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Self-Citation Patterns of Journals Indexed in the Journal Citation Reports

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ABSTRACT

Self-citation patterns of 1,104 journals indexed in the 2018 edition of the Journal Citation Reports were examined to assess the possibility of underlying rank manipulations. The journals included in this study were all found to have a self-citation rate of more than 25%. Our research shows that by excluding self-citation rates, the rank of journals with a high impact factor are not affected; however, for other journals, the removal of even a single self-citation can cause significant rank changes. Self-citation patterns are typical for local language journals as well as journals from upper-middle-income European countries. Impact factors used in research performance evaluations should be used more carefully, particularly when variables such as journal size, publication language, publisher country, and subject area correlate with self-citation rates.

Introduction

Self-citations are commonly recognized as citations or references made to an article written by the same authors or author groups. Many studies have focused on underlying causes or reasons for self-citations. For example, authors may self-cite as part of a strategy to make themselves more visible in their scientific field, or they may be self-citing frequently as a result of egotism (Aksnes 2003). Self-citations may be used to amplify, modify, or correct results reported in previous writings (Tagliacozzo 1977). They may also be used to enhance the authority of a researcher in his/her respective field (Hyland 2003); but as Lawani (1982) suggests, this is an issue that needs to be studied sociologically.

Scholarly outputs are often evaluated in terms of citation counts; hence, the practice of self-citation is sometimes considered suspicious, if not manipulative (Bonzi & Snyder 1991, p. 245). Authors, for instance, can use self-citations to increase their h-index (Bartneck & Kokkelmans, 2011). The impact factor of a journal can also be made to look higher than that of other journals, when self-citations are included. Since the journal impact factor considers citations to articles published in the previous two years, and self-citations generally occur two years after an article's publication (Aksnes 2003, p. 242), the manipulation of a journal impact factor is generally easy. In fact Ioannidis and Thombs (2019) claim that one of the easiest ways to manipulate the impact factor is to increase journal self-citation rates of journals - i.e., to employ what is called a self-citing boost. Self-citation as a practice is not limited to authors, and can thus be extended to journals, institutions, or even countries (Rousseau 1999).

The aim of this study is to assess the self-citation patterns of journals indexed in the Journal Citation Reports (JCR) and to both classify and clarify their effect on journal impact factors. Our focus is on the main characteristics of journals with high self-citation rates, including measures for journal subject areas, publisher country of origin, and publication language.

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Background Literature

Studies concerning the impact factor, a frequently used tool for evaluating scientific publications, have been conducted for many years. One issue that is most frequently addressed is the manipulation of the impact factor through self-citations. Many researchers are in search of what is the 'best' approach to research evaluation. Some have focused on how to minimize citation-based manipulations, others try to discover new evaluation methods, and still others focus on how to resolve existing evaluation problems. The issue of coercive citations has been addressed in recent years, in addition to editorial interventions (e.g. Herteliu et al., 2017; Mahian & Wongwises, 2015; Martin, 2016; Wilhite & Fong, 2012). These subjects are; however, not new, and may be traced back to the 1990s.

In order for a self-citation practice to be a manipulation, Garfield has said that it would have to be excessive, irrelevant, or function as mere 'window dressing' (Garfield, 1997). But, considering the degree to which scientific disciplines depend on self-citation rates, it is hard to define a disciplinary rate that is 'acceptable' or even 'excessive' (Aksnes 2003; Snyder & Bonzi 1998, p. 431). This question has actually been asked by a group of researchers in a study entitled: How much is too much? The difference between research influence and self-citation excess. Here, the authors point to a need for expert interpretation surrounding self-citations (Szomszor et al., 2020).

In the Committee on Publication Ethics (COPE Council 2019) document, editors were given suggestions for how to identify legitimate journal self-citations. The role of an editor is to be aware of relevant literature, and in light of this, to avoid coercing or allowing reviewers to coerce authors into giving citations. Coercive citations can and do seriously affect journal impact factor rankings (Opthof, 2013; Seglen 1997), and tend to be the most difficult to ascertain (Ioannidis, 2015).

Whilst no significant correlation measures have been found between self-citations and impact factors (Livas & Delli, 2018; Nisonger, 2000), examples of excessive self-citation are not unusual (e.g. Al & Soydal 2012; Noorden & Chawla 2019; Oransky 2020). Clarivate now uses experts to determine excessive self-citation patterns in journals, and suppresses those displaying evidence of this from their Journal Citation Reports (JCR) (Clarivate, 2020b). Still, certain cases do and have continued. In 2019 alone, Clarivate suppressed 33 journals due to self-citation manipulations (Clarivate, 2020a). Bold steps are needed to solve this problem (Ioannidis & Thombs, 2019), thus some scholars suggest that the impact factor calculation should be self-citation free (Mavrogenis et al., 2010) or at least self-citation adjusted (Krauss, 2007). Abnormal self-citations, or citation manipulations, might also be detected through algorithms, and identified in an automated manner (Heneberg, 2016; Yu et al., 2014).

Despite many negative concerns surrounding self-citations, Zhao et al. (2018) believe that they are actually more functional than external citations. Here, the authors suggest that they should even hold more value in research evaluations. Zhu et al. (2015), however have said the opposite: self-citations are less likely to be influential, and only correlate slightly with academic influence. In a recent content-based citation-motivation study, authors attributed a lower value to their own tagged self-citations; a finding interpreted in terms of shyness or reticence (Pride & Knoth, 2017). Nevertheless, both Pride and Knoth (2017) and Zhu et al. (2015) still see self-citations as being important to research evaluation processes. Similar conclusions have been drawn where self-citations produce valuable data for bibliometric research (Glänzel et al., 2004).

The unique aspect of our study, compared to previous research, is that we want to know if the impact factor as a measurement tool, is always the 'best' formula to apply to all journals. To what degree are self-citations an underlying manipulation, or could they also be a function of a journal's size, publishing country, specialty area, or publishing language?

Materials and Methods

Data

We used JCR 2018 edition for this study. The impact factor (IF) calculation formula of Clarivate for JCR 2018 is shown in Formula 1.

$$\text{IF } 2018 = \frac{\text{Citations in 2018 to items published in } 2016 + 2017}{\text{Number of citable items (articles and reviews) in } 2016 + 2017} \tag{1}$$

The data extraction tool of JCR was also used to gather all impact factors, with and without self-citations, for a total of 12,558 journals. Thirty-three of the journals that did not have an impact factor available, or a zero-impact factor were excluded. We then unified all the journals that were indexed in both the Science Citation Index-Expanded (SCI-E) and Social Sciences Citation Index (SSCI) of the JCR, this led to a total of 11,866 unique journals.

