The bibliographic impact of epidemiological studies: what can be learnt from citations?

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ABSTRACT

Objective To document one dimension of the impact of an epidemiological study through citations in scientific journals.

Methods Two sets of articles from studies performed in France were considered. They presented original results on occupational risk factors for low back pain and upper limb disorders. Citations of these articles were retrieved through the Web of Science and Google Scholar, and selected according to several criteria. Most citations present in the Web of Science were also retrieved from Google Scholar, except for the most recent articles. In the Web of Science, after exclusion of self-citations and duplicates, the total number of citations was 109 from 23 different countries for the low back pain articles, with 96 citations from 18 countries for upper limb disorders. A relatively large number of the citations belonged to clinical journals outside the fields of occupational health, ergonomics and public health.

Conclusion This study suggests that results dealing with occupational health disseminate into various fields of clinical research. However, this is only one dimension of the impact of a study.

The impact of epidemiological studies examining risk factors in the workplace can be assessed through two main dimensions. The first one is public health and social impact, including consequences on working conditions. Investigators and participants of a study expect that the results will have a public health impact, at least in the long term, with improvement in working conditions, better surveillance, better management of health disorders, and in some cases social consequences such as changes in the list of compensated work-related diseases. The second dimension is the bibliographic or bibliometric impact of the articles which present the results of the study. Researchers cannot ignore this dimension, which is quantified with indices such as the impact factor or the number of citations.[1–3]

At first glance, there is a large gap between these two different approaches to the "impact" of a study, that is, the public health impact versus the bibliographic impact. The usefulness of publications presenting the results of the study in scientific journals is not particularly straightforward if "impact" is considered first as the impact in the working environment, or among occupational physicians, or for the patients.[4] However, public health and societal impact also involves research-related activities such as the publication of literature reviews, since a single study in one country is not enough to influence, for example, regulatory decisions.[5]

What this paper adds

- There is limited research on the impact of studies in general, and little is known about the specific bibliographic impact of studies, although it is relatively easy to document.
- Our objective was to illustrate, using an example, the links between field research and the dissemination of scientific results.
- This study on the bibliographic impact of two sets of original articles suggests that published results on occupational health disseminate into research fields beyond occupational health, ergonomics and public health.
- Analysing citations is relatively easy, and can provide interesting information; citations could be more widely used for highlighting the bibliographic impact of studies.

Little is known about the bibliographic impact of studies, despite the fact that it is relatively easy to document. Our objective was to illustrate, from an example, possible links between the field research and dissemination of the scientific results, and to verify that results of epidemiological studies were taken into account in reviews. These reviews could lead to recommendations or guidelines, and could then be used in practice for prevention in the workplace or the management of work-related diseases.

METHODS

Two sets of articles were considered, a set of four on low back pain (LBP) and a set of five on upper limb disorders (ULD). The three inclusion criteria were: presentation of original results from studies performed in our laboratory; examination (exclusively or not) of occupational risk factors; and an aetiological approach. In order to analyse citations over at least a 5-year period, only articles which could be retrieved in the Web of Science and were published before 2005 were considered.

For LBP, four articles, arising from three different studies, presented results on LBP in general or on sciatica. For ULD, five articles presenting results from the same study were considered. The articles, presented in the appendix and in table 1, differed according to the outcome, incidence or prevalence of a specific disorder. Outcomes were self-assessed (for LBP, sciatica and shoulder disorders) or defined using a standardised clinical examination, performed by occupational physicians.

Table 1 Articles and citations

Date of publication (reference number) (see the appendix)	Journal	Outcome	Specific topic	Number of citations (self-citations excluded) Web of Science	Google Scholar	Year of the first citation (Web of Science)	Number of citations in the first 5 (or 6) years
February 1992 (1)	*SJWEH*	LBP	LBP (association with driving)	64	60	1994	13
March 2000 (2)	*JECH*	LBP	LBP (risk factors according to various definitions)	26	35	2000	14
May 2002 (3)	*JOEM*	LBP	Sick leave for LBP	17	21	2003	9
September 2003 (4)	*OM*	LBP	Sciatica	6	5	2006	4
March 1998 (5)	*OEM*	ULD	CTS	27	34	2000	11
August 2001 (6)	*SJWEH*	ULD	CTS, wrist tendinitis, lateral epicondylitis	35	41	2003	14
September 2003 (7)	*JOEM*	ULD	Medial epicondylitis	13	12	2004	11
January 2004 (8)	*OEM*	ULD	Shoulder disorders	28	52	2004	28
June 2004 (9)	*SJWEH*	ULD	Ulnar nerve entrapment	8	13	2006	8

CTS, carpal tunnel syndrome; LBP, low back pain; ULD, upper limb disorder.
JECH, Journal of *Epidemiology* and *Community Health*; JOEM, *Journal of Occupational and Environmental Medicine*; OEM, *Occupational and Environmental Medicine*; OM, *Occupational* Medicine; SJWEH, *Scandinavian Journal of Work, Environment and Health*.

