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Correlation Study Between Altmetrics and Citations Using the Parameters of Title Rendering, Open Access, and Funding Status

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ABSTRACT

A correlation study between professional academic citations and social media (SM)-dominated Altmetrics measures is of interest to library professionals. Three parameters namely, title wording, open access (OA) facility, and research funding credentials impact the citation of an article. The study investigates how these parameters relate to the literature related to COVID-19, SM, and misinformation. The citations were obtained from the Dimension-Altmetric citation database. The database was searched using the search terms "Covid-19 AND Social Media AND Misinformation". The Mann-Whitney-U test, pearson correlation and point- biserial correlation analysis were used to analyse the 1,489 citations. A moderate positive pearson correlation (r= 0.429, p= 0.00) between the altmetric score and dimension-based citations was found. A significant association between the altmetric score and OA compared to those of non-OA articles was observed. No significant association was found between the altmetric score and the use of specific words in the title of the article except for the length of the title. Articles that received financial support had significantly higher altmetric scores but, in the case of citations, this was not significant.

Keywords: Altmetric score; Citation analysis; Open access; Social media; Dimension database; Title; Research funding; Pandemic; Reader's attention

1. INTRODUCTION

The influence of information generated, exchanged, or shared on social media (SM) or Web 2.0 is measured in terms of an Altmetric score. As Altmetric cannot represent the long-term contribution of research to society, it is used as a measure of consumption by researchers and the general public Barnes[1]. Perhaps this could be one of the reasons why library professionals undertake correlation studies between the citation count and the Altmetric score. Professionals in the library field are eager to quantify the data in this regard by performing various metric studies. Such work is useful to maintain their collection and provide information services. Correlating citation counts with Altmetric scores is one of these research metric's intriguing features. According to Ran[2] the effects of news, blogs, Twitter, Facebook, video, and Mendeley on citations are similar to those of the journal impact factor.

There is an assumption that the use of specific punctuations and a few exclusive or catchy words in the title may result in a higher citation and Altmetric score. Second, the citation advantage of publishing in open access (OA) is a growing topic in library science research. Finally, funded research articles have a citation advantage. Thus, the present study aims to find a correlation between the Altmetric score and the citations having the above characteristics.

One of the grounds for conducting the current research is because COVID-19 has affected both medical professionals and the ordinary people who used SM during the outbreak to learn about the topic.

At the time of the COVID-19 outbreak, not much information about the disease was available. During its course, medical professionals, researchers, and those belonging to allied disciplines have published various articles about disease management, research regarding cure, and have created awareness in journals and other sources. To quickly inform or share their work with their peers, the authors, publishers and other stakeholders regularly use various SM platforms or resources. In the social networking environment, such information also gets easily communicated and dispersed among laypeople. Due to human frailness, some chunk of such information created or shared is unintentionally incomplete or not placed in the right context. This may be due, say to anxiety or ignorance and, thus, can be termed misinformation. Limited peer review mechanisms on social media platforms cause

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complex content sharing and non-professional comments without validation or contextualisation, complicating the situation.

In academic and intellectual communication, librarians act as intermediaries. To this end, the results of the present study can help educate authors, especially young authors, in choosing a title for their work. Considering the growing importance of search engines that select the first few title words for indexing and information retrieval, the title, which serves as the first overview of the study, should be persuasive, insightful, illuminating, and educational to assist the reviewer and editorial team members.

The study uses the dimension database for topic-specific information on early pandemic phases. Longer-term research may provide better insights.

2. OBJECTIVES

- To determine whether Altmetric score and citations are correlated.
- To investigate the specific words in the title and the punctuation used to achieve a higher Altmetric score.
- To test the impact of OA on Altmetric score and citations.
- To test the impact of funded research on Altmetric scores and citations.
- To test the association of individual Altmetric resources viz., news mentions, blogs, Twitter, Facebook, Wikipedia, and Mendeley readers with citations and the Altmetric score together.
- To test the significant association between the Altmetric score and (i) the total number of words used in the title of the articles, and (ii) the full characters of the title of the articles (the length).

