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An Empirical Study on the Asymmetric Behavior of Scientometric Indicator for Journal: A Comparative Evaluation of SJR and H-Index

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Abstract

Scimago Journal Rank (SJR) is a size independent measure of journal evaluation where citation coming from quality journals carries more value than citations from ordinary journals and h-index, used as a metrics for author impact when initially introduced, is now a day's used for journal evaluation in major citation databases like Scopus, Google scholar etc. Both the indicators follow different methods of calculation. SJR is a prestige based measure where the scholarly value of incoming citations matters most than its quantity, while h-index is a quantity based measure where the amount of incoming citations plus the number of published paper both matters. The current study tries to identify how the ranking value of journals changes when compared with the two indicators. The issue was addressed by taking the context of Indian journals indexed in Scopus. Even though the process of calculation for both the indicators is different, it is expected that their ultimate result is same i.e. ranking quality journals at top. The findings of ranking of quality journals represent strikingly different result given by both the indices. The dissimilarity in measure is tested using z-test for two sample means for median difference. Also the biasness of the indicators towards time and subject domains is tested on a raw count.

Keywords: H-index, Impact Metrics, Journal Evaluation, Scientometrics, SJR Indicator

1. Introduction

Journals are the major vehicle in science communication and evaluation of journals by single indicator metric is a major domain of research in scientometrics studies. Study of scientific communication is an age old practice (Garfield, 1995), and quantification of this process of scientific communication got major shift with the launch of Science Citation Index by Garfield (2007) in the 1960s. Later two other products came up, viz., the Social Science Citation index (Klein & Chiang, 2004) (in the year 1973) and Arts and Humanities citation index (Garfield, 1979), currently all these are part of the Web of knowledge (www.webofknowledge.com) product of Claritive Analytics. Basically these citation indexes have formed the very basis of bibliometrics and later given birth to two of its forms (Borgman, & Furner, 2002) i.e. evaluative bibliometrics and relational bibliometrics. While the theories of evaluative bibliometrics is mostly based on the use of citations as a raw count and mostly influenced by the Robert Morton's Sociology of science (Merton, 1973), relational bibliometrics dealt with understanding the structure of science like subject relations, collaborations, network visualizations etc.

Garfield's introduced Journal Impact Factor (JIF) (Garfield, & Sher, 1963) in evaluative bibliometrics as a measure of journal quality. JIF had certain limitations due to being entirely dependent on raw count of citations. Garfield

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(1979) has discussed the associated drawbacks of citation analysis for "larger and complex scientific enterprise" and argued that with proper use, it can be a cost-effective measure for science evaluation. Garfield (1979) indicated about the issue of negative citation, author homographs and value of citation for multi authorship in a discussion paper. With complex subject relationships, limitations arose for use of JIF as a single measure for journal evaluation. One such issue was giving weight-age to incoming citations to a journal, depending on the quality of journal in which the paper is being cited. To overcome this limitation, the first modification for JIF was introduced by Pinski and Narin (1976) by introducing the "Journal influence" measure which was based on complicated citation networks giving value to important nodes i.e. citations coming from high impact journals carrying value in the journal metrics. This leads to the development of Eigen factor metric (Bergstrom, 2007) (used in Journal Citation Reports) and SJR (González-Pereira, Guerrero-Bote, & Moya-Anegón, 2010) (used in Scopus). Further details on such network based ranking methods can be found in the excellent review of Franceschet (2011). The JIF also didn't consider the issue of subject disparity in citations (Postma, 2007; Moed, 2005) i.e. if the number of journals published in a discipline is high, leading to the probability of citations in that discipline being high and thereby resulting in very high impact factor journals for those disciplines. This drawback of impact factor was addressed with the introduction of the indicator: 1. Source Normalized Impact per Paper (SNIP) by Moed (2011) in 2010, and 2. modified version of SNIP introduced by Waltman, *et al.* (2013), for normalizing the subject discipline variance while comparing various journals across disciplines. While these size independent measures (Pinski & Narin, 1976; Bergstrom, 2007; González-Pereira, Guerrero-Bote, & Moya-Anegón, 2010; Moed, 2011; Waltman, Van Eck, Leeuwen van, & Visser, 2013) have come as alternatives to dependency of JIF on citations count, Prathap, Nishy and Savithri (2016) recently have given an interesting power-weakness ratio approach for measuring journal quality where the value of incoming citations as well as the outgoing references were also given weight-age claiming (Prathap, & Nishy, 2016) its usefulness for "localized eco system" of journals cut out from "global journal eco-system". It can be seen from the above discussion that different citation databases are using indicators having different properties, resulting in citation impact at different levels. H-index (Hirsch, 2005) even though introduced as a metrics to represent authors impact, is being used as a measure of journal impact in databases like Scopus, Google scholar etc.

