Bibliometric Analysis of Literature in Cerebrovascular and Cardiovascular Diseases Rehabilitation: Growing Numbers, Reducing Impact Factor

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Abstract

Objectives: To explore temporal trends, geographic distribution, and socioeconomic determinants of scientific production in the field of cerebrovascular and cardiovascular disease (CCD) rehabilitation.

Data Sources: Citations from 1967 to 2008 were downloaded from the PubMed database. Core of the search strategy was the key word cardiovascular diseases in the Medical Subject Headings major field with the subheading rehabilitation. Journal Citation Reports was used to assign an impact factor (IF). Demographic and economic data were retrieved from the International Monetary Fund.

Study Selection: All articles retrieved were included in the bibliometric analysis.

Data Extraction: The search strategy was validated on a random sample of the articles retrieved. The search quality reflected the level of error of the PubMed database.

Data Synthesis: Publications retrieved were 10,379 and have grown 8.6 times in 40 years, faster than the all-diseases rehabilitation field (7.8 times), with a particularly steep growth for cerebrovascular diseases in the last 15 years (5 times). However, in the last decade, the articles' quality (IF) decreased. From 1994 to 2008, 3466 citations were retrieved; 44.4% came from the European Union and 30.3% from the United States. The highest mean IF was reported for France (4.127). The United Kingdom and some relatively small northern European Union countries had the best ratio of IF (sum) to resident population or to gross domestic product. The most frequently used key word was stroke, and 3 journals (Archives of Physical Medicine and Rehabilitation, Clinical Rehabilitation, and Stroke) published one quarter of the articles.

Conclusions: The overall scientific production in the field of CCD rehabilitation showed a steep growth in the last decade, especially because of cerebrovascular research. In the same period, a decrease in the overall IF was observed. The European Union and the United States contributed 3 of every 4 articles in the field, although some Asian countries showed promising performance.

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Cerebrovascular and cardiovascular diseases (CCDs) are the world’s largest killers, claiming 17.1 million lives a year. Advances in medical and surgical management, along with lifestyle modifications, have contributed to a greater likelihood of survival into the senior years. CCD mortality has decreased in many developed countries, and more than half of these patients survive. Great emphasis has been placed on the role of prevention and rehabilitation in the management of CCD. Rehabilitation is increasingly recognized as an integral component of the continuum of care for patients with CCDs. Its application is a class I recommendation in most contemporary clinical practice guidelines and is considered a priority in countries with a high prevalence of the disease. Rehabilitation programs in patients with CCDs typically

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achieve their results through exercise, education, behavior change, counseling, support, and strategies that are aimed at targeting traditional risk factors for CCDs.\textsuperscript{10-12} Several analyses have found that cardiac rehabilitation reduces the chance of dying early by 20% to 25%.\textsuperscript{8} Participating in cardiac rehabilitation can reduce the risk of having a further heart attack by 28%. After 3 years, only 5% of rehabilitation participants had died compared with 36% of those who did not participate.\textsuperscript{13}

The last 50 years has seen an exponential increase in biomedical literature. The importance of quantitative and qualitative assessments plays a pivotal role in decisions regarding grant funding and priority in assigning resources.\textsuperscript{14}

Bibliometrics is a systematic method for evaluating research output that can help map changes in the interest of the scientific community over time,\textsuperscript{15} and can provide insights into both quantitative and qualitative research trends on a specific topic.\textsuperscript{16-23} Quantity refers to the number of articles, and quality to the impact factor (IF)—that is, the average number of times an article published in a given journal is cited as a reference in other articles, which is the most popular way to measure the influence and visibility of a journal.

The bibliometric literature in the field of rehabilitation is limited, and no comprehensive study of the geographic distribution of publications in the field of CCDs is available.\textsuperscript{24,25} Therefore, articles on this topic published from 1967 to 2008 were collected using PubMed and analyzed for geographic and temporal trends. An analysis of IF by country was performed for the most recent years (1994—2008), according to population size and gross domestic product (GDP). Finally, the most common key words and the most popular journals were reported.

Methods

Bibliographic search

Data on articles about CCD rehabilitation published from 1967 to 2008 were downloaded from the PubMed database (National Library of Medicine, National Institutes of Health, Bethesda, Maryland; http://www.ncbi.nlm.nih.gov/pubmed). The search was performed in March 2011. The subheading rehabilitation was introduced in 1967 (a subheading is a heading used in PubMed to define a specific aspect of a concept). Publications dating from 2009 on were excluded from the analysis to avoid underestimations of the most recent publications, because of the known delay of 2 years or more that is necessary to complete the PubMed database.

