

# Editorial

## Bibliometric Research in Occupational Health

Bibliometrics is the use of mathematical techniques to investigate publishing and communication patterns in the distribution of information<sup>1</sup>. A subset of bibliometrics which examines where and when references are cited, otherwise known as *citation analysis*, represents one of the most common methods in this field<sup>2</sup>. Although early studies had investigated the journals of chemistry<sup>3</sup>, engineering<sup>4</sup> and physiology<sup>5</sup>, much of their analysis involved simply counting the number of citations received by each particular journal. This approach is problematic however, as larger journals which publish a correspondingly larger number of articles will tend to attract a larger number of citations, regardless of their value to the field. On the other hand, articles published in some of the smaller journals from smaller research disciplines, may not attract the same number of citations, even though their value to that particular field is high<sup>6</sup>. In one of the first attempts at finding an objective method for journal evaluation, Casey<sup>7</sup> investigated the influence of American and British periodicals on medical progress. Interestingly, only one occupational health journal was mentioned in this study, the *Journal of Industrial Hygiene*.

One of the earliest bibliometric investigations specifically conducted in the field of occupational health was published in 1992 by McCunney and Harzbecker<sup>8</sup>, who reported that occupational medicine journals were 50 times more likely to cite the general medical literature than vice versa. The same authors also looked at *environmental* health periodicals in another article published in the same year<sup>9</sup>, with the authors finding that by 1990, speciality journals had published more articles indexed under the MeSH heading 'environmental pollution' than 15 yr previous. In a 1996 article, Takahashi *et al.*<sup>10</sup> reported that epidemiology was now assuming greater importance for occupational health literature, with the proportion of source items indexed under the term 'epidemiology' having increased over threefold between 1980 and 1990. The concept was then followed up by Sizaret and Kauffmann<sup>11</sup> in a letter. In 1998, Gehanno *et al.*<sup>12</sup> looked at the performance of various bibliographic databases in retrieving information in the field of occupational and environmental toxicology, finding that no single database provided all a researcher's needs. In somewhat of a pioneering move, Takahashi *et al.*<sup>13</sup> proposed an alternative to 'journal-based' impact factors in 1999, suggest-

ing that 'topic-based' measures might be more appropriate. Their article attracted the attention of Eugene Garfield himself<sup>14</sup>, who suggested some refinements to the original proposal. The issue of how to select publications in occupational health was addressed by Gehanno and Thirion<sup>15</sup> in the year 2000, who reported that less than 2% of journals accounted for 25% of articles published, and that only 66% of articles describing occupational diseases were published in journals that actually had an impact factor. Also in the year 2000, Carter<sup>16</sup> published a large historical review of articles from *Occupational Medicine — Oxford* (OM), while in the same year, D'Auria<sup>17</sup> published a historical overview and general content analysis of the same journal.

One of the first investigations of a single occupational health journal was conducted in 2001 by Nemery<sup>18</sup>, who investigated the fate of manuscripts rejected by *Occupational and Environmental Medicine* (OEM). In their study the author found that more than half of all manuscripts rejected by OEM eventually found their way into the scientific literature covered by *Medline*. In 2003, Uehara and colleagues<sup>19</sup> followed up Takahashi *et al.*'s<sup>13</sup> original proposal for topic-based impact factors, with a look at occupational diseases and occupational health services. The authors concluded that topic-based impact factors offered an important reference standard for articles published on the same topic, and hence, grouped them in a manner somewhat akin to a 'virtual' journal. In 2004, Navarro and Martin<sup>20</sup> investigated scientific production and international collaboration in occupational health between 1992 and 2001, using the SCI<sup>®</sup>, finding that more than 50% of articles had been published in North American journals. Another single journal investigation was published in 2005, this time by Gehanno *et al.*<sup>21</sup>, who searched the SCI<sup>®</sup> and found that around 3% of citations in OEM contained at least one major error. In 2006, one of the first bibliometric studies of occupational health journals *not* to use the ISI database was published by Przyłuska<sup>22</sup>. In their study, the author conducted a citation-based analysis of the *International Journal of Occupational Medicine and Environmental Health* (IJOMEH) using the newly-launched *Scopus*<sup>®</sup> database, finding that articles from 1998 were being cited the most often, at a rate of approximately five times each. On the other hand, almost 200 articles published during the time

period studied had never been cited. Although it did not describe an occupational 'health' journal as such, Ogden<sup>23)</sup> published a 50-yr historical and bibliometric review of the *Annals of Occupational Hygiene* (AOH) in 2006, finding that although papers from British authors dominated the first 20 yr of the journal, Scandinavia and The Netherlands were fast becoming major contributors.