Based on a suggestion made earlier by John Ioannidis (see Noorden & Chawla 2019), we chose to focus on journals with a self-citation rate higher than 25%. Our final 'working' dataset consisted of 1,104 journals, and the following information was collected for each:

- Journal subject category: The GIPP mapping table[1] (GIPP Mapping Table 2020) was used to determine main subject classes. Clinical, pre-clinical & health and life sciences were combined as "Life Sciences and Health"; and physical sciences and engineering & technology were combined as "Physical Sciences and Engineering".
- Journals' publication language: Information about publication languages of journals were gathered from specific journal pages of JCR. If the information was not available there, we used the ULRICH's Periodical Directory which is a bibliographic database providing information about serials published all over the world.

[1] GIPP is a broad subject classification of Clarivate which comprises six broad disciplines of science. For more information about subject classification, see https://clarivate.libguides.com/incites_ba/data

- Percentage of cited documents, journal country of origins: SCI-E and SSCI of Web of Science (WoS) was used to find information about rates of cited and uncited documents of journals, whilst the JCR was used to determine the country of origin of each journal. For a classification of these countries we used the World Bank's classification by income and geography (World Bank Country and Lending Groups 2020– World Bank Data Help Desk, 2020).

Analysis

A Spearman's Rho Correlation test was used to analyze the relationship between self-citation and impact factor, as well as self-citation and the number of citable items.[2] As per Cohen's recommendation (Cohen, 1988, p. 77-81), r^2 values which show the variance of the dependent variable explained/predicted by the independent variable, also need to be calculated to understand the size of the correlational effect. We then used Kruskal Wallis and Mann Whitney U tests to compare classified data (e.g. journal quartiles, subject categories, languages) in terms of self-citation rates, percentage of cited documents and number of citable items.

The effect sizes calculated for the Kruskal Wallis (η_H^2), and Mann Whitney U (r_G) tests were based on the following equations (Cohen 2013, p. 10-11, 19-20).

$$\eta_H^2 = (H - k + 1)/(n - k) \tag{2}$$

$$r_G = 2\left(\bar{R}_A - \bar{R}_B\right)/N_T \tag{3}$$

In Formula 2, H is the Kruskal-Wallis test statistic, k is the group numbers that are compared, and n is the number of observations in total. In Formula 3, $\bar{R}_A$ and $\bar{R}_B$ are the average ranks for two compared groups, and N_T is the total number of observations.

A Chi-square test was used to analyze whether the subject category affects journal language and the Cramer V was used for the effect size of the test.

SPSS (version 21) was used to conduct all tests and descriptive statistics. R Commander (with KMggplot2 plugin), Flourish Studio, and Power-user software enabled our data visualizations. Box plot, violin plot, Sankey diagram and scatter plot were created to visualize our findings.

Findings

The findings of our study are divided into two parts: the first part includes the analyses for 11,866 journals indexed in JCR 2018, and the other presents the self-citation patterns of 1,104 journals that have 25% or more self-citation rate.

Effects of self-citations on journal impact factors

According to our results, 10,762 journals (91%) indexed in JCR 2018 have less than a 25% self-citation rate (See Fig. 1). Note that 5% (N=624) of these journals do not have any self-citation for JCR calculation year. The average impact factor of the journals, which have no self-citation, is 1.286 (median=0.656, maximum=26.1, minimum=0.006). The average citable items for the journals without any self-citations is 98 (median=50) while the average number for all journals in JCR 2018 is 270 (median=130).

Generally, the more citable items, the more self-citations; however, the Spearman's Rho correlation coefficient shows that there is a very weak relationship between these variables at the 99% confidence level ($r=0.102$, $p<0.001$, $r^2=0.010$). Only 1% of the variance in self-citation rates of journals can be explained by the differences among the number of citable items in these journals.

Fig. 1 shows that self-citation practices are more common for low-impact factor journals. None of the journals from Quartile 1 (Q1) have a self-citation rate of more than 50%. Although, the correlation between impact factors and self-citation rates was weak at the 99% confidence level ($r=-0.190$, $p<0.001$, $r^2=0.036$), what the Kruskal Wallis test results show is that self-citation rates differ significantly for the impact factor quartiles ($H(3)=383.711$, $p<0.001$, $\eta_H^2=0.032$).[3] Similarly, the number of citable items differ by quartiles ($H(3)=1285.045$, $p<0.001$, $\eta_H^2=0.108$).[4]

It is obvious that the sizes of the journals are quite different from each other. While some journals publish a small number of citable items, others publish more. Therefore, one of the main problems of the impact factor is the calculation made regardless of the size of the journals (number of citable items or number of citations received by the journals). This problem is obvious for the journals with a 100% self-citation rate (see Table 1). For three journals, all the citations were self-citations for the JCR calculation

[2] Number of citable items is the denominator of impact factor calculation and it covers articles and reviews. For more information about citable items, see https://jcr.help.clarivate.com/Content/jcr3-journal-profile.htm

[3] When four groups are compared in pairs using Mann Whitney U test, the results for all comparisons were statistically significant (U: Sum of the ranks of the groups, Z: Z score): **Q1-Q2**, U=3797625.000, Z=-9.132, $p<0.001$, r_G=0.137, **Q1-Q3**, U=3495838.000, Z=-13.859, $p<0.001$, r_G=0.208, **Q1-Q4**, U=3254700.000, Z=-17.330, $p<0.001$, r_G=0.260, **Q2-Q3**, U=4070705.000, Z=-5.014, $p<0.001$, r_G=0.075, **Q2-Q4**, U=3668248.000, Z=-10.919, $p<0.001$, r_G=0.164, **Q3-Q4**, U=3917364.000, Z=-7.299, $p<0.001$, r_G=0.109.

[4] When four groups are compared in pairs using Mann Whitney U test, the results for all comparisons were statistically significant: **Q1-Q2**, U=3639795.000, Z=-11.524, $p<0.001$, r_G=0.173, **Q1-Q3**, U=2861405.500, Z=-23.457, $p<0.001$, r_G=0.351, **Q1-Q4**, U=2311606.500, Z=-31.630, $p<0.001$, r_G=0.474, **Q2-Q3**, U=3501464.500, Z=-13.641, $p<0.001$, r_G=0.204, **Q2-Q4**, U=2817701.500, Z=-23.839, $p<0.001$, r_G=0.358, **Q3-Q4**, U=3616977.500, Z=-11.851, $p<0.001$, r_G=0.178.

