

Publications by Scandinavian university Departments of Anaesthesiology from 2001 to 2015

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Background: This study assessed the contribution made to research by Scandinavian university Departments of Anaesthesiology and their distribution among those departments.

Methods: We committed a PubMed search for all publications originating from Scandinavian university Departments of Anaesthesiology between 2001 and 2015. Articles were assigned to their author's affiliated university department and to 3 time periods 2001-2005, 2006-2010 and 2011-2015. The number of publications, original articles and citations were analysed.

Results: The 23 Scandinavian university Departments of Anaesthesiology published 5190 articles between 2001 and 2015, which make up 91.5% from all anaesthesiology research originating from Scandinavia. Of these 1760 (33.9%) were classified as original articles. The number of publications increased in the observed periods (from 1305 in 2001-2005 to 2452 in 2010-2015), but the share of original articles decreased (from 40% to 31%). Finnish university Departments of Anaesthesiology had the largest share of original articles. The university department of Copenhagen was the most productive Department of Anaesthesiology in terms of number of publications ($n = 1187$) and citation rate of original articles (median 24 citations per original article). Publications from Bergen scored the highest impact (median 19 citations per publication).

Conclusions: The number of publications from Scandinavian university Departments of Anaesthesiology increased between 2001 and 2015, but the share of original articles decreased. Copenhagen was the most productive university Department of Anaesthesiology based on the number of publications and citations of original articles. Finnish university Departments of Anaesthesiology led in the share of original articles out of all publications.

KEYWORDS

Anaesthesiology, bibliometry, Departments of Anaesthesiology, Nordic countries, original research, publications, research, Scandinavia, University departments, University hospitals

1 | INTRODUCTION

Bibliometric analysis makes it possible to compare how different countries and institutions perform in research and has experienced a boost from digital evaluation. In anaesthesiology, researchers

noted a global downward trend in the number of publications. Most worrisome was a declining number of original articles.^{1,2} Some countries have already recognized the inadequate funding situation and started to reorganize their infrastructure to provide more resources.³

Worldwide, the small, affluent and seemingly better organized Scandinavian countries have often achieved some of the highest publication rates per capita^{2,4,5} when normalized to the population size. Previous studies have investigated the performance of these countries.⁶ However, no analysis has ever examined which department of anaesthesiology contributes most to this success within the Scandinavian countries. University departments are deemed to be the centres of medical education and creators of new knowledge and therefore it is assumed that they contribute predominantly to a country's research output. The aim of this retrospective study was to compare the publication output of Scandinavian university Departments of Anaesthesiology.

2 | METHODS

No ethics committee approval was required for this bibliographic study that assessed all articles originating from Scandinavian university Departments of Anaesthesiology. When performing a PubMed-wide search, all identified articles were imported into a database via Perl-scripts meeting the following criteria: (1) the affiliation field of the authors permitted the allocation to a Department of Anaesthesiology by including the word anaesthesia in all possible variations and languages and (2) the publication date of the print version, or the date of electronic publication for online-only versions was between 2001 and 2015. Articles were assigned to a university Department of Anaesthesiology either in Denmark, Finland, Iceland, Norway or Sweden depending on their authors' affiliation field and then to the time periods 2001-2005, 2006-2010 and 2010-2015. A publication was allocated to more than one university department if its authors were affiliated with more than one university department. The number of citations for each article was retrieved from the Web of Science Journal Citation Report database.

The following indicators were reported: the overall number of articles, the number of original research articles, the ratio of original articles, the cumulative and the median number of citations until 2017, namely for each university department and for each period, respectively. A publication was considered an original article if the category of publication was registered as original research in PubMed (ie the electronic database of the US National Library of Medicine): "case reports", "clinical study", "clinical trial (I-IV)", "comparative study", "controlled clinical trial", "evaluation studies", "multi-center study", "observational study", "pragmatic clinical trial", "randomized controlled trial", "technical report", "twin study" or "validation studies" (Figure 1).⁷ Predatory journals were omitted by using PubMed-listed journals only.

Articles were attributed to the field of anaesthesiology journals according to the categories of the Institute of Scientific Information (ISI) Web of Science Journal Citation Report⁸ if published in journals within the categories "Anesthesiology", "Critical Care Medicine", and "Emergency Medicine", and non-anaesthesiology

Editorial comment

This article presents a count of publications and citations for all articles published by Nordic departments of Anesthesia during these recent years, categorizing them by university. Trends over time are demonstrated for both publications and citations.

journals if published in journals of any other ISI Web of Science category.

2.1 | Statistical methodology

All statistical analyses were performed with SPSS Version 24 (IBM Corp. Released 2016, IBM SPSS Statistics for Windows; Version 24.0; IBM Corp., Armonk, NY, USA). Data were rounded and given as absolute or relative frequencies and were tested for differences in time. Due to non-normally distributed data (test for normal distribution: Kolmogorov-Smirnov), the Friedman test was used to test for differences in time over the entire observed period, while the Wilcoxon test was used to assess intragroup differences between 2 time groups. *P* values <.05 were considered statistically significant.

3 | RESULTS

3.1 | Number of overall publications

The 23 Scandinavian university Departments of Anaesthesiology published 5190 articles between 2001 and 2015, constituting 4.5% of 114 802 worldwide published articles from Departments of Anaesthesiology, but the university departments contributed 91.5% of all publications in the field of anaesthesiology originating from Scandinavia. Nearly half (2605) of all publications were published in anaesthesiology related journals according to the Journal Citation Report's categories, with 2585 being published in journals not related to anaesthesiology. The number of overall publications changed from 2001-2005 to 2006-2010 from 1305 to 1433 non-significantly (*P* = .206), while the change from 2006-2010 to 2011-2015 (1433 vs 2452) was statistically significant (*P* < .001). The overall change for the entire period was statistically significant (*P* < .001).