In the long history of evaluative bibliometrics (Thelwell, 2008; Mingers, & Leydesdorff, 2015; Leydesdorff, 2009) the whole process of indicator development has followed a chain where the aim was to develop an indicator which is free from the drawback of the earlier ones. By the words of Waltman and Van Eck (2012) this whole process has led to the development of some rather asymmetric matrices which aims at only lowering weakness of the older ones and thus making the scientometric process more diverting. The current study was undertaken to study the diverting results given by two widely used scientometric indicators, SJR index and h-index, for evaluating a given journal. SJR and h-index is briefly described below.

SJR Indicator: SJR (González-Pereira, Guerrero-Bote, & Moya-Anegón, 2010) indicator introduced in Scopus database, is a type of size independent indicator that uses the journal influence measure along with the field normalization factor. Rather it will be appropriate to say it is more complicated and modified measure of the Eigen factor centrality measure. The algorithm of the SJR indicator and about the complicated quantification of the field normalization and prestige measure are described in Golzalez-Pereira, *et al.* (2011). SJR uses a 3-year citation window. In SJR calculation, the citation network of a journal is first established where nodes are the journals and citations are edges, the more incoming edges to a node, more is the importance of the node. But the calculation of prestige follows an iterative process, where each node is first assigned an equal value and the iteration process is started until differences between journal prestige values in consecutive iterations do not surpass a pre-established threshold. Also, in SJR calculation the self-citation value of a journal is limited to 33%. Studies (Falagas, Kouranos, Arencibia-Jorge, & Karageorgopoulos, 2008) found many correlative behaviors of SJR algorithm with the ISI JIF.

H-index for Journals: h-index (Hirsch, 2005) is an author level indicator that tries to represent quantity and quality at the same time, with a literal representation as a scientist would have h-index if h of his total publication has minimum h number of citations each. In a more simplistic way if we represent a scientist's total citations in Y axis and total publications in X axis in a 2D plane, then h-index is that point in that graph, where X=Y. Since its introduction it has been a controversial indicator, but still it is used in all prominent bibliographic citation databases like Web of Science, Scopus and Google Scholar. The idea of using the h-index for journal evaluation along with JIF was proposed by Braun, Glänzel and Schubert (2006) for more meaningful use of the Impact Factor.

2. Objectives of the Study

The objective of the current study is to evaluate the disparity shown by two different journal indicators h-index and SJR index, when they are used for journal evaluation from the same source of citation network. Also, the bias of the two indicators towards journal age and their subject discipline is assessed in the study. All these were tested taking the example of Indian journals indexed in Scopus.

The following hypothesis was formulated for the study:

H_0: SJR and h-index treat same journals equally and the ranking of a journal does not differ when it is ranked based on SJR and h-index values.

H_A: There is a no correlation among the ranking of journals when the same journal is ranked based on SJR and h-index i.e. SJR and h-index are two asymmetric indices for journal evaluation.

3. Materials and Method Used for the Study

Any kind of indicator whether it is an author, journal or institute is very sensitive to the database where it is applied. Scientific databases like Web of Science, Scopus or Google Scholar generally calculate these matrices based on the network established between the sources of publications that it indexes. Because of the database driven sensitivity of scientometric indicators, it is not possible to compare similar indicator from two different sources. So, to have a level playing field among the matrices to be compared in the study, the portal Scimago Journal and Country Rank (http://www.scimagojr.com/aboutus.php) was used. The portal supplies both h-index and SJR value of journals from the citation data available in Scopus database. A simple search was made in Scimago website with three controlled parameters i.e. geographical location ("India"), item type ("Journals") and Year ("2016"), that retrieved 455 journals. 2016 was chosen as a base year for data collection to have more completion in the citation data. From this master list of 455 journals, o list of top 50 journals based on SJR value was prepared and the relative ranking of those journals based on h-index value from the master list was retrieved (we shall refer to this list as SJR-h index comparative list). Another list was made for top 50 journals based on h-index value and their relative ranking based on SJR value from the master list was retrieved (we shall refer this list as h index-SJR comparative list). Then the median absolute change in ranks of journals in both the list was compared (The prepared comparative rank lists are presented in Appendix 1).

Scimago also groups journals in 27 major thematic areas (macro level subjects) which are further divided into 313 specific subject categories (micro level subjects). Only the micro level subject areas of the journals were considered in the study. For determining the journal age, crucial factor was to determine the origin year. For each journal, the portal maintains a specific page called the journal metrics page which contains basic info of the journal with its performance in the last three years. For determining the origin year, the "coverage year" mentioned in the journal metrics page of Scimago portal was used. But wherever multiple coverage year information (e.g. "Indian Journal of Dermatology, Venereology and Leprology" have coverage year detail spanning three periods 1976-1982, 1985-1995, 2002-ongoing) was available, the most recent one was selected (i.e. for the current example 2002 was chosen).

