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Authorship Trends in the *American Journal of Neuroradiology*

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Authorship Trends in the *American Journal of Neuroradiology*

The authorship demographics in the *American Journal of Neuroradiology* (AJNR) have been changing with time. The clinical demands on neuroradiologists have increased recently. We sought to determine whether there has been a commensurate shift toward more nonradiologist, PhD, multi-institutional, and funded articles being published in the AJNR. We assessed AJNR-published articles for each branch of neuroradiology (Brain, Spine, Head and Neck, Neurointerventional Radiology [NIR], and Pediatrics [Ped]) to determine changes in the authorship characteristics of those who publish in the AJNR across time. We predicted a shift toward multi-institutional, PhD-driven research in all fields except NIR, due to increasing clinical demands on physician neuroradiologists and the need for large datasets for writing definitive articles.

We reviewed 3 months of AJNR articles published during 1998, 2003, 2008, 2013, and 2018 and characterized the degrees and specialties of the first authors, funding status, institutional affiliations, and type of article to assess trends across time. Only original publications were included. A binary logistic model was fitted to the data to test the research hypothesis regarding the relationship between the likelihood that multi-institutional and radiology field, and funding were associated with MDs (compared with PhDs).

Tables 1, 2, and 3 present the results of these analyses. Of the 367 original articles, a radiologist was the first author in 280 (76.3%) articles, followed by neurosurgeons (27, 7.4%) and neurologists (26, 7.1%). Three hundred sixteen (86.1%) articles were written by MD or MD-PhD first authors. One hundred forty-five (39.5%) articles were from multiple institutions; 115 articles (31.3%) were mentioned as funded. Of the funded articles, 74 (64.3%) were first-authored by MDs, and 41 (35.7%), by non-MDs. MDs had a gradually decreasing trend of first authorship from 96.6% in 1998 to 72.0% in 2018. Among MDs, radiologists contributed 80% of the original articles in 1998, which decreased to 66.7% in 2013 and increased back to 77.5% in 2018. The regression model showed that multi-institutional studies were associated with MDs as first authors (OR = 6.5; 95% CI, 3.59–11.77). Also, radiologists exceeded all other subspecialties (OR = 3.42; 95% CI, 1.69–6.93) for MD authors.

Characteristics of AJNR Authors

By viewing trends in authorship, one can assess the state of the specialty in terms of academic output. In radiology, in which MDs and PhDs own considerable authorship space, these trends can reveal the evolution of research productivity. In a study by Emamzadehfard et al,¹ the country of the first author's institution in published articles in AJNR issues from January 2016 to June 2018 was categorized by Brain, Head and Neck, Spine, NIR, and Ped sections. They concluded that contributions to the AJNR from non-US authors dominated in the NIR category, likely due to the more restrictive limitations of the FDA on new NIR devices in the United States compared with Europe. Authors from Asian countries contributed more to Head and Neck articles, likely due to the increased prevalence of thyroid and nasopharyngeal carcinomas as well as Epstein-Barr virus infections in Asia. Authors from European countries published more articles than those in Asian countries in Pediatrics, in part due to authoritative and prolific Italian experts in pediatric neuroradiology. The US prominence was foremost in the Spine, and authors from Canada dominated the non-US spine contributions. Overall, the contributions from non-US authors (55.9%) to the AJNR exceeded those originating from the United States (44.1%).¹

Trend Towards PhD Authorship

Our results show a decline of MD authorship from 96.6% in 1998 to 72.0% in 2018 ($P = .003$). What accounts for the shift away from MD first authorship to more PhD-first authored AJNR articles in this time period? One possibility is the changing research environment for academic radiologists in the United States, who have taken on more clinical responsibilities, with consequent reduction of academic time, energy, and resources for research. Another factor may be the increasing challenge of obtaining research funding in the United States. Fang and Casadevall² documented the lack of academic support granted to American investigators, particularly compared with prior time periods. These findings are in line with our results, which showed the large role of PhD first authors who may benefit from greater resources for research and more funded time.