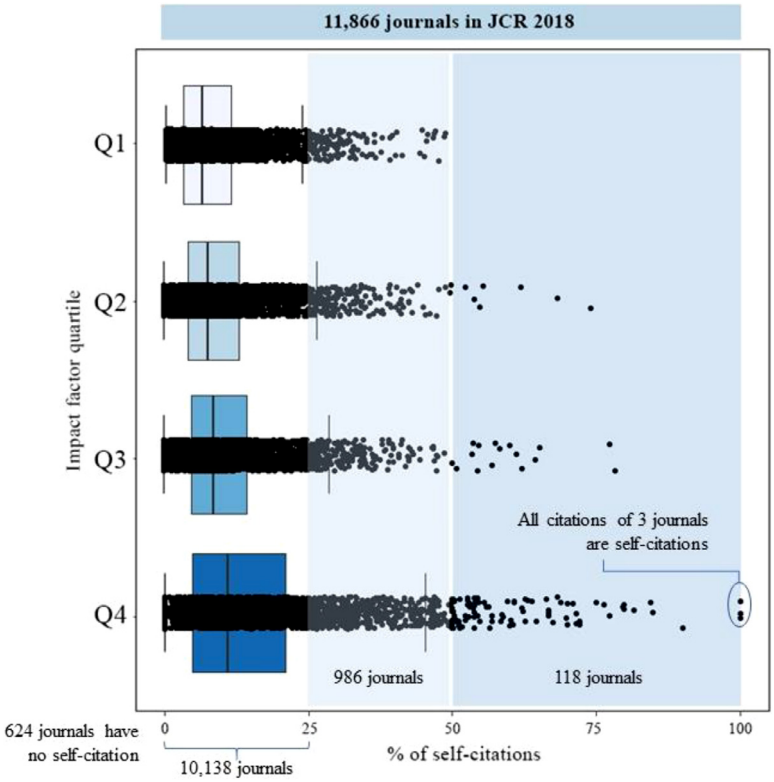

Fig. 1. Journals in JCR 2018, self-citation rates and their distribution to the journal impact factor quartiles

Table 1
Main features of three journals that have 100% self-citation rate

Journal name	Indexed years in WoS	JCR	N of pub (2016-2017)	N of cit (2018)	Journal language*	Subject category
Bulletin de la Societe Linneenne de Lyon	2016-+	2018-+	42	6	French**	Biology
Zeitschrift fur Dialektologie und Linguistik	1983-+	2002-+	23	3	Multilingual***	Linguistics
Dialectologia et Geolinguistica	2008-+	2010-+	14	1	English****	Linguistics

* Language information for the journals gathered from JCR and validated from ULRICH Serials Directory.
** 35 of the items were written in French, three in English, two in German, and two in Spanish.
*** 17 of the items were written in German and six in English.
**** 12 of the items were written in English, one in German, and one in Spanish.

year, however, they each also published a small number of items, which gathered six citations at most. Moreover, there are different aspects such as journal publication language and subject categories, etc.

Self-citations also affect the distribution of journals to the IF quartiles (see Fig 2-a). Although the IF quartile of 10,787 journals (91%) did not change after excluding self-citations from the calculation, there are three journals - i.e., the multilingual journal Ingegneria Sismica (74% self-citation rate), the journal on social sciences, International Journal of Emerging Markets (68% self-citation rate) and Microgravity Science and Technology (62% self-citation rate) - which fall into the bottom quarter from Q2. The quartiles of 1079 journals (9%) are changed after modifying the calculation method (one quartile up or down).

Even though Fig. 2-a shows the quartile changes after excluding self-citations from the IF calculation, it is not enough to figure out the size of the self-citation effects. The differences and changes to journal rankings with or without self-citations are shown in Fig. 2-b. Only the ranks of 51 journals (almost 0.4%) are not changed. Thirty-one of these journals (61%) are in the list of top 100 journals in JCR, and 41 of the journals (80%) are in Q1. The average impact factor of these 51 journals is 29.903 (median= 26.991). The number of journals that have an impact factor of over 29.000 in the complete JCR 2018 is 31.

All of these findings suggest that self-citations do not have important effects on the journals that already have high impact factors. However, these journals constitute a very small proportion amongst all journals. The journal with the maximum impact factor is CA-A Cancer Journal for Clinicians and it has 223.679 IF. The second journal, Nature Reviews Materials has 74.449 IF and the New England Journal of Medicine has 70.670 IF as the third high IF journal. The average impact factor of the journals is 2.486 (median= 1.735) for the whole JCR. 77% of journals have an IF below 3.000. The rank changes are shown in Fig. 2-b. Note that the ranks

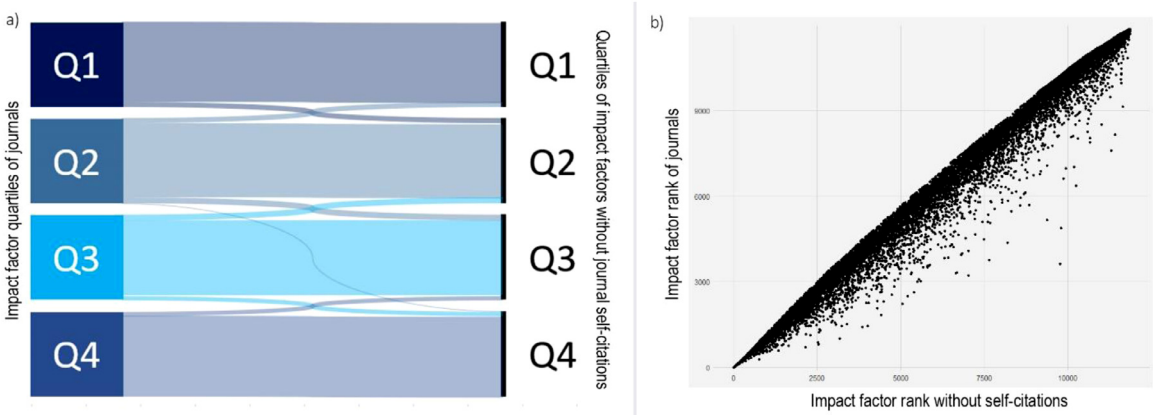

Fig. 2. Journal quartiles and impact factors with and without self-citations

Table 2
Descriptive statistics for 1104 journals that have more than 25% self-citation rate

	Min.	Max.	SD	Mean	25%	Med.	75%
Journal impact factor	0.030	10.754	1.281	1.371	0.513	0.932	1.853
IF without journal self-citations	0.000	7.858	0.890	0.909	0.319	0.599	1.237
N of citable items (2016-2017)	11	10778	702	296	60	113	246
N of all published items (2016-2017)	11	11017	750	341	74	137	293
N of citations (2018)	1	40268	2956	716	40	107	327
N of citations from articles & reviews (2018)	1	39656	2877	681	37	96	300
N of citations from other documents (2018)	0	2569	125	35	1	6	19
N of self-citations (2018)	1	16140	1024	236	14	37	111
% of documents cited	2.56%	100%	24.30%	60.81%	44.19%	62.50%	81.25%
Cited half-life	1	72	5	8	5	7	9
Citing half-life	2.8	68.7	4.7	10.3	7.8	9.4	11.4

changed between 1000-6134 for 463 journals (4%). The median IF for these 463 journals, 73% of which are Q2-Q3 journals, is 1.889, whereas the median self-citation rate is about 34%.