4. Results and Discussion

4.1 Disparity in the Journal Rank on the Basis of Selected Indexes

As described above two comparative ranking lists of journals were prepared, in one list, the ranks of the top 50 SJR value journals were compared with their respective h index based ranks in the master list of journals; and in another list, the ranks of the top 50 h index value journals were compared with their respective SJR index based ranks in the master list of journals. Then change in ranks of journals in both the list was compared and it was seen that both the lists have resulted in change of rankings for the top 50 journals selected in the study. In the SJR-h index comparative list, there were 7 journals in the top 50 SJR list, that suffered positive change in their ranks when they were compared with their respective h index ranks, while other 43 journals ranks were downgraded in h-index based ranking list. The top ranked journal according to SJR value was *Bulletin of the Astronomical Society of India,* which rank became 144 in the h index based ranking list. *International Journal of Applied Pharmaceutics* suffered highest negative change of 278 rank values as it was ranked 22 according to SJR, but ranked 300 according to h-index. Highest positive change of 20 rank values was observed for the journal *Proceedings of the Indian Academy of Sciences, Earth and Planetary Sciences,* as it was ranked 41 according to SJR value, but was ranked at 21 according to h index value in the SJR-h index comparative list. The average negative change in ranks for the 43 journals whose ranks were downgraded when SJR ranks were compared with h index ranks was 93.95; and the average positive change in ranks for the 8 journals whose ranks were upgraded when SJR ranks were compared with h index was 6.71.

Again, in the h index-SJR comparative list, there were 5 journals in the top 50 h- index journal's list that suffered positive change in their ranks, while other 45 journals ranks were downgraded in SJR based ranking list. The top ranked journal based on h index was *Current Science,* whose rank became 131 in the SJR based ranked list. *Journal of the Indian Chemical Society* suffered highest negative change of 287 rank value, as it was ranked 41 based on h index but was ranked 328 based on SJR value. Highest positive change of 39 rank values was observed for *Journal of Carcinogenesis* as it was ranked 42 according to h index but was ranked 3 based on SJR value. The average negative change in ranks for the 45 journals whose ranks were downgraded when h index ranks were compared with SJR ranks was 99.26; and the average positive change in ranks for the 5 journals whose ranks were upgraded when h index ranks were compared with SJR was 19.6. There are only 8 journals which are common (Appendix 1) in both the top 50 list.

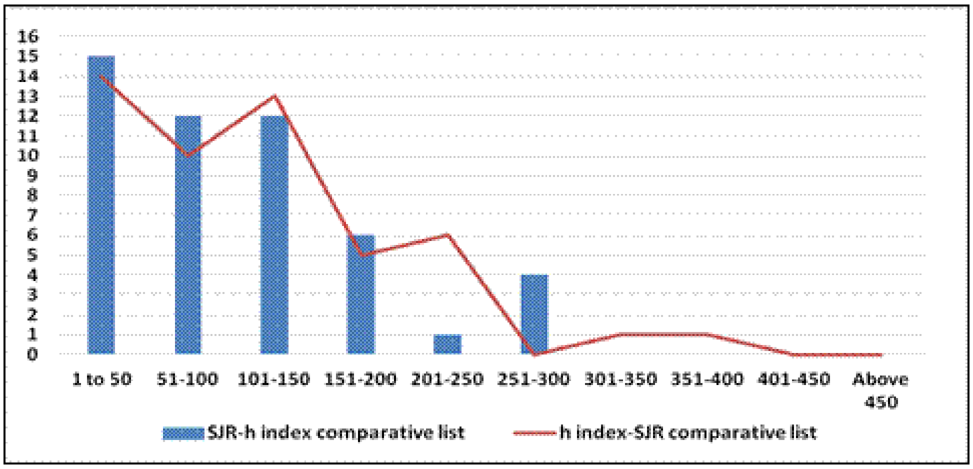

Figure 1. Frequency of journals in different range of ranks.

Because of the higher value of average negative change in rank value in both the comparative lists, further analysis of the top 50 journals from both the list was carried out, finding out the number of journals in specific range of ranks as shown in Figure 1. For the SJR-h index comparative list, the distribution of top 50 h-index based ranked journals in the SJR based master list of 455 journals was checked and similarly for the h index-SJR comparative list, the top 50 SJR based ranked journals distribution was checked in h index based the master list.

Figure 1, it can be observed that SJR based ranking was able to place a journal in top 50, which was placed in the range of 251 to 300 according to h-index based ranking in the master list. H-index based rank placed a journal in top 50, which was ranked in the range 351-400 in master list based on SJR value.

