

A Decade of Global Skull Base Researchers: Authorship Trends from 3,295 Abstracts in the *Journal of Neurological Surgery Part B: Skull Base*

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Abstract

Objective The North American Skull Base Society (NASBS) multidisciplinary annual conference hosts skull base researchers from across the globe. We hypothesized that the work presented at the NASBS annual conference would reveal diverse authorship teams in terms of specialty and geography.

Methods In this retrospective review, abstracts presented at the NASBS annual meeting and subsequently published in the *Journal of Neurological Surgery Part B: Skull Base* between 01/01/2011 and 12/31/2020 were collected. Variables extracted included year, type of presentation, and author names and affiliations. Statistical analyses were performed with SPSS V23.0 with *p*-values less than 0.05 considered significant. Geographic heat maps were created to assess author distribution, and a network analysis was performed to display authorship collaboration between geographic regions.

Results Of 3,312 published abstracts, 731 (22.1%) had an author with an affiliation outside of the United States. Fifty-seven distinct countries were represented. Three-hundred twenty-four abstracts (9.8%) had authorship teams representing at least 2 different countries. The top five US states by abstract representation were Pennsylvania, California, New York, Ohio, and Minnesota. A majority of authors reported neurosurgery affiliations (56.7% first authors, 53.2% last authors), closely followed by otolaryngology (39.1% first authors, 41.5% last authors). No solo authors and very few (3.3%) of the first authors reported a departmental affiliation outside of otolaryngology or neurosurgery.

Keywords

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Conclusions Authors from many countries disseminate their work through poster and oral presentations at the NASBS annual meeting. Ten percent of abstracts were the product of international collaboration. Most authors were affiliated with a neurosurgery or otolaryngology department.

Introduction

The global impact of surgery, and the consequences of its limited availability, is expansive.¹ In particular global neurosurgery recently has evolved, with increasing awareness of its importance leading to advocacy and strengthening multi-national collaborations to improve neurosurgical care throughout the world.^{1–5} The expansion of global neurosurgery has fostered partnerships, aiding low- and middle-income countries (LMICs) in their efforts to increase neurosurgical workforce capacity.⁶ Similar efforts have been undertaken in otolaryngology, ophthalmology, radiation oncology, and interventional radiology.^{7–13} The care for patients with skull base pathologies requires multidisciplinary care by physicians in neurosurgery, otolaryngology, ophthalmology, medical oncology, radiation oncology, endocrinology, oral maxillo-facial surgery, plastic surgery, rehabilitation specialists, and neuroradiology.¹⁴ Global efforts in skull base surgery, including collaboration across borders, are hopefully following these patterns, but given the number of specialties involved, these efforts are more difficult to track.

Academic conferences are instrumental in disseminating newfound global surgical knowledge, reports of successful endeavors, and lessons learned.⁶ As the largest conference devoted to skull base surgery, the North American Skull Base Society (NASBS) annual meeting hosts many global skull base researchers.¹⁴ Since 2011, abstracts presented at the NASBS annual meeting, whether oral or poster presentations, have been published in the *Journal of Neurological Surgery Part B: Skull Base (JNLSB)*. The NASBS annual conference provides an opportunity for skull base researchers to share their research in person, to network, and to ultimately advance the field through dissemination of this research via the journal.¹⁵

Previous analysis of this meeting studied gender distribution, which we have further examined in an accompanying article.¹⁶ However, we remained curious about additional characteristics of researchers contributing to the skull base literature. Considering the recent successes of the global surgery movement as well as the growth of ethnic and gender minorities represented in surgical subspecialties,^{17–21} we believe that there is much to learn via the study of characteristics of authors that had their abstracts accepted to NASBS. Therefore, we evaluated all abstracts presented at the NASBS annual conference and subsequently published in *JNLS B* from 2011 to 2020. The particular focus of the present research was on skull base researcher departmental and geographic affiliations. General characteristics, such as the rate of abstracts accepted per year and the number of authors per abstract, as well as collaborative characteristics including geographic affiliation and authorship specialty were assessed. Given the

prominence of the NASBS annual meeting as a venue to present research in skull base surgery, we hypothesized that authorship for those presenting would be globally diverse despite the focus on “North America” in the society’s and meeting’s title.

Methods

We performed a retrospective review of all abstracts presented at the NASBS annual meeting and subsequently published in *JNLS B* between 01/01/2011 and 12/31/2020. Variables extracted from *JNLS B* included year of abstract publication, type of presentation (oral presentation versus poster presentation), title, first and last author name, first and last author departmental affiliation information, and total number of authors per abstract. Abstracts with affiliation information for either the first or last author which lacked a country of location were excluded from the analysis. Of the 3,327 abstracts in the time period assessed, 3,312 were ultimately included in the analysis.

Articles written by one author ($n=164$; 5.0% of all abstracts) were not considered in the analyses to have a first or last author. Rather, they were labeled as having a “solo author.”

Authorship affiliation information was carefully reviewed. If dual appointments were listed, publicly available information such as faculty profiles or institutional Web sites were utilized to determine the specific author’s primary departmental appointment. As part of the geographic analysis, if dual affiliation locations were listed, the first location listed was designated as the primary affiliation location.

Statistical analyses (which included descriptive statistics, Fisher’s exact, chi squared, and independent samples t -tests) were performed with SPSS V23.²² p -Values < 0.05 were considered statistically significant. For the network analysis, nodes (representing location of an author’s affiliation), edges (representing a collaboration between authors of two locations), and edge weights (representing the relative number of abstracts published with coauthors from the edge-connected locations) were computed using a custom-made MATLAB program, then imported into R version 3.6.1. Geographic maps of authorship density and of authorship collaboration were then created with R package “ggplot2.”²³ As all information utilized was publicly available and all information presented was deidentified, this study did not require institutional review board approval.

Results

Of 3,312 abstracts in the sample, 1,537 (46.4%) were poster presentations and 1,775 (53.6%) were oral presentations at

NASBS (►Table 1). We were able to establish country affiliation for 17,524/17,601 total authors (99.6%) and the departmental affiliation of both first and last author for 435/3,312 abstracts (13.1%). The number of abstracts and mean number of authors per abstract gradually increased each year throughout the time period assessed (►Fig. 1). On average, 5.3 ± 2.6 authors contributed to each abstract, ranging from 1 to 25. The odds of the abstract being an oral, rather than a poster presentation, were higher for abstracts with multiple authors (odds ratio [OR] = 1.7, 95% confidence interval [CI] = 1.2–2.3).

