Original Article

Effective Use of Twitter by Orthopaedic Sports Medicine Journals Can Result in Increased Impact Factor

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Purpose: To determine whether activity on Twitter was correlated with increasing impact factor (IF) among 6 orthopaedic sports medicine journals. **Methods:** Twitonomy software was used to collect account activity for the *American Journal of Sports Medicine*; *Arthroscopy: The Journal of Arthroscopic and Related Surgery; Knee Surgery, Sports Traumatology, Arthroscopy*; *Journal of Shoulder and Elbow Surgery*; *Orthopaedic Journal of Sports Medicine*; and *Sports Health*. Data from 2000 to 2020 were collected. Each journal's annual IF score was collected via scijournal.org. A multivariate regression model was used to predict the influence of different Twitter metrics on IF from 2012 to 2019. The journal name, number of tweets, and interaction of the two were used to predict IF. Additionally, Pearson correlation was used to assess correlations between Twitter account metrics and IF. **Results:** Over the study period, all IFs increased, with the exception of that for *American Journal of Sports Medicine*. The effect size between number of tweets and IF was not the same for each journal. For every additional tweet, *American Journal of Sports Medicine* increased its IF by 0.001 ($P = .18$). *Sports Health* and *Orthopaedic Journal of Sports Medicine* increased their IF by 0.01 ($P = .002$) and 0.022 ($P < .001$), respectively. *Knee Surgery, Sports Traumatology, Arthroscopy* would expect a decrease in its IF by 0.004 ($P = .55$) and *Journal of Shoulder and Elbow Surgery* and *Arthroscopy* would increase its IF by 0.002 ($P = .71$) and 0.001 ($P = .99$), but this was not significant. There was a statistically significant positive correlation between annual tweets and IF across all journals. **Conclusions:** Markers of Twitter account activity, specifically the number of annual tweets, were predictive of an increase in IF among the orthopedic sports medicine journals included in this study. **Clinical Relevance:** The findings of this study may allow orthopaedic sports medicine journals to make more effective, targeted, and productive use of their social media accounts to reach a broader audience, increase their influence, and increase the IF of their journal.

Social media (SoMe) plays an increasing role in social and professional interactions. In 2020 alone, 3.96 billion people worldwide used SoMe and networking, with 72% of the United States population maintaining an account.[1] Within health care, SoMe is used for a variety of reasons, including graduate medical training, patient education, and marketing by both physicians and health care systems.[2-5] Therefore, an understanding of SoMe and its effective use may be linked to improved influence by individual health care providers, medical journals, and the health care industry.

The use of Twitter as a specific SoMe platform is of particular interest to research in the health care field. Twitter data have been used by both psychology and public health researchers because of the large amount of accessible data, real-time nature of communications, and ability to interactively recruit subjects.[5-7] In addition to serving as a source for research, Twitter is an effective tool used by scientific journals to enhance dissemination of published studies. Erskine and Hendricks[8] recently described 4 main information dissemination strategies used by medical journals via the Twitter platform: (1) tweeting the title and link of the

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Received November 14, 2023; accepted March 17, 2024.

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2666-061X/231558

https://doi.org/10.1016/j.asmr.2024.100931

article, (2) posting infographics, (3) linking podcasts, and (4) hosting monthly internet-based journal clubs. They found that all 4 strategies were successful in improving citation-based and alternative metrics for medical journals. Analysis of Twitter account presence and activity by peer-reviewed medical journals has been performed across a variety of medical specialties. Prior studies in neurosurgery, plastic surgery, and radiology as well as other medial subspecialties found that SoMe presence and activity positively influenced a journal's impact factor (IF).[1,9-11] Similar findings in the orthopaedic literature have shown an association between SoMe use and journal altmetrics. The work of Zhang and Earp[12] showed a weak yet positive correlation between SoMe use and the number of citations for trauma and orthopaedic surgery research articles from 2018 to 2019. Similarly, in a study that looked at journals across all subspecialties of orthopaedics, Shaath et al.[13] found that the presence of an account on Twitter or Facebook had a higher correlation with IF. Moreover, higher journal IFs were associated with the presence of a Twitter account, though markers such as number of followers and tweets had no effect on IF.[14] Contrary to these data, Khalid et al.[15] found that IF was strongly correlated with average number of monthly tweets, and tweeted articles had higher citation numbers compared with articles that were not put on Twitter. Finally, a 2020 study by Kunze et al.[16] showed not only that SoMe use was associated with a higher Altmetric Attention Score (AAS), which measures online activity of research on different SoMe platforms, but also that this score had a correlation with higher citation rates across 5 orthopaedic journals. Although these studies within orthopaedics show a positive association between journal or article outreach (or both) and SoMe activity, they all look at specific short periods of time.