Both SJR and h-index attempt to reflect the quality of journals based on their value, greater the value, greater being the quality. But the higher value of average change in rankings in both the list and scatter of journals at all the different rank ranges (Figure 1), reflects the difference in the way journals were ranked by both the indicators. Further analysis is needed to understand the underlying association between the rankings produced by both the indicator. A monotonic relationship among the rankings of journals is expected no matter what scientometric indicator is used to rank them, as all journal evaluation measures only tries to rank the best journals on top. As the same group of 50 journals was evaluated by two different measures, i.e. the population is same but measures of data collection were different z-test for two samples mean was chosen suitable for evaluating the mean in differences produced in the two groups. More on the use of z-test can be found in Kothari (2004). The two tailed z-test results for both the SJR-h index comparative ranking list and h index-SJR comparative ranking list is presented in Table 1.

Table 1. z-Test: Two sample for means

SJR-h index comparative list			h index-SJR comparative list		
	Variable 1	**Variable 2**		**Variable 1**	**Variable 2**
Mean	25.5	104.22	Mean	25.5	112.5
Known Variance	212.5	6054.74	Known Variance	212.5	7205.071
Observations	50	50	Observations	50	50
Hypothesized Mean Difference	0		Hypothesized Mean Difference	0	
z	-7.03124		z	-7.14288	
P(Z<=z) one-tail	1.02351E-12		P(Z<=z) one-tail	4.57E-13	
z Critical one-tail	1.644853627		z Critical one-tail	1.644854	
P(Z<=z) two-tail	2.04703E-12		P(Z<=z) two-tail	9.14E-13	
z Critical two-tail	1.959963985		z Critical two-tail	1.959964	

The calculated z value for one tailed and two tailed distributions with a hypothesized mean difference of 0 at a 5% level of significance for both the SJR-h index comparative list and h index-SJR comparative list was found below than the critical value. Therefore, the null hypothesis (H_0) was rejected and the alternate hypothesis (H_A) was accepted. SJR and h-index don't treat same journals equally and the ranking of a journal differs when it is ranked based on SJR and h-index values, proving the asymmetric behavior of SJR and h-index for journals.

4.2 Analysis of Disparity in Treating Journals of Different Subjects by H-Index and SJR Indicator

Analysis of the subjects of the top journals from both the groups was carried out to check the presence of disparity in both the matrices in treating journals of different subjects. In this analysis subject domains associated with each journal were collected from the taxonomy of the subjects associated with each the journal, from the Scimago Journal rank website. In this process if a journal is found to be associated with multiple subject categories, then each subject category was given a count for the journal. In the top 50 journal based on h-index, journals from 59 subject categories featured, while same in the SJR rank list was 61 (Appendix 2). It is seen that in both the lists, journals from medicine, pharmacy and biological sciences featured most, reflecting the enhanced research in these domains. The micro level analysis of subjects on the collected top 50 list of journals, no conclusive disparity in treatment of journals from different subject disciplines was found.

4.3 Comparison in the Treatment of Journals of Different Age

A good scientometric indicator for journal should be able to treat journals based only on quality independent of their age. It is possible that a journal may be new, but it has published quality contents, for which the journal should get its due valuation.

During the age evaluation, 2016 was taken as current year as data was collected for the same in the study and the beginning year was chosen as the coverage year mentioned in the data source (Appendix 1 for more details). Findings showed that the average age of the journals which featured in h-index list was 29.32 years, while the same for the journals in SJR list was 13.66 year. This implies that SJR indicator was able to place young journals in the top 50 position as compared to h-index indicator and reflecting the biasness of h-index towards older journals.

5. Summary

SJR and h-index both follows two entirely different methods for ranking, while h-index is entirely dependent on citations; SJR employs a different method of giving weight-age to incoming citations. As both the indicators are used for the evaluation of journal, it is important to know how the evaluation differs between SJR and h-index.

Based on the current study conducted by taking 50 selected top Indian journals, variation in the assessment of journal by the selected two indicators could be seen. The relative average change in rankings was found quite high (93.95 ranking positions for SJR-h index comparative list and 99.26 for h index-SJR comparative list). The higher value of this average change in rankings has led to conduct a frequency count in selective range of ranking. The SJR based list featured journals in the top 50, which was ranked in the range of 251-300 according to h-index value in the master list and the h-index based top 50 list featured journals lying in the range of 351-400 in SJR ranking. From the findings of the z-test for two sample mean, the observed z value was found below the critical value that negates any kind of association in the compared ranking list. Micro level subject study didn't yield any conclusive evidence to reflect any kind of subject disparity by the two indicators in the top 50 list. The journal age study yields feature of young journals (average age of journal 13.66 years) in the top 50 list by SJR indicator, which was very high (average age 29.32 years) for top 50 h-index list. This proves the biasness of h-index towards old journals compared to young journals.

