SHORT COMMUNICATION

Regional inequality in radiology research output in the UK: a 5-year bibliometric study

P YOONG, FRCR, C A JOHNSON, FRCR, J M REHMAN, FRCR and A P TOMS, FRCR

Norwich Radiology Academy, Norfolk and Norwich University Hospital, Norwich, UK

ABSTRACT. The objective of this study was to describe the patterns of peer-reviewed general radiology publication rates with reference to deaneries in the UK. This was a retrospective bibliometric analysis of publications in the six highest cited general radiology journals. Publications were identified using a manual search in PubMed between 2005 and 2009. Publications originating from UK radiology departments were identified and subcategorised into primary institution of origin, deanery and publication type. The total number of radiology trainees in each deanery was obtained from the General Medical Council. 913 publications were included in the study. Original papers constituted 48.7% ($n=445$), review articles 30.3% ($n=277$) and case reports 17.4% ($n=159$). The median number of publications in each deanery was 27 [interquartile range (IQR) 11–60], and the median number of publications per trainee was 0.49 (IQR 0.31–0.88). The largest proportion of publications came from the London deanery ($n=354$, 38.8%), followed by Eastern 86 (9.4%), Oxford and Yorkshire 70 (7.7% each). Relative to the number of trainees within each deanery, Oxford had the highest number of publications per trainee (1.78), followed by East Midlands (1.5), London (1.25) and Eastern (0.99). There was a significantly higher publication rate for those deaneries with academic radiologists ($p<0.0001$). There is a marked difference in the volume of published work in the general radiology literature among UK deaneries, even accounting for differences in the number of trainees. This probably means that opportunities for training in research are similarly non-uniform.

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Research forms one of the pillars of clinical governance, and as such is an important tool in maintaining and improving patient care [1]. Audit and research are seen as a vital part of specialist training in clinical radiology. The Royal College of Radiologists encourages registrars to participate in research projects in half-day sessions set aside specifically for this purpose [2]. The output from such activities forms part of the annual appraisal. However, in practice, a trainee's involvement in research activity may be restricted by both their free time outside of work and regional differences in training schemes, such as time spent on service provision, on-call commitments and preparation for the FRCR examinations. Other confounding factors might include local attitudes of both trainers and trainees, and the preferential distribution of research funding towards larger institutions with established research history and facilities.

Some radiology training schemes have recognised departments of academic radiology: trainees on these schemes may benefit from the associated infrastructure and research expertise, and therefore might be expected to have an increased research output. However, it is important to note that many trainees and NHS

consultants successfully publish peer-reviewed articles independent of funding or research infrastructure.

The regional institutions in the UK responsible for postgraduate medical education, training, supervision and continuing professional development are the deaneries. There are a total of 20 deaneries of varying geographical and numerical sizes: 13 in England, 4 in Scotland and 1 each in Northern Ireland and Wales [3]. The Defence Postgraduate Medical Deanery covers armed forces personnel.

Anecdotal observation suggested that there might be significant differences in research output between the deaneries. The aim of this paper was to describe the publication rate in general radiology journals by UK radiologists broken down by deanery.

Methods and materials

This was a retrospective cross-sectional observational study of UK radiology publications in the six highest cited general clinical radiology journals: *American Journal of Roentgenology*, *British Journal of Radiology*, *Clinical Radiology*, *European Radiology*, *Radiographics* and *Radiology*.

A manual review of these publications was performed, with PubMed as a cross-referencing tool, for articles originating in the UK in the 5-year period from 2005 to 2009. The articles were divided into article type (original article, case report, review, other) and primary institution of origin (based on the institution with the majority

Address correspondence to: Dr Philip Yoong, Norwich Radiology Academy, Cotman Centre, Colney Lane, Norwich NR4 7UB, UK. E-mail: Philip.yoong@nnuh.nhs.uk

Figure 1. Histogram illustrating the breakdown of the publications by article type.

of authors, or the institution of the lead/corresponding author if there was no majority). The author names were also recorded. Editorials, commentaries and correspondence were excluded from the study, as were publications where no clear local institution could be identified (e.g. national or international audit results or practice guidelines). As this study concerned clinical radiologists in the UK, publications relating to radiotherapy or medical physics were also excluded, as were publications where the primary institution was abroad.

