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Research Paper

Effects of Altmetrics on Field-Weighted Citation Impact: A Case Study of Iranian Researchers' Osteoporosis Articles

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Abstract

Background and Objectives: Altmetrics enable monitoring, tracking, and evaluating the role of authors and scientific and research publications in line with citations. Therefore, the present study aimed to determine the effects of altmetrics on Field-Weighted Citation Impact (FWCI) of articles published about osteoporosis by Iranian researchers and indexed in Scopus during 2008-2017

Methodology: This study was a descriptive survey and the research population included all the articles on osteoporosis, as a keyword by affiliated authors of Iran, indexed in Scopus during 2008-2017. Based on the initial search, 512 articles were retrieved on February 25, 2018. In addition, the cut-off point was set to six, implying that all the articles with more than six citations were selected as samples. In this regard, 114 articles received at least six citations, and the FWCI for each of these articles was separately extracted from the Scopus database. Subsequently, PlumX data for these articles were manually extracted in five categories of Usage, Captures, Mentions, social media, and Citations. Finally, these data were analyzed using the statistical software R, version 3.3.1.

Findings: Among the examined categories, Usage with the highest mean (216.482 ±468.081) was significantly different from the other categories. However, mentions (13.271±23.478) was least welcomed by users. Besides, among the studied metrics, 'Exports-Saves' (p=0.022), 'Citation Indexes' in CrossRef (p=0.041), 'Time' (p>0.001), and 'Citation Indexes' in Scopus (p>0.001) had a positive and significant correlation with FWCI.

Discussion: In general, the average FWCI increased by an increase in 'Citation Indexes' (in Scopus and CrossRef), 'Exports-Saves', and publication time. Therefore, it is recommended that universities, institutes, and research centers be made aware of the importance of researchers' presence and membership in social networks. This increases the visibility of their research, and thus they can receive enough feedback to evaluate their works.

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Introduction

Over the past few decades, bibliometric and scientometric indices have been used to evaluate researchers' performance. In this context, citation metrics are the most important indices that have provided the basis for extensive studies in various aspects of science (Ebrahimy et al., 2016). By receiving citations, every scientific work obtains the potential to have a greater impact on and more credibility from the community. Thus, these indices are introduced as the main tools for scientific outputs and research performance evaluations. However, citation-based metrics have some limitations such as the lack of the full reflection of all scientific and non-scientific impacts, citation bias, differences in the rate and value of citations due to variations in publication type and date, the nationality of the authors, etc. In addition, these indices are influenced by several factors including high dependency on time that results in the slow accumulation of citations, the uncertainty about citation motives, the possibility of manipulating citation indices, and the limitation of citation database coverage. Accordingly, they cannot be considered as the sole indicator of research impact (Holmberg, 2015). These shortcomings challenge citation analysis. Therefore, different citation indices emerged with research, journal, article, and institution-based goals in order to improve the performance evaluation of research outputs (MacRoberts & MacRoberts, 2010; Smith, 1981).

The comparison of different disciplines is one of the challenging issues in this regard. Nonetheless, most citation-based indices derived from the number of citations could not compare different disciplines. Thus, Elsevier publications proposed an index called the 'Field-Weighted Citation Impact' (FWCI), which aims at eliminating subject differences, along with article age and type. This metric compares the citations of an article with those of similar articles while considering the publication year, type of document (e.g., original article, review article, etc.), and associated discipline(s). An FWCI value greater than 1.00 indicates that, according to average, the article is more cited than similar articles. Furthermore, the basis of its calculation is the ratio of the citations of each document in three years to the average number of citations of all similar documents. This metric reduces the effect of the difference between document types and young and old documents, and thus allows comparing different disciplines (Colledge & Verlinde, 2014).

In addition, the emergence of social networks provided the chance for recording interactions and communications related to scientific works. Using these new channels of communication to predict which articles will become important could greatly improve the discovery process, enabling researchers to identify new ideas relevant to their own projects more rapidly than is currently possible (Akella et al., 2021). Regarding these opportunities, some metrics called *"altmetrics,"* "*alternative metrics,*" or *"article-level metrics"* emerged. Altmetrics are a measure of the dissemination of a publication via social media websites (Lehane, & Black, 2020). These new metrics seek to solve the challenges of citation-based metrics and improve their functions (Torres-Salinas et al., 2013). Furthermore, alternative metrics have drawn more attention to scientometrics as they can capture the quantity and quality of attention from published scientific works on social networks (Nuzzolese et al., 2019). Bornmann (2014) defines this concept as the creation and investigation of new social web-based metrics for information analysis. Moreover, altmetrics attempt to examine the impact of research on document usage and analysis of information that is produced and distributed more rapidly and extensively (Salajegheh & Diari, 2016).

