

Prevention, Diagnosis, and Management of Upper Extremity Lymphedema Complications: Altmetric Analysis of Online Media

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Background: Traditional citation-based metrics do not capture the dissemination of upper extremity lymphedema (UEL) research that occurs online and in mainstream media. There is limited literature reporting the most impactful UEL articles based on citation rate and/or online mentions. We sought to use the Altmetric Attention Score (AAS) to determine the most impactful UEL articles in online media and to report trends in the diagnosis, treatment, and prevention of complications.

Methods: The Altmetric database was queried to identify all published articles regarding the management, diagnosis, and prevention of complications seen in the setting of UEL. Extracted data points included article topic and type, journal, and number of online mentions on several platforms.

Results: Our index search yielded 638 studies published between 2000 and 2021. Fifty articles with the highest AAS scores were included for analysis. The median AAS was 27.5, but the top four articles had AAS scores that were substantially higher (AAS \geq 334) than all other studies. Of the top 50 articles, 68% (34/50) were original research. Of those, 23.5% (8/34) were randomized control trials. The most common article topic was the treatment of UEL (36%; 18/50) followed by diagnostic methods of UEL (30%; 15/50). There were a total of 1156 Twitter mentions (median:14) for the top 50 articles. Of all media platforms, news mentions correlated most strongly with AAS ($R^2 = 0.99$, $P < 0.001$).

Conclusions: Our findings suggest that alternative metrics measure distinct components of article impact and add an important dimension to understanding the overall impact of published research on UEL. (*Plast Reconstr Surg Glob Open* 2022;10:e4024; doi: 10.1097/GOX.0000000000004024; Published online 18 April 2022.)

INTRODUCTION

It is estimated that 15% of breast cancer patients experience upper extremity lymphedema (UEL).¹ If axillary lymph node dissection is required, the incidence of UEL may increase to as high as 40%.² UEL is one of the most significant contributors to morbidity following breast cancer treatment and remains a significant survivorship issue. Impaired lymphatic drainage following breast surgery results in accumulation of lymphatic fluid and subsequent edema in the upper extremity. The swelling, pain,

and reduced mobility that ensue greatly affect quality of life in breast cancer patients.³ Furthermore, patients with UEL are prone to a multitude of complications including infection, loss of limb function, and psychosocial impairment.^{4,5} There is no known definitive cure for UEL, and the optimal treatment modality is debated.⁶ Surgical treatment options have evolved from debulking procedures to microsurgical procedures that target the pathophysiology underlying UEL.⁶ The management of UEL remains a highly studied topic as reflected by the increasing number of peer-reviewed articles published on this topic.

In recent years, alternative metrics (altmetrics) have gained popularity for their ability to supplement traditional citation counts when assessing the impact and influence of a given piece of research. Altmetric (London, UK) is a data

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science company that tracks the online attention generated by scientific articles to calculate Altmetric Attention Scores (AAS), which are updated regularly to provide up-to-date information. The AAS is a weighted score that assesses and quantifies the online impact of an article across various platforms including social media, mainstream news, blogs, and forums.⁷ AAS can range from 0, indicating no generation of online attention, to 367,741, the highest AAS score of 2020.⁸ A higher AAS correlates to a greater degree of online dissemination. Previous studies have utilized the AAS to identify high-impact articles circulating via online media outlets in a variety of medical specialties, such as cardiology,⁹ neurology,¹⁰ and emergency medicine.¹¹

Despite the use of altmetrics in other medical specialties, many journals do not routinely report Altmetric scores to bring visibility to online attention generated by specialty topics.¹² While bibliometric analyses are standard in assessing article impact, traditional citation metrics fail to comprehensively capture the online impact of UEL research, particularly in the modern age of social media. The primary aim of this study was to identify and report the most impactful UEL articles in online media based on AAS. The secondary objective was to report common trends in the prevention, diagnosis, and treatment of UEL based on the most impactful articles as indicated by AAS.

METHODS

The Altmetric database (Digital Science, Holtzbrinck Publishing) was searched for articles pertaining to UEL using the PubMed MeSH term “upper extremity lymphedema.” After stratification by descending AAS, articles were screened by title and abstract to exclude those that were pertaining to topics unrelated to the clinical management of UEL or articles that did not focus on UEL as the central topic. The 50 articles with the highest scores that were most relevant to UEL were included for analysis. The 50 top UEL articles by AAS were reviewed by five independent investigators (KMK, KGK, AAH, PKD, GS) to identify all discussed treatment interventions, diagnostic modalities, clinical management options, and preventative measures for complications in the setting of UEL. The objective of this secondary review was to identify specific topics within the clinical management of UEL which were generating the most attention online through AAS.

