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Diffusion of medical journals analysed through citations

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Impact Factor (IF) is a popular bibliometircs and scientometrics tool for assessing the performance of scholarly journals. But there are many national journals from developing and under developing countries which are not indexed by SCI and are without IF. National journals play a vital role for a country. It is suggested that the performance of a journal cannot be measured by a single indicator. Diffusion of information is a basic notion of publications and citations. So diffusion study has been used to measure the influence of a journal. In this study two Indian non-SCI medical journals, viz., *Indian Journal of Cancer* and *Journal of Communicable Diseases* were selected for diffusion measure. New JDF and equivalent IF is calculated using citations data. Data is collected from Elsevier's SCOPUS database for the period of 2001-2010. It is found that there is improvement in Diffusion factors for both journals, but there is significant rise for *Indian Journal of Cancer.* As *Journal of Communicable Disease* is cited by more number of countries than *Indian Journal of Cancer*, so the former is more international in nature. Generally they have published papers mostly from India, but number of foreign authored papers has been increased in IJC. Open access of IJC may be one of the factors for better performance.

Key words: Diffusion factors, New JDF, Impact Factor, Immediacy index (ID) internationalization, citing journals, citing countries

Introduction

Journals are the primary source of information for researchers. They play a vital role in information communication and dissemination. In 21st century the popularity and international visibility of journals are crucial for the researchers. Diffusion is one of the basic notions in publication and citation analysis and, as such, reviewed by Bar-Ilan[1] in a review of the field of informetrics.

Generally it is viewed that national journals of developing and under developed countries have less diffusion in comparison to developed world. Nobel laureate Raman[2] wrote "While the foundation of the scientific reputation of a country is established by the quality of work produced in its institutions, the superstructure is reared by the national journals which proclaim their best achievements to the rest of the world". So the internationalization of a journal is important to itself as well as for its users.

Institute of Scientific Information (ISI) journal Impact Factor (IF) is the most popular indicator for evaluating the performance of journals. However, a number of studies have discussed the limitations of IF as the sole indicator of a journal's influence because it failures to measure the breadth of influence across the literature of a particular journal title[3-4]. Rousseau (2002) stresses that journal quality is a multifaceted notion and points out that a whole battery of indicators seem preferable.[5]

Review of literature

Diffusion not only refers to a physical process whereby particles of liquids, gases, or solids intermingle as the result of their spontaneous movement caused by thermal agitation, but it also refers to the spread of cultural elements from one area or group of people to others. Essentially, diffusion means spread from something to other things in some medium. In the context of the information sciences, it can be described as a movement through cognitive space. Scientific results are diffused from one field to another or even many many others, from laboratory to article, from science to technology, and from technology to society. Citations of documents are usually considered to be an indicator of the diffusion of the ideas, or some of the ideas, put forward in the cited document[6-7]. Two forms of diffusion are studied: diffusion by publications, originating from the fact that a group publishes in different fields; and diffusion by citations. The studies have indicated that usage is at least a partial requirement for citation in a paper[8]. Citations constitute visible evidence of the diffusion of ideas and are therefore regarded as important in studying the influence or impact of

particular pieces of research. Then the cited documents are the source of diffusion, while the citing documents are the target of diffusion.

In this approach we assume that scientific ideas are diffused via articles. In reality ideas are also diffused through formal and informal talks, e-mails, blogs and other electronic media but we assume that, eventually they all end up in scientific articles[9]. If an article receives citations originating from multiple countries or journals then this article's content is diffused more than when the article has received the same total amount of citations, but originating from just one country or one journal[10].

Diffusion Factor

To explain the citation characteristics of journals Rowlands (2002)[11] presented the citations and ripple effect. The dynamics of how ideas are transferred from one author to another, and from one discipline to another is a central concern within scholarly communication and it is surely relevant to some conception of research quality or influence. If we regard new ideas as being like pebbles thrown into a pond (where the surface of the pond represents the general research literature) we can draw upon two potentially useful metaphors: the size of the splash as the pebble hits the surface of the water, and the characteristics of the resulting ripples. All the three factors devised by ISI (IF, Immediacy index and cited half-life) for journals do not tell about the subsequent ripples, the "breadth" of the reception in citation ripple effect of a particular journal in the marketplace. He introduced new indicator to establish the 'splash' effect of journals that journal diffusion factor, a new approach to measuring research influence: journal diffusion factor (JDF)