Primary institutions were then grouped into a corresponding UK deanery using the Medical Speciality Training website (www.mmc.nhs.uk). The Defence Postgraduate Medical Deanery was excluded because of minimal numbers of trainees and publications. Kent, Surrey and Sussex (KSS) was grouped together with the London Deanery as they were considered one region for clinical radiology speciality training.

Information was obtained from the General Medical Council regarding the total number of clinical radiology trainees in each UK deanery during the data collection period from 2005 to 2009: figures from the year 2008–9 were used in data analysis. These were used to obtain a figure of “publications per trainee” by dividing the number of publications by the number of trainees in each deanery, in order to account for the wide variations in deanery size so that deaneries could be fairly compared.

We obtained information regarding the number of university appointed academic radiologists in each deanery and correlated this with the publication rate in deaneries with and without academic radiologists. Our null hypothesis was that the presence of academic radiologists had no effect on the number of papers published per trainee.

Table 1. Breakdown of publications by journal title

Journal	Number of publications
<i>Clinical Radiology</i>	436
<i>British Journal of Radiology</i>	193
<i>European Radiology</i>	117
<i>Radiology</i>	71
<i>American Journal of Roentgenology</i>	70
<i>Radiographics</i>	26

Results

A total of 913 publications were suitable for inclusion in the study. Original papers formed the largest proportion of articles (Figure 1). The journal most often represented was *Clinical Radiology* ($n=436$, 47.8%). The three North American journals (*American Journal of Roentgenology*, *Radiographics*, and *Radiology*) constituted one-fifth of the total number of publications (Table 1). In terms of trends over time, there was little difference in the number of publications in each year over the 5-year period from 2005 to 2009, ranging from 167 to 187 per year.

Using the latest information available from the General Medical Council, there were a total of 1183 radiology trainees in the year 2008–9, including flexible trainees. The London deanery was the largest in terms of trainee numbers, accounting for 24% of the UK total (Table 2). The smallest deanery was the East of Scotland deanery (13 trainees).

Between 2005 and 2009, there was a wide variation in the number of publications originating from each deanery, even when trainee number was accounted for (Figures 2 and 3). The median number of publications in

Table 2. Total number of publications, trainees, and publications per trainee in each UK deanery in descending order

Deanery	Publications	Trainees	Publications/trainee
Oxford	71	40	1.78
East Midlands	60	40	1.5
London/KSS	354	284	1.25
Eastern	86	87	0.99
Northern	38	43	0.88
West Midlands ^a	52	81	0.64
Yorkshire	70	130	0.54
North West	40	75	0.53
Wessex ^a	28	53	0.52
Peninsula ^a	26	56	0.46
Severn	17	39	0.44
North Scotland	8	18	0.44
Wales	17	48	0.35
East Scotland ^a	4	13	0.31
West Scotland	16	63	0.25
Northern Ireland ^a	8	32	0.25
Southeast Scotland	7	30	0.23
Mersey ^a	11	51	0.22

KSS, Kent, Surrey and Sussex.

^aDeaneries without university-appointed academic radiologists.

Figure 2. Frequency histogram demonstrating the distribution of publications per deanery.

each deanery was 27 [95% confidence intervals (CI) for the median: 13–57, range 8–354, interquartile range (IQR) 11–60]. The median number of publications per trainee was 0.49 (95% CI 0.33–0.78, range 0.22–1.78, IQR 0.31–0.88).

A 2009 survey of clinical academics in UK medical schools (S Fitzpatrick, Medical Schools Council, UK, 2011, personal communication) [4] showed that of a total of 44 university-appointed academic radiologists, 12 were in the London/KSS deaneries and 8 in the Eastern Deanery (Table 3). However, radiologists holding substantive NHS contracts with academic responsibilities were not encompassed by this survey. In the 12 deaneries with known academic radiologists, there were a total of 784 publications and 897 trainees (equating to 0.87 “publications per trainee”), whereas in the 6

deaneries without known academic radiologists there were 129 publications and 286 trainees (0.45 “publications per trainee”). The 10% difference (95% CI 6.6–13.4%) in proportions was statistically significant (χ^2 test with Yates’ correction for continuity; $p < 0.001$, Table 4).