3. METHODOLOGY

The Dimension database (https://www.dimensions.ai/) was searched in the first fortnight of June 2022 using the search strategy "Covid-19 *AND* Social Media *AND* Misinformation" in the keywords and abstract fields for the years 2019 to 2021. The PubMed-based literature often uses "Covid-19" as a single term for the disease; hence, it's used in the same manner in this study. In all, 1,489 citations were found. In addition to bibliographic information, citation counts, the Altmetric score, and counts for a few specific Altmetric resources- News, Blog, Twitter, Facebook, Wikipedia, and Mendeley- were also saved in CSV (comma-separated values) format.

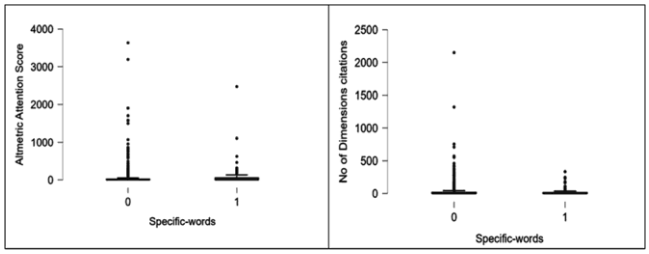
In the next step, the title field was searched for the following particular punctuation marks: commas, semicolons, hyphens, question marks, and exclamation symbols. In addition, the phrases "by," "from," "for," "what," "why," and "how" were also looked up in the article's title (hereinafter *specific words)*. There were very few instances where more than one word or piece of punctuation appeared in the same record.

In addition, the total number of words in the title and the length (number of characters) of the title are specified. There are some cases where the Altmetric score is zero when a citation is received for the same record and vice versa. A limitation of the various Altmetric studies is that these records are excluded. In this study, none of these records were excluded from analysis.

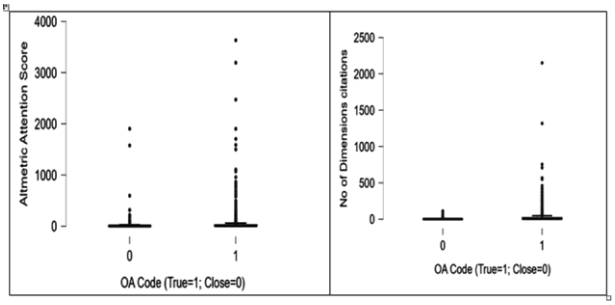
The Pearson correlation coefficient was determined between the Altmetric score and the citations (both continuous variables).

To determine the validity of the objectives, three dummy binary variables were created to track (i) whether specific words appeared in titles, (ii) if articles were published using OA methods, and (iii) if any mention of funds was made in the records. A special case of Spearman correlation viz. Point-Biserial for above three binary variables is used.

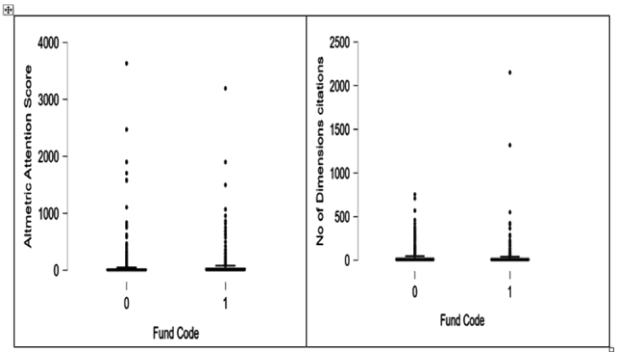
For the Point- Biserial correlation, one assumption is that there is a similar spread between two groups of binary variables (Figure 1). This assumption holds in the present study. Thus, a point-biserial correlation method is used to find the strength and direction of correlation between (a) the Altmetric score, citations, and (b) the use of specific words in the title, OA articles, and fund support (dichotomous variables).



(a) Non-Specific-Words (0) Presence of Specific-Words (1)



(b) Open Access



(c) Fund not mentioned (0) Fund mentioned (1)

Figure 1. Distribution for Altmetric Score and Citations for Point-Biserial.

