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Is there a need for a new journal metric? Correlations between JCR Impact Factor metrics and the Journal Citation Indicator—JCI

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ABSTRACT

In 2021, Clarivate published a new version of the Journal Citation Reports (JCR) including a new indicator. The Journal Citation Indicator (JCI) is a new field-normalized metric at journal-level, which is calculated by averaging the Category Normalized Citation Impact (CNCI) of the journal's articles and reviews published in the preceding three-year period. Unlike the Journal Impact Factor (JIF), it is also calculated for the journals of the Arts & Humanities Citation Index (AHCI) and the Emerging Sources Citation Index (ESCI), which are now included in the JCR. To better understand this new indicator, this article analyses its main statistical characteristics in comparison with the other JCR indicators using all JCR journals and categories. The results highlight the similarities between the JCI and JIF, with a high Pearson correlation (0.853) and a similar distribution. This correlation is also high and homogeneous in the different categories, both for Science and Social Sciences. The JCI is therefore a perfect complement to the JIF, as well as representing an alternative to resolve the well-known problems of the JCR.

1. Introduction

Over recent decades the assessment of scientific research has focused on identifying solid indicators that allow stabilization of the quality of scientific contributions and the journals where they are published (Moed, 2005). Many bibliometric indicators have been used to assess journals, articles, authors, and users in different fields of knowledge and categories, mostly based on citations. Since the publication of the first Journal Citation Reports (JCR)™ in 1976, one of the most common and useful indicators has been the Journal Impact Factor (JIF) of a journal, a quality index obtained by dividing the number of citations in the current year of items published in the two preceding years by the number of 'citable items' (articles and reviews) published in that journal in the same two-year period (Garfield, 2006). The JIF has been used as a standard metric by authors and librarians (Miles et al., 2018) when choosing where to publish articles. Due to its strict selection process, inclusion in the JCR has also become a hallmark of editorial quality and research integrity (Oviedo-García, 2021).

Despite being the most important and useful bibliometric indicator, the JIF has received criticisms regarding its calculation procedure. Some are related to the definition of 'citable items' (articles and reviews) (Bornmann et al., 2012), while others focus on the use of the two preceding years to represent research impact, issues which have been discussed broadly in the literature (Bensman, 2007). Others have suggested a number of possible modifications and improvements (Althouse et al., 2009). Authors such as Simons (2008) and Alberts (2013) consider the JIF susceptible to manipulation, resulting in unethical behavior. In spite of the controversy surrounding its use and possible manipulation (Falagas & Alexiou, 2008), the fact is that it continues to be used as a benchmark to evaluate the quality of individual publications and the work of scientists (Bornmann & Williams, 2017; Paulus et al., 2018). However, its huge

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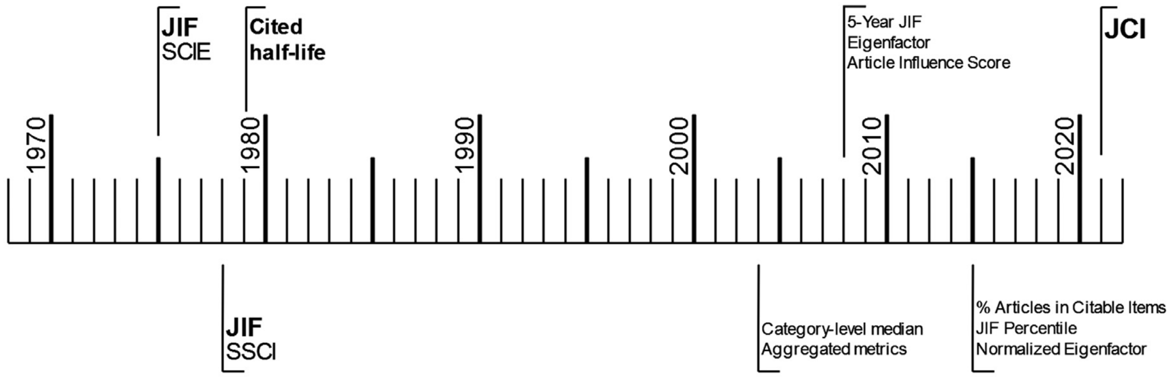

Fig. 1. Timeline of Journal Citation Reports indicators.

Table 1
Journal and indicator coverage – Journal Citation Index, Journal Impact Factor and Journal Citation Indicator – in the Journal Citation Reports (2020 edition) according to database.

		Coverage according to database				
	TOTAL	*SSCI*	*SCIE*	*AHCI*	*ESCI*	*CLASSICJCR*
1.1. General coverage						
Total journals in the JCR (with duplicates across categories)	29,606	3527	9531	1793	7285	12,360
Unique journals (without duplicates across categories)	20,994	2460	8797	1349	7285	11,916
Total number of categories	254	58	178	28	246	229
1.2. Coverage of the JIF and JCI						
Journals with Journal Impact Factor (JIF) calculated	12,323	3519	9501	–	–	12,323
Journals with Journal Citation Indicator (JCI) calculated	20,943	3520	9510	1790	7263	12,333
Journals with JCI and JIF calculated	12,321	3518	9500	–	–	12,321

limitations in the field of Arts and Humanities are also well-known (Bordons et al., 2002; González-Alcaide et al., 2012), identifying several causes, such as a lower number of citations or too small citation windows (Nederhof, 2006). Therefore, its application in these areas is conceptually and methodologically motivated and not due to processing.

In recent years, the JIF and journal indicators used in assessment processes at author level have also been strongly criticized in different manifestos such as the San Francisco Declaration on Research Assessment (DORA, 2012), Leiden (Hicks et al., 2015), and the recommendations contained in the report known as The Metric Tide (Wilsdon et al., 2015). In light of this situation, Clarivate Analytics has added new metrics to the JCR with the aim of eliminating some of the JIF's limitations. These include the 5-Year Journal Impact Factor (Nierop, 2010), which takes into account a five-year period, the Journal Impact Factor without Self Cites, the Eigenfactor Score (ES) (Bergstrom et al., 2008; West et al., 2010), which also takes into account a five-year period and gives weight to the citations received, and the Article Influence Score (AIS) (Rizkallah & Sin, 2010). These indicators have been available since the 2007 edition (released in 2008) of the JCR (West et al., 2008). Fig. 1 provides an overview of the incorporation of the different indicators into the JCR.