During the whole observation period the university Department of Anaesthesiology of Copenhagen achieved the most publications (1187), followed by Stockholm (712) and Helsinki (524). These departments also led the field in the period 2001-2005 with Copenhagen (239) in first place, ahead of Stockholm (192) and Helsinki (148). Between 2006 and 2010, Copenhagen (284) led, followed by Helsinki (187), which had overtaken Stockholm (183). Between 2011 and 2015, Copenhagen (664) again led ahead of Stockholm (337) and Aarhus (236). Data for all departments is shown in Table 1.

3.2 | Number of original articles

Of the 5190 articles, 1760 (33.9%) were identified as original research. From 2001 to 2005 517 articles were published, subsequently dropping to 474 in the period 2006-2010 ($P = .198$), after which the number increased again to 769 from 2011 to 2015 ($P < .001$). The overall change over all 3 time periods was statistically significant ($P < .001$).

For the entire period 2001-2015 Copenhagen led with 372 original articles ahead of Helsinki (250) and Stockholm (246). From 2001 to 2005, Stockholm published the most original research articles (81), while Helsinki and Copenhagen tied for second place with 78

articles each. In 2006-2010 Helsinki was first (95) ahead of Copenhagen (78) and Stockholm (58), while in 2011-2015 Copenhagen held first place (216) followed by Stockholm (107) and Helsinki (77).

3.3 | Share of original research to overall publications

Of all publications, original articles accounted for 40% in 2001-2005, dropping to 33% in 2006-2010 and 31% in 2011-2015. The largest share over the entire observed period was achieved by Tampere (61%), followed by Turku (57%) and Helsinki (48%). From 2001 to 2005 79% of all publications from Tampere were original articles,

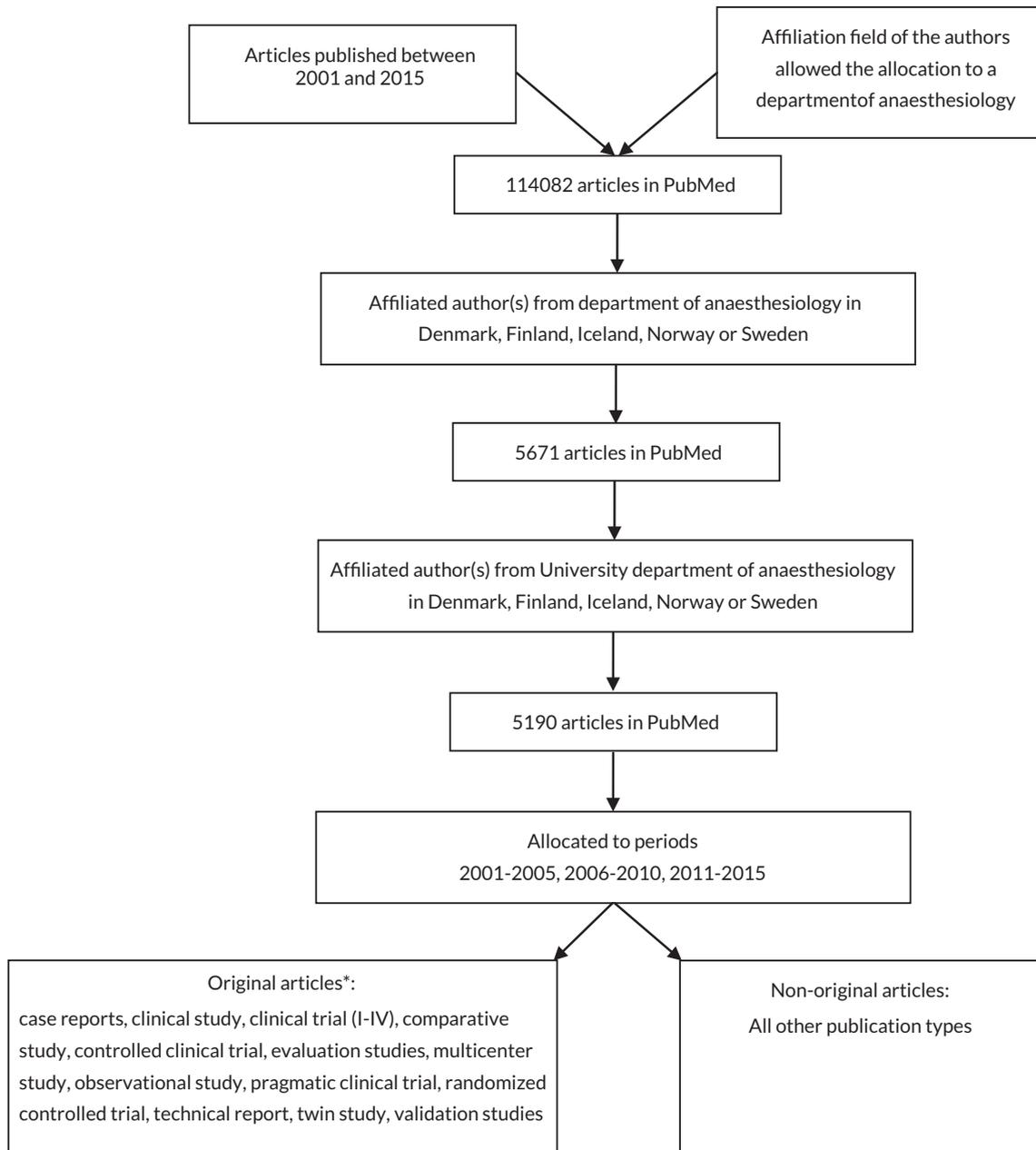


FIGURE 1 Flow diagram. *Based on their study design, 17 of 80 publication types listed in PubMed have been defined as original articles⁷

