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Citation analysis of the 100 top-cited articles on the topic of hidradenitis suppurativa since 2013 using Sankey diagrams

Bibliometric analysis

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Abstract

Background: Hidradenitis suppurativa (HS) is a chronic, inflammatory and debilitating dermatosis characterized by painful nodules, sinus tracts and abscesses in apocrine gland-bearing areas that predominantly affect women worldwide. New therapeutic interventions based on the clinical manifestations of patients have recently been introduced in numerous articles. However, which countries, journals, subject categories, and articles have the ultimate influence remain unknown. This study aimed to display influential entities in 100 top-cited HS-related articles (T100HS) and investigate whether medical subject headings (i.e., MeSH terms) can be used to predict article citations.

Methods: T100HS data were extracted from PubMed since 2013. Subject categories were classified by MeSH terms using social network analysis. Sankey diagrams were applied to highlight the top 10 influential entities in T100HS from the three aspects of publication, citations, and the composited score using the hT index. The difference in article citations across subject categories and the predictive power of MeSH terms on article citations in T100HS were examined using one-way analysis of variance and regression analysis.

Results: The top three countries (the US, Italy, and Spain) accounts for 54% of the T100HS. The T100HS impact factor (IF) is 12.49 (IF = citations/100). Most articles were published in *J Am Acad Dermatol* (15%; IF = 18.07). Eight subject categories were used. The "methods" was the most frequent MeSH term, followed by "surgery" and "therapeutic use". Saunte et al, from Roskilde Hospital, Denmark, had 149 citations in PubMed for the most cited articles. Sankey diagrams were used to depict the network characteristics of the T100HS. Article citations did not differ by subject category ($F(7, 92) = 1.97$, $P = .067$). MeSH terms were evident in the number of article citations predicted ($F(1, 98) = 129.1106$; $P < .001$).

Conclusion: We achieved a breakthrough by displaying the characteristics of the T100HS network on the Sankey diagrams. MeSH terms may be used to classify articles into subject categories and predict T100HS citations. Future studies can apply the Sankey diagram to the bibliometrics of the 100 most-cited articles.

Abbreviations: DS = descriptive statistics, HS = hidradenitis suppurativa, IBP = impact beam plot, IF = impact factor, MeSH = medical subject headings, NEChiSQ = AAC indicators bases on nodes, edges, and chi-squared statistics, PMC = PubMed Central, RA = research achievements, RD = research domains, SNA = social network analysis, T100HS = 100 top-cited articles on the topic of hidradenitis suppurativa.

Keywords: bibliometric, citation analysis, hidradenitis suppurativa, medical subject heading, PubMed, Sankey diagram, social network analysis

1. Introduction

Hidradenitis suppurativa (HS) is a chronic, inflammatory and debilitating dermatosis characterized by painful nodules, sinus tracts, and abscesses in the apocrine gland-bearing areas. It mostly affects the axillary, inguinal, and anogenital regions. HS often occurs after puberty, with a female preponderance (female to male ratio, 3:1).[1] Intense pain lesions and

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All data generated or analyzed during this study are included in this published article [and its supplementary information files].

All data are publicly available in the PubMed library.

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malodorous discharge torment HS patients, causing profound negative impacts on the patient's quality of life, increasing suicidal ideation, and imposing a significant financial burden on the healthcare system and patients.[2] Although the pathogenesis of HS remains incompletely elucidated, follicular hyperkeratosis with occlusion and rupture leading to subsequent inflammatory response has been proposed to contribute to HS pathogenesis.[3] Therefore, the clinical evaluation and management of HS remain challenging. Numerous articles related to HS have been published over the past decade. However, the countries, journals, subject categories, and articles that have an ultimate influence on the topic of HS remain unknown.

1.1. Treatment and therapy in HS

The multifaceted clinical features of HS and the unpredictable course of the disease make management strategies highly variable, making it difficult to reach a uniform consensus on treatment. A variety of medical interventions, including antibiotic therapy and excisional surgical intervention, have been used to reduce the disease burden of HS, and treatment selection is individualized among patients, which greatly depends on the clinical presentation and disease severity. Adalimumab, a monoclonal antibody against tumor necrosis factor α (TNF-α), was the first biological agent approved by the U.S. Food and Drug Administration (FDA) for patients with moderate to severe HS.[4] However, owing to the highly variable effectiveness of adalimumab, other novel potential therapeutic targets are currently under investigation, including anti-interleukin-17 (IL-17), IL-1α, and complement inhibitors.[4,5] These advancements have substantially motivated physicians to intensify their therapeutic approaches and provide more information on the therapeutic possibilities of HS.

