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REVIEW ARTICLE

Current concepts on bibliometrics: a brief review about impact factor, Eigenfactor score, CiteScore, SCImago Journal Rank, Source-Normalised Impact per Paper, *H*-index, and alternative metrics

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Abstract

Background Understanding the impact of a publication by using bibliometric indices becomes an essential activity not only for universities and research institutes but also for individual academicians. This paper aims to provide a brief review of the current bibliometric tools used by authors and editors and proposes an algorithm to assess the relevance of the most common bibliometric tools to help the researchers select the fittest journal and know the trends of published submissions by using self-evaluation.

Methods We present a narrative review answering at least two related consecutive questions triggered by the topics mentioned above. How prestigious is a journal based on its most recent bibliometrics, so authors may choose it to submit their next manuscript? And, how can they self-evaluate/understand the impact of their whole publishing scientific life?

Results We presented the main relevant definitions of each bibliometrics and grouped them in those oriented to evaluated journals or individuals. Also, we share with our readers our algorithm to assess journals before manuscript submission.

Conclusions Since there is a journal performance market and an article performance market, each one with its patterns, an integrative use of these metrics, rather than just the impact factor alone, might represent the fairest and most legitimate approach to assess the influence and importance of an acceptable research issue, and not only a sound journal in their respective disciplines.

Keywords Algorithms · Bibliometrics · Citation · Journal impact factor · Self-evaluation

Introduction

Understanding the impact of a publication is a mandatory activity in the publishing world, so universities and research institutes must be familiar with the currently accepted methods by using *bibliometrics*, which are documents and citation-based measures applied most commonly to journals, but also to articles, authors, and institutions. These kinds of metrics focus on measuring different aspects of performance, including impact, output, and prestige [1].

The number of citations a paper receives is one of the measures of scientific merit [2]. Academic writers usually agree that the general goal of scientific authors is to produce high-quality, high-impact basic/clinical research, a task that requires endless after-hours work; contradictorily, only from 10 to 14% of the published information becomes useful, and most articles are never cited again, except by the very authors who published them [3]. Publishing original papers, reviews, editorials, letters to the editor, and other types of scientific articles represents a crucial stage of the research process that impacts on author and journal profiles and research institutions' ranking, either negatively or positively [4].

Citation data are used by researchers when deciding where to submit their manuscripts; by their part, funding bodies utilise them for evaluating grant proposals, and tenure committees make a call for deciding tenure cases [5]. So, it is currently

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accepted that the scientific literature forms a network of scholarly articles, connected by citations [6]. Each citation reflects the assessment of an individual or a group of scholars regarding which papers are interesting and relevant to their work [7]. There exists a preference for authors to be published in journals that exceed the citation potential of their articles; this fact links the evidence that world top universities are those with the highest number of highly cited papers. This success is reflected in the so-called citations per faculty score, which indirectly make these universities famous all over the world. This position also brings points for academic peer-review revision, and attracts international academic and research collaboration (international factors used for a university ranking may include a proportion of international faculty) [4].

Nowadays, bibliometric information can be used to answer two highly common questions of amateur researchers when targeting a journal to submit their first paper: How can an author understand the impact of her last published article? Moreover, how prestigious is a journal based on its impact metrics, so she chooses the fittest journal to submit her next manuscript?

In this paper, we provide not only a brief review of the current bibliometric tools available to evaluate journals and researcher's performance, but also point out their limitations and propose a simple algorithm that indicates how these tools might be used for self-evaluation for the researcher's written productivity.

Journal-level bibliometrics

Assessing the quality of journals has been employed as a form of analysis of post-graduate programmes. With the escalating cost of journals on the one hand and budgetary limitations on the other, the librarian and the faculty members are often called upon to identify a core of quality journals for an institutes' library, using suitable assessment criteria [8]. For medical journals, the two most widely applied methods for evaluating a research paper's quality are the number of citations a paper receives and the impact factor (IF). While many scholars and editors abstain from the notion of attributing the success of individual articles by the prominence of the journal, scientific authors continue to place great importance on the journal impact factor in their decisions to submit their manuscripts.

Bibliometrics can be classified based on different contexts or perspectives. The term *prestige metrics*, for example, encompasses those measures that attempt to measure a journal's reputation within the community by looking at the origin of citations. They use a principle similar to Google PageRank when ranking web pages according to links between pages. In this group, we have the *SCImago Journal Rank*, the *Eigenfactor metrics*, and the *Source-Normalised Impact per Paper (SNIP)*. In other perspectives, we might group those metrics which aim to normalise by the rate of citation in a subject group; with these criteria, we could group the IF, cited half-life, CiteScore, SCImago Journal Rank, and the Source-Normalised Impact per Paper.

The following section depicts the IF origin, actors, and criticism, besides some other widely used bibliometric tools.

Impact factor

Historical background

It was Garfield and Sher, from the Institute of Scientific Information (ISI), who first suggested how reference counting could measure impact, but the term impact factor was not used until the publication of the 1961 Science Citation Index (SCI) in 1963 [9]. Since then, impact factor (IF) has been widely considered as one of the leading proxies for mainly evaluating the quality, importance, and influence of medical journals to their respective discipline [9, 10].