It may be noted that mixed results were found for the Point-Biserial correlation (Table 1). Further, the Shapiro-Wilk and Kolmogorov-Smirnov tests also revealed that the Altmetric score and citations did not follow a normal distribution. Therefore, to analyse and infer the results, the Mann-Whitney U test was employed. For statistical analysis, SPSS version 20 was employed. The Box-Whisker charts are created using JASP 0.162 version.

4. REVIEW OF LITERATURE

Because citation counts have certain limitations in today's SM context, the use of Altmetric scores is considered an alternative assessment tool. The term "Altmetric" was coined in Jason Priem's tweet in 2010 for the first time. In a Web of Science (WoS)- based study, it was found that, except for Twitter and Mendeley readers, the presence of Altmetric data is very low. In addition, it is observed that the main Altmetric data is concentrated on publications from the fields of biomedical and health sciences, social sciences and humanities, and life and earth sciences Fang[3], *et al.* The fact that the Altmetric effect occurs quickly- within days- in contrast to citations is one of the main issues with the Altmetric score. Moreover, it serves as a measure of the consumption of information for both scholars and the general population. Barnes's[1] critical analysis has highlighted the following constraints. First, the citation impact is more significant for the academic community and is typically measured over a period of two years or longer. Second, according to majority of studies, there is little or no association between citations and the Altmetric score. Thirdly, the Altmetric score with a zero value is frequently ignored in studies.

Jenkins, Ilicic & Barklamb[4], *et al.* have investigated the issue of credibility and authenticity in SM, as well as the factors that influence communication. Their findings are that Facebook and Twitter were the most common SM platforms, whereas Instagram is a less-researched platform in comparison. Depending on the SM platform, different communication styles were more effective. The language that is used, as well as expertise heuristics and bandwagon heuristics, are factors that affect communication effectiveness. Another significant factor in the usage of SM is the gaps in the literature.

Blogs are now an established part of the information landscape as grey literature in the Web 2.0 environment. The Twitter (micro blogging) service is becoming popular with the use of mobile devices Farace & Schöpfel[5].

To comprehend how information spreads, researchers have examined the Tweets from the World Health Organisation (WHO). The study's criteria included the Tweet's subject, any links or emojis it contained, as well as its length. Hönings[6], *et al.* have studied the subject and presentation of a Tweet affect its spread, according to research using multiple inferential analyses. Buchanan & Beckett[7] found in their study that regardless of perspective, information on vaccinations is widely shared on Facebook.

Azer & Azer[8] have assessed the characteristics of highly cited articles in medical professionalism and their Altmetric scores using the WoS database. A significant positive correlation was found from 2007 onward between the number of citations and the Altmetric score. They found that among various Altmetric resources, only Twitter (54 %) and Mendeley (62 %) were popular. No significant correlation between the number of authors and institutes with the Altmetric score was found. They have stressed that future studies should investigate the specific features of the highly cited articles and the factors influencing them across scholars and non-scholars.

Paiva, Lima & Paiva[9] examined some features of the titles that can help predict the number of articles viewed and the number of citations. This includes the full characters of the title, the use of colons, the question mark, and the hyphen. Similarly, an economics-based study by Guo, *et al.* [10] found that from 2000 onwards, when online search dominates, a positive correlation is found between title length and the number of citations. Thus, the authors, reviewers, and editors can use these functions to increase the impact of their publications.

Shekhani, Shariff & Bhulani[11], *et al.* have found the punctuation (55 %) in the titles of the articles to have a strong positive correlation with the citation rate. OA articles have a low positive correlation with citation counts. Similarly, in multiple regression analysis, a statistically significant association was found between citations and the number of words counted. Murphy[12], *et al.* have considered the length of the titles, use of punctuations and specific words in the title, and citation rates in their study.

The best titles strike a balance between being clear and informative, expressing the core idea, and emphasising the significance of the study. The use of certain words, which can serve the purpose of keywords, is useful for retrieval too. To this end, depending upon the type of study, some words such as *what, why, where, when, how*, and *whose* are used by various authors. Bahadoran[13], *et al.* have studied how the use of certain prepositions such as *by, from, for, in*, and *of* in the title of the article can help enhance the visibility of the article in a web environment.

