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Trends in Twitter Utilization Among Academic Otolaryngologists

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Objective: To characterize Twitter utilization among academic otolaryngologists and evaluate the relationship between Twitter utilization and research productivity.

Methods: Data were collected manually from accredited US otolaryngology residency programs from July–November 2021. Program and faculty demographics were documented, including citations and H-index for faculty and Doximity reputation and US News and World Report ranking for programs. Twitter metrics were also recorded. Descriptive analyses and multivariable logistic regression models were used to identify predictors of Twitter utilization.

Results: Currently, 333 (16%) faculty and 70 (62%) programs have a Twitter account. Of these, 36 (11%) and 27 (39%), respectively, were created in 2020. The regression model indicates that for each 5 unit increase in H-index, the odds of having a Twitter account increase 22% (OR 1.22, 95% CI 1.10–1.34, $p = 0.0009$). The number of faculty with a Twitter account predicts the existence of program Twitter accounts (OR:1.49, 95% CI 1.01–2.19, $p = 0.04$). Finally, of the 323 faculty with a Twitter account and available Scopus profile, we found that the number of individuals with Twitter use out of proportion to their academic productivity was low ($n = 8/323$).

Conclusion: The H-index is a significant predictor of faculty Twitter accounts, whereas the number of faculty with Twitter is a significant predictor of program Twitter utilization. Although Twitter utilization is increasing, especially during the coronavirus pandemic, the findings indicate that there is ample room for growth, particularly amongst faculty with strong academic portfolios.

Key Words: altimetrics, H-index, otolaryngology, social media, Twitter.

Level of Evidence: NA

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INTRODUCTION

Over the past several years, social media use has increased notably.[1] Twitter, in particular, has gained significant traction among the medical community.[2] The utility of Twitter in medicine and medical education is multifold and includes showcasing residency programs, networking among professionals, and dissemination of research.

Among otolaryngology residency programs, the use of Twitter, among other social media platforms, is on the rise.[3–6] After the shift toward virtual interactions driven by the COVID-19 pandemic, social media allows the opportunity for programs to highlight their unique aspects outside of the formal application process. Furthermore, programs can reach a broader audience including medical students who may apply in future application cycles. In this role, social media is becoming an increasingly important tool for residency programs.

Social media also creates a new avenue for individuals to connect with peers, collaborators, and mentors.[7,8] Twitter allows for users to share their thoughts or reshare thoughts posted by others in concise, 280-character tweets. By establishing a presence on social media, individuals can connect with people who share similar interests regardless of their institution or geographic region. This has been found to be particularly valuable in connecting trainees of minority backgrounds with mentors of a similar identity.[9]

The evidence suggesting the influence of Twitter within medicine is growing. A recent randomized trial indicated that tweeting scholarly work resulted in significantly more article citations.[10] Similar results indicating a positive relationship between Twitter activity and article citations have been found across multiple medical specialties.[11–14] In a retrospective study of leading otolaryngology journals, it was found that articles mentioned on Twitter had 1.6 times as many citations as articles that were not mentioned on Twitter.[15] These data highlight the growing and valuable utility Twitter holds for authors in promoting their research.

Given the new popularity of this avenue in building professional connections and disseminating information to the public, it is important to characterize its use in otolaryngology. This study aims to provide insight to the extent to which academic otolaryngologists in the United States (US). have made use of Twitter and evaluate the relationship between Twitter utilization and research productivity.

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MATERIALS AND METHODS

All data was manually collected from July 2021 through November 2021. This study involved only publicly available data and therefore was not subject to review by the Institutional Review Board per guidelines.

Population and Demographics

One hundred and thirteen accredited US otolaryngology residency programs with publicly available faculty listings were identified. From each program website, the resident class size, number of fellowship programs, number of faculty, and location was recorded. Location was subsequently categorized per the 2020 US census divisions. The Doximity residency program reputation ranking and US News and World Report ranking for "Best Hospitals for Ear, Nose & Throat" for each program were also noted.