The IF was created to compare journals regardless of their size [11]. A by-product of the SCI was the Journal Citation Reports (JCR), which was first published in 1975 [9]. IF is calculated annually by the ISI for those journals indexed in its database, and it is published by the JCR [12, 13]. The current JCR have two editions covering journals in the areas of science, technology, and social sciences [14]. Internationally applied, there is the JIF for medical journals announced by the JCR with the application of Journal Citation Index (JCI), regarding journals that are categorised under the SCI and SCI Expanded (SCIE), managed by Thomson Reuters via Web of Science [15].

Impact factor measurement

The IF for a given publication is calculated by dividing the number of times the articles published in a journal are cited during the two previous years, by the number of articles published by that journal in the same interval [16].

Actors interested in the IF value

There are several actors nowadays interested in the IF value: (A) authors, who consider how to select a journal that would give greater visibility to their papers; (B) librarians, who acknowledge IF as a choice parameter related for a title of greater scientific interest, which should be part of the scientific collections for institutions they work for; (C) medical editors who frequently use it as a performance index of their journal; they agree that IF is an index of influence in fundraising, a means of ranking their journals related to their peers, and an attraction of quality papers to be published [12, 17–19]; (D) journals per se that use the IF to "advertise" their quality and to entice potential authors in submitting high-quality papers to them [20]; (E) funding agencies that use IF to select researchers and institutions of higher merit, which would best meet the demands of institutions [21]; (F) promotion committees of academic institutions that commonly use the IF to judge applicants' publication quality for promotion and tenure and departmental chairs who may use it in the hiring and assessment process of recruits [22]. Journals with higher IF are generally considered more renowned than those with lower IF [23].

Criticism against IF

Some groups believe that the IF is not useful in analysing the scientific quality of a single article, nor of a researcher, neither of an institution [24–26]. There exist four main criticisms about IF: (1) doubts about whether it actually measures the quality, or just the quantity, of publications; (2) despite the fact that the calculation period base for citations is concise, it does not take into account that classical articles, which are cited more frequently than original ones, even decades after being written; (3) IF results are not comparable in different areas of research; (4) self-citation, the impact of the review articles, citation to non-citable items, the total number of citable items, and English language bias [27]. For instance, oncology or immunology publications have an IF higher than that of paediatric or ophthalmologic publications [28]. Table 1 presents a list of circumstances that affect IF calculation.

Cited half-life

It is the calculated point (age in the year) where 50% of the citations are underage and 50% of the citations are over that age. The cited half-life is a measure of *the rate of decline of the citation curve*. It is the number of years that the number of current citations takes to decline to 50% of its initial value. It is a measure of how long articles in a journal continue to be cited after publication [14].

CiteScore

CiteScore is the youngest metric and was published on December 2016 [34]. It is a free measure for the average number of citations received per document issued in a serial; it is also one of the three major indices included in Scopus by Elsevier to rank publication sources [35]. CS metrics became a new standard that gives a more comprehensive, transparent, and current view of a journal's impact. CS metrics, as a part of the Scopus basket for journal metrics, includes Source-Normalised Impact per Paper (SNIP), SCImago Journal Rank (SJR), citation and document counts and percentage cited. The integration of these metrics into Scopus provides insights into the citation impact of more than 22,220 titles [36]. Furthermore, the use of CiteScore has been reported

Table 1 Conditions that affect the IF calculation [29–33]

Condition	Definition	Remarks
Type of articles	Only original manuscripts and review articles	Letters to the editor or editorials are not included in the denominator of the calculation but may be cited and, therefore, are considered in the numerator of the IF calculation. Journals such as *Nature* or *Science* may have the IF inflated because of that bias.
Fields or sub-fields of knowledge	Number of references cited per article (density of citations)	Articles on exact sciences, in general, have lower-density citations than those related to health sciences. IFs of health science journals are, on average, much higher than those of exact science journals, such as mathematics.
The period for including citations	IF is annually published by the JCR and takes into account only the citations of a journal over two consecutive years.	There is a direct benefit for those journals dealing with fields whose pace of knowledge updating is rather fast. Thus, the citation of articles occurs immediately after its publication, creating a bias of increased IF journals. Fields such as biological or exact sciences tend to have a higher IF than those whose knowledge production takes place at a slower pace, as it is with social sciences or humanities.
Distribution of citations	Distribution of citations is non-parametric.	Fewer than 20% of the articles account for more than 50% of the total number of citations of journals, including many articles that have never received any citation.
Source of citations	IF counts the number of citations without taking into account the source of the citations.	Citations from prestigious journals are worth no more than citations from lower-tier journals.
Type of articles	The proportion of original research papers and review papers	A journal's IF can be increased by reducing the number of original research papers and increasing the number of editorials (which are not counted in the denominator of IF). Reviewing papers receive, on average, twice as many citations as original articles.

for journals in behavioural neuroscience [37], dermatology [38], pharmaceuticals science and molecular medicine [39], trade [35], structural chemistry [40], and nursing [41].

