The impact factors of open access and subscription journals across fields

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We have compared the 2-year and 5-year impact factors (IFs), normalized impact factors (NIFs) and rank normalized impact factors (RNIFs) of open access (OA) and subscription journals across the 22 major fields delineated in Essential Science Indicators. Journal Citation Reports (JCR) 2012 has assigned 2-year IF to 1,073 OA and 7,290 subscription journals and 5-year IF to 811 OA and 6,705 subscription journals. Overall 12.8% of journals listed in JCR are OA, but a higher percentage of journals are OA in 9 fields, including multidisciplinary (31%), agriculture (19.1%) and microbiology (19.1). Overall 2-year IF is higher than 5-year IF in about 31.5% journals in both OA and subscription journals. But among physics journals, two-thirds of OA journals and 58% of subscription journals have a higher 2-year IF. For multidisciplinary journals the mean RNIF is higher for OA journals than subscription journals. Higher proportion of subscription journals had mean RNIF above 0.5: 361 of 1,073 OA journals (33.6%) and 3,857 of 7,280 subscription journals (52.9%) had a 2-year mean RNIF above 0.5 and 277 of 811 OA journals (34.2%) and 3,453 of 6705 (51.5%) subscription journals had a 5-year mean RINF above 0.5. Moving to OA has proven to be advantageous to developing country journals; it has helped a large number of Latin American and many Indian journals improve their IF.

Keywords: Impact factor, normalized impact factor, open access journals, rank normalized impact factor, subscription journals.

Impact factor

Garfield[1] first mentioned the idea of an impact factor (IF) in 1955, and it was only in the early 1960s he, along with Irving H. Sher, devised the journal impact factor (JIF) to help select journals for *Science Citation Index*. The evolution of the idea of IF is well documented[2]. From then on, it has been used widely for different purposes, often indiscriminately, e.g. in the evaluation of performance by individual scientists, ranking institutions and countries, selection of candidates for awards and fellowships of academies, and granting of promotions and tenures in universities. Despite warning against such uses by Garfield himself[2], the literature of scientometrics is replete with improper use of IF. Many critics have commented on such misuse. Many seem to forget the cardinal principle that all citation studies should be normalized to take into account variables such as the discipline, citation density and half-life[3]. Some even gather improper datasets and draw conclusions beyond what the data warrant[4].

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We believe, as do many others[5], that IF has its uses and condemning it outright will be tantamount to throwing the baby out with the bathwater. As far as journals and their evaluation are concerned, despite all the criticisms, JIF continues to be a valid indicator.

Open access

Open access (OA) to science, through OA repositories and OA journals in the fields of science, technology and medicine (STM), has transformed the scholarly communication scenario in the past decade. Scientists in developing countries and those working in institutions with modest funding in developed countries now have free on-line access to thousands of journals and a few million research papers and soon, with increased acceptance and adoption of the open data movement[6], will have free access to a huge volume of mineable data. The emerging trend of OA publishing is reflected in the number of OA journals indexed in the *Directory of Open Access Journals* (*DOAJ*), which rose from 500 in 1999 to 9,826 on 9 June 2014.

According to Morrison[7], roughly 30% of peer-reviewed journals were OA in December 2012. The rate of growth of OA journals is now greater than that ten years ago[8]. Unfortunately, many predatory publishers have sprung up

and are publishing new OA journals solely with the aim of making money through the author-pays model. These spurious publishers and their journals are growing at an alarming rate. They have also attracted the attention of the media[9,10]. According to Beall[11], India publishes an unduly large number of such journals. Bohannon[12] carried out a sting operation and exposed the murky nature of predatory OA journals. But *JCR*'s strict evaluation procedure will not allow any predatory journal to get into it.

Several studies have shown that barrier-free OA journals ensure greater accessibility, visibility, citability and impact than subscription journals[13–18]. Even in The Netherlands, USA, UK and Germany, often referred to as the big four publishing countries because of their domination in for-profit journal publishing, there is an overall trend of increasing impact for both open and closed journals, with a huge gain for OA journals in particular[19]. Björk *et al.*[20] have shown that the number of OA papers has been growing and for articles published in 2008, it stood at 20.4% of all papers published – 8.5% in journals (publisher sites) and 11.9% in searchable repositories. They also pointed out that since 2000, the number of OA journals was growing by 18% annually and the number of articles by 30%. A subsequent study commissioned by the European Commission called the SOAP project survey[21], the largest to touch issues in OA publishing so far, reports that approximately 10% of papers published currently appeared in OA journals. We found that 12.75% of Indian research papers published in OA journals in 2009 as indexed in *Science Citation Index Expanded* (*SCIE*), which is higher than the global average[22]. Clearly, both OA overall and publishing in OA journals are gaining acceptance. In a recent paper, Björk[23] concluded that 'the situation has nevertheless improved significantly' in the last ten years.