The following year, 2007, would see a relative flurry of bibliometrically-focussed articles being published in the field of occupational health. In August, Gehanno *et al.*<sup>24)</sup> published the first detailed investigation of citation classics from five core occupational medicine journals, finding that only 85 of approximately 15,500 articles published in this field since 1949 had actually been cited more than 100 times. Individual journals also received the attention of various authors during 2007, with three articles from INDUSTRIAL HEALTH describing citation classics<sup>25)</sup> and impact factors<sup>26)</sup>, as well as a 20-yr analysis of citation indexing and publishing trends between 1987 and 2006<sup>27)</sup>. In a Supplement to the *Scandinavian Journal of Work, Environment and Health* (SJWEH), Burdorf and Viikari-Juntura<sup>28)</sup> described their bibliometric analysis of the SJWEH over the past 10 yr. When using the Thomson Scientific/ISI *Web of Science*<sup>®</sup> database to track citations, the authors found that review articles attracted a two to three-fold higher number of citations than the average 'source item'. Although not strictly bibliometric research as such, late 2007 also saw calls for the standardisation of periodicals in our field via the introduction of *Uniform Requirements* for occupational medicine journals<sup>29)</sup>.

In early 2008 Ogden and Bartley published an article describing the ups and downs of journal impact factors<sup>30)</sup>, and although it focussed mainly on the AOH, also included some analysis of other journals in our field such as the SJWEH. An article describing citation trends and citation classics at OM was also published by Smith<sup>31)</sup> in the first half of the year, and one which demonstrated the rise of impact factor scores in this particular journal. Following the mid-year release of new (2007) impact factors by Thomson Scientific, editors from various fields began writing commentaries describing their particular journal's performance in the latest rankings. In a recent journal article for example, Palmer and Loomis<sup>32)</sup> described how OEM's latest impact factor is now over 50% higher than it was in 2003, and has continued to steadily climb over the past four years. Although an upward trend for impact factors has already been demonstrated in other health fields such as general medicine<sup>33)</sup> and public health<sup>34)</sup>, many scholars have long suspected that this was also occurring in the journals of occupational

health. Such a phenomenon was confirmed in 2008 with the publication of a citation-based trend analysis of five core journals in occupational medicine. In his article, Smith<sup>35)</sup> demonstrated how the average number of citations received each year had grown from around 5,000 in 1985, to over 17,000 per year by 2006. The author also revealed how the impact factor scores of individual occupational medicine journals had increased between 108% and 186%, with an overall improvement of 158% during this particular time period. Such a finding was not entirely unexpected however, as Falagas and colleagues<sup>36)</sup> have previously demonstrated that the highest impact factor score in scientific journals had risen from 29.4 in 1984 to 52.4 by 2004.

Although impact factors may well be increasing, our discipline still suffers from various limitations intrinsic to the size of the field. Similar to other smaller disciplines such as tropical medicine<sup>37)</sup>, occupational health is often hampered by the relatively short citation-counting period used for calculating journal impact factors. Many occupational diseases often have a long lag time, and this means that the importance of many articles relating to these industrial diseases may not be apparent early on. In a previous study of citation classics for example<sup>24)</sup>, the most highly-cited article in our field was almost 60 yr old. As such, it can be supposed that the current two-year citation 'window' is probably too short for disciplines with relatively long lag times, such as ours. Furthermore, there is also the issue of 'scientific prestige', as not all occupationally-related articles will eventually find their way into the occupational health literature, due to authors often preferring to send their work to periodicals with intrinsically higher impact factors<sup>25)</sup>. This is also true for citations in occupational health, given that McCunney and Harzbecker<sup>8)</sup> previously demonstrated how occupational medicine articles were 50 times more likely to cite general medicine journals, than vice versa. Increasing a potential author's motivation to publish in dedicated occupational health journals represents another key challenge, although having dedicated 'Special Issues' focussing on specific occupational health topics may be useful in this regard<sup>38)</sup>.

