SHORT COMMUNICATION

Predictors of Altmetric Score in Top-Cited Orthopaedic Articles: A Bibliometric Analysis

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Abstract

Research articles are increasingly being disseminated on social media, which is not captured by traditional bibliometrics. The Article-Level Metric score captures the 'social' impact of such research articles as well. The current bibliometric analysis was planned to identify predictors of high Altmetric score in the top-cited articles related to orthopaedic surgery. Multilevel, mixed-method, linear regression was employed to adjust for clustering of article-level and journal-level factors among 810 articles from 27 journals. The study was conducted at Aga Khan University, Karachi, Pakistan from June to December 2023. In multivariable, multilevel, linear regression, each additional citation led to a 0.33-unit increase in Article-Level Metric score (β=0.33, p=0.02), articles published in the Netherlands had a higher score by 10.6 units compared to Germany (β=10.60, p=0.01), and each additional unit increase in journal's impact factor increased the score by 1.73 units (β=1.73, p=0.04)

Keywords: Bibliometrics, Altmetric, Twitter, Social media, Research.

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Introduction

Research articles are increasingly being disseminated on social media by researchers, physicians, healthcare organisations, and journals[1]. This new method of dissemination of articles is not captured by traditional bibliometric systems. These indices are important as they are used as a measure of the productivity and effectiveness of a researcher, organisation and journal. This information is part of the decision-making for hiring, promotions and grant funding, therefore, it is important to keep it up to date with advances in the field. A modern metric should include the "social" impact of research articles, in addition to the traditional indicators of impact, such as the number of citations.

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Article-Level Metric, or Altmetric, first appeared in 2010[2], and was proposed as a holistic metric that accounts for the "social" impact of research articles in addition to the number of citations. Altmetric uses citations of an article along with how often an article is recommended, seen, discussed on social media (Facebook, Twitter, Wikipedia, etc.), and saved (e.g. in Mendeley, CiteUlike, etc.)[2]. The Altmetric Institution defines the Altmetric score as "a weighted count of all of the mentions Altmetric has tracked for individual research output, and is designed as an indicator of the amount and reach of the attention an item has received."[3]

While relatively new, research funders and charitable organisations, such as the Wellcome Trust and John Templeton Foundation, are already paying attention to Altmetric analysis[1,4]. The Altmetric score not only accounts for more "modern" methods of research dissemination, but is also updated in real time when the more traditional bibliographic metrics accrue over years 1. A study from the United Kingdom found that the Altmetric score appeared to be an important predictor of interval citation gain, and better at predicting future citations than the historical and established impact factor[5].

With the rise in the use of Altmetric score, it is essential to gauge its performance compared to traditional metrics. While previous studies have looked at articles with top Altmetric scores[6] and social media has been reported to be pivotal in improving online-visibility of the article[7], no research, to our knowledge, has been done in the feield of orthopaedics with regard to the Altmetric score of articles with top citations. This information is essential for all stakeholders, as it provides an evidence-based comparison of the lesser-known Altmetric with the more familiar citation metrics. The current study was planned to identify predictors of high Altmetric score in the top-cited articles related to orthopaedic surgery.

Materials and Methods

The bibliometric analysis was conducted at Aga Khan University, Karachi, Pakistan from June to December 2023 using SCImago Journal & Country Rank, linked to the Scopus database (Elsevier B.V.), which was accessed online at www.scimagojr.com[8]. All journals listed in the subject category "Orthopaedics and Sports Medicine" were extracted. Journals were excluded if they related to sports-medicine-only, endocrinology, bone and mineral health, physical therapy, emergency medicine, trauma surgery, or basic sciences. Also excluded were open-access journals and those with language of publication other than English.

The countries of publication were retrieved from the respective journal websites and the impact factors were taken from the Journal Citation Report 2021 (Updated 2022)[9]. Harzing's Publish or Perish 2022[10] (Macintosh Operating System graphical user interface edition) was used to get traditional bibliometrics, including the number of citations, three-year and 10-year G-index and H-Index, citations per paper, and citations per year. Publish or Perish was also used to extract the top 30 most cited articles for each journal in 2022. Altmetric scores for these articles were recorded using the Google Chrome Bookmark available at altmetric.com[11]. Twitter.com[12] (now called 'X') was used to extract information about each journal's Twitter account, date of creation, and the number of followers. Sources of funding were taken from the declared sources in each article published. The level of evidence (LOE) was determined, with Level I for systemic review (SR) and meta-analyses of randomised controlled trials (RCTs), Level II for prospective cohort and SR of cohort studies, Level III for retrospective cohort, case-control studies and SR of case-control studies, Level IV for case series and cross-sectional studies, and Level V for case report, expert opinions, etc.

Data was analysed using Stata version 17. Categorical variables were reported as frequencies and percentages, while continuous variables were recorded as median with interquartile range (Q1-Q3) (IQR). Multilevel, mixed-method linear regression was used to determine the predictors of Altmetric score in the top-cited articles. The significance level at the univariate level was 0.250, while at the multivariable level, it was $p<0.05$.

Table-1: Journal- and article-level characteristics of the studies analysed.