Various publications have analysed the correlation between different indicators applied to journal evaluation (Elkins et al., 2010; Okagbue & Teixeira da Silva, 2020; Rousseau & STIMULATE 8 Group, 2009), and also in different fields of Medicine, such as Pediatric Neurology (Kianifar et al., 2014), Occupational Therapy (Brown et al., 2018) and Nuclear Medicine (Ramin & Sarraf Shirazi, 2012). Although they all conclude that several indicators should be used collectively for a better evaluation of journals and articles, the reality is that these new alternatives correlate well with the JIF (Gorraiz et al., 2021; Torres-Salinas & Jiménez-Contreras, 2010). However, the inclusion of new indicators did not definitively resolve issues such as the lack of the JIF in Arts and Humanities disciplines or, more recently, the lack of indicators for journals included in the Emerging Sources Citation Index (ESCI). This situation led Clarivate to launch a new version of the JCR in 2021 (2020 edition) and a new indicator: the Journal Citation Indicator (JCI).[1]

Table 1 gives an overview of the current status of the JCR and the coverage of the JIF and JCI in the Web of Science Core Collection. The JCR currently includes a total of 29,606 scientific journals (20,994 of which are unique). Of this corpus, only 12,323 have a JIF, given that neither the journals of the Arts & Humanities Citation Index (AHCI) nor those of the ESCI have these calculations. In total, the AHCI and ESCI include 8610 scientific journals for which Clarivate has calculated the JCI indicator. It should also be noted that all the scientific journals that have a JIF have a JCI calculated. Therefore, the new JCR now integrates all the citation indexes and

[1] https://clarivate.com/blog/introducing-the-journal-citation-indicator-a-new-field-normalized-measurement-of-journal-citation-impact/

all the journals have associated bibliometric indicators. Likewise, the total number of new scientific categories included is 254. The latest version of the JCR is the most ambitious to date, both in terms of the number of journals and the number of indicators.

The JCI is a field-normalized metric. The first proposals for standardized citation indicators date back to the 1980s (Moed et al., 1985; Vinkler, 1986), and have been reformulated and discussed in recent years (Torres-Salinas et al., 2018; Waltman, 2016). The main objective of these measures is to offer an article-level metric that takes into account three variables: field (category), document type (article, review, etc.), and year of publication (Moed et al., 1995). Its practical usefulness has led to its popularization in the different bibliometric databases, and we can find it under the name of Field Weighted Citation Impact (FWCI) in Scopus (Elsevier, 2018), Relative Citation Ratio (RCR) in Pubmed (Hutchins et al., 2016) and Category Normalized Citation Impact (CNCI) in Clarivate's InCites. In the case of the CNCI, it shows the relative citation impact of a particular paper as the ratio of citations compared to a global baseline (Clarivate Analytics, 2018).

The new JCI is directly integrated into this family of indicators. The JCI value represents the average category-normalized citation impact for articles and reviews published in the preceding three-year period. According to Clarivate, the JCI is calculated in the same landscape as the data that Web of Science uses for the preparation of the other metrics in JCR. This data is calculated at the time of JCR extraction, thereby providing a stable metric even if the value of the article citations changes in Web of Science and InCites (Clarivate, 2021). For the design of the JCI the most relevant parameters in the calculation are: I) average expected citations in the category; II) CNCI; and III) average normalized impacts. Finally, the JCI is the average of the CNCI of the journal's articles and reviews (citable items) published in the preceding three-year period, as opposed to the JIF which considers citations from the current year. The interpretation is the same as other normalized indicators: a value of 1.0 means that, across the journal, the papers published received a number of citations equal to the average citation count in that category.

In this scenario of the launch of a new JCR and the proposal of a new indicator, a study that contextualizes and provides more detailed knowledge of some of the characteristics of the new JCI indicator is pertinent. The main objective of this article is to perform an initial statistical analysis of the JCI and its relationship with other indicators, especially the JIF. This will be carried out through a study of the correlations between the JCR indicators. More specifically, the following objectives were established:

1 To establish the main statistical characteristics of the JCI in comparison with the other JCR indicators.
2 To establish the JCR indicators with which the JCI has the highest Pearson correlation coefficient.
3 To determine whether there are any differences in the correlations according to the thematic categories of the journals.
4 To perform a regression analysis to further investigate the association between the JIF and the JCI indicators and to observe whether JCI could predict JIF.

We consider that the results can improve knowledge of the new version of the JCR, helping to better understand the new functioning of the JCI indicator and therefore make more appropriate use of it. Therefore, the target audiences of this study are: bibliometricians, librarians, scientific publishers and evaluation agencies. The results of this study may help them to decide regarding the adequacy of using the JCI in professional and scientific contexts.

2. Materials and methods

The 2020 edition of the JCR was downloaded on 18 November 2021. All available journals and indicator data were retrieved, consisting of a total of 20,994 journals organized in 254 Web of Science categories and 4 databases (citation indexes): Science Citation Index Expanded (SCIE), Social Sciences Citation Index (SSCI), Arts & Humanities Citation Index (AHCI) and Emerging Sources Citation Index (ESCI). In order to obtain a more global overview, each Web of Science category was assigned an Essential Science Indicators (ESI) category using the equivalence scheme proposed by Arroyo-Machado and Torres-Salinas (Arroyo-Machado & Torres-Salinas, 2021). We compared the JCI with the main indicators of the JCR: Journal Impact Factor (JIF), 5-Year Journal Impact Factor (5-Year JIF), Immediacy Index, Eigenfactor, Total Citations and Article Influence Score (AIS). It should be noted that some journals do not include all the indicators, particularly the JIF (9361 journals do not include it).

