

A 2D Evaluation of Altmetrics Influence in Citation Growth: Case Study of Indian Research Articles in PLoS Journals

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ABSTRACT

The general approach of research impact evaluation is entirely based upon citations. But in the current Web2.0 era, this citation based evaluation process often do not include the generic discussions people make in social media, blogs, online scholarly discussion forums or even the online readership of the article. Altmetrics, often referred as the article level metrics is a tool that have emerged, which crowd source all the non-citation based discussions from various web2.0 platforms and tries to reflect the overhaul attention that an article gets. Since its introduction, altmetrics have been able to gather a good attention from the scientific community, and researchers are trying to evaluate if it does have scholarly value to complement the citation based impact measure process. The current study tries to evaluate altmetrics penetration in Indian research articles and the influence of altmetrics in the citation growth process. The problem was addressed taking the example of Indian research articles published in PLoS journals. Two hypothesis were set for the study and PLoS altmetrics data were taken to run the *t*-test for paired sample mean to test the hypothesis. Findings from the *t*-test estimated a low significant p value, hence rejecting the null hypothesis and accepting the alternate hypothesis proving the positive influence of altmetrics in the citation growth process for the Indian research articles in PLoS journals. Also the presence of altmetrics data in the Indian research articles of PLoS journals is evaluated in the study.

Keywords: Altmetrics, Scientometrics, *t*-Test, Indian research.

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INTRODUCTION

Altmetrics- article level metrics or sometimes also called as alternative metrics are tools to measure scholarship impact from across different web2.0 platforms other than the traditional process of citation.^[1] In true sense, altmetrics crowd source an article's uses and mentions in different media platforms like social networking sites (Facebook, Twitter), news articles, scientific blogs, social bookmarking sites including the article's total downloads, total views etc. and gives a consolidated view of overall attention that the article is getting over the web. Altmetrics can be termed as a subfield of webometrics.^[1]

The traditional method of measuring scientific impact is based on citations received in scholarly publications. Various methods under it is covered under the broader domain of evaluative

bibliometrics^[2] and works^[3-5] under it uses different citation based scientometrics indicators as a sign of scientific impact. These type of scientometrics indicators can be categorized as author level, journal level or institutional level based on their uses of evaluation. Citations are also used as a parameter to rank individual articles in search results of major citation and bibliographic databases like Web of science, Scopus, Google Scholar etc. However, these types of scientometrics indicators are limited to measure the impact up to citation level only. But with the emergence of Web2.0, it has given the scientists a platform to collaborate for research and share their findings using services like social media, online bookmarking, blogging etc. Studies^[6,7] from Springer Nature conducted amongst researcher's all over the world finds that 95% of the researchers uses some sort of social media for their professional research related activity. The studies^[6,7] enunciated that discovering research related content, support for research content, sharing of content, self-promotion of research and scientific collaboration building are the top five reasons that compels researchers to use the web2.0 platforms. Moreover, with the growing attention to plagiarism issues in scientific publications, researchers are now a days uses Reference Management (RM) tools

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to generate citations to their articles. These RM tools acts as online bookmarking tool for the researchers where they can directly save their interest articles to their respective RM profiles. Studies^[8,9] finds 76% to 79% uses of reference management tool by the research community and there fore the RM bookmarking or saves by the research community can be another parameter to measure the attention that specific scieitific articles get. This higher use of social media, blogging platforms, RM tools for research related activities by the research community have actually created a series of events in the science communication process that actually can be clubbed as “Scientometrics 2.0”^[10] which further can be used as a complementary to citations for filtering of quality research. More over the interest of general public in science related news and activities over social media have tremendously increased.^[11] The study^[11] from Pew Research Centre also finds the significant higher growth rate of science related news and activities over Facebook and Twitter and reflected the tremendous increase in user interaction to such posts for the period from 2014 to 2017. Thus, with the higher increased interest of general public in science related activities, discoveries and news, the social media attention that scientific articles get can be a useful parameter to evaluate societal value research impact amongst general public. Instead citation, which requires some generous amount of time to accumulate, social media share and likes, discussion in scientific blogs and news item are thought to be useful tool to measure the scientific attention.