The CiteScore for year *N* (CiteScore *N*) sums the citations received in year *N* to documents published in years *N*-1, *N*-2, and *N*-3, and divides these by the number of documents published in the three consecutive years *N*-1, *N*-2, and *N*-3 [35].

$$\text{CiteScore } N = \frac{\text{citation count in } N \text{ documents}}{\text{documents } (N-3)-(N-1)}$$

For instance,

$$\text{CiteScore } N = \frac{\text{citation count in 2019}}{\text{documents 2016}-2018}$$

According to Scopus, the 3-year CiteScore time window was chosen as the best fit for all subject areas [35].

SCImago journal rank

The SJR is a metric based on data from Scopus that was developed by Felix de Moya at the University of Granada, Spain [42]. It is based on the centrality concepts that were first developed in social network analysis, and many of the terms used to measure centrality reflect their sociological origin [43]; indicators of centrality identify the essential vertices within a graph. Applications include identifying the most influential person(s) in a social network, key infrastructure nodes in the internet or urban networks, and super-spreaders of disease. SJR differs from the IF in that it counts citations in a given year to documents in a 3-year publication window, and it weights citations: not every citation is counted equally, but it is assigned a greater or lesser value based on the SJR of the journal giving the citation [1]. The SJR values are available free at *www.scimagojr.com* and are also included in the Scopus™ database [44].

Source-Normalised Impact per paper

Source-Normalised Impact per Paper (SNIP) measures contextual citation impact by weighting citations based on the total number of citations in a subject field. The SNIP also uses a 3-year publication window so that a higher proportion of total cites made to a journal are included in the calculation, it only counts peer-reviewed documents, and it only counts citations made to peer-reviewed documents. This unique perspective enables a direct comparison of sources in different subject fields. The impact of a single citation is given higher value in subject areas where citations are less likely and vice versa [45].

SNIP is calculated by dividing the "raw impact per paper" (RIP) over the "relative database citation potential" (RDCP), expressed as a formula, SNIP = RIP/RDCP [46]. The RIP is the number of citations in a selected year, for example, "2018" received by the papers published in the three previous years (2017, 2016, and 2015) in a certain journal divided by the total number of papers. Before using RDCP, we need to define first DCP; it means the *database citation potential*. If you consider the references of the papers which cited in the year "2018" the papers published in a certain journal in the three previous years (2017, 2016, and 2015), among these references, you consider only the references published during the same 3-year period. The DCP is obtained by dividing the total number of those references by the number of citing papers; only citations of the journals belonging to the database are included and other journals are ignored. The normalisation of the DCP by dividing it over the median DCP of the database is known as the RDCP [47].

The SNIP differs from IF in that it includes a correction for variation in citation behaviour and database coverage across research fields, which allows one to compare any journal to any other journal, and removes the need to assign journals to subject categories [48]. SNIP helps authors to identify which journals are performing best within their subject field and where to publish [49].

Eigenfactor metrics

The *Eigenfactor*™ score (ES) and the *Article Influence*™ score (AIS) use citation data to assess and track the influence of a journal about other journals. *Eigenfactor*™ metrics are available only for JCR years 2007 and later at www.eigenfactor.org.

Eigenfactor score

Eigenfactor score (ES) is considered an indicator for the global influence or repercussion of JCR journals. ES calculation is based on the number of times articles from the journal published in the past 5 years have been cited in the JCR year, but it also considers which journals have contributed to these citations, so that highly cited journals will influence the network more than lesser-cited journals. References from one article in a journal to another article from the same journal are removed so that the Eigenfactor scores are not biased by journal self-citation [23, 50].

ES uses a complex algorithm, similar to Google's Page Rank, which takes into account not only the number of citations but also their "quality" by assigning specific weights to the source of the citations. ES performs the iterative calculation of the level of citations received by a journal based on whether the said citations are in more or less cited journals and, accordingly, more or less influential [20].

The ES assesses the true dissemination of an article; that is, its use, as well as the category of journals which include it in their reference lists [28]. Notably, the ES does not have a denominator, and it is sensitive to a total number of citable items. In other words, journals with a low number of articles are likely to have lower ES [27]. Thus, journals that publish copious articles have higher ES than those that publish sparse articles if the average quality of the published articles is coincident among these journals [20]. The complete details of the Eigenfactor algorithm can be found at http://www.eigenfactor.org/methods.htm. Table 2 presents some common elements between Eigenfactor™ and Article Influence™ scores.

Three previous studies in the *Gastroenterology and Hepatology* [52], *Neurosciences* [53], and *Radiology, Nuclear Medicine & Medical Imaging* [54] categories revealed that—among the alternative bibliometrics to the IF, reported annually by the Web of Knowledge managed by Thomson Reuters [15] [*5-year impact factor*, *immediacy index*, *no. of articles* [published], *cited half-life*, ES, and *article influence score*]—the ES was the best predictors of 2-years-ahead citations.