There were 164 solo-authored abstracts. Of the 16 solo authors who reported a departmental affiliation, 93.8% were affiliated with neurosurgery, compared with only 56% of the first authors of multiauthored abstracts. Correspondingly, first authors of multiauthored abstracts had higher odds of being affiliated with an otolaryngology department (OR = 10.3, 95% CI = 1.3–78.5). No solo authors and very few (3.3%) of the first authors reported a departmental affiliation outside of otolaryngology or neurosurgery (►Table 1). Radiation oncology and neuroscience or neurology comprised the majority of the remaining affiliations represented

Table 1 Sample data for the 3,312 abstracts in the study

	Solo-authored abstracts (n = 164; 4.95% of total sample)	Multi-authored abstracts (n = 3148, 95.05% of total sample)	Odds ratio	95% CI	p-Value
Presentation type					
Poster	96 (58.5%)	1,441 (45.8%)	0.6	[0.4–0.8]	0.002
Oral	68 (41.5%)	1,707 (54.2%)	1.7	[1.2–2.3]	
Reported a department affiliation	16 (9.8%)	455 (14.5%)	1.6	[0.9–2.6]	0.108
Neurosurgery	15 (93.8%)	255 (56.0%)	0.1	[0.0–0.6]	0.002
Otolaryngology	1 (6.3%)	185 (40.7%)	10.3	[1.3–78.5]	0.004
Other	0 (0.0%)	15 (3.3%)	1.0	[0.9–1.0]	1.000
Reported country affiliation	164 (100%)	3,148 (100%)			
United States of America 48	50 (30.5%)	2,489 (79.1%)	8.6	[6.1–12.1]	<0.001
India 18	23 (14.0%)	45 (1.4%)	0.1	[0.1–0.2]	<0.001
Japan 23	13 (7.9%)	58 (1.8%)	0.2	[0.1–0.4]	<0.001
China 9	11 (6.7%)	44 (1.4%)	8.6	[6.1–12.1]	<0.001
Czech Republic 12	11 (6.7%)	1 (0.0%)	0.0	[0.0–0.1]	<0.001
Canada 7	1 (0.6%)	142 (4.5%)	7.7	[1.1–55.4]	0.009
Reported state affiliation	48 (96.0% of those with a US affiliation)	2444 (98.2% of those with a US affiliation)			
California	7 (14.6%)	267 (10.9%)	0.7	[0.3–1.6]	0.058
Virginia	5 (10.4%)	19 (0.8%)	0.1	[0.0–0.2]	0.006
Arizona	4 (8.3%)	82 (3.4%)	0.4	[0.1–1.1]	1.000
Florida	4 (8.3%)	101 (4.1%)	0.5	[0.2–1.3]	0.818
Louisiana	4 (8.3%)	78 (3.2%)	0.4	[0.1–1.0]	1.000
Pennsylvania	3 (6.3%)	352 (14.4%)	2.5	[0.8–8.2]	<0.001
New York	2 (4.2%)	243 (9.9%)	2.5	[0.6–10.5]	0.001
Ohio	1 (2.1%)	228 (9.3%)	4.8	[0.7–35.2]	<0.001
Minnesota	1 (2.1%)	146 (6.0%)	3.0	[0.4–21.8]	0.010

Note: For the multiauthored abstracts, statistics correspond to the first author's affiliation, to allow for comparison. States and countries of affiliation listed are limited to include the top 5 for each group. To evaluate significance between dichotomous variables, Fisher's exact test was used. Otherwise p-values correspond to, and are reported for, chi-squared test.

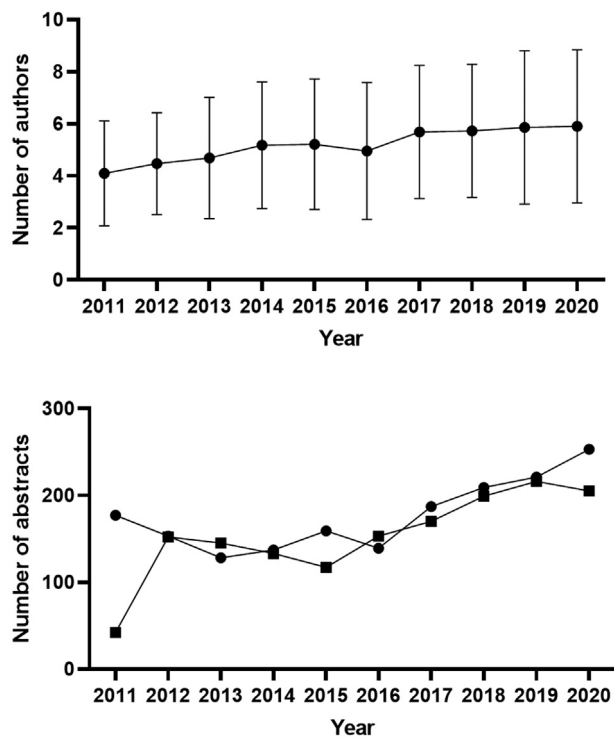


Fig. 1 Line charts of abstracts per year. (Top) Mean number of authors on each accepted abstract, per year since 2011. Error bars represent standard deviations. (Bottom) Number of accepted oral (circle) and poster (square) presentations per year since 2011.