The issue of using altmetrics as an alternative to the well established process of measuring scientific impact through citations is still cloudy as the process of increasing altmetrics values can be abused^[12] More over unlike citations, the lack of authority and regulations practices with unlimited platform availability (As altmetrics uses different sources for data) stands as a hinder to the widespread uses of altmetrics in academia^[13] But when properly understood and used, altmetrics can give a deep rooted insight of real article usages level, as Journal Impact Factor can only reflect impact upto journal level only not to article level.^[14] More over altmetrics give scholars a faster mean to measure their article impacts than the traditional citation based metrics.^[13] Altmetrics make it possible for the scholars to track the user demographics of their articles^[15] thus helping to measure the actual societal impact of research in real sense. Altmetrics seems to have a great future as a possible measure of impact along with the citation based metrics^[16] and therefore it is necessary to know the presence of altmetrics data in the research articles of Indian scholars.

Objectives and Research Limitations of the Study

Indian government now a days is giving much emphasis to the research impact of the academic and research institutions. NIRF is one such example where Research and Professional

Practice (RPP) is one of the parameters to find institutional ranking^[17] RPP score is entirely based on publication and citation. Seeing the vast accaptibility of altmetrics worldwide by the accademic community, it is soon thought to be part of academic evaluation process even though much research in this area is needed. Therefore, assessment of the current scenario of altmetrics data in Indian publications, will help the scientists to decide on the future course of altmetrics issues in their specific research areas. To be more specific about publications, the study was limited to Indian articles published in the journals of Public Library of Science (PLoS) in the year 2017. The reason for choosing PLoS journals is because of their higher quality, wider visibility in worlds’s research community and their superior self managed citation and altmetrics data standard. The following objectives have been chosen to address in this study,

- i. To assess the penetration of altmetrics in Indian research articles of PLoS journals.
- ii. To study the effect of altmetrics in citation data of Indian research articles. For having a more statistical conslusion to this objective following hypothesis were formulated,

H_0 = Altmetric do not have any impact in the citations gained by the articles.

H_a = Altmetric influences the citation growth of articles.

MATERIALS AND METHODS

Methodologies for the Study

Source of Data

Altmetrics data for research articles is provided by many platforms. Altmetrics.org, Impactstory.org are such platforms that maintains altmetrics related services. There are publishers who maintains their own altmetrics data. For the current study Altmetrics data avalable for the Public Library of Science (PLoS) journals were used. PLoS ia a not-for-profit open access scholarlrly publisher, it primarily publishes 9 journals. All the articles published in the 9 journals of PLoS were considered for the study. PLoS is considered to be one of the industry leader in maintaining standard altmetrics data about its publicatons. PLoS is known for developing the open source altmetrics data crawling application named Lagotto^[18] in 2009 and have been retriving and maintainig the altmetrics data since then for its articles which is freely accessible worldwide.

Process of Identifying Indian Research Articles

Defining author credit for research publications for collaborative paper is complicated measure. The issue is often debated^[19] for calculating h index, publication and citation credit for individual authors, institutions and countries. Equal credit counting,^[20] frational credit counting^[21] harmonic credit

counting^[22] and weighted credit counting are different available measures in this regard. All of these measures have their own advantages and disadvantages. Full or equal credit counting process is adopted for the study as it is used by Govt. of India's NIRF ranking scheme, Times higher education ranking scheme (It also uses fractional counting along with Equal credit scheme) as well as Web of Science Journal Impact Factor and h-index for institution and authors. So for the current study, any article that have atleast one author affiliated to any Indian institution was considered as an Indian article.

Research Data Retrieval from PLoS Altmetrics Portal

PLoS altmetrics portal (<http://almreports.plos.org/>) was used to collect data. A report was generated in the portal with country limitation "India" and time span from "01-01-2017" to "31-12-2017", that retrieved, articles with Indian institution affiliation published in PLoS journals in the year 2017.

The report contained details of 766 articles and was than exported in .txt format for further analysis and interpretation for addressing the said objectives of the study.

The collected report from PLoS contained altmetrics data available across different platforms. The different sources of altmetrics available in the PLoS report is mentioned in Table 1. For calculating the effect of altmetrics in citation, cumulative citation for the articles from Crossref, Scopus, Web of science were taken.