1.2. Bibliometric analysis and graphical study

With the increased attention on HS, especially targeted therapies for optimizing HS treatment in recent years,[6–8] we believe that bibliometric analysis is a useful tool for analyzing published literature, offering an efficient way to measure the scientific impact of articles by employing mathematical models and techniques in a particular field.[9,10] In this type of analysis, entities (e.g., countries, institutions, and authors) are identified. Researchers typically use citation counts to indicate their interest in journal articles.[11] Hence, bibliometric analyses can identify study hotspots, track evolution, reflect future trends, and provide comprehensive knowledge to researchers.[12,13]

In the PubMed database,[14] a search of titles containing the phrase "100 top-cited" retrieved 186 publications. There are three categories of information in these articles: descriptive statistics (DS), significant topics or article types with specific research domains (RD), and research achievements in entities (RA).[15] By using citation analysis, a widely used method to evaluate academic influence, the most influential articles were identified in orthopedic surgery,[16] subspecialties of arthroscopy,[17] foot and ankle,[18] arthroplasty,[19] pediatric orthopedics,[20] and spinal deformities.[21–24]

Although these studies helped us identify the main features that created an enormous distinction within the field and provided an overview for physicians and researchers in a discipline, two perspectives were frequently ignored because of the lack of a visualization for highlighting all relevant entities on a picture[25–27] and a way to predict the number of article citations for the future.[28–31]

1.3. Study aims

Some previous bibliometric analyses have focused on HS[32,33]; however, these analyses mostly performed basic analyses and listed superficial information about HS trends. Intuitive visualization and in-depth discussion are required to gain a better understanding of this enigmatic disease and its treatment options. Hence, our research goals were to analyze the 100 top-cited articles on HS treatment (T100HS) using a thorough search strategy to display influential entities in T100HS on the Sankey diagram[34,35] and investigate whether medical subject headings (i.e., MeSH terms) could be used to predict article citations. Assess the trends and clinical significance of the most frequently studied topics.

2. Methods

2.1. Data source

A two-step process was used to arrange data. First, we searched the PubMed database on April 22, 2022, using the keywords ("2013"[Date - Publication]: "2022"[Date - Publication]) and ((HS and treatment [MeSH Major Topic]))) without restrictions on language or country and matched articles to the number of citations on the ICite analysis website.[36] Publications with major MeSH topic were included in the analyses. Relevant metadata (e.g., year of publication, country of origin, research category, document type, publishing journal, citation count and MeSH terms) were collected from T100HS.[37]

Second, based on the article metadata, two parts were included: visualizations using the Sankey diagram[34,35] to display all relevant entities and their associations and inferring statistics using MeSH terms to predict article citations for articles in addition to DS, RD, and RA,[15] as frequently reported in traditional bibliographical studies.[16–23]

This study did not require ethical approval, as all data were obtained from a publicly available database.

2.2. Data arrangements and presentations

To identify the 100 most-cited clinical studies on HS treatment, we reviewed the titles and abstracts of the articles, excluded irrelevant papers and ranked the final search results based on the number of citations. We extracted major entities from each article, including the title, abstract, authors, publication year, country of origin, citation counts, journal, identity number in PubMed (PMID), and major topic MeSHs. If the authors had more than one affiliation from different countries, the first affiliation was used as the country of origin. Major topics MeSHs (with the symbol of asterisk for each article in PubMed) were covered and subheadings were removed.

2.2.1. DS. Two tables were produced to present the contributions denoted by publications and citations from countries/regions over the years, and the journal distributions of the literature.

2.2.2. Major topics or article types with RD. Article subject categories (based on MeSH terms in PubMed and T100HS) were identified using social network analysis (SNA)[26] and Pajek software.[38] Closer terms appeared in identical subnetworks. Relevant terms gathered in subject categories were highlighted on a dynamic visual dashboard as a mode of the traditional word cloud.[39] The most frequently used terms in the respective clusters implicit the themes which is highlighted by SNA. As such, each article can be further classified according to the representative MeSH terms of the belonging clusters. One-way analysis of variance along with a box plot was performed to examine the differences in article citations among the subject categories.

2.2.3. RA. Citation analysis was conducted to understand the RAs that contributed to HS among the subject categories and other article-related metadata (i.e., entities). The T100HS[37] since 2013 were dotted on the impact beam plot (IBP),[36,40] a

new visualization tool using citation percentiles (i.e., via the percent rank function in MS Excel, Microsoft Corp.) to display the article impact from 0 to 100 by years (based on normalized citation percentiles for each article).[36,41] The overall hT index[42,43] and h-index[44] were compared with the median score on the IBP using the online technique.[45]

2.2.3. Visualizations using the Sankey diagram. One look is worth a thousand words and quite a few numbers.[46] The Sankey diagram is a data visualization technique that allows researchers to depict the association between article characteristics. In our study, Sankey diagrams[34,35] were drawn based on article numbers and hT-indices[42] in T100HS for entities, including publication years, subject categories, document types, journals, countries of origin, institutes, and authors. The more proportional publications (or citations and hT-indices) in the Sankey diagram would have more giant blocks in the height and flow. By observing the width and color of the flow, we can examine the relationship between entities and their neighbors.

2.2.5. Inferring statistics using MeSH terms to predict article citations. The impact factors (IFs = mean citations) of MeSH terms were computed based on equal-sized proportions and citations in an article.[11] The weighted scores yielded by the MeSH weights (i.e., the number of citations per article) in each article were used to predict the original citations.[11,15,47] Regression analysis was applied to examine the prediction power of MeSH terms on article citations in T100HS.