All faculty (excluding part-time faculty, non-otolaryngologists, and research faculty) were identified through the residency program website and recorded. All collected faculty-level variables were either obtained from the residency program website or cross-referenced across multiple online sources. These variables include location of practice, academic title, fellowship trained/type, medical school degree type, additional degrees, and year of residency graduation.

TABLE I.
Faculty Demographics.

Variable	All faculty	Twitter	No Twitter
Number	2127	333 (16%)	1794 (84%)
US census region			
Northeast	671	79 (12%)	592 (88%)
Midwest	518	103 (20%)	415 (80%)
South	573	93 (16%)	480 (84%)
West	353	58 (16%)	295 (84%)
Other	12	0 (0%)	12 (100%)
Title			
Professor	451	84 (19%)	367 (81%)
Associate professor	476	89 (19%)	387 (81%)
Assistant professor	678	93 (14%)	585 (86%)
Instructor	24	2 (8%)	22 (92%)
Clinical professor	20	4 (20%)	16 (80%)
Clinical associate professor	42	6 (14%)	36 (86%)
Clinical assistant professor	126	14 (11%)	112 (89%)
Clinical instructor	54	3 (6%)	51 (94%)
Fellowship trained (Y)	1618	279 (17%)	1339 (83%)
Fellowship division			
Allergy	3	1 (33%)	2 (67%)
FPRS	232	47 (20%)	185 (80%)
Head and neck oncology	394	72 (18%)	322 (82%)
Laryngology	171	40 (23%)	131 (77%)
Neuro-otology	278	43 (15%)	235 (85%)
Pediatrics	361	45 (12%)	316 (88%)
Sinus/Anterior Skull Base	214	38 (18%)	176 (82%)
Sleep	13	0 (0%)	13 (100%)
H index			
Quartile 1 (0–4)	542	55 (10%)	487 (90%)
Quartile (5–8)	439	72 (16%)	367 (84%)
Quartile 3 (9–17)	546	108 (20%)	438 (80%)
Quartile 4 (18–144)	482	97 (20%)	385 (80%)
Citations			
Quartile 1 (0–96)	483	51 (11%)	432 (89%)
Quartile 2 (97–337)	485	81 (17%)	404 (83%)
Quartile 3 (338–1064)	475	96 (20%)	379 (80%)
Quartile 4 (1065–78569)	481	95 (20%)	386 (80%)
Medical degree			
MD	2082	331 (16%)	1751 (84%)
DO	36	1 (3%)	35 (97%)
MBBS	8	0 (0%)	8 (100%)
Additional degrees			
MPH/MSPH	67	11 (16%)	56 (84%)
MBA	42	12 (29%)	30 (71%)
PhD	95	23 (24%)	72 (76%)
MA/MS	67	15 (22%)	52 (78%)
DMD/DDS	5	0 (0%)	5 (100%)
Other*	38	8 (21%)	30 (79%)
Year of residency graduation			
1960–1970	7	0 (0%)	7 (100%)
1971–1980	63	1 (2%)	62 (98%)
1981–1990	208	18 (9%)	190 (91%)
1991–2000	395	54 (14%)	341 (86%)
2001–2010	592	117 (20%)	475 (80%)
2011–2021	853	143 (17%)	710 (83%)

*Other degrees include: Bphil, Mphil, DMA, MCR, Med, MSEd, MME, MPA, MSCR, MT, PA-C, PharmD, MHS, MHPA, MMHC, MPA, CCC-SLP.

Research Metrics

Using Elsevier's abstract and citation database, Scopus, the number of citations and Hirsch index (H-index) for each author was recorded. If multiple profiles existed for an author at different institutions, the profile with the highest H-index was utilized.

Twitter Metrics

Individual faculty and program Twitter accounts were searched for using multiple key words including "otolaryngology", "ENT", "OHNS", "residency", and "[institution name]" as appropriate. Strictly personal faculty accounts, defined as not mentioning their profession, institution, or research in their profile or tweets, were not commonly identified but excluded.

For each program Twitter, the month and year of account creation and handle were noted. For each individual faculty Twitter, the month and year of account creation, date of last tweet/retweet, number of tweets, number of followers, number following, number of likes, and handle were catalogued.