TABLE 1 Absolute number of original and all articles from Scandinavian university Departments of Anaesthesiology. Note that university departments have been ranked according to the number of articles in 2001-2015

| | 2001-2005 | | 2006-2010 | | 2011-2015 | | 2001-2015 | |
|---|-----------|------|-----------|------|-----------|------|-----------|------|
| | Original | All | Original | All | Original | All | Original | All |
| Copenhagen | 78 | 239 | 78 | 284 | 216 | 664 | 372 | 1187 |
| Stockholm | 81 | 192 | 58 | 183 | 107 | 337 | 246 | 712 |
| Helsinki | 78 | 148 | 95 | 187 | 77 | 189 | 250 | 524 |
| Aarhus | 20 | 75 | 27 | 98 | 68 | 236 | 115 | 409 |
| Uppsala | 18 | 56 | 12 | 92 | 62 | 214 | 92 | 362 |
| Oslo | 31 | 73 | 31 | 100 | 43 | 162 | 105 | 335 |
| Lund | 20 | 65 | 14 | 68 | 53 | 165 | 87 | 298 |
| Gothenburg | 30 | 71 | 26 | 69 | 43 | 139 | 99 | 279 |
| Linköping | 20 | 46 | 10 | 28 | 34 | 89 | 64 | 163 |
| Kuopio | 29 | 65 | 17 | 30 | 21 | 50 | 67 | 145 |
| Odense | 3 | 15 | 6 | 32 | 29 | 96 | 38 | 143 |
| Bergen | 9 | 35 | 14 | 36 | 15 | 68 | 38 | 139 |
| Trondheim | 15 | 33 | 8 | 28 | 29 | 70 | 52 | 131 |
| Örebro | 21 | 37 | 19 | 44 | 19 | 50 | 59 | 131 |
| Turku | 11 | 27 | 29 | 42 | 32 | 58 | 72 | 127 |
| Oulu | 15 | 30 | 10 | 25 | 18 | 43 | 43 | 98 |
| Aalborg | 4 | 10 | 6 | 15 | 20 | 71 | 30 | 96 |
| Umeå | 5 | 24 | 5 | 25 | 13 | 43 | 23 | 92 |
| Malmö | 11 | 27 | 1 | 14 | 6 | 35 | 18 | 76 |
| Tampere | 15 | 19 | 11 | 14 | 20 | 42 | 46 | 75 |
| Tromsø | 5 | 15 | 4 | 18 | 10 | 37 | 19 | 70 |
| Stavanger | 2 | 6 | 2 | 16 | 13 | 43 | 17 | 65 |
| Reykjavík | 3 | 8 | 0 | 5 | 8 | 24 | 11 | 37 |
| Publication with more than 1 university affiliation ^a | -7 | -11 | -9 | -20 | -187 | -473 | -203 | -504 |
| Total ^a | 517 | 1305 | 474 | 1433 | 769 | 2452 | 1760 | 5190 |

^aA publication was allocated to more than one university department if the authors were affiliated with more than one university department.

followed by Örebro (57%) and Helsinki (53%). In 2006-2010, Tampere led again (79%), followed by Turku (69%) and Kuopio (57%). From 2011 to 2015, Turku (55%) had overtaken Tampere (48%) for first place and Kuopio (42%) came in third (Figure 2).

3.4 | Publication trends

The Scandinavian university Departments of Anaesthesiology raised the number of overall publications produced by them from 270 per year in 2001 to 881 in 2015. Compared to 2001-2005, 10 years later overall publications almost doubled (+87%). At the same time, original articles increased from 99 in 2001 to 273 in 2015. A slow and continuous rise in overall publications is seen from 2001 to 2013, whereas the absolute number of original articles is quite stable. However, it is noteworthy that the steep rise only started in 2014.

Stavanger (+617%), Aalborg (+610%) and Odense (+540%) were the university Departments of Anaesthesiology that raised their

output more than 5-fold. However, all these departments had published little in 2001. From 2001 to 2015, the mean average rise in overall publications was +115%. The department in Kuopio was the only one to experience a decline in overall publications (-23%) (Figure 3).

3.5 | Citations per publication

Of the 5190 publications investigated 4383 were cited at least once. Considering only the original articles, 1662 of 1790 articles were cited at least once. The overall citation rate of all publications was 14.5 citations per article and for original articles 18.5. The difference between original and non-original articles decreased from 9.5 in 2001-2005 to 4.3 in 2006-2010 and 3.2 in 2011-2015 (Figure 4).

