

Twitter Buzz and Citations: Who's Tweeting Matters for Plastic Surgery Literature

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Background: Plastic surgery and social media have become inextricably linked through patient procurement, practice growth, and academic exposure. Other surgical fields have demonstrated that tweeting is positively correlated with increased citations. This study aimed to elucidate the effect of Twitter on traditional bibliometrics in plastic surgery and parse out the kinds of tweets that are most correlated with citations.

Methods: Articles from May to October of 2018 from *Plastic and Reconstructive Surgery* and *Aesthetic Surgery Journal* were analyzed to determine the citation count, number and backgrounds of Twitter users tweeting about the article, and total tweets. Multiple linear regression was performed to correlate these variables to citation count.

Results: A total of 369 articles were analyzed. *Plastic and Reconstructive Surgery* had significantly more average tweets per article compared to *Aesthetic Surgery Journal* (21.8 versus 10.2, $P < 0.001$). Additionally, a number of tweets ($r = 0.45$, $P < 0.001$) and reaching more total followers ($r = 0.48$, $P < 0.001$) were both positively correlated with citations. Multiple linear regression demonstrated that tweets from self-identified scientists were positively correlated with citations ($r = 0.99$, $P = 0.001$). Tweets from science communicators had no correlation with citations ($r = -0.012$, $P = 0.726$). Tweets coming domestically from the country of the author were also associated with more citations ($r = 0.164$, $P = 0.013$).

Conclusions: Twitter activity, including the number of followers reached, for an article is positively correlated with citations. Interestingly, the kind of person tweeting affected the citations as well. Domestic tweets and those from scientists were associated with more citations. This implies that Twitter can be an effective form of academic dissemination, provided the “right” Twitter users are promoting the article. (*Plast Reconstr Surg Glob Open* 2023; 11:e5281; doi: 10.1097/GOX.0000000000005281; Published online 25 September 2023.)

INTRODUCTION

The rise of social media over the past few decades has unquestionably transformed all fields of medicine. In addition to connecting physicians across geographic barriers, social media serves to bring physicians closer with their own patients and the general public at large. Social distancing as a result of the COVID-19 pandemic limited in-person networking among colleagues and hindered

physicians' ability to connect with patients, creating even further impetus for the growth of the role of social media in healthcare.

Social media has even become an avenue to communicate scientific research, which has increased the general public's exposure to information previously confined to members of academia. In particular, the prevalence of pertinent keywords—such as terms appearing in “hashtags”—in social media posts allows for dissemination of information to those interested, regardless of academic affiliation.¹ Many specialties have highlighted the strengths of use of social media throughout the pandemic and advocated for its utility in disseminating information and connecting physicians across the country.²

Plastic surgery is a field that has become inextricably linked with social media through patient procurement and practice growth. However, the academic effects of social media within plastic surgery have yet to be studied.

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Of the top 12 journals in plastic surgery, six journals maintain a presence on social media through a Twitter profile.³ Although a journal’s presence on Twitter is not associated with the impact factor of the journal,³ studies indicate a positive correlation between impact factor of an individual article and its Altmetric score, a metric for calculating online attention.⁴ The language used within a tweet may impact public perception, suggesting certain keywords may be associated with a positive sentiment, enabling greater diffusion of information.⁵ Researchers in urology, radiation oncology, and thoracic surgery have demonstrated that an increase in a research article’s activity on Twitter, a social media platform where users “tweet” blog-style posts, is positively correlated with the number of citations.^{6–8} These studies, however, do not separate by the kind of user tweeting or evaluate the reach of those users based on the number of followers.

This study aimed to elucidate the effect of Twitter on traditional bibliometrics in the field of plastic surgery and to parse out the kinds of tweets that are most correlated with academic citations. We attempted to further the understanding of the current social media drivers on Twitter (such as total number of tweets and classification of the Twitter user, both based on the scientific identity of that user as well as the number of followers that user may reach), which promote the greatest dissemination of information and exposure not only in academia, but across the general population as well.

MATERIALS AND METHODS

Data harvest was performed of all original articles published in *Plastic and Reconstructive Surgery* (PRS) and *Aesthetic Surgery Journal* (ASJ) from a 6-month period from May 2018 to October 2018. These two journals were chosen because they have the highest impact factor for journals in the field of plastic surgery and, therefore, likely the broadest Twitter activity. We decided to analyze 2018 to allow lag time for citations to accumulation and chose the months of May to October to try to reduce any bias of journal readership at the beginning or end of a calendar year. Altmetric data were obtained for every article, which included number of citations of the article and the number of tweets that contain the direct link to the article. Additionally, when available, Altmetric includes the country of origin of the tweeter based on geolocation data, and categorizes the Twitter user based on information from their profile.