(► **Fig. 2**). Similar to first authors, only 511 (16.2%) of last authors reported a specific departmental affiliation. Of those, 283 (55.4%) reported a neurosurgery and 223 (43.6%) reported an otolaryngology primary appointment (► **Fig. 2**). There were a greater number of other specialties

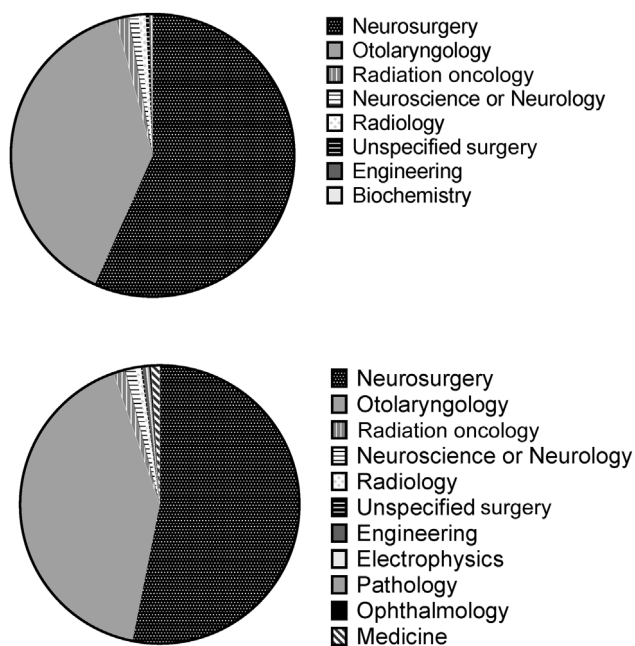


Fig. 2 Pie charts of departmental affiliation of first and last author. (Top) First author. (Bottom) Last author.

represented by last authors, including radiation oncology, neuroscience or neurology, radiology, unspecified surgery, engineering, electrophysics, medicine, pathology, and ophthalmology.

Annual meetings since 2011 were exclusively held in the United States.¹⁴ Meeting locations included: New Orleans, Louisiana (2011); Las Vegas, Nevada (2012); Miami, Florida (2013); San Diego, California (2014); Tampa, Florida (2015); Scottsdale, Arizona (2016); New Orleans, Louisiana (2017); Coronado, California (2018); Orlando, Florida (2019); and San Antonio, Texas (2020).¹⁴ States of each annual meeting are denoted by dots in ► **Fig. 3**.

The most frequent country of affiliation for authors was the United States (► **Table 2**). First authors were most-commonly affiliated with an institution in the United States ($n = 2489$, 79.1%). The states most-frequently represented among first authors included Pennsylvania ($n = 352$, 11.2%), California ($n = 267$, 8.5%), New York ($n = 243$, 7.7%), Ohio ($n = 228$, 7.2%), and Minnesota ($n = 146$, 4.6%; ► **Fig. 3**). These same five states were the most represented among all authors (► **Table 3**). First authors were also commonly affiliated with an institution in Canada ($n = 142$, 4.5%). The provinces/territories most frequently represented included Ontario ($n = 88$, 62.0%), British Columbia ($n = 22$, 15.5%), and Quebec ($n = 13$, 9.2%). Among those first authors with affiliations in Mexico ($n = 16$, 0.5%), the states represented were Mexico City ($n = 11$, 68.8%), Michoacán ($n = 3$, 18.8%), and Mexico ($n = 2$, 12.5%). Similarly, 80.3% of last authors ($n = 2527$) reported a US affiliation. The most frequently represented states for first authors remained the same for last authors, with few differences (► **Fig. 3**). Canadian and Mexican affiliations for last authors were reported in 141 (4.5%) and 11 (0.3%) of studies, respectively.

In total, 57 different countries were represented as affiliations of contributing authors to the NASBS conference. Countries from all continents, excluding Antarctica, were represented (► **Fig. 4**). Of the 3,312 abstracts in our sample, 731 (22.1%) had an author with an affiliation outside of the United States. This percentage ranged from a minimum of 6.5% in 2014 to a maximum of 29.9% in 2016, but we did not detect any statistically significant trend over the 10 years period (Mantel-Haenszel test of trend; $p = 0.196$). The most common non-North American affiliated countries for first authors were Japan (58, 11.2% of non-North American countries), India (45, 8.7%), China (44, 8.5%), and Germany (41, 7.9%). Of last authors not affiliated with an institution in North America, the most-commonly affiliated countries included Japan (51, 10.6% of non-North American countries), India (48, 10.0%), United Kingdom (42, 8.8%), and Germany (42, 8.8%).

Collaborative efforts were assessed by examining the geographic affiliations of all authors on a given abstract. International collaboration was assessed using network analysis. Many collaborations spanned countries and continents (► **Fig. 5**). Of the 3,312 published abstracts, 324 (9.8%) had authorship teams representing at least two different countries. The majority of collaborative abstracts had at least one author in the United States (216/324, 66.67%), consistent