Between 2001 and 2015, publications from Bergen scored the highest median (19 citations per publication), followed by Copenhagen and Helsinki (with 18 each; Table 2). Reykjavik had the

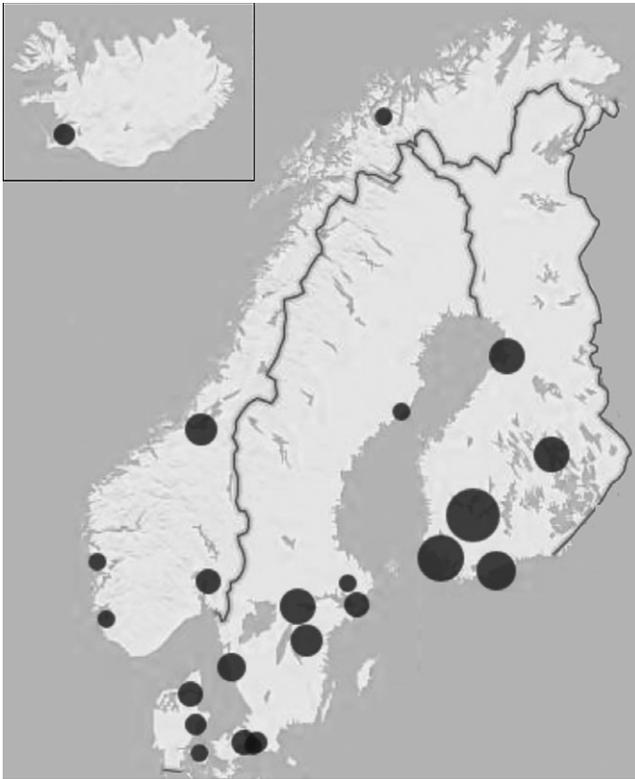


FIGURE 2 Map of Scandinavian university Departments of Anaesthesiology, size of circle corresponds to share of original articles of all publications between 2001 and 2015 in relation to the largest share

highest median for a single article (110 citations in 2014), with the most cited single article being from Oslo (1321 citations). Stockholm led in 2001-2005 with a median of 28 citations per publication, while Oslo led in 2006-2010 with a median of 29. Publications from Bergen and Stavanger shared first place in 2011-2015 with a median of 14 citations per publication (Figure 5).

Regarding original articles, between 2001 and 2015 Oslo and Copenhagen shared the lead (24 citations per publication), followed by Uppsala (20). A single publication from Turku was cited 170 times in median in 2003; the most cited single original article was a cooperation between Helsinki and Stockholm with 762 citations. Copenhagen was first in citations per original article between 2001-2005 (median 45) and also held the lead in 2006-2010 (30). In 2011-2015, Oslo came in first with 33 citations per original article (Figure 6).

4 | DISCUSSION

The number of publications from Scandinavian university Departments of Anaesthesiology increased between 2001 and 2015, but the share of original articles decreased. Copenhagen was the most productive university Department of Anaesthesiology based on the number of publications and citations of original articles. Taking all articles into consideration, publications from Bergen achieved the highest impact. Finnish university Departments of Anaesthesiology led in the share of original articles out of all publications, with Tampere holding first place.

This study is the most sophisticated bibliometric analysis hitherto for Scandinavian university Departments of Anaesthesiology. The methodology has been used in recent studies.^{1,2,9} We recognize the difficulty experienced in comparing the research activity of different countries and departments due to varying legal requirements and resources. Hence, eliminating these factors by using each university also as a denominator is a more suitable approach for such a bibliometric assessment. We analysed the absolute number of publications - privileging larger universities - but also the share of original articles out of all publications as well as publication trends over the entire period to evaluate the development of departments and countries. To limit temporal influences, we divided the entire period into 3-5 year periods.

Compared to the university Departments of Anaesthesiology in Germany, Austria and Switzerland, which are countries with a similar successful bibliometric background, the Scandinavian university Departments of Anaesthesiology contributed almost the same amount to the worldwide number of articles originating from the field of anaesthesiology (4.5% vs 5.7%),⁹ although the overall population in Scandinavia is roughly one-fourth that of Germany, Austria and Switzerland (approx. 26 vs 99 million). The number of Scandinavian university Departments of Anaesthesiology (23) is only half that of Germany, Austria and Switzerland (45). Considering only the publications between 2001 and 2010 in order to compare the numbers,⁹ Copenhagen had an even higher output of articles (523) than Berlin (479). Also Stockholm (375) and Helsinki (335) would rank in the top 5 after Innsbruck (421). Similarly, considering only original articles as compared to Putzer et al's observations, Helsinki would lead (173), ahead of Vienna and Copenhagen (156 each), Berlin (141) and Stockholm (139).

In general, the share of original articles out of all articles decreased in Scandinavian university Departments of Anaesthesiology.

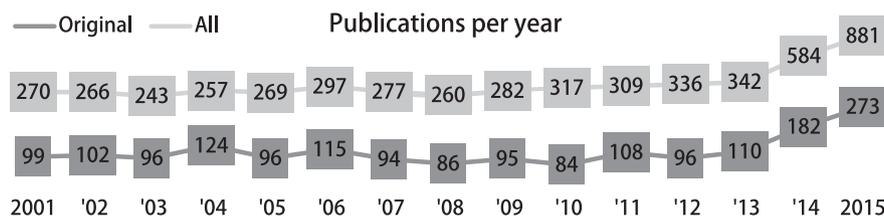


FIGURE 3 Annual evolution of publications from Scandinavian university Departments of Anaesthesiology between 2001 and 2015 (note that y-scales are logarithmic)

