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A Bibliographic Analysis of the Most Cited Articles in Global Neurosurgery

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Abstract

OBJECTIVE: Global neurosurgery is the practice of neurosurgery with the primary purpose of delivering timely, safe, and affordable neurosurgical care to all who need it. The aim of this study is to identify the most frequently cited articles in global neurosurgery through a bibliographic review to characterize articles and trends around this growing topic.

METHODS: The top most-cited articles in global neurosurgery were determined by searching the Web of Science database using a priori search terms. Articles with at least 5 citations were selected, and there were no time period or language restrictions. The data were extracted from each included article and all characteristics were summarized.

RESULTS: A total of 932 articles were identified using the search terms; 69 articles fulfilled inclusion criteria and 17 articles were selected that had more than 5 citations. The articles' number of citations ranged from 6 to 98 for the most-cited article. Authors from, or affiliated with, 14

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CRedit AUTHORSHIP CONTRIBUTION STATEMENT

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countries contributed to the 17 articles, and the country that had the greatest representation was the United States. The main topic discussed was surgical capacity, the second topic was the treatment of different neurosurgical conditions, and volunteerism was the third topic.

CONCLUSIONS: There is currently a deficit in both the amount of literature surrounding the topic of global neurosurgery and how much that literature is cited. Developing innovative ways to increase academic productivity within, or in collaboration with, low-middle income countries is essential to contribute to global neurosurgery.

Keywords

Global neurosurgery; Global surgery; Neurosurgery

INTRODUCTION

The publication of the *Lancet* Commission on Global Surgery and the adoption of the World Health Organization Resolution WHA68.15 in 2015^{1,2} prioritized providing access to safe and effective surgical care in global health. As recognition of the high prevalence of neurosurgical conditions has increased, it has become undeniable that neurosurgery is an important component to essential surgical care. Through the continued efforts of individuals involved in the global neurosurgery movement, neurosurgery remains a priority in the international effort to address the disparities in surgical care necessary to achieve the United Nations goal of Universal Healthcare Coverage by 2030.^{3,4}

At the annual conference for the American Association of Neurosurgical Societies in 2019, former president of the World Bank Dr. Jim Yong Kim highlighted the growth in the number of global neurosurgery publications. Despite this growing body of literature, there has been no formal bibliographic analysis conducted. Other surgical specialties have conducted similar analyses.⁵⁻⁸ Bibliometric analyses are a useful way to measure what literature currently exists and which studies have been most impactful. For neurosurgery, bibliometric analyses have been previously used to study the most relevant citations in the field overall⁹ and within numerous sub-specializations, such as pediatric neurosurgery,¹⁰ neurovascular surgery,¹¹ and other prevalent neurologic diseases and injuries within the field,¹²⁻¹⁵ but not yet as it relates to global neurosurgery. Bibliometric analyses also have been important in surveying the literature about global neurosurgery within specific low-middle income countries (LMICs).^{16,17} The purpose of this paper is to perform a bibliometric analysis of the most-cited journal articles in global neurosurgery to provide a better understanding of academic productivity and trends in this growing topic. This paper focuses on global neurosurgery as a concept or topic, which includes workforce, training, capacity, and other factors, and not simply on neurosurgical literature that exists outside high-income countries (HICs).

METHODS

We performed a bibliographic search of the most-cited articles relating to global neurosurgery using Web of Science (v.5.34; Galter Health Sciences Library & Learning Center, Chicago, Illinois, USA) in January and February 1, 2020.

The database was independently searched by 2 investigators (M.N.-J. and D.W.) and cross-checked to ensure repeatability of methods using a priori search terms, as well as inclusion and exclusion criteria. The following search terms for topic and title were used: (global health) OR (global mission) OR (surgical mission) OR (international mission) OR (public health) OR (international health) OR (lancet commission) OR (global surgery) AND (neurosurgery) OR (neurological surgery) OR (neurological) OR (surgery) OR (central nervous system) OR (brain) OR (spine).