RESULTS AND DISCUSSION

Findings against Objective 1

In the current study, the altmetrics penetration for Indian research is checked on three categories *viz.* Social media share (on Facebook and Twitter), Mention in Scientific Blogs and News Media (on Wikipedia, Nature blogs, Science Seeker and F1000 prime) and Online readership and saves in Mendeley RM software. For citation to the articles, cumulative citation data from Crossref, Scopus, Web of science were taken.

Table 2 represents altmetrics penetration for the Indian research articles in PLoS journals. Out of the total 766 articles published in PLoS journals in the year 2017, 748 articles, i.e. 97.65% articles have at least minimum one altmetrics event associated with them. Online save and readership in Mendeley is the highest event associated with the Indian articles, while mention in Scientific blogs and news media is lowest for the Indian articles, with only 3.91% share of total articles.

Table 3 represents the distribution of altmetrics associated with the Indian research articles. The combined altmetrics value of the 748 articles are 12397 from the three categories of altmetrics selected for the study. In these 12397 altmetrics, 9878 (79.68%) are from Mendeley saves, 2328 (18.77 %

from social media and 191 (1.54%) scientific blogs and media. For social media altmetrics was found present only for twitter, while that for Facebook was zero. Figure 1 represents the overhaul altmetrics share of articles in different platforms.

Findings Against Objective 2

The process of research evaluation is not a novel practice when it is based matrices that does not consider citation as a parameter.^[23] Thelwall *et al.*^[23] further elaborated that positive correlation in a generic correlation study between two scientometrics indicators may assume some kind of association between the tested indicators, but correlation study between altmetrics and citation might not be a good practice, as probability of higher altmetrics to new articles is high and citation requires some time to accumulate, therefore biasness towards negative correlation is present in such correlation tests.

In our current study, out of 766 articles, there were 748 articles for which minimum one altmetrics value was present. Again out of total 766 articles, 493 articles had minimum of one citation in the selected citation sources for the study. Among those 493 articles, altmetrics was present for all except 7 articles. The total altmetrics value for the 493 articles with minimum one citation were 9259 out of total 12397,

Table 1: Altmetrics Sources Available in PLoS.

Views and Downloads	Citations	Reference Management saves	Social Media	Scientific Blogs/Media
PLoS Total	CrossRef	Mendeley	Twitter	Wikipedia
PLoS view	Scopus		Facebook	Research Blogging
PLoS pdf downloads	Pubmed citations			Nature blog
PLoS xml downloads	CiteULike			Science seeker
PMC total	Web of science			Reddit
PMC view	PMC Europe citations			Wordpress
PMC pdf downloads	PMC europe database citations			Figshare
	DataCite			F1000Prime

PMC= PubMed Central

Table 2: Altmetrics Penetration in Indian Articles (Article Wise Distribution).

Total articles	Articles with Min one altmetrics	Articles in Social Media	Articles with Reference management saves	Articles in Scientific Blog/Media
766	748 (97.65%)	327 (42.68%)	748 (97.65%)	30 (3.91%)

Table 3: Altmetrics Distribution in the Indian Articles (Platform wise Distribution).

Total articles	Articles with min one altmetrics	Social media		Scientific blogs/News media			Reference Management Saves	
		Face-book	Twitter	Wikipedia	Nature blogs	F1000 Prime	Mendeley	
766	748	No of articles	327	0	28	0	3	748
		Altmetrics value* (individual platform)	2328	0	185	0	6	9878
		Total combined altmetrics value	2328		191			9878
				2328+191+9878= 12397				

*Altmetrics value refers to total no of share, save or mention to articles.

Table 4: Comparison of Altmetric and Citation Share Amongst the Articles.

Total articles	Articles with altmetrics	Articles with citation	Articles without citation	Articles with citation but without altmetrics	Total share of altmetrics for articles with citation	Total altmetrics for articles without citation
766	748	493	273	7	9259 (74.69% of total 12397)	3138 (25.31% of total 12397)

Table 5: Result of t-test.