Author attitude

While OA publishing is growing rapidly, some people have doubts about its sustainability and the quality of papers published in gold OA journals. Many authors believe that OA journals will necessarily have low IF and thus avoid publishing in them. The issue of quality of OA journals was first addressed by McVeigh[24], when she compared the IF of OA and subscription journals indexed in 2002 and 2003 *JCR* and other ISI (now Thomson Reuters) citation databases; there were only 239 OA journals. In 2008, 355 OA journals were indexed in the science edition of *JCR* 2008 (ref. 25). Recently, Björk and Solomon[26] compared the scientific impact of 610 OA journals with 7,609 subscription journals using *Web of Science* (*WoS*) data and an overlapping set of 1,327 OA journals with 11,124 subscription journals using *Scopus* data at both the journal and the article levels using 2-year IF of those journals. They observed that OA journals had the same levels of scientific impact and quality as subscription journals, particularly in biomedicine and for journals funded by article processing charges. Swan[15] had also arrived at the same conclusion. The IFs of Indian OA journals are rising since 2004, since they went open access[27]. Packer[28,29] reported that 'more than 85% of the journals within the SciELO collections saw their impact factor increase in 2006 and 2007' and 'the impact factor of SciELO journals in *JCR* rose from 1998 to 2007, with an average increase of 244%'.

Even though more than 9,800 peer-reviewed OA journals are listed in *DOAJ*, only a small part (about 9.4%) has been indexed in *JCR*. Many OA journals were started recently and do not yet meet the criteria used for inclusion in *JCR* or *WoS*. This is true of many subscription journals too.

In this article, we characterize the 1,080 OA journals and 7,331 subscription journals in *JCR* 2012 by 22 major fields, country of publication, and two- and five-year IF. We calculate the rank normalized impact factor (RNIF) for all journals and compare the mean RNIF and mean normalized impact factor (NIF) of OA and subscription journals at the level of major fields.

Methodology

A comprehensive list of OA journals is not readily available. To find out IF of OA journals, one needs to compile a list of *JCR*-indexed OA journals. It is a cumbersome task that can only be achieved by adding titles from non-Thomson Reuters data sources to journals indexed in *WoS*[30]. The number of OA journals indexed differs from database to database. We looked up four different sources, viz. *DOAJ*, *WoS*, *Scopus* and *PubMed Central* (*PMC*). We compared the consolidated list of OA journals collected from these sources with journals listed in *JCR* 2012 by matching the ISSN, journal title and abbreviated title, and identified 1,080 OA journals in *JCR* 2012 (science edition)[31]. These 1,080 journals have been considered in the present analysis. *DOAJ* listed 9,972 OA journals (at the time of data collection on 7 August 2013), of which only 936 are found in *JCR* 2012. The corresponding figures for *Scopus*, *WoS* and *PMC* are 2101 and 746, 1178 and 917 and 1033 and 114 respectively. We requested Thomson Reuters to provide us with the list of OA journals indexed in *WoS*, as the *WoS* OA journals list (http://science.thomsonreuters.com/cgi-bin/linksj/open-search.cgi) available in the public domain was incomplete and had only 705 OA titles. The list provided by Thomson Reuters has 1,178 titles (private communication from the Technical Support team of Thomson Reuters at Bangalore, on 29 July 2013).