The purpose of this study was to determine whether activity on Twitter was correlated with increasing IF among 6 orthopaedic sports medicine journals. We hypothesized that the more a journal engaged on Twitter via posts, retweets, and user mentions the higher the associated IF would be.

Methods

Twitonomy software (Diginomy Technologies) was used to collect account activity and usage data for the following medical journals: *American Journal of Sports Medicine* (*AJSM*); *Arthroscopy: The Journal of Arthroscopic and Related Surgery* (*Arthroscopy*); *Knee Surgery, Sports Traumatology, Arthroscopy* (*KSSTA*); *Journal of Shoulder and Elbow Surgery* (*JSES*); *Orthopaedic Journal of Sports Medicine* (*OJSM*); and *Sports Health*. These journals were chosen because they were active on Twitter and are commonly read and cited sports medicine journals known to the orthopaedic surgery academic community. Only journals with an IF $\geq$2 were included in our study.

Account metrics collected included number of annual tweets, tweets per day, retweets, user mentions (tweets by other accounts that tag @username to directly engage with said account), number of tweets liked or retweeted, number of tweets replied to, ratio of followers to following, and number of hashtags used. These data were collected beginning on the first day of Twitter account inception until the last day of that calendar year and then continually assessed in subsequent years from January 1 to December 31. Data were collected retrospectively in March 2021 to obtain data from the date of Twitter account inception to December 31, 2020. Each journal's annual IF scores were collected for 2000-2020 via scijournal.org. Data collection for journals founded after 2000 began with the date of first publication.

Statistical Analysis

SPSS software (IBM) was used to develop a multivariate regression model to predict the influence of different Twitter metrics on IF for the years 2012-2019. This interval reflected the most abundant amount of data available for all journals studied. Analysis of the data showed that there was statistical significance in the relationship between journal name and IF ($P < .001$) and number of tweets and IF ($P = .001$). Therefore, the main effects of journal and number of tweets as well as the interaction of the two were used to predict IF. Tweets per day, retweets, user mentions, number of tweets replied to, ratio of followers to following, and number of hashtags were not included in the regression model because there was no significance found between these variables and IF and limited data were available across all journals. Because of the collinear nature of number of tweets and favorited tweets, number of tweets was chosen as a better predictor of IF. *AJSM* was used as the reference journal because it had the highest IF among all journals across the entirety of the study period. Additional statistical analysis was conducted to assess correlations between Twitter account metrics and IF using Pearson correlation. The data included for this portion of statistical analysis included data from the inception of the journal's Twitter account to December 31, 2020. Statistical significance was defined as $P < .05$.

Results

The average account activity was 8.2 years across the 6 journals. In 2008, *Sports Health* was the first of the publications analyzed to have a dedicated Twitter account. Many journals created a Twitter account in 2012, including *AJSM*, *Arthroscopy*, *KSSTA*, and *JSES*. *OJSM* started a Twitter account in 2015 (Table 1). The mean IF for all journals in 2000 was 1.51; this did not

Table 1. Journal IF From 2000 to 2020

Journal	Twitter Account	Year of First Publication	Year of Twitter Account Creation	IF 2000	IF 2020
American Journal of Sports Medicine (AJSM)	@AJSM_SportsMed	1976	2012	2.32	5.04
Arthroscopy: Journal of Arthroscopic and Related Surgery	@ArthroscopyJ	1985	2012	1.38	5.07
Knee Surgery, Sports Traumatology, Arthroscopy (KSSTA)	@KSSTA	1992	2012	1.14	3.74
Journal of Shoulder and Elbow Surgery (JSES)	@JSESMedia	1992	2012	1.19	3.09
Sports Health	@sports_health	2008	2008	NA	3.13
Orthopaedic Journal of Sports Medicine (OJSM)	@ojsm_sportsmed	2014	2015	NA	2.54

IF, impact factor; NA, not applicable.