Altmetric categorizes Twitter users into four major categories: scientists, practitioners, science communicators, and general public. They define a scientist as someone who is familiar with research and is in some sort of scientific field. Practitioners are clinicians or researchers who are working in clinical fields. Science communicators are users who link frequently to scientific articles from a variety of journals and publishers.⁹

Pearson correlation matrices were used to correlate tweets, users, and followers to the number of citations. Multiple linear regression was performed to analyze the effect of the type of user tweeting and geographic location. Finally, Student *t* test was performed to compare ASJ

Takeaways

Question: Does tweeting affect bibliometrics in plastic surgery literature? If so, which types of tweets correlate with increased citations?

Findings: Altmetric data, including number of tweets and citation count from two plastic surgery journals, were analyzed. Twitter activity is correlated with increased citations. This is especially true among scientists, users with more followers, and users in the same country as the authors.

Meaning: Twitter use among the plastic surgery community correlates with increased bibliometrics, suggesting Twitter is an effective form of academic dissemination and provides insight as to what kind of Twitter activity may be most beneficial for promoting articles.

& PRS. All statistical analysis was performed with Stata 14.0 (StataCorp. 2015. Stata Statistical Software: Release 14; College Station, Tex.: StataCorp LP.)

RESULTS

A total of 369 articles were analyzed, of which 234 articles were from PRS and 135 articles were from ASJ. **Table 1** displays the average number of citations, tweets, Twitter users, and followers per article from both ASJ and PRS. Articles in PRS had statistically significant higher mean citations (8.1 versus 3.5), Twitter users per article (14.4 versus 7), tweets (21.8 versus 10.3), and total number of followers of Twitter users (161330.5 versus 44600.9).

Pearson correlation coefficients were calculated for citations and tweets, Twitter users, and total number of followers. The number of citations was statistically significantly positively correlated with tweets, the number of Twitter users, and the number of followers. The strongest correlation was to the number of Twitter users tweeting about the article with a Pearson coefficient of 0.514 ($P < 0.001$). **Table 2** displays the correlation coefficients of all independent variables analyzed.

Multiple regression was performed to compare citations to the geographic location of the tweet. **Table 3** displays the results of the regression, with tweets of domestic and unknown origin generating statistically significant

Table 1. Comparison of Journals

Mean Number per Article	PRS	ASJ	<i>P</i>
Citations	8.1	3.5	<0.001
Twitter users	14.4	7	<0.001
Tweets	21.8	10.3	<0.001
Followers	161330.5	44600.9	<0.001

Table 2. Correlation to Citations

	Correlation Coefficient	<i>P</i>
Twitter users	0.514	<0.001
Tweets	0.445	<0.001
Followers	0.483	<0.001

Table 3. Comparison of Citations to Geographic Location of Twitter User

	Correlation Coefficient	Standard Error	P
Domestic	0.164	0.066	0.013
International	0.106	0.063	0.093
Unknown	0.461	0.183	0.012

"Domestic" is relative to article's author's country of origin. N= 369; r squared: 0.28.

Table 4. Comparison of Citations to Scientific Background of User

	Correlation Coefficient	Standard Error	P
General public	0.218	0.084	0.01
Medical practitioners	0.031	0.156	0.842
Scientists	0.979	0.256	<0.001
Science communicators	-0.131	0.375	0.726

N=365; R squared: 0.33.

positive correlation with the number of citations. The number of tweets of international origin had a positive correlation with the number of citations that trended towards significance ($P = 0.09$).

Multiple regression was then performed to correlate citations to the type of Twitter users who were tweeting about the article. Table 4 displays the results of the regression. The number of tweets from the general public and scientists had statistically significant positive correlation with the number of citations. Tweets from scientists had a higher impact compared with tweets from the general public with respective β coefficient of .98 and .22. Science communicators had no correlation with citations with a statistically insignificant β coefficient of -0.131.