The search strategy was built basically by inputting the key word cardiovascular diseases in the Medical Subject Headings (MeSH) major field (majr). The specific key words included in the MeSH cardiovascular diseases are detailed in figure 1.

Rehabilitation was set as a subheading to define the specific aspect of the analysis. To exclude cancer, that is not classified in cardiovascular diseases in clinical settings, the key word neoplasms was inputted in the MeSH majr with NOT operator. Finally, the date of publication (dp) of the articles is also specified and a group of special key words were added to include only research publications, as identified in publication type field (pt).

The final search strategy was the following:


The search strategy was validated on a random sample of the articles retrieved. The quality of the search reflected the level of error of the PubMed database.

Keywords

Key words are MeSH terms assigned to PubMed articles by trained indexers that choose them in the MeSH thesaurus.\textsuperscript{26} Key words used to index articles were grouped in 6 categories in agreement with the MeSH tree structure (table 1), and their frequency was computed with the Excel software.\textsuperscript{a}

Countries

The first author’s country identified the country of origin of the article. The European Union (EU) was defined as the 15 official member states plus Norway. For the non-EU countries, only data from the 13 countries with more than 15 entries during 1994 to 2008 were evaluated. The remaining countries accounted for a total of 50 articles with impact factor (1.4%).

IF, demographic and economic data

Journal Citation Reports (JCR) (Thomson Reuters) 2008 edition was used to assign IF to the articles. For each country, demographic and economic data referred to 2008 were retrieved from the International Monetary Fund.\textsuperscript{27} Population size was expressed in millions of inhabitants, and GDP was expressed in current billion U.S. dollars.

A relational database was created with the ad hoc software Research Management System (SeSMIT, AFaR)\textsuperscript{b} as previously described,\textsuperscript{28} and was used in all subsequent analyses.

Results

Historical overview

The total number of CCD rehabilitation articles retrieved in PubMed in the period 1967 to 2008 was 10,379, and increased from 142 in the
Figure 2A shows the comparison of the temporal trend of CCD rehabilitation articles with the “rehabilitation subset” (all the articles that are retrieved by the rehabilitation subheading), in logarithmic scale. The CCD articles increased 8.6 times from 1967 to 2008, 10% more than the whole rehabilitation subset (7.8 times). A different trend was apparent: while the latter showed a rather steady growth, the former showed a 20-year plateau period with no increase (from 1975 to 1993). After that, the productivity started to rise again, with good growth over the past 15 years.

Figure 2B reports on the number of articles in the whole field of CCD rehabilitation and, separately, in the subfields of rehabilitation after cerebrovascular (including stroke), cardiac, and other diseases (see fig 1). Scientific production on cerebrovascular diseases rehabilitation was almost negligible and increased slowly in the first period (from 38 articles in 1967 to 1968 to 116 in 1991 to 1992), but showed a steep increase in the last 15 years considered (up to 809 citations in 2007 to 2008), accounting for most of the growth of the whole CCD field. On the other hand, scientific production on cardiac rehabilitation showed only minor variations all along the 1970s, 1980s, and 1990s, with a frankly growing trend only in the last biennia.

The quality and completeness of data available in PubMed in the period 1967 to 1993 were not complete enough to allow a detailed evaluation; therefore, we focused on the period 1994 to 2008, when a total of 6097 citations were retrieved. Of these, 6009 were geographically classified (the first author’s country was not retrieved for 88 citations) and were subjected to more specific analysis (see supplemental figure 1, available online only at www.archives-pmr.org/).
Research topics

The publication type analysis showed that the publications were mostly clinical trials, followed by reviews, comparative studies, case reports, evaluation studies, and guidelines.

The key words (MeSH terms) used by PubMed experts to classify the 6009 selected articles included as many as 2313 different terms. Only 1180 (51%) of these were used more than twice, and 388 (16.8%) more than 15 times.

Table 1 shows the top 5 terms for each group of key words (MeSH terms). The most frequently used key word was stroke, from the group of “diseases” (3457 times).

