

Robert KACZMARCZYK^a
 Felix KING^a
 Linda TIZEK
 Tilo BIEDERMANN
 Alexander ZINK

Technical University of Munich, School of
 Medicine, Department of Dermatology and
 Allergy, Biedersteiner Strasse 29,
 80802 Munich, Germany

Reprints: Robert Kaczmarczyk
 <Robert.Kaczmarczyk@mri.tum.de>
 <alexander.zink@tum.de>

Visualising the past to plan the future: a network analysis of the largest European dermatology conference

Background: The annual conference of the European Academy of Dermatology and Venereology is one the largest dermatology conferences worldwide. **Objectives:** Network analysis can be used for in-depth insight into trending topics and underlying trends at the congress. **Materials & Methods:** Network analysis was employed to assess the entirety of the submitted abstracts to the congress in 2019. The data were processed, analysed, and visualised using easy-to-understand network graphs. Topics were then compared to their respective global burden (Disease Adjusted Life Years [DALYs]) and the number of respective publications on PubMed in the year 2018. **Results:** Overall, 1,280 lecture titles and 1,941 poster titles were included in the final analysis. The most frequently used terms were “patients” ($n = 473$), “treatment” ($n = 301$), and “psoriasis” ($n = 335$). Relative to DALYs, “psoriasis” (+21.9%) among others, was rather over-represented, while “fungal skin diseases” (-7.6%) and “urticaria” (-6.4%) were under-represented. Compared to the relative number of PubMed publications in 2018, “psoriasis” (+20.3%), “acne” (+7.9%), and “alopecia” (+3.1%) were over-represented, while “melanoma” (-22.5%), “dermatitis” (-4.2%) and “pruritus” (-3.4%) were rather under-represented. **Conclusion:** The network analysis showed that the congress was a patient and therapy-centred event. An explanation for the particular focus on chronic inflammatory skin diseases and melanoma would be the introduction of new therapies at the congress. To delineate trends over time, a longitudinal network analysis including several congresses should be conducted and could be used to determine additional topics to be included in future events

Key words: network analysis, dermatology, scientography, conference, digital medicine, psoriasis, melanoma, DALY

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When Europe’s dermatologists congregate annually at the congress of the European Academy of Dermatology and Venereology (EADV), there is so much to see and experience that it is simply not possible for everyone to do so. In 2019, the event was held in Madrid, Spain and attracted around 13,000 visitors from over 100 countries, providing a jaw-dropping number of 1,280 lectures and 1,941 posters, making it one of the largest conferences in dermatology worldwide. The latest developments in scientific research and clinical practice were laid out by most prolific researchers and clinicians in dermatology. They were shared and discussed in order to influence patient care around the world [1].

Because of the sheer volume of large congresses, it is hard to grasp which topics were especially focused on and which, conversely, were rather under-represented. The focus of worldwide research on a specific topic can

be somewhat interpreted by the number of publications available on PubMed, the publication database by the United States National Library of Medicine. For example, in 2018, there were around 20,000 publications focusing on dermatologic diseases such as psoriasis, atopic dermatitis, and urticaria; the highest number corresponding to melanoma-related publications [2]. Another way to interpret the significance and importance of specific diseases is to use Disability-Adjusted Life Years (DALYs), a measure of the overall global disease burden expressed as the number of years lost due to illness, disability, and early death [3, 4]. Skin conditions were responsible for 41.6 million DALYs in 2013, meaning that 1.8% of the global burden of disease was due to a skin condition. Dermatitis, which causes 9.3 million DALYs, had the highest burden worldwide, followed by acne vulgaris (7.2 million DALYs), urticaria (4.7 million DALYs), and psoriasis (4.7 million DALYs) [3]. Considering Europe, the burden of psoriasis, for example, was higher in Western and Northern Europe compared to Eastern Europe [5].