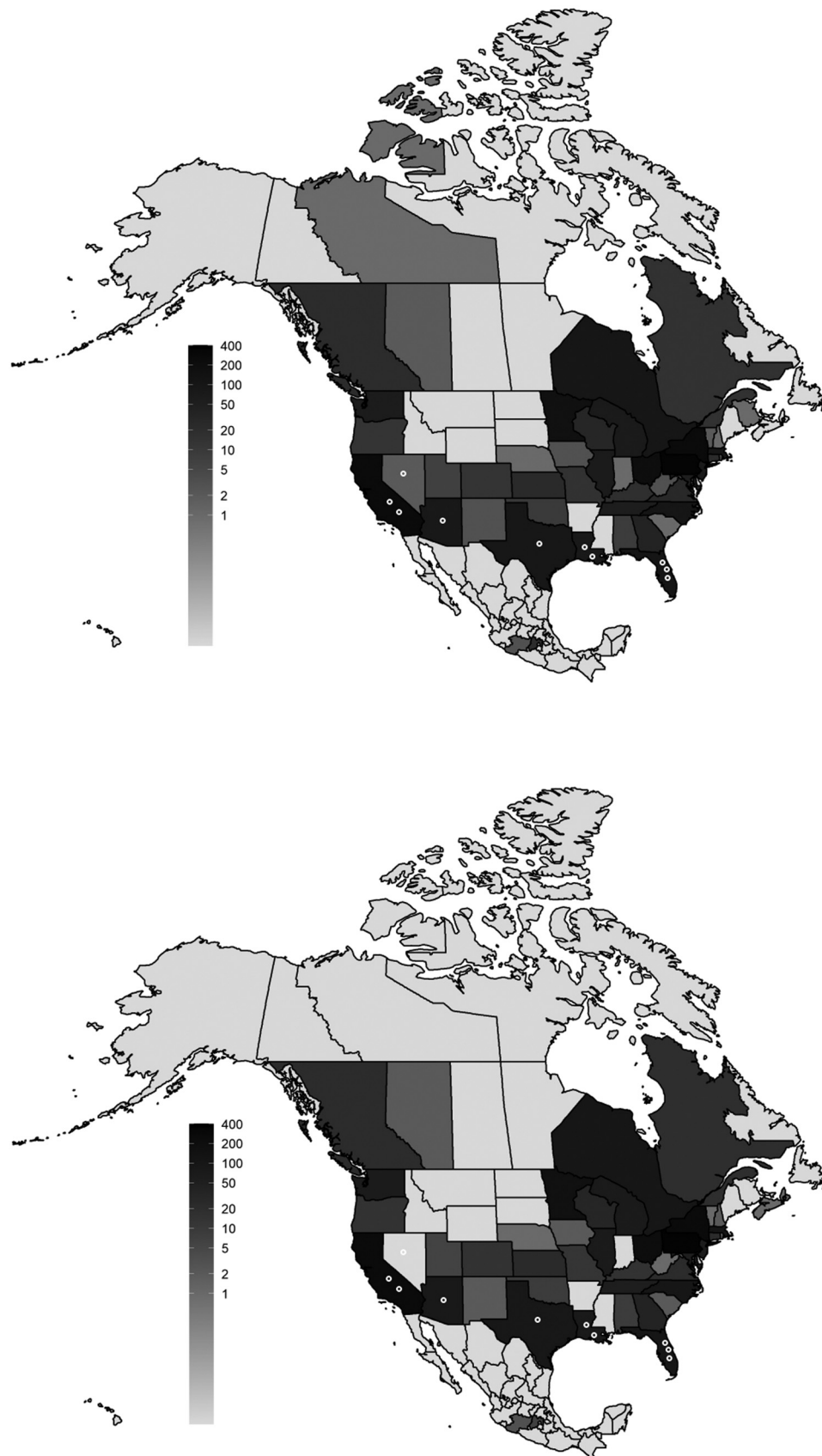


Fig. 3 Heat map of those authors reporting a Canada, United States of America, or Mexico departmental affiliation, demonstrating frequency of author geographic affiliations by state/province/territory. Quantities are displayed on a logarithmic scale to better depict changes between the countries with fewer authors represented. White circles on each region represent the approximate location of an annual meeting held between 2011 and 2020. Top map represents affiliations of first authors. Bottom map represents last author affiliations.

Table 2 Top 15 countries by abstract representation (i.e., 2,829 abstracts had at least one author with a US affiliation)

Country	Abstracts
United States	2,829
Canada	202
India	96
China	94
Japan	93
Germany	88
Egypt	77
United Kingdom	72
Italy	68
Brazil	48
Australia	46
Saudi Arabia	45
Mexico	42
Spain	36
Russia	35

Table 3 Top 15 states by abstract representation (i.e., 543 abstracts had at least one author with a Pennsylvania affiliation)

States	Abstracts
Pennsylvania	543
California	448
New York	367
Ohio	363
Minnesota	224
North Carolina	206
Florida	186
Massachusetts	181
Arizona	146
Michigan	140
Washington	137
Texas	136
Illinois	132
New Jersey	114
Virginia	97

with the affiliation of the majority of authors. The most common collaborations once the United States was removed were between Saudi Arabia and Canada (►Fig. 6). Interstate collaboration was likewise notable (►Fig. 7). Of the 2,829 abstracts which had at least one author affiliated with a US institution, 586 (20.7%) were cowritten by authorship teams which spanned multiple states. Pennsylvania, Ohio, California, and New York had the greatest collaborative efforts.

Discussion

Through the retrospective review of 10 years of NASBS annual meeting abstracts, we were able to extract and analyze authorship data to discover trends in skull base research over the past decade. Overall, there was a positive trend in the total number of abstracts accepted to the NASBS annual conference, as well as an increase in the average number of contributing authors to each project, consistent with findings in related studies.^{24–27} The most commonly reported departmental affiliation at the NASBS annual conference was neurosurgery, closely followed by otolaryngology. We found that, overwhelmingly, abstract authors were associated with North American institutions. Most North American authors were from institutions in the United States and Canada. Authors from outside of the United States were present on approximately 22% of all conference abstracts.

We hypothesized that the abstracts of the NASBS annual conference would be rich in authorship diversity, in terms of both specialty and geographic representation. Given its skull-base focus, we expected a strong specialty representation of both neurosurgery and otolaryngology, and our analysis confirmed this. Our results also demonstrated contributions by authors from other subspecialties including radiation oncology, ophthalmology, neuroscience and neurology, though these were less prevalent. One reason for this lower prevalence may be the high priority placed on research by both neurosurgeons and otolaryngologists. Neurosurgery has the second highest average h-index for assistant professors, associate professors, and professors with mean h-indices of 5, 10, and 19, respectively, among academic physicians in various medical specialties.²⁸ Otolaryngology follows with h-indices of 4.6, 8.1, and 15.6 for the same categories, while the other, (lesser represented), specialties at NASBS trail behind.²⁸ Regarding medical trainees, the 2020 AAMC *Charting Outcomes in The Match for US Allopathic Seniors* reports that neurosurgery applicants have the highest average number of abstracts, presentations, and publications among matched applicants, at an average of 23.4.²⁹ Also on the upper end of the spectrum is otolaryngology, with an average of 13.7 publications per matched applicant.²⁹ Comparatively, other specialties less represented at NASBS such as neurology, interventional radiology, and diagnostic radiology, all fall in the middle-to-lower end of average publications, with means of 7.2, 10.3, and 6.4 publications, respectively.²⁹ Though radiation oncology is also not as well represented at NASBS, it falls on the upper end of the research spectrum, with a mean publication number of 15.6 per applicant.²⁹ This challenges the idea that lack of emphasis on research contributes to less representation at the NASBS conference, and suggests that it is more multifactorial. Our study also may underestimate the contributions of some specialties given that we did not assess departmental affiliation of middle authors.