TABLE 2 Median of citations per original and all articles from Scandinavian university Departments of Anaesthesiology. Note that university departments have been ranked according to the median of citations of all and original articles in 2001-2015 and alphabetically in case of equal numbers

| | 2001-2005 | | 2006-2010 | | 2011-2015 | | 2001-2015 | |
|--------------------|-----------|-----|-----------|-----|-----------|-----|-----------|-----|
| | Original | All | Original | All | Original | All | Original | All |
| Bergen | 20 | 26 | 12 | 17 | 12 | 14 | 13 | 19 |
| Copenhagen | 45 | 27 | 30 | 21 | 14 | 8 | 24 | 18 |
| Helsinki | 26 | 25 | 21 | 19 | 13 | 12 | 16 | 18 |
| Uppsala | 22 | 22 | 9 | 22 | 7 | 10 | 20 | 17 |
| Turku | 19 | 22 | 22 | 22 | 3 | 7 | 14 | 17 |
| Oslo | 23 | 15 | 25 | 29 | 33 | 9 | 24 | 16 |
| Kuopio | 20 | 21 | 12 | 17 | 7 | 10 | 14 | 15 |
| Gothenburg | 31 | 24 | 15 | 16 | 11 | 13 | 15 | 15 |
| Tampere | 22 | 15 | 10 | 13 | 4 | 6 | 15 | 15 |
| Örebro | 25 | 19 | 9 | 12 | 7 | 7 | 18 | 14 |
| Stockholm | 22 | 28 | 13 | 14 | 11 | 11 | 16 | 14 |
| Lund | 21 | 16 | 18 | 14 | 10 | 8 | 18 | 12 |
| Aarhus | 25 | 19 | 19 | 16 | 8 | 6 | 17 | 12 |
| Stavanger | 0 | 19 | 0 | 11 | 5 | 14 | 0 | 12 |
| Linköping | 20 | 18 | 12 | 10 | 6 | 6 | 12 | 10 |
| Malmö | 17 | 12 | 0 | 11 | 5 | 7 | 5 | 10 |
| Tromsø | 10 | 15 | 11 | 16 | 2 | 5 | 4 | 10 |
| Oulu | 17 | 12 | 4 | 9 | 4 | 6 | 5 | 9 |
| Trondheim | 18 | 14 | 6 | 8 | 6 | 5 | 8 | 8 |
| Odense | 0 | 2 | 7 | 5 | 9 | 8 | 8 | 6 |
| Umeå | 15 | 12 | 5 | 8 | 5 | 5 | 6 | 6 |
| Reykjavík | 0 | 0 | 0 | 7 | 0 | 7 | 0 | 6 |
| Aalborg | 0 | 9 | 8 | 8 | 3 | 4 | 0 | 5 |
| Total ^a | 28 | 23 | 20 | 19 | 11 | 8 | 20 | 19 |

^aA publication was allocated to more than one university department if the authors were affiliated with more than one university department.

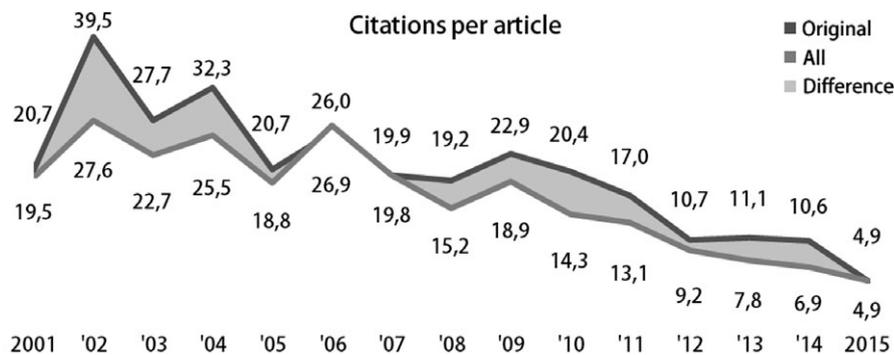


FIGURE 4 Annual evolution of the citations per article from Scandinavian university Departments of Anaesthesiology between 2001 and 2015

Nevertheless, it was still higher than in Austria, Germany and Switzerland; first in 2001-2005 (40% vs 33%) and also in 2006-2010 (33% vs 28%, respectively). This marker is a valuable parameter of the priority of a department to "create" new knowledge,

but the negative trend to a declining share is an alarming sign, and consistent with other recently published studies.^{1,2} On the other hand, it is interesting that 4 Finnish university Departments of Anaesthesiology lead this ranking with 2 smaller departments