2.2.6. Article numbers and patterns of countries pertaining to journals and categories. Article numbers and patterns of five dominant countries pertaining to five dominant journals and five dominant subject categories were compared based on three scenarios of most cited articles: Top 100, Top 50, and Top 30. Three indicators (named AAC indicators bases on nodes, edges, and chi-squared statistics (NEChiSQ)) were observed, including absolute advantage coefficients (AACs) (see Equations (1)-(3))[47–49] in (1) nodes (i.e., countries, journals, and subject categories) and (2) edges (i.e., weights between the two adjacent nodes) on the Sankey diagram; and ChiSQ $(=\chi^2)$ *statistics* in two occasions (i.e., countries between journals and categories) as well as three scenarios of the most cited articles (i.e., Top 100, Top 50, and Top 30).

$$AAC = (R_{12}/R_{23})/(1 + (R_{12}/R_{23})), \quad (1)$$

$$R_{12} = A1/A2, \quad (2)$$

$$R_{23} = A2/A3, \quad (3)$$

where the AAC ratio is determined by the three consecutive numbers of values (e.g., counts in nodes and weights in edges in descending order denoted by $A1$, $A2$, and $A3$ in Eqs. (2) and (3)). The ACC ranged from 0 to 1.0, representing the strength of dominance for the top one when compared to the next two members. Through the computation of AAC, the dominance strength in a variable (i.e., country, journal, or category) can be measured and judged by the effect size, with criteria of <0.5, between 0.5 and 0.7, and not less than 0.7 as the small, medium, and large effect size, respectively.

The null hypothesis is that those NEChiSQ indicators among the three scenarios of the most cited articles (i.e., Top 100, Top 50, and Top 30) are totally identical.

2.3 Statistics and tools

A visual representation on a dashboard was developed to present the research results. Author-made modules were constructed via the following process: we create all graphs in MS Excel, including the preparedness for producing the Sankey diagrams, and created pages of HTML with Google Maps.

The t value based on the correlation coefficient is denoted by the formula.$\left(= CC \times \sqrt{\frac{n-2}{1-CC\times CC}}\right)$[11] Simple regression analysis was performed using MedCalc statistical software, version 9.5.0.0 (MedCalc, New York, NY), to generate a prediction equation. The significance level was set at a type I error (0.05).

A scatter plot was used to display the relationship between {article citations, MeSH weights} and citations obtained from the ICite analysis[36] in the T100HS. All relevant information on the entities can be linked to dashboards on Google Maps. The dashboard of Google Maps is uniquely created using traditional BibExcel software.[50] The Sankey diagram was drawn using the MS Excel module and deposited in Supplemental Digital Contents 1, http://links.lww.com/MD/H643 and 2, http://links.lww.com/MD/H644.

3. Results

3.1. DS

The top 100 most frequently cited articles in the field of treatment related to HS are listed in a link.[37] Twenty countries have listed in the T100HS (Table 1). A total of 54% of T100HS is occupied by the top three countries (USA, Italy, and Spain). The USA dominated the field, with 35 T100HS articles (n = 35) and 8.26 citations per article, followed by Italy (n = 11, 8.64 citations per article) and Spain (n = 8, 12.88 citations per article), as shown in Table 1.

The two dominant journals with the highest number of publications were *J Am Acad Dermatol* (n = 15, IF = 18.07) and *Dermatol Surg* (n = 8, IF = 5). *Br J Dermatol* had the highest average number of citations per article (50.25), far beyond the other journals in our study. The overall T100HS impact factor was 12.49 (IF = citations/100), as shown in Table 2.

3.2. Major topics or article types with RD

Eight subject categories denoted by MeSH terms were classified using SNA. The most frequently occurring MeSH terms were "methods," followed by "surgery" and "therapeutic use". A visual presentation with the highest frequency of MeSH terms is provided via the blue triangle line linked together in Figure 1. Article citations did not differ by subject category ($F(7, 92) = 1.97$, $P = .067$). At the bottom of Figure 1, the box plot shows the distribution of weighted citations for each category.

3.3. RA in entities

To identify the relationship between the investigated characteristics on the topic of HS treatment, we constructed a Sankey diagram to show the flow of information, including article citation counts, categories, published journals, origin countries, institutions, and authors, as shown in Figures 2 and 3. We can see that the top three categories are "methods" (31%), followed by "therapeutic use" (22%), and "surgery" (21%). In other words, these subject categories account for the majority of publications in T100HS. Only the top-dominant entities with the closest relationships are displayed and connected by arcs (or, say, edges in the Sankey) from left to right. For example, 2015 is connected mostly with journal articles and then sequentially links to the next entity *J Am Acad Dermatol*. Through the following arcs, we can speculate that the US, Henry Ford Hospital (US), and four authors ranked top in publications; see the higher block in Figure 2.

Similarly, the top three that earn the highest citations in T100HS are "methods" (297), "therapeutic use" (277), and "complications" (218), respectively, as shown in Figure 3. Other entities with more citations were the 2015, journal article, *Br J*

Table 1

Distribution of publications for countries/regions over years.

Area	2013	2014	2015	2016	2017	2018	2019	2020	2021	n	ci	IF
Africa			1							1	30	30
Egypt			1							1	30	30
Asia	1	3	2	1	2	1	1			11	72	6.55
China	1		1		1	1	1			5	24	4.8
India		1								1	3	3
Japan		2	1		1					4	33	8.25
Turkey				1						1	12	12
Europe	3	4	8	5	4	5	9	6	3	47	731	15.55
Denmark			2	1	1		1			5	241	48.2
France	1	1				3				5	32	6.4
Germany				1				1	2	4	51	12.75
Ireland			1					1		2	5	2.5
Italy			2	1		1	4	3		11	95	8.64
Netherlands			1		2	1	1		1	6	94	15.67
Norway				1						1	4	4
Poland							1			1	18	18
Spain	1	1	2		1		2	1		8	103	12.88
U.K.	1	2		1						4	88	22
N. America		3	8	2	2	1	4	12	5	37	384	10.38
Canada			2							2	95	47.5
US		3	6	2	2	1	4	12	5	35	289	8.26
Oceania		1								1	10	10
Australia		1								1	10	10
S. America		1		1	1					3	22	7.33
Chile		1		1						2	16	8
Colombia					1					1	6	6
n	4	12	19	9	9	7	14	18	8	100	1249	12.49

IF = ci/n.