Figure 1 shows the number of journals unique to any one database, number of journals covered by any two

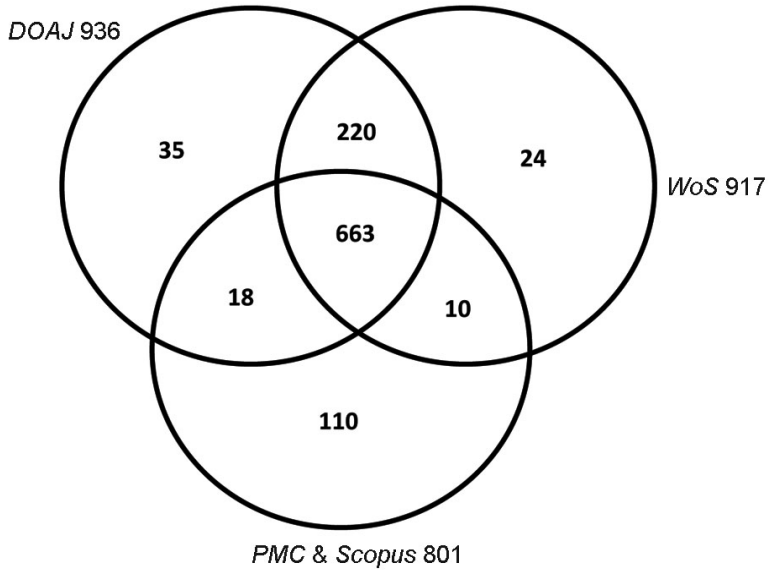

Figure 1. Open access journals indexed in different databases and *JCR* 2012 science edition (data collected on 27 July 2013).

databases, and the number of journals common to all three databases. As there are four databases, and as we could only combine three in a two-dimensional Venn diagram, we merged *Scopus* and *PMC* first and included the combined database as one of the three members in the Venn diagram. There were 746 OA journals in *Scopus* that were indexed in *JCR* of which 59 were common with *PMC*. Apart from these, *PMC* had 55 other OA titles.

The number of OA journals considered in our study is much higher than that by McVeigh[24]. We assigned major fields to all 8,411 journals indexed in *JCR* 2012 using the classification followed in *Essential Science Indicators* (*ESI*)[32]. Unlike in other Thomson Reuters databases, each journal is assigned to only one of 22 subject categories in *ESI*. Gumpenberger *et al.*[30] have used the same set of 22 *ESI* categories. Even the databases themselves often classify some journals under more than one major field, and the same journal may be classified under different fields in different databases, e.g. *Bioscience*, *Biotechnology and Biochemistry* (ISSN: 0916-8451) is classified under the major field Life Sciences and subfield Biochemistry, Genetics and Molecular Biology in *Scopus*. The same journal is classified under four fields, viz. Biochemistry and Molecular Biology; Biotechnology and Applied Microbiology; Chemistry; and Food Science and Technology, in *WoS*. *Micro and Nano Letter* (ISSN: 1750-0443) is classified under Nanoscience and Nanotechnology; Materials Science, Multidisciplinary in *WoS*, and under Physical Sciences, Chemical Engineering, Engineering, Materials Science, and Physics and Astronomy in *Scopus*.

We assigned country of publication for journals from the source list of *JCR* 2012 available in the Thomson Reuters website[31].

Impact measures are available from three sources, viz. the often-used IFs provided by *JCR* based on *WoS* data, the *SCImago Journal Rank Indicators* (*SJR*) and the CWTS, Leiden, *SNIP* (source normalized impact per paper) based on *Scopus* data. We chose the *JCR* IF as we are working with data from *JCR* and *SCIE*.

IFs are not like physical constants; by the very nature of the way they are calculated, they are bound to vary from year to year. For example, the IF as seen from *JCR* 2009, 2010 and 2011 for *New England Journal of Medicine* is 47.05, 53.484, 53.298 and that for *Pramana – Journal of Physics* is 0.349, 0.561, and 0.575 respectively.

Garfield[3] insisted that when journals were studied across fields, the ranking should be normalized to take into account variables such as field, or discipline, and citation practices. For comparing IFs across disciplines, Marshakova-Shaikevich[33] and Sen[34] have suggested techniques for normalizing JIF. We have adopted the more objective RNIF method for subject categories suggested by Pudovkin and Garfield[35]:

> For any journal j, the RNIF $\mathrm{rnIF}j = (K - Rj + 1)K$, where Rj is the *JCR* rank of journal j and K is the number of journals in its category. If a journal j has $\mathrm{rnIF}j = X$, it means that $100\% \times (1 - X)$ of the journals in its *JCR* category have higher IF values. The top

journals in each subject category will have rnIF equal to 1.0 and the median journals will have mIF close to 0.5.

We compared the 2-year and 5-year RNIF, mean RNIF and mean NIF of OA and subscription journals indexed in *JCR* 2012 (science) for different fields as classified in *ESI*.