JDF in standardized form is the average number of citing journals per 100 source citations within a given time window. As the number of journals in database is specified so journals which receive large number of citations will have low JDF. That will be injustice to highly cited journals. So Frandsen (2004)[12] tried to rectify the diffusion factor for which he replaced the number of citations with the number of publication in the JIF fraction which can be verbally expressed as the average number of different journals an average article is cited by within the given time window. He replaced JDF with New JDF which can be presented as

$$\text{New JDF} = JDF(Np, Nc, Yp, Yc, j) = \frac{R(k,i,j)}{\sum_{i=yp}^{yp+Np-1} \text{Py(i,J)}}$$

Where : Np = the length of the publication period measured in years; Nc = the length of the citation window measured in years; Yp is the beginning year of the publication period; Yc is the beginning year of the citation window; i is the publication year(s); k is the citation year(s); j is the cited journal under investigation; Py(i,j) is the number of citable units published in year(s) k of the journal j; and R(k, i, j) is the number of different journals that cites the documents published in year(s) k of the journal j in the year(s) i

Objectives of the study

- To calculate the New Journal Diffusion Factors (NJDF), journal Impact Factors (IF) and Immediacy Index (ID) for two non-IF journals;
- To find the geographical distribution of citations;
- To assess the possible impact of open access in diffusion of journals.

Methodology

In this study we have selected two medical journals published from India, *Indian Journal of Cancer* (IJC)[13] and *Journal of Communicable Diseases* (JCD)[14]. Both the journals are not covered in Science Citation Index and are available in open access on the Web.

IJC is the official publication of the Indian Cancer Society and Indian Society of Oncology and online version is developed by an open access publisher Medknow, part of Wolters Kluwer Health. It is available freely in internet from 2003. JCD is published by the Indian Society for Malaria and Other Communicable Diseases. Free access started from 2012 with back issues from 2006. The study used publication-citation method for analyzing diffusion. Data was collected from SCOPUS database of Elsevier. Publications from 2001-2010 are selected for study. Also citations for the same period were taken for analysis. To study internationalization of journals all the affiliating countries of authors of citing papers are collected.

Analysis

Publication-Citation matrix

Tables 1 & 2 give the publication-citation matrix for the two journals IJC and JCD. In these tables number of unique new journals citing to the published items are also presented. The new journals were added from top to bottom in the column. Second row of both the tables contain the number of publishing

Table 1—Publication-Citation matrix for *Indian Journal of Cancer* (IJC)

PY→	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CY↓	25	26	25	36	38	29	29	54	87	144
2001	0	0	0	0	0	0	0	0	0	0
2002	1#1	0	0	0	0	0	0	0	0	0
2003	0	2#2	0	0	0	0	0	0	0	0
2004	4#4*	6#5	6#5	2#2	0	0	0	0	0	0
2005	12#12	10#10	17#14	18#17	1#1	0	0	0	0	0
2006	8#8	15#14	16#14	32#27	13#11	0	0	0	0	0
2007	7#5	10#8	15#14	37#35	28#25	9#9	2#2	0	0	0
2008	12#11	9#8	22#19	32#27	38#33	7#7	11#11	4#3	0	0
2009	6#5	10#9	24#21	64#49	41#31	9#9	17#16	23#16	10#7	0
2010	10#7	13#12	14#11	45#31	44#27	7#7	25#22	40#35	63#54	20#15

Note-PY-Publishing year, CY-Citing year, Second row contains number of publications in the respective year

Table 2—Publication-Citation matrix for *Journal of Communicable Diseases* (JCD)

PY→	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CY↓	48	55	52	53	59	55	52	51	48	47
2001	0	0	0	0	0	0	0	0	0	0
2002	4#2	0	0	0	0	0	0	0	0	0
2003	15#12	1#1	0	0	0	0	0	0	0	0
2004	16#14	12#11	2#1	0	0	0	0	0	0	0
2005	27#17	32#20	8#5	1#1	0	0	0	0	0	0
2006	24#14	32#22	18#17	11#9	2#2	1#1	0	0	0	0
2007	18#11	28#18	17#14	25#18	17#14	8#7	0	0	0	0
2008	21#14	35#19	29#20	30#24	33#29	42#34	1#1	0	0	0
2009	16#11	34#21	20#19	31#23	34#20	31#26	10#8	12#12	0	0
2010	20#14	26#14	14#8	21#13	21#16	24#18	12#10	22#19	3#3	1#1

