

Dermatologic research in the Nordic countries 1989–2008 – a bibliometric study

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Introduction

Scientific articles published in peer-reviewed scientific journals are the most visible result of research, and the number of articles generally reflects research activity.¹ Bibliometrics can be defined as a set of quantitative techniques to evaluate the scientific production of individual researchers, research units or countries based on the number of articles published in scientific journals, which may be ranked according to citation frequency and origin.^{1–4} Bibliometric methods are increasingly used to evaluate the scientific production of geographic regions and countries in many specialties, including dermatology,^{5,6} radiology,⁷ urology,⁸ and pathology.⁹ Such studies are important for recognizing factors that may promote or inhibit research activity and performance.

The Nordic countries of Sweden, Denmark, Finland, and Norway contribute significantly to dermatologic

Abstract

Background Bibliometric methods, based on the count of articles published in scientific journals, are increasingly used to evaluate scientific productivity. Bibliometric studies may identify factors that promote or inhibit research performance. We set out to analyze dermatologic research activity in Sweden, Denmark, Finland, and Norway using bibliometric methods.

Methods We performed repetitive searches on Medline, using the PubMed interface, for the period 1989–2008. Dermatologic articles were defined as all articles in dermatologic journals plus articles in nondermatologic journals in which the address of first author included an institution of dermatology. Articles were allocated to the country of first author's address.

Results The number of dermatologic articles from Sweden, Denmark, Finland, and Norway was 1896 (214 per million inhabitants), 1502 (281), 1017 (196), and 249 (55), respectively. Dermatologic articles represented 1.4%, 2.3%, 1.6%, and 0.6% of each country's total number of Medline articles in English over the same period. Similar patterns were found in relation to gross domestic product, number of dermatologists, and number of medical schools. After 2000, the yearly number of dermatologic articles from Denmark increased and that from Finland decreased, whereas the numbers from Sweden and Norway remained relatively stable.

Conclusions Despite similarities in social and economic conditions in Sweden, Denmark, Finland, and Norway, there are great differences in dermatologic research activity in the four countries, with Denmark performing best and Norway poorest. Historical and cultural factors may partly explain these differences.

research and have a respected position in international dermatology. The region is characterized by stable political and social conditions, high gross domestic product (GDP), and well-organized healthcare and educational systems. These factors are probably important for the quality and quantity of the clinical, experimental, and epidemiologic research in dermatology performed in these countries.

The development of dermatologic research in the four Nordic countries over the last decades has not been explored systematically. Anecdotal reports on low academic activity in dermatology in Norway contrast the situation in Sweden, Denmark, and Finland.^{10,11} To identify factors that are associated with high research activity, we performed a bibliometric analysis of dermatologic scientific articles published by authors from these countries in the 20-year period from 1989 through 2008.

Materials and Methods

We performed pilot searches checking titles, lists of authors and abstracts (when available) for errors in classification, and developed adequate search criteria. Repetitive searches in Medline, using the PubMed interface, were then performed on May 25th, 2009, with some additional searches performed on June 26th, 2009.

A dermatologic article was defined as either an article in a scientific journal classified by the National Library of Medicine as a dermatologic journal ($n = 97$), except *Veterinary Dermatology*, regardless of the profession, specialty, address, or affiliation of its first author, or an article in other scientific journals, indexed in Medline, in which the address or affiliation of its first author included a clinical unit or research institution of dermatology. All original research articles, review articles, case reports, editorials, commentaries, and research letters were included. Only articles written in English were included, reflecting the current publication practice in dermatology in the Nordic countries.

The articles were allocated to the country of first author's address or affiliation, so that one article was counted only once, regardless of the number of countries involved in multi-authored articles. Country was identified with the search criteria "Sweden"/"Swedish", "Denmark"/"Danish", "Finland"/"Finnish", and "Norway"/"Norwegian" as address/affiliation, excluding "Denmark Hill" (London, UK) and "Swedish Medical Center" (Seattle, USA).

The total numbers of dermatologic articles for each year for the period 1989–2008 were noted. These numbers were compared with the number of inhabitants (in 2000), the 2000 GDP, and the total number of Medline articles in English from Sweden, Denmark, Finland, and Norway, respectively, for 1989–2008. Similar comparisons were made to the numbers of certified dermatologists, national dermatologic society members, and medical schools. Iceland was not included because of its small size (281,000 inhabitants in 2000). Data on number of inhabitants and GDP were obtained from OECD statistics.¹² Articles published electronically ahead of print were counted only once in the total number of articles.