We searched the database since its inception (1900 to February 1, 2020) without language restrictions for all studies, including non-original research and reviews. Studies describing neurosurgical patients, procedures, or the topic of global neurosurgery were included. Those describing military response aid or relief, articles with only abstracts or poster presentations, and strictly epidemiology articles that do not identify global neurosurgery as a thematic topic were excluded. The articles were organized in descending order of “Times Cited.” The primary search reviewed the title and abstract of each study. Manuscripts meeting initial inclusion criteria were identified and these articles were read in full text for the secondary search.

The top articles with the most citations were selected because the number of citations per article beyond this became very low (<5 citations). Articles with the same number of total citations were ranked higher when they had a larger number of citations over a shorter time period.

The following data were extracted from each included article: title, source journal, study design, main topic, language, neurosurgery subspecialty, 2018 impact factor, total citations, average citations per year, year of publication, volume, page numbers, PubMed ID, authors, number of authors, each author’s affiliated institution and country, and if the institutions were affiliated with hospitals, medical schools, or non-governmental organizations. Institutions affiliated with hospitals, medical schools, or non-governmental organizations were determined by the address listed for the corresponding author. Furthermore, the country was determined by all authors affiliated institutions, and we considered all countries that authors were affiliated in the case that the authors had more than one country affiliation. Finally, the order of the list was determined by the number of citations, and if the articles had the same number of citations we prioritized the year of publication. This study involves publicly available articles with deidentified patient information; therefore, an institutional review board approval or informed consent was not necessary.

RESULTS

A total of 932 articles were identified using search terms and 69 articles met our initial inclusion criteria. Full text of these articles were reviewed to identify the 17 most cited articles in global neurosurgery, which had a combined 333 citations from 1997 to 2019 (Table 1).¹⁸⁻³⁴ See Supplementary Table 1 for a complete table of additional articles that did not have a sufficient number of citations for study inclusion but otherwise met inclusion criteria.³⁵⁻⁴⁶ The most-cited article was “Global neurosurgery: the current capacity and deficit in the provision of essential neurosurgical care. Executive Summary of the Global

Neurosurgery Initiative at the Program in Global Surgery and Social Change” by Dewan et al 2019.¹⁸ The number of citations per article ranged from 98 for the most cited article to 6 for the least cited article, with a mean of 19.6 (standard error [SE]: 5.5) citations per article. Twelve of the seventeen articles had fewer than 20 citations each. The number of citations per year since the publication was determined for each article, ranging from 0.75 to 49 citations per year, with a mean of 5 (SE: 2.7) citations per year. The total number of citations per year tends to increase slowly, and there have been low peaks over the years, especially in 2015 and 2017. The lowest total number of citations was 18 in 2015 and 2017; the greatest number was 109 in 2019.

The total number of authors per article ranged from 1 to 13, with a mean of 4.5 (SE: 0.80). Only 7 authors, Dr. Miguel Arraez, Dr. Mark Bernstein, Dr. Robert Dempsey, Dr. Walter Johnson, Dr. Kee Park, Dr. Franco Servadei, and Dr. Benjamin Warf, contributed more than 1 article to this list.^{18,22,24,27,31,33,34} The institutions of the corresponding author with the greatest number of articles on the list was the University Health Network ($n = 2$ articles)^{27,31} and University of Wisconsin School of Medicine and Public Health ($n = 2$ articles).^{24,33} All articles were affiliated with hospitals or medical schools, whereas 3 articles also had affiliations with non-profit organizations.^{24,25,31}

Authors from, or affiliated with, 14 countries contributed to the 17 articles (Figure 1). The average number of countries represented in authorship per article ranged from 1 to 6, with a mean of 2.06 (SE: 0.5). The country that had the greatest representation of authorship amongst the 17 articles was the United States ($n = 13$ articles), followed by Canada ($n = 6$) and Spain ($n = 5$). Among the 17 articles, 10 articles were written by authors from, or affiliated with, multiple countries. Of the 10 articles with multicountry authorship, the countries represented most were again the United States ($n = 8$), Canada ($n = 5$), and Spain ($n = 5$). Of the 7 remaining articles that had authors from, or affiliated with only 1 country, the United States represented 5 of those articles, followed by 1 from Canada and 1 from Sweden. The 17 articles had at least 1 author from or affiliated with an HIC. Four articles had at least 1 author from, or affiliated with, an LMIC, with authors from South Africa, Uganda, India, and Colombia.^{18,22,28,29} Three of the 4 articles included a greater number of authors from, or affiliated with, HICs than LMICs (Figure 1).