Several data elements were extracted from each article, including title, article type, article topic, year of publication, journal name, authors, institutional affiliations, and online mentions (ie, number of times the article was mentioned in the news, blogs, Twitter, Facebook, and Wikipedia). Article type was identified from the article abstract and classified into the following categories: original research (further sub-classified into prospective cohort, retrospective cohort, case-control, case series, case report, randomized controlled trial, or laboratory study), descriptive epidemiology, systematic review/meta-analysis, review article (nonsystematic), editorial/expert opinion, clinical commentary, or other. Article topics included diagnostics, treatment, and prevention of complications. Articles containing all three of these topics with no clear

Takeaways

Question: (1) How does the online dissemination of upper extremity lymphedema (UEL) research through mainstream media differ compared to academic journals? (2) Which research regarding the prevention, diagnosis, and management of UEL has had the most impact based on degree of online dissemination?

Findings: Articles with the highest Altmetric Attention Scores (AAS) were most commonly prospective cohort studies focusing on UEL treatment. Of all media platforms, news mentions correlated most strongly with AAS.

Meaning: The evaluation of online impact should serve as an adjunct to traditional citation metrics when characterizing the overall impact of upper extremity lymphedema research.

focus were categorized as clinical management. The institutional affiliation of the first author was utilized to categorize the geographic origin of the article as American (originating from the United States), Europe (originating from Europe), or other.

STATA 15.1 (StataCorp LLC, College Station, Tex.) was used for statistical analysis. The number of online mentions and AAS were described with median and interquartile range (IQR). Spearman correlation and logarithmic regression were used to determine the relationship between online mentions and AAS.

RESULTS

Our index search identified a total of 638 studies published between 2000 and 2021. Of the top 50 articles by AAS, the median AAS was 27.5 (IQR 18–43). AAS and mention data are summarized in [Table 1](#). Seventy-eight percent (39/50) of these studies had an AAS below 50. The top 50 articles were published between 2003 and 2020 in 27 journals, with the most common journals being *Plastic and Reconstructive Surgery* (n = 6, 12% 6/50), *Journal of Clinical Oncology* (10%; 5/50), and *Annals of Surgical Oncology* (10%; 5/50). Of the top 50 articles, 20% (n = 10) were published in journals specific to plastic and reconstructive surgery. A list of the top 50 UEL articles by AAS can be found in Supplemental Digital Content 1. (See [table, Supplemental Digital Content 1](#), which displays the top 50 articles according to AAS. <http://links.lww.com/PRSGO/C6>.)

Of the top 50 articles, the most common article type was original research (68%; 34/50), of which the most common subgroup was prospective cohort (22%; 11/50), followed by randomized controlled trial (16%; 8/50) and case series (14%; 7/50). The next most common article type was nonsystematic review (12%; 6/50). Article types comprising the top 50 UEL articles by AAS are summarized in [Figure 1](#). The most common article topic was the treatment of UEL (36%; 18/50), followed by diagnostic methods of UEL (30%; 15/50). Of the top 50 UEL articles by AAS, 26% pertained to the clinical management of UEL, which discussed the diagnosis, treatment, and

Table 1. Mention Data for Articles with the Top 50 AAS

Mention Data	Median	IQR	Total # Mentions
AAS (overall average)	27.5	18–43	—
Facebook	1	0–4	181
Twitter	14	5–14	1156
News	1	0–4	374
Mendeley readers	67	45–134	5375
Dimensions citations	31.5	19–94	4229

prevention of complications without emphasizing a single topic. Article topics discussed within the top 50 UEL articles by AAS are summarized in Figure 2. Of the included articles, 60% originated from within the United States (30/50), followed by 24% originating from outside the United States or Europe (12/50), and 16% from Europe (8/50). Geographic origin of the top 50 UEL articles by AAS is summarized in Figure 3. Article type exhibited the strongest correlation with AAS ($R^2 = 0.85, P < 0.001$), whereas article topic ($R^2 = 0.01, P = 0.88$) and geographic origin ($R^2 = 0.06, P = 0.72$) did not demonstrate any significant association with AAS.