In an additional analysis, the numbers of articles in the ten highest-ranking dermatologic journals, according to the journals' Impact Factor in 2008,¹³ were recorded. This includes the four dermatologic journals ranked the highest in 2003 by both Impact Factor and Y-factor, another journal ranking system.^{2,4}

Results

Sweden had the highest total number of Medline articles ($n = 138,928$) and Norway the lowest ($n = 40,745$) in the 20-year period (Table 1). Sweden also had the highest number of Medline articles per the number of inhabitants, and Norway had the lowest. The number of Medline

Table 1 Dermatologic articles (in English) in the period 1989–2008 with first author from Sweden, Denmark, Finland, or Norway, compared with number of inhabitants (in 2000), gross domestic product (GDP) (in 2000), and numbers of Medline articles in English (in 1989–2008), certified dermatologists (in 2008), members in national dermatologic societies (in 2008), and medical schools in each country

	Sweden	Denmark	Finland	Norway
Inhabitants (millions)	8.87	5.34	5.18	4.49
GDP (billions USD)	246.0	153.7	132.8	162.8
Medline articles	138,928	66,555	61,891	40,745
Per million inhabitants	15,633	12,463	11,948	9075
Certified dermatologists ^a	356	146	185	138
Members in national society ^b	533	337 ^c	336	221
Medical schools	6	3	5	4
Dermatologic articles	1896	1502	1017	249
in dermatologic journals	1493	1253	782	212
In non-dermatologic journals	403	249	235	37
Per million inhabitants	214	281	196	55
Per billion USD GDP	7.7	9.8	7.7	1.5
% of Medline articles	1.4	2.3	1.6	0.6
Per certified dermatologist	5.3	10.3	5.5	1.8
Per member in national society	3.6	4.5	3.0	1.1
Per medical school	316	501	203	62

^aData from a joint Nordic working group for medical specialist education (Einar Skoglund, personal communication).

^bData from Nordic Dermatological Association (Agneta Andersson, personal communication).

^cIncludes some company members.

articles per year rose steadily in all four countries, counting a total of 11,414 in 1989 and 22,969 in 2008 (Fig. 1).

Sweden had the highest number of dermatologic articles ($n = 1896$) and Norway the lowest ($n = 249$) during the study period (Table 1). Per number of inhabitants, GDP, and number of Medline articles, Danish dermatology performed best, while Norwegian dermatology performed much poorer than the other three countries. Similar patterns were found in relation to number of certified dermatologists, number of national dermatologic society members, and number of medical schools in each country.

The total number of dermatologic articles in the four countries per year was relatively stable throughout the study period, with the mean number per year being 236 (range 193–289). The numbers of dermatologic articles for each country are shown in Fig. 2. From around 2000, the number of articles from Denmark increased and from Finland decreased, while the numbers of articles from Sweden and Norway were relatively stable throughout the whole period.

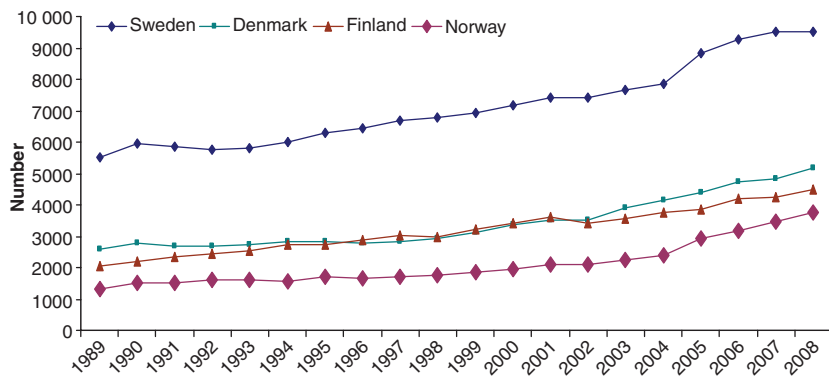


Figure 1 Scientific articles, written in English, indexed in Medline with first author from Sweden, Denmark, Finland, and Norway per year in the period 1989–2008

The numbers of articles in the ten highest-ranking dermatologic journals are shown in Table 2, with Norway having fewer articles than the other three countries, both numerically and relative to the country's number of articles in dermatologic journals. The proportion of articles in *Journal of Investigative Dermatology*, *Journal of the American Academy of Dermatology*, *British Journal of Dermatology*, and *Archives of Dermatology* was 22.1% in Sweden, 24.5% in Denmark, 27.3% in Finland, and 23.6% in Norway. The journals *Contact Dermatitis* and *Acta Dermato-venereologica* had the highest numbers of articles, constituting 22.2% and 20.6%, respectively, of all articles in dermatologic journals from the four countries.