Presenting at large professional society conferences such as NASBS is strongly associated with career advancement; presenters increase their visibility and further establish themselves as experts in their field.¹⁵ Increasing author

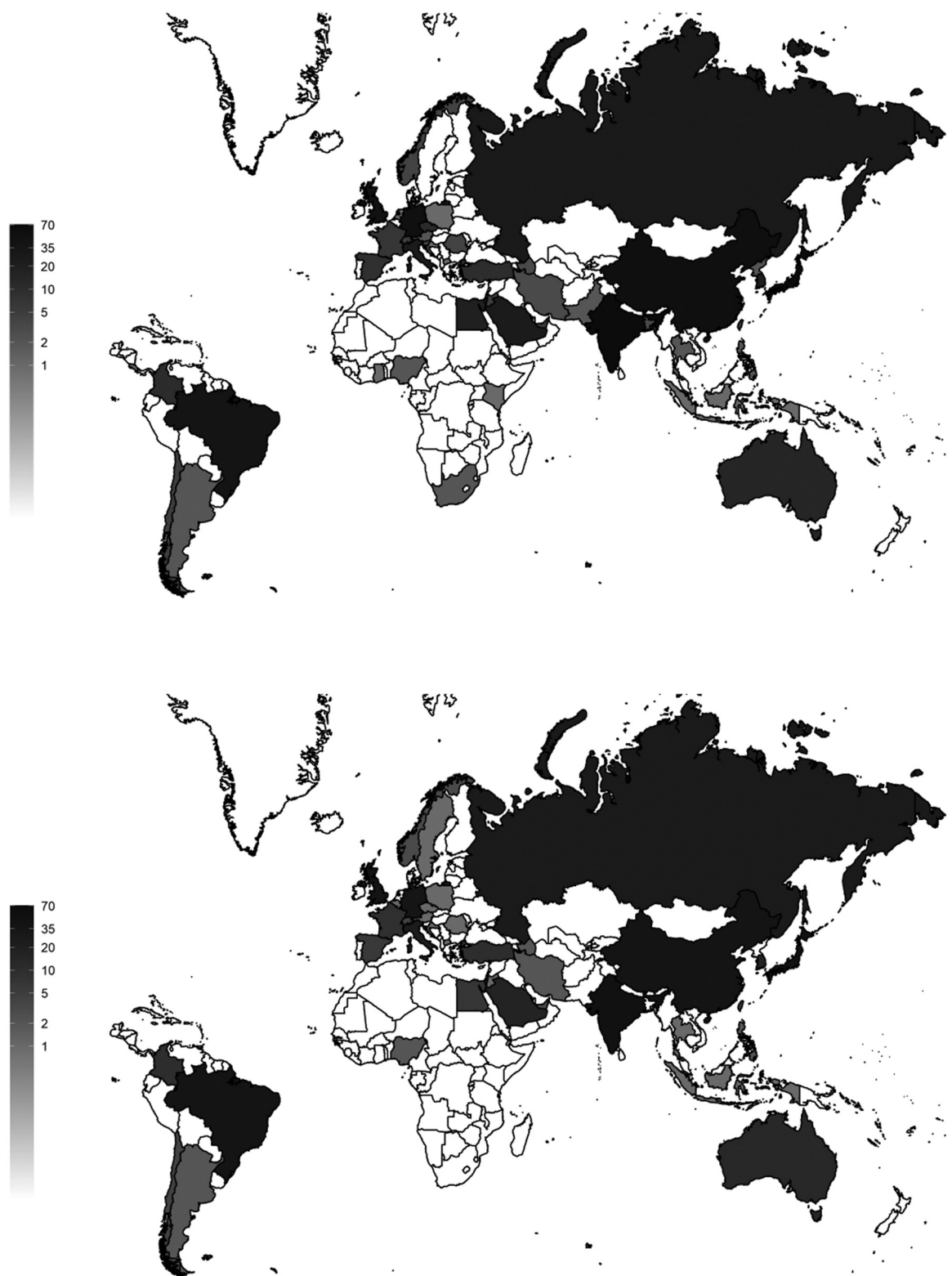


Fig. 4 Heat map of those authors reporting a country of affiliation outside of the North American continent, with top map representing first authors and bottom map representing last authors. Quantities are displayed on a logarithmic scale to better depict changes between the countries with fewer authors represented.

