Footprint of Reports From Low- and Low- to Middle-Income Countries in the Neurosurgical Data: A Study From 2015 to 2017

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OBJECTIVE: **In 2015, the Lancet Commission on Global Surgery highlighted the disparities in surgical care worldwide. The aim of the present study was to investigate the research productivity of low-income countries (LICs) and low- to middle-income countries (LMICs) in selected journals representing the worldwide neurosurgical data and their ability to report and communicate globally the existing differences between high-income countries (HICs) and LMICs.**

METHODS: **We performed a retrospective bibliometric analysis using PubMed and Scopus databases to record all the reports from 2015 to 2017 by investigators affiliated with neurosurgical departments in LICs and LMICs.**

RESULTS: **A total of 8459 reports by investigators self-identified as members of neurosurgery departments worldwide were identified. Of these, 6708 reports were included in accordance with our method in the final analysis. The systematic search resulted in 459 studies reported by LICs and LMICs. Of these, 334 reports were included for the full text evaluation. Of the 6708 reports, 303 (4.52%) had been reported with an LMIC affiliation and only 31 (0.46%) with an LIC. The leading countries were India with 182 (54.5% among LMICs and LICs; 2.71% overall), followed by Egypt at 66 (19.76% among the LMICs and LICs; 0.98% overall), with a large difference compared with other countries such as Uganda at 9 (2.69% among the LMICs and LICs) and Tunisia and Pakistan at 8 each (2.4% among the LMICs and LICs). A few reports studies had been generated by collaboration with HIC neurosurgeons.**

CONCLUSIONS: **Our results have shown that research studies from LMICs are underrepresented. Understanding and discussing the reasons for this underrepresentation are necessary to start addressing the disparities in neurosurgical research and care capacity. Future engagements from international journals, more partnership collaboration from HICs, and tailored funding to support investigators, collaborations, and networks could be of help.**

INTRODUCTION

In 2015, the Lancet Commission on Global Surgery highlighted the disparities in surgical care worldwide.[1] Subsequently, the neurosurgical community started giving more attention to the current capacity and deficit in the provision of essential neurosurgical care, focusing, in particular, on low- to middle-income countries (LMICs).[2] Recently, Dewan et al.[3] showed that 44% of neurosurgeons worldwide were based in high-income countries (HICs). An increasing number of studies have reported disparities in epidemiology, patient management, neurosurgical procedures, and complications between HICs and LMICs.[3] Nevertheless, these data have been limited, because the contribution from LMICs to the neurosurgical data

Key words
- Developing countries
- Education
- Global neurosurgery
- Literature
- World health

Abbreviations and Acronyms
HIC: High-income country
LIC: Low-income country
LMIC: Low-to middle-income country
TBI: Traumatic brain injury

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has been modest. Among the most cited systematic reviews and meta-analyses, no first author from LMICs has been found.[4] Focusing on the reported neurosurgical data, the publication output of LMICs has been very limited. Among the top 20 most publishing countries in the neurosurgical data in 2011, just 1 country (India) belonged to the LMICs or low-income countries (LICs).[5]

Therefore, we conducted a bibliometric analysis of reports from LICs and LMICs to investigate the research productivity of these countries in the worldwide neurosurgical data and their ability to publish and communicate globally the existing differences between HICs and LMICs. In addition, we sought to determine the contribution, in terms of the generation of knowledge, of LMICs and LICs to the neurosurgical data reported in international medical journals and in which LMICs and LICs is this research performed. Moreover, we sought to determine whether the knowledge of the clinical management of neurosurgical disease in these countries could be the basis for any further intervention aimed to improve neurosurgical education and patients care.

MATERIALS AND METHODS

We performed a bibliometric analysis of reports from publicly available databases (i.e., Scopus and PubMed). From 2015 to 2017, Scopus and PubMed studies reported by investigators affiliated with neurosurgical departments in LICs and LMICs were included. This method has been described in part previously.[6,7] The reports indexed by Scopus and PubMed include the author's departmental location (i.e., city, state, country). This field was used to determine the country of origin. The distribution of countries into LIC and LMIC groups was performed using the World Bank classification[2] (**Figure 1**). Only reports defined as "journal articles" were included (i.e., original research articles, reviews, trials, and other scientific reports). Occasionally, journals report nonscientific information, such as bibliographies, news items, comments, and roll calls of reviewers. These are not indexed as "journal articles" and, thus, were excluded. We chose 14 neurosurgical journals and 3 general medical journals from the Journal of Citation Reports 2015, primarily using ranking according to their impact factor. Those with the highest ranking for medicine (*New England Journal of Medicine*, *Lancet*, and *Journal of the American Medical Association*), neurology and neurosurgery (*Lancet Neurology*, *Journal of American Medical Association Neurology*, *Journal of Neurology, Neurosurgery, and Psychiatry*, *Journal of Neurosurgery*, *Neurosurgery*, *World of Neurosurgery*, *Acta Neurochirurgica*, *Neurosurgery Focus*, *Neurosurgical Review*), and the journals best representing neurosurgical subspecialties (*Journal of Neurotrauma*, *Journal of Neurosurgery Spine*, *Spine*, *European Spine Journal*, *Stereotactic and Functional Neurosurgery*). Study selection was an iterative process in which the selected abstracts and full texts were initially reviewed to identify and agree on the inclusion criteria. These were then subsequently "tested" and refined through further review. Two of us (M.P.T., R.S.) independently screened the reports included for full-text review, with one of us (F.S.) providing a third review to determine the inclusion or exclusion status in the case of disagreement. Details of the exact search strategy are included in **Supplementary Appendix 1**.