Journals

Of the 6009 articles published in the period 1994 to 2008, 2543 (42.3%) were not indexed in the JCR. The indexed articles (3466; 57.7%) were published in 415 journals, only 93 (22.4%) of which printed more than 6 articles. On the other hand, the first 3 journals (Archives of Physical Medicine and Rehabilitation, Clinical Rehabilitation, and Stroke) published one quarter of the articles. Table 2 reports the first 19 journals, publishing at least 30 articles each (1.0% of the total). A wide range of journals published scientific literature on CCD rehabilitation, including some of the most important journals in the following JCR categories: rehabilitation (10 journals), cardiac and cardiovascular systems (5), peripheral vascular diseases (2), geriatrics and gerontology (1), and nursing (1).

Number of articles

The following analysis (number of articles, IF, and sociodemographic variables) was focused on publications with IF issued in the period 1994 to 2008, with a total of 3466 citations retrieved. The number of articles in the field of CCD rehabilitation research in the selected countries increased from 323 in the first triennium to 1087 in the last triennium (table 3). During these years, the EU published 1540 articles (44.4% of the total), the U.S. 1050
(30.3%), Canada 263 (7.6%), Japan 132 (3.8%), and Australia 107 (3.1%). The most productive EU countries were the United Kingdom (UK) with 492 articles (31.9% of EU articles), Germany with 235 (15.3%), and the Netherlands with 164 (10.6%).

Quality of articles

Overall, the mean IF of articles on CCD rehabilitation was 2.009, and the highest mean (4.127) was reached in France (see table 3). The mean IF of all countries was 1.564 in 1994 to 1996, peaked at 2.292 in 2000 to 2002, and came down to 1.989 in the last triennium. A slope downwards was observed for most of the most productive countries, including the EU, U.S., Canada, and Japan. The UK and Italian average IF halved in the last decade, while France had its highest mean IF (6.880 in 1994–1996) gradually cut by more than two thirds in the final triennium (2.133 in 2006–2008).

Scientific production vis-à-vis population and GDP

To take into account differences in the size of country population, the ratio of the IF sum in 1994 to 2008 to the resident population was calculated and is depicted in figure 3 for the most productive countries. This index showed a mean value of 16.03 for Canada, 11.06 for Australia, and 7.83 for the U.S. The EU mean value was 9.15 and was particularly elevated in the UK (18.63) and in a few relatively small European countries: Sweden (25.07), the Netherlands (18.71), Norway (17.60), Denmark (16.05), and Belgium (12.87).

To provide an evaluation of the research quality by resources available in each country, we calculated the ratio of the IF sum to GDP (see fig 3). This parameter was particularly high for Canada (35.56), Australia (23.62), and the U.S. (16.50). In the EU (mean, 17.89), the best performances were in Sweden (48.04), the UK (42.59), and the Netherlands (37.86).

Discussion

This work represents the first effort to explore the geographic distribution and temporal trends of research in CCD rehabilitation. This is a moment of technological improvement mostly because of the use of information and communications technology. In parallel, patients addressed to rehabilitation centers have clinical pictures of increasing complexity. This new scenario is likely to determine changes in the level and quality of scientific production. Bibliometric indicators can intercept these changes efficiently, contributing to the evaluation of the activities of a scientist, a research unit, an institution, and a country, and providing methods for the allocation of resources.

Rehabilitation is a relatively new area of medicine worldwide and continues to evolve. The scientific interest in CCD rehabilitation, as represented by the number of publications, has increased rapidly in recent years, after a 20-year period of no growth. On a 4 decades base, there has been an increase of 8.6% in scientific production, in line with all-diseases rehabilitation that has grown 7.8%, while cancer rehabilitation increased 11.6%. The articles published in CCD rehabilitation accounted for 8.3% of the total rehabilitation literature (cancer rehabilitation for 1.4%). Scientific production on cardiac diseases has been leading in CCD rehabilitation for decades, but in the new millennium it has been passed by research on rehabilitation after cerebrovascular diseases, which grew much more steeply.

The analysis based on indexed articles published between 1994 and 2008 showed that the 2 world leaders in CCD rehabilitation scientific activity were the EU and the U.S., publishing nearly three quarters (74.7%) of the journal articles together. These are the regions where the highest probability of survival from CCDs (the leading cause of death in the world) has been reached, accompanied by the need for rehabilitation. Although the EU published 46.6% more articles than the U.S., the latter had, on average, a higher IF. This can be explained by taking into account the different availability of resources among the 2 regions, the large girth of the American scientific community, the tendency of American authors to cite American articles preferably and to publish their works in American journals, and the preference of American reviewers to accept American articles.

