

The focus
of many
pathology
researchers:
a cancer cell



Publication Analysis 2000-2006

Pathology

European-based authors published fewer articles in pathology journals than their US colleagues, yet they collected more citations. The same picture emerged within Europe: Most articles for England, but most citations for Germany.

The problem with pathology is that today's real scientific world of pathology has increasingly ceased to exist as a clearly defined experimental research discipline. On the other hand, however, it is still a very important medical specialty as well as an indispensable teaching discipline in medical education. (By the way, pathology is not the only biomedical discipline displaying this problem.)

Wikipedia, for example, defines pathology as "the study and diagnosis of disease through examination of organs, tissues, cells and bodily fluids." It "is a broad and complex scientific field which seeks to understand the mechanisms of injury to cells and tissues, as well as the body's means of responding to and repairing injury." Finally, concerning *experimental pathology Wikipedia* states, "In the broadest sense, nearly all research which links manifestations of disease to identifiable processes in cells, tissues, or organs can be considered experimental pathology."

That means, as long as there is any connection to any disease, anything goes. Someone holding a university chair in pathology must of course teach pathology to medical students but can otherwise do experimental research on almost anything he wants.

One consequence of this is that the borders to other medical research disciplines have actually been wiped out. Where, for example, is the difference today between the pathologist investigating inflammation or allergy and the immunologist studying the same topics? Or between the pathologist specialising in the mechanisms and diagnosis of lymphomas and an experimental haematologist engaged in the same questions? Or between the pathologist looking for specific expression profiles of cancer cells and the oncologist or human geneticist doing the same thing? To cut a long story short, it is almost impossible to clearly define what pathology research is and what it is not.

"Border problems"

Of course, the experimental pathologists themselves don't care much about these "border problems". However, it poses real difficulties for any comparison of publication outputs in pathology research. The reader should keep that in mind when turning to the results of our publication analysis "pathology".

For the reasons noted above, we restricted the analysis of national publication performance in pathology research exclusively to the 60 specialist journals in this field as listed by Thomson Scientific's database "Web of Science" (see tables on p. 339). Just by publishing in them means that the authors, irrespective of the "name" of their fields, thereby demonstrate that they regard their results to be the most relevant to the pathology community.

On the other hand, we had to exclude multi-disciplinary journals such as *Nature* or *The Lancet* from the analysis anyway since "Web of Science" provides no tools to reliably extract articles pertaining only to pathology. Indeed, the most prominent papers in the field might thus have been omitted from this part of the analysis. However, we believe that the countries' performances in the expert pathology journals suffice to provide valid indicators for their overall productivity in pathology research between 2000 and 2006.

As diverse as biomedicine itself

Rudolf Virchow (1821-1902), known as the founder of modern experimental pathology, would surely be happy to note that his home country Germany still emerges as Europe's number one in pathology when applying this approach. However, Virchow's descendants only achieved this top rank because their articles during the years 2000-2006 have been cited more frequently on average than those of their English colleagues. The latter published more than 6,000 articles in the pathology journals between 2000 and 2006, which in turn have been cited about 36,000 times to-date. Over the same period, German co-authors had only amassed about 5,000 articles in the same journals; however, altogether these have earned them about 1,000 citations more than all articles co-signed by researchers from England.

Far out of sight of the two top ranks, France and Italy follow with almost identical citation numbers. Ranks 5-7 are occupied by the Netherlands, Spain and Switzerland - the only remaining nations with five-digit citation numbers. Norway (13) and Portugal (17) performed considerably better than in most of the other biomedical research disciplines, whereas Israel ranks lower than "usual" (18).

Since these ranks and overall numbers strongly depend on the pure number of articles (which in turn is dependent on the number of researchers in the respective country), it might be more interesting to calculate the average citation rate per article for each country. The unexpected but clear race leader here is Finland with almost 14 citations per article in the pathology journals, followed by Switzerland (9.75), Belgium (9.55) and The Netherlands (9.21).

For the whole of Europe the average rate is 5.76 citations per article in the pathology journals. In contrast to almost all other biomedical disciplines, Europe thus outperforms its pathology colleagues in the US who collected “only” 5.1 citations per article in the pathology journals (see yellow table). This is also the reason why Europe achieved more citations overall than the USA, although US-based co-authors published altogether more articles.

Another unusual fact, when compared to previous publication analyses, is that Japan came in with more articles and more citations than England and Germany.

Let's finally turn to Europe's most cited “heads” and “papers” (see tables, next page). The five most highly cited papers published between 2000 and 2006 with corresponding addresses

Europe...