include *OJSM* or *Sports Health* because these journals did not earn IFs until 2014. The mean IF for all journals in 2020 was 3.77. Over the study period, all IFs increased, except for *AJSM*, which had a consistent increase in IF from 2000 to 2019 and then dropped greater than 1 point from 6.18 (2019) to 5.04 (2020) (Fig 1). An increase in IF correlated with the number of annual tweets over time (Fig 2). This is also illustrated in Table 2, which shows a strong positive correlation between annual tweets and IF, with all journals having statistically significant findings: *AJSM* ($R = 0.67$, $P = .02$), *Arthroscopy* ($R = 0.78$, $P = .003$), *KSSTA* ($R = 0.83$, $P = .03$), *JSES* ($R = 0.65$, $P = .003$), *OJSM* ($R = 0.86$, $P = .01$), and *Sports Health* ($R = 0.94$, $P < .001$). Percentage of tweets favorited also had a statistically significant positive correlation for *AJSM*, *Arthroscopy*, *KSSTA*, *JSES*, and *OJSM*, but no statistical significance was found for *Sports Health* ($R = 0.82$, $P = .07$). The number of user mentions was found to be weakly correlated for *AJSM* ($R = 0.50$, $P < .001$) and *Arthroscopy* ($R = 0.37$, $P = .029$). Annual retweets and number of hashtags used also did not show any statistical significance for correlation with IF, with the exception of *Sports Health* ($R = 0.60$, $P = .008$).

The multivariate regression model had an R^2 of 0.982. The regression model analysis overall showed that increasing number of tweets was predictive of an increase in IF; however, this was not statistically significant across all journals, and the same effect was not seen across all journals (Table 3). *Sports Health* had the largest predicted increase in IF with each additional tweet from its account ($\beta = 0.001$, $P = .002$). Similar findings were found for *OJSM*, with a predicted increase in its IF of $\beta = 0.022$ ($P < .001$), whereas *AJSM* ($\beta = 0.001$, $P = .18$), *JSES* ($\beta = 0.002$, $P = .71$), and *Arthroscopy* ($\beta = 0.001$, $P = .99$) had a predicted increase in their IF, but this was

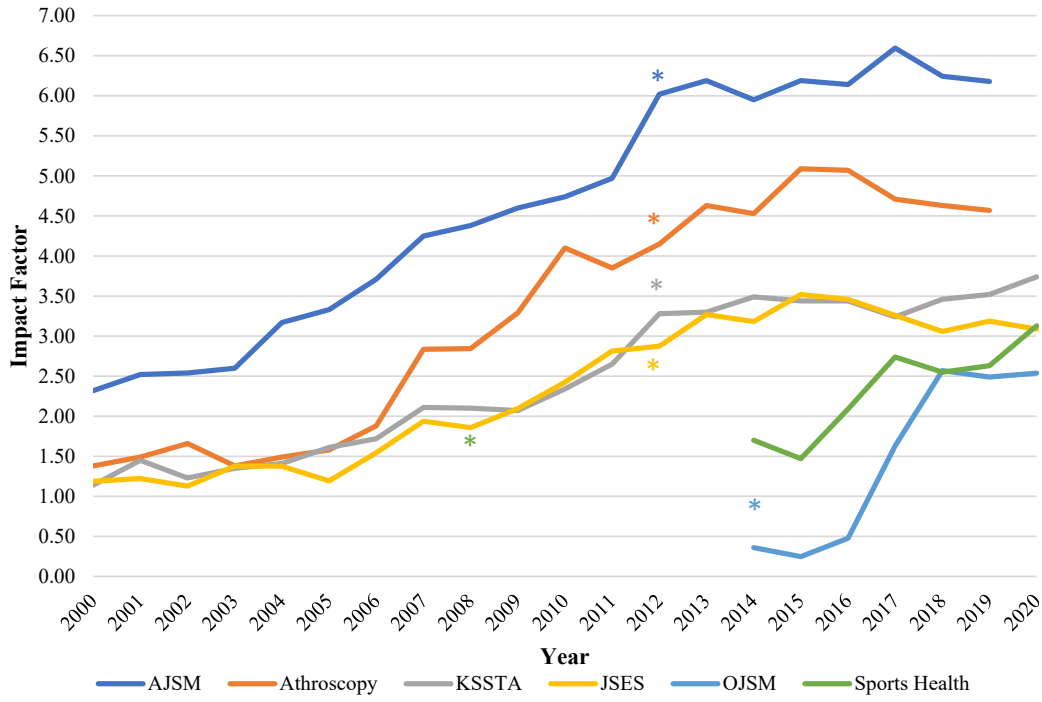

Fig 1. IF from 2000 to 2020. Asterisk denotes the year of Twitter account creation for each of the listed journals. (*AJSM, American Journal of Sports Medicine*; *Arthroscopy: The Journal of Arthroscopic and Related Surgery*; IF, impact factor; *JSES, Journal of Shoulder and Elbow Surgery*; *KSSTA, Knee Surgery, Sports Traumatology, Arthroscopy*; *OJSM, Orthopaedic Journal of Sports Medicine*.)