Nazim & Ashar[14] discovered no statistically significant difference between OA and non-OA medical journals using the Mann-Whitney-U test. Another study that used point-biserial correlation that was based on WoS discovered that the OA citation advantage only applies to a few subject areas and depends on how often the citations are used. Basson, Blanckenberg & Prozesky[15] have shown that other factors for citation advantage include the type of document and the year of publication.

Solla[16], *et al.* have contended that in statistical analysis, the p-value shows the difference between the two groups that is statistically significant, but the effect size shows the magnitude, which is independent of the sample size, thus helping to overcome type II or β error. The magnitude, which is independent of the sample size. There by helping to overcome type II or β error upto here. In this context, a Cohen's effect size of up to 0.2 is regarded as low, a value of 0.5 is medium, and a value of 0.8 is large.

5. FINDINGS AND DISCUSSION

A total of 1,489 records were retrieved. The average word count when special words are used is 14.32 (SD= 4.86) compared to the absence of this feature (16.86, SD= 4.96). Similarly, the length of the title in terms of total characters (alphabets or letters including space) when special words are found is 104.98 (SD= 35.61), and in the absence of specific words (118.52, SD= 34.71).

A moderate but significant positive Pearson correlation (r= 0.429, p= 0.000) between the Altmetric score and the citations was found.

Table 1. Point-biserial correlation

	Altmetric score	Citations
Specific words	0.020 (p=0.445)	-0.026 (p=0.317)
OA	0.12 (p=0.656)	0.076 (p=0.003)
Fund code	0.20 (p=0.445)	0.036 (p=0.167)

From Table 1 it can be seen that a significant but low Point-biserial correlation exists only for citations and OA (r_{pb}= 0.076, N= 1489, p= 0.003), and in the rest of the cases, no significant association is found for any other parameters. Thus, it can be said that the use of specific words in the title is not helpful in attracting readers significantly. In other words, the merit of the topic is more important. Fund support and citations have a modest positive correlation with one other and with the Altmetric score, but this correlation is not statistically significant.

To find the distribution of the Altmetric score and citations Shapiro-Wilk and Kolmogorov-Smirnov tests are used.

First, Shapiro-Wilk analysis of the distribution of the Altmetric score (statistic = 0.220, p=.000) and Kolmogorov-Smirnov (D (1489) = 0.302, p= 0.000) respectively, show that the variable does not follow a normal distribution.

Second, Kolmogorov-Smirnov (D (1489) = 0.386, p=0.000), and Shapiro-Wilk (statistic = 0.248, p= 0.000) further show that the data in the citations are not regularly distributed. Thus, in the present study the Mann-Whitney U test was used to determine the association between the Altmetric score and citations (both are dependable variables -DV) across (i)the use of specific words in the title (ii) OA, and (iii) fund support (as independent variables- IV).

First, the Altmetric score and citation counts are discussed with reference to the presence or absence use of specific words in the title, OA, and fund support. Second, individual Altmetric resources, the number of words, and the total length of the titles are discussed.

Asymptotic significance and same shape (distribution) is present in all three figures (2,3 & 4), and 0.05 is used as the significance level.

5.1 Use of Specific Words

The Altmetric score (U= 128685.5, p= 0.438) is not statistically associated with any specific words. Despite the fact that having particular words (mean rank = 800.65, N= 194) outranks having no specific words in the title (736.66, N= 1,295). Among the citations received, the mean rank for those papers when specific words are used (727.31) was less than when such words are not used (747.65), although this difference is not statistically significant (U= 120903.00, p= 0.453).These two features are shown (Figure 2). For this parameter, a small Cohen's effect size (0.070) is discovered.

Thus, it can be interpreted that the use of specific words has helped in scoring higher mean rank by chance only and doesn't influence the Altmetric score significantly. Furthermore, in terms of citations received with a lower mean rank when the special words are used shows that over a period use of such words was not influential in receiving higher citations. Thus, both Altmetric score and citations are seen to be complementary to each other as authors select the topic on merit and were not influenced by catchy titles alone.