The methods applied to the journal indicators are mainly based on descriptive statistics and correlations. We used the Pearson correlation as it is commonly applied to continuous variables such as certain bibliometric indicators (Purkayastha et al., 2019; Ravenscroft et al., 2017). The Spearman correlation was excluded as it works better with ranked data and highly skewed distributions, such as citation counts and altmetric mentions (Thelwall, 2017). Correlations were made both overall and by Web of Science categories. To analyze the distribution of the data and detect inequalities, the Gini index and the Lorenz curve were obtained for each journal indicator. The former is a coefficient used to measure inequality ranging between 0 (total equality) and 1 (total inequality), while the latter is a graphical representation that shows the distribution of the cumulative percentages of individuals and of the variables measured. The resulting curve is compared to the perfect inequality line. We also performed a regression analysis building a linear regression model using the JIF as the dependent variable and the JCI as the independent variable. However, due to the skewed distribution of these values, we performed a normalization of the data. To do so, we ranked the journals by indicating their position in each category according to the JCI and the JIF indicators. This linear regression model is not only constructed at a general level including all journals, but different sub-models have been built differentiating between SCIE and SSCI journals and by categories. This is intended to test the robustness of this general relationship and to identify cases that do not adjust to it. The analysis was conducted in R (version 3.6.2), and all the data and scripts for data pre-processing and creation of figures are available at doi: 10.5281/zenodo.5776350. Supplementary figures are available at doi: 10.5281/zenodo.5776882.

Table 2
Descriptive statistics for main bibliometric indicators included in the JCR (2020 edition).

	Journal Citation Indicator	Journal ImpactFactor	5-YearJournal ImpactFactor	TotalCitations	Immediacy Index	Eigenfactor	Article Influence Score
Mean	**0.806**	3.439	3.648	5675.532	0.879	0.006	0.806
Standard error	**0.005**	0.039	0.035	118.073	0.018	0.000	0.009
Median	**0.640**	2.5	2.688	1143.500	0.489	0.001	0.505
Mode	**0.43**	1	3	13	0	0	0
ES	**0.912**	5.471	4.954	20,316.183	3.010	0.024	1.468
Variance	**0.832**	29.929	24.547	8	9.058	0.001	2.156
Coefficient of variation	**113.179%**	159.066%	135.794%	357.961%	342.524%	424.213%	182.182%
Kurtosis	**1757.886**	3659.949	1034.886	537.619	2825.047	924.878	441.064
Skewness coefficient	**24.082**	42.528	19.778	17.650	42.861	23.954	14.040
Count	**29,540**	20,034	19,922	29,606	28,990	29,606	29,557
Maximum	**77.64**	508.702	332.984	915,939	259.056	1.237	79.357

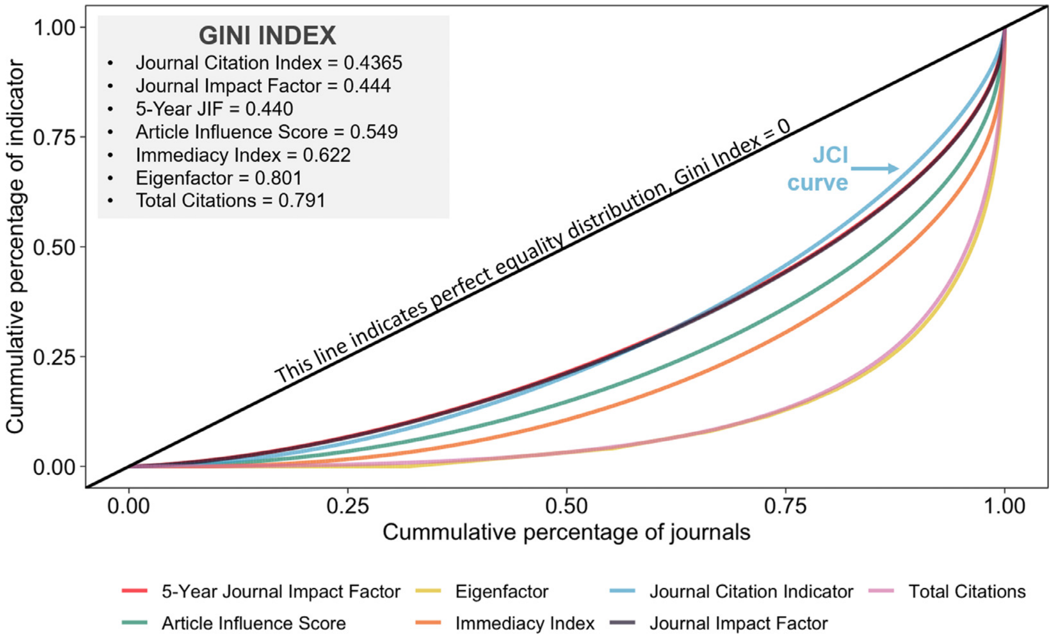

Fig. 2. Lorenz curve and Gini Index of the main bibliometric indicators included in the JCR 2020 edition.

3. Results

3.1. Statistical characteristics

Table 2 shows the main characteristics of the seven JCR indicators analysed. The average JCI value is 0.806, a value much lower than the average of the JIF and the 5-Year JIF of around 3.5. It can also be seen that the maximum JCI value reached by a journal is 77.64. These two descriptive indicators are closer in principle to the AIS, which has a mean of 0.806 and a maximum of 79.357. Both indicators move in very similar magnitudes. However, considering the coefficient of variation, none of the indicators is homogeneous, being the JCI the lowest with 113.179%, followed by the JIF and the 5-Year JIF with 159.066% and 135.794%, respectively. This table also shows that the maximum of all variables is significantly higher in comparison to the mean. This means that most categories have almost all their citations at the top of their list or a limited number of journals have many more citations compared to the rest of the journals on the list. It is interesting to note that all the metrics are well balanced in this respect.