Statistical Analysis

The Kardashian index (K-index), named for Kim Kardashian and previously described by Hall,[16] was calculated

for all faculty with a Twitter account to compare the individual's expected number of followers to their actual number of followers. To calculate the expected number of followers, the faculty's number of citations (a proxy for their academic productivity) was plotted against their number of Twitter followers (a proxy for their social media presence). From this plot, a linear regression model was generated to determine each individual's expected number of followers from their number of citations. The ratio of actual to expected followers was defined as the K-index and was stratified into low (≤0.25), expected (0.26–5.0) and high (>5.0).[16] In essence, the K-index is a measure of discrepancy between a physician's social media profile and publication record, where a high index indicates a seemingly outsized following based on the individual's research prowess. Academic productivity as it relates to a faculty's number of tweets (an alternate proxy for social media presence) was also plotted for visual comparison.

Multivariable logistic regression models were created to analyze predictors of faculty and program Twitter utilization. All statistical analyses were performed using the SAS JMP Pro software and statistical significance was defined as $p < 0.05$.

TABLE II.
Program Demographics.

Variable	All programs	Twitter	No Twitter
Number	113	70 (62%)	43 (38%)
US census region			
Northeast	31	14 (45%)	17 (55%)
Midwest	31	21 (68%)	10 (32%)
South	33	21 (64%)	11 (33%)
West	17	13 (76%)	4 (24%)
Other*	1	0 (0%)	1 (100%)
Historically AOA (Yes)	10	2 (20%)	8 (80%)
Resident class size			
1	15	4 (27%)	11 (73%)
2	25	14 (56%)	11 (44%)
3	35	21 (60%)	14 (40%)
4	24	18 (75%)	6 (25%)
5+	14	13 (93%)	1 (7%)
Number fellowship programs			
0	55	23 (42%)	32 (58%)
1	14	11 (79%)	3 (21%)
2	11	7 (64%)	4 (36%)
3	10	8 (80%)	2 (20%)
4	8	7 (88%)	1 (13%)
5+	15	14 (93%)	1 (7%)
Number of faculty			
0–10	32	16 (50%)	16 (50%)
11–15	25	13 (52%)	12 (48%)
16–22	28	16 (57%)	12 (43%)
23–133	28	25 (89%)	3 (11%)
% faculty with twitter			
0%–25%	95	54 (57%)	41 (43%)
26%–50%	16	14 (88%)	2 (13%)
51%–100%	2	2 (100%)	0 (0%)
US news ranking quartile			
Not ranked	38	10 (26%)	28 (74%)
2–21	19	15 (79%)	4 (21%)
22–40	19	14 (74%)	5 (26%)
41–71	18	17 (94%)	1 (6%)
72–111	19	14 (74%)	5 (26%)
Doximity reputation ranking quartile			
1–29	29	25 (86%)	4 (14%)
30–58	28	20 (71%)	8 (29%)
59–86	28	18 (64%)	10 (36%)
87–125	28	7 (25%)	21 (75%)

*Other includes programs located in US territories.

RESULTS

Demographic information of faculty and programs are summarized in Tables I and II. As of November 2021, we identified 113 US otolaryngology residency programs and 2127 academic faculty. Of these, 70 (62%) of US otolaryngology residency programs and 333 (16%) of academic faculty had a Twitter account. Characteristics of the faculty Twitter profiles are described in Table III. Faculty have a median (IQR) of 94 (21–282) tweets and 150 (53–349) followers.

Predictors of Twitter Utilization

Predictors of Twitter utilization were identified for both individual faculty (Table IV) and residency programs (Table V). The prediction model indicates that faculty in the Midwest have 64% greater odds of having a Twitter account when compared to the referent faculty group in the Northeast (OR 1.64, 95% CI 1.13–2.36, $p = 0.009$). Compared with professors, assistant professors have 49% less odds of having an account (OR 0.51, 95% CI 0.3–0.86, $p = 0.01$). In contrast, one-year increases in the year of residency completion, an approximator of decreasing age, results in 6% greater odds of having a Twitter account (OR 1.06, 95% CI 1.04–1.09, $p < 0.0001$). Finally, for each 5 unit increase in a faculty member's H-index, the odds of having a Twitter account increase 22% (OR 1.22, 95% CI 1.10–1.34, $p = 0.0009$). Other variables assessed in the model such as having an additional degree, fellowship type, and total number of citations, did not show statistically significant associations.