		Table 5.1: Paired Samples Statistics.							
		Mean	N	Std. Deviation	Std. Error Mean				
Pair 1	Citation	3.1031	766	6.0034	0.2169				
	Altmetrics	16.1841	766	20.6425	0.7458				
		Table 5.2: Paired Samples Correlations.							
			N	Correlation	Sig.				
Pair 1	Citation and Altmetrics		766	.606	4.159E-078				
		Table 5.3: Paired Samples Test.							
		Paired Differences		t	df	Sig. (2-tailed) (P value)			
		95% Confidence Interval of the Difference							
Pair 1	Citation - Altmetrics	Mean-13.0809	Std. Deviation 17.6594	Std. Error Mean 0.638	Lower-14.3335	Upper-11.8284	-20.501	765	8.830E-075

Sig.= Significance; N=No of articles; df= degrees of freedom.

i.e. 74.69% of total altmetrics value for 766 articles were from articles with citation. The other 25.31% altmetrics out of total 12397 were associated with the 273 articles which didn't had any citation in the selected citation sources within the selected time period of the study. Table 4 represents the distribution of altmetrics amongst the articles with citation and articles without citation.

For testing the hypothesis of the study *t*-test for paired sample mean was chosen. As for the study is data set consists of citation and altmetrics score for the same articles within a selected time period, *t*-test for paired sample mean was thought suit-

able option for hypothesis testing purpose. IBM SPSS v20 was used for conducting the test. Even though for larger sample size of more than 30, *z*-test for paired sample mean is suggested, but the SPSS documentation^[24] elaborates that the difference in *z*-test and *t*-test value is negligible in such cases and therefore *t*-test can also be performed Table 5 represents the finding of the *t*-Test.

From the t-test ((result in Table 5.1, Table 5.2 and Table 5.3))

- The obtained *P* value < 0.05, shows the high significance of the test. This also leads to rejection of the null hy-

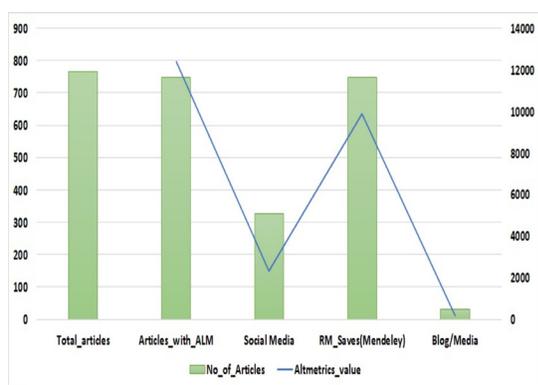


Figure 1: Altmetrics Share amongst Articles and their Value Across Platforms.

pothesis set for the study and acceptance of the alternate hypothesis. From the alternate hypothesis it can be concluded that altmetrics does have a positive influence in the citation value of the Indian research articles.

- A moderate correlation value of 0.606 between altmetrics and citation values of the articles (Table 5.2) acts as an additional positive supplementary to the acceptance for the alternate hypothesis.

CONCLUSION

In the growing attention to altmetrics based research evaluation process, the current study tries to reflect the altmetrics attention that the Indian research articles are able to gather. The study was limited to the Indian articles published in nine journals of PLoS in the year 2017. PLoS altmetrics report generation portal was used as a data source for finding out the altmetrics and citation data of the articles. The study tries to evaluate the overall altmetrics penetration to the Indian articles and test the influence of the altmetrics in increasing the number of citation to the selected articles in a hypothesis based approach. *t*-test for paired sample mean was used for testing the hypothesis. Out of the total 766 articles published in 2017, there were 748 articles (97.65%), to which at least one altmetrics event was associated. Indian articles are able to gather a strong attention in Mendeley readership, followed by share in microblogging site twitter (42.68%). The *t*-test result showed a very low significant *p* value than the set demarking value of 0.005, which led to rejection of the null hypothesis and acceptance of the alternate hypothesis thus helping to proof the positive influence of altmetrics in increasing the citations for the Indian research articles.

The study takes a two-dimensional empirical approach for understanding the effect of altmetrics in the Indian research articles. Even though the finding of the study is independent of the variable "Time" which is often considered as the third dimension for citation-based studies, still it provides a strong statistical base of argument for altmetrics as a supportive tool

for research impact evaluation along with citation-based measures. The findings of the study can be thought to be an addition to the positive wave in the big debate of usefulness of altmetrics for research impact improvement.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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None.

ABBREVIATIONS

RM: Reference Management; **RPP:** Research and Publication Productivity; **PLoS:** Public Library of Science; **ALM:** Altmetrics.

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