Fig. 2 shows the Lorenz curve for the seven indicators. The Lorenz curve is a graphical representation of the inequality of income distribution in each territory. Applied to bibliometric indicators, it represents the greater or lesser asymmetry of the indicators. Also, at the bottom of the table we have included the Gini values, which numerically summarize the Lorenz curve. In the graph the

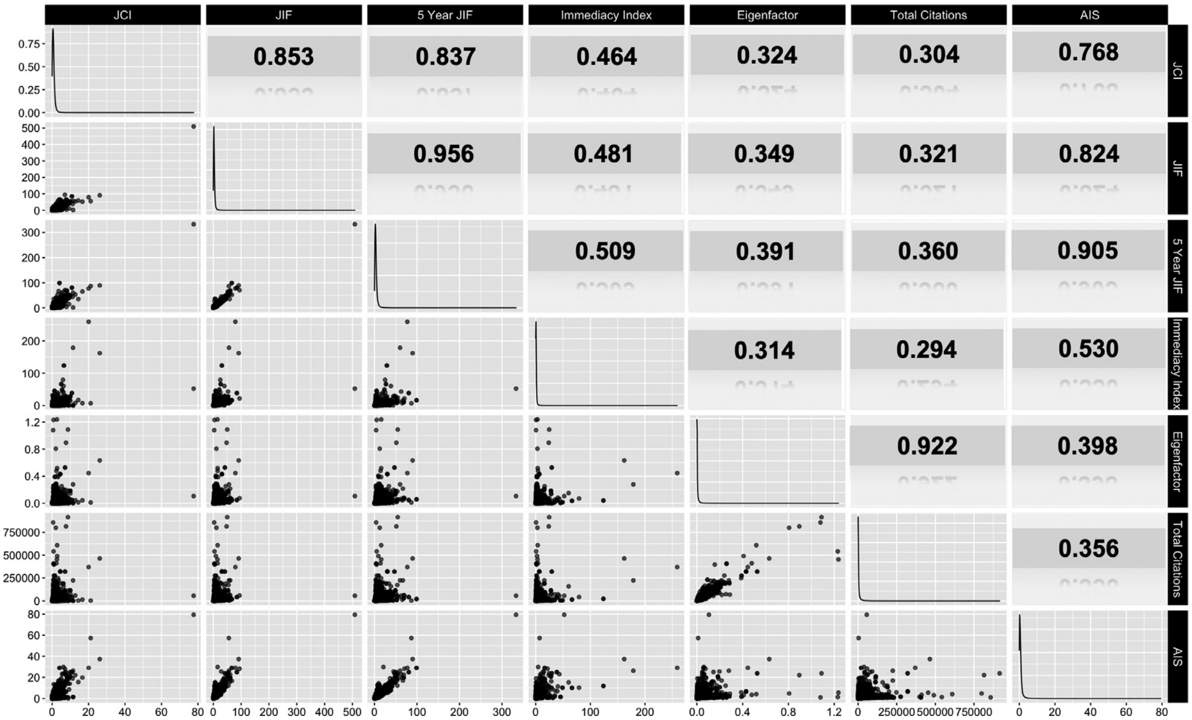

Fig. 3. Main Pearson correlations between the seven indicators of the JCR (2020 edition). The p-value is less than 0.001 for all correlations.

indicators are grouped into three clusters. The first one clearly shows how the JCI, JIF and 5-Year JIF have an almost identical Lorenz curve closer to the straight line, which represents an equitable distribution, although the JCI (blue line) is the indicator with the least pronounced curve. This similarity is clearly reflected in the Gini indicator, which is 0.4365 in the case of the JCI and 0.444 and 0.440 for the JIF and 5-Year JIF respectively. Despite the number of citations is asymmetric and unequal, given that evidently a smaller percentage of articles accumulate many citations, these indicators are the least skewed and could better represent the journal population. A second group of indicators consists of the AIS and Immediacy Index, with more asymmetric curves, and the third group consists of the Total Citations and Eigenfactor, which have the most unequal curves.

Fig. 3 shows the correlation matrix of the seven indicators, all of them with a p-value of less than 0.001. The correlation of the JCI with the rest of the indicators shows a very clear pattern. The new JCR indicator correlates significantly with the two JIFs, both the traditional two-year version ($r = 0.853$) and the five-year version ($r = 0.837$). It also shows a moderate correlation with the AIS ($r = 0.768$). Finally, the JCI does not show any correlation with the other indicators analysed, with the lowest correlation for the number of citations ($r = 0.304$). The correlation patterns are very similar to those obtained for the Lorenz curve and the Gini. In the specific case of the JIF, the highest correlation is with the 5-Year JIF ($r = 0.956$), while the second highest is with the JCI.

3.2. Correlations by categories

Fig. 4 shows a boxplot with the values of the correlation between the JCI and the two JIF indicators across 229 categories included in the new JCR, distinguishing between Science and Social Sciences journals. The correlations of the JCI with the two JIF indicators are very similar, with a notable number of categories showing high and highly significant correlations. However, there is a difference between databases (citation indexes) because the concentration or number of scientific categories with high correlations is lower in the case of Social Sciences. As we can see in all cases, the number of JCR categories that correlate insignificantly (i.e., considering a Pearson correlation coefficient of 0.6) are very few, and only Andrology, Cultural Studies, Ethnic Studies, Logic, Microscopy and Quantum Science & Technology categories have a p-value higher than 0.001 in the correlations between the JCI and the two JIF indicators, and Psychology, Psychoanalysis between the JCI and 5-Year JIF. Moreover, all cases of lower correlations correspond to smaller categories if we consider the number of journals. More specifically, the average of the significant correlations of the JCI with the JIF (two years) is 0.892. In the case of Science journals this average increases to 0.904 and in the case of Social Sciences journals it is 0.857.