DISCUSSION

The pursuit of publishing is ubiquitous across all specialties of medicine. Not only do authors want to feel like their research efforts are making a difference in their field, but some institutions even use article impact metrics to assist in the evaluation of faculty candidates, determining promotions, tenure, and even funding of future research.⁶

It is no secret that social media has greatly impacted the field of plastic surgery. The two are inextricably linked through patient procurement, practice growth, and even academic exposure.¹⁰⁻¹² Twitter, in particular, is a social platform that connects users all over the globe with similar interests and allows them to share ideas. Its accessibility, ease of use, and ability to reach a broad audience are all attributes that make it good at disseminating information. Like all social media,¹³ Twitter use is increasing over time, and this is also true among the plastic surgery community. Boyd et al showed a five-fold increase in number of tweets in plastic surgery literature from 2013 to 2016.⁴ Paradis et al have found similar results when examining the use of Twitter over time in the field of radiation oncology.⁸

Although print journals are still the primary means of sharing new research ideas, tweeting has the unique capability of reaching scientists and nonscientists alike,

enables faster distribution, and encourages interactions and facilitates discussion between users in a way that a print journal cannot.⁶⁻⁸ These reasons may help explain why recent studies have demonstrated that Twitter buzz, and even tweeting in general, is positively correlated with increased citations in the fields of urology, thoracic surgery, and radiation oncology.⁶⁻⁸ Although studied in other fields, Twitter use and its impact on citations has yet to be analyzed in plastic surgery literature. In this study we sought to determine the effect of Twitter on traditional bibliometrics in the field of plastic surgery. Our results support the findings of prior studies, and we believe it highlights Twitter's capability of spreading new plastic surgery research and ideas, which ultimately leads to an increase in traditional bibliometrics.

Historically, traditional bibliometrics such as the journal impact factor and citation count, defined as the number of times the article is cited in other articles, are indicators of an article's measured "importance." The rise of social media and the use of Twitter in the scientific world, however, begs the questions of whether Twitter use surrounding an article can be used as a metric of an article's impact, as this may reflect more real-world information spread as opposed to solely in the world of academia. Companies like Altmetric are already beginning to try to incorporate these data to help judge article impact.¹⁰

A study from 2011 by Eysenbach et al determined that top-cited articles can be predicted from top-tweeted articles (within 3 days of publication) with 93% specificity and 75% sensitivity.¹⁴ More recent studies have also examined the impact of Twitter on various surgical subspecialties' literature dissemination. They have all underlined this sentiment and agree that presence on Twitter is associated with an increase in number of citations.⁶⁻⁸ Our results support the idea that Twitter can have positive influence in spreading scientific information and suggests that Twitter use can impact traditional bibliometrics. Specifically, we found a positive correlation between the number of tweets and number of citations ($r = 0.445$, $P < 0.001$). This is in line with what was found in the urology and radiation oncology literature.^{6,8}

We found an even stronger relationship between number of Twitter users tweeting about the article and citation count ($r = 0.514$, $P < 0.001$). It can be assumed that having a larger number of unique Twitter users tweeting led to a greater spread and more overall publicity when compared with one user who tweeted about the article more than one time. This makes sense, given that having more unique users tweeting results in a wider net of total followers reached, with an increased dissemination of the information.

Although it appears true that any publicity is good publicity, not all Twitter use is created equal, and there is certainly a caveat to this paradigm. We found that different plastic surgery journals receive differing levels of engagement from Twitter users. Specifically, PRS had significantly more "buzz" in the form of number of users (14.1 versus 7, $P < 0.001$), followers (161,330.5 versus 44,600.0 $P < 0.001$), and tweets (21.8 versus 10.2, $P < 0.001$) on average per

article compared with ASJ. This may be accounted for by different readership and impact factors of the respective journals.

We also determined that Twitter user's scientific background affected the correlation of tweeting with citation count. Specifically, having a greater number of tweets from self-identified scientists was strongly positively correlated with citations ($\beta = 0.99$, $P = 0.001$), whereas tweets from scientific communicators, defined as journalists, bloggers and editors, had no correlation with citations ($\beta = -0.131$, $P = 0.726$). This implies there is value in having Twitter users with reputable scientific backgrounds promote an author's article. It is logical that other researchers are more willing to cite articles already vouched for by accredited sources with science backgrounds. It is also likely that Twitter users with differing degrees of scientific backgrounds would have different audiences. For instance, a scientist is more likely to follow, as well as interact with, an article promoted by another scientist than that of a scientific communicator.