The articles were published in 10 journals with a mean 2018 impact factor of 2.9 (SE: 0.7; range: 1.665 to 5.562). *World Neurosurgery* published 4 of the most cited articles, followed by the *Journal of Neurosurgery*, *Neurosurgery*, and *Neurosurgical Focus* with 2 articles each. Sixteen of 17 articles were published between 2010 and 2019, with the most articles published in 2018 ($n = 4$, Figure 2). The articles comprised 9 different types, with cross-sectional studies comprising the greatest number of articles ($n = 3$). All articles were published in English.

Topic Areas

The main topic discussed was capacity ($n = 9$ articles),^{18,22,23,25,26,30,32-34} including current neurosurgical workforce capacity, or lack thereof, neurosurgical care in LMICs, reasons for lack of capacity for neurosurgical care in LMICs, and the need to train more neurosurgeons and invest more resources towards neurosurgical care in LMICs. Six articles discussed the

treatment of various neurosurgical conditions globally, including epilepsy, metastatic disease of the spine, traumatic brain injury, spine disorders, and psychiatric neurosurgery. 19-21,28,29,31 Only 2 articles dealt with the involvement of trainees or surgeons from HICs in LMICs (Figure 3).^{24,27}

The most-cited article was by Dewan et al.¹⁸ This study estimated the density of specialist providers, an important indicator of the Lancet Commission on Global Surgery.¹ The authors quantified the number of patients who experience neurologic disorders or injuries requiring neurosurgical consultation globally, common conditions requiring neurosurgical care, the need for additional neurosurgeons globally, and the geographic disparity in the distribution of neurosurgeons.

DISCUSSION

In this study, we identified characteristics of the top 17 most commonly cited manuscripts published in the neurosurgical literature involving global neurosurgery, highlighting that neurosurgical capacity has been the primary focus of major global neurosurgical studies to date and that there is an ongoing need to involve more LMICs in global neurosurgery research (Figures 1 and 3).

This study shows both a relatively low number of total overall citations from the top 17 cited articles ($n = 333$) and a relatively low number of average citations per year per article, with the majority of the articles ($n = 12$) having fewer than 20 citations per year. A similar review done by Cebron et al.,⁵ which analyzed the top-cited literature in global plastic and reconstructive surgery, found a much greater number of total combined citations, 541 overall, during the shorter time frame from 2000 to 2015 (15 years) as compared with our findings from 1997 to 2020 (23 years). The review done by Cebron et al.⁵ also found greater results for average citations per article at 21.7 compared to our findings of 18.5, respectively. The relatively low number of average citations per year per article found in this review again suggest that global neurosurgery is still a relatively younger field and is continuing to grow. In addition, medical mission trips have been a longstanding staple within the field of plastic surgery and may contribute to the robust literature that has been cited within the field. There are many ways that the community of global neurosurgery can support these growth efforts to increase academic work and build more robust research infrastructures within LMICs. This can include having investigators from HIC working in collaboration to support the needs that have been identified by those from LMICs, and also by increasing internal grant funding opportunities to protect local researchers from external influence. The review done by Franzen et al.⁴⁷ highlights these strategies for research capacity building in LMICs in global health research more generally, much of which can be tailored and adapted for the subspecialty of global neurosurgery.