Discussion

This study documents large differences in dermatologic research activity between Sweden, Denmark, Finland, and Norway, despite great similarities in social, political and economic conditions. The low number of articles from Norway is especially noteworthy. By contrast, Denmark had a high number of dermatologic articles, both numerically and relative to the size of its population, GDP, and numbers of Medline articles, certified dermatologists, national dermatologic society members, and medical schools.

The causes of these differences are many and complex. Norway and Finland were relatively poor countries for centuries and became independent, modern states much later than Sweden and Denmark. The academic traditions in Sweden and Denmark, as well as in Finland, are longer and stronger than in Norway. The first universities in Sweden, Denmark and Finland were founded in 1477 (Uppsala), 1479 (Copenhagen) and 1640 (Åbo), respectively, while Norway got its first university as late as 1811 (Oslo). After World War II, the economic differences between the four countries have gradually diminished, especially after the discovery of oil in the North Sea in the late 1960s, which changed Norway from a relatively poor country to a very rich one. Although the number of scientific articles from Norway increased nicely after 2004, the total scientific production in the study period was lower than that in the other three countries, with the performance in dermatology being especially poor.

Reliable and comparable data on numbers, salaries and working conditions for doctors and dermatologists in university hospitals and research institutions in the four countries are difficult to obtain, interpret and compare. In Norway, recruiting and retaining dermatologists with academic qualifications to university departments of dermatology has been difficult for many years.¹⁰ This has not been the case in the other three countries. As of 2009, many teaching positions in Norway are either

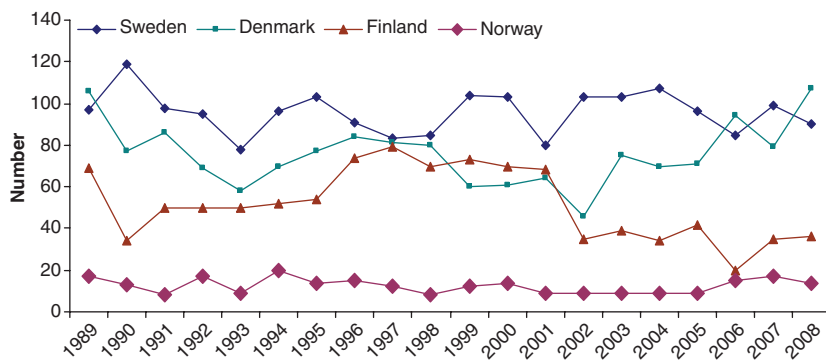


Figure 2 Dermatologic articles (in English) with first author from Sweden, Denmark, Finland, and Norway per year in the period 1989–2008

Table 2 Articles in the 10 highest-ranking dermatologic journals, according to their 2008 Impact Factor (IF),¹³ with first author from Sweden, Denmark, Finland, or Norway, in the period 1989–2008

	IF	Sweden	Denmark	Finland	Norway	Total
Number of articles in dermatologic journals		1493	1253	782	212	3740
Journal of Investigative Dermatology ^a	5.251	106	82	77	22	287
Pigment Cell & Melanoma Research	4.634	4	0	0	0	4
Journal of the American Academy of Dermatology ^a	4.081	56	56	23	8	143
British Journal of Dermatology ^a	3.489	149	137	105	19	410
Contact Dermatitis	3.470	306	288	216	21	831
Archives of Dermatology ^a	3.402	19	32	9	1	61
Experimental Dermatology	3.259	34	36	18	4	92
Journal of Dermatological Science	2.973	9	9	1	0	19
Acta Dermato-venereologica	2.456	382	239	104	47	772
Skin Pharmacology and Physiology	2.388	0	1	0	0	1
Total		1065	880	553	122	
% of all articles in dermatologic journals		71.3	70.2	70.7	57.5	

^aThe four highest-ranking dermatologic journals in 2003, according to both Impact Factor and Y-factor⁴.

vacant or temporarily filled by dermatologists with limited scientific experience and ambitions.¹⁰ Many dermatologists in Norway are drawn to private practice because of more autonomy, better working conditions, higher income, and poor hospital career planning,¹⁴ probably to a higher extent than dermatologists in the other three countries. Consequently, academic dermatology in Norway is small and extremely vulnerable. On the positive side, the number of dermatologic scientific articles has been relatively stable during the last two decades, indicating no rapid decline or imminent collapse. Improving the academic standard of Norwegian dermatology is a challenge not only to dermatologists but also to all university hospitals and universities in Norway.^{10,15}