We used MS Access and wrote few SQL scripts for data analysis.

Analysis

The *JCR* 2012 (science edition) has indexed 8,411 journals published from 81 countries (Table 1). Of these, 1,080 (approx. 13%) published from 68 countries are OA. Only 1,073 OA journals are assigned an IF in *JCR* 2012. Of the 7,331 subscription journals, only 7,290 are assigned an IF. Thus 48 journals indexed in *JCR* 2012 do not have an IF. UK and USA are the leading publishers of OA journals. Of the 2,806 US journals indexed in *JCR* 2012, only 149 titles are OA (5.3%). Of the 1,696 UK journals, 165 titles are OA (9.7%). Fifteen countries accounted for more than 74% of OA journals in *JCR* 2012. More than 91% of subscription journals are published from 16 countries. Only five of the 652 journals from The Netherlands (indexed in *JCR* 2012) are OA. But nearly half of the Indian journals indexed in *JCR* 2012 (45 of 99), 37 out of 54 Turkish journals and, thanks to SciELO, 92 of the 99 Brazilian journals are OA.

Table 1. Distribution of open access (OA) and subscription journals indexed in *JCR* 2012 by publishing country

Journal country	OA journals	Subscription journals	All journals[a]
United States of America	149	2,657	2,806
United Kingdom[b]	165	1,531	1,696
The Netherlands	5	647	652
Germany	28	533	561
Japan	67	172	239
France	12	180	192
Switzerland	29	154	183
Peoples R. China	14	137	151
Russia	3	147	150
Poland	48	83	131
Italy	21	106	127
Australia	8	92	100
Brazil	92	7	99
Canada	18	81	99
India	45	54	99
South Korea	22	67	89
Denmark	5	73	78
Spain	28	47	75
Turkey	37	17	54
Singapore	3	49	52
61 countries	281[c]	497[d]	778[e]
Total	1,080[f]	7,331[g]	8,411

[a]Arranged by number of journals; [b]England, Scotland and Wales are included under United Kingdom; no journal from Northern Ireland; [c]From 48 countries; [d]From 48 countries; [e]From 61 countries; [f]Although 1,080 OA journals are listed in *JCR* 2012, impact factor values are given only for 1,073 journals; [g]Although 7,331 subscription journals are listed in *JCR* 2012, impact factor values are given only for 7,290 journals.

OA journals are not equally distributed across disciplines. Table 2 gives the distribution of OA and subscription journals in *JCR* 2012 by field. Here 1,965 titles in *JCR* 2012 are classified under clinical medicine, accounting for 23.4%. Of these, 288 journals are OA (the largest in this collection). *JCR* 2012 indexed 130 OA journals in plant and animal science, 69 OA journals in biology and biochemistry, 59 OA journals in geosciences, 58 OA journals in mathematics, and 54 OA journals in engineering. But no OA journal is classified under economics and business. Among the subscription journals indexed in *JCR* 2012, 1,677 are under clinical medicine, 811 are under engineering and 637 are under plant and animal science.

The mean RNIF based on two-year IF of OA journals is below 0.5 for all fields except multidisciplinary, which has 0.521. Twelve fields, including space science, materials science, and neuroscience and behaviour have a mean RNIF above 0.4. The lowest mean RNIF of 0.314 is recorded for OA journals in chemistry. On the other hand, mean RNIF for subscription journals is greater than 0.5 for all fields and the lowest mean RNIF of 0.504 is recorded for materials science. The mean NIF of OA journals is lower than the subscription journals in all fields except clinical medicine, which has a value of 60.358 for OA journals and 26.791 for subscription journals.

The mean RNIF and mean NIF based on the five-year IF available in *JCR* 2012 are given for all fields in Table 3. Here 895 journals, including 269 OA journals are not assigned five-year IF values. The mean RNIF based on five-year IF of OA journals is below 0.5 for all fields except microbiology and materials science; but 11 fields, including neuroscience and behaviour, multidisciplinary, and computer science have mean RNIF above 0.4. The lowest mean RNIF of 0.288 is recorded for OA journals in engineering. The mean NIF of OA journals is less than that of subscription journals for all fields except clinical medicine, which has a value of 35.807 for OA journals and 26.0 for subscription journals. Three fields, viz. physics, biology and biochemistry, and molecular biology and genetics have five-year mean NIF greater than 5.0 for OA journals. Six fields, including physics, clinical medicine and chemistry have five-year mean NIF greater than 20.0 for subscription journals.