Journal evaluation and journal quality both are multifaceted notions (Roussea, 2002). The aim of the study is not to reflect on the quality of the journal but to analyze the differences that arise in measuring the quality due to use of any given indicator. It is hoped that better quality indicators for journal impact would emerge.

6. References

Borgman, C.L. & Furner, J. (2002). Scholarly communication and bibliometrics, Annual Review of Information Science and Technology. 36:3–72. https://doi.org/10.1002/aris.1440360102.

Bergstrom, M. (2007). Measuring the value and prestige of scholarly journals. College & Research Libraries News. 68:3146. https://doi.org/10.5860/crln.68.5.7804.

Braun T, Glänzel W & Schubert A. (2006). A Hirsch-type index for journals. Scientometrics. 69: 169–173. https://doi.org/10.1007/s11192-006-0147-4.

Falagas, M.E., Kouranos, V.D., Arencibia-Jorge, R. & Karageorgopoulos, Drosos E.(2008). Comparison of SCImago journal rank indicator with journal impact factor. The FASEB Journal. 22: 2623-2628. https://doi.org/10.1096/fj.08-107938. PMid: 18408168.

Franceschet, M. (2011). PageRank: standing on the shoulders of giants. ACM Communications. 54:92–101. https://doi.org/10.1145/1953122.1953146.

Garfield, E. (1955). Citation Indexes for Science: A new dimension in documentation through association of ideas. Science, 122:108-111. https://doi.org/10.1126/science.122.3159.108. PMid: 14385826.

Garfield, E. (2007). The evolution of the science citation index. International Microbiology. 10:65-69. PMid: 17407063.

Garfield, E. (1979). Will ISI's arts and humanities citation index revolutionize scholarship? Current Contents. 35:5-9.

Garfield, E & Sher, I.H. (1963). New factors in the evaluation of scientific literature through citation indexing. American Documentation. 14:195–201. https://doi.org/10.1002/asi.5090140304.

Garfield, E. (1979). Is citation analysis legitimate evaluation tool? Scientometric. 1: 359-375. https://doi.org/10.1007/BF02019306.

González-Pereira, B., Guerrero-Bote V.P. & Moya-Anegón F. (2010). A new approach to the metric of journals' scientific prestige: The SJR indicator. Journal of Informetrics. 4: 379-391. https://doi.org/10.1016/j.joi.2010.03.002.

Hirsch, J. (2005). An index to quantify an individual's scientific research output. Proceedings of the National Academy of Sciences of the United States of America. 102: 16569–16572. https://doi.org/10.1073/pnas.0507655102. PMid: 16275915, PMCid :PMC1283832.

Klein, Daniel B. & Chiang, Eric. (2004). The Social Science Citation Index: A Black Box with an Ideological Bias?. Econ Journal Watch. 1:134-165.

Kothari, C.R. (2004). Research methodology: methods and techniques. 2nd revised ed. New Delhi: New age international publishers.

Leydesdorff, L. (2009). How are new citation-based journal indicators adding to the bibliometric toolbox? Journal of American Society for Information Science & Technology. 60:1327–1336. https://doi.org/10.1002/asi.21024.

Merton, R.K. (1973). The Sociology of Science: Theoretical and Empirical Investigations. 1st ed. Chicago: University of Chicago Press.

Moed, H. F. (2005). Citation Analysis in Research Evaluation. 1st ed. Dordrecht: Kluwer Academic Publishers.

Moed, H. (2011). The Source-Normalized Impact per Paper (SNIP) is a valid and sophisticated indicator of journal citation impact. Journal of Association of Information Science and Technology. 62:211-213. https://doi.org/10.1002/asi.21424.

Mingers, John & Leydesdorff, L. (2015). A review of theory and practice in scientometrics. European Journal of Operational Research. 246:1-19. https://doi.org/10.1016/j.ejor.2015.04.002.

Pinski, G. & Narin, F.(1976). Citation influence for journal aggregates of scientific publcations: Theory with application to the literature of physics. Information Processing & Management. 12:297–312. https://doi.org/10.1016/0306-4573(76)90048-0.

Postma, E. (2007). Inflated impact factors? The true impact of evolutionary papers in non-evolutionary journals. PLoS One. 2: 999. https://doi.org/10.1371/journal.pone.0000999. PMid: 17912376, PMCid: PMC1994586.

Prathap G, Nishy P & Savithri, S. (2016). On the orthogonality of indicators of journal performance. Current Science. 111:876-881. https://doi.org/10.18520/cs/v111/i5/876-881.

Prathap, G. & Nishy, P. (2016). An alternative size-independent journal performance indicator for science on the periphery. Current Science. 111: 1802-1810. https://doi.org/10.18520/cs/v111/i11/1802-1810.