Table 2

Distribution of publications for journals over years.

Journal	2013	2014	2015	2016	2017	2018	2019	2020	2021	n	ci	IF
J Am Acad Dermatol	1	1	6					5	2	15	271	18.07
Dermatol Surg	1	2	1	1		1	1		1	8	40	5
Int Wound J			2		2		1	1		6	70	11.67
Br J Dermatol			2				1	1		4	201	50.25
Photodiagnosis Photodyn Ther					1	2	1			4	21	5.25
Am J Clin Dermatol			1		1			1		3	34	11.33
Clin Exp Dermatol		1	1				1			3	71	23.67
Dermatology		1						2		3	37	12.33
Int J Dermatol				1		1		1		3	25	8.33
J Eur Acad Dermatol Venereol			1				2			3	51	17
J Plast Reconstr Aesthet Surg		1	1	1						3	58	19.33
JAMA Dermatol								1	2	3	9	3
Dermatol Ther			1	1						2	47	23.5
G Ital Dermatol Venereol								2		2	6	3
J Drugs Dermatol				1				1		2	29	14.5
Semin Cutan Med Surg					2					2	17	8.5
Urology		1	1							2	37	18.5
Actas Dermosifiliogr		1								1	13	13
Actas Dermosifiliogr (Engl Ed)								1		1	2	2
Aesthetic Plast Surg		1								1	4	4
Subtotal	2	3	2	4	3	3	7	2	3	29	206	7.1
n	4	12	19	9	9	7	14	18	8	100	1249	12.49

Dermatol, Denmark, Roskilde Hospital (Denmark), and author Saunte from Denmark, with 149 citations.

T100HS since 2013 with dots are shown in the IBPs (Fig. 4). Each dot on the beam plot represents one or more publications, which are plotted on the *x*-axis according to the citation percentiles. The vertical line represents the mean score. $h = 20$ and $hT = 16.73$ are computed based on article citations. Readers are invited to scan the QR code on the IBP and click on the dot (e.g., the rightmost one in 2015). The most cited article authored by Saunte et al from the Department of Dermatology, Roskilde Hospital in Denmark will immediately appear, with 149 citations in the PubMed database (PMID: 26198191).[51]

3.4. The Ht-index in T100HS

One look is worth a thousand words and quite a few numbers.[46] The top 10 entities with higher hT indices are shown in the Sankey diagram. The entities with higher hT indices

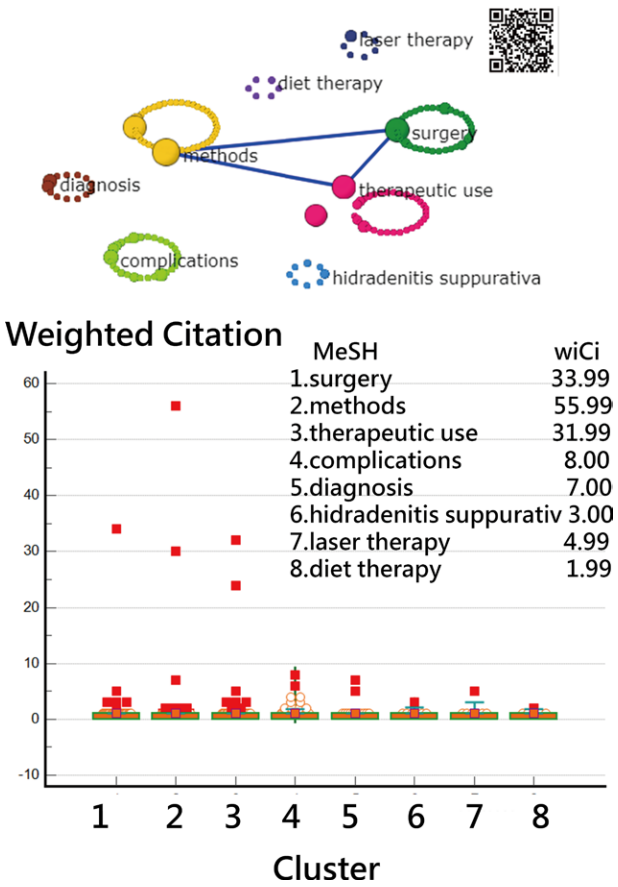

Figure 1. Classification of article categories using social network analysis and the box plot.

were the 2015, journal article, *J Am Acad Dermatol*, the US, Henry Ford Hospital (US), and the author Zouboulis from Germany, with two articles having 15 and 11 citations, and hT = 3.8.

3.5. Inferring statistics using MeSH terms to predict article citations

We found no significant difference in article citations among categories ($F(7, 92) = 1.977$, $P = .067$). However, MeSH terms were evident in the prediction power of article citation counts ($F(1, 98) = 129.1106$; $P < .001$). The prediction equation was defined as article citation = –13.0020 + 2.3741 × MeSH weight.

