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Alternatives to the impact factor

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ABSTRACT

Objective: To explore alternative bibliometric markers to the well-established journal impact factor. The bibliometric evolution of a leading ENT journal over a six year period is discussed with critical analysis of a predetermined set of bibliometric alternatives to the journal impact factor.

Design: Retrospective review of the bibliometric performance of Clinical Otolaryngology over a six year period.

Results: The results of the study reveal that Clinical Otolaryngology has made steady bibliometric progress when the impact factor (IF) is considered with a gradual increase in impact factor from 1.098 in 2006 to a peak of 2.393 in 2011. Self-citation rates reported by the Journal Citation Report (JCR) demonstrated a significant decline during 2007 with a reported self-citation rate of 0%. The SCImago Journal Rank (SJR) database however recorded a self-citation rate of 67. Independent evaluation demonstrated a 56 self-citations during this period. The percentage of review articles published remained stable during the period in question. A lagged association between the number of review manuscripts and the IF failed to demonstrate any significant correlation ($r = -0.19$). Comparison between the IF and the Eigen factor (EF) as well as the SJR yielded negative correlation ($r = -0.46$) and ($r = -0.35$) respectively. The Article Influence score (AIS) and Source Normalised Impact per Paper (SNIP) were the only bibliometric alternatives to demonstrate a positive correlation when compared to the IF ($r = 0.94$) and ($r = 0.66$) respectively.

Conclusions: The necessity of bibliometric markers cannot be called into question however the most widely employed of these, the journal impact factor has come under increased scrutiny of late. Despite some of the advantages offered by novel bibliometric markers, these do not necessarily compare favourably to the IF with regards to bibliometric performance. The only two markers to demonstrate a positive correlation when compared to the IF were the AI score and SNIP which would suggest that these are potential alternatives to the IF and have the added advantage that they are open access.

Introduction

The advent of the electronic age has not only resulted in a significant expansion of available information but also the accessibility of this information. Scientific journals are now commonly available online and offer subscribers full access to unpublished manuscripts as well as past and present issues of the publication. The growing number of peer reviewed

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publications as well as newly established channels of publication such as conference proceedings and open access archives, highlights the need for specific measures to establish the relevance of these sources to avoid potential information overload. The most commonly employed of these is the journal impact factor, which has become firmly established as the leading bibliometric ranking measure since its inception in the 1950s. It rapidly evolved to become more than just a measure of the journal's relevance and is now often viewed as an indication of journal and author prestige which has far reaching implications with regards to research funding amongst others.[1] The impact factor, as a bibliometric measure, however has certain shortcomings including the fact that it is published by a private for Profit Company and could potentially be manipulated to some extent through measures such as self citation as well as encouraging the publication of review articles, which are known to have a superior citation rate.[2] A further quandary is the disparity in impact factor between specialities and in particular when subspecialties, such as Otorhinolaryngology, are considered. This is of particular concern for trainees competing to gain a position within the higher surgical training scheme in Ireland, where points allocated for publications are directly related to the impact factor of the journal within which the manuscripts are published. In light of these factors, numerous alternatives to the impact factor have been proposed.[1–5] The most notable of these include the SCImago journal ranking (SJR) as well as the recently proposed source normalised impact per paper (SNIP), both of which are published by Scopus.[4] The aim of this study was to explore alternative bibliometric markers to the well established journal impact factor, using the bibliometric evolution of a leading ENT journal (Clinical Otolaryngology) as a measure.

Material & methods

Eleven separate bibliometric markers were recorded for Clinical Otolaryngology over a six year period (2006–2011). Data was gathered from the Thompson Reuters, Web of Knowledge – journal citation report (JCR) and the Scopus, SCImago – journal and country rank (SJR) databases for each of the markers. These markers included the impact factor (IF), total citations per year, immediacy index, number of eligible manuscripts published, percentage review articles, SCImago journal rank (SJR), source normalised impact per paper (SNIP), Eigen factor (EF), article influence score (AI), percentage papers not cited and the cited half life. The five bibliometric measures recorded (SJR, SNIP, EF, AI score and IF) for Clinical Otolaryngology were documented for each of the years in question and analysed for correlation. The bibliometric performance of Clinical Otolaryngology was gauged accordingly in an attempt to identify a potential bibliometric alternative measure to the impact factor. Statistical analysis was performed using SPSS statistics 17.0 (IBM, USA) software.