All the results presented above prove that it is important to understand the self-citation patterns of journals, and at least now from our own dataset. In the next section, the journals with 25% or more self-citation rates have been evaluated in more depth on the basis of language, discipline and the geographical distribution of publisher countries.

Self-citation patterns of journals which have high self-citation rates

Descriptive statistics

1,104 journals that have a 25% or more self-citation rate were evaluated in more depth to define the main patterns of journal self-citations (see Table 2). According to Table 2, half of the journals with 25% or higher self-citation rate have an impact factor lower than one (i.e., 0.599 without self-citations). Similarly, although the maximum number of citable items is 10,778 for a journal, 75% of journals have published only 246 citable items at most. This is similar for the number of citations. Although there are journals with a high number of citations, 75% of these journals have gathered 327 citations at most. This confirms the problem of size differences amongst the journals, both in terms of the number of publications and citations.

Languages and subject categories of journals

Fig. 3 shows that the self-citation rates of the English language journals are lower than the others. The average self-citation rate of the English language journals is 34% (median=31.3%), while it is 39% (median=34.1%) for multilingual journals and 41% (median=38.1%) for local language journals. A Kruskal Wallis test confirms significant differences between journal language and the self-citation rates (H(2)=56.252, p<0.001, η^2_H=0.049).[5] Based on a Mann-Whitney U test, we found that the language differences are most evident between English and local language journals.

Average self-citation rates also depend on the journals' subject categories. For all English language journals in the physical sciences, the average self-citation rate is 33.8%, whilst it is 34.3% for life sciences, and 35% for social sciences. The average self-citation rate for the multilingual physical science journals is 36.2% and 42.2% for local language journals. The self-citation rates for the life &

[5] Mann Whitney U test results between the groups are:* **English-Multilingual**: U=38350.500, Z=-2.901, p=0.004, r_G=0.168, **English-Local**: U=46327.000, Z-7.298, p<0.001, r_G=0.351, **Local-Multilingual**; U=8301.500, Z=-2.298, p=0.022, r_G=0.160

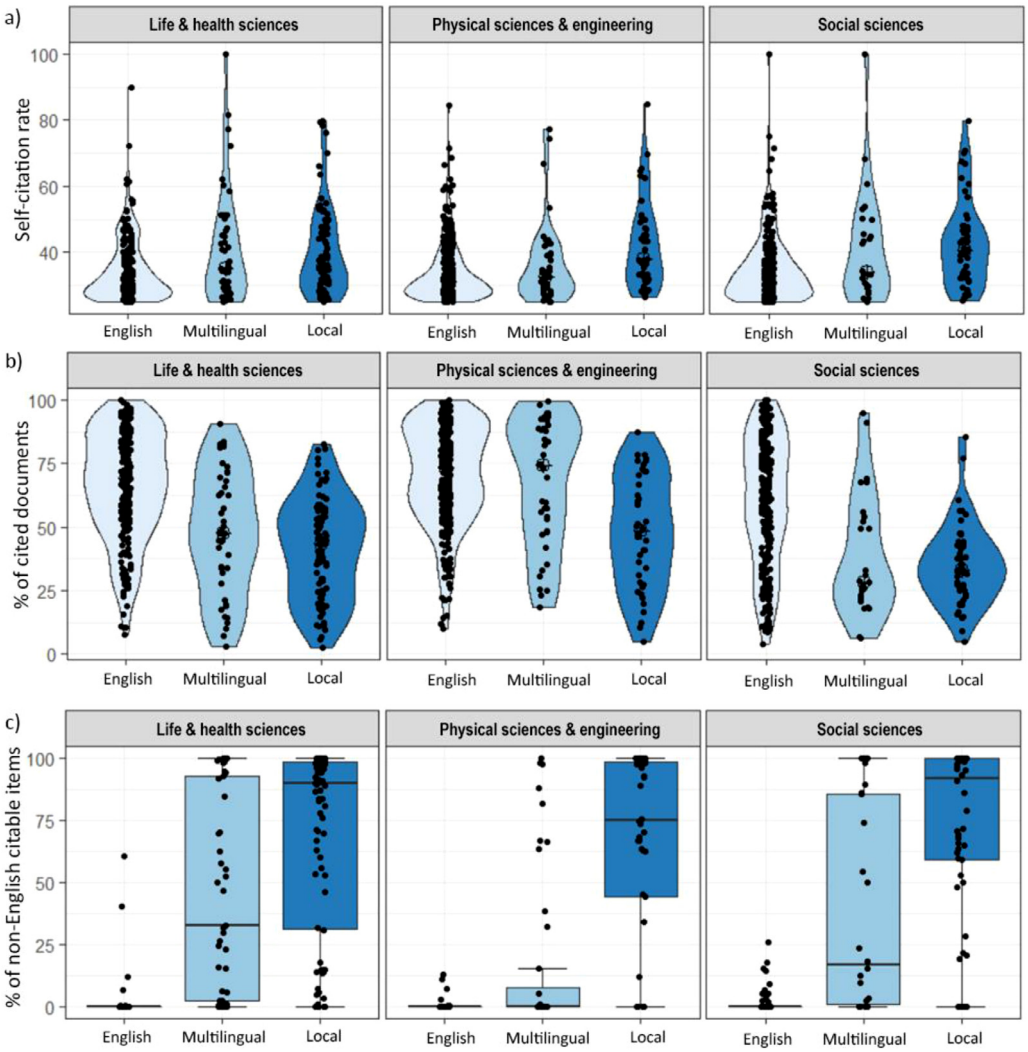

Fig. 3. Distribution of journals that have 25% or more self-citation rate to the research fields and languages

health sciences and social sciences are almost the same for the multilingual journals. The highest self-citation rate was observed for local language journals classified in the social sciences (avg=42.8%). However, the difference between subject categories and self-citation rates is not statistically significant. The most significant difference is found between physical sciences & engineering and social sciences, where there is a very high p-value and a low effect size (U=63097.000, Z=-1.977, p=0.048, r_G=0.084). On the other hand, note that the language of the journals differs according to their subject categories ($\chi^2(4)$=38.593, p<0.001, V=0.132). The life and health sciences have the lowest rate of English journals (63%) but have the highest percentage for local (24%) and multilingual journals (12%).