Additionally, none of the individual Altmetric resources has shown any significant association with Altmetric score and citation (Table 2). However, the total number of words used in the title and the length of the title have shown a significant association (Table 2). This finding can be interpreted as the readers prefer a quick grasp of the topic. Another probable

Table 2. Use of specific words

	News mentions	Blog mentions	Twitter mentions	Facebook mentions	Wikipedia mentions	Number of mendeley readers	No. of words in title	Length of title
Mann-Whitney U	121442.500	119188.500	116756.000	122763.000	123520.000	118626.000	90162.500	98340.500
Wilcoxon W	961898.5	959644.500	957212.000	141484.000	142241.000	137347.000	930618.500	938796.500
Z	-0.775	-1.54	-1.494	-0.635	-0.756	-1.155	-6.276	-4.795
Asymp. Sig. (2 tailed)	0.438	0.123	0.135	0.526	0.45	0.248	0	0
Mean rank (0)	742.21	740.47	738.59	746.78	746.19	749.97	718.07	724.38
Mean rank (1)	763.44	763.76	775.44	788.05	733.08	711.64	925.84	883.46

Grouping Variable: Presence (1) Specific words (0 =Absence of specific words, N= 1295); (1 = Specific words used, N= 194)

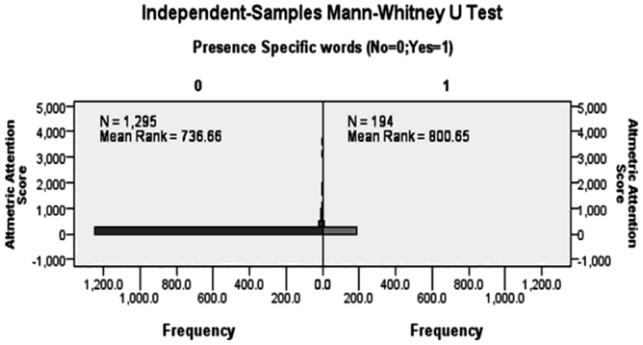


Figure 2a

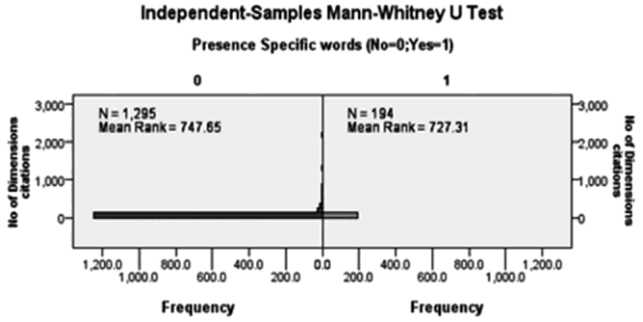


Figure 2b

Figure 2. Use of specific words.

reason is that SM is used mainly with hand-held devices and the display of short titles is preferred to reading easily. This result is in line with the findings of those of Guo, Ma C, Shi Q[10], *et al.*

5.2 Open Access

With the Altmetric score and OA, the Mann- Whitney U test shows a significant difference between the groups (U= 130161.5, p= 0.000) with a small Cohen effect (0.092).Thus, it can be said that the OA group (mean score= 759.11, N = 1,320) was significantly higher than the non-OA group (mean score= 634.81, N= 169). Also, interms of citations received, articles published in OA have a higher mean ranking (781.43) than non- OA with a mean ranking of (460.45), and this was significant (U= 159628.50, p= 0.000) (Figure 3).