^a These authors contributed equally

To process, analyse, and visualise big data such as all titles of a conference with 13,000 visitors, network analysis, an upcoming computational method, could be used to make big data accessible for interpretation. Network analysis is able to map knowledge structures by the co-occurrence of specific words in any data set of any size, which makes it a valuable tool, especially in times of big data and artificial intelligence [6, 7]. This tool has been widely used in social and political sciences [8, 9]. However, in the medical field, it has only scarcely been used aside from a small number of epidemiological publications [10-12].

The objective of this study was to use network analysis for an in-depth insight into topics that were focused on at one of the largest dermatology congresses in Europe and compared them to respective worldwide publications available on PubMed and the respective global burden of disease measured with DALYs.

Materials and methods

Data sources/measurement

The 28th annual congress of the EADV took place from the 9th to the 13th of October 2019 in Madrid, Spain. The titles from the official program were used to perform a retrospective network analysis. All congress titles were classified into poster and lecture. The data were extracted from the official program pdf file using *tabula v1.2.1* open-source software [13] and then pre-processed using custom written python code. The extracted data were first split into titles, countries, cities, and authors. Redundant titles in lecture sessions were removed to prevent an artificial increase in word count. The data were then cleaned to exclude filling words such as “and”, “so”, and “or” and standardised *e.g.* “acne inversa” and “hidradenitis suppurativa”. Disease entities with names comprising more than one word were split (*e.g.* “atopic dermatitis” into “atopic” and “dermatitis”).

Software

The networks were composed using open-source software *Gephi v0.9.2* [14] and a *ForceAtlas 2* [15] layout. The terms and their connections were sized proportionally to their counts. To keep the output manageable, filters were applied. Thus, only terms with more than 200 connections were included in the overall network graph (more than 30 connections in the lecture network graph and more than 100 connections in the poster network graph).

Comparison between conference topics and DALYs and PubMed publications

To assess the importance of each skin disease at the conference, the count for each skin disease was divided by the total count of all words-related to any skin disease. Accordingly, proportions were calculated, meaning that a skin disease with a high proportion would receive a high level of attention. Using the same method, the importance of a skin disease was calculated based on DALYs in 2013 [3] and the number of publications available

on PubMed between January 1st, 2018 and December 31st, 2018 [2]. Then, all relative values were compared to assess whether there was a relative over- or under-representation at the congress. A negative percentage indicates under-representation, whereas a positive percentage reflects relative over-representation.

Statistics

Descriptive data were generated for posters and lectures. Additionally, for each skin disease, absolute and relative numbers were calculated. The reciprocal of the network density parameter was used to assess the congress diversity. Network diversity was conveyed through values from 1, indicating that all abstract titles were the same, and infinite, meaning that none of the words used in the abstract titles were ever used twice.

Statistical analysis was carried out using Python’s “pandas v0.24.2” [16]. Since we extracted the submissions from the pdf file of the official conference program, there was no missing data.

Moreover, we used *OpenCage Geocoder* library [17] to match the cities with the corresponding coordinates and visualised the locations with *Google Maps API* on an interactive map. To assess geographic differences, the classification of countries provided by the *UN Statistics Division* was used [20].

Results

Overall, we analysed a total of 30,898 words in 3,221 congress titles in the official program with an average count of 9.0 words per title.

After cleaning data to exclude filling words, the total word count of lectures was 5,715 words with an average length of 5.1 words per title and of posters 16,712 words with an average length of 8.6 words per title. The terms with the highest proportion relative to the total word count in given categories were “patients” ($n = 473$, 3.7%), “treatment” ($n = 301$, 2.8%), and “psoriasis” ($n = 335$, 2.8%) (*figure 1A*). Considering lectures and posters, the diseases which received most attention at the conference were “psoriasis” ($n = 335$, 33.4%), “dermatitis” ($n = 169$, 17.8%), “acne” ($n = 107$, 11.3%), “melanoma” ($n = 88$, 9.3%), and “urticaria” ($n = 48$, 5.1%).