Fig. 5 shows the categories grouped according to their ESI field and correlation values between the JCI and JIF. The ESI field of Clinical Medicine has the largest number of categories (a total of 16) with the highest correlation values, i.e., between 1 and 0.95. Also, in Clinical Medicine there are 20 categories with correlation values between 0.94 and 0.90. Eight categories of the Engineering

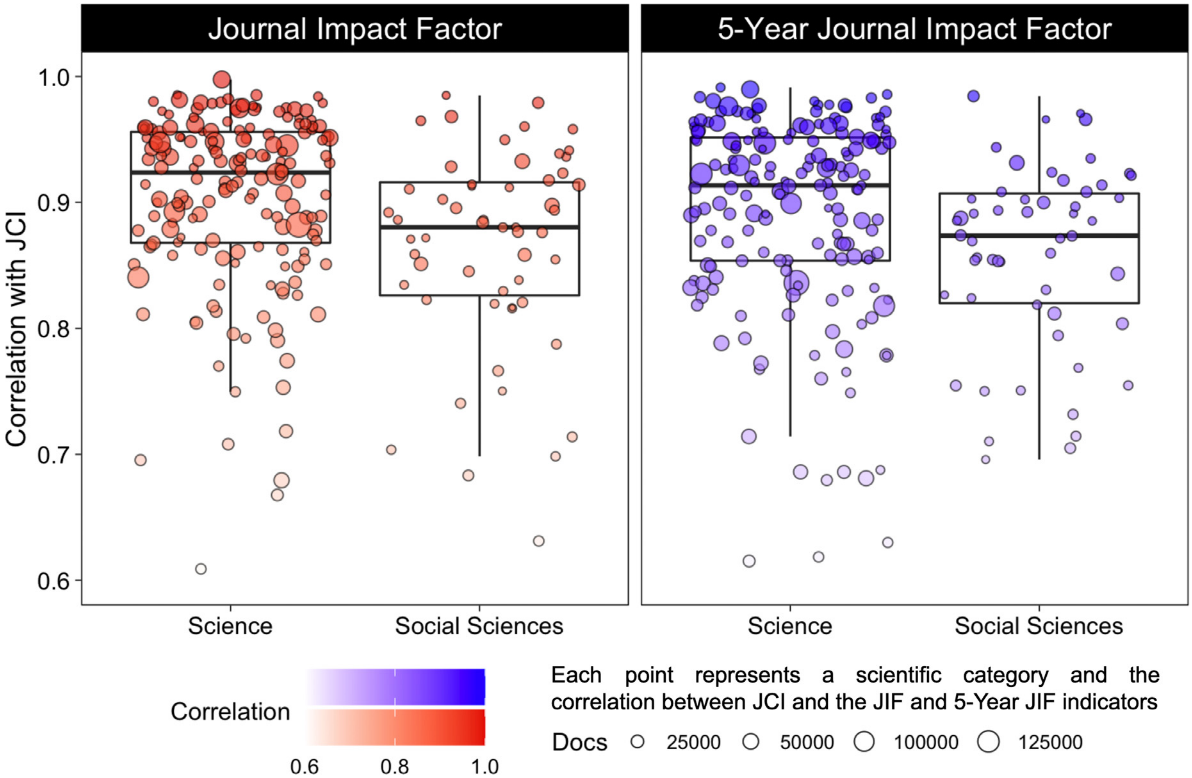

Fig. 4. JCI-JIF and JCI-5-Year JIF correlations by Science and Social Sciences journals. Category size indicates the total number of articles. There are two categories with a correlation coefficient of less than 0.6 and seven with a p-value greater than 0.001 that are not included.

ESI field fall in the correlation segment 1–0.95. This ESI field is generally characterized by high correlations, mostly above 0.799 (88.89%). Most of the ESI fields have similar characteristics to those described, although with certain nuances. For example, most of the categories included in the ESI field of Psychiatry and Psychology are between 0.89 and 0.85, a total of seven. In the ESI fields of Physics, Immunology and Microbiology the categories between 0.94 and 0.90 predominate. On the negative side, there are 30 categories with correlations below 0.799. The ESI field of Social Sciences, General has a total of nine categories with lower correlation values (less than 0.799) and there is only one category with a correlation higher than 0.95. In Computer Science, Physics and Chemistry there are three categories with values below 0.799 in all of them.

In Table 3 we present some of the Pearson correlation coefficients for 93 categories. The correlation coefficient between the JCI and the JIF indicators was calculated. The complete data can be found in the supplementary material (doi: 10.5281/zenodo.5776404). A total of 123 categories (53.71%) have a correlation coefficient above 0.90. The biomedical categories Oncology ($r = 0.998$), Peripheral and Vascular Diseases ($r = 0.985$) and Respiratory System ($r = 0.982$) are some of the most highly correlated. The engineering categories with the highest correlations are Robotics ($r = 0.984$) and Telecommunications (0.982). The categories with lower correlations include highly applied disciplines such as Spectroscopy ($r = 0.609$). Categories with correlations of less than 0.799 include three Computer Science categories, two Chemistry categories and other small categories.

In Social Sciences, the areas most closely related to Science are the ones with the best correlation, for example Psychology, Biological ($r = 0.985$) and Green & Sustainable Science & Technology ($r = 0.979$). Most areas of Psychology (Clinical, Applied, Social, Educational and Multidisciplinary) are between 0.899 and 0.85. Other relevant Social Sciences categories with significant correlations include Business ($r = 0.928$), Economics ($r = 0.898$) and Political Science ($r = 0.918$). The categories with the worst correlations include Sociology ($r = 0.766$) and Communication ($r = 0.741$). In the specific case of Information and Library Science, the correlation is 0.902. Some Humanities categories of the JCR have significant values, such as Linguistics ($r = 0.821$) and History ($r = 0.820$). Categories with a multidisciplinary profile have the worst correlation values, such as Social Sciences, Interdisciplinary ($r = 0.683$).