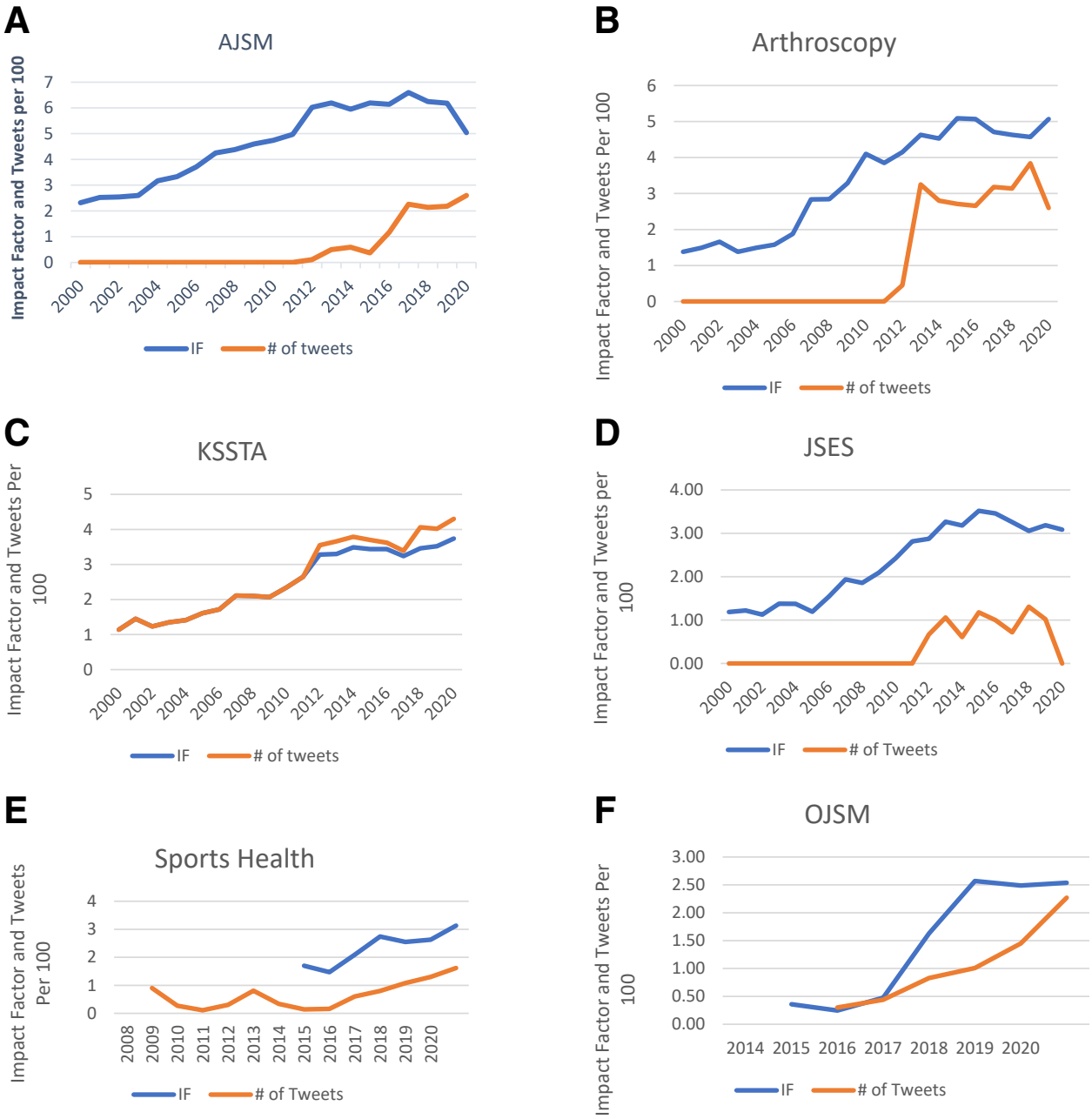

Fig 2. Relationship between annual IF and number of annual tweets from 2000 to 2020. (A-F) Relationship between IF and annual average tweets over time. (*AJSM, American Journal of Sports Medicine*; *Arthroscopy, Arthroscopy: The Journal of Arthroscopic and Related Surgery*; IF, impact factor; *JSES, Journal of Shoulder and Elbow Surgery*; *KSSTA, Knee Surgery, Sports Traumatology, Arthroscopy*; *OJSM, Orthopaedic Journal of Sports Medicine*.)

not statistically significant. Comparatively, *KSSTA* had a predicted decrease in its IF with each additional tweet ($\beta = -0.004$, $P = .55$); however, this also was not statistically significant (Table 2).