The top four articles identified in this study had AAS scores that were substantially higher (AAS ≥ 334) than all other included articles. Of these articles, 50% focused on UEL treatment (2/4),^{13,14} 25% on diagnostic strategies (1/4),¹⁵ and 25% on the overall management of lymphedema (1/4).¹⁶ Three of these articles^{14–16} were published in the *Annals of Surgical Oncology* (75%; 3/4), whereas the other¹³ was published in *Plastic and Reconstructive Surgery* (25%; 1/4). These four articles comprised of two case series^{13,14} and two guideline practice articles.^{15,16} All four

of the articles with the highest AAS originated from within the United States.

Among the top 50 articles, there were a total of 1156 Twitter mentions (median: 14, IQR: 5–31), followed by 374 mentions in news (median: 1, IQR: 0–4), and 181 Facebook mentions (median: 1, IQR: 0–4). Of all media platforms, news mentions correlated most strongly with AAS ($R^2 = 0.99, P < 0.001$) whereas the other online media sources did not demonstrate a significant association with AAS (Facebook: $R^2 = 0.0167, P = 0.37$; Twitter: $R^2 = 0.0074, P = 0.55$). Conventional citation metrics also did not demonstrate a significant association with AAS (Dimension Citations: $R^2 = 0.0003, P = 0.90$; Mendeley Readers: $R^2 = 0.005, P = 0.62$).

DISCUSSION

To our knowledge, this study is the first of its kind to utilize AAS to identify and report articles investigating the diagnosis and management of UEL complications, a specific topic within plastic surgery. Of the top 50 most impactful articles based on AAS, a majority were prospective cohort studies originating from the United States focusing on either treatment or diagnosis of UEL. While randomized controlled trials were the next common article type, UEL literature may benefit from additional RCTs as they offer the strongest level of evidence. Altmetrics adds a unique dimension to the characterization of article impact, differing from traditional citation-based metrics. As the accessibility of scientific research extends beyond the sphere of academia and medical professionals alike, altmetrics provide the ability to quantify the impact of

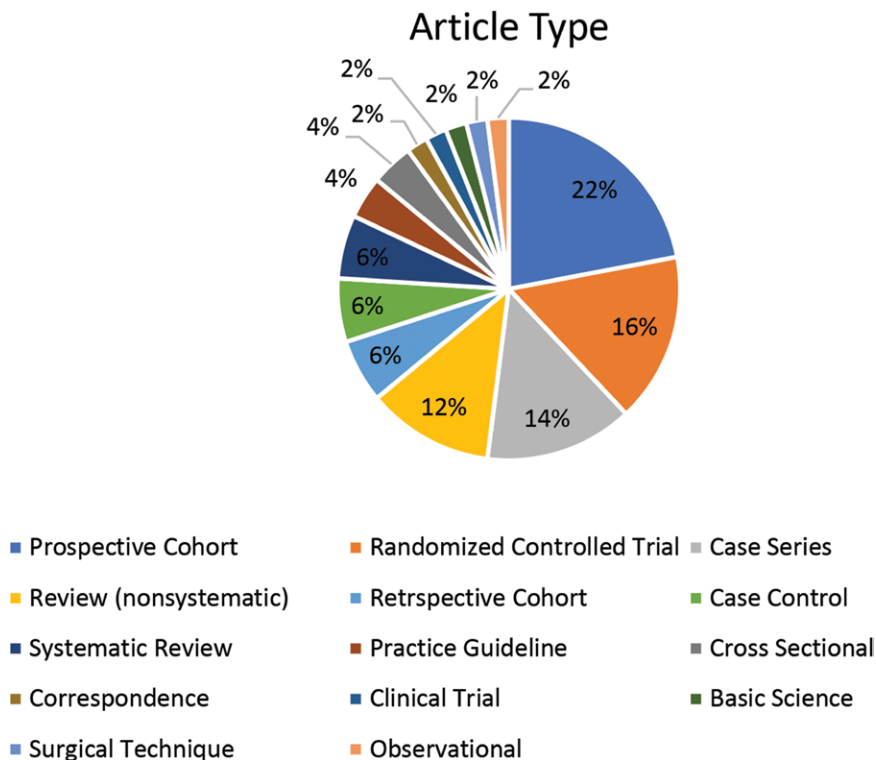


Fig. 1. Articles with the top 50 AAS according to article type.

