output were the UK (21.1%), Germany (18.7%), France (15.7%), Italy (12.5%) and The Netherlands (7.3%).

The ratio between the number of occurrences and country population was 97 (Table 1, column B1). Small countries generally performed better than large ones. Sweden ranked first with the best score (212), followed by Denmark (176), The Netherlands (174), Finland (161) and Norway (135). The ratio between the number of occurrences and GDP showed a mean value of 4.8 (Table 1, column B2). Finland and Sweden ranked first

(8.5), followed by The Netherlands (8.4), UK (7.3) and Denmark (6.6).

The mean IF of occurrences by the EU in oncological journals was 3.1 (Table 1, column B3). Among nations with an IF higher than 3, The Netherlands ranked first with a mean IF of 3.8, followed by the UK (3.6), Germany (3.5), Belgium (3.4), Finland (3.3), Denmark (3.2), France, Italy, Portugal and Sweden (3.1).

3.1. Analysis of the journals

Table 2 shows the 54 journal titles with a number of occurrences higher than 100 (approximately 1/3 of the total) and the main SCI Category to which they belong (the total list of journal titles can be obtained from the authors).

The*European Journal of Cancer* was the leading journal with 1459 occurrences, followed by *Blood* and *The International Journal of Cancer,* with 904 and 482 occurrences, respectively. Many categories other than oncology were represented. The mean IF values ranged from 0.177 to 27.766 and 33 titles (61%) had a mean IF higher than 3.

4. Discussion

The findings of our present analysis confirm those of our previous survey. There are, however, some surprising results.

The ratio of the percentage of published papers in 1995 shows that the UK still produced the most cancer research literature, confirming the pre-eminence of the country's scientific culture and language. Bibliometric analyses are influenced by the language in which papers are written, since they are based on the ISI database which covers mainly English language journals. Nations with a strong tradition of publishing in their native languages and less prone to submitting papers to internationally peer-reviewed English-language journals could be penalised in comparative studies drawing on databases including only a few non-English-language publications [7–8].

The top five ranking countries were the same, only Italy falling from second to fourth, and France and Germany advancing from fourth and third to third and second, respectively. The remaining countries retained their previous ranking.

The ratio between the number of occurrences and the country population in millions of inhabitants in this study showed a very similar trend compared with the previous survey. The top five ranking countries were the same. For the remaining countries, it should be pointed out that Italy fell from seventh to 11th place and Belgium rose from 10th to seventh.

The ratio between the number of occurrences and the GDP expressed in billions of US dollars showed some changes. Although smaller countries continued to perform better than larger ones, Norway moved from fourth to ninth place, while the UK took fourth place. For the remaining countries, only Italy showed an important drop in ranking, while Belgium and Ireland moved up the rankings.

Table 1
Comparison of the oncological productivity in the surveyed countries (1995)

Country	No. papers	% (EU = 100)	No. occurrences	% (EU = 100)	Papers/million population	Occurrences/million population	Papers/GDP	Occurrences/GDP	Mean	IF
	A		B		A1	B1	A2	B2	A3	B3
Austria	93	2.3	885	2.5	12	110	0.50	4.8	2.4	3.0
Belgium	97	2.4	1231	3.4	10	123	0.46	5.8	2.3	3.4
Denmark	106	2.6	903	2.5	21	176	0.78	6.6	2.4	3.2
Finland	91	2.2	806	2.2	18	161	0.96	8.5	2.6	3.3
France	558	13.7	5641	15.7	10	100	0.44	4.5	2.0	3.1
Germany	580	14.3	6733	18.7	7	83	0.30	3.5	2.1	3.5
Greece	54	1.3	410	1.1	5	40	0.71	5.4	1.3	2.3
Ireland	26	0.6	259	0.7	7	73	0.59	5.8	2.0	2.7
Italy	761	18.7	4494	12.5	13	79	0.65	3.8	2.2	3.1
Luxembourg	0	0.0	10	<0.1	0	25	0.00	0.5	0.0	3.0
The Netherlands	410	10.1	2636	7.3	27	174	1.31	8.4	2.9	3.8
Norway	91	2.2	579	1.6	21	135	0.80	5.1	2.6	2.9
Portugal	13	0.3	138	0.4	1	14	0.17	1.8	1.6	3.1
Spain	117	2.9	1799	5.0	3	46	0.22	3.4	2.1	2.6
Sweden	288	7.1	1843	5.1	33	212	1.33	8.5	2.5	3.1
UK	778	19.1	7595	21.1	13	131	0.74	7.3	2.8	3.6
EU	4063	100	35962	100	11	97	0.55	4.8	2.4	3.1
World	11117									

IF, Impact Factor; UK, United Kingdom; EU, European Union; GDP, gross domestic product; A = data from previous survey; B = current data.