Discussion

The main finding of this study is that for every journal studied except *KSSTA*, there was a predicted increase in IF for each additional tweet from the respective account. However, statistical significance was found only for *Sports Health* and *OJSM* ($P \leq .002$). Although the regression analysis did not find statistical significance across all journals, there was a strong positive correlation between annual tweets and IFs for all journals studied that was statistically significant. The regression analysis did not find any association between IF and other Twitter metrics, such as number of hashtags used, year, and percentage of tweets favorited;

Table 2. Pearson Correlation Between Twitter Metrics and IF

Journal Name	Correlation Coefficient	*P* Value
AJSM		
Annual Tweets	$R = 0.67$	.02
Number of hashtags	$R = 0.30$	.10
% Tweets favorited	$R = 0.81$	< .001
Annual retweets	$R = 0.63$	.866
User mentions	$R = 0.50$	< .001
Arthroscopy		
Annual Tweets	$R = 0.78$	.003
Number of hashtags	$R = 0.38$	.09
% Tweets favorited	$R = 0.81$	< .001
Annual retweets	$R = 0.61$	.13
User mentions	$R = 0.37$	.029
KSSTA		
Annual Tweets	$R = 0.83$	.03
Number of hashtags	$R = 0.76$	.73
% Tweets favorited	$R = 0.78$	< .001
Annual retweets	NA*	NA*
User mentions	NA*	NA*
JSES		
Annual Tweets	$R = 0.65$	.003
Number of hashtags	NA*	NA*
% Tweets favorited	$R = 0.54$	< .001
Annual retweets	NA*	NA*
User mentions	NA*	NA*
OJSM		
Annual Tweets	$R = 0.86$	.01
Number of hashtags	$R = 0.53$	.17
% Tweets favorited	$R = 0.81$	.05
Annual retweets	$R = 0.76$	.07
User mentions	$R = 0.56$	.09
Sports Health		
Annual Tweets	$R = 0.94$	< .001
Number of hashtags	$R = 0.60$	.008
% Tweets favorited	$R = 0.82$	.07
Annual retweets	$R = 0.54$	.12
User mentions	$R = 0.74$	.01

AJSM, American Journal of Sports Medicine; *Arthroscopy, Arthroscopy: The Journal of Arthroscopic and Related Surgery*; IF, impact factor; *JSES, Journal of Shoulder and Elbow Surgery*; *KSSTA, Knee Surgery, Sports Traumatology, Arthroscopy*; NA, not applicable; *OJSM, Orthopaedic Journal of Sports Medicine*.

*Not reported longitudinally.

however, there was a positive correlation between the percentage of tweets favorited for all journals, with the exception of *Sports Health*. Other findings include an overall increase over time in IF for all journals, with an average of 1.51 in 2000 and 3.77 in 2020, with the exception of *AJSM*, which had a consistent increase in IF from 2000 to 2019 and then dropped greater than 1 point from 6.18 (2019) to 5.04 (2020).

The study model had an R^2 of 0.982. This indicates that 98.2% of variability in the data can be explained using our model and that our independent variables were good at predicting our dependent variable, which was IF. As mentioned, our results show that the effect size of each additional tweet was not the same across journals; however, there was a strong positive correlation between annual number of tweets and IF, which was statistically significant for all journals during the study period. This suggests that the volume of Twitter activity, rather than the mere presence of an account, may be a more important factor for enhancing article dissemination among readers and thus may positively influence IF. Our findings mirror prior SoMe research in comparable surgical fields and subspecialties.