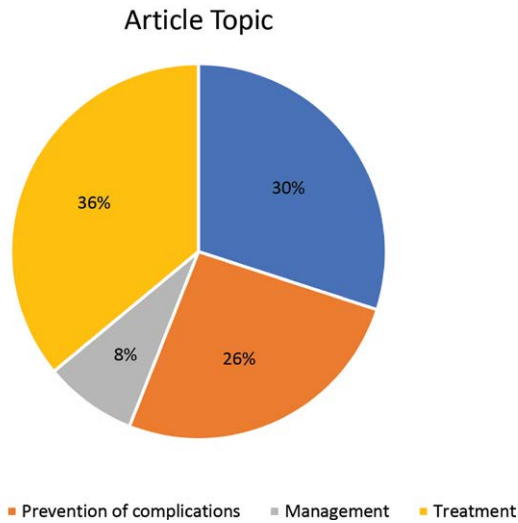


Fig. 2. Articles with the top 50 AAS according to article topic.

UEL research via online media. Furthermore, the global increase in social media engagement highlights the need for a supplement to conventional bibliometrics to demonstrate the overall impact an article may have beyond the scope of academia. Therefore, the utilization of AAS to supplement traditional citation-based metrics within plastic surgery may better characterize the overall impact generated by an article.

With regard to geographic origin, this study demonstrates a strong predominance of articles published in the United States. This is consistent with reports from a recent bibliometric analysis of the most-cited articles pertaining to abdominoplasty, which found a significant contribution by United States-based researchers. A majority of the top

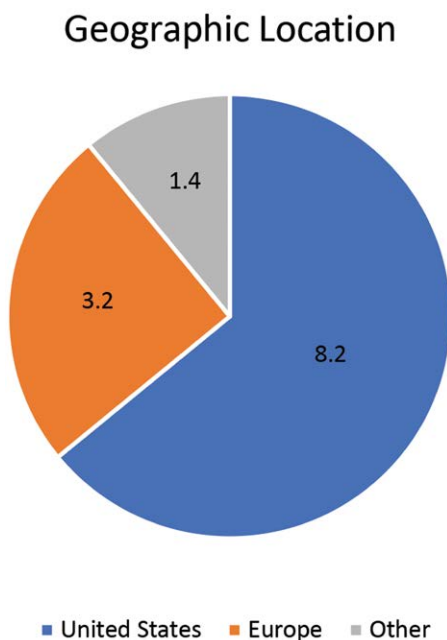


Fig. 3. Articles with the top 50 AAS according to geographic location.

50 UEL articles by AAS also originated from the United States, suggesting a publication bias concerning research in this field. Of note, the four articles with the highest AAS identified in the current study also originated from the United States, a trend consistently seen in Altmetric analyses in other subspecialties such as Orthopedic surgery.¹⁷ These findings may suggest that UEL research published from within the United States generates greater online attention when compared with the international community. However, considering the large interest surrounding UEL in the United States, specifically in a global context, it would be valuable to assess the geographic breakdown of online attention, as the AAS may be confounded by corresponding geographic interest.

Analysis of the top 50 UEL articles demonstrated that AAS strongly correlates with news mentions. UEL is a devastating and life-altering complication seen in up to 150,000 breast cancer patients annually in the United States alone.¹⁸ The prevalence of UEL secondary to breast carcinoma has become the subject of widespread public awareness campaigns by groups such as the Susan G. Komen Foundation and the American Cancer Society.¹ These organizations may assist in the dissemination of UEL research by publicizing new innovations in UEL management through news media outlets and their wide networks.¹⁹ These findings suggest that news media outlets play a powerful role in disseminating UEL research and may increase publicity more effectively than other public online platforms.

The vast majority of the top 50 UEL articles focused on the various treatment modalities available for UEL. Of these treatment-focused articles, 59% primarily discussed conservative therapy in treating UEL. However, articles emphasizing surgical management trended toward significance in generating greater online media attention compared with those focusing on conservative management (mean AAS = 188.6 versus 31.7; $P = 0.075$). While conservative therapy is the mainstay of UEL treatment,²⁰ as highlighted by the representative majority of the top 50 UEL articles identified,¹⁶ studies relating to surgical treatment of UEL seem to have greater dissemination and presence in online media. Specifically, the most online attention appears to be generated from reports of patient outcomes following lymphatic outflow obstruction through vascularized lymph node transfer (VLNT), lymphovenous anastomosis (LVA), or bypass (LVB). In total, 10% of the top 50 UEL articles mentioned LVA or LVB and 12% mentioned VLNT, highlighting online excitement surrounding research on microvascular reconstructive surgery options for UEL management. Online attention generated for microsurgical treatment of UEL is evidenced in the high AAS of Chang et al (AAS = 339), who reported favorable outcomes following LVB,¹³ and Gratzon et al (AAS = 334), who found a reduction in UEL symptoms one year after VLNT.¹⁴ Nonetheless, the consensus amongst the top 50 UEL articles is that combined decongestive therapy is the gold standard to reduce overall limb size, volume, and complications of UEL, a finding that is consistent with the current literature.²¹ Whether rooted in the flash value of surgery or hope of solving a devastating complication,