3.6. Article numbers and patterns of countries pertaining to journals and categories

The results from a small study on the relationship among Top 30, Top 50, and Top 100 are shown in Figure 7. It can be seen that NEChiSQ indicators among the three scenarios of the most cited articles (i.e., Top 100, Top 50, and Top 30) are not totally identical. For example, a small dominance effect on countries (=0.49) in the Top-30 scenario at the bottom of Figure 7 against large effect (with AAC = 0.74) in Top-100 and Top-50 scenarios, and a medium dominance effect on journals (=0.61) in the Top-30 scenario at the bottom of Figure 7 against large effect (with AAC = 0.77) in Top-100 and Top-50 scenarios.

Figure 7 shows that the top five countries, journals, and categories differ greatly between the three scenarios, which indicate that their sample sizes result in different trends.

3.7. Online dashboards shown on Google Maps

All dashboards in the figures appear immediately once the QR code (or link[52–55]) is clicked. Readers are advised to examine the details of each entity's information on dashboards.

4. Discussion

4.1. Principal findings

In a bibliometric analysis of the PubMed database, we identified the 100 most-cited articles related to HS and its treatments from 2013 to 2021. According to our results, the top three countries (the United States, Italy, and Spain) account for 54% of the T100HS. The top three countries for medical research productivity in the field of HS treatment are the United States and European countries, which is consistent with overall global publication trends.[56]

The prevalence of HS varies significantly around the world, ranging from 0.03% to 4%.[57] As determined by a meta-analysis published in 2020,[57] Europe (0.8%) and the USA (0.2%) were the two countries with the highest prevalence of HS, which may also explain the above-mentioned findings.

In the current study, the Sankey diagram indicates that the majority of articles from the US, Italy, or Spain were published primarily

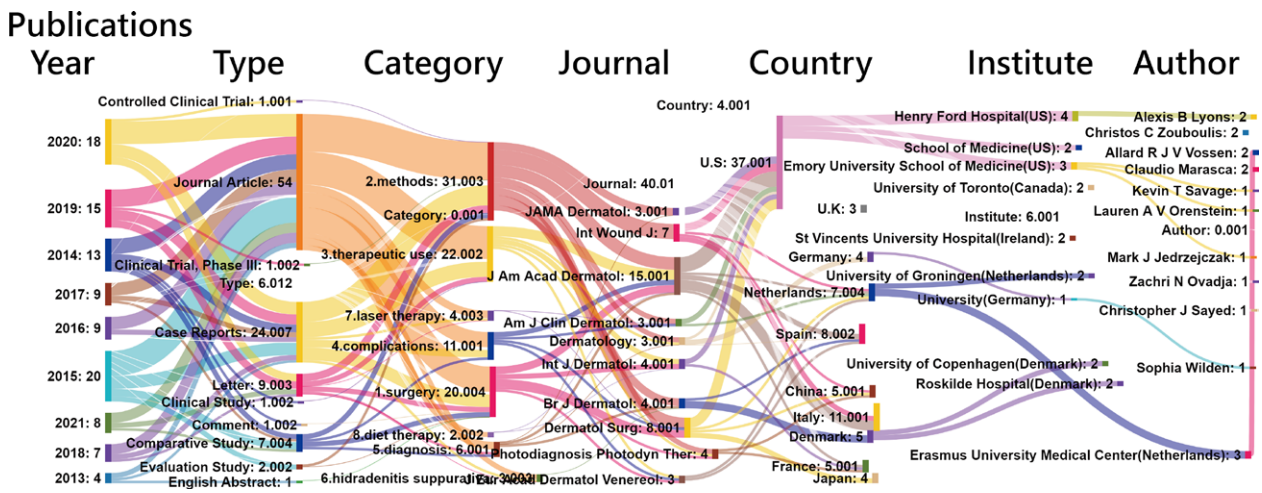

Figure 2. Publications of variables for top elements of each entity using the Sankey diagram.

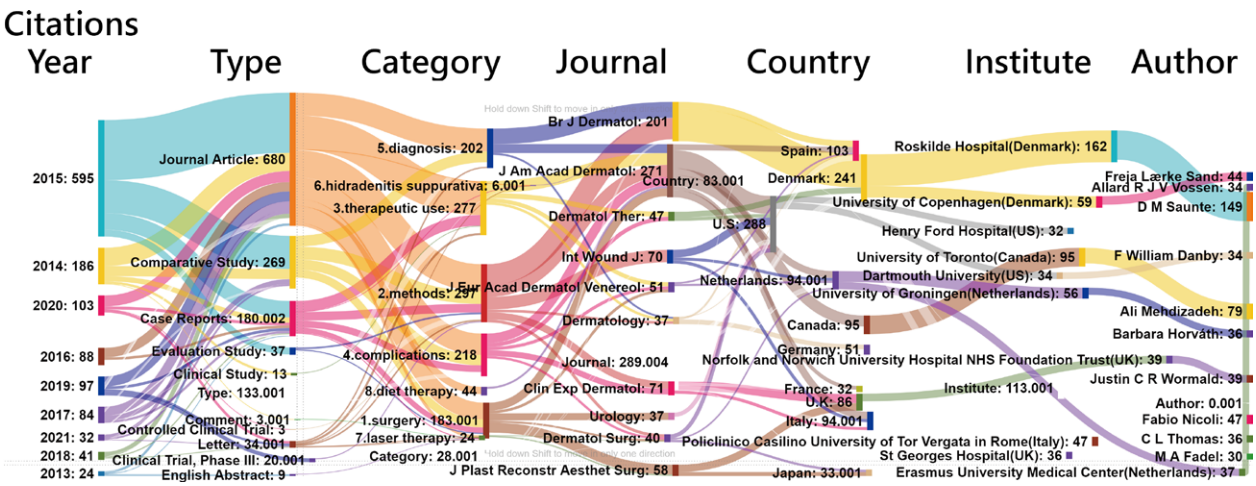

Figure 3. Citations of variables for top elements of each entity using the Sankey diagram.

