CIRUGÍA ESPAÑOLA

www.elsevier.es/cirugia

Editorial

The Hirsch's h-index: a new tool for measuring scientific production

Índice h de Hirsch: una nueva herramienta para medir la producción científica

Science barely exists until it is published.[1] It is only then that the information goes beyond its author and the scientific community can share that knowledge. In the health sciences area, in particular, one item that is much valued is the researching capacity of the professional involved, and, within such and as a direct consequence of it, the final product: the scientific publication. Evaluating an author makes perfect sense in a competitive system, where the highest score has impacts on the researcher's career or in accessing to financing resources. As a result, establishing a system to evaluate the scientific activity is today an unavoidable need, since it is the only avenue to optimising those always restricted resources that are allocated for research activities.[2]

The central dogma for evaluation is that no simple parameter can match revision "by peers," which is a complex evaluating procedure that entails substantial difficulties.[3] Bibliometric indicators are a valuable tool to study scientific activity, when used correctly, and this is the reason why it is important to know the optimal conditions for their application as well as their limitations.[2] Science is a multidimensional activity where economic, social, and scientific elements interact simultaneously. This multidimensional reality largely complicates the processes that evaluate scientific activity, which require the combined use of diverse indicators.[2]

As it was graphically pointed out by Imperial and Rodríguez-Navarro, for a long time has science been seeking for a golden ratio, a quantitative method, a single indicator, simple in itself and valid for all branches of science and all disciplines, able to represent the value of an author as well as his or her contributions.[4-6] However, at least for the time being, none of the bibliometric indicators can be considered decisive in itself, as each one of them takes only a facet of reality, always imperfectly, so that they become really useful when used together.

The main contribution of the bibliometric indicators is not to replace the experts, but to aid them when deciding and provide objectivity and transparency to evaluation processes. Doubtless enough, despite the objections that can and should be brought against bibliometric indicators, they are currently a useful and objective tool to provide a better understanding and evaluation of the research activity.[2] However, for example, the simple recount of publications by a researcher is not an indicator reliable enough to measure such researcher's contribution to progress in science. Moreover, an author's capacity to be cited by other authors is a sign of certain acknowledgement or credit that the scientific community grants a production–impact, ergo sum.[7] However, using the *number of citations* received as a bibliometric indicator also has certain limitations, as it makes possible that flashing but isolated successes, contributions fortunate but fortuitous, and even scientifically rare "lucky hits" can prevail over the value of an earnest career sustained steadily along time.

Amongst the most diverse impact indicators, the best known has been termed "impact factor" (by Thomson Scientific). The "impact factor" of a journal in a year is the quotient resulting by dividing the number of current year citations to the source items published in that journal during the previous 2 years. Unfortunately, as it has been brilliantly expressed by Camí in an article titled "Impactolatría: diagnóstico y tratamiento" (Impactolatry: diagnosis and treatment), some colleagues practise an incontinent cult or worship to the "impact factor," as if it were the panacea to evaluation in science.[7] Impactolatry involves a simplistic practice that presupposes that the "impact factor" of a journal is indicative of quality or importance in a particular scientific investigation, and, by extension, of the authors appearing in such journal. However, in spite of the extended use of this index, it has been repeatedly demonstrated that the "impact factor" of a journal does not grant the quality of each and every work published in it. As a result, publishing in an impact journal is not necessarily an indicator of quality for the manuscript. Imperial and Rodríguez-Navarro[3] pointed out

that it is remarkably interesting how so complex an issue as scientific evaluation is being worked out by many evaluation agencies with a method that clearly lacks both empirical and theoretical support as it does this one of the "impact factor" in journals. By contrast, and judging by the relevant limitations of this indicator, we could conclude that the "impact factor" should be banned from scientific evaluations, or, at least, should be complemented with other indexes.[3,5,6]

As evidenced here, to evaluate a researcher in a manner that is both objective and simple at the same time it would be necessary to resort to some type of indicator that would bring together and simplify the wide range of measuring devices available (such as the number of works published, total citations received, number of citations per work, journal "impact factor," etc). In this context of superabundance and chaos of bibliometric indexes, in the year 2005 an article by Jorge Hirsch, a physics professor at the University of California, San Diego, was published, where an index termed *h*[8] was proposed. Hirsch's idea consists in taking each and every single work by an author and arranging all of them in a descending order given by the citations received. Every work has, therefore, apart from a number of citations, a number in the *ranking* given by the descending order, which we will simply call range. Accordingly, we build 2 lists of numbers: an ascending list with the ranges, and a descending list with the number of citations. When values from each list cross, the result is the *h*-index.[9,10] As a result, each researcher has an *h* index of x when x in his documents has been cited at least with x citations each one. For example, an *h*=20 means that an author has 20 publications that have been cited each one of them at least 20 times (but such author does not have 21 publications that have been cited at least 21 times each one).

The *h* index has a number of advantages that make it very useful and attractive, among which the following can be included: *a)* it is very simple to calculate; *b)* it combines, in the same bibliometric index, the "quantity" factor (number of publications) with the "quality" factor (citation rate) in a well-balanced manner, much better than gross recounts of documents and citations; *c)* a good correlation has been found between *h* index scoring and those from evaluation by peer revision[3,8,11]; *d)* it assesses scientific endeavour along the whole professional or academic activity as opposed to "lucky hits" (flashing isolated successes) that can have a high but clearly restricted impact.[9,10] The *h* index aspires to be the indicator that best expresses the mean value of international visibility for all the works of a given author, for which its creator has termed it "career indicator." Thus, the value of the *h* number represents the scientific bibliography of an author, as it does not measure immediateness but long periods of time[4]; and *e)* the *h* index has demonstrated that it is capable of predicting scientific career advancement and future achievements of authors more accurately than other bibliometric indicators.[12]