Results

The results of the study reveal that Clinical Otolaryngology has made steady bibliometric progress when the impact factor is considered with a gradual increase in impact factor from 1.098 in 2006 to a peak of 2.393 in 2011, which translates to an increase in impact factor ranking, within the field of Otorhinolaryngology, from 11th during 2006 to 6th in 2011. Throughout this period Clinical Otolaryngology remained within the top 15 Otolaryngology journals ranked according to the IF with a mean impact factor rank of 1.62.

Self-citation rates reported by the JCR demonstrated a significant decline during 2007 with a reported self-citation rate of 0%. The SJR database however recorded a self-citation rate of 67 (for the three years preceding 2007). To further delineate this discrepancy the authors conducted a retrospective review of the reference lists of all manuscripts published in Clinical Otolaryngology during 2007 and identified 56 citations to manuscripts published in the same journal during the preceding 2 years (2005 and 2006). The authors failed to identify the cause of the aforementioned discrepancy despite reviewing a large subset of the raw data (Table 1).

Despite being a recognised means of increasing journal impact factor, the percentage of review articles published remained relatively stable throughout the period in question (Graph 1). A lagged association between the number of review manuscripts published in the two years used to calculate the IF and the journal IF value (Table 3) failed to demonstrate any significant correlation ($r = -0.19$).

Direct comparison between the IF and alternative bibliometric measures demonstrated poor performance correlation as illustrated in Table 4. Both the EF and SJR suggested negative correlation, whilst comparison of the IF and SNIP revealed a positive correlation coefficient; however these findings failed to reach statistical significance. The AI score was the only alternative to the IF which demonstrated a significant degree of positive correlation with the performance of the IF (Graph 2) during the period in question ($r = 0.9383$, $p = 0.006$). All recorded bibliometric markers are included in Table 2.

Discussion

The journal IF was developed by Dr. Eugene Garfield, founder of the Institute for science information (ISI), during 1955.[6] Currently it is managed by Thomson Reuters, a private commercial institution based in the United States and is published annually in the JCR, which is available through the web of science portal, a subscription service.[4] The journal impact factor for a particular year (e.g. 2000) is calculated by dividing the total number of citations during the same year (2000) to articles published in the two preceding years (1999 and 1998) by the total number of manuscripts published during the corresponding years (1999 and 1998).[3,7] Following its introduction, the journal impact factor rapidly rose to bibliometric stardom to become firmly established as the leading bibliometric ranking measure. For the purpose of this review it served as the gold standard against which other, novel bibliometric measures were weighed against in an effort to determine whether these proposed measures are viable alternatives.

This begs the question why alternatives to the impact factor are required? Despite the accolades bestowed upon it, the journal impact factor has been criticised by some due to

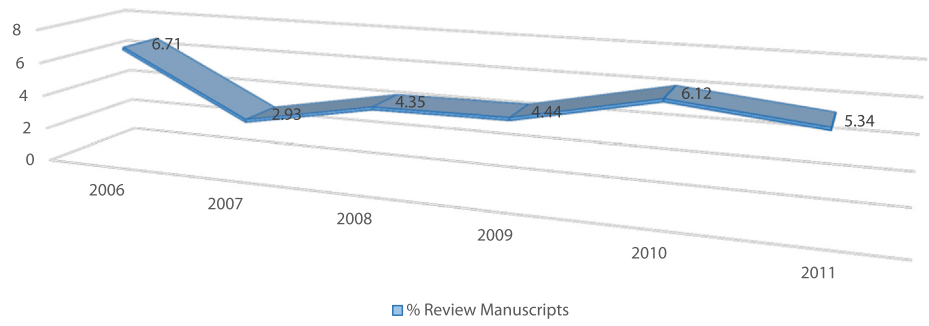
Table 1 – Description of various bibliometric markers.[11,12]