The 20 most common words used in posters and lectures are presented in *figure 1B*. Overall, 11 terms were in both top 20, namely “skin”, “treatment”, “diseases”, “patients”, “psoriasis”, “dermatitis”, “clinical”, “atopic”, “cell”, “melanoma”, and “carcinoma”. However, in posters, the terms “patients” ($n = 396$, 2.4%), “case” ($n = 289$, 1.7%), and “psoriasis” ($n = 267$, 1.6%) were the top three words, whereas in lectures “skin” ($n = 88$, 1.5%), “treatment” ($n = 88$, 1.5%), and “diseases” ($n = 81$, 1.4%) were most common (*figure 1B*).

Network graph visualisation of conference topics

As demonstrated by the visualisation of terms in *figure 2A*, each with at least 200 connections, some key aspects of

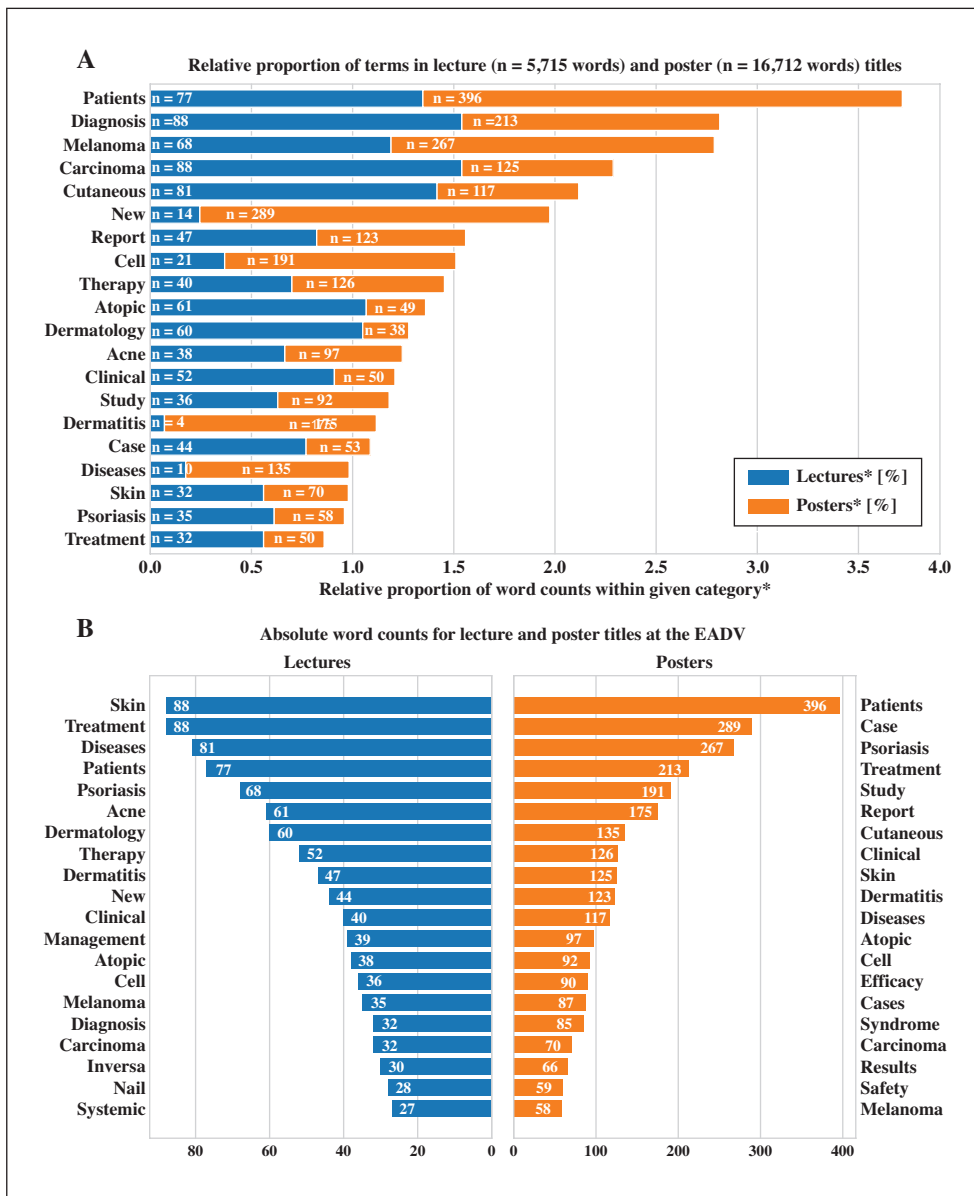


Figure 1. The most common disease terms appearing in all titles of the scientific conference program (A) and in lecture and poster titles separately (B) (disease terms in bold were present in the top 20 categories for both lecture and poster titles).

the conference were the therapy of patients with psoriasis and its safety and efficacy (words connected in blue colour), atopic dermatitis and its treatment and outcome (green colour), and a rather broad mixture of topics around “skin diseases”, “case reports”, “melanoma” and different types of “skin carcinoma” (brown colour) (figure 2A).

By including only words used in lecture titles with more than 30 connections, the network graph of lectures revealed several different theme clusters around “therapy”, “psoriasis” and “patient”, “hidradenitis suppurativa” and “skin disease” (figure 2B). The network graph of posters with more than 100 connections demonstrated that the network around “psoriasis” and “patient” along with “treatment” was somewhat comparable between poster and lecture titles; the significant focus on case reports covering a broad field of dermatologic diseases including, for

example “basal cell carcinoma”, “lupus”, “lichen”, “lymphoma”, “mycosis fungoides”, or “alopecia”, was specific to posters (figure 2C).

Contributing nations

Germany contributed the most lectures ($n = 157$, 12.3%), followed by Spain ($n = 139$; 10.9%), and the Netherlands ($n = 102$, 8.0%), whereas the highest number of posters came from Spain ($n = 274$, 14.1%), followed by Tunisia ($n = 140$, 7.2%), and Germany ($n = 99$, 5.1%) (figure 3A). Comparing the top 20 contributing nations for lectures and posters, the data show that while only three contributing nations for lectures were non-European (US, China, and Canada), half of the poster-contributing nations were non-European (figure 3A). Visualising all