But, the two-year mean NIF in four fields, viz. clinical medicine, computer science, engineering, and multidisciplinary are higher than the five-year mean NIF for all journals. With respect to OA journals, six fields, including clinical medicine, multidisciplinary and pharmacology and toxicology have greater two-year mean NIF than

Table 2. Distribution of open access and subscription journals indexed in *JCR* 2012 by major fields[a] along with the two-year impact factor (IF) of different fields

	OA journals				Subscription journals				All journals			
Field	Number	Highest IF[b]	Mean RNIF	Mean NIF	Number	Highest IF[b]	Mean RNIF	Mean NIF	Number	Highest IF[b]	Mean RNIF	Mean NIF
Agricultural sciences	51	3.577	0.372	1.330	216	9.158	0.533	4.877	267	9.158	0.502	4.596
Biology and biochemistry	69	12.690	0.414	5.248	340	32.438	0.519	16.836	409	32.438	0.501	16.259
Chemistry	49	3.590	0.314	1.126	463	41.298	0.521	21.509	512	41.298	0.501	20.689
Clinical medicine	288	153.459	0.393	60.358	1677	51.658	0.519	26.791	1965	153.459	0.500	76.769
Computer science	17	4.910	0.448	2.198	304	9.256	0.505	4.670	321	9.256	0.502	4.642
Economics and business	0	0.000	0.000	0.000	56	4.659	0.509	2.371	56	4.659	0.509	2.371
Engineering	54	1.953	0.335	0.654	811	26.303	0.512	13.457	865	26.303	0.501	13.167
Environment/ecology	32	7.260	0.411	2.985	271	17.949	0.512	9.196	303	17.949	0.502	9.004
Geosciences	59	5.510	0.420	2.317	322	14.368	0.516	7.416	381	14.368	0.501	7.203
Immunology	6	3.882	0.344	1.337	85	36.556	0.517	18.895	91	36.556	0.505	18.479
Materials science	36	6.071	0.482	2.929	273	35.749	0.504	18.023	309	35.749	0.502	17.932
Mathematics	58	4.200	0.445	1.870	414	5.952	0.509	3.029	472	5.952	0.501	2.982
Microbiology	25	8.136	0.466	3.789	106	22.490	0.513	11.533	131	22.490	0.504	11.331
Molecular biology and genetics	49	11.340	0.421	4.771	220	41.063	0.520	21.350	269	41.063	0.502	20.608
Multidisciplinary	9	2.927	0.521	1.525	20	38.597	0.516	19.897	29	38.597	0.517	19.964
Neuroscience and behaviour	30	5.224	0.467	2.441	207	31.673	0.507	16.063	237	31.673	0.502	15.903
Pharmacology and toxicology	34	9.178	0.319	2.928	167	33.078	0.540	17.857	201	33.078	0.502	16.621
Physics	27	22.333	0.417	9.322	276	44.982	0.510	22.936	303	44.982	0.502	22.565
Plant and animal science	130	6.231	0.343	2.135	637	23.654	0.533	12.605	767	23.654	0.501	11.842
Psychiatry/psychology	12	6.242	0.398	2.482	141	16.008	0.512	8.200	153	16.008	0.503	8.056
Social sciences, general	42	4.283	0.423	1.813	275	5.953	0.514	3.057	317	5.953	0.502	2.986
Space science	3	13.833	0.491	6.786	50	23.333	0.511	11.913	53	23.333	0.509	11.887
Total	1,080[c]				7,331[c]				8,411[c]			

[a]The major fields are as in *Essential Science Indicators* (Thomson Reuters); [b]All IFs used here are 2-year IFs taken from *JCR* 2012 (science edition); [c]Although some of the journals do not have 2-year IF values, we have considered all journals. RNIF, Rank Normalized Impact Factor; NIF, Normalized Impact Factor.

five-year mean NIF. Many OA journals are recent additions to *JCR* and will take time to get cited.

Similarly, two-year mean NIF of four fields of subscription journals, viz. clinical medicine, computer science, engineering, and pharmacology and toxicology is greater than the five-year mean NIF.