The program prediction model indicates that each additional faculty with a Twitter account in a given program results in a 49% greater odds of the program having a Twitter account (OR 1.49, 95% CI 1.01–2.19, $p = 0.04$). However, having more faculty in total is associated with a lower odds of a program having a Twitter account

TABLE III.
Physician Twitter Account Characteristics.

Variable	Median (IQR)
Total tweets	94 (21–282)
Total following	128 (50–322.5)
Total followers	150 (52.5–349)
Total likes	116 (17–499)

TABLE IV.
Multivariable Logistic Regression Analysis of Predictors of Faculty Twitter Utilization.

Variable	Odds Ratio (95% CI)	*p* value
Region		0.04*
Northeast	Reference	Reference
Midwest	1.64 (1.13–2.36)	0.009*
South	1.35 (0.93–1.95)	0.11
West	1.04 (0.68–1.60)	0.86
Academic title		0.10
Professor	Reference	Reference
Associate professor	0.85 (0.55–1.31)	0.46
Assistant professor	0.51 (0.30–0.86)	0.01*
Clinical associate professor	0.75 (0.27–2.14)	0.59
Clinical assistant professor	0.82 (0.40–1.75)	0.63
Clinical instructor	0.34 (0.07–1.59)	0.17
Clinical professor	2.12 (0.56–8.04)	0.27
Instructor	0.40 (0.08–1.92)	0.25
Fellowship		0.17
None	Reference	Reference
FPRS	1.34 (0.81–2.22)	0.26
Head and neck oncology	1.03 (0.66–1.61)	0.90
Laryngology	1.57 (0.92–2.68)	0.10
Neuro-otology	0.99 (0.61–1.63)	0.98
Other (Sleep + Allergy)	0.40 (0.05–3.14)	0.38
Peds	0.80 (0.49–1.29)	0.36
Sinus/anterior skull base	0.83 (0.48–1.42)	0.50
H Index (per five point increase)	1.22 (1.10–1.34)	0.0009*
Total number of citations	0.99 (0.99–1.00)	0.29
Additional degree (Y)	1.26 (0.90–1.77)	0.18
Year of residency graduation	1.06 (1.04–1.09)	<.0001*

*p-value <0.05.

(OR 0.95, 95% CI 0.91–0.99, $p = 0.03$). All other variables assessed in the model including the residency class size, number of fellowships offered, ranking, and region were not significantly associated.

TABLE V.
Multivariable Logistic Regression Analysis of Predictors of Program Twitter Utilization.

Variable	Odds ratio (95% CI)	*p* value
Region		0.04
Northeast	Reference	
Midwest	8.17 (0.68–97.64)	0.17
South	1.78 (0.32–9.82)	0.56
West	2.68 (0.33–21.48)	0.93
# Residents	1.29 (0.48–3.43)	0.61
# Fellowships	1.35 (0.92–1.97)	0.13
# Faculty total	0.95 (0.91–0.99)	0.03*
# Faculty with twitter	1.49 (1.01–2.19)	0.04*
US News ranking	1.10 (0.99–1.04)	0.44
Doximity ranking	0.99 (0.97–1.03)	0.88

*p-value <0.05.