But of course not all are advantages, for the *h* index also has its inconveniences, amongst which are the following: *a)* it does not take into account the quality of the journals where the articles are published, which is why it has been said that *h* index could, in theory at least, be artificially blown up with citations from "low level or mediocre"[11] journals; *b)* it tends to favour those authors with longer scientific careers against younger authors as *h* index is assessed upon the whole number of citations from researchers[3,11,13]; *c)* it includes neither number of authors nor their order in the article in question; *d)* it could allow a researcher to "rests on his/her laurels" and let their articles "do the work for him/her", as the number of citations could continue to increase, even if no new articles are published[8]; and *e)* it is inadequate to compare researchers from different scientific areas.[3,13,14] Particularly in medicine, there are clear differences depending on the basic or clinical character of the activity: clinical areas frequently present less productivity, as professionals involved usually prioritise health assistance over publication of results.[2] The main problem lies in the fact that even within the same specialty (medical, for example) there may be differences that prevent comparing 2 authors fairly, because some research areas are "popular" or "hot" in a certain moment and will have, in theory, more chances to be cited.[5,6,13]

Regarding possible values for *h* index, how much is a lot? Hirsch cautiously indicates that values for *h* should automatically lead to a permanent position in a university and scientific career advancement, including appointment as member of the National Academy of Sciences in the United States (which for physicists would be *h*=45). In the case of physical sciences, Hirsch concludes that a value *h*=20 after 20 years of scientific activity characterises a career crowned by success, values *h*=35-45 after 20 years are seen only among the best scientists, and a value *h*=60 characterises a singular individual, exceptionally gifted for science.[8]

In summary, *h* index, recently proposed by Hirsch, has revolutionised the evaluation arena for scientific research by presenting a balance between number of publications and number of citations to these; in other words, the main advantage of the *h* index is that it combines in one single indicator a measure of quantity with other of impact of production. However, growing popularity of *h* index entails the risk of reducing the evaluation to one single indicator. In spite of the fact that, as it has been mentioned earlier, research is a multifactorial process that can hardly be reduced to one single dimension.[11,13,15] Obviously enough, the work of a lifetime cannot be summarised by a single number, the *h* number. As Hirsch himself pointed out, a single number can only provide an approximation to the multifaceted profile of a researcher, and thus should be considered in combination with other factors to be evaluated of that same scientist. We still ignore how far the *h* index will reach, what its validity and future applications will be, but, if it resists the scrutiny of the scientific community, this index should be an element to be included in the process of selection and evaluation of scientists.[1]

REFERENCES

1. Gisbert JP, Panes J. Scientific publication, bibliometric indicators, and Hirsch's h-index. Gastroenterol Hepatol. 2009;32:140–9.
2. Bordons M, Zulueta MA. Evaluation of the scientific activity through bibliometric indices. Rev Esp Cardiol. 1999;52:790–800.

3. Rodríguez-Navarro A, Imperial-Ródenas J. Índice h. Guía para la evaluación de la investigación española en ciencia y tecnología utilizando el índice h. Comunidad de Madrid. Consejería de Educación. Dirección General de Universidades e Investigación. 2007 [consulted May 4, 2009]. Available from: URL: www.madrimasd.org.
4. Gálvez-Toro A, Amezcua M. The Hirsch's h-index: An update on the author's evaluation methods and their contributions in scientific publications [consulted May 4, 2009]. Available from: URL: http://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S1132-12962006000300009&lng=en&nrm=iso
5. Imperial J, Rodríguez-Navarro A. Utilidad del índice h de Hirsch para evaluar la investigación. Análisis Madrid [con- sulted May 4, 2009]. Available from: URL: http://www.madrimasd.org/informacionIdi/analisis/analisis.asp?id=24360&sec=2&tipo=g
6. Imperial J, Rodríguez-Navarro A. Usefulness of Hirsch's h- index to evaluate scientific research in Spain. Scientometrics. 2007;71:271–82.
7. Cami J. Impactolatry: Diagnosis and treatment. Med Clin (Barc). 1997;109:515–24.
8. Hirsch JE. An index to quantify an individual's scientific research output. Proc Natl Acad Sci USA. 2005;102:16569–72.
9. Grupo Scimago. El índice h de Hirsch: aportaciones a un debate. El profesional de la información. 2006;15:304–6.
10. Grupo Scimago. El índice h de Hirsch: su aplicación a algunos de los científicos españoles más destacados. El profesional de la información. 2007;16:47–9.
11. van Raan AFJ. Comparisons of the Hirsch-index with standard bibliometric indicators and with peer judgment for 147 chemistry research groups. Scientometrics. 2006;67:491–502.
12. Hirsch JE. Does the H index have predictive power?. Proc Natl Acad Sci USA. 2007;104:19193–8.
13. Kelly CD, Jennions MD. The h index and career assessment by numbers. Trends Ecol Evol. 2006;21:167–70.
14. Costas R, Bordons M. Una visión crítica del índice h: algunas consideraciones derivadas de su aplicación práctica. El profesional de la información. 2007;16:427–32.
15. Costas R, Bordons M. Bibliometric indicators at the micro-level: Some results in the area of natural resources at the spanish CSIC. Research evaluation. 2005;14:110–20.

Javier P. Gisbert
Servicio de Aparato Digestivo, Hospital Universitario de la Princesa, Centro de Investigación Biomédica en Red de Enfermedades Hepáticas y Digestivas (CIBEREHD), Madrid, Spain
E-mail address: gisbert@meditex.es

Julián Panés
Servicio de Gastroenterología, Institut de Malalties Digestives, Hospital Clinic, CIBEREHD, Barcelona, Spain