Table 1: The distribution of first authors, degrees, institutions, funding, and fields across time

	1998		2003		2008		2013		2018	
	Count	%	Count	%	Count	%	Count	%	Count	%
Radiologist vs nonradiologist										
Radiologists	48	80.0%	55	83.3%	52	76.4%	56	66.7%	69	77.5%
Nonradiologists	12	20.0%	11	16.7%	16	23.6%	28	33.3%	20	22.5%
Degree										
Both MD and PhD	1	1.7%	4	6.2%	5	8.6%	9	11.3%	16	18.0%
MD	56	96.6%	56	86.2%	47	81.0%	58	72.5%	64	72.0%
PhD	2	3.4%	5	7.6%	6	10.4%	10	12.5%	8	8.9%
Master of Science	0	0.0%	0	0.0%	0	0.0%	3	3.7%	1	1.1%
Institution										
Multiple institutions	17	28.3%	15	22.7%	19	27.9%	43	51.2%	51	34.5%
Single institution	43	71.7%	51	77.3%	49	72.1%	41	48.8%	38	65.5%
Funding										
Funded	12	20.0%	14	21.2%	17	25.0%	39	46.4%	33	37.1%
Unfunded	48	80.0%	52	78.8%	51	75.0%	45	53.6%	56	62.9%
Field										
Brain	13	21.7%	26	39.4%	30	44.8%	28	33.7%	33	39.8%
Head and Neck	24	40.0%	7	10.7%	9	13.4%	14	16.9%	13	15.7%
IR-Vascular	16	26.7%	14	21.2%	19	28.4%	25	30.1%	22	26.5%
Peds	6	10.0%	13	19.7%	2	3.0%	10	12.0%	5	6.0%
PNS-Spine	1	1.6%	6	9.0%	7	10.4%	6	7.3%	10	12.0%

Note:—IR indicates interventional radiology; PNS, peripheral nervous system.

Table 2: Distribution of radiologists versus nonradiologists in the field of neuro-IR

Field	Nonradiologist (Count)	Radiologist (Count)
Non-IR	57	214
Neuro-IR	30	66

Table 3: Regression model of predictor factors and association with radiology versus nonradiology

Predictor Factor	Exp(B)	95% CI for Exp(B)		P Value
Funding (funded vs unfunded) ^a	0.662	0.372	1.178	.160
Degree (PhD vs MD)	0.826	0.351	1.947	.663
Field				
Head and neck				.019
Brain	1.911	1.012	3.611	.046
Spine	2.551	0.860	7.564	.091
Neuro-IR	1.269	0.696	2.315	.437
Pediatric	6.758	1.900	24.035	.003
Year				
1998				.029
2003	2.856	1.295	6.299	.009
2008	2.271	1.065	4.843	.034
2013	1.601	0.819	3.128	.169
2018	2.414	1.232	4.732	.010

Note:—Exp(B) indicates exponential of the regression coefficient.

^a Studies we are analyzing that were funded or non-funded.

Funded versus Unfunded Research

We found a concomitant increasing trend toward funded articles in the *AJNR*. Lim et al³ studied the publishing of funded original articles in 2 major American radiology journals, the *American Journal of Roentgenology* (*AJR*) and *Radiology*, between 2001 and 2010. They showed that only 26.9% (1758 of 6542) of original articles were funded, a proportion that is remarkably low in comparison with other specialties, but close to the 31.3% of *AJNR*

articles that we report herein.³ One study documented that 77% of the original articles published in the major medical and neurologic journals in 1991 were funded.⁴ While the trend in the *AJNR* is toward an increase in funded original articles, radiology literature still trails other specialties significantly in the publication of funded studies.

Radiologist versus Nonradiologist Authorship in the *AJNR*

In our study, we show that of the 367 original articles, radiologists were the first authors in 280 (76.3%) articles, followed by neurosurgeons (27, 7.4%) and neurologists (26, 7.1%). Lim et al³ also evaluated the contributions of radiologists versus nonradiologists in original radiology articles and found that although radiologists still have the most prominent role in radiology research, 12.4% (811 of 6542) of articles had a nonradiologist as the first author, including 15.4% in *Radiology* (541 of 3571).³ One contributing factor to high number nonradiologist contributions was likely the growth in multidisciplinary collaborative studies among radiologists and clinicians from other medical specialties in which the first author was not a radiologist. Additionally, many nonradiologists who are performing radiology or radiology-related research may be choosing to submit their publications to radiology journals rather than clinical journals. This possibility may be particularly true in NIR, in which neurosurgeons and neurologists have a greater participation rate than diagnostic neuroradiologists. These trends indicate that radiology research is spreading throughout the clinical literature with more interplay between radiologists and nonradiologists. In summary, MDs and radiologists still dominate authorship in the *AJNR*; however, there are trends from 1998 to 2018 toward more PhD-authored, multi-institutional, and funded articles.

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