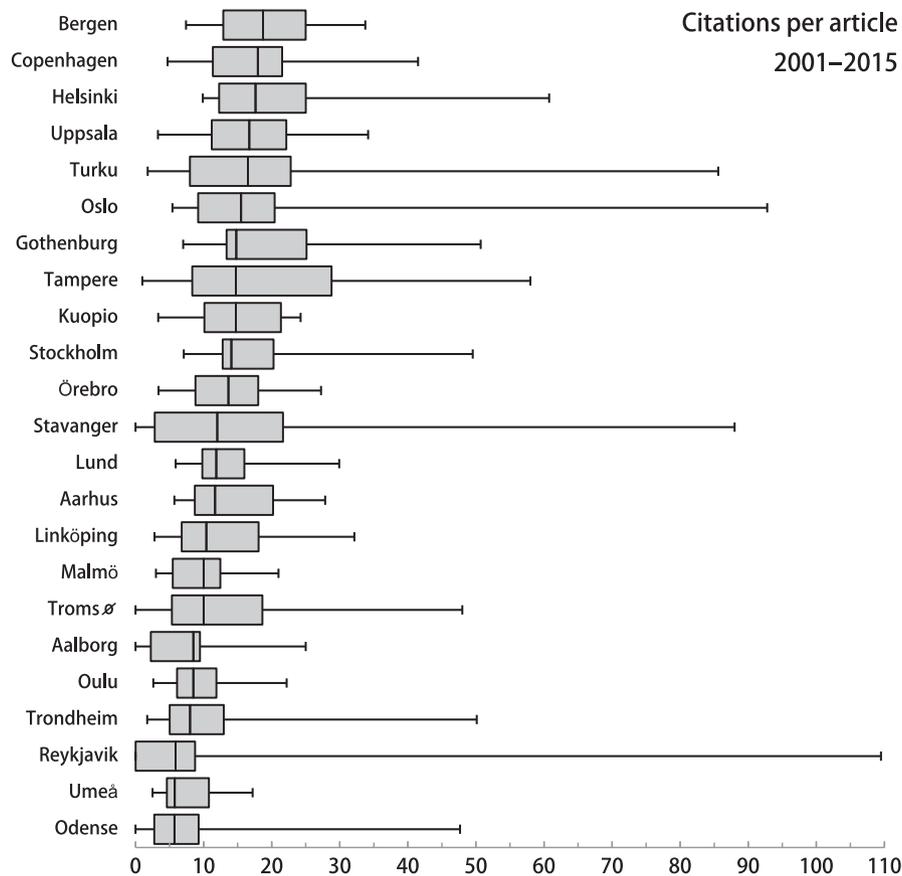


FIGURE 5 Box plots of citations per publication (all publications between 2001 and 2015 considered), university Departments of Anaesthesiology are listed according to the median achieved. The central line within the box depicts the median, the edges of the box interquartile ranges and the whiskers the range

(Tampere and Turku) who even passed the 50%-original-articles threshold.

Between 2001 and 2013, there was a slow and continuous rise in overall publications, whereas the number of original articles was stable. The surge in publications in 2014 and 2015 is mainly due to PubMed's change to allow multiple denominations of authors in the affiliation field in 2012.⁹ Thus, 2 or even more departments may have been listed as an originator of a given publication, which is shown by the rise from 11 articles in 2001-2005 and 20 in 2006-2010 and 473 in 2011-2015. However, in this study, an article by several authors from the same department was counted only once. However, this "double-counting" does not detract from the fact that publications from Scandinavian university Departments of Anaesthesiology do not follow the trend to a decrease in research as seen in several other countries.^{9,10} It appears that the Scandinavian countries are still following their trend from the 1980s and 1990s to increase their research output further.⁶ Also, Danish research activity halted its reported decline^{6,11} after the 1990s, and overtook even Sweden in 2011-2015 (971 vs 943 overall articles, respectively), who had been the "undisputed leader" in the 1980s and 1990s.

With 84% cited articles, the Scandinavian university Departments of Anaesthesiology exerted a very high impact on the field in light of the fact that fewer than 25% of the published articles in major journals were cited at least once.¹² It also indicates a continuation of the trend from the previous 2 decades, starting from 55% to 70%.⁶ Nevertheless, the decreasing difference in the numbers of citations between original and non-original articles over the entire observed period is also a warning for the quality of Scandinavian research. One explanation could be minor quality, but it could also be that original articles were only cited more frequently in the longer run. This has to be subjected to further investigation.

The question about how to best measure quality in bibliometric studies still awaits a final answer.¹³ Some recognize the h-index as a quality indicator for authors,¹⁴ while earlier bibliometric studies calculated the Journal Impact Factor (JIF) for the quality of an article placed in it.⁴ But there is no correlation between the academic value expressed in the JIF and a single article, it is merely presumed that articles published in high JIF journals are more relevant than are those published in lower-ranked journals.¹³ Hence, the number of citations per article is more relevant than the JIF of the journal in which the article was published. By using