Article influence score

AIS determines the average influence of a journal's articles over the first 5 years after publication. It is obtained from the *Eigenfactor*™ score, based on its same iterative algorithm, but considering the number of articles in the journal [28]. In the AIS, there is a numerator, as well as a denominator, which is the number of citable papers, except that it uses ES—rather than the total number of citations—as the numerator. AIS is measured by dividing a journal's ES by the number of articles in the journal, normalised as a fraction of all articles in all publications [20].

Each citation is multiplied by the *quality* of the citing journals, resulting in greater weights for citations that come from highly cited journals and less weight from poorly cited journals. The mean AIS is 1.00; a score higher than 1.00 indicates that each article in the journal has above-average influence; a score of less than 1.00 indicates that each article in the journal has below-average influence [23]. This measure is roughly analogous to the 5-year IF in that it is a ratio of a journal's citation influence to the size of the journal's article contribution throughout 5 years [23].

Immediacy index

The immediacy index of a journal depicts how often, on average, authors cite very recent articles from a particular journal and, hence, how rapidly the average paper from that journal is adopted into the literature. The immediacy index gives a measure of the skewness of the curve, that is, the extent to which the peak of the curve lies near to the origin of the graph [14] (Table 3]).

Table 2 Comparative features between ES and AIS [51]

Features	Remarks
Eigenfactor™ scores and *Article Influence*™ scores rank journals much as Google ranks websites.	Scholarly references join journals in a vast network of citations. Their algorithm uses the entire network structure (instead of purely local citation information) to evaluate the importance of each journal.
Eigenfactor.org™ reports journal prices as well as citation influence.	In collaboration with journalprices.com, *Eigenfactor.org* provides information about price and value for thousands of scholarly periodicals, while the *Eigenfactor scores* and *Article Influence scores* do not incorporate price information directly; the Cost-Effectiveness Search orders journals by a measure of the value per dollar that they provide.
Eigenfactor.org™ contains 115,000 reference items.	*Eigenfactor.org* not only ranks scholarly journals in the natural and social sciences, but also lists newsprint, PhD theses, popular magazines, and more. In doing so, it more fairly values those journals, bridging the gap between the social and natural sciences.
Eigenfactor™ scores and *Article Influence*™ scores adjust for citation differences across disciplines.	Different disciplines have different standards for citation and different time scales on which citations occur. The average article in a leading cell biology journal might receive 10–30 citations within 2 years; the average article in the leading mathematics journal would do very well to receive two citations over the same period. By using the whole citation network, their algorithm automatically accounts these differences and allows better comparisons across research areas.
Eigenfactor™ scores and *Article Influence*™ scores rely on 5-year citation data.	In many research areas, articles are not frequently cited until several years after publication. Therefore, those measures that only look at citations in the first 2 years after publication can be misleading. The *Eigenfactor* score and the *Article Influence* score are calculated based on the received citations over a 5-year period.
Eigenfactor™ scores and *Article Influence*™ scores are entirely free and completely searchable.	ES and AIS can be found at ISI website to registered subscribers, but also at the website from the University of Washington, http://www.eigenfactor.org

Table 3 Conditions that affect *H*-index calculation [55–57]

Condition	Definition	Remarks
Number of articles	Number of articles of great interest	The higher the number of articles of great interest published, the higher the number of citations achieved, and the higher the *H*-index, reflecting the academic and scientific quality of the researcher and his/her production capacity.
Number of articles	Total number of articles	May hide the lack of relevance of each text in isolation.
Number of citations	Presence of self-citation	Some citations lack the distinction between active and inactive scientists, the dependence of scientific age, differences between areas, and gender. Authors can considerably inflate their *H*-index through self-citations
Preferences of faculty members	Epistemological beliefs and methodological preferences	Among social scientists in anthropology, sociology, social work, political science, economics, and psychology, there is an epistemological/methodological effect making positivists and quantitativists globally more productive than constructivists and qualitativists.

Table 4 compares the advantages and disadvantages of the most critical metrics.

Researcher-level bibliometrics

The common assessment of the number of papers published, initially widely accepted and used, is no longer sufficient as a means of assessing researchers' scientific strength. The quality of publications is now seen as an identifying feature [21].

H-index

The *H*-index has become an approach of surveying researchers' productivity and impact [62. The *H*-index of a particular author is the number of the numeric sequence of papers which some citations equal to or is greater than the rank of the sequence [63, 64].

It is not only the most precise method to measure researchers' scientific quality, but also an acceptable device for assessing current production and forecasting its future scientific performance, as it combines productivity and impact [65, 66]. The *H*-index, in absolute terms, cannot be used to balance researchers from different fields, but in general, the highest *H*-index values are recognised among researchers working with life sciences [67]. An open-source option to calculate this index is the software called *Publish or Perish*, which uses tools from *Google Scholar* to retrieve and analyse academic citations [68].