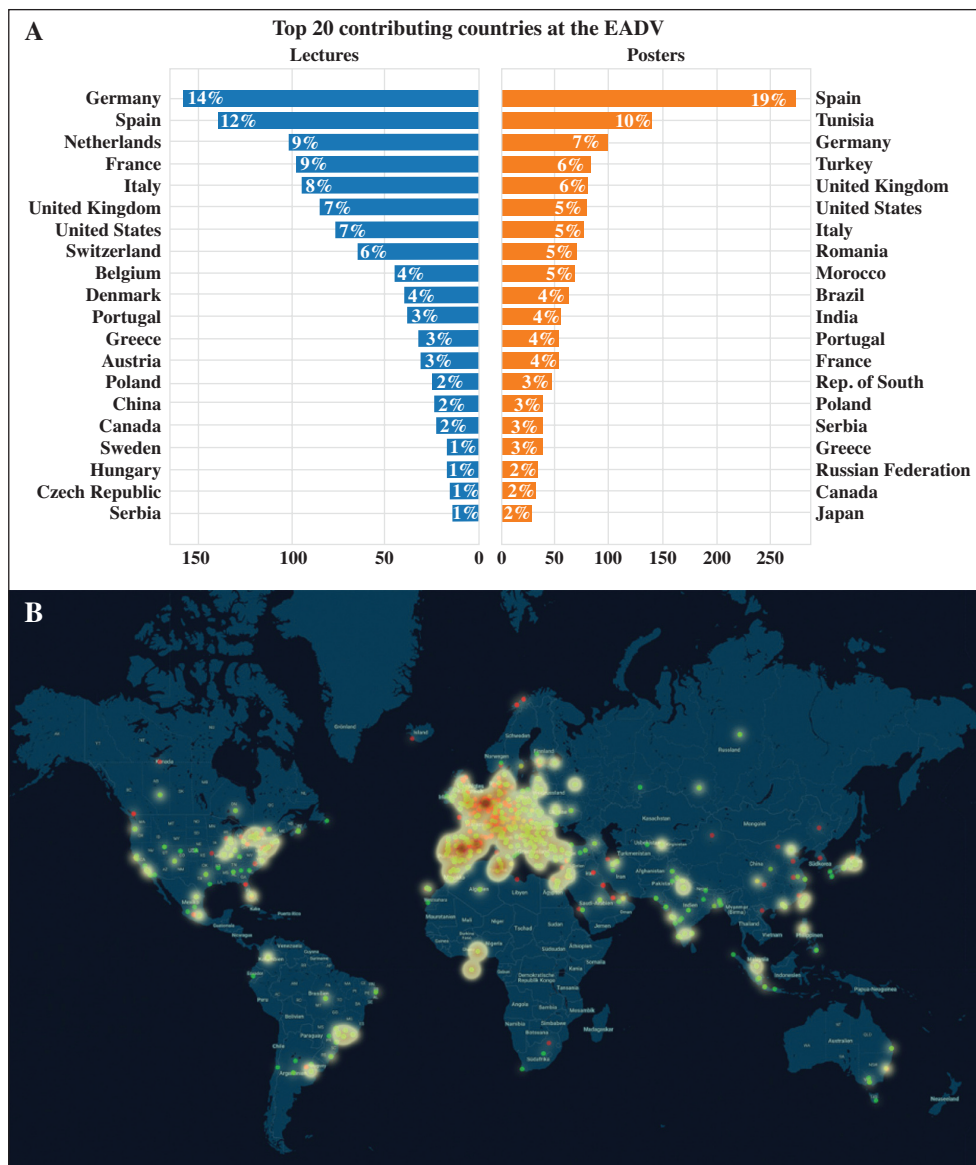


Figure 3. A) Countries contributing the highest number of lectures and posters (the top 20 categories for both are highlighted in bold). B) Visualisation of the geographical origins of submissions in google maps. The areas are color-coded in shades of yellow and red, depending on the number of contributions. Red indicates an area with particular activity. An interactive map is available at <https://nwgraphs.web.app>.

Discussion

Summary

In summary, the applied network analysis of the largest European dermatology conference in 2019, the EADV, revealed several clusters of main interests regarding lectures and posters, as well as close collaborations from contributing European nations. In particular, the focus of the contributions was patient-centred and therapeutic approaches. It is likely that this trend was associated with novel insights into the pathomechanisms of these diseases which is underlined by the respective comparisons with the number of PubMed publications. Naturally, as new medications in these fields are emerging [18, 19], conferences serve to instruct European clinicians. However, there seemed to

be a regional disparity as contributors from Western Europe provided substantially more lectures compared to their colleagues from Eastern Europe.

Lectures and posters

The analysis has shown that the congress had a particular focus on the treatment of patients. Chronic inflammatory skin diseases, such as psoriasis and atopic dermatitis, were among the diseases which received the most attention. This showed that the congress functioned as a clinically oriented, patient-centred educational platform for European dermatologists. Most likely this is due to their high prevalence in Europe as well as new emerging and promising treatment options for related diseases [20-22]. The posters had a special emphasis on the presentation of clinical case