In addition to the number of citations overall and the average number of citations per article per year, the breadth of the journals represented in the results is also relatively small. The majority of the articles were published in only 3 journals: *Neurosurgery*, *Journal of Neurosurgery*, and *World Neurosurgery*, which is not an accurate depiction of the wide range of journals within the field. Having the majority of articles published in these 3

journals, which are all based in the United States, and also having the majority of authors affiliated with the United States, may be indicative of a publishing bias. A review done by Madhugiri et al.,⁴⁸ which attempted to identify the “core” journals in neurosurgery by number of articles cited from each journal and compare it with the h-index and impact factor rank list, identified the most impactful journals in neurosurgery to be the *Journal of Neurosurgery*, *Neurosurgery*, *Spine*, *Acta Neurochirurgica*, *Stroke*, and *Journal of Neurotrauma*. It is notable that 4 of the 17 articles identified in this bibliographic review were published in some of the most impactful neurosurgery journals. As global neurosurgery continues to develop as a field, investigators should aim to expand both the topics researched, and the journals to which they submit their publications. One way to increase the diversity of publications and journals to which they are published is to increase the quantity of the research being done in the field, another reason building research capacity within LMICs is so crucial.

Overall, the most commonly discussed content area was the topic of neurosurgical capacity in terms of workforce and neurosurgical care. Neurosurgical workforce capacity can be defined as a network of neurosurgeons who work in concert to deliver neurosurgical care and also as providing neurosurgical care such as the provision of operative, perioperative, and nonoperative management for all neurosurgical conditions (both modified from Meara et al.).¹ The articles focused on this topic highlighted both the current state capacity in global neurosurgery and the need for building capacity in the field. The most commonly cited article, by Dewan et al.,¹⁸ highlights this need and expands on the major barriers of implementing global neurosurgery in LMICs. Despite the increased focus on global neurosurgery, there is still a major lack in the workforce within LMICs, and over the past 2 decades, there have been increased efforts to mitigate the problem of capacity. Although early capacity efforts in global neurosurgery, as with other surgical fields, focused on volunteering and surgical mission trips for patients in LMICs that had an immediate need,²⁴ capacity building is evolving to focus on more sustainable efforts such as collaborating and training surgeons within the LMICs.⁴⁹⁻⁵¹

Countries that were represented in the authorship of the literature were largely from, or affiliated with, HIC, with only 15% of the authors originating from, or affiliated with, an LMIC (Figure 1). In addition, all of the articles in this review were in English. These findings demonstrate an additional area of growth needed within the field, as academic productivity is important in contributing to crucial knowledge and advancing the field of neurosurgery in LMICs. Reasons for limited academic productivity that are often cited include insufficient mentoring, lack of administrative support, and lack of funding.^{22,52} In addition to the geographic spread of the authors, only 2 of the articles included in this review had collaborations between institutions from HIC and LMICs. Future academic studies within global neurosurgery should focus on establishing more robust partnerships between HIC and LMIC authors, as collaboration will lead to studies with greater insights into opportunities to further develop the field of neurosurgery within LMICs.

Although documentation of the need for expansion of neurosurgical resources and infrastructure is important, documentation alone is insufficient to resolve existing disparities in the provision of neurosurgical care. Mitigating disparities requires deliberate action to

identify and develop possible initiatives to address areas of need in neurosurgical care. Although short-term interventions such as providing surgery to those in need are beneficial, long-term plans that include continuing medical education for practicing neurosurgeons, supporting new neurosurgical training programs, and strengthening health systems through health policy reform may be more sustainable.⁵³ A greater degree of equity in clinical and research collaborations between HICs and LMICs is necessary to create and deliver these solutions. Partnerships that combine various stakeholders including neurosurgeons, institutions, professional associations, non-governmental organizations, and national governments may be particularly effective in providing a united front to advocate for augmentation of neurosurgical capacity and collaboratively devising action plans to accomplish predetermined goals.⁴ We hope that the documentation of inequities in global neurosurgery publications in this study provides the foundation for comprehensive action to address research disparities.