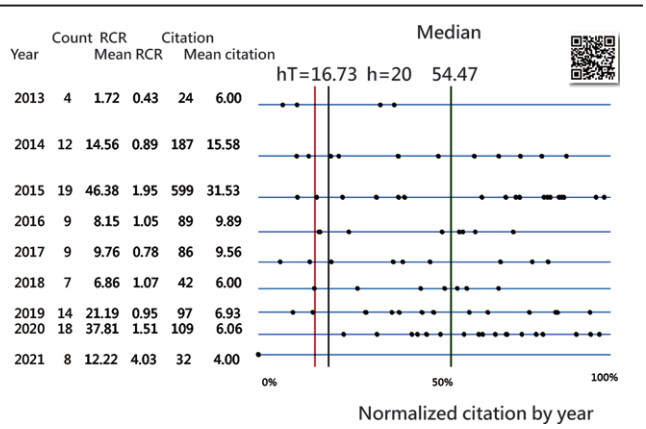

Figure 4. Impact beam plot for the T100HS. T100HS = 100 top-cited articles on the topic of hidradenitis suppurativa.

in the *J Am Acad Dermatol*. The result is not surprising since *J Am Acad Dermatol* is one of the premier dermatology journals with a high IF. It is inherent that researchers tend to select journals with high IF for citations. Moreover, a distinct difference found in comparison with the study[32] is attributed to their differences in sample sizes (100 vs 50), year span (2013-2021 vs 1950-2020), and bibliometric databases (PubMed vs Web of Science).

A rapid increase in publications has been observed on the topic of HS treatment, with 84% (84/100) of the total articles published during the past five years. It is important to note that adalimumab, a biological agent with high efficacy, was the first to be approved by the US Food and Drug Administration for the treatment of moderate to severe HS patients in 2015. HS research may have grown as a result of this.

Additionally, the overall T100HS impact factor was 12.49 (IF = citations per 100). The most frequently cited article was published by *J Am Acad Dermatol* (15%; IF = 18.07), followed by *Dermatol Surg* (8%; IF = 5).

Eight subject categories were identified based on SNA. The most frequently occurring MeSH terms were methods, followed by surgery and therapeutic use. The category "method" ranked first. Using SNA to classify subject categories in articles is promising and expected in bibliometrics.[24]

There is no single effective management strategy for HS. Thus, physicians typically use different treatment modalities, such as combination therapy or novel approaches, to assist patients in combatting this disorder. There is a possibility that dermatologists are highly interested in finding multifaceted approaches to make an evidence-based decision for patients with HS.

Furthermore, we presented Sankey diagrams to illustrate the network characteristics of T100HS. There was no difference in article citations between the category clusters ($F(7, 92) = 1.977$, $P = .067$) (Fig. 1). A significant association was found between MeSH terms and the number of article citations ($F(1, 98) = 129.1106$; $P < .001$).

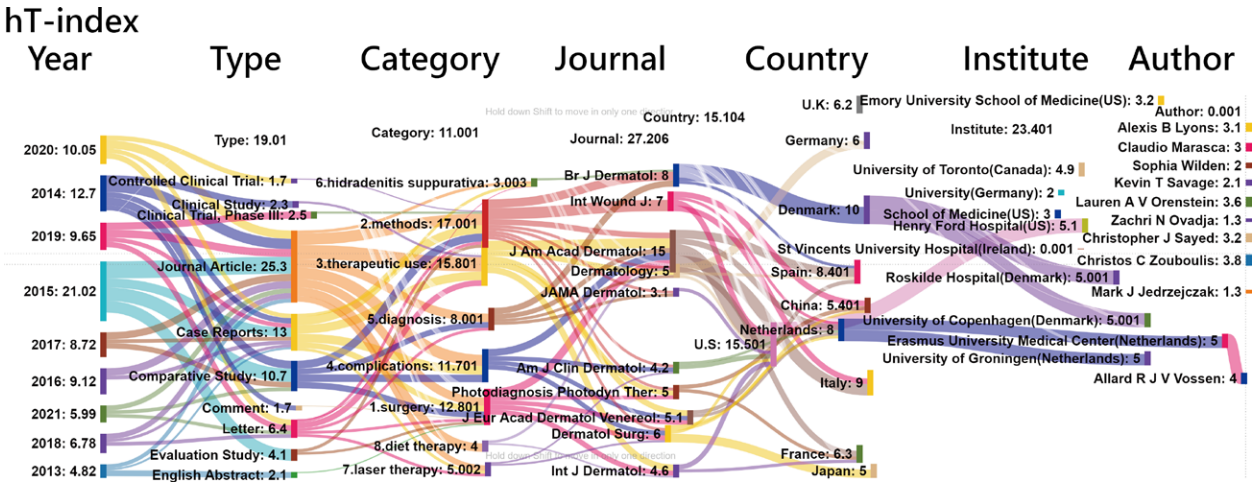

Figure 5. hT-index of variables for top elements of each entity using the Sankey diagram.