There are other, more general, issues to consider when using citation-based bibliometric analysis to establish the relative merits of occupational health journals. Importantly, the task of assessing periodical quality itself is never an easy one, and it is well-known that assessing the performance of a medical journal can be a notoriously difficult undertaking<sup>39)</sup>. Assessing the merit of individual *articles* published in occupational health journals is also difficult. Because journal impact factors are read-

ily available, it has long been tempting to use them for evaluating individual scientists or research groups, even though the dramatic shortcomings of such an approach have already been highlighted in this regard<sup>40</sup>. As a potential solution, Eugene Garfield proposed using citation counts for individual articles and authors when evaluating their publication list<sup>41</sup>, and this approach may have potential in the occupational health field. Similarly, the development of specific indicators such as the H-index<sup>42</sup> are also promising, although they have not yet been adequately studied in our field. Aside from developing a more appropriate assessment system for occupational health journals, there are other, perhaps more wide-reaching, issues for us to consider. There is now growing evidence to suggest that the entire bibliometric approach might be significantly modified in the near future, in all fields of medicine including occupational health, via the metamorphosis of scientific communications, such as open-access, online-only periodicals, or even sharing scientific knowledge without the use of traditional periodicals<sup>43</sup>. It will be interesting to see what impact such changes might have in the field of occupational health.

## References

- 1) Diodato V (1994) Dictionary of Bibliometrics. 1–185, Haworth Press, Binghampton.
- 2) Smith DR (2008) Bibliometrics, dermatology and contact dermatitis. *Contact Dermatitis* **59**, 133–6.
- 3) Gross PLK, Gross EM (1927) College libraries and chemical education. *Science* **66**, 385–9.
- 4) Bradford SC (1934) Sources of information on specific subjects. *Engineering* **137**, 85–6.
- 5) Brodman E (1944) Methods of choosing physiology journals. *Bull Med Libr Assn* **32**, 479–83.
- 6) Smith DR (2007) Historical development of the journal impact factor and its relevance for occupational health. *Ind Health* **45**, 730–42.
- 7) Casey AE (1942) Influence of individual north American and British journals on medical progress in the United States and Britain. *Bull Med Libr Assoc* **30**, 464–6.
- 8) McCunney RJ, Harzbecker J (1992) The influence of occupational medicine on general medicine: a look at the journals. *J Occup Med* **34**, 279–86.
- 9) McCunney RJ, Boswell R, Harzbecker J (1992) Environmental health in the journals. *Environ Res* **59**, 114–24.
- 10) Takahashi K, Hoshuyama T, Ikegami K, Itoh T, Higashi T, Okubo T (1996) A bibliometric study of the trend in articles related to epidemiology published in occupational health journals. *Occup Environ Med* **53**, 433–8.
- 11) Sizaret A, Kauffmann F (1997) A bibliometric study of the trend in articles related epidemiology published in occupational health journals. *Occup Environ Med* **54**, 357–8.
- 12) Gehanno JF, Paris C, Thirion B, Caillard JF (1998) Assessment of bibliographic databases performance in information retrieval for occupational and environmental toxicology. *Occup Environ Med* **55**, 562–6.
- 13) Takahashi K, Aw TC, Koh D (1999) An alternative to journal-based impact factors. *Occup Med (Lond)* **49**, 57–9.
- 14) Garfield E (1999) Refining the computation of topic based impact factors--some suggestions. *Occup Med (Lond)* **49**, 571–2.
- 15) Gehanno JF, Thirion B (2000) How to select publications on occupational health: the usefulness of Medline and the impact factor. *Occup Environ Med* **57**, 706–9.
- 16) Carter T (2000) The three faces of Occupational Medicine: printed paper, problems in practice, and professional purpose. *Occup Med (Lond)* **50**, 460–70.
- 17) D'Auria D (2000) The parting glass. *Occup Med (Lond)* **50**, 452–5.
- 18) Nemery B (2001) What happens to the manuscripts that have not been accepted for publication in Occupational and Environmental Medicine? *Occup Environ Med* **58**, 604–7.
- 19) Uehara M, Takahashi K, Hoshuyama T, Tanaka C (2003) A proposal for topic-based impact factors and their application to occupational health literature. *J Occup Health* **45**, 248–53.
- 20) Navarro A, Martin M (2004) Scientific production and international collaboration in occupational health, 1992–2001. *Scand J Work Environ Health* **30**, 223–33.
- 21) Gehanno JF, Darmoni SJ, Caillard JF (2005) Major inaccuracies in articles citing occupational or environmental medicine papers and their implications. *J Med Libr Assoc* **93**, 118–21.
- 22) Przyłuska J (2006) International Journal of Occupational Medicine and Environmental Health in world documentation services: the SCOPUS based analysis of citation. *Int J Occup Med Environ Health* **19**, 1–5.
- 23) Ogden T (2006) Annals of Occupational Hygiene at volume 50: many achievements, a few mistakes, and an interesting future. *Ann Occup Hyg* **50**, 751–64.
- 24) Gehanno JF, Takahashi K, Darmoni S, Weber J (2007) Citation classics in occupational medicine journals. *Scand J Work Environ Health* **33**, 245–51.
- 25) Smith DR (2007) Japanese journals also have their citation classics in occupational medicine. *Scand J Work Environ Health* **33**, 397–9.
- 26) Sawada S, Smith DR, Araki S (2007) The impact factor and INDUSTRIAL HEALTH. *Ind Health* **45**, 501–2.
- 27) Smith DR, Sawada S, Araki S (2007) Twenty years of publishing trends and citation indexing at INDUSTRIAL HEALTH, 1987–2006. *Ind Health* **45**, 717–20.
- 28) Burdorf A, Viikari-Juntura E (2007) Bibliometric analysis of the Scandinavian Journal of Work, Environment and Health - results from the past 10 years. *Scand J Work Environ Health* **33**, 318–9.
- 29) Smith DR, Takahashi K (2007) Towards uniform