Bibliometric marker	Description
Impact factor	The average amount of citations (during the year in question) to manuscripts published in the journal during the two preceding years. Includes self-citations in calculation.
Total citations	The total number of citations to the journal during that particular year.
Immediacy index	The average number of times an article is cited during the year that it is published.
Self cites	Reference to a manuscript published within the same journal.
Citable items	Includes original and review articles.
Reviews (%)	Percentage of review manuscripts published in journal.
SJR	A measure of the journal's impact or influence and expresses the average number of weighted citations received in the year in question by articles published during the preceding three years.
SNIP	Measures the citation impact by weighting citations based on the total number of citations within a subject field. Citations from subject areas where citations are less likely carry a higher value.
EF	Based on the amount of times articles (published during the preceding 5 years) from the journal have been cited in the year in question. Takes into consideration the source of the citation with a higher significance attributed to highly cited sources. Self-citations are excluded from calculation.
AI score	The average influence of the journal's manuscripts for the first five years post publication and is closely related to the Eigenfactor.
Not cited (%)	Manuscripts published during the preceding 3 years that have never been cited.
SJR ranking	SJR rank within a particular field e.g. Otorhinolaryngology
IF ranking	IF journal rank within a particular field.
EF ranking	EF rank within a particular field.
AI ranking	AI rank within a particular field.

the fact that it is published by a private for profit company and whilst all citations for the given year are taken into account as the numerator, only manuscripts deemed to be original research or review papers, by employees of the company are included in the denominator. This in turn has resulted in poor reproducibility of the calculated impact factor which often serves as a source of conflict between publishers, editors and the ISI.[2] The inconsistency identified during the course of this study with the 0% review articles listed in the ISI database for 2007 is particularly worrisome and despite their efforts the authors of this report were unable to establish the aetiology of this significant error. This certainly calls into question the accuracy of other data included in the ISI Journal Citation Report database and therefore the IF itself. A further criticism is the near exclusive analysis of journals published in English, which translates to a distinct disadvantage of journals published in any other language.[2,6,8] Furthermore it has been demonstrated that it is possible to manipulate the impact factor through measures such as self citation as well as increasing the quantity of review manuscripts published, as it is a well established fact that these manuscripts attract higher citation rates.[1,2,6] This criticism is not however applicable to all journals as demonstrated by the results above. A final quandary is the disparity of JIF between different specialties and subspecialties. Authors are more likely to be lured to submit their work to high impact factor journals, due to the perceived prestige of these journals, which might not be the most appropriate platform for dissemination of their research and will not necessarily reach the target audience.[1]

The most prominent alternatives to the IF include the EF, AI score, SJR and the SNIP. All of these ranking measures, bar the SNIP, stem from a recent trend in research away from the focus of raw citation analysis, of which the JIF would be an example, toward the consideration of the quality and origin of each individual citation. These measures therefore take into account not only the quantity of citations, but also the quality and origin of each individual citation to determine the bibliometric impact of a journal within its field.[9]

The Eigenfactor score is an open access, bibliometric ranking tool developed by the University of Washington and utilises citation data from the ISI to provide a measure of the overall importance of all papers published within a particular journal during a year.[1,2] It automatically excludes self citation from calculation and the manner in which journals are ranked is not dissimilar to the model used by Google to rank web pages.[1,4] The Article influence score is closely related to the EF



Graph 1 – Percentage review Manuscripts.

Table 2 – Summary of all data collected.

	2006	2007	2008	2009	2010	2011
Impact factor	1.098	1.477	1.614	1.569	1.561	2.393
Total citations	1848	1967	2046	2224	1957	2187
Immediacy index	0.307	0.579	0.411	0.760	0.205	0.289
Self cites	128	56	169	158	90	111
Citable items	75	57	73	50	39	45
Reviews (%)	6.71	2.93	4.35	4.44	6.12	5.34
SJR	0.104	0.108	0.101	0.128	0.126	0.095
SNIP	0.331	0.578	0.676	0.962	0.957	0.928
EF	0.004	0.005	0.004	0.003	0.003	0.003
AI score	0.332	0.455	0.427	0.453	0.502	0.610
Not cited (%)	30.49	50.73	51.30	53.33	69.39	88.55
SJR ranking	15	15	20	12	10	14
IF ranking	11	6	10	12	13	6
EF ranking	14	12	16	15	20	20
AI ranking	14	10	14	14	15	15

Table 3 – Correlation between number of review manuscripts published and impact factor.