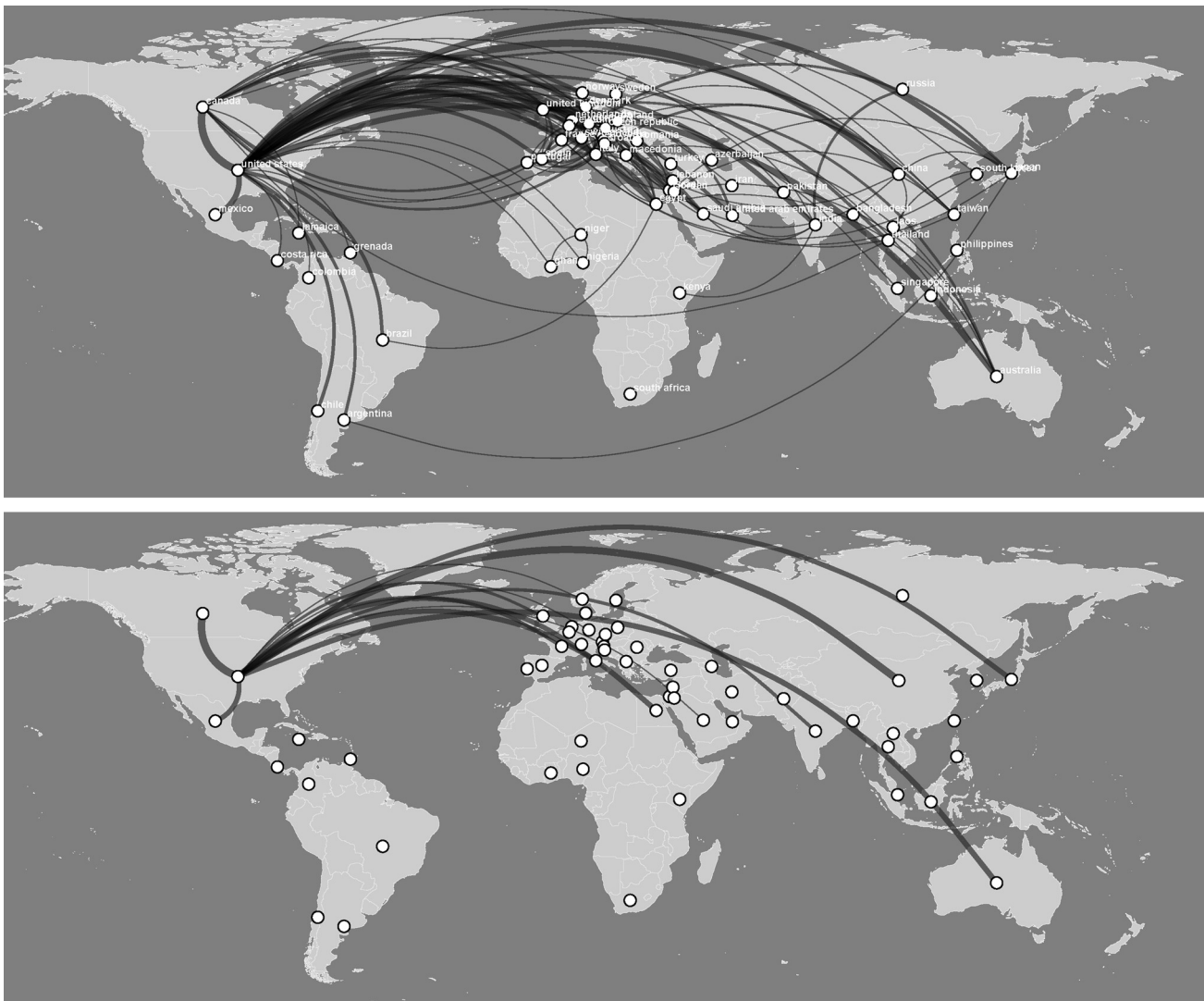


Fig. 5 International network analysis for North American Skull Base Society (NASBS) abstract collaboration. Each line represents a collaborative relationship, between authors of the involved countries, on an NASBS abstract. Thicker lines represent greater number of abstracts with authors from the two involved countries collaborating. Top panel shows results with a threshold of 1 abstract minimum. Bottom panel shows results with a threshold of 6 abstracts minimum.

and speaker representation from traditionally underrepresented groups may help foster an environment where attendees are more encouraged to network, engage in discussion, and collaborate.^{30–32} Evaluation of representation at otolaryngology conferences demonstrated the pipeline effect in academic medicine.³⁰ Greater representation of women in leadership positions has frequently been found to be associated with greater society membership of female physicians in general.³⁰ Although this study did not show causality, this pipeline effect thus suggests that increasing representation from underrepresented groups (geographic regions, gender, institutions) in leadership positions may increase overall membership from those groups in skull base societies such as NASBS, and advance the democratization of skull base research.

Our second hypothesis addressed geographic association among authors of accepted papers at NASBS: we predicted that there would be a high degree of geographic diversity among authors due to the growing collaboration in skull base

research. This hypothesis was true. While most authors were from the United States, there were a total of 57 countries represented at the conference. A little over one in five conference abstracts featured an author with an affiliation outside of the United States. There was extensive involvement of countries outside of North America, and extensive international collaboration, which is notable because the NASBS annual meeting is consistently held in North America and the society title emphasizes that same geographic region.

Among authors from the United States, the states with the greatest representation also hold the greatest number of top 50 neurosurgical residency programs based on Doximity reputation ranking^{33,34}: Pennsylvania and California with five each, New York with six, Ohio and Minnesota with three each. Similar trends in these states exist for the top 50 otolaryngology programs. These states are each home to multiple skull base fellowship programs¹⁴: California with six, Pennsylvania, Ohio and New York each with three, and

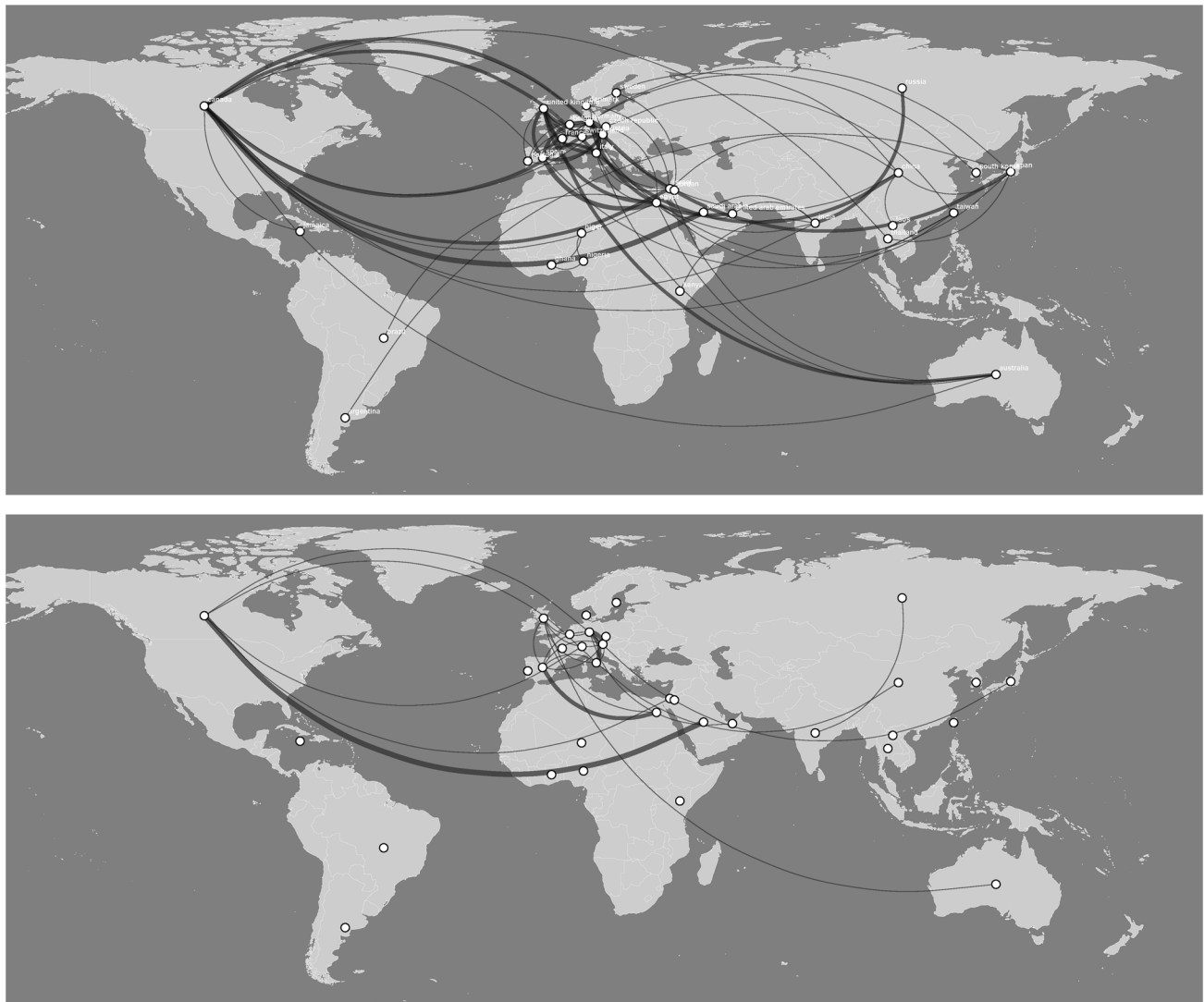


Fig. 6 International network analysis for North American Skull Base Society (NASBS) abstract collaboration, excluding abstracts with any authors from the United States. Each line represents a collaborative relationship, between authors of the involved countries, on an NASBS abstract. Thicker lines represent greater number of abstracts with authors from the two involved countries collaborating. Top panel shows results with a threshold of 1 abstract minimum. Bottom panel shows results with a threshold of 2 abstracts minimum.