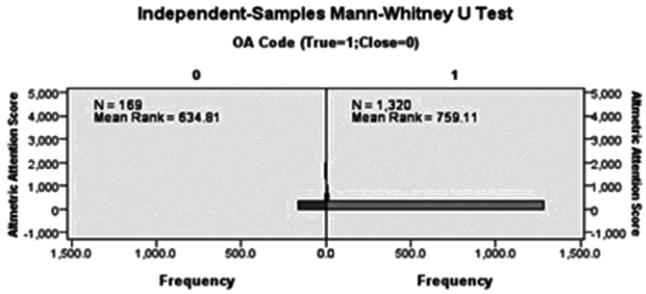


Figure 3a

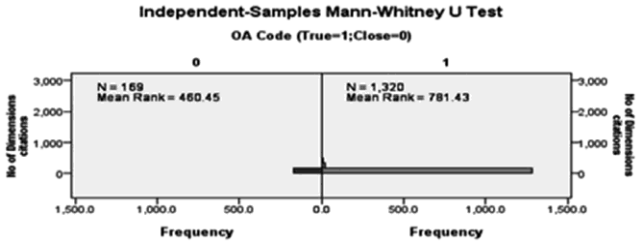


Figure 3b

Figure 3. Contribution to OA and non-OA.

5.3 Fund Support

For articles that got funding, the Altmetric score was significantly higher (U= 258831.00, p= 0.000) and had a higher mean rank (824.84, N= 422) than papers that were not sponsored, which had a mean rank of 713.42 (N = 1,067). However, in terms of the number of citations received, publications with financing have a higher mean rank (751.57) than articles without support, which have a mean rank of 742.40. This was not, however, statistically significant, as shown by (U= 227910.50, p= 0.709) and depicted (Figure 4). A low Cohen's effect size of (0.117) is found for this parameter.

Now many publishers, aggregators, and libraries offer current awareness and selective dissemination services using SM platforms. Furthermore, administrative, and academic requirements for authors to quantify the impact of their work earlier in the process, as well as authors' behavior to share and disseminate their findings using SM, have contributed to a significantly higher Altmetric score. On the other hand, when a longer

Table 3. OA and non-OA

	News mentions	Blog mentions	Twitter mentions	Facebook mentions	Wikipedia mentions	Number of mendeley readers	No. of words in title	Length of title
Mann-Whitney U	102448.500	104352.000	94213.500	102710.000	108609.000	63050.000	101838.000	99688.000
Wilcoxon W	116813.500	118717.000	108578.500	117075.000	122974.000	77415.000	116203.000	114053.000
Z	-2.06	-1.995	-3.299	-2.579	-1.519	-9.214	-1.847	-2.252
Asymp. Sig. (2tailed)	0.039	0.046	0.001	0.010	0.129	0.000	0.065	0.024
Mean rank (0)	691.2	702.47	642.48	692.75	727.66	458.08	687.59	674.82
Mean rank (1)	751.89	750.45	758.13	751.89	747.22	781.73	752.35	753.91

Grouping Variable: OA Status (0 = Non-OA, N=169); (1 = OA, N=1320)

period of time is used to accumulate the citations, no significant association was found, and only citations that are useful for future work were cited. However, a low Cohen's size effect suggests that results have limited practical implications.

In the next stage, some of the following individual Altmetric resources, including news mentions, blogs, Twitter, Facebook, Wikipedia, and Mendeley readers, were considered. Besides these resources, the number of words used in the title and the length of the title were included.

In the case of grouping variable, specific-words with the Altmetric score (Table 2), only the length of the title and the number of words counted in the title were significantly associated. While none of the individual Altmetric resources have shown a significant association.

In the case of the total number of words (U= 90162.50, p= 0.000), the mean rank of use of specific words (925.84) was more than the non-use of specific words (718.07). Whilst, for the length of the title (U= 98340.50, p= 0.000), the use of special words mean rank (883.46) was higher than that in the case of the non-use of specific words (724.38).

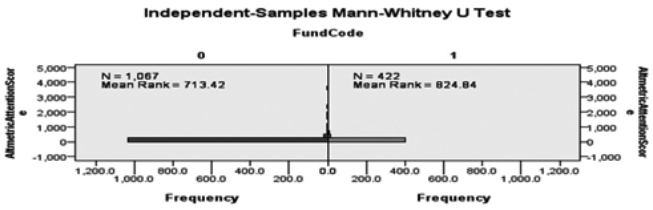


Figure 4a

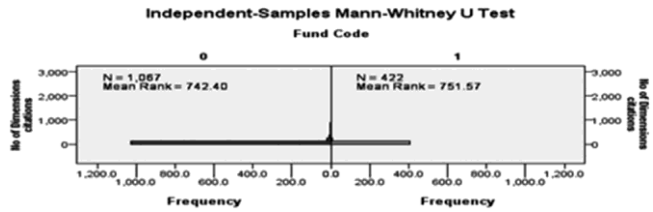


Figure 4b

Figure 4. Fund code.