Note-PY-Publishing year, CY-Citing year, *-Published items of 2001 are cited by 4 times in 2004 and cited by 4 new (unique) journals, Second row contains number of publications in the respective year

items in respective years. Cells carries (X#Y) – Number of Citations#Number of journals. For example, IJC received 12 citations in 2005 to articles that it published in 2001. These 12 citations occurred in 12 different journals, and all these citations are published in the journals which are not involved in citing previous years i.e. 2001-2004. The number of items published in JCD is almost constant in the period of observation but in IJC the rate of increase is more from 2008. For IJC, published items in 2001, 2002 & 2003 are cited in the next year of their publications but after that citations are received in the same year of publications. It shows the time gap between publication and literature assimilation is reduced. In case of JCD except for two years all other years published items are cited in the next year.

New Journal Diffusion Factor (NJDF)

Diffusion factor introduced by Frandsen (2004) is regarded as improved one than the Rowlands (2002), so in this study we have taken Frandsen's indicator "New Journal Diffusion Factor" NJDF to study diffusion of both journals. NJDF is calculated as follows

Two year NJDF ($NJDF_2$) for IJC in 2004 is calculated as:

$$NJDF_2(2004) = \frac{5+5}{25+26} = 0.196$$

Three year NJDF ($NJDF_3$) for IJC in 2004 is calculated as:

$$NJDF_3(2004) = \frac{4+5+5}{25+26+25} = 0.184$$

In the above calculation, number of items published in 2001 i.e. 25 is cited by 4 unique journals in 2004, published items in the year 2002 i.e., 26 cited by the 5 unique journals in 2004 and published items in the year 2003 i.e. 25 cited by 5 unique journals in 2004.

Table 3—NJDF, IF & ID of Indian Journal of Cancer (IJC) & Journal of Communicable Diseases (JCD)

	IJC					JCD				
Year	$NJDF_2$	$NJDF_3$	IF_2	IF_3	ID	$NJDF_2$	$NJDF_3$	IF_2	IF_3	ID
2003	0.0392	NA	0.0392	NA	NA	0.126	NA	0.155	NA	NA
2004	0.196	0.184	0.235	0.21	0.055	0.112	0.167	0.13	0.193	NA
2005	0.508	0.471	0.573	0.535	0.026	0.057	0.162	0.085	0.256	NA
2006	0.513	0.525	0.608	0.616	NA	0.098	0.17	0.116	0.189	0.018
2007	0.507	0.669	0.552	0.718	0.068	0.184	0.234	0.219	0.299	NA
2008	0.31	0.531	0.31	0.406	0.074	0.327	0.385	0.401	0.457	NA
2009	0.385	0.366	0.481	0.449	0.114	0.194	0.293	0.213	0.335	NA
2010	0.631	0.652	0.73	0.752	0.138	0.222	0.212	0.252	0.245	0.021

NJDF-New Journal Diffusion Factor, IF-Impact Factor, ID-Immediacy Index

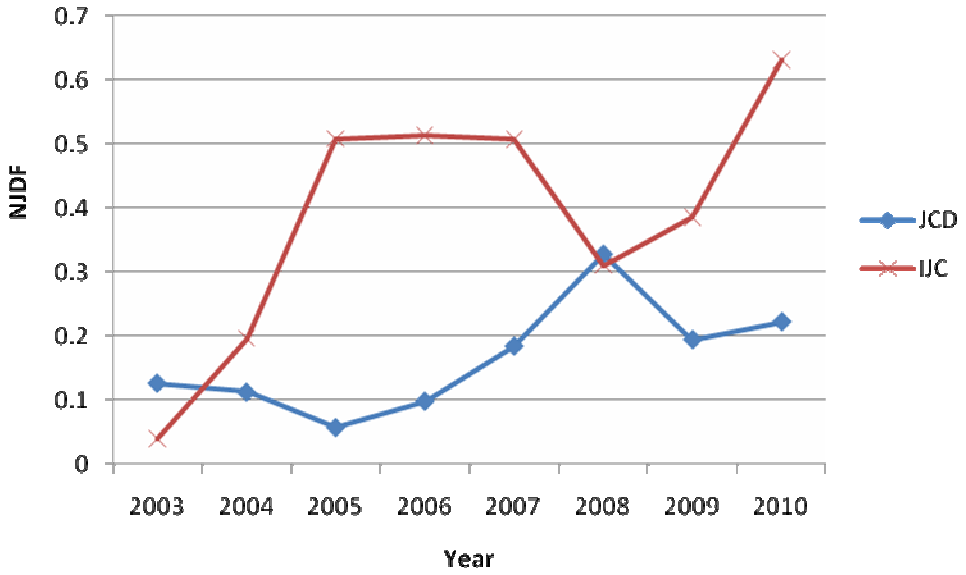

Fig. 1—$NJDF_2$ of JCD & IJC from 2003-2013

Impact factor (IF) is a popular indicator for measuring the performance of journal. IF of a journal is calculated by dividing the number of current year citations to the source items published in that journal during the previous two years.