Most countries increased their scientific production during the years surveyed. When considering the contribution of single countries, the UK, Germany, and the Netherlands ranked in the top 3 places for the absolute number of articles in the EU, while among the non-EU countries (besides the U.S.), those with the highest numbers were Canada and Japan. Other Asian countries, like Taiwan, Israel, and China, performed relatively well in CCD rehabilitation research and recently ranked among the leading countries in various biomedical fields. Such good performance was not seen in the literature on cancer rehabilitation. The aging index (AI) (the ratio of people 60y and older to children younger than 15y) of the countries may be one of the keys to explaining the underrepresentation of countries in South America, Africa, and, to

<table>
<thead>
<tr>
<th>Table 2</th>
<th>List of 19 journals, publishing at least 1% of the total articles on CCD rehabilitation from 1994 to 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journals</td>
<td>% of Articles</td>
</tr>
<tr>
<td>Archives of Physical Medicine and Rehabilitation</td>
<td>11.1</td>
</tr>
<tr>
<td>Clinical Rehabilitation</td>
<td>7.5</td>
</tr>
<tr>
<td>Stroke</td>
<td>6.0</td>
</tr>
<tr>
<td>Disability and Rehabilitation</td>
<td>4.9</td>
</tr>
<tr>
<td>American Journal of Physical Medicine and Rehabilitation</td>
<td>3.7</td>
</tr>
<tr>
<td>Journal of Rehabilitation Medicine</td>
<td>2.8</td>
</tr>
<tr>
<td>Neurorehabilitation and Neural Repair</td>
<td>2.5</td>
</tr>
<tr>
<td>Journal of Rehabilitation Research and Development</td>
<td>2.0</td>
</tr>
<tr>
<td>Physical Therapy</td>
<td>2.0</td>
</tr>
<tr>
<td>American Journal of Cardiology</td>
<td>1.8</td>
</tr>
</tbody>
</table>

www.archives-pmr.org
a lesser extent, Asia. As we might expect, more developed countries have a much higher AI than less developed countries. For example, in the year 2000, Europe had an AI of 116 and Japan 157, but the AI of Africa was 12.3 Moreover, some of these countries publish their articles mainly in non-English journals not indexed in JCR.

In regards to the mean IF, the most productive countries, after the U.S., are Canada and Switzerland. In the EU, France, the UK, and Sweden ranked in the top 3 positions, even higher than the U.S. In the last decade, a decline of the mean IF of studies in CCD rehabilitation has been observed in most highly productive countries. The reason for this is not clear, and such a trend has not been reported in similar studies.22,23 Most surprising is that the IF seemed to decline despite the recent increase in the number of publications and in the interest in the field. A decline in the IF of the most popular journals cannot be the explanation, as the same JCR 2008 edition was used to assign IFs to all the articles, irrespective of their publication date. Possibly low-IF journals opened to this kind of research, or new journals have been created to publish the growing numbers of articles in this relatively young discipline, and new journals still struggle to make their way through more established fields.

Table 3 Numbers of published articles on CCD rehabilitation and mean IF by country from 1994 to 2008