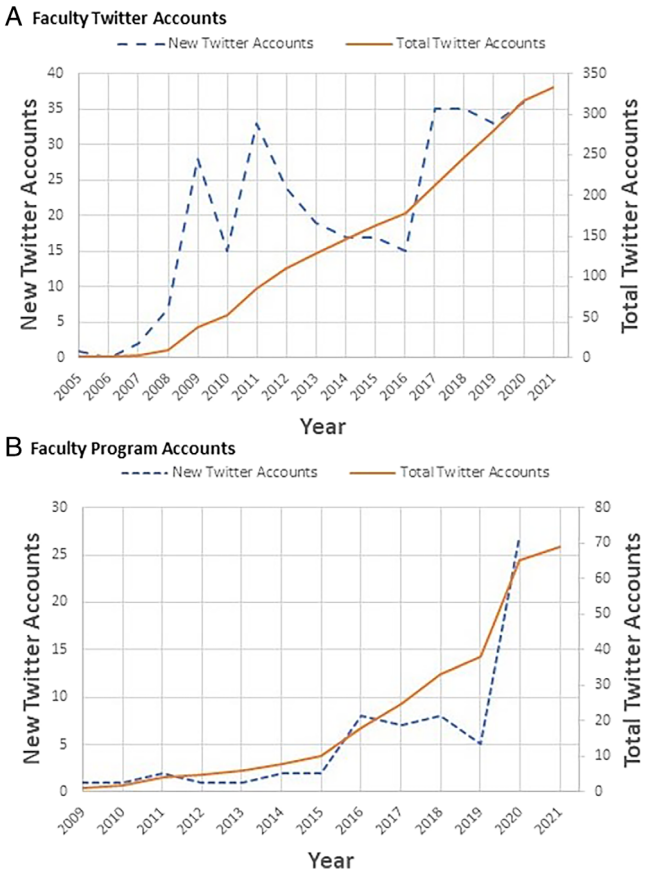


Fig. 1. Trends in Twitter utilization over time in (A) academic otolaryngologists and (B) otolaryngology residency programs. 2021 data is incomplete and includes faculty accounts created prior to September 2021 and program accounts prior to November 2021.

Temporal Trends in Twitter Utilization

New and total Twitter accounts each calendar year are depicted in Figure 1. The first faculty Twitter account was created in 2005, whereas the first program Twitter account was created in 2009. As of November 2021, there were 70 program Twitter accounts in total, 27 (39%) of which were created in 2020, and 333 individual Twitter accounts, 36 (11%) of which were created in 2020.

Research Activity and Twitter Utilization

The K-index for all academic faculty with a Twitter account is described in Figure 2A. Of the 323 faculty with a Twitter account and available Scopus profile, 8 (2.5%) had a high K-index. In Figure 2B, six of the eight individuals with a high K-index fall in the "high citations, high followers" category. On the other hand, 120 (37%) had a low K-index.

Figure 2B, C provide additional insight into the relationship between academic productivity and Twitter utilization. Figure 2B demonstrates that of individuals with a high number of citations, 60/323 (19%) fell into the low followers category and, of individuals with a low number