Minnesota with two.³⁵ Lastly, the top five represented states are each home to three NASBS Multidisciplinary Teams of Distinction,¹⁴ with the exception of Minnesota having two. With a high concentration of skull base specialists and trainees, these states may have relatively greater opportunities for research and collaboration, contributing to their high degree of representation at the NASBS annual meeting.

Conversely, although NASBS is a conference exclusively hosted in North America, there was a strong discrepancy in representation of Canadian authors versus Mexican authors. Of first authors, 4.5% held Canadian affiliations, while only 0.5% held Mexican affiliations. One reason there may be such a significant difference in Canadian/Mexican authorship is language barriers. Publications in *JNLS B* are written in English, which could limit non-English speaking authors from both attending the conference and presenting or publishing their research, particularly those without access to translating services. Additionally, the highest concentrations of NASBS authors in Mexico and Canada seem to be based

around the locations of the major neurosurgical residency programs.³⁶ In Mexico, there are three neurosurgical residencies, compared with fourteen in Canada.³⁶ Fewer programs in general may be associated with fewer opportunities to partake in academic skull base research.

The majority of NASBS annual meetings are held on the southern border of the United States,¹⁴ with some of the most recent host cities being San Antonio, Coronado, Orlando, and Scottsdale. While states that frequently host the NASBS annual meeting, such as California, Texas, Florida, and New Mexico, all have large amounts of contributing authors to the conference, there are other states with high authorship representation that have never hosted an NASBS conference (e.g., Pennsylvania, New York, Minnesota, Massachusetts). Notably, Canada has hosted the conference twice, in 2005, and 2008.

The most represented non-North American countries were of varied income status, including Japan (high income), India (lower middle income), and China (upper middle

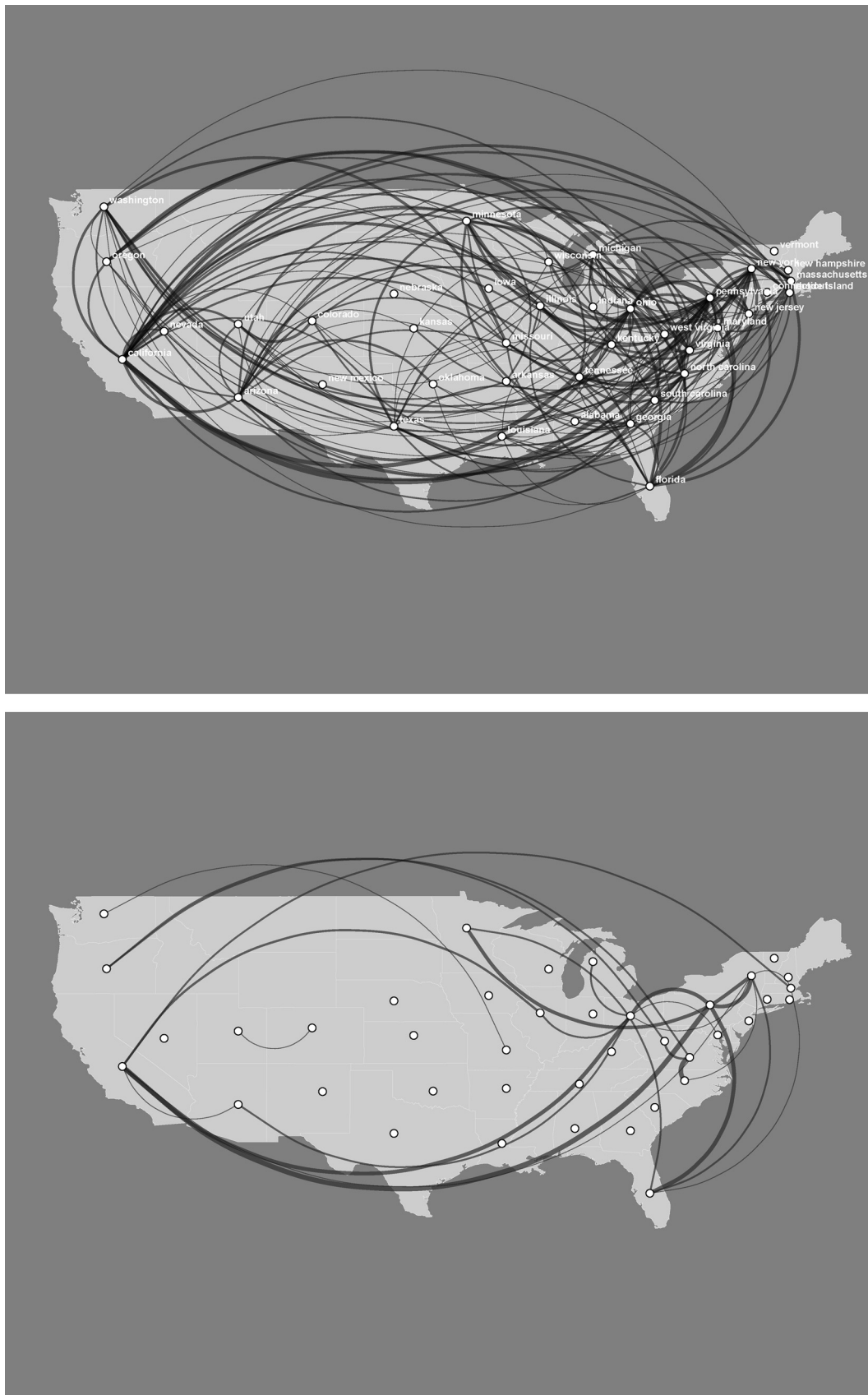


Fig. 7 Interstate network analysis for abstract collaboration. Each line represents a collaborative relationship, between authors of the involved states, on a North American Skull Base Society (NASBS) abstract. Thicker lines represent greater number of abstracts with authors from the two involved states collaborating. Top panel shows results with a threshold of 1 abstract minimum. Bottom panel shows results with a threshold of 6 abstracts minimum.

income).³⁷ Though Japan comparatively has a much smaller population than both India and China, they had the greatest representation among non-North American first authors at NASBS. This may reinforce the idea that a country's population size may not be as determinative of skull base research production as its economic status; we believe more research on this topic is necessary before drawing any conclusions.