Number of review manuscripts published in 2 preceding years	Impact factor	JCR year
18 (2004 + 2005)	1.098	2006
13 (2005 + 2006)	1.477	2007
14 (2006 + 2007)	1.614	2008
10 (2007 + 2008)	1.569	2009
13 (2008 + 2009)	1.561	2010
14 (2009 + 2010)	2.93	2011

and is available online at www.Eigenfactor.org. It is calculated by dividing the EF score for a particular journal by the number of manuscripts published.[4] As a bibliometric measure it resembles the 5 year IF and aims to provide an insight into the influence of the manuscripts published in a journal during the first 5 years following publication.[4] Whilst the bibliometric

Table 4 – Correlation coefficient of various bibliometric markers compared to the impact factor.

Bibliometric measure	Correlation coefficient	*p* value
Eigenfactor	−0.461	0.357
SCImago Journal Rank	−0.35	0.5
Source Normalised Impact per Paper	0.66	0.154
Article influence score	0.94	0.06

performance of the EF failed to demonstrate any correlation to the IF, the AI score on the other hand was one of two bibliometric alternatives to the IF to demonstrate a positive correlation with the IF. The correlation reached statistical significance and would suggest that the AI score could be considered as a viable alternative to the IF with the added advantage that it is an open access source. The fact that it differs from the impact factor with regards to the period used for calculation (5 years vs. 2 years) and is dependent upon the EF (which demonstrated a negative correlation coefficient) for calculation are two criticism to take into account if the AI score is to be utilised as an alternative to the IF.

The final two bibliometric measures that were considered were the SCImago Journal Rank and the Source Normalised Impact per Paper, both of which are produced by Scopus and are open access resources as well. Calculation of the SJR is not dissimilar to the EF, however it utilises the Scopus database which at present contains more than 17,000 journals and periodical publications in its directory, which is substantially more comprehensive than the JCR.[1,4,9] According to the developers of the SJR it is a bibliometric measure which aims to provide information regarding the average prestige per paper published in a journal, independent of its size.[9] A 3 year citation window is used to calculate the SJR and the journal's self citation rate is limited to a maximum of 33%, a measure that effectively excludes manipulation through the use of self

Graph 2 – Correlation between Article Influence Score and Impact Factor.

citation.[9] Previous reports suggest that the SJR measures up well, in terms of bibliometric performance, when compared to the JIF.[6,8] A further advantage of the SJR is the greater number of Otorhinolaryngology journals included in their official ranking (92) compared to the JIF (41). Despite the advantages mentioned the SJR demonstrated a negative correlation ($r = -0.35$) when compared to the performance of the IF over a defined period and calls into question its suitability as an alternative to the well established IF.

The SNIP was developed by H.F Moed and aims to assess a journal's impact within a set context which avoids the disparity encountered between different specialities, an Achilles heel of the JIF. The context within which the SNIP is assessed is determined by the reference practices of journals within the subject field in question as well as the extent to which the database covers this field.[10] The weight of a single citation is adapted according to likelihood of receiving citations from within a particular field and is given more weight in fields that attract fewer citations, such as subspecialties.[1] The other advantages of the SNIP include the consideration of immediacy by taking into account how rapidly a manuscript is likely to have an impact within a particular field as well as the limitation of editorial manipulation.[1] The SNIP was the only other bibliometric marker to demonstrate a positive correlation coefficient ($r = 0.66$) and whilst this did not reach statistical significance due to the small sample size it certainly warrants consideration as an alternative bibliometric marker to the IF, in light of the advantages if offers.

Conclusion

Whilst the necessity of bibliometric markers cannot be called into question, the most widely employed of these, the journal impact factor has come under increased scrutiny of late. In smaller subspecialties, authors are by virtue of the perceived prestige of high impact factor journals, more likely to submit their work to these journals despite the fact that this might not be the most appropriate platform for their work. Despite some of the advantages offered by novel bibliometric markers, these do not necessarily compare favourably to the IF with regards to bibliometric performance. The only two markers to demonstrate a positive correlation when compared to the IF were the AI score and SNIP which would suggest that these are potential alternatives to the IF and has the added advantage that they are open access.

Conflict of interest

None to declare.

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