Two year IF for IJC in 2004 is calculated as:

$$IF_2(2004) = \frac{6+6}{25+26}0.235$$

In the above calculations published items of the year 2002 i.e. 25 cited by the number of times in 2004 is 6 and published items of the year 2003 i.e. 26 cited by the number of times in 2004 is 6.

Using publication-citation matrix of Tables 1 & 2 NJDF and IF are calculated. So for two year study the indicators were calculated from 2003 and for three year study indicators from 2004 are calculated. The subscript number in the indicators shows the number of years of study for that indicator. Overall it is found that both indicators have increased in this period of study. But the rate of increase for IJC is more than the JCD. Except in 2003 and 2008 $NJDF_2$ of IJC is more than the JCD.

Immediacy index (ID) is the ratio between numbers of citations received to the current year of publications divided by the number of items published in the journals.

ID shows how quickly the content of a journal is utilized by the users. As the rate of obsolescence is increasing so ID is an important indicator in performance study. Here ID of IJC was not available for 2003 and 2006, but it is increasing in the period 2007-2010. Where as in JCD the indicator is available only for two years i.e., 2006 & 2010. This indicates that there is a gap in publication and its use for JCD comparative to IJC.

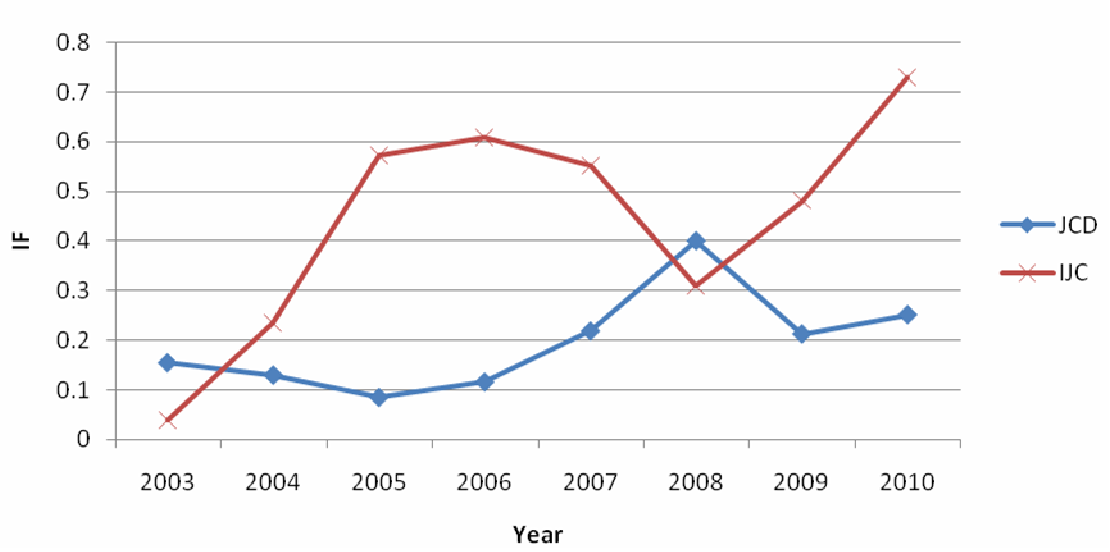

Fig. 2—Impact Factor (IF) of IJC & JCD

Table 4—IF Range of Citing Journals of IJC & JCD

Sl. no.	IF Range	IJC		JCD	
		No. unique sources	No. of times cited	No. unique sources	No. of times cited
1	1>IF≥0	89	149	62	99
2	5>IF≥1	247	378	67	390
3	10>IF≥5	34	46	21	28
4	IF≥10	11	16	9	14
5	Non-SCI sources	187	297	139	310
	Total	568	886	298	841