Additionally, altmetrics offer the possibility to monitor, track, and evaluate the impact of authors and scientific and research publications. These actions are performed through analyzing the collected data from different social networks such as Twitter, Facebook, Mendeley, Scientific

Blogs, CiteULike, etc. (Donato, 2014). Regarding the altmetrics sources of data, these metrics can fill the gaps and overcome the challenges of citation-based metrics, including timeliness and biases. However, they also have some defects. For example, one can more easily manipulate the applied statistics in altmetrics. These manipulations include automatic downloading, purchasing, or collusion for tweets, posts, etc. (Konkiel, 2013). Therefore, although it might be impossible to replace citation-based metrics in the present situation, altmetrics act as a complementary metric to citation-based metrics in many contexts (Holmberg, 2015) and the two metrics seem to measure different aspects of the impact of scholarly work and should be used in tandem for determining the reach of a scientific article (Asaad et al., 2020).

A review of the recorded literature shows that scant attention, if any, has already been paid to the relationship between the altmetrics and Field-Weighted Citation Impact (FWCI). Therefore, in the present study, the effects of altmetrics on FWCI have been investigated. Human diseases have always been of interest to researchers, and those that have long-term effects and reduce individuals' efficiency have received more scholarly attention. Osteoporosis is the fourth major health threat after myocardial infarction, stroke, and cancer, and is more prevalent in Asian countries than non-Asian countries (Soleymanian et al., 2014). Various studies have reported that the level of knowledge, attitude, and practice of people with osteoporosis are undesirable (Asadi Shavaki & Salehi, 2016; Kastner et al., 2014; Park et al., 2015). Therefore, social media can play an essential role in changing peoples' behavior, especially in a field such as osteoporosis.

So far, several studies have examined the relationship between altmetrics and citation indicators in various medical and non-medical fields. Based on their results, a positive relationship was found between citation count and a) usage including downloads and reads (e.g., Schloegl & Gorraiz, 2010; Nieder et al., 2013; Vaughan et al., 2017; Thelwall, 2018), b) Mendeley mentions (e.g., Bar-Ilan et al., 2012), c) visibility and save in Mendeley and CiteULike (e.g., Ebrahimy et al., 2016), d) presence in social networks (e.g., Bong & Al-Ebrahim, 2017), and e) other altmetric indicators (e.g., Mullins et al., 2020). Another study also showed that Mendeley readership is the most important factor in predicting early citations, followed by factors such as the academic status of the readers (e.g., student, postdoc, and professor), followers on Twitter, online post length, author count, and the number of mentions on Twitter, Wikipedia, and across different countries (Akella et al., 2021). The results of the mentioned studies showed that there is a positive correlation between altmetrics and citation count. In other words, the visibility of such research increases because altmetrics consider the research findings in social media. As said before, research has not yet been devoted to the study of the altmetrics effect on Field-Weighted Citation Impact (FWCI) of articles. As is known, FWCI is a normalized indicator for the citation counts of similar articles in a field. Accordingly, research about altmetrics and FWCI can reveal whether a relationship exists between FWCI and each of the altmetrics indicators. Considering the regularity of scientometrics studies in 10-year intervals, the present study has sought to review papers on osteoporosis published under Iran affiliations (2008-2017) in order to investigate the effects of altmetrics on FWCI.

Methodology

This descriptive survey used altmetrics indicators, and osteoporosis was considered as the broadest MeSH term. Our research population included all articles on osteoporosis, as a keyword by Iran affiliated authors, indexed in Scopus during 2008-2017. Using the following search string, 512 articles were retrieved on 2.25.2018.

(KEY (osteoporosis) AND AFFILCOUNTRY (Iran)) AND PUBYEAR >2007 AND PUBYEAR < 2018

FWCI is an indicator that normalizes citation count, and the cut-off point setting based on the conditions of scientometrics studies is common in the literature. Considering the need for the manual data collection in this step, a cut-off point was set based on average citations. These articles received 2609 citations, representing that the average number of citations to the retrieved articles was about 5.1. Therefore, the cut-off point was set to six, indicating that all the articles with more than six citations were selected as samples. In this regard, 114 articles received at least six citations. In addition, FWCI for each of these articles was separately extracted from the Scopus database. Then, PlumX data were manually extracted for each article in five categories (i.e., *Usage*, *Captures, Mentions, social media,* and *Citations*). Eventually, the obtained data were evaluated by the statistical software R, version 3.3.1, and stepwise multiple linear regression with the significance level of 0.05 was used due to the non-normality of the data.