The second part (b) of Fig. 3 shows the citation advantage of English language journals. The average percentage of cited documents is 66% for English, 53% for multilingual, and 41% for local language journals. On average, 71% of the physical science documents published in English language journals are cited. This means that scholars who work within the physical sciences and publish papers in English language journals have more citation potential than the others. The lowest rate was calculated for the local language social science journals (35%). The citation potential of a paper is lower for the social sciences in comparison to other fields. This has been confirmed previously by Kulczycki et al., 2020. Although the lingua franca of scientific production is English for some fields, researchers from the Social Sciences and Humanities often publish in local languages (Kulczycki et al., 2020). Moreover, a Kruskal Wallis test proves that the subject category of the journal can affect the percentage of cited documents (H(2)=64.006, p<0.001, η^2_H=0.056). However, as mentioned earlier, the subject category of the journal does not affect its self-citation rate.

The most interesting finding (see Fig 3-c) is that the journals indexed as local or multilingual in JCR published English language articles, and the English language ones published papers in different languages. 23 of the 180 local language journals contain citable items, which are in English. 23 of the 809 English language journals have published articles in a language other than English; however,

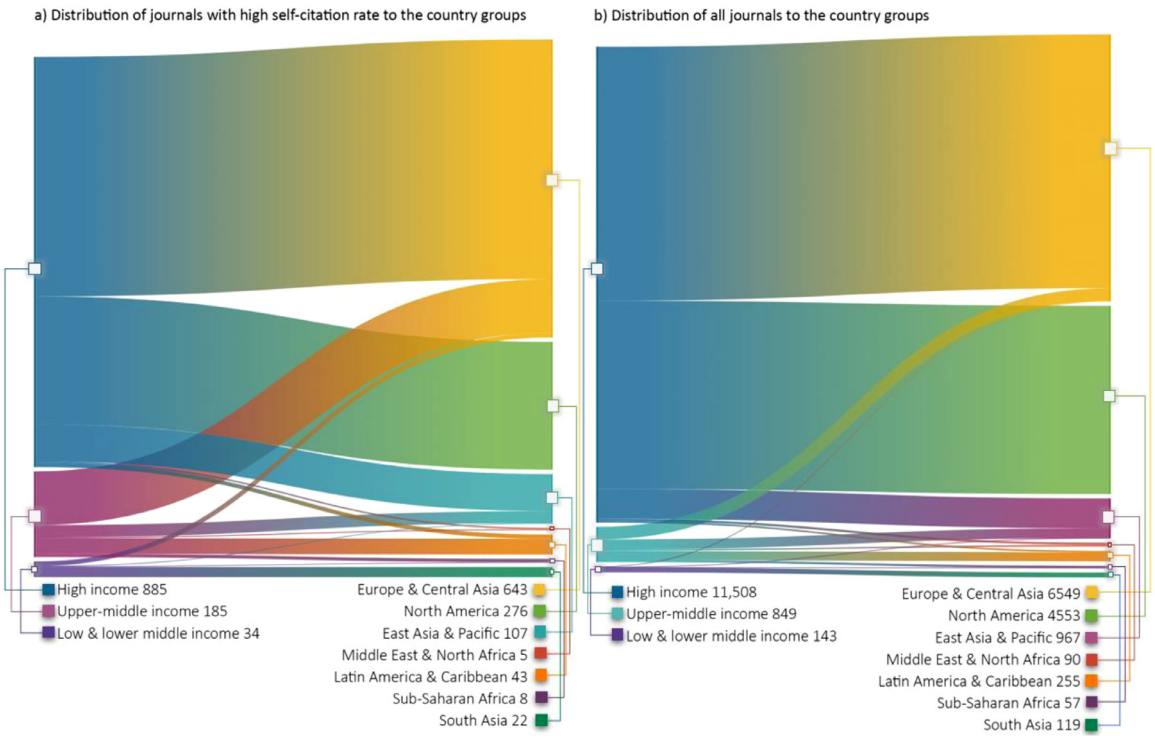

Fig. 4. Distribution of journals to the country groups in terms of income and geography (distribution for countries is showed in Appendix 1)

the share amongst all publications is not very high. The top share is for the journal Medicina del Lavoro. In this particular journal, 60% of its citable items were in two languages (57% in Italian, 3% in Portuguese) even though the journal is indexed as an "English language journal" by JCR. The official language of the journal is defined as both Italian and English by ULRICH's Periodicals Directory. Overall, it is important to understand authors' and journal editors' motivations for publishing in a language that is different from the journal's main publication language.

Effects of publisher countries on self-citation rates

The journals that have high self-citation rates have publishers from 59 different countries. 265 of the journals are from the USA, 204 from the United Kingdom, 100 from Germany, and 77 from Russia. It is an expected result to have the USA, United Kingdom, and Germany in the top three, due to their large publisher and research bases (i.e. publishers and institutions). Ten countries have only one journal. Based on self-citation rates, Argentina has the highest average self-citation rate with 62.3% self-citations to its five journals. The average self-citation rate of Slovenia, which has four journals, is 58.8%. Fig. 4 provides insight into whether the country of origin of a journal affects its self-citation rate. Here we see that the distribution of journals with high-self citation rates corresponds with how the World Bank classifies countries on the basis of income levels and geography.

One of the main criticisms concerning citation indexes is that they mostly include journals that publish scientific content in English-language; hence, do not reflect the entire scientific universe or scientific peripheries such as developing countries (Arunachalam & Manorama, 1989). To solve this, WoS has expanded its coverage to provide regional representation opportunity to local journals, however, English language journals of developed countries are still primarily included by the indexes (Demeter, 2017; Ràfols & Molas-Gallart, 2016; Santin et al., 2019). Our results confirm this. The indexes, are, for the most part, designed to include the journals of developed countries (see Fig 4-b). However, when high self-citation rates are considered, we can easily see the position of journals from upper-middle-income level European and Central Asian countries. Whilst the share of journals from upper-middle income European and Central Asian countries in the whole JCR is not that big (2.4%), it still represents 10.5% of journals with high-self citation rates.