Table 4 presents the number of journals with 2-year and 5-year IF under major fields. *JCR* 2012 has assigned both 2-year and 5-year IF for 7,516 journals – 811 OA and 6,705 subscription journals. Of these, for 255 OA and 2,125 subscription journals (roughly around 31.5%), 2-year IF is greater than 5-year IF. Notably, at least 50% of OA journals under physics, microbiology and immunology have greater 2-year IF than 5-year IF. For 155 out of 266 subscription journals in physics, 27 out of 47 journals in space science, 44 out of 81 journals in immunology, 585 out of 1,478 subscription journals classified under clinical medicine, 195 out of 764 subscription journals in engineering, and 191 out of 448 subscription journals in chemistry, 2-year IF is greater than 5-year IF.

We looked at the number of journals above and below the mean RNIF (0.5) in each field. The data for mean RNIF based on both 2-year and 5-year IF are presented in Table 5 for OA and subscription journals in all 22 major fields. Out of 1,073 OA journals having 2-year IF, 361 (33.64%) have mean RNIF greater than 0.5 or above. Under multidisciplinary and neuroscience and behaviour, more than 50% of journals have 2-year mean RNIF greater than 0.5. Of the 811 OA journals, 277 (or 34.16%) have 5-year mean RNIF greater than 0.5. More than 50% of OA journals classified under multidisciplinary, neuroscience and behaviour, and space science have mean 5-year RNIF greater than 0.5. Larger numbers of subscription journals with 2-year IF (52.91%) than OA journals are in the mean RNIF range 0.5–1.0. In all fields, except multidisciplinary, 50% or more subscription journals are in the 2-year mean RNIF range 0.5–1.0. 3,453 out of 6,705 subscription journals (or 51.5%) have mean 5-year RNIF greater than 0.5. Except neuroscience and behaviour, and materials science, more than 50% of subscription journals in all fields are in the 5-year mean RNIF range 0.5–1.0.

There is a widespread misconception that OA journals are of low impact. Of the 1,073 OA journals for which *JCR* 2012 has assigned 2-year IF, 39 have IF $\geq$ 5.0 and 9 have IF $\geq$ 10.0. Arranging all journals in each major field in descending order of their 2-year and 5-year JIF, we find that several OA journals are in the top 10, 20, 50 and 100 journals. For example, *JCR* lists 131 microbiology journals, including 25 OA journals. Of these, 18 are

Table 3. Distribution of OA and subscription journals indexed in *JCR* 2012 by major fields[a] along with the five-year IF of different fields

	OA journals				Subscription journals				All journals			
Field	Number	Highest IF	Mean RNIF	Mean NIF	Number	Highest IF	Mean RNIF	Mean NIF	Number	Highest IF	Mean RNIF	Mean NIF
Agricultural sciences	37	4.471	0.370	1.653	195	10.188	0.527	5.372	232	10.188	0.502	5.116
Biology and biochemistry	59	13.447	0.443	5.963	326	38.707	0.512	19.809	385	38.707	0.501	19.404
Chemistry	45	3.671	0.340	1.249	448	45.795	0.517	23.684	493	45.795	0.501	22.944
Clinical medicine	201	88.55	0.404	35.807	1,478	50.807	0.513	26.081	1,679	88.550	0.500	44.301
Computer science	15	5.907	0.489	2.890	275	7.854	0.502	3.946	290	7.854	0.502	3.941
Economics and business	0	0	0	0.000	50	7.474	0.510	3.812	50	7.474	0.510	3.812
Engineering	44	2.395	0.288	0.689	764	17.778	0.513	9.118	808	17.778	0.501	8.900
Environment/ecology	23	7.522	0.427	3.212	247	18.495	0.509	9.411	270	18.495	0.502	9.282
Geosciences	51	5.556	0.455	2.531	303	18.196	0.509	9.264	354	18.196	0.501	9.124
Immunology	4	3.381	0.397	1.342	81	43.742	0.510	22.308	85	43.742	0.505	22.089
Materials science	29	8.677	0.503	4.364	255	42.376	0.502	21.272	284	42.376	0.502	21.272
Mathematics	39	4.189	0.464	1.943	377	8.414	0.505	4.250	416	8.414	0.501	4.217
Microbiology	16	8.917	0.504	4.494	95	23.227	0.505	11.720	111	23.227	0.505	11.718
Molecular biology and genetics	45	12.392	0.413	5.122	206	44.026	0.521	22.953	251	44.026	0.502	22.101
Multidisciplinary	8	2.927	0.490	1.435	18	38.159	0.532	20.303	26	38.159	0.519	19.813
Neuroscience and behaviour	23	5.169	0.496	2.566	191	35.888	0.503	18.054	214	35.888	0.502	18.028
Pharmacology and toxicology	17	5.714	0.325	1.857	154	33.205	0.523	17.351	171	33.205	0.503	16.700
Physics	24	16.417	0.415	6.814	266	51.882	0.510	26.436	290	51.882	0.502	26.030
Plant and animal science	96	6.813	0.324	2.205	580	29.248	0.530	15.503	676	29.248	0.501	14.646
Psychiatry/psychology	7	6.473	0.399	2.584	129	26.624	0.509	13.561	136	26.624	0.504	13.410
Social sciences, general	26	3.072	0.409	1.257	220	8.903	0.513	4.567	246	8.903	0.502	4.470
Space science	2	1.573	0.337	0.530	47	34.261	0.518	17.733	49	34.261	0.510	17.480
Total	811[b]				6,705[b]				7,516[b]			