These rankings changed considerably when countries were compared according to their mean IF. Only the Netherlands, the UK and Denmark held their original positions at first, second and sixth, respectively. The remaining countries had very different results compared with those of the previous survey, with countries such as Germany, Belgium, Portugal and France ranking well and nations such as Norway, Sweden, Austria and

Table 2
Journals analysis (1995)

Journals	IF	Occurrences	ISI Category
European Journal of Cancer	2.407	1459	Oncology
Blood	9.507	904	Hematology
International Journal of Cancer	3.362	482	Oncology
British Journal of Cancer	2.938	442	Oncology
British Journal of Surgery	2.287	387	Surgery
Gastroenterology	10.25	337	Gastroenterology
Journal of Biological Chemistry	6.963	330	Biochemistry
Cancer Research	8.426	315	Oncology
Oncogene	6.772	299	Oncology
Leukemia	3.227	267	Hematology
Lancet	16.135	261	Medicine General Internal
British Journal of Haematology	3.370	231	Hematology
Anticancer Research	1.045	222	Oncology
Journal of Investigative Dermatology	4.584	221	Dermatology
Cancer	3.296	213	Oncology
Annals of Oncology	2.548	210	Oncology
International Journal of Oncology	1.181	179	Oncology
European Journal of Immunology	5.256	176	Immunology
Journal of Clinical Oncology	7.878	174	Oncology
Journal of Immunology	6.937	166	Immunology
Biochemical and Biophysical Research Communications	2.671	164	Biochemistry
Experimental hematology	3.591	161	Medicine Research
Hepatology	5.849	161	Gastroenterology
FEBS Letters	3.504	159	Biochemistry
Leukemia and Lymphoma	1.046	159	Hematology
Carcinogenesis	3.336	158	Oncology
Bulletin du Cancer	0.177	155	Oncology
Cancer Genetics and Cytogenetics	1.489	149	Oncology
Proceedings of the National Academy of Sciences of the United States of America	9.040	148	Multidisciplinary Sciences
Biochemical Journal	3.579	145	Biochemistry
Journal of Clinical Pathology	1.427	145	Pathology
Bone Marrow Transplantation	2.184	143	Hematology
Gut	4.546	137	Gastroenterology
Histopathology	1.544	137	Pathology
Acta Oncologica	0.776	134	Oncology
Presse Medicale	0.604	134	Medicine General Internal
European Journal of Biochemistry	3.136	131	Biochemistry
British Medical Journal	4.994	130	Medicine General Internal
Laboratory Investigation	4.653	130	Pathology
New England Journal of Medicine	27.766	128	Medicine General Internal
Journal of Clinical Endocrinology and Metabolism	4.575	128	Endocrinology
Journal of Virology	5.821	127	Virology
British Journal of Dermatology	1.838	125	Dermatology
Medicina Clinica	0.896	124	Medicine General Internal
EMBO Journal	12.643	123	Biochemistry
British Journal of Urology	1.079	122	Urology
Journal of Cellular Biochemistry	2.686	116	Biochemistry
Genes Chromosome & Cancer	4.653	114	Oncology
Journal of Pathology	3.251	114	Pathology
Tumori	0.408	114	Oncology
Onkologie	0.328	113	Oncology
American Journal of Pathology	6.501	110	Pathology
British Journal of Pharmacology	3.619	107	Pharmacology
Genomics	3.424	105	Biotechnology

IF, Impact Factor; ISI, Institute of Scientific Information.

Spain faring worse. It is not easy to understand the reasons for such results, although the larger sample analysed may need to be taken into account. In essence, the more papers analysed, the more stable the IF is.

There are two other considerations to note. First, the custom of a country to publish in journals other than those indexed by ISI in the SCI Oncology Category may have influenced the results. The analysis showed that almost all the countries that ranked well published many articles in non-oncological journals which were not included in the previous study. Second, the better ranking of some countries in this study should be viewed as the result of intense collaborative activity [9]: researchers of some nations may more often be co-authors rather than corresponding authors. Indeed, most governments are increasingly encouraging international collaboration among researchers in the belief that this will bring about cost savings and other benefits. Modern research has never been more complex and, often, no single group (or individual, for that matter) will possess all the knowledge, skills, techniques and funding required for such demanding efforts. In addition, the increasingly pivotal role played by the European Community in supporting EU research has given a strong emphasis to collaboration.

In conclusion, there are no ready recipes for scientometric evaluation: each system has its own validating features. Different evaluation methods can lead to different results, and care needs to be taken in the interpretation of these. Problems with citation analysis as a reliable evaluation instrument have long been recognised, from Chapman, who in 1989 delineated 25 shortcomings, biases, deficiencies and limitations [10], to Egghe and colleagues, who in a recent article dealt with the problem of methodology, showing that different scoring methods can yield totally different rankings [11].

Performing an evaluation also entails objective responsibilities, which demand that different methods be used and compared. Scientometric researchers are taking pains to explore features of scientific productivity, but are far from finding the solution to all of the problems.

In addition to different bibliometric indicators, effective assessment should take into account other parameters, such as resources (i.e. personnel and infrastructures), levels of investment, policy goals, effects on research targets (i.e. technology, systems, education, social structure), expressions of knowledge other than published papers (i.e. patents and trained students), and finally the cultural evolution of a nation. Admittedly, however, statistical reports in these fields are both difficult to obtain and almost invariably not homogeneous.

A final consideration regards the analysis of the main journals in which papers were published. It must be emphasised that the number of occurrences does not correspond to the number of publications, since a single paper (and the journal in which appeared) may be counted as an entry many times for many countries. All the same, the trend is well characterised: although journals belonging to the category of Oncology' were preferred, a great many articles were published in a variety of other categories. Because oncology is a field of research that involves many scientific branches (haematology, genetics, immunology, biochemistry, epidemiology to name just a few), this result was predictable.

Finally, although most of the publications of EU authors in 1995 were submitted to international journals with a good IF, the analysis of each country showed that in some cases journals published in the authors' home country were preferred (e.g. *Revista Clinica Espanola* for the Spanish, *Tumori* for the Italians, *Irish Medical Journal* for the Irish, *Onkologie* for the Germans, etc.). This indicates that national cultures, language, customs and tradition still influenced the publishing practices of European researchers.

Acknowledgements

We are grateful to Mr Thomas Wiley for language editing of the manuscript.

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