Roussea, Ronald. (2002). Journal Evaluation: Technical and practical issues. Library Trends. 50: 418-439.

Thelwell, Mike. (2008). Bibliometrics to webometrics. Journal of Information Science. 34: 605-621. https://doi.org/10.1177/0165551507087238.

Waltman L, Van Eck N.J., Leeuwen van T.M. & Visser, M.S. (2013). Some modifications to the SNIP journal impact indicator. Journal of Informatrics, 7: 272-285. https://doi.org/10.1016/j.joi.2012.11.011.

Waltman, L. & Van Eck, N.J. (2012). The inconsistency of the h-index. Journal of the American Society for Information Science and Technology. 63: 406-415. https://doi.org/10.1002/asi.21678.

Appendix 1

SJR-h index comparative list						h index-SJR comparative list					
Top SJR	**SJR Rank**	**H index ranks**	**Begin year**	**Cur-rent**	**Age**	**Top H Index**	**H index ranks**	**SJR ranks**	**Begin year**	**Cur-rent**	**Age**
Bulletin of the Astronomical Society of India	1	144	2008	2016	8	Cur-rent Scn.	1	131	1993	2016	23
Pharma-cognosy Reviews	2	58	2009	2016	7	Indian Jl. of Medi-cal Re-search	2	4	1950	2016	66
Jl. of Carcino-genesis	3	42	2002	2016	14	Indian Jl. of Experi-mental Bio-logy	3	8	1965	2016	51
Indian Jl. of Medi-cal Re-search	4	2	1950	2016	66	Jl. of Bio-scns.	4	11	1979	2016	37
Noise and Health	5	22	2002	2016	14	Bulle-tin of Mate-rials Scn.	5	119	1979	2016	37
Jl. of Pharma-cology and Pharma-cothera-peutics	6	125	2010	2016	6	The Jl. of the Asso-ciation of Phy-sicians of India	6	210	1961	2016	55

Inter-national Jl. of Artificial Intelli-gence	7	142	2009	2016	7	Indian Jl. of Pharma-cology	7	51	1994	2016	22
Indian Jl. of Experi-mental Biology	8	3	1965	2016	51	Jl. of Post-gradu-ate Medi-cine	8	68	1961	2016	55
Conser-vation and Society	9	124	2011	2016	5	Indian Jl. of Pharma-ceuti-cal Scns.	9	97	1978	2016	38
North American Jl. of Medical Sciences	10	103	2011	2016	5	Jl. of Chemi-cal Scns.	10	99	2002	2016	14
Jl. of Bio-sciences	11	4	1979	2016	37	Indian Pedi-atrics	11	76	1964	2016	52
Jl. of Conser-vative Dentistry	12	146	2011	2016	5	Indian Jl. of Phy-siology and Pharmacology	12	149	1959	2016	57
Tropical Ecology	13	70	1998	2016	18	Indian Jl. of Pedi-atrics	13	113	1950	2016	66
Annals of Thoracic Medicine	14	64	2006	2016	10	Jl. of Scienti-fic and Indus-trial Re-search	14	196	1994	2016	22
Indian Jl. of Medical Micro-biology	15	17	2003	2016	13	Indian Jl. of Oph-thal-mology	15	21	1971	2016	45
Indian Jl. of Derma-tology, Venereo-logy and Lepro-logy	16	30	2002	2016	14	Neuro-logy India	16	69	1994	2016	22
Jl. of Anaes-thesio-logy Clinical Pharma-cology	17	96	2002	2016	14	Indian Jl. of Medi-cal Micro-biology	17	15	2003	2016	13
Jl. of Global Infec-tious Diseases	18	133	2011	2016	5	Indian Jl. of Chemi-stry - Section B Orga-nic and Medi-cinal Chemi-stry	18	243	1996	2016	20
Physio-logy and Molecu-lar Bio-logy of Plants	19	75	2000	2016	16	Pra-mana – Jl. of Physics	19	157	1973	2016	43
Hepa-tology Inter-national	20	32	2008	2016	8	Jl. of Food Scen. and Tech-nology	20	24	1994	2016	22
Indian Jl. of Ophthal-mology	21	15	1971	2016	45	Procee-dings of the Indian Aca-demy of Scins., Earth and Plane-tary Scins.	21	41	1978	2016	38