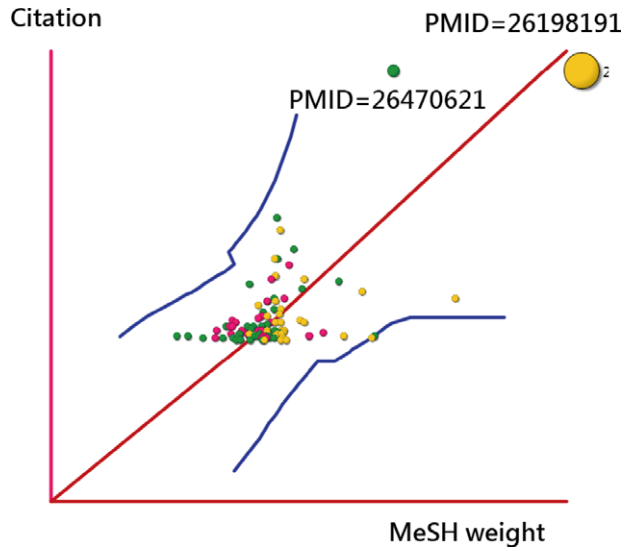

Figure 6. Predicting article citations using weights of MeSH terms. MeSH = medical subject headings.

4.2. Additional information

T100HS articles from the PubMed database were categorized into eight categories based on MeSH terms using SNA. We used Sankey diagrams to determine the features and underlying relationships in T100HS articles. Using these concise diagrams, dermatologists may find relevant articles more efficiently, facilitating evidence-based decision-making for patients with HS.

The SNA was used to determine the article subject categories associated with frequent counts and citations. A combination of publications and citations contributed to the highest hT-index for the category "methods", followed by "therapeutic use" and "surgery". A possible reason for this result is that dermatologists must realize that HS-related articles with higher hTs are present in the domain of dermatological research. This may be partly attributed to the critical role and interest of the three subjects revealed in T100HS. This study applied SNA to classify T100HS and provides deeper insight into the hot spots and topics related to HS. From our point of view, the classification approach can be applied to other science mapping studies, not limited to HS, in the future.

Additionally, the reasons for demonstrating the hT-index in the current study are: the hT-index has an identical h-core with the h-index,[44] there is a strong association with the h-index,[42,43] and all publications and citations are taken into account to overcome the disadvantages associated with many bibliometric indices.

To date, no studies related to T100HS have been identified in the PubMed database. This study is the first to use bibliometric analysis in the field of HS treatment. In Figure 4, a dashboard-type IBP provides information rather than the 100 articles listed across all the papers in a study. This is a unique and modern approach that has not been reported in the literature. The IBP presents the T100HS in a single view and provides more context than a single metric, such as a citation metric (or the h-index[44]) alone in bibliometrics. A bibliometric analysis can be performed in this manner using the hT-index in the future.

4.3. Three most-cited articles

The top-cited paper titled "Diagnostic delay in hidradenitis suppurativa is a global problem" was published in *Br J Dermatol* by Saunte et al[51] in 2015. A total of 149 citations were found for this article, which was categorized as a "diagnosis" in our study. This study revealed that a mean diagnostic delay of more than