All journals of Armenia (3 journals) and Uzbekistan (one journal) which are indexed in JCR have a 25% or more self-citation rate. This is followed by Ukraine with 60% (9 out of 15 journals) and Russia with 51% (77 out of 151 journals). Due to the fact that the countries are unequally represented in the citation indexes, it is difficult to compare their self-citation practices and thus observe specific patterns. We might consider that the high self-citation rates are due to language barriers, but, the Armenian, Uzbekistani, and Ukrainian journals have all been classified as English by JCR and did not publish any non-English articles in the JCR calculation year. Similarly, only seven of the 77 Russian journals were classified according to their local language (Russian) and had published Russian papers. Only one journal was found to be multilingual, however, only 2.4% of its content was non-English in the JCR calculation year.

Table 3
Impact of publishing one bibliometric item about the journal (SC: self-citation, IF: impact factor)

Journal name	Published item(s), SC of the item(s)/all SC	IF of journal	IF -excluding item(s)	IF Difference
Archeosciences-Rev A	"Archaeometry: A discipline of the past or an interdisciplinary challenge or the future? Reflections from the outcome of 40 years of GMPCA Conferences", (24/24)	1.292	0.292	1.000 (342%)
J Cardiovasc Magn R	"Journal of Cardiovascular Magnetic Resonance 2017", 198/280	5.070	4.080	0.990 (24%)
J Neurosurg Anesth	"Neuroanesthesiology Update", 89/101	2.957	2.010	0.947 (47%)
Arterioscl Throm Vas	"Reporting sex and sex differences in preclinical studies" (323 times) & "Recent highlights of ATVB lipoproteins" (117 times), 440/915	6.618	5.776	0.842 (15%)
Minerva Anestesiol	"A year in review in Minerva Anestesiologica 2017", two parts, 140/217	2.840	2.217	0.623 (28%)
J Nucl Cardiol	"Review of cardiovascular imaging in the Journal of Nuclear Cardiology 2017", Part I & II, 150/487	4.112	3.512	0.600 (17%)
Augment Altern Comm	"Methodological advances, opportunities, and challenges in AAC research", 24/69	2.706	2.235	0.471 (21%)
J Clin Monit Comput	"Journal of Clinical Monitoring and Computing 2017 end of year summary: respiration" (33 times), "Journal of Clinical Monitoring and Computing 2017 end of year summary: anesthesia" (27 times), "Journal of Clinical Monitoring and Computing 2017 end of year summary: cardiovascular and hemodynamic monitoring" (27 times), 87/158	2.179	1.848	0.331 (18%)
J Oil Palm Res	"Oil palm economic performance in Malaysia and R&D progress in 2017", 20/47	0.893	0.714	0.179 (25%)
Fleischwirtschaft	"Review 2017 the topics of meat industry from research and development in the past twelve months", 23/28	0.172	0.070	0.102 (593%)

Specific self-citation practices

As a result of our study we have found some interesting self-citation patterns. We cannot say that the patterns are due to some form of "manipulation"; however, our results show that one single self-citation can affect the IF of some journals. The drawback is that it can open new paths for editors who wish to increase their journal's impact factor and thus become permanently included in one or more citation indexes.

Practice 1: Publishing one bibliometric review or article about the journal to analyze previous years' papers. Table 3 shows 10 journals that published a review or an article to present insights about previous years. For example, all self-citations of the journal ArcheoSciences-Revue d Archeometrie stem from one article containing all contributions from a field-related conference. The more interesting finding is how this journal's IF changed from year to year. Although its impact factor was 0.375 in 2017 (9 citations covering one self-citation and 24 citable items) and 0.300 in 2019 (9 citations covering three self-citations from one editorial material and 30 citations), it grew by a value of 1.292 in the JCR 2018, because of this one article. The IF ranks of the journal were 85/86 in 2019 (Q4) and 76/80 (Q4) in 2017 for the Chemistry, Analytical category and 199/200 (Q4) in 2019, 185/190 (Q4) in 2017 for Geosciences, Multidisciplinary. However, its rank has increased to 62/84 for Chemistry (Q3), Analytical and 150/195 (Q4) for Geosciences, Multidisciplinary in 2018. All statistics presented in Table 3 show that impact factors can improve, even by a single paper.

Practice 2: Publishing one editorial material and citing papers from previous years. Although different document types such as editorial materials, letters, or corrections are not counted as citable items, their citations are counted in the calculation of impact factors. We found that as a tradition, some journals publish editorial materials to summarize their previous year's activities and this affects their impact factors. Table 4 shows 19 examples of this. The editorial materials include summaries for papers published in 2017, evaluations related to the outcomes of the conferences, presentations of special issues, or an analysis of the journal for a determined period.

Practice 3: Publishing a lot of non-citable items (editorial materials, letters, etc.). As mentioned previously, only the number of citable items (articles and reviews) published by journals are used as the denominator in the impact factor calculation, while citations from all types of documents (editorial materials, letters, and even corrections) are included in the numerator. However, a journal's practice of publishing editorial materials or publishing more meeting abstracts than articles can affect its position in the JCR. HLA (IF=2.785) is one example. This journal mostly publishes meeting abstracts. The total number of publications of the journal in the JCR calculation year is 1032 and only 93 of these are citable items. If the impact factor calculation covered not only the number of articles and reviews but also all types of documents, the impact factor of the journal would have been 0.250 in 2018. Moreover, if the citations from non-citable items were not counted, the impact factor would be 2.354. This shows how a small change in the calculation method, can change the journal's ranking. Table 5 presents all the journals which published many non-citable items and made self-citations to their papers published in 2016-2017.