Country	Citations	Articles	Cit./Art.
1. Germany	37,240	5,039	7.39
2. England	36,248	6,189	5.86
3. France	18,820	3,226	5.83
4. Italy	18,808	3,158	5.96
5. Netherlands	15,916	1,728	9.21
6. Spain	11,638	2,187	5.32
7. Switzerland	10,793	1,107	9.75
8. Finland	8,375	602	13.91
9. Sweden	7,660	841	9.11
10. Scotland	6,689	978	6.84
11. Austria	6,492	885	7.34
12. Belgium	6,325	662	9.55
13. Norway	4,040	551	7.33
14. Denmark	3,823	507	7.54
15. Ireland	3,736	782	4.78
16. Greece	2,979	580	5.14
17. Portugal	2,803	394	7.11
18. Israel	2,646	446	5.93
19. Poland	2,032	532	3.82
20. Wales	1,834	347	5.29

Articles which appeared between 2000 and 2006 in pathology journals as listed by Thomson Scientific. Their citation numbers were recorded up until September 2007. A country's figures are derived from articles where at least one author working in the respective European nation is included in the author's list. Israel is included because it is a member of many European research organisations (EMBO, FEBS etc.), as well as participating in the EU Research Framework Programmes.

... and the world

	Citations	Articles	Cit./Art.
Europe	168,243	29,212	5.76
USA	167,288	32,818	5.10
Japan	40,561	6,452	6.29
Canada	18,048	2,698	6.69
Australia	8,525	1,818	4.69
China	5,290	1,021	5.18

in Europe, and at least co-authored by European pathology researchers, nicely demonstrate some of the “hot topics” in pathology, i.e. tumour classification and diagnosis (papers 1 and 5), cancer treatment (3), inflammation/immunology (2) and cardiovascular diseases (4). Equally, these issues reflect the current red-hot fields in biomedical research, which again demonstrates the topical “boundlessness” of pathology research.

This becomes even more evident when taking a look through the list of the most-cited Europe-based pathology researchers. Manel Esteller, the most cited of all, for example, is working in epigenetics, particularly focussing on how alterations in DNA methylation and chromatin are involved in the appearance and progression of human tumours. Since 2001 he has been group leader in the Molecular Pathology Programme of the Spanish National Cancer Research Centre in Madrid. He wrote his most cited paper in 2001, as first author, about results he had obtained as a Research Associate in the Division of Tumor Biology at the Johns Hopkins University in Baltimore. The paper, entitled “A gene hypermethylation profile of human cancer”, was decisive in finally establishing promoter hypermethylation of tumour suppressor genes as a common hallmark of all human tumours.

Interestingly, the second most cited researcher, Tony Kouzarides from the Gurdon Institute and the Department of Pathology at the University of Cambridge, publishes in a very similar field: How misregulation of histone modification generates uncontrolled growth of the cell and thereby contributes to tumour formation.

Don't draw too many conclusions

Other research fields by which European pathologists and neuropathologists were especially able to collect many citations ranged from cancer formation (particularly lymphomas), prion diseases and *Helicobacter* infection to a whole bunch of immunological questions. The best example for the latter is the Swiss Nobel prize winner Rolf Zinkernagel (14).

In contrast to these molecular or cellular pathologists a few clinical pathologists, however, did not primarily earn their ranks by their specific research topics but rather instead by contributing their expertise to big clinical multicentre studies.

Therefore, to be honest, all these examples should make clear that the “authors” were primarily listed because “pathology” appeared in the names of their institutes. However, the immense variety of their diverse research topics doesn't really allow for a direct comparison. So, one should take this list at face value and not draw too many conclusions.

RALF NEUMANN



Publication Analysis 2000-2006 – Pathology

Most Cited Authors...