The best strategy for a high *H*-index is publishing papers that are highly cited by others; productivity, also, has a positive effect on the *H*-index [55]. Figure 1 depicts the graphs corresponding to the *H*-indices of two researchers in the health sciences field: one junior clinical researcher with about 70 citations; the other, a senior neuroscientist with more than 2200 citations. Although initially intended for authors, the *H*-index can be calculated for any set of documents, for example, the publication output of a country, an institution, or for the output of a journal [1].

G-index

It is based on the *distribution* of citations received by a given researcher's publications: given a set of articles ranked in decreasing order of the number of citations that they received, the *G*-index is the (unique) largest number such that the top g articles received (together) at least g^2 citations [69]. It is a criticism answer for the *H*-index: once an article belongs to the *H* top class (defining *H*), it is unimportant whether or not this paper continues to be cited or not, and, if cited, it is unimportant whether this paper receives 10, 100, or 1000 more citations [70]. The *G*-index modifies the *H*-index a little bit, dealing with the performance of the top articles and counting their number of citations, even when they are declared to be in the top class. The *G*-index takes away the disadvantages of the *H*-index while keeping its advantages; it considers both the number of well-cited publications and their overall citation performance throughout the entire journal's existence [71].

HC-index

The contemporary *H*-index attempts to address the shortcoming of the *H*- and *G*-indices that they do not consider: the age of each article (that is, the year when it was published) by placing more weight on recent works and reducing the impact of older publications. The HC-index's methodology means that it ages each article when calculating its citation impact by encouraging well-cited recent works [72].

Individual *H*-index

The individual *H*-index divides the standard *H*-index by the average number of authors in the articles that contribute to the *H*-index, in order to reduce the effects of co-authorship [73].

Table 4 Advantages and disadvantages of the main bibliometric indicators accepted by institutions and authors [58–61]

	Advantage	Disadvantages
Impact factor	• It is a measure of the dissemination of knowledge. • It is quantifiable; therefore, it is objective. • It is the accepted metric in institutions that follow publications or by referees; then, authors use it when they are interested in being read, be known, and be cited.	• The journal has a limit cited during the 2 previous years. • It includes only journals indexed in the web of science database. • It places equal value on citations received from all sources. • JCR database bibliometrics charge a subscription rate.
Eigenfactor	• It gives greater importance to the citations in journals cited more often by other journals, which are therefore assumed to have more significant influence. • It gives the proportion of citations a journal receives rather than the absolute number of citations received, allowing for better comparison across disciplines. • The inclusion of a built-in evaluation of the previous 5-year interval.	• Eigenfactor assigns journals to a single category, making it more difficult to compare across disciplines. • Some argue that the Eigenfactor score is not much different from raw citation counts. • JCR database bibliometrics charge a subscription rate.
SCImago Journal Rank	• It includes more journals than the ISI Web of Knowledge. • It covers a more extended period to count appointments for 3 years. • It limits self-citations. • It ponders citations based on the importance of the journal. • SJR database is freely available online.	• SJR omits a large amount of information, putting into question its transparency, reliability, and suitability for evaluative purposes in its current form.
Source-Normalised Impact per Paper	• It measures the influence a journal has while also accounting for the variation in citation norms among disciplines. • Calculated on a journal by journal basis, it is suitable for comparing one discipline with another, or interdisciplinary titles that fall between subject categories.	• Citations from selected sources and selected document types only. • Journals with high SNIP values do not correlate as well with citation indicators as journals with high SJR values.
CiteScore	• It gives a more comprehensive, transparent and current view of a journal's impact. • It provides insights into the citation impact of more than 22,220 titles. • The use of a 3-year time window provides the best fit for all subject areas. • Its database is freely available online.	• CiteScore cannot modify the data published until the next publication, even when an error is identified. • The vast quantity of titles included may dilute the quality of its outcomes. • It skews against journals with a lot of front matter. • It seems to favour journals that fall under the Elsevier umbrella, as well as Emerald, which claimed to assist in CiteScore's development.

E-index

Since the *H*-index underestimates the actual number of citations by about 30% to 50%, the *E*-index helps to estimate the citations of papers not covered by the *H*-index, that is, the citations of papers published after that one corresponding to the *H*-index [74]. Because of the loss of citation information, comparisons based on the *H*-index alone can be misleading. Therefore, for accurate and fair comparisons, it is necessary to use the *E*-index together with the *H*-index. It is a necessary *H*-index complement, especially for evaluating highly cited scientists or for precisely comparing the scientific output of a group of scientists having an identical *H*-index [73].

M-index

It is defined as *H*-index/*n*, where *n* is the number of years since the scientist's first published paper [62]; it is also called *m*-quotient and allows comparing scientific careers of different times [51].

Q-index

It is an indicator to know how strategically an author has placed self-citations and which serves as a tool to detect possible manipulation of the *H*-index [55].

Other indices

There are some other index proposals such as age-weighted citation rate (AWCR); age-dependent index, which is calculated by using a square root (AW-index); individual *H*-index (*Publish or Perish variation*); and the multi-authored *H*-index; their description goes beyond the scope of this brief review. However, the information is available online [68, 75, 76].