Citations of the nine articles, until 1 July 2009, were retrieved through the Web of Science and Google Scholar.[2 6] They were analysed separately for the two subsets, LBP and ULD.

Citations in the Web of Science, which allowed the retrieval of precise and comparable information, were described according to the type of journal and the type of paper. Five categories of journals were considered: occupational medicine ("occupation", "work" or a similar term in the title, and a focus on health or medicine); ergonomics ("ergonomics" or a similar term, in the title); generalist or clinical journal (general medical journal, or reference to a medicine speciality in the title); epidemiology and public health (the presence of one of those terms, or "social" and "medicine" in the title, or similar in a language other than English); and other. Articles classified as "reviews" are those based on a systematic search with a description of the selection method. Reviews dealing with interventions rather than with factors associated with disorders or their consequences, were not taken into account here in the list of reviews. The country of origin was assessed according to the country of the first author (more precisely, the country where the work had been performed).

The delay between publication and citation was also considered. In some cases this delay could not be calculated very precisely; for that reason some of the citations "in the first 5 years" are in fact in the first 6 years after publication (table 1).

For both subgroups of articles, and only for reviews dealing with aetiology or risk indicators, we investigated how the content of our articles was used. For other citations, which most often presented original results, we considered that the section dealing with comments on our article(s) was too limited for an analysis of the content.

RESULTS

The number of citations per article, after exclusion of self-citations, ranged from 6 to 64 in the Web of Science and from 5 to 60 in Google Scholar.

In general, citations present in the Web of Science were also retrieved by Google Scholar, except for the most recent articles. Among the 22 citations in the Web of Science in 2009, only 10 were also provided by Google Scholar. On the other hand, Google Scholar gave additional citations: those in journals not considered by the Web of Science; books, dissertation theses and reports; and citations from websites. Generally speaking, Google Scholar retrieved more citations in languages other than English, and documents seldom cited themselves. Duplicates also occurred. For one paper (reference 1 in the appendix) more citations were retrieved by the Web of Science than by Google Scholar, with 19 citations in the Web of Science not retrieved by Google Scholar. The "missing" references included citations in specialised journals (such as *Vehicle Design* or the *Journal of Sound and Vibration*) and in reviews.[7 8] For one paper (reference 8 in the appendix), there was a large discrepancy in the opposite direction, with 28 references in the Web of Science compared to 52 in Google Scholar; a noticeable number of the additional citations in Google Scholar came from South America (14 from Brazil, three from Chile, and one from Colombia).

For LBP articles, the total number of citations in the Web of Science was 127, decreasing to 113 after exclusion of 14 self-citations. This was further reduced to 109 after exclusion of four duplicates (citations which appeared twice or more because several of the four articles were cited). The delay between publication and first citation ranged from 0 to 3 years, and the number of citations in the first 5 years from 4 to 14.

Fourteen citations were reviews, dealing with various topics.[7–20] Four of them focused on lifestyle and personal factors, rather than occupational factors: LBP and body weight,[8] cigarette smoking,[9 10] and gender and clinical pain experience in general.[11] Three concerned physical load and manual material handling,[7 12 13] and one psychosocial work factors.[14] Effects of exposure to car driving and whole body vibration, for low back or health in general, was the subject of three reviews,[15–17] and one additional review concerned sitting.[18] Finally, one review dealt with risk factors for LBP in general,[19] and one with prediction of sickness absence.[20]

For ULD, the number of citations in the Web of Science was 111, after exclusion of 25 self-citations. This was reduced to 96 after exclusion of 15 duplicates. The median delay from publication to first citation was 2 years. The number of citations in the first 5 years ranged from 8 to 28. There were no duplicates with the citations of the LBP articles.

Among the 96 citations, most of them presented results from a single study. Seven were formal reviews dealing with ULD in general[21] or risk factors associated with ULD: occupational factors,[22] psychosocial work factors,[23 24] the aetiology of carpal tunnel syndrome (CTS),[25] work-related factors of CTS,[26 27] work-related factors of elbow disorders,[28] and gender differences in ULD.[29] Three were also less formal syntheses or general presentations, mainly for a target audience of researchers or practitioners belonging to fields other than occupational health.[30–32] For one of them,[30] partly based on reviews by the

National Institute for Occupational Safety and Health and the National Research Council, the manuscript was in free access.