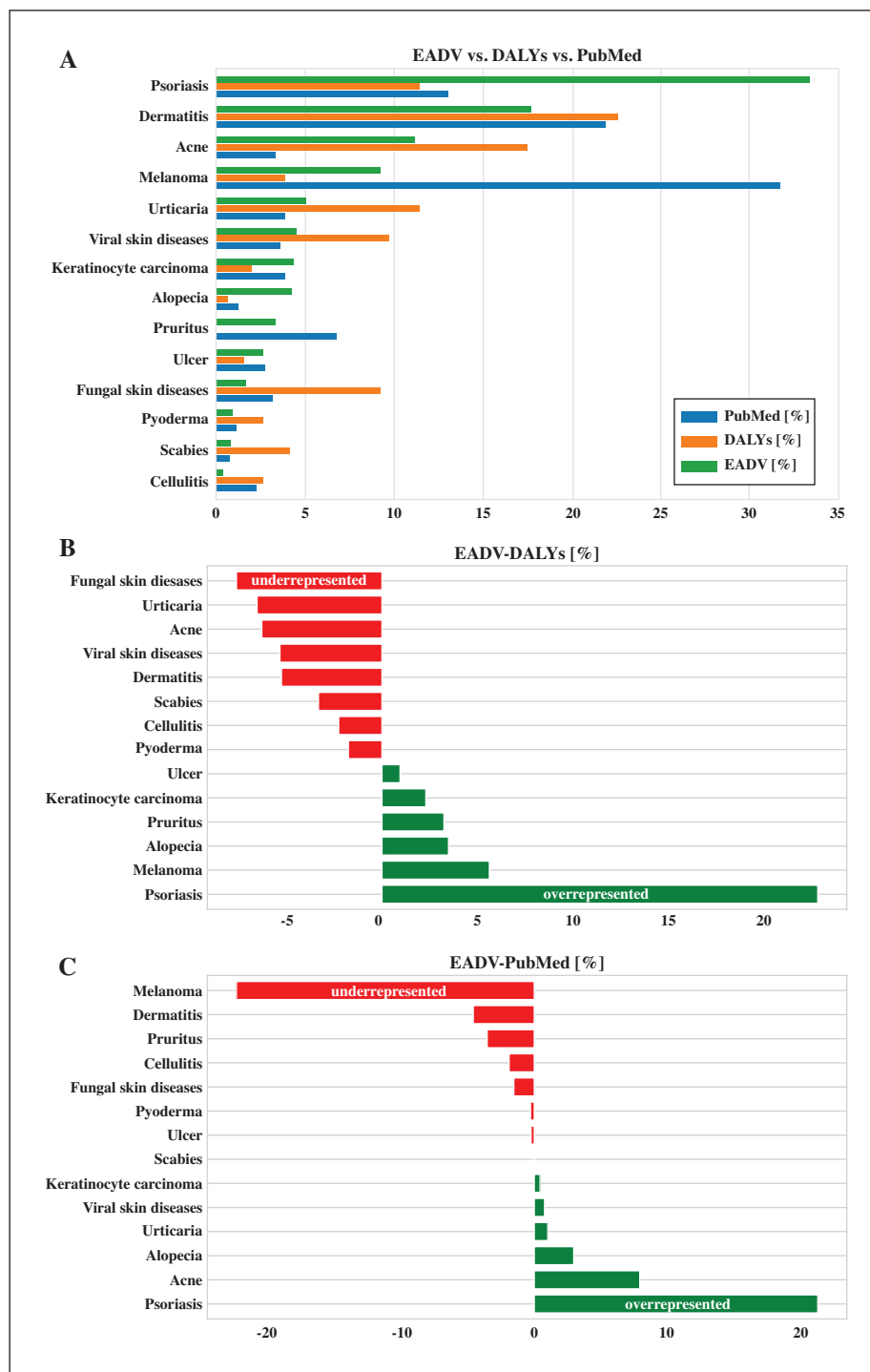


Figure 4. Relative representation of disease terms in the titles of the conference program relative to the global disease burden study in 2017 and publications on PubMed in 2018 (A), DALYs (B), and publications available on PubMed (C).

reports, which was also expected and, interestingly, focused on psoriasis and atopic dermatitis as well.