Altmetrics (social media and other web-based metrics)

Recently introduced social- and web-based metrics are named *Altmetrics*; they aim to measure the impact of papers promptly

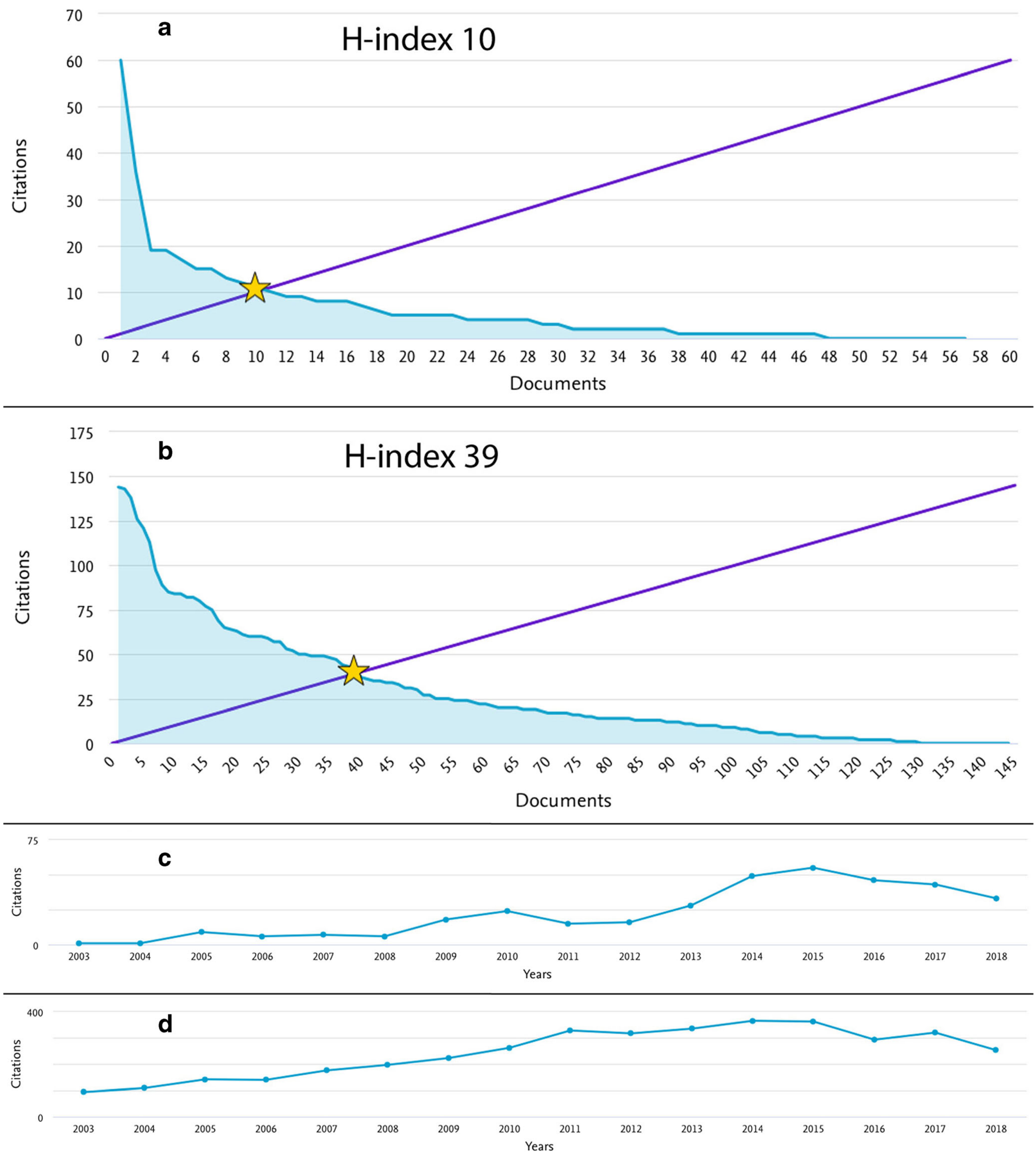

Fig. 1 **a** and **b** *H*-indices comparison between a junior clinical researcher with 55 publications and a senior scientist in neurosciences with more than 255 published papers. **c** and **d** Graphic representation of the annual number of citations for each researcher: the young clinical researcher with 357 citations and the senior investigator with 5531 citations

after publication by tracking the online attention they receive. This altimetry appeared as an alternative to the traditional bibliometric indices and *H*-index, in the midst of the dissatisfaction caused by evaluations using traditional scientific scientometric assessments and after behavioural changes reflecting the rise of the internet and the electronic availability of every journal [77]. The author's impact is now becoming a more and more important alternative to the impact factor; then, *Altmetrics* covers not just citation counts but also various other aspects of the impact of an article such as how many data and knowledge bases refer to it, article views, full-text downloads, Facebook likes, or mentions in social media and news media [78]. Its algorithm watches social media sites (e.g. Twitter, Facebook, Pinterest, Google+), science blogs, and many mainstream media outlets (including *The NY Times*, *The Guardian*, and non-English-language publications like Die Zeit & Le Monde and special interest publications like *Scientific American* and *New Scientist*); furthermore, it has reference managers who spot academic papers. It cleans up these data, enriches them, and then allows authors, readers, and researchers to see it in context. Despite that, not every article is discussed in public online. Altmetrics track around a hundred thousand mentions a week, with some 3000 new articles seen in a day [79].