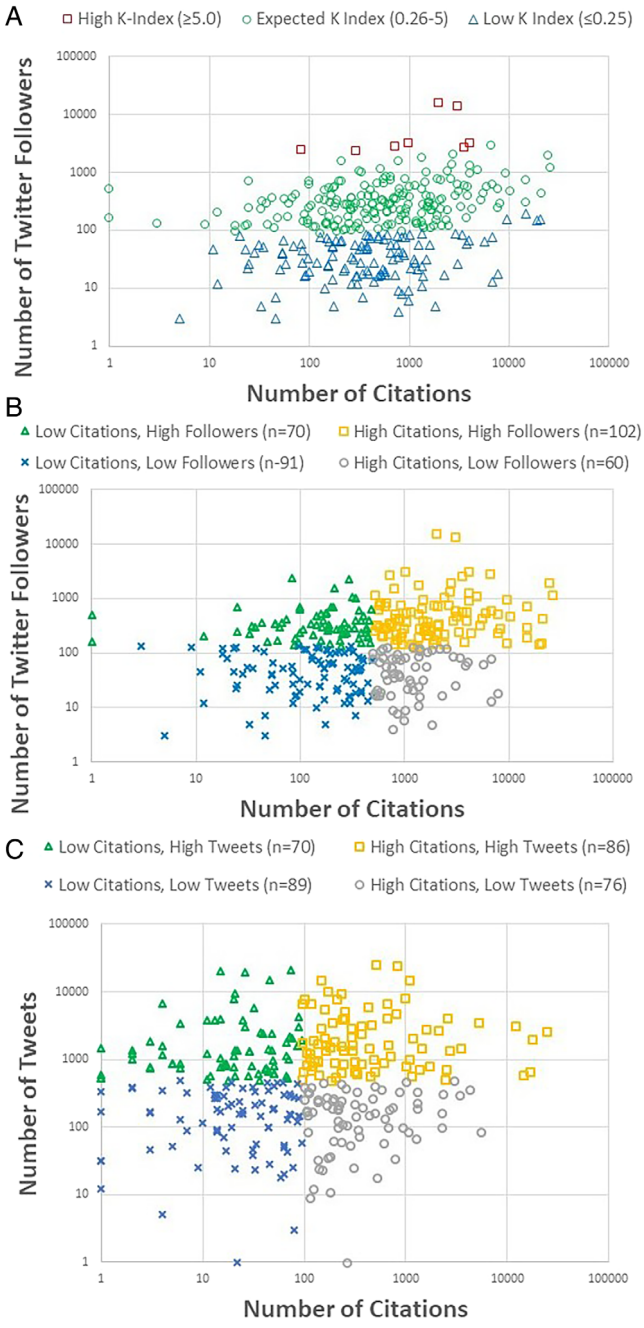


Fig. 2. Academic productivity and Twitter utilization. All academic otolaryngologists with a Twitter account (A) stratified by K-index. (B) stratified by number of followers and citations. (C) stratified by number of tweets and citations.

of citations, 70/323 (22%) fell into the high followers category. In Figure 2C, of individuals with a high number of citations, 76/323 (24%) had a low number of tweets and, of the individuals with a low number of citations, 70/323 (22%) had a high number of tweets. Specifically, the percent of individuals in the "high Twitter, low academic productivity" and "low Twitter, high academic productivity" are of interest as these individuals may be over- or under-utilizing Twitter, according to the Kardashian index paradigm.

DISCUSSION

Twitter utilization in the field of otolaryngology is growing. In this study, we characterize the use of Twitter among academic otolaryngologists and residency programs and evaluate its association with research productivity.

Of the 2127 academic otolaryngology faculty identified in this study, 333 (16%) had a Twitter account. This number has risen steadily over the last decade. Of the 113 US residency programs identified, 70 (62%) had a Twitter account. Unlike faculty Twitter accounts, program Twitter accounts saw a jump between 2019 and 2020—likely attributable to the effects of the COVID-19 pandemic on the application process.

Adjusting for other variables in the prediction model, we found that younger faculty (as estimated by a more recent year of residency graduation) in the Midwest with a greater H-index were most likely to have a Twitter account. It was expected that younger faculty would be more likely to have a Twitter account, given that Twitter is generally used by younger individuals. Yet, faculty with the academic title assistant professor were significantly less likely to have a Twitter account. Other tested variables (additional degrees achieved, fellowship type, and total number of citations) were not statistically significant.

It is seemingly contradictory that our model predicts younger faculty are more likely to have a Twitter whereas assistant professors, who are generally earlier in their career, are less likely to have a Twitter account. However, this can be explained by the distribution of faculty across the academic titles. We found that although the raw number of faculty with Twitter accounts was similar between professors, associate professors, and assistant professors, the percent of faculty in each category with a Twitter account differed (Table VI). As a result, even though Twitter use is low across all otolaryngologists, the lack of Twitter use was most pronounced in the assistant professor category.

Interestingly, younger faculty with the title professor are most likely to have a Twitter account per the prediction model. This finding is further delineated in Table VI to depict the relation between age, academic title, and Twitter use. These "young professors" have risen to prominence in their field quickly. Plausibly, their increased social media use could be attributed to a virtuous cycle in which social media use contributes to increased attention

TABLE VI.
Twitter Use in Association with Age and Academic Title.

Academic title/ Year of residency graduation	Professor	Associate professor	Assistant professor	Total
1966–1989	8% (9/111)	4% (1/24)	0% (0/16)	7% (10/151)
1990–2009	22% (70/321)	17% (45/272)	6% (7/126)	17% (122/719)
2010-Present	29% (5/17)	24% (43/178)	16% (86/533)	18% (134/728)
Total	19% (84/449)	19% (89/474)	14% (93/675)	

and academic status which then furthers their social media use.