Strengths and Limitations

There are several limitations of the present study. First, by including only articles that have greater than 5 citations, we are excluding articles that are important within global neurosurgery but may not be as heavily cited yet because of the relative novelty of the field. This includes an article by Mansouri and Ibrahim about the impact of the Lancet Commission on Global Surgery specifically on the field of neurosurgery.³⁶ In addition, Web of Science is the only database that offers the citation information necessary to do a bibliometric review such as this, which limits the articles that we can capture and may cause the authors to miss other important articles in circulation. Finally, the search terms and/or search strategy (i.e., the specific search string or only searching using search terms in English) may not be sufficient in capturing all the articles that exist within global neurosurgery. Despite these limitations, this review provides an overview of the current state of global neurosurgery academic works, and how the field of global neurosurgery is continuing to mature. In addition, this review is an opportunity to identify areas for future direction within the field.

CONCLUSIONS

This bibliometric review reveals the current state of literature within the field of global neurosurgery and has identified clear areas that can be improved with ongoing efforts in research and collaboration. This review highlights the progress that has been made within global neurosurgery with the relative increase in the number of citations and identifying barriers that exist within the field. Future directions could include identifying innovative and sustainable ways to increase academic research output from LMICs to further advance the field of global neurosurgery.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations and Acronyms

HICs	High-income countries
LMCIs	Low-middle income countries
SE	Standard error

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 53. Haglund MM, Fuller AT. Global neurosurgery: innovators, strategies, and the way 500 forward: JNSPG 75th Anniversary Invited Review Article. *J Neurosurg*. 2019;131:993–999. [PubMed: 31574484]

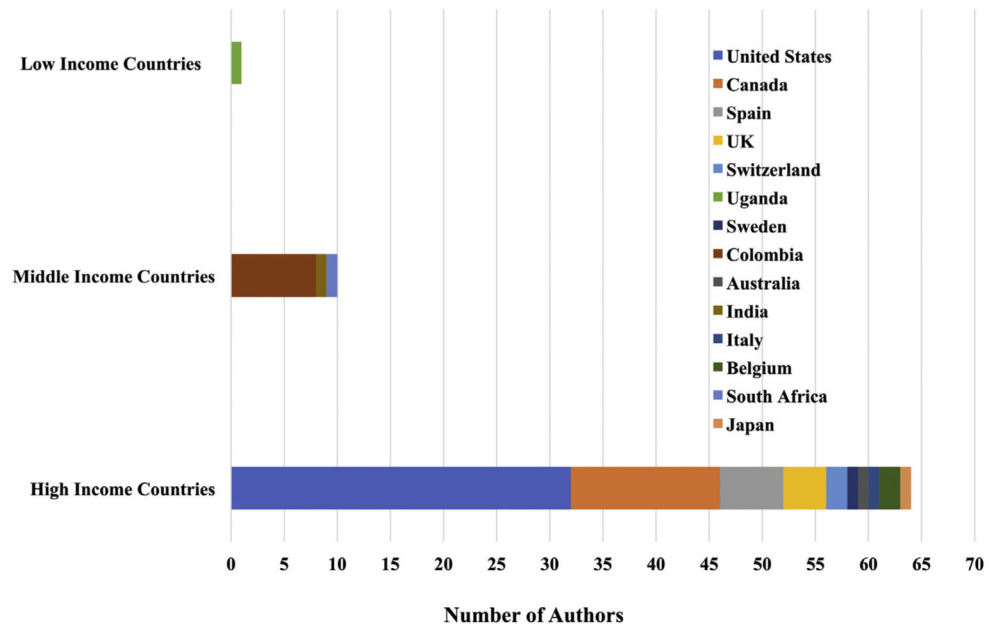


Figure 1. Number of contributing authors from the top 17 most-cited articles in global neurosurgery organized by World Bank Income Classification and Country of Affiliation. The *stacked bar chart* shows an aggregate of all contributing authors by World Bank Income Classification and Country of Affiliation. Income groups are divided into low-income countries, middle-income countries, and high-income countries. Countries are arranged by a decreasing number of authors. UK, United Kingdom.