Table 5—Geographical distribution of Citers in different Continents

	Africa		Asia		Europe		N. America		S. America		Oceania	
Journal	NT	NC	NT	NC	NT	NC	NT	NC	NT	NC	NT	NC
IJC	29	8	535	26	239	25	254	5	39	7	28	2
JCD	59	22	542	26	228	23	136	5	52	6	16	2

Citing Journals

IJC and JCD have published total 464 and 520 items respectively in 2001-10. Total number of times cited in this period is 886 and 841 respectively. The Impact Factors of citing journals are collected from JCR 2011. The number of journals with different IF range is presented in the Table-4. IJC is cited by more number of journals having IF more than one in comparison to JCD. It is due to availability of more high impact journals in new biology area than communicable diseases[15]. Number of unique titles citing IJC is approximately double than the JCD. As more number of unique titles are involved in citing of IJC so diffusion factors are more than that of JCD.

Citing countries

The affiliating country of citing authors was collected to study the geographical distribution of citations. The number of countries from different continents with the number of times citing are arranged in the Table 5. It is found that authors from 84 countries have participated in citing process of JCD whereas 73 for IJC. The difference is due to the fact that more number of countries from Africa have cited to JCD. Communicable disease problem is rampant in two continents i.e. Africa and Asia. In Asia both are cited by equal number of countries but in Africa JCD is cited by more number of countries. More number of citations from European and North American countries for IJC indicates that

Table 6—Maximum Citing countries for IJC and JCD

Sl.no.	IJC	JCD
1	India (279)	India (367)
2	USA (213)	USA (103)
3	China (56)	UK(60)
4	UK (49)	Brazil (28)
5	Turkey (40)	Canada (27)
6	Germany (37)	Belgium (24)
7	France (31)	Iran (23)
8	Brazil (28)	Switzerland (23)
9	Japan (28)	China (20)
10	Rest 66 countries (363)	Rest 76 countries (358)

Table 7—Publishing countries in IJC and JCD

	IJC			JCD		
Sl. no.	Country	No. of papers	% of Total	Country	No. of papers	% of Total
1	India	398	85.77	India	480	92.3
2	USA	26	5.6	Nigeria	5	0.96
3	Iran	18	3.87	Nepal	3	0.57
4	UK	12	2.58	USA	2	0.38
5	Turkey	9	1.93	Germany	2	0.38
6	Egypt	5	1.07	Bahrain	2	0.38
7	Rest 26 countries	47	10.12	Rest 6 countries	6	1.15

the research activity in cancer is more in these countries. In Table 6, maximum citing first nine countries are presented with number of times cited. For both journals India has the maximum contributors followed by USA. The number of citations for IJC by USA is more than twice that of JCD.

NT-No. of times cited by the authors of that continents, NC-No. of citing countries of that continent

Number of times cited is given in parenthesis

Publishing countries

Publications by foreign authors show the diffusion of international literature in journal content. The affiliating countries of authors of published papers for the period 2001-2010 were collected. Number of papers from different countries is presented in the Tables 7. It is observed that authors from more number of countries have participated in IJC than JCD. In both cases maximum number of publications is from India. It is found that number of foreign authored papers has increased in IJC after 2006.

Conclusion

In the observed period the values of $NJDF_2$ of IJC are from 0.0392-0.631 where as for JCD it is 0.057-0.327. Diffusion factors for both the journals have improved in the period of study, but there is remarkable increase for IJC. The content of IJC is available freely in internet from 2003; it may be one of the factors for improving the diffusion. Similarly also the popular citation indicator IF for both journals are improved. Journals having IF less than that of IJC and JCD are listed in ISI JCR 2011. So these titles should be listed in the JCR.

Previous study has reported that most of the medical journals of India are irregularly published[16]. So ID is rarely derived. But the ID of IJC is increasing trend so it can be assumed that it is serious in publication work.

Geographical distribution of citers shows that the journals are cited by various countries of different continents as per their subject of publications. As the number of countries doing research in communicable diseases is more so the number of citing countries for JCD is more. So in terms of internationalisation of literature JCD is more international than IJC.

Number of foreign or multinational collaborated papers in a journal shows its international visibility. It directly increases the potential user base for a publication. So papers from abroad should be encouraged.

We find both the journals have been used and assimilated by the scholars of the world in their fields and the trend is increasing. They have attained some characteristics of international periodicals. The content of both the titles are available freely which is a positive step to increase the use of their content. The output of this study will be helpful for users, authors and editorial committee of journal to understand the influence of journals.

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