Inter-national Jl. of Applied Pharma-ceutics	22	300	2011	2016	5	Noise and Health	22	5	2002	2016	14
Journal of Vector Borne Diseases	23	40	2003	2016	13	Sa-dhana – Aca-demy Procee-dings in Engi-neering Sciens.	23	204	1984	2016	32
Jl. of Food Science and Techno-logy	24	20	1994	2016	22	Natio-nal Medi-cal Jl. of India	24	233	1988	2016	28
Jl. of Human Repro-ductive Sciences	25	120	2009	2016	7	Jl. of Envi-ron-mental Bio-logy	25	75	1988	2016	28
Middle East African Jl. of Ophthal-mology	26	159	2011	2016	5	Jl of the Geo-logical Society of India	26	124	1979	2016	37
Indian Journal of Clinical Biochemistry	27	43	1986	2016	30	Intern-ational Jl. of Pharm-Tech Re-search	27	57	2009	2016	7
Surgical Neuro-logy Inter-national	28	112	2011	2016	5	Indian Jl. of Medi-cal Sciens.	28	156	2013	2016	3
Indian Jl. of Psy-chiatry	29	85	2009	2016	7	Indian Jl. of Che-mistry - Section A Inor-ganic, Phy-sical, Theore-tical and Analy-tical Che-mistry	29	215	1996	2016	20
Global Jl. of Flexi-ble Sys-tems Man-agement	30	170	2006	2016	10	Indian Jl. of Derma-tology, Vene-reology and Lepro-logy	30	16	2002	2016	14
Saudi Journal of Gas-tro-entero-logy	31	73	2006	2016	10	Indian Jl. of Gastro-entero-logy	31	96	1982	2016	34
JP Jl. of Heat and Mass Transfer	32	296	2010	2016	6	Hepato-logy Intern-ational	32	20	2008	2016	8
Jl. of Ad-vanced Pharma-ceutical Techno-logy and Research	33	104	2010	2016	6	Econo-mic & Politi-cal Week-ly	33	122	2007	2016	9
Interna-tional Jl. of Tricho-logy	34	193	2009	2016	7	Indian Jl. of Bioche-mistry and Biophy-sics	34	127	1972	2016	44
Jl. of Natural Science, Biology and Medicine	35	126	2010	2016	6	Indian Heart Journal	35	137	1964	2016	52
Endo-scopic Ultra-sound	36	195	2012	2016	4	Indian Jl. of Pure and App-lied Physics	36	141	1993	2016	23

Jl. of Indian Acade-my of Forensic Medicine	37	276	2011	2016	5	Indian Jl. of Pure and App-lied Mathematics	37	214	1996	2016	20
Indian Jl. of Derma-tology	38	87	2006	2016	10	Jl. of Gene-tics	38	93	1985	2016	31
Cyto-Jl.	39	82	2004	2016	12	Indian Drugs	39	382	1989	2016	27
Jl. of Minimal Access Surgery	40	99	2005	2016	11	Jl. of Vector Borne Disea-ses	40	23	2003	2016	13
Proceed-ings of the Indian Academy of Sciences, Earth and Planetary Sciences	41	21	1978	2016	38	Jl. of the Indian Che-mical Society	41	328	1996	2016	20
Jl. of Plant Bioche-mistry and Biotech-nology	42	69	1992	2016	24	Jl. of Carci-noge-nesis	42	3	2002	2016	14
Pharma-cognosy Magazine	43	68	2008	2016	8	Indian Jl. of Clini-cal Bioche-mistry	43	27	1986	2016	30
Jl. of Nanome-dicine and Nanotech-nology	44	179	2010	2016	6	Intern-ational Jl. of Phar-macy and Phar-maceu-tical Sciens.	44	142	2009	2016	7
Indian Jl. of Urology	45	81	2006	2016	10	Interna-tional Jl. of Chem.-Tech Re-search	45	145	2009	2016	7
Jl. of Stem Cells and Regene-rative Medicine	46	226	2010	2016	6	Indian Jl. of Fibre and Textile Re-search	46	139	1990	2016	26
Annals of Neuro-sciences	47	275	2011	2016	5	Indian Jl. of Micro-biology	47	50	1996	2016	20
Sankhya: The Indian Jl. of Statistics	48	153	2005	2016	11	Indian Jl. of Chemi-cal Techno-logy	48	182	1994	2016	22
Indian Jl. of Anaes-thesia	49	122	2010	2016	6	Indian Jl. of Dental Re-search	49	165	1989	2016	27
Indian Jl. of Micro-biology	50	47	1996	2016	20	Indian Jl. of Cancer	50	102	1965	2016	51
			Total age		**683**				**Total age**		**1466**
			Average age		**13.66**				**Average age**		**29.32**