Findings

Descriptive information is provided in Table 1. Based on the data, the highest means belonged to 'Abstract Views' (max =2275, mean = 176.912, & std. deviation =381.711), 'Full Text Views' (max =1222, mean= 32.684, & std. deviation =135.456), and 'Readers' (max =143, mean = 19.763, & std. deviation =23.116). On the other hand, the lowest means were related to 'News Mentions' (max =1, mean = 0.008, & std. deviation =0.093) and 'References' in Wikipedia (max =1, mean = 0.008, & std. deviation =0.093). Regarding the time of publication, the mean (std. deviation) year was 3.394 (2.093). In addition, the minimum and maximum FWCI were 0.13 and 51, respectively.

Table 1. Descriptive information of investigated articles (Altmetrics & FWCI)

Type	Metric	Minimum	Maximum	Mean	Std. Deviation
Usage	Abstract Views (EBSCO)	.00	2275.00	176.912	381.711
	Link-outs (EBSCO)	.00	126.00	6.719	16.591
	Full Text Views (EBSCO)	.00	1222.00	32.684	135.456
	Clicks (Bitly)	.00	7.00	.166	.939
Captures	Readers (Mendeley)	.00	143.00	19.763	23.116
	Exports-Saves (EBSCO)	.00	217.00	12.587	28.676
Mentions	Blog Mentions (Blogs)	.00	1.00	.035	.184
	News Mentions (News)	.00	1.00	.008	.093
	References (Wikipedia)	.00	1.00	.008	.093
Social Media	Shares, Links & Comments (Facebook)	.00	66.00	1.359	6.847
	Tweets (Twitter)	.00	9.00	.263	1.022
Citations	Citation Indexes (Scopus)	6.00	169.00	19.052	25.331
	Citation Indexes (CrossRef)	.00	135.00	10.070	19.974
	PubMed Central	.00	40.00	3.201	5.675
	Clinical Citations (DynaMed Plus Topics)	.00	1.00	.026	.160
	FWCI	.13	51.00	2.189	5.073
	Time	.00	8.00	3.394	2.093

Note. FWCI: Field-weighted citation impact.

According to Table 2, among the investigated categories, *Usage* with the highest mean (216.482±468.081) was significantly different from the other ones. On the other hand, *mentions* (0.526±0.224) received the least attention from users.

Table 2. Descriptive information by PlumX categories

No.	Metric (type)	Minimum	Maximum	Mean	Std. Deviation
1.	**Usage**	.00	2746.00	216.482	468.081
2.	**Captures**	.00	269.00	32.350	41.041
3.	**Mentions**	.00	1.00	.0526	.224
4.	**Social Media**	.00	66.00	1.622	6.886
5.	**Citations**	.00	175.00	13.271	23.478

Based on the results of stepwise multiple linear regression, 'Exports-Saves' (p=0.022), 'Citation Indexes' in CrossRef (p=0.041), 'Time' (p<0.001), and 'Citation indexes' in Scopus (p<0.001) had a positive and significant correlation with FWCI. In other words, the average FWCI represented an increase by increasing citation indexes in Scopus and CrossRef. This issue applies when exporting or saving the information of an article. According to R^2= 51%, it can be stated that 51% of changes in the FWCI are due to alterations in all the variables in Table 3.

Table 3. Results of stepwise multiple linear regression between Altmetrics and FWCI

No.	MODEL	STD. ERROR	T	P-VALUE
1.	Link-outs (EBSCO)	.006	1.831	.069
2.	Full Text Views (EBSCO)	.000	1.848	.067
3.	Exports-Saves (EBSCO)	.004	2.323	.022
4.	Blog Mentions (Blogs)	.490	1.106	.271
5.	Citation Indexes (CrossRef)	.008	2.069	.041
6.	Citation Indexes (Scopus)	.007	4.651	<.001
7.	Time	.034	7.269	<.001

Note. FWCI: Field-weighted citation impact.