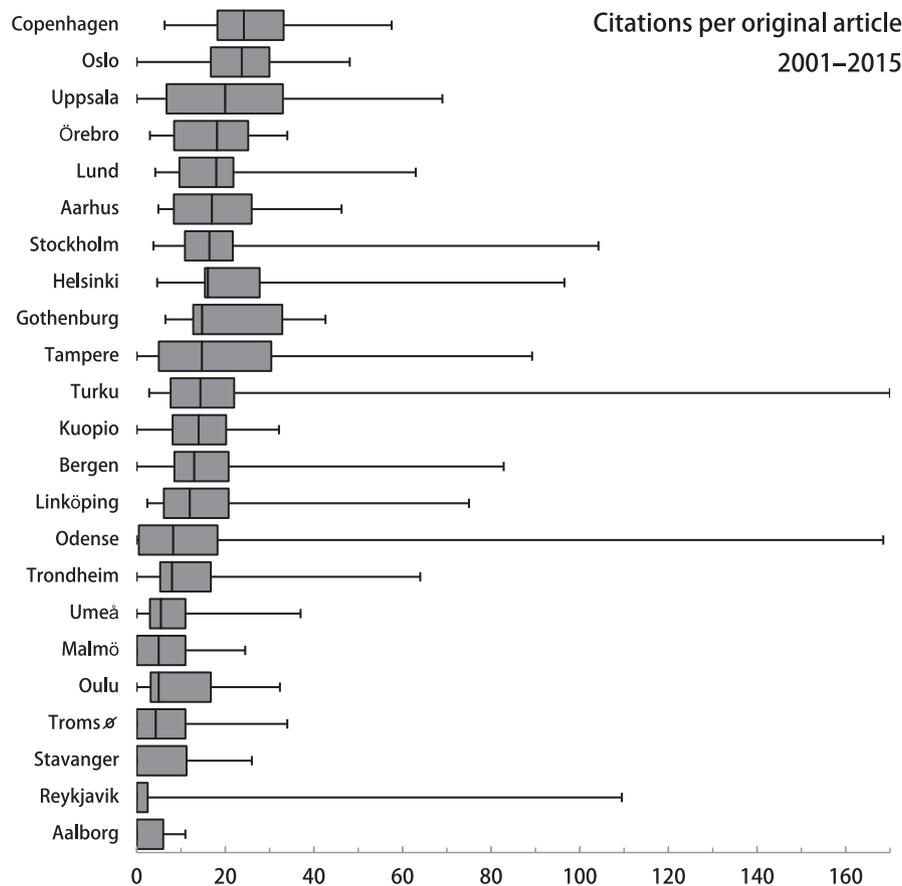


FIGURE 6 Box plots of citations per publication (only original publications between 2001 and 2015 considered), university Departments of Anaesthesiology are listed according to the median achieved. The central line within the box depicts the median, the edges of the box interquartile ranges and the whiskers the range

the median number, we also cut the “tail” of papers that are cited more or less frequently.¹³ However, the citation rate is always comparable only within the same period of time. This may explain the difference and the decline in citations year by year in ascending order, because after all, a more recent publication has not yet had the chance to be cited as often as an article published several years ago.

In our observed period 2001–2015, overall publications from Bergen and original articles from Copenhagen achieved the highest median of citations per publication. Taking the 2 rankings together, it is easy to say that Copenhagen's University department published the highest quality in anaesthesiological research. Nonetheless, it is important not to forget all the surrounding circumstances, for example, the size and the work force of a department, which unfortunately are impossible to reconstruct and use as a denominator. Recently, Cools et al² evaluated the performance of publications per capita and per anaesthesiologist in Europe, and demonstrated again the leading position of the Scandinavian countries.

With regards to different conditions, the funding of scientific activity differs between countries, universities and departments. National economic differences play an important role in a country's

publication output.¹⁵ In Scandinavian countries, the gross domestic expenditure on research and development (GERD) is fairly similar ranging from 2% in Norway to 3% in Sweden, namely of gross domestic product (GDP) in 2015.¹⁶ Clinical research in Scandinavia is largely funded by the governments.¹⁷ In 2011 Medin et al¹⁷ evaluated the cost efficiency of university hospitals in Denmark, Finland, Norway and Sweden. They concluded that Finland had the most cost-effective medical research due to the low expenditures, while Norway had the highest expenditures for teaching and research. Finland and Sweden exhibited the highest total number of citations, while Denmark and Norway scored the highest means in the top 5% publications. Unfortunately, cost efficiency was not calculated for research, but was combined with teaching. Although this study is the most detailed ever done on cost efficiency in Scandinavian university hospitals, the research output described cannot be compared with our results because publications in the whole field of medicine were assessed.

4.1 | Limitations

The present study has several limitations. Firstly, only articles eligible on Pubmed were included. Thus, the result may differ

TABLE 3 Number of citations of original and all articles from Scandinavian university Departments of Anaesthesiology. Note that university departments have been ranked according to the number of all articles in 2001-2015

| | 2001-2005 | | 2006-2010 | | 2011-2015 | | 2001-2015 | |
|--------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
| | Original | All | Original | All | Original | All | Original | All |
| Copenhagen | 3188 | 6190 | 2176 | 5725 | 2142 | 4790 | 7506 | 16 705 |
| Stockholm | 2669 | 5295 | 769 | 2982 | 1359 | 3239 | 4797 | 11 516 |
| Helsinki | 3201 | 5072 | 2403 | 3779 | 862 | 2163 | 6466 | 11 014 |
| Oslo | 703 | 1146 | 793 | 3703 | 912 | 1781 | 2408 | 6630 |
| Uppsala | 556 | 1228 | 289 | 1860 | 1184 | 2058 | 2029 | 5146 |
| Aarhus | 500 | 1467 | 625 | 1599 | 702 | 1703 | 1827 | 4769 |
| Gothenburg | 807 | 1558 | 489 | 1410 | 869 | 1663 | 2165 | 4631 |
| Lund | 354 | 1004 | 252 | 1093 | 631 | 1486 | 1237 | 3583 |
| Bergen | 162 | 901 | 217 | 620 | 604 | 1012 | 983 | 2533 |
| Kuopio | 655 | 1343 | 249 | 460 | 183 | 597 | 1087 | 2400 |
| Turku | 309 | 945 | 568 | 766 | 293 | 522 | 1170 | 2233 |
| Örebro | 551 | 741 | 340 | 583 | 192 | 430 | 1083 | 1754 |
| Linköping | 369 | 780 | 238 | 481 | 154 | 403 | 761 | 1664 |
| Odense | 57 | 106 | 384 | 514 | 284 | 939 | 725 | 1559 |
| Tampere | 312 | 355 | 208 | 265 | 776 | 931 | 1296 | 1551 |
| Trondheim | 450 | 887 | 70 | 234 | 140 | 329 | 660 | 1450 |
| Reykjavik | 23 | 23 | 0 | 90 | 667 | 770 | 690 | 883 |
| Oulu | 306 | 410 | 130 | 255 | 69 | 217 | 505 | 882 |
| Stavanger | 50 | 207 | 35 | 248 | 145 | 317 | 230 | 772 |
| Malmö | 190 | 362 | 0 | 168 | 48 | 195 | 238 | 725 |
| Tromsø | 63 | 257 | 67 | 275 | 42 | 147 | 172 | 679 |
| Umeå | 99 | 285 | 104 | 223 | 54 | 153 | 257 | 661 |
| Aalborg | 0 | 90 | 62 | 126 | 89 | 328 | 151 | 544 |
| Total ^a | 14 736 | 29 709 | 10 400 | 27 300 | 7351 | 18 189 | 32 487 | 75 198 |