- requirements for manuscripts submitted to journals in occupational medicine. *Occup Med (Lond)* **57**, 613–4.
- 30) Ogden TL, Bartley DL (2008) The ups and downs of journal impact factors. *Ann Occup Hyg* **52**, 73–82.
  - 31) Smith DR (2008) Citation trends and citation classics at Occupational Medicine. *Occup Med (Lond)* **58**, 80–2.
  - 32) Palmer KT, Loomis D (2008) OEM's impact factor reaches a new high. *Occup Environ Med* **65**, 578.
  - 33) Chew M, Villanueva EV, Van Der Weyden MB (2007) Life and times of the impact factor: retrospective analysis of trends for seven medical journals (1994–2005) and their Editors' views. *J R Soc Med* **100**, 142–50.
  - 34) Lopez-Abente G, Munoz-Tinoco C (2005) Time trends in the impact factor of Public Health journals. *BMC Public Health* **5**, 24.
  - 35) Smith DR (2008) Citation analysis and impact factor trends of 5 core journals in occupational medicine, 1985–2006. *Arch Environ Occup Health* **63**, 114–22.
  - 36) Falagas ME, Zouglakis GM, Papastamataki PA (2006) Trends in the impact factor of scientific journals. *Mayo Clin Proc* **81**, 1401–2.
  - 37) Smith DR (2008) Citation indexing and the development of academic journals in tropical medicine. *Mem Inst Oswaldo Cruz* **103**, 310–2.
  - 38) Smith DR, Leggat PA, Araki S (2007) Emerging occupational hazards among health care workers in the new millennium. *Ind Health* **45**, 595–7.
  - 39) Tobin MJ (2004) Assessing the performance of a medical journal. *Am J Respir Crit Care Med* **169**, 1268–72.
  - 40) Seglen PO (1997) Why the impact factor of journals should not be used for evaluating research. *BMJ* **314**, 498–502.
  - 41) Garfield E (1999) Journal impact factor: a brief review. *CMAJ* **161**, 979–80.
  - 42) Hirsch JE (2005) An index to quantify an individual's scientific research output. *Proc Natl Acad Sci USA* **102**, 16569–72.
  - 43) LaPorte RE, Linkov F, Villasenor T, Sauer F, Gamboa C, Lovalekar M, Shubnikov E, Sekikawa A, Sa ER (2002) Papyrus to PowerPoint (P 2 P): metamorphosis of scientific communication. *BMJ* **325**, 1478–81.

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