Table 4
Impact of publishing editorial materials about previous years' studies (SC: self-citation, IF: impact factor)

Journal name	Published item(s), SC of the item(s) / all SC	IF of journal	IF -excluding item(s)	IF Difference
Image Anal Stereol	"Image analysis & stereology: 2017 research highlights", 22/24	1.778	1.166	0.612 (53%)
J Bus Logist	"Methods to our madness: adapting methods to the changing nature of our problems", 25/58	3.171	2.560	0.611 (24%)
Int J Confl Violence	"News from the Editors (Editorial to Volume 12, 2018)", 14/15	1.130	0.521	0.609 (117%)
Ing Sismica-Ital	"Design and assessment of steel structures in seismic areas: Outcomes of the last Italian Conference of Steel Structures", 17/78	2.561	2.146	0.415 (19%)
J Fam Theor Rev	"Act II Curtain Call: JFTR, 2014-2018", 11/36	2.804	2.565	0.239 (9%)
Augment Altern Comm	"Reflections on a special issue: motivations to encourage intervention designs", 12/69	2.706	2.470	0.236 (10%)
Austral Entomol	"Are taxonomic publications involving nomenclatural acts on Early View Code compliant?", 21/46	1.769	1.538	0.231 (15%)
Rev Policy Res	"Over a decade of scholarship on the politics and policy of science and technology", 14/34	1.864	1.651	0.213 (13%)
Zygon	"Focus and flexibility: Zygon's profile and practice", 19/50	0.648	0.472	0.176 (37%)
Resuscitation	"Resuscitation highlights in 2017", 74/731	4.572	4.422	0.150 (3%)
J Foot Ankle Res	"Journal of Foot and Ankle Research: the first ten years" (8 times), "Special theme article: science and sociology of footwear" (7 times), 15/48	1.604	1.462	0.142 (10%)
J Lit Res	"Invoking quantum physics: Fifty volumes of methodological complexity in literacy research", 6/21	1.886	1.750	0.136 (8%)
Contact Lens Anterio	"The scientific dry eye disease journey: From the beginning to the end of the beginning", 16/67	1.985	1.865	0.120 (6%)
Xenotransplantation	"Xenotransplantation literature update, November/December 2017", 10/130	3.484	3.373	0.111 (3%)
Handchir Mikrochir P	"HaMiPla Best Paper Award - Your Favourites in 2017", 10/41	0.809	0.702	0.107 (15%)
J Brand Manag	"Twenty-five years of the Journal of Brand Management", 8/38	1.829	1.723	0.106 (6%)
J Radiol Prot	"Principles and technicalities: The Bernard Wheatley Award for 2017", 16/55	1.327	1.228	0.099 (8%)
Tenside Surfact Det	"Editorial", 11/32	0.748	0.661	0.087 (13%)
Emerg Nurs	"A look back", 7/35	1.489	1.413	0.076 (5%)

Discussion

The impact factor has been the subject of many studies as a result of calculation problems. While some researchers believe that self-citations should be excluded from the IF calculation, others suggest that it is possible to design a system that will detect abnormal self-citation distributions. What we show in this study is that there is also a need to fine tune the parameters related to measuring self-citation 'excessiveness' (Opthof 2013, p. 165). An essential part of this fine-tuning process is to investigate the self-citation patterns of journals in relation to languages, subjects, and publisher countries, for clearer policymaking. Some journals might appear to be manipulating self-citations, when they are simply following standard procedures. On the other hand, an underlying manipulation from another journal may in fact not even be noticed.

Almost all journals' impact factor rankings change when self-citations are excluded from the calculation. One of our key findings is that there is no change amongst the very few high-impact factor journals. It is possible; however, to see the same pattern in the university ranking systems. In such systems, there has been no change amongst the top 100 universities for many years, yet, significant changes are observed in the tail-end of the rank distribution. Consistency is therefore more common in the top ranks (Doğan 2017, p. 113). The effort that any university undertakes to become listed amongst the top 100 universities will not be able to counter this reality.

In a similar vein we show how the value of an impact factor might be manipulated; however, it does not change the ranking of a journal in relation to Matthew effect (Larivière & Gingras 2010, p. 426). But, this does not mean that journals with high impact factors do not have excessive self-citations. These journals may still be making excessive self-citations, even if IF differences between top journals and the others do not allow them to lose their position. It is therefore important for policymakers to understand the many underlying problems related to the impact factor calculation.

Our findings also emphasize the fact that journals are different in size. Some journals publish many articles, and some very few. Because the impact factor calculation is the same for every journal, most systems do not differentiate between an impact factor for a journal with 1000 citable items and 1000 self-citations versus a journal with one citable item and one citation. We have found striking examples related to the size differences of journals and their number of publications and citations. Essentially, not all journals are equal, and so it is quite problematic to assess them using one formula.

The relationship between the journal language and field of study is statistically significant, but, there is no meaningful relationship between self-citations and fields. This confirms that the practice of self-citation in all subjects/fields is almost the same. However, language is a more significant issue for self-citation patterns. We show a relationship between the self-citation rate and official language of a journal. Since the highest self-citation rate was determined for local social science journals, we can see the importance

Table 5
Impact of publishing a lot of non-citable items and citing previous years' studies (SC: self-citation, IF: impact factor, EM: editorial material)