	Cit-ations	Art-icles		
1. Manel Esteller , Mol. Pathol. Pr. Spanish Natl. Canc. Ctr. Madrid	7,785	153		
2. Tony Kouzarides , Gurdon Inst. & Dep. Pathol. Univ. Cambridge	6,920	76		
3. Chris J.L.M. Meijer , Pathol. Med. Ctr. Free Univ. Amsterdam	6,567	296		
4. Andreas Rosenwald , Pathol. Univ. Würzburg	6,364	117		
5. Alberto Mantovani , Mario Negri Inst. & Gen Pathol. Univ. Milan	6,035	190		
6. Siamon Gordon , Sir William Dunn Sch. Pathol. Univ. Oxford	4,210	160		
7. Hans K. Müller-Hermelink , Pathol. Univ. Würzburg	4,203	231		
8. Guido Sauter , Pathol. Univ. Hamburg	4,115	169		
9. Adriano Aguzzi , Neuropathol. Univ. Zurich Hosp.	3,950	184		
10. Fiona Powrie , Sir William Dunn Sch. Pathol. Univ. Oxford	3,719	46		
11. Elias Campo , Pathol. Univ. Barcelona Hosp. Clin.	3,638	238		
12. Rik J. Scheper , Pathol. Free Univ. Amsterdam Hosp.	3,620	172		
13. Herman Waldmann , Sir William Dunn Sch. Pathol. Univ. Oxford	3,502	127		
14. Rolf Zinkernagel , Pathol. Exp Immunol. Univ. Zurich Hosp.	3,463	115		
15. Manfred Stolte , Pathol. Klinikum Bayreuth	3,402	266		
16. Wolfgang Brück , Neuropathol. Univ. Göttingen	3,253	182		
17. James Shepherd , Pathol. Biochem. Royal Infirmary Univ Glasgow	3,221	142		
18. Claudio Franceschi , Expt. Pathol. Univ. Bologna	3,199	196		
19. Lars A. Akslen , Pathol. Haukeland Univ. Hosp. Bergen	3,132	75		
20. Barry A. Gusterson , Pathol. Western Infirmary Univ. Glasgow	3,120	60		
21. Michael J. Mihatsch , Pathol. Univ. Basel	2,887	119		
22. Hermann-Josef Gröne , Pathol. German Canc. Res. Ctr. Heidelberg	2,810	155		
23. Harald Stein , Pathol. Charité Univ. Med. Berlin	2,778	205		
24. Raphael Sciot , Pathol. Univ. Hosp. Gasthuisberg Louvain	2,777	167		
25. Paul J. van Diest , Pathol. Free Univ. Amsterdam Hosp.	2,777	189		
26. Bernhard Odermatt , Clin. Pathol. Univ. Zurich Hosp.	2,745	95		
27. J. Han J.M. van Krieken , Pathol. Radboud Hosp. Univ. Nijmegen	2,734	135		
28. Andrew J. Bannister , Gurdon Inst. & Dep. Pathol. Univ. Cambridge	2,718	25		
29. Philippe Gaulard , Pathol. Hosp. Henri Mondor Creteil	2,683	125		
30. George L Scheffer , Pathol. Free Univ. Med. Ctr. Amsterdam	2,610	96		

Citations of articles published between 2000-2006 were recorded until September 2007. The "most cited papers" had corresponding addresses in Europe or Israel.

... and Papers

	Citations
1. Sørlie, T; [...]; Thorsen, T; Quist, H; [...]; Lønning, PE; Børresen-Dale, AL Gene expression patterns of breast carcinomas distinguish tumor subclasses with clinical implications. <i>PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA</i> , 98 (19): 10869-10874 SEP 11 2001	973
2. Read S, Malmstrom V, Powrie F Cytotoxic T lymphocyte-associated antigen 4 plays an essential role in the function of CD25(+)CD4(+) regulatory cells that control intestinal inflammation. <i>JOURNAL OF EXPERIMENTAL MEDICINE</i> , 192 (2): 295-302 JUL 17 2000	836
3. Joensuu, H; Roberts, PJ; Sarlomo-Rikala, M; Andersson, LC; Tervahartiala, P; [...]; Demetri, GD Effect of the tyrosine kinase inhibitor STI571 in a patient with a metastatic gastrointestinal stromal tumor. <i>NEW ENGLAND JOURNAL OF MEDICINE</i> , 344 (14): 1052-1056 APR 5 2001	674
4. Shepherd, J; Blauw, GJ; Murphy, MB; Bollen, ELEM; Buckley, BM; [...]; Twomey, C; Westendorp, RGJ Pravastatin in elderly individuals at risk of vascular disease (PROSPER): a randomised controlled trial. <i>LANCET</i> , 360 (9346): 1623-1630 NOV 23 2002	650
5. Munoz, N; Bosch, FX; de Sanjose, S; Herrero, R; Castellsague, X; Shah, KV; Snijders, PJF; Meijer, CJLM Epidemiologic classification of human papillomavirus types associated with cervical cancer. <i>NEW ENGLAND JOURNAL OF MEDICINE</i> , 348 (6): 518-527 FEB 6 2003	635