Coefficients[a] a. Dependent Variable: FWCI

Discussion

Nowadays, the evaluation method of the researchers' performance has changed with the advent of the altmetrics. In addition to the use of citation-based indices, the performance of each researcher and his/her impact are now evaluated in terms of such issues as the number of shared documents, the number of document views, downloads, bookmarks, likes, and comments. In other words, these indices are complementary metrics for citation-based indices (Zahedi, 2015). However, the findings of this study showed that many authors do not seek to present their publications on social networks, which is in line with the findings of Costas et al. (2014) estimating the altmetrics activity of publications as extremely low.

The results also revealed that among the investigated altmetrics in Scopus, 'Abstract Views,' and 'Full-Text Views' at EBSCO and Mendeley Readers were more favored by researchers and audiences compared to 'News Mentions.' Akella et al. (2021) have stated in this regard that Mendeley readership is the most important factor in predicting the early citations. In contrast, the findings showed that references from Wikipedia received the least attention. This is consistent with the results of Serrano-Lopez et al. (2017) indicating that Wikipedia is not regarded as a direct source for various subject fields. Furthermore, the analysis of altmetrics affecting FWCI demonstrated that the 'Export-Saves' in EBSCO, 'Citation Indexes' in CrossRef, 'Citation Indexes' in Scopus, and 'Time' influenced the FWCI. In other words, an increase in 'Export-Saves' and 'Citation Indexes,' as well as distribution duration on social networks and related databases increased the number of citations among articles with the same type, age, and subject field. Contrarily, no significant correlation was observed between FWCI and downloads. However, McGillivray & Astell (2019) reported a significant correlation between downloads and citation count.

In line with our findings, multiple studies indicated a positive correlation between saves, bookmarks, or the number of Mendeley readers with the citation number of articles in Scopus (e.g., Bar-Ilan et al., 2012; Ebrahimy et al., 2016; Thelwall, 2018; Huang et al., 2018; Akella et al., 2021). It is mentioned that saving or reading a document indicates using that document which provides the context for citing it in citation databases. Therefore, the use of social networks to introduce and provide a basis for using the research output plays a significant role in promoting knowledge translation through knowledge transfer, applying the evidence, and actualizing research results. The results of another study demonstrated that there is a strong positive correlation between download and citation count (Ruan et al., 2018). Thus, it can be assumed that downloads and saves are similar in this respect (Bong & Ale Ebrahim, 2017; Mullins et al., 2020; Nieder et al., 2013; Schloegl & Gorraiz, 2010; Vaughan et al., 2017). These studies confirm the role of saves and downloads in citation count. However, no significant correlation was found between the other altmetrics and FWCI. It is noteworthy that altmetrics vary from country to country and field to field (Banshal et al., 2018). Given that articles by Iranian researchers on osteoporosis constitute the present research's community, one of the reasons may be the limited community along with the lack of access by Iranian researchers to some social networks, such as Twitter and Facebook. In such circumstances, researchers cannot have easy access to all social networks, which leads to the limitation of the altmetrics impact on the evaluation of researchers' performance.

Conclusion

In general, the findings of this study showed positive correlations between some aspects of altmetrics and FWCI in osteoporosis research by Iranian researchers. As mentioned earlier, this finding may be due to the limited research community and limited awareness of researchers about the impact of altmetrics on increasing the citation count of articles. Generally, altmetrics have great strengths despite their limitations, including but not limited to reducing the time interval between publication and evaluation and evaluating articles based on their audience acceptance. In view of

the aforementioned, it is essential to derive benefit from altmetrics. In other words, it is important to consider altmetrics alongside other citation indices due to the ease of access to article information on social networks and the role of these networks in promoting science. To this end, familiarizing researchers with the types and functions of these measures can improve the transmission of scientific information to the target community. In this sense, using altmetrics facilitates knowledge translation in areas such as health and medicine, especially in specialties such as osteoporosis. Moreover, using altmetrics for osteoporosis as the most common metabolic bone disease increases awareness, corrects inappropriate beliefs, reduces health care costs for individuals and the health system, and ultimately, applies research evidence to the goals of knowledge translation. Finally, it is recommended that universities, institutes, research centers, and research policymakers increase their awareness about the role of social networks in the promotion of science and encourage their researchers to participate actively in these networks. It is also recommended that future scholars study the effect of altmetrics on FWCI with respect to the current subject area or other diseases such as myocardial infarction, stroke, and cancer.

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Conflict of interest

No conflict of interests has been reported by the authors.

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