The Altmetrics algorithm compute an overall score, taking into account volume (number of mentions), importance of the sources (news being weighted more than blogs, which at times are weighted more than Tweets), and authoritativeness of the authors (a mention from an expert in the field is worth more than one from a layperson). Its visual representation uses a colourful "doughnut" showing the proportional distribution of mentions by source type, and links to the available source data. This tool was incorporated into Scopus as a powerful third-party web application that runs within the sidebar of Scopus articles and abstract pages. It is a quick and easy way to see the entire social or mainstream media mentions gathered for a particular paper, as well as saved counts on popular reference managers [80].

The San Francisco Declaration on Research Assessment

In recent years, several journals accepted that they do not consider the impact factor to be a reliable method of assessing the impact or value of individual articles [81]. The San Francisco Declaration on Research Assessment (DORA) [82] lists some deficiencies that limit the use of the IF as a tool for research assessment:

- Citation distributions within journals are highly skewed.
- The properties of the journal impact factor are field-specific: it is a composite of multiple, highly diverse article types, including primary research papers and reviews.
- Journal impact factors can be manipulated (or "gamed") by editorial policy.
- Data used to calculate the journal impact factors are neither transparent nor openly available to the public.

DORA also made recommendations for improving the way in which the quality of research output should be evaluated:

- Do not use journal-based metrics.
- Be explicit about the criteria used in evaluating the scientific productivity of grant applicants.
- Significantly reduce emphasis on the journal impact factor as a promotional tool.
- When involved in committees making decisions about funding, hiring, tenure, or promotion, make assessments based on scientific content rather than publication metrics.
- Wherever appropriate, cite primary literature in which observations are first reported rather than reviews in order to give credit where credit is due.

Considering that this is a review article, we did not want to extend too much in the number of personal opinions, but to keep an objective perspective, while balancing the positive and negative issues of each metric; then, readers will make their own decision about which metrics result more convenient for their purposes. Table 4 depicts the advantages and disadvantages of the main bibliometric indicators accepted by institutions and authors.

Our proposed method to use bibliometrics

This proposal is based on our experiences as authors. Recent evidence shows that ES and SJR surpass the IF in the quality appreciation of journals [52]. By no means do we tell others that our method must be followed. Further studies should assess the growing evidence in this field. For now, we propose a simple approach product of our training and judgement perspective. According to our experience, authors, even senior investigators, most of the time do not know which of their papers will be the most cited. The calculation and understanding of the citation process is a daily academic workhorse for those doing research, as well as evaluating researchers and journals. The majority of citations to a journal are made on a minority of the articles (typically 50% of total citations go to less than 20% of articles, and about 50% of articles are responsible for 90% of the citations) [29].

In this context, Fig. 2 depicts a researcher targeting the next journal to submit their manuscript: (1) We choose a group of journals with impact factor > 1 (this is a recommendation from our institution). (2) Our rank selection of journals is in decreasing order of ES- and SJR-based quartiles. At this step, we choose those journals with the higher scores. (3) An additional filter in our selection would consider other significant metrics as the cited half-life, immediacy index, SCImago/SNP, and CiteScore. Once this order is settled, we can choose the best journals in our previous selection with the higher scores of the third step. (4) After the manuscript has been published and the researchers are trying to evaluate their performance, we use the *H*-index for an overall performance assessment. The researcher would decide