Journal name	SC from EMs and letters / all SC	IF of journal	IF -excluding item(s)	IF Difference
Clin Nucl Med	414/485 from EMs.	6.703	4.837	1.866
J Cachexia Sarcopeni	204/388 from EMs. One EM entitled "Contemporary publication patterns in the Journal of Cachexia, Sarcopenia and Muscle by type and sub-speciality: facts and numbers" cited 70 times, and "Time to jump on the bandwagon: The Journal of Cachexia, Sarcopenia and Muscle in 2018" 61 times.	10.754	9.231	1.523
Eur J Prev Cardiol	594/855 from EMs, letters and the other document types.	5.640	4.172	1.468
J Travel Med	166/274 from EMs and letters.	4.155	2.985	1.170
Anaesthesia	296/516 from EMs, letters and corrections.	5.879	4.821	1.058
Neurol India	159/240 from EMs and letters.	2.708	1.814	0.894
Hell J Cardiol	78/117 from EMs and letters.	2.269	1.430	0.839
Rev Esp Cardiol	137/239, 63 from EMs (one EM is "Revista Espanola de Cardiologia: Current situation and new projects" (31 times)), 68 from letters and six from corrections.	5.078	4.257	0.821
J Nucl Cardiol	163/487 from EMs and letters	4.112	3.460	0.652
Emergencias	65/120 from EMs and letters. The title of one of the editorials is "Emergencias' impact factor from 2010 to 2017: a detailed analysis of our journal's metrics"	3.350	2.718	0.632
Arthroscopy	273/611 from EMs and letters.	4.433	3.923	0.510
Hum Resour Dev Q	16/26 from EMs.	3.000	2.500	0.500
Phytocoenologia	19/31 from two EMs.	1.750	1.318	0.432
J Environ Eng Geoph	24/52 from EMs and letters.	1.534	1.120	0.414
J Classif	18/19 from three EMs.	1.636	1.227	0.409
Spat Econ Anal	16/24 from EMs.	1.902	1.512	0.390
Hla	34/68 from EMs. The editorial entitled "Nomenclature for factors of the HLA system, update November 2017" cited HLA 15 times.	2.785	2.419	0.366
Microbes Environ	41/74 from four EMs.	2.575	2.212	0.363
Aesthet Surg J	92/272 from EMs, letters and other types of documents.	3.480	3.121	0.359
Psychiat Prax	33/85 from EMs, letters and corrections.	1.813	1.468	0.345
Psychiatr Pol	57/66 from six EMs.	1.311	0.970	0.341
Educ Assess Eval Acc	12/19 from EMs.	1.722	1.388	0.334
Arterioscl Throm Vas	173/915 from EMs and letters.	6.618	6.286	0.332
J Strategic Stud	28/39 from five EMs.	1.482	1.152	0.330
Laryngo Rhino Otol	37/52 from EMs.	0.853	0.534	0.319
Isr J Health Policy	23/33 from EMs. One EM entitled "The IJHPR's growing scientific impact" cited seven times.	1.662	1.351	0.311
J Bras Pneumol	34/43 from EMs.	1.371	1.096	0.275
Child Abuse Rev	17/23 from five EMs.	1.206	0.936	0.270
Contemp Pacific	10/12 from EMs.	0.591	0.363	0.228
Metals-Basel	181/590 from EMs.	2.259	2.053	0.206
An Sist Sanit Navar	17/23 from EMs and letters.	0.533	0.344	0.189
M S-Med Sci	40/68 from EMs and news items.	0.661	0.482	0.179
Am J Pharm Educ	51/139 from EMs and letters.	1.737	1.563	0.174
Hist Phil Life Sci	9/21 from EMs.	0.750	0.576	0.174
Indian J Ophthalmol	75/116 from EMs and letters.	0.977	0.805	0.172
Can Rev Sociol	9/13 from three EMs.	0.772	0.614	0.158
Phys Teach	30/70 from EMs and letters.	0.638	0.492	0.146
Soc Compass	9/11 from three EMs.	0.625	0.484	0.141
Rev Port Cardiol	27/41 from EMs. One EM entitled "Highlights of the Portuguese Journal of Cardiology in 2017" cited 11 times.	0.785	0.646	0.139
Psychoanal Hist	3/5 from EMs. Total number of citations of this journal is 10.	0.435	0.304	0.131
J Hist Econ Thought	6/11 from EMs.	0.761	0.630	0.131
Stahlbau	20/34 from EMs.	0.404	0.286	0.118
Z Eval	5/7 from EMs.	0.349	0.232	0.117
Can Public Pol	8/20 from EMs.	0.899	0.797	0.102
Laeknabladid	4/8 from EMs.	0.289	0.244	0.045
Rev Colomb Entomol	3/4 from corrections.	0.197	0.157	0.040
Math Intell	2/3 from two EMs.	0.125	0.100	0.025

of multilingualism in science. Regional or local journals have different characteristics than international English-language journals and the rules set for international journals are not enough to protect national/local scientific practices. Local journals have a local audience and exist in small 'pools', and their citation potential is also low, so, these characteristics may skew citation distributions and self-citation rates. It is therefore problematic to measure both international and local journals using the impact factor, as a universal measurement tool. More consideration at this point needs to be given to the characteristics of local journals in a research evaluation.

Appendix 1

Distribution of journals with 25% or more self-citation rates to the countries and their total number of journals in JCR 2018

Rank	Country	N of all journals indexed in JCR 2018	N of journals that have 25% or higher self-citation rate	Share (%)	Rank	Country	N of all journals indexed in JCR 2018	N of journals that have 25% or higher self-citation rate	Share (%)
1	Armenia	3	3	100.0	31	Spain	129	19	14.7
2	Uzbekistan	1	1	100.0	32	Bulgaria	14	2	14.3
3	Ukraine	15	9	60.0	33	Brazil	130	18	13.8
4	Russia	151	77	51.0	34	South Korea	130	18	13.8
5	Belarus	2	1	50.0	35	Germany	744	100	13.4
6	Romania	51	18	35.3	36	South Africa	54	7	13.0
7	Ethiopia	3	1	33.3	37	New Zealand	55	7	12.7
8	Iceland	3	1	33.3	38	Mexico	40	5	12.5
9	Serbia	22	6	27.3	39	Greece	17	2	11.8
10	Argentina	19	5	26.3	40	Norway	34	4	11.8
11	Bangladesh	4	1	25.0	41	Singapore	62	7	11.3
12	Pakistan	12	3	25.0	42	Poland	142	16	11.3
13	Chile	39	9	23.1	43	Japan	252	26	10.3
14	Colombia	18	4	22.2	44	China	225	23	10.2
15	Venezuela	9	2	22.2	45	Hong Kong	10	1	10.0
16	Hungary	37	8	21.6	46	Portugal	11	1	9.1
17	Malaysia	14	3	21.4	47	Belgium	23	2	8.7
18	Slovenia	19	4	21.1	48	Australia	175	15	8.6
19	Croatia	40	8	20.0	49	Canada	130	11	8.5
20	Estonia	5	1	20.0	50	Lithuania	24	2	8.3
21	Philippines	5	1	20.0	51	Scotland	24	2	8.3
22	Slovakia	21	4	19.0	52	Sweden	26	2	7.7
23	France	198	37	18.7	53	United Kingdom	3075	204	6.6
24	Italy	125	23	18.4	54	USA	4423	265	6.0
25	Austria	39	7	17.9	55	Denmark	71	4	5.6
26	India	103	18	17.5	56	Iran	38	2	5.3
27	Czechia	52	8	15.4	57	Switzerland	299	14	4.7
28	Israel	13	2	15.4	58	Netherlands	983	46	4.7
29	Taiwan	39	6	15.4	59	UAE	39	1	2.6
30	Turkey	59	9	15.3					

For journals that have a 25% or more self-citation rate, the main pattern with respect to impact factor calculations, was the use of published bibliometric analyses about previous years as well as non-citable items, and citations from corrections. This pattern clearly affects the impact factor of a journal. As we have found, only one bibliometric item can change an impact factor and thus change the journal's IF rank more than 10-ranks (the case of ArcheoSciences-Revue d Archeometrie). Every journal, field, and article is different, so it is not possible to find a formula to represent them all. An indicator such as the impact factor in research evaluation clearly does not represent all journals equally and there are deficiencies in the way that the calculation is formulated.

CRediT authorship contribution statement

Zehra Taşkın: Conceptualization, Methodology, Data curation, Visualization, Formal analysis, Writing – original draft. **Güleda Doğan:** Conceptualization, Methodology, Data curation, Visualization, Formal analysis, Writing – review & editing. **Emanuel Kulczycki:** Conceptualization, Methodology, Writing – review & editing. **Alesia Ann Zuccala:** Conceptualization, Methodology, Writing – review & editing.

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