^aA publication was allocated to more than one university department if the authors were affiliated with more than one university department.

from investigations using additional bibliometric databases. However, we consider our results valid because Pubmed is the most established database. Secondly, data were lacking in the affiliation field. For instance, in several journals up to two-thirds of all affiliation fields were incomplete. Improvements in data quality would be dearly needed.⁹ Also, our study may have missed publications because Departments of Anaesthesiology may have more generalized names such as "Department of Perioperative Medicine". Thirdly, since 2012 PubMed allows multiple denominations of authors in the affiliation field.² This new feature contributes mainly to the rise in publications in 2014-2015 (see Table 1 for more details) and could exponentiate the number of citations from that time on. On the other hand, articles may have been missed out before 2012 because it was not possible to list the affiliation of any co-authors. Furthermore, it is impossible to reconstruct the contribution of various authors (and their departments) to an article to assess the value of the authors placement within the list of authors.¹³ Fourthly, we did not rule out self citations. Lastly, we did not assess the active workforce of Departments of Anaesthesiology involved in

research, which might have shifted the ranking towards other university departments.

5 | CONCLUSIONS

The number of publications from Scandinavian university Departments of Anaesthesiology increased between 2001 and 2015, but the share of original articles decreased. Copenhagen was the most productive university Departments of Anaesthesiology based on the number of publications and citations of original articles. Taking all articles into consideration, publications from Bergen achieved the highest impact. Finnish university Departments of Anaesthesiology led in the share of original articles out of all publications, with Tampere holding first place.

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CONFLICT OF INTEREST

The authors do not have any conflict of interest.

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REFERENCES

1. Ausserer J, Miller C, Putzer G, et al. International publication trends originating from anaesthetic departments from 2001 to 2015. *Anaesthesia*. 2017;72:1243-1250.
2. Cools E, Ausserer J, van de Velde M, Hamm P, Neururer S, Paal P. Anaesthesiology research in the European Union and the European Free Trade Association. *Eur J Anaesthesiol*. 2017;34:1-10.
3. Sellevold OFM. Frontiers in Scandinavian anaesthesiology. *Acta Anaesthesiol Scand*. 2005;49:891-893.
4. Figueredo E, Sanchez Perales G, Munoz Blanco F. International publishing in anaesthesia - how do different countries contribute? *Acta Anaesthesiol Scand*. 2003;47:378-382.
5. Pomaroli A, Hauffe H, Benzer A. Who publishes in the large anaesthesia journals? *Br J Anaesth*. 1994;72:723-725.
6. Skram U, Larsen B, Ingwersen P, Viby-Mogensen J. Scandinavian research in anaesthesiology 1981-2000: visibility and impact in EU and world context. *Acta Anaesthesiol Scand*. 2004;48:1006-1013.
7. PubMed Help [Internet]. Bethesda (MD). National Center for Biotechnology Information (US); 2005. [Table, Publication Types]. https://www.ncbi.nlm.nih.gov/books/NBK3827/table/pubmedhelp.T.publication_types/. Accessed February 26, 2018.
8. Thomson Reuters' ISI web of knowledge. Journal Citation Report 2017. <https://apps.webofknowledge.com>. Accessed January 12, 2017.
9. Putzer G, Ausserer J, Wenzel V, et al. Publication performances of university clinics for anesthesiology: Germany, Austria and Switzerland from 2001 to 2010. *Anaesthesist*. 2014;63:287-293.
10. Feneck RO, Natarajan N, Sebastian R, Naughton C. Decline in research publications from the United Kingdom in anaesthesia journals from 1997 to 2006. *Anaesthesia*. 2008;63:270-275.
11. Nilsson LB, Jensen TU, Skovgaard LT, Viby-Mogensen J. Research in Danish departments of anesthesiology at the turn of the century. A bibliometric analysis. *Ugeskr Laeger*. 2001;163:6121-6127.
12. McVeigh ME, Mann SJ. The journal impact factor denominator: defining citable (counted) items. *JAMA*. 2009;302:1107-1109.
13. Flaatten H, Rasmussen LS, Haney M. Publication footprints and pitfalls of bibliometry. *Acta Anaesthesiol Scand*. 2016;60:3-5.
14. Pagel PS, Hudetz JA. H-index is a sensitive indicator of academic activity in highly productive anaesthesiologists: results of a bibliometric analysis. *Acta Anaesthesiol Scand*. 2011;55:1085-1089.
15. Bould MD, Boet S, Riem N, Kasanda C, Sossou A, Bruppacher HR. National representation in the anaesthesia literature: a bibliometric analysis of highly cited anaesthesia journals. *Anaesthesia*. 2010;65:799-804.
16. International Monetary Fund. World economic outlook database October 2016 Edition. <http://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx>. Accessed January 12, 2017.
17. Medin E, Anthun KS, Häkkinen U, et al. Cost efficiency of university hospitals in the Nordic countries: a cross-country analysis. *Eur J Health Econ*. 2011;12:509-519.

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