The dermatologic research activity in Denmark is remarkably and increasingly high. This reflects a long-lasting and strong scientific tradition in Danish dermatology. As early as in 1903, the Nobel Prize in physiology or medicine was awarded to a Danish physician, Niels Finsen (1860–1904), for his pioneer work on light treatment of lupus vulgaris and other skin diseases.¹⁶ Compared with the other three countries, the number of certified dermatologists, medical schools and academic dermatology departments is low. In Denmark, it is common to complete a PhD thesis before entering formal specialist training in dermatology, contributing to a high research production and a lower number of certified dermatologists. The excellent scientific performance by Danish dermatology can also be seen as a result of a long-term policy of having strong and closely related academic departments. This policy has been easier to execute in Denmark, which is much smaller geographically and much

more densely populated than the three other countries. The medical culture in Denmark, as well as in Sweden and Finland, seems to be more scientifically oriented than in Norway, especially in dermatology. Doctors at academic departments, including dermatologists, are expected to perform and publish clinical and experimental research and are given better opportunities, economically and otherwise, to fulfill these expectations than in Norway.

While performing strongly in the years before the turn of the millennium, Finnish dermatology produced fewer scientific articles over the last decade. Funding research has become more difficult in Finland in recent years,¹¹ but we are not aware of other changes in Finnish dermatology and/or academia that explain the decline or might represent a study bias.

The quality of a scientific article is difficult to measure. The impact factor of a scientific journal, introduced by Eugene Garfield (b. 1925) in 1955, is a measure of how often articles in that journal are cited during the first 2 years after publication, divided by the number of articles that the journal published.^{1–3} It is a measure of average citation frequency, not of quality. Nevertheless, Impact Factor is by many regarded as an indicator of the quality and prestige of the journal. The widespread use (and misuse) of Impact Factor has drawn considerable attention and criticism.^{3,17,18} Other journal ranking systems, such as weighted PageRank and Y-factor, have been introduced, taking into account the origin of citations, with citations in high-ranking journals counting more than citations in low-ranking journals.^{2,4}

We decided against including journal ranking in our main analyses. We did, however, register the number of articles published in the most high-ranking dermatologic journals according to two journal ranking systems. The findings are more difficult to interpret, but indicate that the differences between Norway and the other three countries are more related to the quantity than to the quality of dermatologic research. Two journals, *Contact Dermatitis* and *Acta Dermato-venereologica*, counted for more than two-fifths of all Nordic articles in dermatologic journals, probably because their editorial offices are based in Denmark and Sweden, respectively.

The overall production of scientific articles rose steadily in all four countries during the 20-year period, while the number of dermatologic articles was relatively stable, leading to a reduction in the proportion of dermatologic articles. This reflects an increased activity in other fields of medical research, including research based on new technology and scientific knowledge.

Although the number of indexed scientific articles is a reliable proxy for research activity, bibliometric methods have many limitations, including various publication and cultural biases.^{1,2,17} These limitations are less relevant when comparing neighboring countries with similar social, political and economic conditions, as in this study.

The total number of dermatologic articles, as defined in our study, does not cover the total amount of dermatologic research in the four countries. Articles with non-Nordic first author and articles published in nondermatologic journals with dermatologists only as co-authors were not included. This means that an unknown number of scientific articles based on international and/or interdisciplinary collaboration with contributions from Nordic dermatologists were excluded. Multi-authored articles were allocated to the country of first author's address/affiliation only, to avoid difficult and potentially biased assessments of co-authors' relative contributions, based on the assumption that first authors contribute more to an article than co-authors. Similarly, articles in nondermatologic journals were included only when the address/affiliation of first author was a dermatologic institution, to exclude articles with limited dermatologic input. We believe that this is a relevant and pragmatic search strategy for a comparative bibliometric study. It is possible that dermatologic institutions in Sweden, Denmark, and Finland more often employ researchers working in immunology, genetics, public health, etc. and publishing their work in nondermatologic journals than Norwegian dermatologic institutions do. Moreover, it is possible that first author of international reports tends to come from the scientifically most active countries and/or those with pharmaceutical industry. Both factors would implicate a

bias in favor of those countries. The inclusion of editorials, commentaries and review articles is meant to reflect the scientific standard of the country but may also represent a bias.

The data on numbers of inhabitants and GDP were from 2000, the year closest to the mid-year of the period 1989–2008 available on the web site of OECD.¹² Using means and standard deviations for number of inhabitants and GDP for the whole 20-year period would have been more appropriate, but is unlikely to change our main findings. Number of inhabitants and GDP rose each year in all four countries.

Conclusions

Bibliometric studies may identify factors that promote or inhibit dermatologic research in any part of the world. This study documents large differences in dermatologic scientific publishing between Sweden, Denmark, Finland, and Norway, with Denmark performing best and Norway poorest. Historical and cultural factors may partly explain these differences.

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