3.3. Linear regression and practical applications

For the linear regression analysis, the JIF and JCI values are replaced by the journal's rank in the category according to them. Fig. 6 shows the regression between the JIF and the JCI in the 236 SCIE and SSCI categories. The model obtained using all the data

Table 3
Significant Pearson's correlation coefficients between the Journal Citation Indicator (JCI) and the Journal Impact Factor (JIF) for different categories.

Pearson's correlation	Science Edition	Social Sciences Edition
Between		
1 – 0.95	**54 Categories**	**6 Categories**
60 Categories	ONCOLOGY- **0.998**	PSYCHOLOGY. BIOLOGICAL - **0.985**
in this range	MYCOLOGY- **0.985**	GREEN & SUSTAINABLE SCIENCE & TECH - **0.979**
	PERIPHERAL VASCULAR DISEASE - **0.985**	PSYCHIATRY - **0.968**
	ROBOTICS - **0.984**	GERONTOLOGY - **0.965**
	RESPIRATORY SYSTEM - **0.982**	SOCIAL SCIENCES. BIOMEDICAL - **0.960**
	TELECOMMUNICATIONS - **0.982**	SUBSTANCE ABUSE - **0.958**
	CRITICAL CARE MEDICINE - **0.980**	
	IMAGING SCIENCE & PHOTOGRAPHIC TECH - **0.979**	
	MEDICINE. GENERAL & INTERNAL- **0.979**	
	ENGINEERING. OCEAN - **0.979**	
	… 44 more categories	
Between	**52 Categories**	**14 Categories**
0.949–0.90	RHEUMATOLOGY- **0.949**	HOSPITALITY. LEISURE. SPORT & TOURISM - **0.950**
66 Categories	REPRODUCTIVE BIOLOGY - **0.949**	SOCIAL SCIENCES. MATH. METHODS - **0.941**
in this range	ORTHOPEDICS - **0.948**	TRANSPORTATION - **0.939**
	BIOCHEMISTRY & MOLECULAR BIOLOGY- **0.948**	PUBLIC ADMINISTRATION - **0.936**
	CHEMISTRY. PHYSICAL - **0.948**	PUBLIC. ENVIR.L & OCCUPATIONAL HEALTH - **0.933**
	RADIOLOGY. NUCLEAR MEDICINE - **0.947**	BUSINESS - **0.928**
	SURGERY - **0.946**	GEOGRAPHY - **0.923**
	ENGINEERING. ELECTRICAL & ELECTRONIC - **0.945**	POLITICAL SCIENCE - **0.918**
	BIOTECHNOLOGY & APPLIED MICROBIOLOGY - **0.943**	SOCIAL ISSUES - **0.914**
	… 42 more categories	… 10 more categories
Between	**38 Categories**	**17 Categories**
0.899–0.85	COMPUTER SCIENCE. ARTIFICIAL INTEL. - **0.900**	ECONOMICS - **0.898**
55 Categories	PSYCHOLOGY - **0.900**	PSYCHOLOGY. CLINICAL - **0.896**
in this range	PHYSICS. MATHEMATICAL - **0.897**	PSYCHOLOGY. APPLIED - **0.894**
	CELL BIOLOGY - **0.897**	PSYCHOLOGY. SOCIAL - **0.892**
	PHYSICS. APPLIED - **0.893**	DEVELOPMENT STUDIES - **0.886**
	FISHERIES - **0.891**	PSYCHOLOGY. EDUCATIONAL - **0.886**
	MATHEMATICS. APPLIED - **0.891**	PSYCHOLOGY. MULTIDISCIPLINARY - **0.884**
	OCEANOGRAPHY - **0.889**	ERGONOMICS - **0.880**
	MARINE & FRESHWATER BIOLOGY - **0.889**	CRIMINOLOGY & PENOLOGY - **0.880**
	MATERIALS SCIENCE. BIOMATERIALS - **0.888**	NURSING - **0.877**
	… 28 more categories	… 7 more categories
Between	**16 Categories**	**9 Categories**
0.849–0.80	ELECTROCHEMISTRY- **0.849**	HEALTH POLICY & SERVICES - **0.845**
25 Categories	HISTORY & PHILOSOPHY OF SCIENCE - **0.849**	HISTORY & PHILOSOPHY OF SCIENCE - **0.838**
in this range	CHEMISTRY. MULTIDISCIPLINARY - **0.841**	WOMENS STUDIES - **0.835**
	MATHEMATICS. INTERDISCIPLINARY APP. - **0.83**	ANTHROPOLOGY - **0.830**
	ENTOMOLOGY - **0.835**	LAW - **0.823**
	ANATOMY & MORPHOLOGY - **0.834**	LINGUISTICS - **0.821**
	MICROBIOLOGY - **0.831**	HISTORY - **0.820**
	GEOCHEMISTRY & GEOPHYSICS - **0.828**	PSYCHOLOGY. PSYCHOANALYSIS - **0.816**
	EVOLUTIONARY BIOLOGY - 0.826	AREA STUDIES - **0.816**
	NUTRITION & DIETETICS - **0.818**	
	… 6 more categories	
Less Than	**14 Categories**	**10 Categories**
0.799	POLYMER SCIENCE - **0.799**	FAMILY STUDIES - **0.787**
24 Categories	PHYSICS. ATOMIC. MOLECULAR & - **0.796**	SOCIOLOGY - **0.766**
in this range	ENGINEERING. AEROSPACE - **0.792**	HISTORY OF SOCIAL SCIENCES - **0.750**
	GREEN & SUSTAINABLE SC & TECH. - **0.790**	COMMUNICATION - **0.741**
	MECHANICS - **0.774**	REHABILITATION - **0.714**
	BEHAVIORAL SCIENCES - **0.770**	REGIONAL & URBAN PLANNING - **0.704**
	ENGINEERING. MECHANICAL - **0.753**	URBAN STUDIES - **0.698**
	COMPUTER SCIENCE. HARD. & ARCH. **- 0.750**	SOCIAL SCIENCES. INTERDISCIPLINARY - **0.683**
	COMPUTER SCIENCE, INTER. APP - **0,718**	BUSINESS. FINANCE - **0.631**
	… 5 categories more	PSYCHOLOGY, EXPERIMENTAL – **0.42**

Note: Correlations for all categories are available in the supplementary material (**doi: 10.5281/zenodo.5776404**).