From (Table 3) it was found that in the case of OA, except for Wikipedia and the number of words in the title, all other parameters were significantly associated. Thus, the results can be interpreted that in the context of OA articles that were easily available to read, download, and share by scholars and common people alike have helped for a higher Altmetric attention score as well as citation advantage in a short span of the topic.

Although Wikipedia was created with the idea of an encyclopedia, along with an important aspect of the dynamic update, allowing ordinary people to update the content, has shown limited use. This is because very little prior information was made available about the virus, which could be used and shared. On the other hand, by virtue of any new news, blog, Facebook, or Twitter update is quickly disseminated and diffused. However, all such Web 2.0 resources lack validated information being exchanged. While working on the virus, academics and researchers employed a variety of scholarly materials for both current and future usage, as shown by greater Mendeley counts.

The length of the titles (U= 99688.00, p= 0.024) was significantly associated with the OA, with a mean rank of (753.98); non- OA (674.87). While the number of words in the title (U= 101838.00, p= 0.065)was not statistically significant (OA mean rank = 752.35; non-OA = 687.59). This suggests that when the article is accessible in the OA, short titles were having a higher score.

After closely examining both the strata, namely OA and the use of specific words, the only common factor was the length of the title to receive a higher Altmetric score.

Table (4) for the articles having fund support shows that except for the News mention and Twitter none of the Altmetric resources was significantly associated with the fund support. This can be explained in the context that authors wish to share their findings (a) at the earliest with their peers and (b) the librarians, various publishers, and aggregators are offering current information services on various social media platforms. However, no citation advantage is seen in the current

Table 4. Fund support

	News mentions	Blog mentions	Twitter mentions	Facebook mentions	Wikipedia mentions	Number of mendeley readers	No. of words in title	Length of title
Mann-Whitney U	206514.500	216387.500	188061.000	222432.000	221286.5	220538. 500	218960.500	237033.500
Wilcoxon W	792141.500	786165.500	757839.000	792210.000	791064.5	309791. 000	788738.500	326286.500
Z	-.2.970	-1.71	-4.969	-0.556	-1.404	-0.615	-0.828	-1.591
Asymp. Sig. (2tailed)	0.003	0.087	0.000	0.578	0.16	0.538	0.408	0.112
Mean rank (0)	727.55	736.80	710.25	742.46	741.39	749.39	739.21	732.85
Mean rank (1)	789.13	765.73	832.86	751.41	754.12	734.10	759.64	773.19

dataset. Perhaps more cross-sectional and longitudinal studies in the future may give better insight.

Thus, it was inferred that the titles describing the work precisely and if available in OA were likely to score higher values than the absence of these features.

6. CONCLUSION

The study investigated the correlation between article title specific words, OA, and fund support, focusing on higher Altmetric scores and citation counts. Results showed OA significantly correlates with both scores, while articles mentioning fund support had higher significant Altmetric scores but no citation advantage. Specific words in titles score higher in Altmetric but not statistically significant; no significant advantage in citations.

Our results reveal that none of the Web 2.0 resources was significantly associated with the Altmetric score or citations in terms of specific words used in the title. However, publication in the OA was significantly associated with most of the Web 2.0 resources investigated, except Wikipedia. Whereas the only common variable was the length of the title across both the strata, viz., OA, and specific words. Thus, it could be said that the use of special punctuation or specific words was relevant and significant in terms of the length of the title. This, in turn, suggests that the use of precise and catchy titles, if available in OA, has attracted a higher Altmetric score for the dataset used. It can be concluded that the use of specific words can enhance visibility. Publications with financial support were significantly associated with an Altmetric score but not with citations. To this end, SM platforms were useful in creating awareness.

Various search engines and web services use some keywords from article titles when indexing. In this regard, the librarians can educate users on publishing practices and provide researchers with knowledge on how to write attractive titles and OA publications.

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