research surrounding the microsurgical treatment of UEL appears to be generating the most online attention, as measured by AAS.

The secondary objective of this study was to assess online attention surrounding the diagnosis and prevention of complications related to UEL. There are a variety of diagnostic modalities available, however, literature consensus centered on the use of bioimpedance spectroscopy, circumferential tape measure, and lymphoscintigraphy for diagnosis of UEL.^{15,20} Within the top 50 UEL articles, 24% mentioned circumferential tape measure, 18% mentioned lymphoscintigraphy, and 16% mentioned bioimpedance spectroscopy as diagnostic methods. The diagnostic method that generated the most online attention was the study by Ridner et al²² (AAS = 160), which reported the utility of bioimpedance spectroscopy in detecting subclinical UEL in the setting of breast-cancer-related lymphedema. While advantages and disadvantages for each diagnostic method outlined within the literature and in the present study remain, the literature consensus has yet to translate into a clinical diagnostic standard for the detection and evaluation of UEL.²³

Regarding the prevention of complications secondary to UEL, only 8% of UEL articles within the top 50 focused primarily on this topic, which may highlight a disparity in the execution, urgency, and dissemination of such research, when compared with topics such as treatment or diagnosis of UEL. Of the UEL prevention strategies discussed, intraoperative axillary management was mentioned in 16% of studies, whereas exercise was mentioned in 8% of studies. Following intraoperative axillary lymph node dissection, radiation, or sentinel lymph node biopsy (SLB), there is an increased risk of cellulitis and seroma.²⁴ Guide practices reported within UEL articles with the highest AAS agreed with existing recommendations²⁰ advocating for microsurgical management via VLNT, LVB¹⁶ or intraoperative reverse axillary mapping²⁵ to minimize complications following axillary lymph node dissection or SLB related UEL. Based on the contents of the top 50 UEL articles, the benefits of exercise seem to be garnering media attention,^{26,27} with 14% mentioning the potential in reducing the risk of complications secondary to UEL.²⁸ Although the online popularity of exercise for UEL is in line with current recommendations for exercise as an adjunct for complication risk reduction, there are mixed data regarding its efficacy as a monotherapy.²⁹

Limitations

There are several limitations inherent to Altmetric that may have affected the findings of the present study. Altmetric is updated daily, and therefore it is possible to generate a different list of top 50 articles depending upon the specific date on which the search was performed. Additionally, if journals or individual researchers were so inclined, they could inflate the AAS of their articles via self-promotion through online journal clubs or other social media outlets.^{30,31} Moreover, Altmetric does not

account for context and is solely dependent upon the volume of online mentions. Thus, both negative and positive discussion equally impact AAS, and a high AAS may not necessarily reflect a high-quality study.³⁰⁻³³ AAS is also dependent on social media platforms for the dissemination of scientific articles online and would have been limited to news outlet or academic journal websites as the means of generating attention. Articles published after 2004 would be more likely to have higher AAS because this was when Facebook was founded, and subsequently would provide a greater platform for disseminating scientific research.

CONCLUSIONS

The present study identified the top 50 most impactful UEL articles by AAS in online media. Within these articles, attention generated regarding the diagnosis, treatment, and prevention of complications in the setting of UEL was consistent with the current guidelines in the management of this feared outcome. Articles about microvascular treatment in the setting of UEL seemed to generate greater online attention when compared with those discussing diagnosis or complication prevention. While online media has inherent bias and conflicts of interest, AAS should not be used solely to gauge article impact or guide clinical practice, rather as an adjunct to traditional citation-based metrics. These findings suggest that alternative metrics measure distinct components of article impact and add an important dimension to understanding the overall impact of published research on UEL.

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