Journal Included	n = 27
Countries	
USA	13 (48.2%)
UK	7 (25.9%)
Germany	4 (14.8%)
Netherlands	2 (7.4%)
Italy	1 (3.7%)
Impact Factors	2.47 [1.65-3.08]
H-Index	
3-Year	26 [15-29]
10-Year	69 [48-110]
G-Index	
3-Year	33 [20-43]
10-Year	95 [63-146]
Twitter Account	
Yes	20 (74.1%)
No	7 (25.1%)
Years Since Twitter Account Creation	10 [5.5-11]
Number of Followers on Twitter	1828 [399-7219]
Article Included	n = 810
Number of Citations	7 [3-11]
Altmetric Score	0 [0-3]
Funding Source	
None Declared	655 (82.1%)
Foundation	38 (4.69%)
University	31 (3.83%)
Industry	29 (3.58%)
Government	25 (3.09%)
Multiple	22 (2.72%)
Findings	
Positive	323 (39.9%)
Negative	44 (5.4%)
Neutral	49 (6.1%)
Not Applicable	394 (48.6%)
Level of Evidence	
1	90 (11.1%)
2	63 (7.8%)
3	252 (31.1%)
4	273 (33.7%)
5	132 (16.3%)

Results

Of the 27 journals, most were published in the United States 13(48.2%), followed by the UK 7(25.9%), Germany 4(14.8%), the Netherlands 2(7.4%) and Italy 1(3.7%). The median impact factor was 2.47 (IQR: 1.65-3.08), the 10-year H-Index was 26, and the 10-year G-Index was 95. The median age of the Twitter account was 10 years (IQR: 5.5-11) years, with 1,828 (IQR: 399-7219) followers (Table 1).

A total of 810 articles were evaluated from these 27 journals. The median citations were 7 (IQR: 3-11), while the median Altmetric score was 0 (IQR: 0-3). Most studies did not have a declared source of funding 655(82.1%), while a foundation 38(4.69%) or a university 31(3.83%) were the most common sources of funding for the funded studies. The most common level of evidence was 4, representing 273(33.7%) articles, followed by 3, which had 252(31.1%) articles (Table 1).

In the univariate analysis, the number of citations (p= .002), country of the journal (p=0.168), the journal impact factor (p=0.002), three-year H-Index (p=0.201), 10-year H-Index (p=0.006), three-year G-Index (p=0.225), 10-year G-Index (p=0.006), and presence of Twitter account

Table-2: Multilevel, mixed-model, multivariable linear regression with Altmetric score as the dependent variable.

	Univariate			Multivariable		
	Unadjusted Coefficient	Confidence intervals	p-value	Adjusted Coefficient	Confidence intervals	p-value
Level of Evidence						
1	2.48	-3.78, 8.74	0.437			
2	-3.3	-10.21, 3.60	0.348			
3	0.74	-4.32, 5.81	0.774			
4	-0.76	-5.66, 4.15	0.762			
5	REF					
Funding Source						
Industry	-2.75	-14.86, 9.35	0.656			
Government	0.3	-12.20, 12.80	0.962			
Foundation	1.87	-9.60, 13.34	0.749			
University	-0.26	-12.19, 11.66	0.966			
None Declared	-2.95	-12.24, 6.35	0.534			
Multiple	REF					
Findings						
Positive	1.68	-1.61, 4.97	0.317			
Negative	3.14	-3.74, 10.02	0.371			
Neutral	-0.04	-6.58, 6.50	0.99			
Not Applicable	REF	REF				
Number of Citations	0.39	0.14, 0.63	0.002	0.33	0.06, 0.61	0.02
Country of the Journal						
USA	1.72	-3.92, 7.37	0.55	3.98	-1.06, 9.03	0.12
UK	-4.36	-10.54, 1.83	0.168	1.22	-4.69, 7.13	0.69
Netherlands	4.56	-3.99, 13.11	0.296	10.6	2.81, 18.40	0.01
Italy	-2.64	-13.68, 8.40	0.639	0.4	-9.03, 9.82	0.93
Germany	REF			REF		
Journal Impact Factor	2.6	0.98, 4.21	0.002	1.73	0.01, 3.45	0.04
3-Year H-Index	0.13	-0.07, 0.33	0.201			
10-Year H-Index	0.07	0.02, 0.11	0.006			
3-Year G-Index	0.09	-0.06, 0.24	0.225			
10-Year G-Index	0.05	0.01, 0.08	0.006			
Twitter Account						
Yes	3.73	-1.05, 8.51	0.126			
No	REF					
Years Since Twitter Account Creation	-0.04	-0.75, 0.67	0.914			
Number of followers on twitter	0	0.00, 0.00	0.427			

(p=0.126) were significant factor (p<0.250). When adjusted for covariates, only the number of citations (beta [β]=0.33; 95% confidence interval [CI]: 0.06, 0.61; p=0.02), country of the journal (Netherlands: β=10.60: 95%CI: 2.81, 18.40; p=0.01 with Germany as reference), and journal impact factor (β=1.73; 95%CI: 0.01, 3.45; p=0.04) were significantly associated with Altmetric score (Table 2).

Discussion

Despite the rising social media dissemination of medical research, it is generally not measured by traditional research productivity and effectiveness metrics. Although Altmetric has been the most common metric that combined traditional metrics and the social impact of research articles, its predictors are not well-known, especially in orthopaedics. The current study used multi-level regression, adjusting for journal-level variables, and found that the number of citations, country of the journal, and impact factor of the journal were the predictors of the Altmetric score.

Previous research on the topic reported that articles with higher Altmetric scores were mostly highly cited, too[6]. Therefore, social media attention was given to the same articles that got attention in traditional metrics. However, the current study found that top-cited articles did not necessarily have high Altmetric scores. Similar findings have been reported in the literature related to anaesthesia as well[13].

The current study has limitations as it captured Altmetric scores at a single point in time, which may change as time from publication increases.

Conclusion

Not all top-cited orthopaedic articles were found to have high Altmetric scores. Predictors of high Altmetric scores included number of citations, country of the journal, and impact factor of the journal.

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