ESI Fields ↓	JCR Categories classified according its correlation value and ESI Field				
	Correlation Between 1 - 0,95	Correlation Between 0,94 - 0,90	Correlation Between 0,89 - 0,85	Correlation Between 0,84 - 0,80	Correlation Minor Than 0,799
	Nr of JCR categories inluded in each ESI Field ↓	Nr of JCR categories inluded in each ESI Field ↓	Nr of JCR categories inluded in each ESI Field ↓	Nr of JCR categories inluded in each ESI Field ↓	Nr of JCR categories inluded in each ESI Field ↓
Clinical Medicine	16	20	6	1	
Engineering	8	7	7	2	3
Materials Science	5	1	2	1	1
Plant & Animal Science	4	1	4	2	
Psychiatry/Psychology	4	1	7	1	2
Geosciences	4	3	3	1	
Agricultural Sciences	4	3		2	
Environment/Ecology	2	1	2		1
Neuroscience & Behavior	2	1			1
Computer Science	2	1	2	1	3
Biology & Biochemistry	1	3	1	1	
Physics	1	4	3		2
Pharmacology & Toxicology	1		2		
Immunology	1	2			
Social Sciences, General	1	11	7	7	7
Multidisciplinary	1				
Molecular Biology & Genetics	1		3		
Microbiology	1	2		1	
Mathematics	1		2	1	
Space Sciences	1	1			
Chemistry	1	2	2	3	3
Economics & Business	1	2	2		1
Arts & Humanities	1			1	
Total Nr. of JC categories	**60**	**66**	**55**	**25**	**24**

Fig. 5. Distribution of the categories according to their correlation values between JCI and JIF according to their Essential Science Indicators (ESI) field. Only correlations with a p-value of less than 0.001 are included.

has an R^2 of 0.898, with little variation when differentiating between SCIE and SSCI. For the SCIE categories the R^2 value is 0.903 and for SSCI 0.885, and the p-values in both cases are less than 0.001. This reflects the good association between JIF and JCI or, in other words, JCI would allow us to predict the position that the journal would occupy in the JIF ranking of a given category. However, we found differences between the regression models created for each category. Although the mean R^2 of all the models created is 0.807, 0.829 in the case of SCIE categories and 0.738 for SSCI, there are 35 categories with values lower than 0.7. In this sense we find the worst results in Logic (R^2=0.17) and Microscopy (R^2=0.25).

Finally, because of the relationship found between the JIF and JCI indicators, we have carried out a practical application to illustrate the potential opportunities that this may offer. We intend to estimate the position of the journals of a category in the JIF ranking from the position in the JCI ranking, thus being able to integrate journals without JIF and observe how the ranking is altered. An estimate that can be useful, for example, to authors by providing them with a wider range of journals from which to choose to submit their publications. In this sense, the value of ESCI journals in addressing emerging topics has been previously pointed out, as well as their problems in terms of impact are a limitation when compared to other journals (Huang et al., 2017), so the JCI could improve their visibility.

We have constructed a model for the Information Science and Library Science category using the 85 journals that are indexed in SSCI and have JIF. This has an R^2 of 0.871, indicating a good fit, so taking this relationship as valid we estimate the position that the 164 journals in the area would occupy in the JIF ranking. Fig. 7 compares the original position occupied by the 85 journals with JIF based on that value with the position predicted from the JCI of the 164 journals, marking the quartiles of this new ranking to better appreciate in which positions the ESCI journals are placed. Although most of the ESCI journals are integrated in the last two quartiles, altering the positions of some SSCI journals, we also find some of them in the highest positions. These are the cases of Transforming Government- People Process and Policy and Journal of Data and Information Science that occupy positions 41 and 42, respectively, the last of the first quartile and the first of the second. All this highlights the usefulness of this new indicator, reaching where the JIF does not reach, and allowing in this case a comparison in which almost twice as many journals in this area are considered, with some ESCI journals standing out.

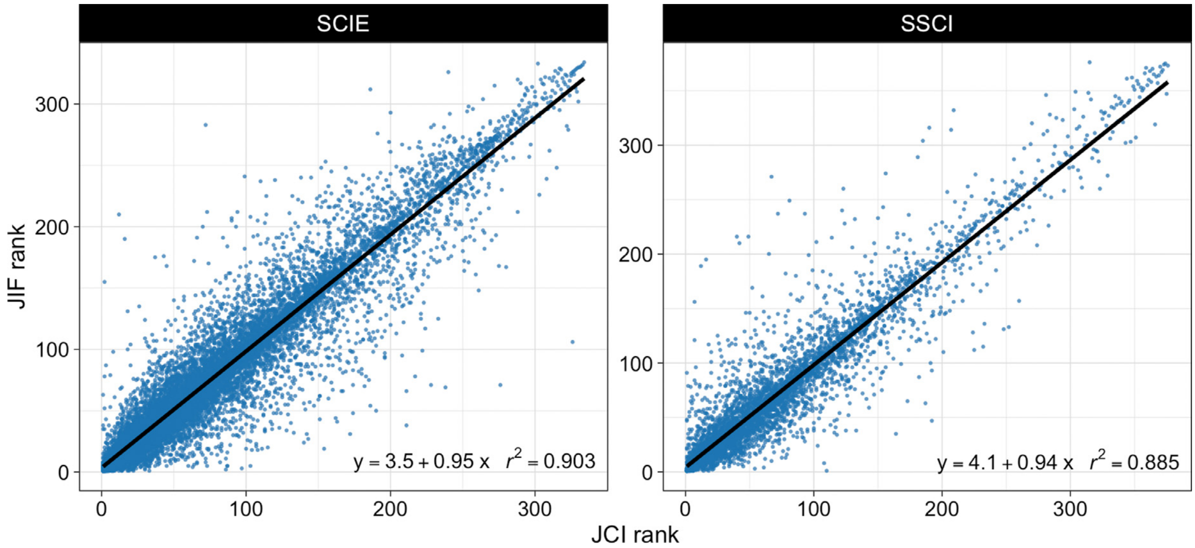

Fig. 6. Linear regression models between JIF and JCI ranked values by SCIE and SSCI categories.