Appendix 2

Micro level subject categories of top 50 h index journals						Micro level subject categories of top 50 SJR journals					
S.N.	**Subject category**	**Ns.**	**S.N.**	**Subject category**	**Ns.**	**S.N.**	**Subject category**	**Ns.**	**S.N.**	**Subject category**	**Ns.**
1	Medicine (miscellaneous)	5	31	Hepato-logy	1	1	Pharma-cology	5	31	Food Science	1
2	Pharma-cology	5	32	Econo-mics, Econo-metrics and Finance (miscel-laneous)	1	2	Medicine (miscel-laneous)	4	32	Repro-ductive Medicine	1
3	Pharmaceu-tical Science	4	33	Biophy-sics	1	3	Plant Science	4	33	Clinical Bioche-mistry	1
4	Multidisci-plinary	3	34	Cardio-logy and Cardio-vascular Medicine	1	4	Pharma-ceutical Science	4	34	Psychia-try and Mental Health	1
5	Chemistry (miscel-laneous)	3	35	Applied Mathe-matics	1	5	Surgery	4	35	Business and Inter-national Manage-ment	1
6	Chemical Engineering (miscel-laneous)	3	36	Genetics	1	6	Biotech-nology	3	36	Atomic and Molecular Physics, and Optics	1
7	Pharma-cology	3	37	Clinical Bioche-mistry	1	7	Dermato-logy	3	37	Earth and Planetary Sciences (miscel-laneous)	1
8	Materials Science (miscel-laneous)	2	38	Dentistry (miscel-laneous)	1	8	Infectious Diseases	3	38	Agro-nomy and Crop Science	1
9	Pediatrics, Perinato-logy and Child Health	2	39	Cell Biology	1	9	Surgery	3	39	Biome-dical Engineer-ing	1
10	Physics and Astronomy (miscel-laneous)	2	40	Mecha-nics of Materials	1	10	Bioche-mistry, Genetics and Molecular Biology (miscel-laneous)	3	40	Urology	1
11	Inorganic Chemistry	2	41	Pharma-cology (medical)	1	11	Plant Science	3	41	Bioche-mistry	1
12	Drug Discovery	2	42	Physio-logy	1	12	Molecular Biology	3	42	Neuro-science (miscel-laneous)	1

13	Health, Toxicology and Mutagenesis	2	43	Infectious Diseases	1	13	Ecology	2	43	Statistics and Pro-bability	1
14	Oncology	2	44	Political Science and Inter-national Relations	1	14	Hepato-logy	2	44	Micro-biology	1
15	Bioche-mistry, Genetics and Molecular Biology (miscel-laneous)	2	45	Bio-chemistry	1	15	Ophthal-mology	2	45	Cancer Research	1
16	Physical and Theoretical Chemistry	2	46	Mathe-matics (miscel-laneous)	1	16	Gastroen-terology	2	46	Public Health, Environ-mental and Occu-pational Health	1
17	Organic Chemistry	2	47	Pharma-ceutical Science	1	17	Pathology and Forensic Medicine	2	47	Pulmo-nary and Res-piratory Medicine	1
18	Bio-technology	1	48	Para-sitology	1	18	Anesthe-siology and Pain Medicine	2	48	Infectious Diseases	1
19	Agricultura-l and Bio-logical Sciences (miscel-laneous)	1	49	Electro-chemistry	1	19	Drug Discovery	2	49	Anesthe-siology and Pain Medicine	1
20	Ophthalmo-logy	1	50	Cancer Research	1	20	Cell Biology	2	50	Physio-logy	1
21	Neurology	1	51	Polymers and Plastics	1	21	Ecology, Evolution, Behavior and Sys-tematics	2	51	Parasito-logy	1
22	Micro-biology (medical)	1	52	Molecular Biology	1	22	Astro-nomy and Astro-physics	1	52	Neurology (clinical)	1
23	Pharma-cology, Toxicology and Phar-maceutics (miscel-laneous)	1	53	Physio-logy (medical)	1	23	Health, Toxico-logy and Muta-genesis	1	53	Strategy and Manage-ment	1
24	Food Science	1	54	Speech and Hearing	1	24	Otorhino-laryngo-logy	1	54	Statistics, Probabi-lity and Uncer-tainty	1
25	Earth and Planetary Sciences (miscel-laneous)	1	55	Toxi-cology	1	25	Artificial Intelli-gence	1	55	Oncology	1

26	Otorhi-nolaryn-gology	1	56	Sociology and Political Science	1	26	Agricul-tural and Biological Sciences (miscel-laneous)	1	56	Speech and Hearing	1
27	Environ-mental Engineering	1	57	Pharma-cology (medical)	1	27	Dentistry (miscel-laneous)	1	57	Manage-ment, Monitor-ing, Policy and Law	1
28	Geology	1	58	Environ-mental Science (miscel-laneous)	1	28	Cardio-logy and Cardio-vascular Medicine	1	58	Radio-logy, Nuclear Medicine and Imaging	1
29	Dermato-logy	1	59	Materials Science (miscel-laneous)	1	29	Micro-biology (medical)	1	59	Pharma-ceutical Science	1
30	Gastro-enterology	1				30	Pharma-cology, Toxico-logy and Pharma-ceutics (miscel-laneous)	1	60	Nature and Landscape Conser-vation	1
									61	Bio-engineer-ing	1