While the global representation pattern was quite impressive, researchers from LMICs were generally underrepresented. One reason for this may be that skull base surgery is resource-intensive.^{6,38} Many procedures require a multidisciplinary team of physicians in neurosurgery, ENT, anesthesia, radiology, and nursing care. Furthermore, technology such as magnetic resonance imaging and intensive care unit-level care are often necessary for perioperative care. The monetary cost of skull base surgery, not just for hospital systems, but for individuals, is another substantial barrier to care. These costs may also limit the ability of researchers.³⁹ LMICs need high-quality surgical care; lack of access to surgical care globally causes an estimated 3 times as many deaths as human immunodeficiency virus/acquired immunodeficiency syndrome, tuberculosis, and malaria combined.³⁸ Approximately 23,300 additional neurosurgeons are needed to treat patients in LMICs annually.³⁹ Likewise, current evidence suggests a shortage of otolaryngologists in LMICs.⁴⁰ In 2012, a survey of 18 developing, sub-Saharan African countries identified a shortage of 4,699 otolaryngologist surgeons.⁴⁰ We, therefore, believe our findings reinforce the principle that addressing the factors that contribute to disparities in skull base surgery between high-income countries and LMICs cannot only help to redress the inequity in patient care³⁸ but also redress the inequity in research.

Geographic authorship representation may help us to understand the patient populations currently represented in skull base research. For example, if researchers are more likely to study those populations present in their geographic vicinity, and skull base researchers from Germany frequently publish, we believe individuals living in Germany *may* be disproportionately represented in skull base literature relative to those individuals from countries with fewer prolific skull base researchers. Regarding the North American participation, US- and Canada-affiliated researchers were overrepresented relative to those affiliated with an institution in Mexico. If certain skull base conditions disproportionately affect individuals in Mexico, then we would be concerned regarding the relative lack of representation of research from that country in our sample. Addressing social determinants of health to achieve health equity is a major global health initiative.⁴¹ We hope this discussion encourages further collaborative global research efforts in skull base surgery.

We commend the deliberate efforts of NASBS annual meeting organizers in creating a global research symposium. The annual meeting now includes a Global Education Session that allows expert surgeons from around the world to present cases.¹⁴ Additionally, NASBS offers both an International and a North American Travel Scholarship.¹⁴ To date, recipients have been affiliated with institutions in Mexico, Lithuania, Turkey, Abud Dhabi, Germany, The Philippines,

Indonesia, South Africa, India, Spain, Finland, Nigeria, Czech Republic, and Sri Lanka.¹⁴ The NASBS also has a successful annual Grant Program, which has offered grants to deserving researchers between \$5,000 and \$20,000.¹⁴ The goal of this program is to encourage collaboration, foster clinical skills, and answer important skull base-related scientific questions.¹⁴ Any physician is welcome to apply for membership in NASBS, and dues for members outside of North America are discounted relative to those located in North American countries. All of these efforts have likely contributed to the international representation in NASBS conference abstracts.

Our study has several limitations. The departmental affiliation was not reported by a majority of the authors we analyzed. Thus, we do not know whether the affiliations collected and analyzed were a representative sample. We also did not assess departmental affiliations for middle authors. It is possible that there were authors in our sample from many other departments/specialties that our study did not capture, as a result. If dual affiliation locations were listed, the first location listed was designated as the primary affiliation location. This strategy represents another potential limitation of our analysis; however, this only affected 28/3312 (0.85%) of first authors and 14/3312 (0.42%) of last authors, and as such we believe that this would not meaningfully alter our conclusions.

As we continue to strive for greater gender, racial/ethnic, and geographic representation in skull base surgery, this study highlights several areas for future research. We did not evaluate the content of the research done, including whether the content varies by authors' geographic region. Future studies might consider stratifying authors of accepted papers each year by geographic location, and comparing the content of abstracts by location of author affiliation. This information might be helpful to assess current, and inform future, global neurosurgery efforts. Data from other conferences and/or journals of skull base research might also be assessed. Skull base surgery is becoming increasingly collaborative and multidisciplinary. In fact, NASBS designates certain programs throughout the country who exemplify the multidisciplinary nature of skull base surgery, known as "NASBS Multidisciplinary Teams of Distinction."¹⁴ An interesting future study would be to evaluate all authors' specialties, training, and departmental affiliations/appointments to analyze the degree of interdisciplinary collaboration among authors of papers accepted to NASBS. Because we believe achieving diversity among skull base researchers is a necessary condition to further the field, we also share our dedicated analysis of the role of gender at the NASBS annual meeting, cited here.¹⁶

Particularly in the wake of the coronavirus disease 2019 pandemic, we have seen an emergence of virtual conferences. We, therefore, wonder whether virtual conferences have had any impact on representation by researchers around the world. An online format eliminates the barriers of travel and is typically less costly for participants than in-person meetings. If more researchers have the opportunity to attend NASBS, does the competitiveness of the conference increase? Future investigators may answer these questions by assessing beyond the month of February, 2020.

Conclusion

Attending and presenting at academic conferences provide critical opportunities for researchers and are associated with career advancement and funding. In this retrospective review of a decade of abstracts presented at the NASBS annual meeting and published in *JNLS B*, we describe the characteristics of researchers who contribute to the global skull base literature. We found that authors from over 57 countries have presented and published their research at the NASBS. The majority of all first and last authors had neurosurgery and otolaryngology affiliations. LMICs are under-represented at this meeting—we predict that continuing to prioritize their involvement in skull base surgery will only increase collaboration and strengthen the field.

Conflict of Interest

None declared.

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