Wong et al.[17] showed that increased activity on SoMe platforms is associated with an increased IF in otolaryngology journals. In the general surgery literature, Mobarak et al.[18] showed that the number of cumulative tweets over a 6-year period was positively correlated with IF. Ultimately, our findings suggest that an increased volume of Twitter activity, specifically the number of annual tweets, which had statistical significance in our regression model and Pearson correlation, correlates with an increase in reach and influence of orthopaedic sports medicine journals, thereby resulting in increased bibliometric measures such as journal IF. This is in contrast to the research of Hughes et al.,[14] which found that specific account markers (i.e., number of followers, tweets per day, or years active on Twitter) were not directly associated with changes in IF in orthopaedic surgery journals when examined over a 1-year period. Their work found that only the presence of a Twitter account was positively correlated with IF. This may be explained by the temporal difference between studies, as our study examined data over an average of 8 years (2012-2019) (although our study included data collected from 2000 to 2020). Furthermore, Shaath et al.[13] found a positive correlation between number of Twitter and Facebook followers and

Table 3. Effect Size (β Coefficient) of Each Additional Tweet on IF

Journal	Effect of Tweet on IF, β Coefficient	*P* Value	95% Confidence Interval
American Journal of Sports Medicine (AJSM)	0.001	.18	−0.001 to 0.004
Sports Health	0.01	.002	0.003-0.014
Orthopaedic Journal of Sports Medicine (OJSM)	0.022	< .001	0.015-0.026
Knee Surgery, Sports Traumatology, Arthroscopy (KSSTA)	−0.004	.55	−0.022 to 0.012
Journal of Shoulder and Elbow Surgery (JSES)	0.002	.71	−0.006 to 0.009
Arthroscopy: Journal of Arthroscopic and Related Surgery	0.001	.99	−0.003 to 0.003

IF, impact factor.

journal IF ($P = .003$), but the authors did not find any significance between the number of posts and journal IF ($P = .13$). This study also differs from ours as it captures data from 1 calendar year (2022) and does not look at data over time as our study did. Additionally, the authors used each account's Twitter page directly to obtain the data and did not have the granular data that we were able to obtain from Twitonomy.

Additional studies published in the orthopaedic literature have used alternative markers of bibliometric influence to compare different journals. A study done by Kunze et al.[16] looked at AAS and found that the AAS of a journal had a statistically significant positive correlation with a higher number of citations for a specific article. This study used IF as the sole marker of traditional bibliometric influence to compare orthopaedic sports medicine journals. The AAS was not included in our study because it is a measure of online popularity of individual articles rather than an assessment of the entire journal's yearly influence. Additionally, a study by Saha et al.[19] showed a strong correlation between IF and internal medicine journal quality when assessed by ratings given by blinded physicians, suggesting it as a high-quality influence marker.

Other account metrics, such as percentage of tweets favorited and hashtags used, were not found to be statistically significant in our regression model and thus were not included in our final analysis. In our correlation data, there was a weaker but positive correlation between these metrics and IF, which was not statistically significant across all journals. These results may suggest that there are specific ways of engaging over Twitter that may be more impactful than others. Knowing this may allow for more directed and effective use of SoMe by journals to enhance their influence.

Limitations

There are several limitations to our study. First is the inability to include more recent data through 2023. An attempt was made to obtain these data from Twitonomy to include profile analytics for each journal through 2023; however, there was a change in the Twitter application programming interface, which restricted the data that Twitonomy was able to collect. Moreover, this limited the ability to collect data about additional journals we would have liked to include in our analysis that met our inclusion criteria, such as the *British Journal of Sports Medicine*. The greatest limitation of our study was that we were unable to obtain complete data for all journals, and there were also varying time frames for which each of the journals had data. This limited the time frame for our analysis to 2012-2019. The missing data could have contributed to the lack of significance found between IF and other Twitter metrics, such as percentage of favorited tweets and number of hashtags used.

Conclusions

Markers of Twitter account activity, specifically the number of annual tweets, were predictive of an increase in IF among the orthopedic sports medicine journals included in this study.

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: M.K.M. reports a consulting or advisory role with Arthrex. M.K.M. is also a board or committee member of the American Academy of Orthopaedic Surgeons; American Orthopaedic Association; American Orthopaedic Society for Sports Medicine; Arthroscopy Association of North America; Association of Bone and Joint Surgeons; International Society of Arthroscopy, Knee Surgery, and Orthopaedic Sports Medicine; and Ruth Jackson Orthopaedic Society. M.K.M. is also a member of the editorial or governing board of *American Journal of Sports Medicine* Electronic Media, *Arthroscopy*, *Journal of Bone and Joint Surgery* (American), and OrthoInfo. C.J.T. is a board member of the Society of Military Orthopaedic Surgeons. C.J.T. also reports travel reimbursement from the Arthroscopy Association of North America. C.J.T. is also a podcast editor for *Arthroscopy*. All other authors (K.K., T.R.L., S.M.S.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

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