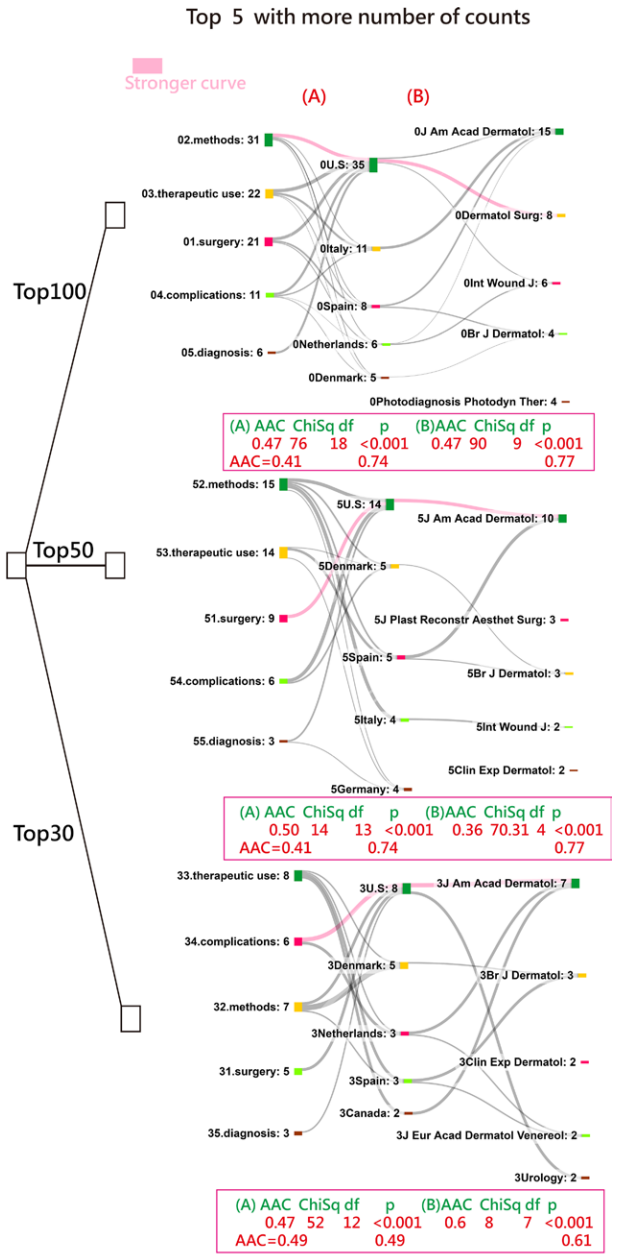

Figure 7. Article numbers and patterns of countries pertaining to journals and categories based on NEChiSQ indicators. NEChiSQ = AAC indicators bases on nodes, edges, and chi-squared statistics.

seven years was noted due to insufficient awareness of HS. Early and accurate diagnosis is crucial for preventing disease progression. It is therefore crucial that primary care physicians, dermatologists, and surgeons recognize this disease at an early stage. HS patients can benefit from integrated and prompt care from multiple specialties as well as aggressive treatment to improve their prognosis.

The second most highly cited article was written by Mehdizadeh et al,[58] published in 2015 in *J Am Acad Dermatol*, and classified as "complications" in our study. This article was cited 79 times. This study showed that the highest recurrence rate of HS postoperatively was observed after minimally invasive procedures such as deroofing procedures (27%). The recurrence rates in the wide excision groups were lower, particularly those using skin flaps (8%) or skin grafts (6%) as closure methods.[58]

Clinical physicians who are considering surgical treatment for advanced HS are reminded of the possibility of wide excision as a better alternative.

The third most-cited article was authored by Nicoli et al[59] and was titled "Severe hidradenitis suppurativa treatment using platelet-rich plasma gel and Hyalomatrix" which was published in 2015 in *Int Wound J*. It was cited 47 times and classified as "methods" within our study. A patient with severe HS who underwent secondary wound closure with PRP gel and Hylaomatrix was documented in the article. This article sheds light on potential treatment approaches for this distressing disease. It is the reason why this publication has been frequently cited in many studies.

4.4. Implications and changes

Seivright et al[32] examined the top 50 most-cited articles on HS using bibliometric analysis. An overall publication trend was examined using a traditional diagram and each metric was examined separately (e.g., study topics and country of origin). In addition, Seivright et al[32] highlighted that the number of cited articles related to HS pathogenesis and comorbidities has significantly increased over the past few decades. Below are some key features that are intended to compensate for the shortcomings of the previous study.

First, instead of using many tables and graphs in a traditional manner (e.g., the study[32] used too much space to list all 50 articles), we use the Sankey diagram and IBP.

Second, we use a Sankey diagram to illustrate the relationships between the article characteristics and the influential entities. With the help of SNA, different variables were integrated into one picture (e.g., Fig. 1) displayed on Google Maps. In terms of article categories, "method" earned the highest mean number of citations. There are numerous treatments available for HS, and physicians are concerned more about improving management that might alleviate patients' symptoms and improve their prognosis and quality of life.

Third, there is statistical evidence that the major topic MeSH terms are associated with citations of articles. Therefore, it is possible to identify the most dominant research topic in the field of HS treatment by applying the major MeSH terms to predict the number of article citations. Moreover, while the previous study[32] presented entities primarily using statically statistical graphs (e.g., bar graphs), we identified the major MeSH terms using a dynamic dashboard.

Last, we discuss in detail the characteristics of the top three most frequently cited HS articles since 2013 that contributed to their frequent citation and hT-index in HS, which differs from the traditional approaches used before for displaying entities merely on a statistic graph or table.

4.5. Limitations

Despite the results shown above, there are still a few limitations to mention in our study that warrant further investigation. First, we retrieved the data and top-cited articles from a single search database. There is a possibility that publications in other major citation databases, such as Scopus, Web of Science, and Google Scholar, have been overlooked and the number of citations has been underestimated.

Second, there may be biases in the citation extraction process owing to the time effect, which can greatly influence the number of citations. Some recently published but important literature may have had fewer citations and may even have been omitted since we analyzed articles published prior to 2021.

Third, although the visual presentation in our study is unique, condensing all relevant entities on one graph may become overly complex. In a short time period, it is difficult for readers to absorb all the information without becoming confused unless a useful and meaningful diagram can be provided, such as the Sankey diagram presented in this study.

Fourth, the number of articles cited may be affected by confounding factors such as journal impact factors and authorship. As a result, this number may not accurately reflect the actual impact of an article.

5. Conclusion

A breakthrough was achieved by drawing a Sankey diagram to understand the network characteristics of T100HS. MeSH terms can be used to classify article categories and predict T100HS citations. In future studies, the Sankey diagram may be used to quantify bibliometric data for the 100 top-cited articles, rather than focusing on HS only, as in this study.

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Author contributions

T.Y.Y and T.W.C initiated the research, collected data, conducted the analysis, and wrote the manuscript. T. Y. Y. and T. W. C. contributed to the design of the study and provided critical reviews of the manuscript, and F.J.L contributed to the interpretation of the results and monitored the study.
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Supervision: Feng-Jie Lai.
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Visualization: Tsair-Wei Chien.
Writing – original draft: Ting-ya Yang.
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