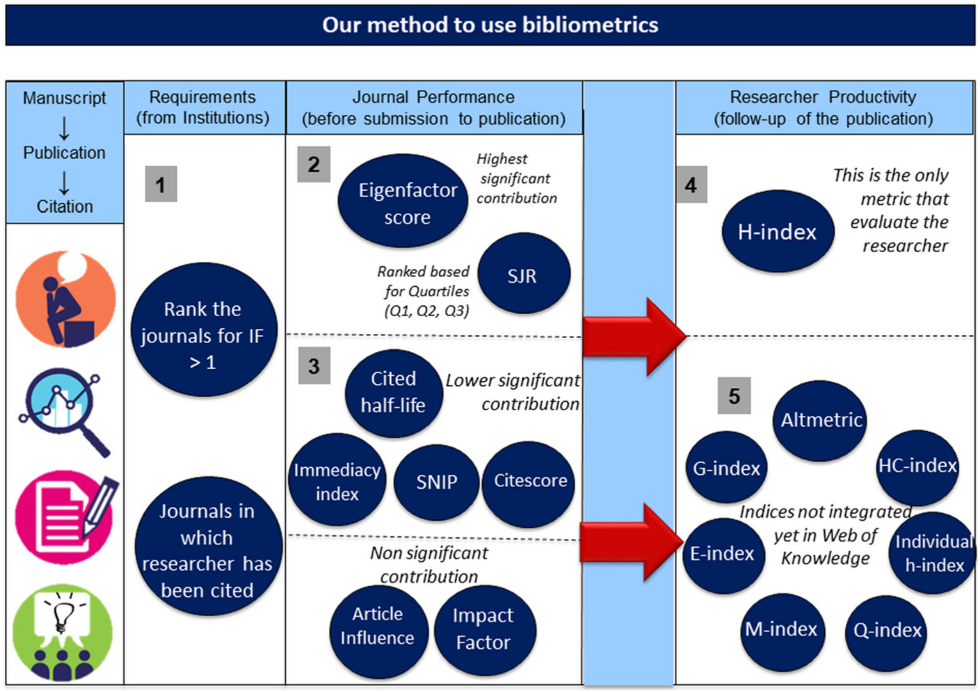

Fig. 2 Presentation of our proposed method to use bibliometrics

which range of previous publication he/she wishes to include in the assessment. Finally, in the right-side column of Fig. 2, we can easily consider our step 5, which requires that an author knows about supplementary alternative bibliometrics (Altmetrics, *G*-index, individual *H*-index). We suggest a reasonable waiting time before counting the first citations over 2 years. Investigators, then, may evaluate by themselves their performance with the *H*-index. At this point, we recommend 5 years after graduation for starting juniors or at any moment for seniors. An investigator may build and present a *summary table of the journals in which his/her research's papers have been cited.* This table is easily gotten by using the tools from the ISI Web of Knowledge website.

Table 5 presents an example of this proposed summary table. This last stage would give a global understanding

Table 5 Example of an ideal summary table containing bibliometric data of *all the journals* in which the manuscripts of a hypothetical researcher (from the neurosciences field) were cited. The table was slightly modified from a search in the ISI Web of Knowledge. The modification consisted in the addition of one column: the Author's citations. In this example, there is evidence of the researcher's productivity and his/her versatility because of crossable research lines inferred by publications in basic sciences and clinical medical journals. This may be used as a supplement for the author *H*-index

Abbreviated journal title	ISSN	* Author's citations in each journal	JCR data						*Eigenfactor*™ metrics	
			Total cites of journal	Impact factor	5-year impact factor	Immediacy index	Articles	Cited half-life	*Eigenfactor*™ score	*Article Influence*™ score
Acta Protozool	0065–1583	1	577	0.881	1.000	0.065	31	8.3	0.00119	0.327
Exp Parasitol	0014–4894	2	4218	1.869	1.841	0.767	223	9.4	0.00803	0.477
J Eukaryot Microbiol	1066–5234	2	2424	2.397	2.245	0.281	64	7.4	0.00596	0.739
Parasitol Int	1383–5769	1	1190	2.259	2.366	0.396	106	4.2	0.00444	0.635
Parasitol Res	0932–0113	14	5741	1.812	1.723	0.344	366	4.8	0.01407	0.395
Ann Neurol	0364–5134	22	30,338	10.746	10.132	1.708	192	9.1	0.07254	3.995
Clin Neurol Neurosur	0303–8467	2	2367	1.636	1.585	0.317	186	5.2	0.00699	0.450
J Public Health Pol	0197–5897	1	417	1.635	1.484	0.138	29	6.6	0.00167	0.692

about researchers' performance. They would know not only the number of articles and their corresponding citations (from the *H*-index) but also a whole view of the journals that cited their papers in previous years (some investigators might contribute to different areas of knowledge during their careers). This approach might help to understand the individual research structure and the social network that surrounds it. There are, at least, a dozen of other bibliometric indices whose explanation goes beyond the aims of this review. Coming years will tell us about their usefulness and acceptance by the scientific community. So far, we have summarised a series of tools, and a single productive process, that can be used as a reliable academic compass.

Our integrative approach might help individual faculty members, within a university or research centre or a funding institution, to (1) plan the submission of their research work (manuscript), (2) track the impact of their paper, and (3) have a global perspective of their performance some years later.

Conclusions

The journal assessment landscape has radically changed since the last decade. There is an excess of metrics available for investigators and institutions evaluating journals, and scientists' performances have not reached any consensus about their usage. Bibliometric indices can only be compared among similar components (similar disciplines). We encourage the use of quartile distributions within each category/discipline as a simple metric. Authors must firstly identify what metric(s) they will consider before submitting their manuscripts and which metric(s) they will use to evaluate and select the fittest journal, as well as being capable of tracking their individual performances over the years. Every metric has its patterns, advantages, and limitations. Alternative metrics enable people to assess a journal from a different social perspective. An integrative use of the metrics above mentioned, rather than just IF alone, might represent the fairest and most legitimate approach to assess the influence, growth, and publishing trends of acceptable research issues, and not only a sound high-IF journal in their respective disciplines.

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