Among the 109 citations of the LBP articles, 43 were in occupational medicine journals, 13 in ergonomics journals, and nine in epidemiology and public health journals. Thirty six were in clinical journals. Eight were citations in other types of journal, including biology and experimental studies (more precisely, on sex differences in chronic pain in mice) publications.

For ULD articles, there were relatively fewer citations in occupational medicine journals and more in clinical journals. Only 27 of the 96 citations were in the field of occupational medicine. Ten were in ergonomics journals. A large proportion of citations (42/96) came from generalist journals and clinical journals in the fields of rheumatology, physical therapy, neurology, hand surgery and care. There was one citation for 21 journals, two citations for nine journals, and three citations for one journal. Nine citations were in epidemiology or public health journals. The remaining journals dealt with various topics, such as environmental research, obesity, midwifery and women's health, applied mathematics and computation. It must be noted that citations in clinical journals could also deal with experimental design and laboratory animals. This was the case with a study on CTS in rats, published in the *Journal of Orthopaedic and Sports Physical Therapy*.

Among the countries of origin of the 109 citations of LBP papers, the USA came first with 18 citations (16.5%), followed by the Netherlands and the United Kingdom (14 citations each) and Canada (12 citations); Denmark, Finland, France and Germany provided six to eight citations. There were three citations from Italy, three from Japan, three from Norway, and one or two from 12 other countries.

Among the 96 citations of the ULD papers, there was also great variation in the country of the first author, with a majority coming from the USA (34 authors, 35.4%), followed by the Netherlands (nine authors), the United Kingdom, France, Brazil and Finland (six or seven each), Canada (five), Italy (four), Australia (three) and nine other countries with one or two first authors.

In the citations classified as reviews, we examined how the content of our article(s) had been used. In all of them our results were correctly interpreted. This was the case even if the general conclusion of the review was different from the main message in our article, which was the case for a few of the reviews.[13 25] On some topics, especially the role of occupational factors, conclusions could differ according to the review.

DISCUSSION

Both the Web of Science and Google Scholar provide interesting information on the bibliographic impact of articles. Google Scholar is generally considered to be less accurate and reliable[6] and some citations, especially reviews, are missing from it. Another reason for preferring the Web of Science is that additional analyses are easier to retrieve, since the data are presented in a homogeneous way, with enough information for retrieving papers.[2] However, Google Scholar gives specific information, for example on the impact in various countries through citations in national scientific journals, which are less often referenced in the Web of Science.

Among the citations, only a small proportion, especially for ULD, were reviews considering results from several similar studies in the field of occupational health. Others could be viewed as dissemination of results from occupational health to research and practice in other clinical fields. The impact in other fields of clinical research of these epidemiological results, published in occupational health journals, was not expected, especially since the data collection was rather far from a clinical context. One can wonder whether the same would be observed for other studies on a similar topic, or dealing with other work-related diseases. The fact that some results are slightly different for the two sets of articles suggests that the conclusions might differ according to the topic. In other fields such as occupational cancer, the links from publications to reviews, and from reviews to policies, are probably more direct, including classification of substances as carcinogens, leading to norms for exposure in the workplace.

In the process of dissemination of scientific results from field studies, we thought that reviews, which provide a synthesis on a given question, reflected scientific consensus. However, there is a lack of consistency between the conclusions of the reviews in some cases, especially on the role of occupational factors for LBP and ULD.

The approach here was based on articles describing original results, with a specific interest in citations in literature reviews. It would be interesting also to consider a "top-down" approach starting from reviews, guidelines or recommendations, and checking citations of these articles. However, analysing citations for this purpose would require other methods, since the number of citations is expected to be much larger, especially in Google Scholar.

One of our results, which might be rather general for epidemiological studies, is that bibliographic impact is a slow process, with few citations in the 2 years following publication, whereas the impact factors of journals are based on citations in the first 2 years.[3] This is important also for those who have collected the data: they cannot rely too much on scientific publication for an impact in the short term.

Disseminating results in clinical journals does not fulfil the main expectations of field professionals who take time and expend energy collecting data in a working environment. The results show that the impact of a study must be seen not only as providing scientific answers and helping to bring about changes in a specific field and for a given country, but as having an impact in the larger scientific community, in terms of countries and scientific fields. This includes potential impact among clinicians leading to a better understanding of the role of working conditions in the aetiology of LBP and ULD.

The public health impact of scientific results in the workplace is difficult to quantify and relies on the promotion of scientific results not only by researchers but also by field actors and decision makers.

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APPENDIX

Articles considered in the analysis

Low back pain

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Upper limb disorders

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