[a]The major fields are as in *Essential Science Indicators* (Thomson Reuters).
[b]Only those journals which have 5-year IF values are considered.

Table 4. Comparison of 2-year and 5-year IF of journals in the 22 major fields

	No. of OA journals				No. of subscription journals			
Field	2-yr IF	5-yr IF	2-yr IF > 5-yr IF	Equal IF	2-yr IF	5-yr IF	2-yr IF > 5-yr IF	Equal IF
Agricultural sciences	51	37	5	0	215	195	41	3
Biology and biochemistry	69	59	16	2	338	326	110	4
Chemistry	48	45	17	1	460	448	191	13
Clinical medicine	287	201	73	5	1660	1478	585	20
Computer science	17	15	3	0	301	275	55	4
Economics and business	0	0	0	0	56	50	4	0
Engineering	54	44	19	0	811	764	195	7
Environment/ecology	32	23	4	0	271	247	33	4
Geosciences	58	51	13	3	322	303	71	3
Immunology	6	4	2	0	84	81	44	1
Materials science	36	29	12	1	271	255	71	4
Mathematics	58	39	12	0	413	377	89	3
Microbiology	25	16	9	1	103	95	34	3
Molecular biology and genetics	47	45	11	2	218	206	86	4
Multidisciplinary	9	8	1	1	20	18	7	2
Neuroscience and behaviour	30	23	6	0	207	191	54	5
Pharmacology and toxicology	34	17	4	0	166	154	53	1
Physics	27	24	16	0	276	266	155	6
Plant and animal science	129	96	26	2	635	580	154	11
Psychiatry/psychology	12	7	1	0	140	129	21	2
Social sciences, general	41	26	5	0	273	220	45	2
Space science	3	2	0	0	50	47	27	0
Total	1,073[a]	811[b]	255	18	7,290[a]	6,705[b]	2,125	102

[a]No. of journals for which 2-year IF is given; [b]No. of journals for which 5-year IF is given.

Table 5. Number of journals with RNIF <0.5 and RNIF >0.5 in major fields (based on 2- and 5-year IFs)