Furthermore, the geographic location of the Twitter user also affected the degree of Twitter's impact on citation count. Twitter users in the same country as the authors had a slightly greater correlation on number of tweets than international Twitter users. Although both positively correlated, only domestic Twitter users demonstrated statistical significance. It is possible that this is confounded by the disproportionate use of Twitter in the United States compared with that of other countries.

Taken together, our results demonstrate that use of Twitter in the plastic surgery community is correlated to increased traditional bibliometrics. They also suggest that Twitter is an effective form of academic dissemination and provide insight as to what kind of Twitter activity may be most beneficial for promoting the article academically. Although not a replacement for print journals, it is important to understand the impact that Twitter has on the research field for plastic surgeons. It is equally essential to realize that tweeting offers the unique ability to disseminate academic research to the general public, an area that has historically been inaccessible to the average person. Traditional bibliometrics largely focus on an article's impact in academia; however, one could make the argument that the ultimate goal of research is to bring new information to the populace, an endeavor now made simpler through social media.

There are several limitations to our study. First, these results are not necessarily generalizable to Twitter's impact on all plastic surgery literature. This is further exacerbated by the fact that only two journals, the ones with the greatest social media presence, were included in this study. Articles in journals with less of a social media presence may have their citations respond differently to tweets. Additionally, there are confounders inherent to social media such as accounts' ever-changing number of followers and the inability to determine how many of each accounts' followers actually read each tweet. Furthermore, we could not account for the content of each tweet, and all tweets were equally weighted. For example, tweeting an article with a thought-provoking comment may result

in more user engagement than simply tweeting the article link or abstract screenshot.

More and more attention is given to the power of social media in the sphere of research. Journals have already started to increase their social media presence to broaden their influence and increase their own impact. Although we have already started looking at the social media factors in an article's bibliometrics, we may soon start including a journal's social media presence in calculating its overall impact.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

REFERENCES

- Chen AD, Furnas HJ, Lin SJ. Tips and pearls on social media for the plastic surgeon. *Plast Reconstr Surg*. 2020;145:988e–996e.
- Wang A, Dumont AS. Increased utilization of social media in neurosurgery during the COVID-19 pandemic. *World Neurosurg*. 2020;143:575–576.
- Asyyed Z, McGuire C, Samargandi O, et al. The use of Twitter by plastic surgery journals. *Plast Reconstr Surg*. 2019;143:1092e–1098e.
- Boyd CJ, Ananthasekar S, Kurapati S, et al. Examining the correlation between altmetric score and citations in the plastic surgery literature. *Plast Reconstr Surg*. 2020;146:808e–815e.
- Chopan M, Sayadi L, Clark EM, et al. Plastic surgery and social media: examining perceptions. *Plast Reconstr Surg*. 2019;143:1259–1265.
- Hayon S, Tripathi H, Stormont IM, et al. Twitter mentions and academic citations in the urology literature. *Urology*. 2019;123:28–33.
- Luc JGY, Archer MA, Arora RC, et al. Does tweeting improve citations? one-year results from the TSSMN prospective randomized trial. *Ann Thorac Surg*. 2021;111:296–300.
- Paradis N, Knoll MA, Shah C, et al. Twitter: a platform for dissemination and discussion of scientific papers in radiation oncology. *Am J Clin Oncol*. 2020;43:442–445.
- How does ALTMETRIC track Twitter. Digital Science. Available at <https://help.altmetric.com/support/solutions/articles/6000235926-twitter>. Accessed September 19, 2021.
- Zhou JZ, Lemelman BT, Done N, et al. Social Media and the dissemination of research: insights from the most widely circulated articles in plastic surgery. *Plast Reconstr Surg*. 2018;142:555–561.
- Vardanian AJ, Kusnezov N, Im DD, et al. Social Media use and impact on plastic surgery practice. *Plast Reconstr Surg*. 2013;131:1184–1193.
- Cho MJ, Li AY, Furnas HJ, et al. Current trends in the use of social media by plastic surgeons. *Plast Reconstr Surg*. 2020;146:83e–91e.
- Social Media Fact sheet. Pew Research Center: Internet, Science & Tech. Available at <https://www.pewresearch.org/internet/fact-sheet/social-media/>. Published November 16, 2022. Accessed November 22, 2022.
- Eysenbach G. Can tweets predict citations? Metrics of social impact based on Twitter and correlation with traditional metrics of scientific impact. *J Med Internet Res*. 2011;13:e123.