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>NR</td>
<td>mIF</td>
<td>IFrank</td>
<td>NR</td>
<td>mIF</td>
</tr>
<tr>
<td>Germany</td>
<td>492</td>
<td>3.741</td>
<td>2</td>
<td>42</td>
<td>5.197</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>164</td>
<td>2.951</td>
<td>9</td>
<td>6</td>
<td>1.749</td>
</tr>
<tr>
<td>France</td>
<td>144</td>
<td>4.127</td>
<td>1</td>
<td>9</td>
<td>6.880</td>
</tr>
<tr>
<td>Italy</td>
<td>122</td>
<td>3.030</td>
<td>8</td>
<td>14</td>
<td>3.851</td>
</tr>
<tr>
<td>Spain</td>
<td>82</td>
<td>1.997</td>
<td>17</td>
<td>36</td>
<td>1.517</td>
</tr>
<tr>
<td>Denmark</td>
<td>64</td>
<td>2.301</td>
<td>16</td>
<td>6</td>
<td>1.352</td>
</tr>
<tr>
<td>Norway</td>
<td>51</td>
<td>3.279</td>
<td>5</td>
<td>5</td>
<td>3.396</td>
</tr>
<tr>
<td>Austria</td>
<td>51</td>
<td>3.154</td>
<td>6</td>
<td>4</td>
<td>5.708</td>
</tr>
<tr>
<td>Sweden</td>
<td>39</td>
<td>3.422</td>
<td>3</td>
<td>8</td>
<td>2.118</td>
</tr>
<tr>
<td>Finland</td>
<td>32</td>
<td>2.669</td>
<td>12</td>
<td>3</td>
<td>3.855</td>
</tr>
<tr>
<td>Belgium</td>
<td>26</td>
<td>1.497</td>
<td>22</td>
<td>2</td>
<td>0.285</td>
</tr>
<tr>
<td>Ireland</td>
<td>23</td>
<td>1.092</td>
<td>25</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>Greece</td>
<td>10</td>
<td>1.486</td>
<td>NA</td>
<td>1</td>
<td>0.719</td>
</tr>
<tr>
<td>Portugal</td>
<td>5</td>
<td>0.659</td>
<td>NA</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>0</td>
<td>0.000</td>
<td>NA</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>EU Total</strong></td>
<td>1540</td>
<td>2.376</td>
<td>154</td>
<td>2.492</td>
<td>234</td>
</tr>
<tr>
<td>U.S.</td>
<td>1050</td>
<td>3.415</td>
<td>4</td>
<td>119</td>
<td>3.251</td>
</tr>
<tr>
<td>Canada</td>
<td>263</td>
<td>3.053</td>
<td>7</td>
<td>12</td>
<td>3.133</td>
</tr>
<tr>
<td>Japan</td>
<td>132</td>
<td>2.869</td>
<td>11</td>
<td>7</td>
<td>2.997</td>
</tr>
<tr>
<td>Australia</td>
<td>107</td>
<td>2.346</td>
<td>15</td>
<td>9</td>
<td>2.176</td>
</tr>
<tr>
<td>Taiwan</td>
<td>70</td>
<td>1.588</td>
<td>20</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td>Israel</td>
<td>60</td>
<td>1.838</td>
<td>19</td>
<td>3</td>
<td>1.815</td>
</tr>
<tr>
<td>China</td>
<td>50</td>
<td>2.551</td>
<td>14</td>
<td>1</td>
<td>2.166</td>
</tr>
<tr>
<td>Switzerland</td>
<td>46</td>
<td>2.906</td>
<td>10</td>
<td>4</td>
<td>0.773</td>
</tr>
<tr>
<td>New Zealand</td>
<td>25</td>
<td>1.896</td>
<td>18</td>
<td>1</td>
<td>0.465</td>
</tr>
<tr>
<td>Russia</td>
<td>21</td>
<td>0.151</td>
<td>29</td>
<td>7</td>
<td>0.203</td>
</tr>
<tr>
<td>Turkey</td>
<td>20</td>
<td>1.506</td>
<td>21</td>
<td>1</td>
<td>2.166</td>
</tr>
<tr>
<td>Singapore</td>
<td>16</td>
<td>1.276</td>
<td>23</td>
<td>4</td>
<td>1.480</td>
</tr>
<tr>
<td>Brazil</td>
<td>16</td>
<td>1.128</td>
<td>24</td>
<td>0</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3416</td>
<td>2.376</td>
<td>154</td>
<td>2.657</td>
<td>337</td>
</tr>
<tr>
<td>Others</td>
<td>50</td>
<td>1.229</td>
<td>1</td>
<td>0.346</td>
<td>2</td>
</tr>
<tr>
<td><strong>All Total</strong></td>
<td>3466</td>
<td>2.009</td>
<td>323</td>
<td>1.564</td>
<td>482</td>
</tr>
</tbody>
</table>

Abbreviations: IFrank, rank of IF (countries with ≥15 entries); mIF, mean IF; NA, not applicable; NR, numbers of published articles on CCD rehabilitation.