The largest proportion of publications came from the London deanery ($n = 354$, 38.8%), followed by Eastern 86 (9.4%), Oxford 70 and Yorkshire 70 (7.7% each). Relative to the number of trainees within each deanery, Oxford had the highest number of publications per trainee (1.78), followed by East Midlands (1.5), London (1.25) and Eastern (0.99) (Table 2).

Prolific senior authors made notable contributions to the overall totals. The three highest cited individuals were from London and authored 88 articles, 25% of the

Figure 3. Frequency histogram demonstrating the ratio of publications per trainee per deanery.

Table 3. The location of the 44 university-appointed academic radiologists in the UK (2009)

Deanery	Number of academic radiologists
London/KSS	12
Eastern	8
Northern	5
East Midlands	4
Oxford	3
Scotland–north	3
Scotland–south east	2
North West	2
Yorkshire	2
Wales	1
Severn	1
Scotland–west	1

KSS, Kent, Surrey and Sussex.

London total. The top 2 authors were established academic radiologists and authored 54 articles.

Discussion

Although radiologists from the UK are among the highest publishers in Europe, second only to Germany [5], the potential regional differences in publication number within the UK have not been previously documented.

This study is a snapshot assessing radiology publication rates in six general radiology journals as a balance between ease of data collection and providing useful information on research activity. To quantify true research activity would be challenging and involve including a very large number of other journals, books and abstracts from scientific meetings.

The key finding of this retrospective analysis is a clear difference in the number of publications in the highest cited general radiology journals among the UK deaneries. There remains a difference when trainee number is used to produce a proportionate unit of publications/trainee. There is also a significantly higher publication rate in those deaneries with academic radiologists.

Although it is likely that some individuals may be more driven than others and may be more productive during their training, this would imply that significant regional differences in research opportunities in training programmes exist. There is some evidence to support this, as academic radiology departments are typically centred on large institutions that are mostly found in the larger regions, such as those encompassed by the London and Eastern deaneries (Table 3). Indeed, in this study the “publication per trainee” figure is higher in the deaneries with academic radiology departments than in those without.

Table 4. A contingency table demonstrating the trainee number and publication number in deaneries with and without academic radiologists

	Number of trainees	Number of publications
With academic radiologists	897 (76%)	784 (86%)
Without academic radiologists	286 (24%)	129 (14%)
Total	1183	913

Furthermore, original research requires time, patience and frequently funding and ethical approval. A trainee’s ability to undertake a research project that results in a publication may be limited by preparation for Fellowship of the Royal College of Radiologists (FRCR) examinations, on-call commitments and other service provision. Within a department, the number of consultants interested in research and available to supervise and motivate trainees performing research is an important variable. However, dedicated academic radiologists in the UK have been declining in number and there is some concern about the future of academic radiology [6]. Recent surveys also suggest that radiology trainees are currently less inclined to pursue a career path in academia [7]. Recent changes in the UK training scheme aim to provide a more integrated and clearer route of entry into academic radiology [8]. It remains to be seen how this will alter the publication patterns shown in this study, given that many publications are case reports and review articles as opposed to original research.

There are limitations to this study. Academic output also includes abstracts for posters and oral presentation at scientific meetings, which were not included in this study. Owing to our inclusion criteria, our search did not include all collaborative work where a non-radiologist was the corresponding/lead author. Many imaging publications are found in specialty, modality-specific or general scientific journals; a previous study suggests that a third of articles from European radiology departments are published in non-radiology journals [5]. However, it could be argued that most radiology trainees would be aiming to publish in mainstream general radiology journals, and therefore this study may provide a useful overview of research opportunities for trainees in the UK.

In conclusion, this is a unique study attempting to compare radiology research output between regions in the UK. There were substantial inequalities in general radiology research output between 2005 and 2009. The reasons for this are undoubtedly multifactorial and may be related to regional differences in both training schemes and research facilities.

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