Contributors

Lectures were dominated by Western European nations with Germany at the top of the list, followed by the host country, Spain, and the Netherlands. Eastern European

countries were rather under-represented. For future conferences, network analysis could be used to include additional countries, for example, by special invitation and preferred ranking of topics tailored to the needs of different countries with different structures in dermatologic healthcare. As the situation was different for poster submissions, in which top contributors came from around the world, one option might be to switch posters to lectures for selected topics,

considering that a remarkable number of posters but only few lectures were provided by countries such as Romania.

Disease-adjusted life years

We detected a discrepancy between the analysed network and the DALYs of skin diseases worldwide, as published in 2017 by Karimkhani *et al.* [3]. This analysis could suggest that the diseases, psoriasis and melanoma, received disproportionately more attention in the 2019 conference. However, recent advances in dermatology and healthcare for both diseases combined regarding the overall disease burden might be a rather simple explanation [22, 23]. Instead, atopic dermatitis was rather under-represented at the congress when compared to the global disease burden, which is even more surprising considering the recent advances and new treatment options on the rise [24-26] and the fact that many atopic dermatitis patients are still substantially impaired by the disease [21]. Based on their global burden measured by DALYs [3], viral and fungal skin diseases were also rather under-represented. It seems reasonable to tie this disparity with recent advances and new insights into the pathomechanism of, for example, psoriasis and melanoma, for which there are several new treatment options available, whereas new developments and treatments for fungal and viral skin diseases are scarce [27].

PubMed

The distribution of the contributions to the largest European dermatology congress in 2019 were mostly in line with the focus of international dermatological research published on PubMed [2]. The only relevant discordances that we were able to detect were between congress titles and PubMed results of 2018 regarding psoriasis and melanoma. Psoriasis therefore received a relatively excessive amount of attention, and melanoma not enough. The disproportionate attention on psoriasis, again, might be due to the fact that Europe, as a wealthy part of the world with good public health care systems, is a hotspot for psoriasis research and healthcare, and is promoted by the WHO, as documented in their global psoriasis report [5]. The reason why melanoma was under-represented could be linked to the fact that despite a constant increase in incidence and mortality in Europe, it is still a disease that is not so prevalent with research limited to large and specialized centres [28].

Limitations

There are some study limitations. A downfall of the method is that the titles of contributions may not always reflect the true content. If an author chooses not to include the name of the disease corresponding to the focus of a contribution, but instead uses a rather vague title, qualitative categorization is not possible using network analysis. Fungal and viral skin diseases are harder to standardize than terms such as “psoriasis” and “melanoma”, because sometimes only the pathogen of a certain disease is included in the title. Also, fungal and viral skin diseases cannot be further specified, similar to titles such as “non-melanoma skin cancer”. In order to exclude unnecessary

words (such as “and” or “between”), meticulous selection is required to reduce information loss while keeping the dataset manageable.

Obviously, the generalisability of the results is limited. Firstly, not all relevant European scientists and clinicians in the dermatologic field contribute to annual conferences such as the EADV 2019. Therefore, some actors might not have been part of the analyses. Secondly, the qualitative analyses only signalled the volume of contributions. A researcher, for example, who made a single contribution corresponding to an important study, was treated by network analysis like any other contributor. Thirdly, all authors of a contribution were treated equally. This means that the hierarchy among the authors was not reflected by the results of the analysis, thus the leading author, who may have contributed the idea and composed most of the text, was not distinguished from others who may have only contributed a minor part, *e.g.* expert advice.

Conclusion

Network analysis of conferences may provide an overview of the focus of the targeted community. It is a modern and useful tool to access large sets of data and make them easy to evaluate. In the future, longitudinal network analysis of several congresses may provide more detailed information, including the delineation of topic trends, and may be used to determine additional regions and topics to be included in future events. ■

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