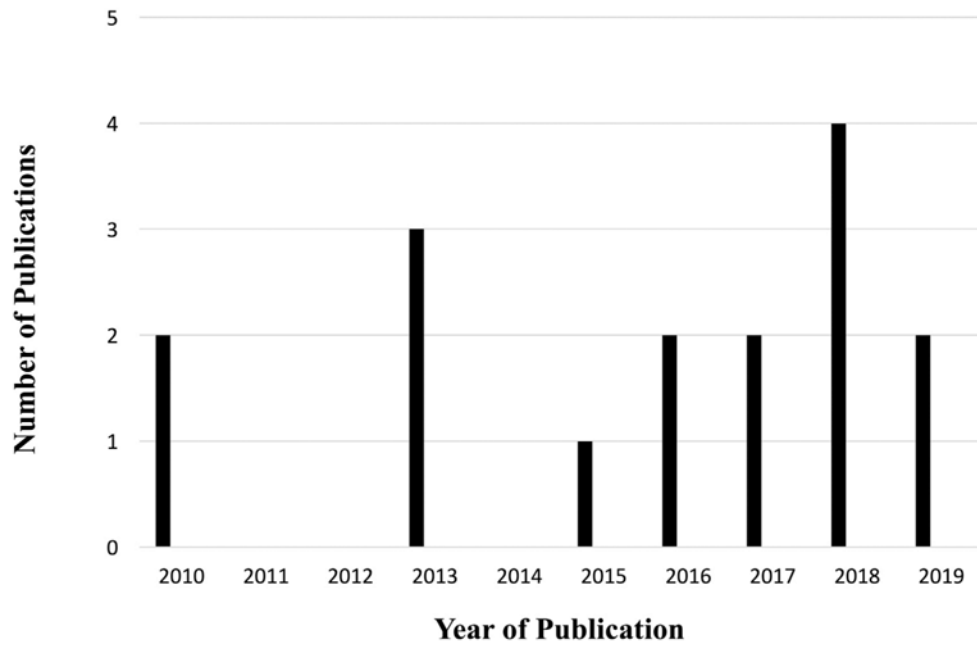


Figure 2. Number of publications per year from the top 17 most-cited articles in global neurosurgery from 2010 to 2019. Number of publications by year of the top 17 cited articles in global neurosurgery. This figure excludes the publication from 1997.

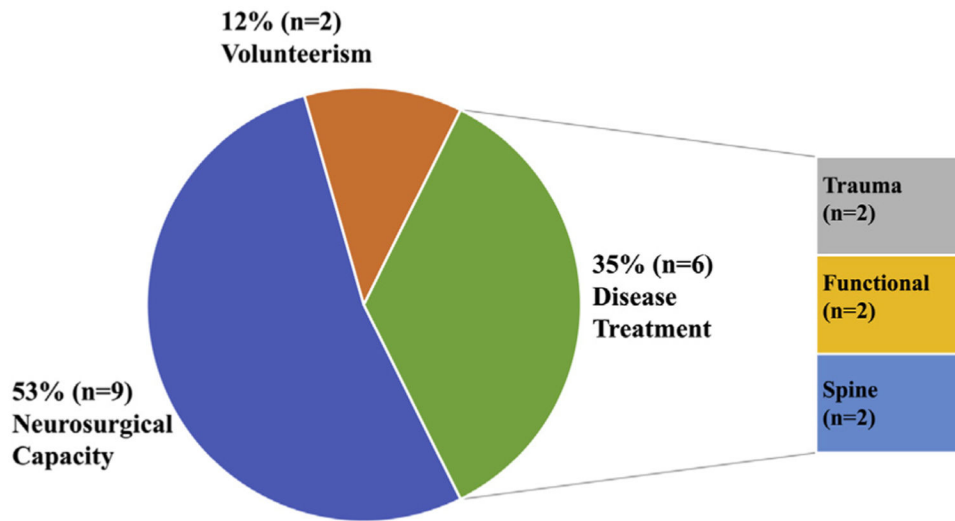


Figure 3. Main topics themes in the top 17 most-cited articles in global neurosurgery. Pie chart of main article topics in the top 17 most-cited works in global neurosurgery. The topics include capacity, disease treatment, and volunteerism.