	OA journals 2-year mean RNIF				OA journals 5-year mean RNIF				Subscription journals 2-year mean RNIF				Subscription journals 5-year mean RNIF			
		Range				Range				Range				Range		
Field	Number[a]	0.0–0.499	0.500–1.0	% Range 0.500–1.0	Number[b]	0.0–0.499	0.500–1.0	% Range 0.500–1.0	Number[a]	0.0–0.499	0.500–1.0	% Range 0.500–1.0	Number[b]	0.0–0.499	0.500–1.0	% Range 0.500–1.0
Agricultural sciences	51	40	11	21.57	37	29	8	21.62	215	92	123	57.21	195	86	109	55.90
Biology and biochemistry	69	45	24	34.78	59	36	23	38.98	338	157	181	53.55	326	156	170	52.15
Chemistry	48	38	10	20.83	45	34	11	24.44	460	213	247	53.70	448	212	236	52.68
Clinical medicine	287	192	95	33.10	201	130	71	35.32	1,660	772	888	53.49	1478	709	769	52.03
Computer science	17	11	6	35.29	15	8	7	46.67	301	146	155	51.50	275	136	139	50.55
Economics and business	0	0	0	0.00	0	0	0	0.00	56	27	29	51.79	50	24	26	52.00
Engineering	54	39	15	27.78	44	36	8	18.18	811	393	418	51.54	764	367	397	51.96
Environment/ecology	32	21	11	34.38	23	15	8	34.78	271	130	141	52.03	247	119	128	51.82
Geosciences	58	36	22	37.93	51	30	21	41.18	322	153	169	52.48	303	146	157	51.82
Immunology	6	4	2	33.33	4	3	1	25.00	84	40	44	52.38	81	39	42	51.85
Materials science	36	23	13	36.11	29	20	9	31.03	271	129	142	52.40	255	167	88	34.51
Mathematics	58	30	28	48.28	39	20	19	48.72	413	204	209	50.61	377	187	190	50.40
Microbiology	25	15	10	40.00	16	9	7	43.75	103	47	56	54.37	95	46	49	51.58
Molecular biology and genetics	47	27	20	42.55	45	27	18	40.00	218	103	115	52.75	206	98	108	52.43
Multidisciplinary	9	3	6	66.67	8	3	5	62.50	20	11	9	45.00	18	9	9	50.00
Neuroscience and behaviour	30	15	15	50.00	23	10	13	56.52	207	103	104	50.24	191	96	95	49.74
Pharmacology and toxicology	34	26	8	23.53	17	14	3	17.65	166	73	93	56.02	154	71	83	53.90
Physics	27	18	9	33.33	24	16	8	33.33	276	133	143	51.81	266	128	138	51.88
Plant and animal science	129	99	30	23.26	96	74	22	22.92	635	281	354	55.75	580	263	317	54.66
Psychiatry/psychology	12	7	5	41.67	7	4	3	42.86	140	68	72	51.43	129	63	66	51.16
Social sciences, general	41	21	20	48.78	26	15	11	42.31	273	134	139	50.92	220	107	113	51.36
Space science	3	2	1	33.33	2	1	1	50.00	50	24	26	52.00	47	23	24	51.06
Total	1,073	712	361	33.64	811	534	277	34.16	7,290	3,433	3,857	52.91	6,705	3252	3453	51.50

[a]No. of journals that have 2-year IF values; [b]No. of journals that have 5-year IF values.

in the top 100, 7 are in the top 50, and 3 are in the top 20 in the list of journals arranged in descending order of 2-year JIF. In mathematics, three OA journals are found in the top 10. In the list of journals arranged in descending order of 5-year JIF, 15 OA microbiology journals are in the top 100 and 7 are in the top 50. These numbers are bound to increase with time. After all, OA is a business model meant to increase access to a journal and has nothing to do with the content and quality of the papers published in a journal. Björk and Solomon[26], and Swan[15] have reported that there is not much difference between OA and subscription journals in citability and IF.

Conclusions

We used JIF, the most often used evaluation tool, to measure the impact of OA and subscription journals. Our study shows that while many journals from developing countries, especially Latin America and India, have improved their visibility and impact by adopting OA in every field[18,27–29], the IFs of subscription journals in general are greater than those of OA journals. Most subscription journals have the backing of well-entrenched publishing firms who promote them through exhibitions at conferences, book fairs and mass mailing. Publishers also push their journals through 'bundling'. Most OA journals have to be content with merely claiming that they are freely accessible on the net. It would take a long time before these journals win the confidence of many authors and readers.

In all fields except clinical medicine, subscription journals have recorded much higher 2-year and 5-year mean NIF. Thanks to *CA – Cancer J. Clin.*, which has a very large IF, OA journals in clinical medicine have a higher mean NIF than subscription journals.

The 2-year mean RNIF of subscription journals is in all but one field larger than that of OA journals; however, the difference is only marginal in three of the 22 fields, viz. space science, materials science, and neuroscience and behaviour. In multidisciplinary sciences, the 2-year mean RNIF is greater than that of subscription journals. The 5-year mean RNIF of subscription and OA journals is nearly the same in materials science and microbiology. In all other fields subscription journals have a greater 5-year mean RNIF than OA journals. However, in computer science, and neuroscience and behaviour, the difference is marginal.

We believe that there is a need for developing alternative tools or indicators for measuring the influence of scholarly journals and research performance of individuals and institutions. The current excessive dependence on JIF may not last long.

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