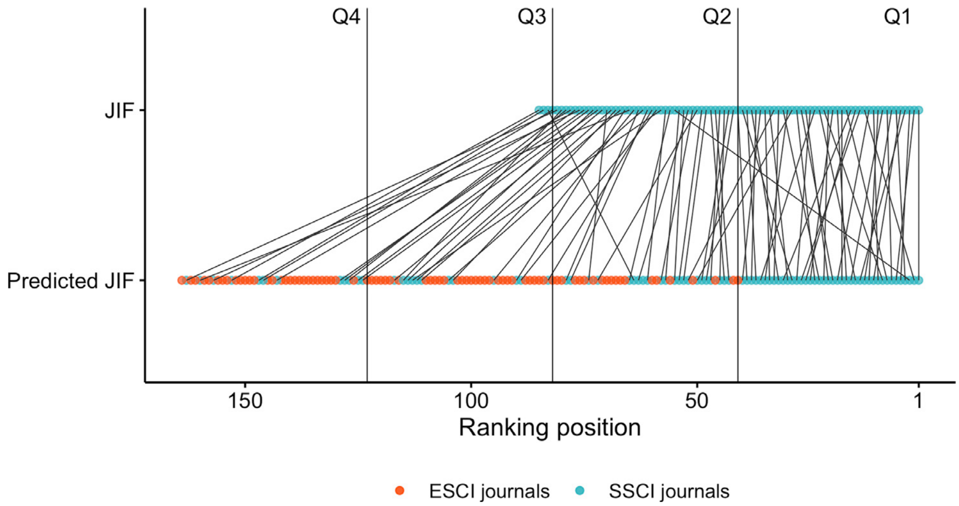

Fig. 7. Comparison of JIF ranking and predicted JIF ranking in Information Science and Library Science. The prediction has been done through a linear regression model using the JCI ranking (R^2=0.871) for both SSCI and ESCI journals.

4. Conclusions

This paper offers a first analysis of the statistical characteristics of the Journal Citation Indicator (JCI), an indicator recently introduced in the Journal Citation Reports (JCR) from Clarivate Analytics. The JCI has similar properties to the JIF and the 5-Year JIF. This similarity was confirmed by the Lorenz curve and the Gini index, which have similar distributions for the three indicators—the Gini values of the JCI and the JIF are 0.4365 and 0.444 respectively. As a non-size dependent indicator, it is not as asymmetrically distributed as the AIS or the Total Citations, which are highly influenced by the total number of papers published by the journal.

The JCI indicator shows a strong and positive correlation with the JIF (0.865) and the 5-Year JIF (0.850). But it does not correlate with any of the other indicators included in the JCR. If we observe the correlation between the JCI and the JIF across categories we find very high correlation values in most of the categories, both in the Science and Social Sciences areas. In total, between the JCI and JIF there were 60 categories with correlation values between 1 and 0.95 and only 24 had values below 0.799. Therefore, the correlations are homogeneous and similar in the different categories.

In this context many indicators have been proposed for journal evaluation, studying their correlations with the JIF. These indicators tend to show similar results to the ones found here: new indicators have a very significant correlation with the Journal Impact Factor. For instance, the Eigenfactor and Article Influence Score have a strong correlation with the JIF (Elkins et al., 2010; Rousseau & STIMULATE8 Group, 2009). This correlation is also observed in most scientific areas (Torres-Salinas & Jiménez-Contreras, 2010).

Similarly to what Elkins et al. (2010) indicated in a related study, we can state that the JCI reflects the same underlying construct of average citability per article in a journal as the JIF. It may therefore be concluded that the JCI and the JIF are very similar indicators.

The JCI is an indicator that is better adapted to the new characteristics of the JCR. It attempts to address the traditional problems of the JIF by improving the citation window, it allows comparison of related areas and it is calculated for the entire range of the Web of Science Core Collection. Therefore, it is a perfect complement to the JIF with similar results which can be very useful for the large set of journals included in the ESCI and the Arts and Humanities areas which are not included in the traditional JCR. As regards to our initial question in the title, we do observe a need for a new indicator for Clarivate Analytics and for journal publishers included in ESCI and A&HCI. The new JCR and its new JCI indicator represent a viable alternative to resolve some of the issues that have dogged the JCR since its or its origins. Clarivate Analytics has identified the need to offer indicators for all its journals and the JCI solution is statistically acceptable and a well-focused business strategy: JCR now integrates all its journals and all have impact indicators.

Finally, JCI serves as a possible proxy for the JIF, being of use to scientific publishers and researchers who use the JCR as a tool for selecting journals for publication. From a journal management point of view, the JCI has a practical implication for journal monitoring, knowing the value of JCI and using regression analysis, it is possible to know precisely how it would be positioned if it had a JIF calculated. However, according to the results of the regression analysis, there are categories where it cannot be applied. In this article we have shown how in categories where the R^2 value is high, as in the case of "Information Science & Library Science", it is possible to generate rankings that integrate all the journals. Regression analysis for predicting the JIF based in the JCI becomes useful for monitoring the evolution and future of a journal.

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Declarations of Competing Interest

None.

CRediT authorship contribution statement

Daniel Torres-Salinas: Conceptualization, Methodology, Supervision, Writing – review & editing. **Pilar Valderrama-Baca:** Validation, Writing – original draft. **Wenceslao Arroyo-Machado:** Data curation, Visualization, Software, Writing – review & editing.

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