Table 1.

Summary of Top 17 Global Neurosurgery Publications

Authors	Title of Manuscript	Total Number of Citations	Average Citations Per Year	Institution of Corresponding Author	Source Journal
Dewan et al., 2019 ¹⁸	Global Neurosurgery: The Current Capacity and Deficit...	98	49	Vanderbilt University	<i>J Neurosurg</i>
Silfvenius, 1997 ¹⁹	A Global Survey on Epilepsy Surgery, 1980–1990...	47	1.96	Umea University	<i>Epilepsia</i>
Street et al., 2010 ²⁰	Introducing a New Health-Related Quality of Life Outcome Tool...	26	2.36	Vancouver General Hospital, University of British Columbia	<i>Spine (Phila Pa 1976)</i>
Laxe et al., 2013 ²¹	Development of the International Classification of Functioning...	23	2.88	Institut Guttmann, Universitat Autonoma de Barcelona	<i>Brain Injury</i>
Muir et al., 2016 ²²	Global Surgery for Pediatric Hydrocephalus...	23	4.6	Boston Children's Hospital, Harvard Medical School	<i>Neurosurg Focus</i>
Ravindra et al., 2015 ²³	The Need for Cost-Effective Neurosurgical Innovation...	18	3	Primary Children's Hospital, University of Utah	<i>World Neurosurg.</i>
Dempsey and Nakaji, 2013 ²⁴	Foundation for International Education in Neurological Surgery...	17	2.13	University of Wisconsin School of Medicine and Public Health	<i>Neurosurgery</i>
Härtl and Ellegala, 2010 ²⁵	Neurosurgery and Global Health: Going Far and Fast, Together	13	1.18	Weill Cornell Medical College	<i>World Neurosurg</i>
Sader et al., 2017 ²⁶	Barriers to Neurosurgical Training in Sub-Saharan Africa...	11	2.75	University of Toronto	<i>World Neurosurg</i>
Fallah and Bernstein, 2019 ²⁷	Barriers to Participation in Global Surgery Academic...	11	2.5	Toronto Western Hospital, University Health Network	<i>J Neurosurg</i>
Green et al., 2018 ²⁸	The Global Spine Care Initiative...	8	2.67	Stanford Healthcare- Qualcomm Health Center, National University of Health Sciences	<i>Eur Spine J</i>
Charry et al., 2017 ²⁹	Predicted Unfavorable Neurologic Outcome Is Overestimated...	7	1.75	Fundacion Universitaria Navarra-Universidad de Jaen	<i>World Neurosurg</i>
Sacco et al., 2018 ³⁰	A study to Assess Global Availability of Fetal Surgery for Myelomeningocele	7	2.33	Institute for Women's Health, University College London	<i>Prenat Diagn</i>
Mendelsohn et al., 2013 ³¹	The Contemporary Practice of Psychiatric Surgery...	6	0.75	Toronto Western Hospital, University Health Network	<i>Stereotact Funct Neurosurg</i>
Corley and Häglund, 2016 ³²	How Neurosurgery Fits into the Global Surgery 2030 Agenda	6	1.2	Duke University Medical Center	<i>Neurosurgery</i>
Dempsey, 2018 ³³	Global Neurosurgery: The Role of the Individual Neurosurgeon...	6	2	University of Wisconsin School of Medicine and Public Health	<i>Neurosurg Focus</i>

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Authors	Title of Manuscript	Total Number of Citations	Average Citations Per Year	Institution of Corresponding Author	Source Journal
Rosseau et al., 2018 ³⁴	Global Neurosurgery: Current and Potential Impact of Neurosurgeons...	6	2	Harvard Medical School	<i>Neurosurg Focus</i>

The top 17 most-cited articles by authors, title, publication year, total citations, average citations per year, institution, and journal. Abbreviation for journal titles used: National Library of Medicine (PubMed) abbreviations.