Canada, Australia, and the EU showed the highest scores when the sum of IF was standardized by population size or GDP. In the EU, these findings extend to CCD rehabilitation research the common observation of many bibliometric studies, that small developed countries are often much more efficient in terms of scientific production than large countries.16-23

The journal that published the most articles on CCD rehabilitation was Archives of Physical Medicine and Rehabilitation (11.1% of the articles). Most articles were published in journals dedicated to rehabilitation (10), followed by cardiac and cardiovascular systems (5) and peripheral vascular diseases (2). The first position of the journal Archives of Physical Medicine and Rehabilitation is in agreement with previous analyses.33,34

The analysis of key words revealed a high degree of dispersion in the use of terms, a problem that affects many biomedical disciplines. Only 16.8% of key words are cited more than 15 times, while 32% are cited twice or once only, showing the need for standardization. In the present study, we recoded key words in order to group under the same heading similar concepts expressed with a different term. Indeed, the most commonly used key words for diseases reflect...
the incidence of CCDs very closely, with stroke ranking at the top. Other key words indicate that exercise training program is an integral component of CCD rehabilitation. Key words referring to psychotherapy are among the most reported.

Some general comments stem from these results. First, the period of limited growth in scientific production in CCD rehabilitation in the 1970s and 1980s, contrasted by the steeper growth starting from the second half of the 1990s, reflects the evolution of the beliefs of the medical community, which only recently fully accepted the role of rehabilitation in the treatment strategy of patients with CCDs. Second, the list of most frequently assigned key words reveals the discrepancy between research and clinical practice, with some key words of major clinical impact (eg, asthenia, dyspnea) ranking among the less frequently assigned key words. Finally, the lack of top medical journals among those publishing articles on CCD rehabilitation reflects, not surprisingly, the limited interest of medical research in preventive issues.

A comparison between the present bibliometric evaluation of research on CCD rehabilitation and a similar analysis that was conducted recently on cancer rehabilitation showed the following:

- The EU had the leadership in CCD rehabilitation in regards to the number of articles with IF, while in cancer rehabilitation the first producer was the U.S.
- The mean IF of all articles on CCD rehabilitation was lower and showed a tendency to decrease, in contrast to the mean IF of the cancer rehabilitation literature that grew from 1.300 in 2000 to 2002 to 3.373 in 2006 to 2008.
- The EU mean IF was lower than 1 in cancer but higher than 2 in CCD rehabilitation, while the U.S. performed better, with an IF of about 3.4 in both cases.

In ranking the other main producers according to the number of articles and IF, there were no major differences between CCD and cancer rehabilitation, except for Asian countries, whose scientific production reached higher quantity and quality in CCD than in cancer rehabilitation.

**Study limitations**

First, the attribution of an article to a country was based on the first author’s affiliation, and international cooperation may not be adequately reflected. However, it was shown that different methods give similar results.

Second, the IF is an indirect way to measure the quality of scientific production. The IF measures the average value of a journal, not of the individual article, and can be affected by many factors (subject field, number of authors, content type, size of the journal, etc). However, although IF has been criticized at times, the literature reveals a generally good consensus on an approach that, albeit imperfect, is simple and objective.

Finally, the PubMed database is biased in favor of journals published in English. Therefore, nations with a strong tradition of publishing in their native languages, such as China, Japan, and Russia, may be underestimated in comparative studies.

**Conclusions**

This study shows that the number of publications in CCD rehabilitation has increased rapidly in recent years. The growth has been steeper for the cerebrovascular than for the cardiovascular disease rehabilitation literature and, accordingly, the most frequently used key word was stroke. The EU and the U.S. contributed most of the publications, but some Asian countries also had a good performance. France, the UK, Sweden, and the U.S. had the highest mean IF, while the UK and some relatively small northern EU countries had the best ratio of the IF (sum) to the resident population or to the GDP. Surprisingly, in the last years, a decrease of the mean IF has been observed in most highly productive countries.

An analysis comparing nations enables a country to define its position with respect to its competitors and is an essential step to understand science priorities and develop disease control policies, establishing a useful tool in an era of cost-effectiveness and quality control.

**Suppliers**

a. Microsoft Excel; Microsoft Corp, One Microsoft Way, Redmond, WA 98052.
b. ReMS-Research Management System, Medical Statistics & Information Technology, Fatebenefratelli Association for Research (AFaR), Isola Tiberina, Lungotevere de’Cenci, 5 - 00186 - Rome, Italy.

**Keywords**

Bibliometrics; Cardiovascular diseases; Cerebrovascular disorders; Publications; Rehabilitation

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Cerebro-cardiovascular rehabilitation bibliometric study

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Supplemental Fig 1  Flowchart of the numbers and analyses of retrieved articles.