In terms of residency programs, those which had a greater number of individual faculty with Twitter accounts were most likely to have a program Twitter account. This was an interesting finding as the number of faculty in total did not achieve a meaningful level of significance. This indicates that it is specifically increased Twitter use among faculty, not simply increased program/faculty size which influences the likelihood of program Twitter use. Other tested variables (number of residents, number of fellowships offered, USNWR ranking, Doximity ranking, and region) did not achieve statistical significance.

It was unexpected that both methods of ranking programs, USNWR and Doximity, did not achieve statistical significance. Previous studies have found that higher ranked programs were more likely to have a Twitter account.[4,17] However, this discrepancy may be attributable to the fact that our multivariable regression analysis allowed us to adjust for other variables used in the prediction model whereas previous studies did not adjust for these variables.

We utilized the previously described K-index to evaluate the relationship between Twitter use and research productivity. This index was developed to distinguish between Twitter users who are "famous for being famous" and those who are famous for their scientific contributions.[16] Given the widespread use of Twitter to disseminate information and the impact Twitter can have on an article's number of citations, it is important to characterize whether high-impact Twitter users have correspondingly high scientific contributions. As seen in Figure 2A, otolaryngology has relatively few "science Kardashians" (as defined by Hall's criteria of a K-index >5.0). Furthermore, six of the eight individuals with a high K-index in otolaryngology fall into the "high citations, high followers" category. Thus, although these individuals broached the threshold K-index identified by Hall, these individuals may not necessarily have an inappropriately high Twitter following, but rather their high following may be justified by their high number of citations.

To our knowledge, this is the first study to analyze Twitter use in academic otolaryngologists as it relates to their research productivity. These data highlight room for increased Twitter use in the field of otolaryngology, particularly among faculty with "low Twitter, high academic productivity," with 19% (Figure 2B) and 24% (Figure 2C) falling into this group. By increasing Twitter use among this group, not only will important research be shared among the diverse population of Twitter users, but otolaryngologists in training will also have more opportunities to connect with potential mentors in their field.

An important strength of this study is that this is the first study to comprehensively analyze Twitter use among academic otolaryngology faculty. In doing so, we identify areas in which we can improve our utilization of Twitter as a research and educational tool. Furthermore, in our analysis of otolaryngology residency program Twitter use, this is the only study to utilize a multivariable model to assess the impact of different factors on the odds of Twitter use. This allows for a nuanced understanding of which programs are most likely to engage in Twitter use.

In contrast, this study is not without limitations. One limitation is that although strictly personal Twitter accounts were excluded, we are unable to assess the extent to which an individual faculty's tweets are personal or professional. Therefore, this mixture may inflate our estimation of Twitter usage as it relates to academic productivity. Data were collected over the period of 5 months which may introduce variability in metrics recorded. To minimize this temporal variation, academic data and Twitter data for each faculty member were always collected in the same week. Finally, although efforts were made to search for and verify accurate information, data were captured manually and there may be metrics that were not found due to data collection error.

CONCLUSION

In this analysis, we found increased utilization of Twitter amongst academic otolaryngologists and otolaryngology residency programs over the last decade. Adjusting for other variables in the model, we identified that individuals practicing in the Midwest or having an academic title of professor are most likely to have a Twitter account. Having a greater H-index or being younger (closer to residency graduation) was also associated with an increased odds of having a Twitter account. The number of individual faculty with a Twitter account was a predictor of program Twitter accounts. Importantly, we demonstrated that in the field of otolaryngology, Twitter utilization is generally not out of proportion with academic productivity. Rather, Twitter is an underutilized platform with apparent untapped potential for disseminating research, networking, and showcasing residency programs.

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CONFLICT OF INTEREST STATEMENT

The views expressed herein are those of the author(s) and do not necessarily reflect the official policy or position of the Defense Health Agency, the Brooke Army Medical Center, the Department of Defense, nor any agencies under the US Government.

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