LIC and LMIC Productivity

When an article had been reported by >1 author affiliated with neurosurgical departments in LICs and LMICs, the first author affiliation was chosen. If the other authors were affiliated with an LIC or LMIC, but not the first author, we assigned the report to the country with the highest number of authors. In rare cases of uncertainty, the report was reviewed to determine the relevant contribution from each author and country for that specific study.

Focus by Topic

Analysis of the focus by topic was performed by grouping the MeSH terms according to neurosurgical subspecialty. We classified the collected articles into 9 topics: trauma (further divided into traumatic brain injury [TBI] and spine injury), tumor (further divided into brain tumor and spine tumor, including both malignant conditions [e.g., glioblastoma multiforme] and benign conditions [e.g., cysts and pituitary adenomas]), vascular neurosurgery (e.g., arteriovenous malformations, cerebral aneurysms, subarachnoid hemorrhage, endovascular procedures, cerebral ischemia), functional neurosurgery (e.g., stereotactic radiosurgery, deep brain stimulation, epilepsy, intractable pain), pediatrics (all subspecialties concerning children and adolescents), hydrocephalus (in adults, including studies of endoscopic third ventriculostomy, cerebrospinal fluid shunts), spine (e.g., all nontraumatic pathologic features affecting the spine but excluding tumors), infection (i.e., all reports whose main topic was an infective process), and miscellaneous (i.e., reports of neurosurgical conditions in different hospitals, a history of neurosurgery in specific countries, peripheral nerve pathologic features, central nervous system plasticity, neurosurgical training).

RESULTS

LMIC and LIC Productivity

From January 1, 2015 to December 31, 2017, a total of 8459 reports by investigators who had self-identified as members of neurosurgery departments worldwide were identified in 17 journals using our study method. After title and abstract screening, 1751 reports had been eliminated, and 6708 were included in the final analysis. The systematic search resulted in 459 studies reported by LICs and LMIC. After title and abstract screening of these 459 studies, 125 were excluded, leaving 334 studies for full text evaluation. The PRISMA (preferred reporting items for systematic reviews and meta-analyses) method is shown in **Figure 2**. Of the 6708 studies, 303 (4.52%) had been reported with an LMIC affiliation and only 31 (0.46%) with an LIC (**Figure 3**).

The 17 journals containing reports by investigators affiliated with a neurosurgical department in an LMIC or LIC and their 2015 impact factor as assessed using the Journal of Citation Report are listed in **Table 1**. The leading countries, in terms of contribution, were India with 182 (54.5% of LMICs and LICs; 2.71% overall), followed by Egypt at 66 (19.76% of LMICs and LICs; 0.98% overall), with a large difference compared with the other countries such as Uganda at 9 (2.69% of LMICs and LICs) and Tunisia and Pakistan at 8 each (2.4% each of LMICs and LICs). The contribution to LMIC and LIC research productivity is presented in **Table 2**. We did not identify any outputs for 54 LICs and LMICs in our analysis.

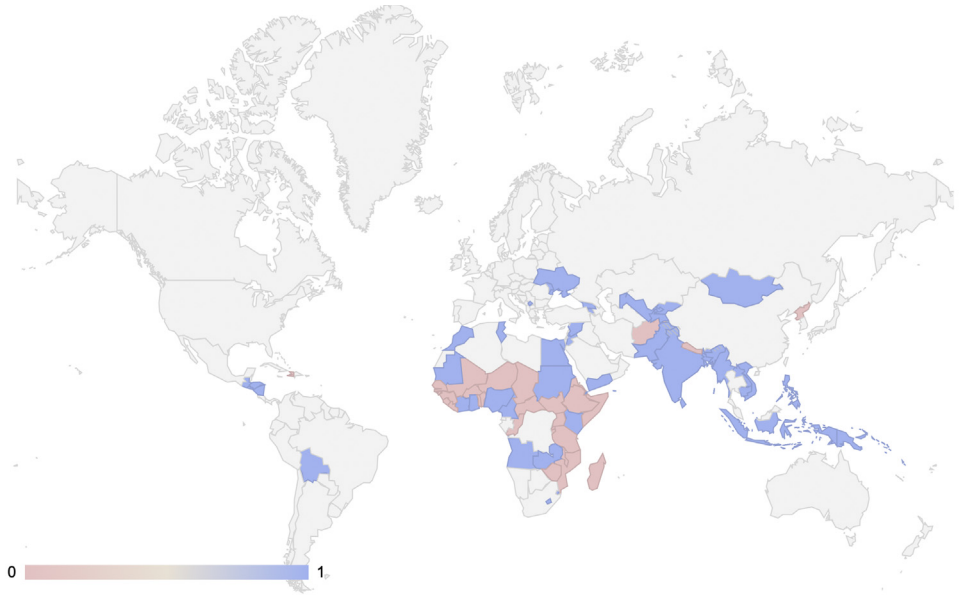

Figure 1. Map showing low-income countries (LICs) and low- to middle-income countries (L-MICs) according to the World Bank classification, the study selection process of reports included in the final analysis, and studies reported by investigators affiliated with neurosurgical departments in LIC and L-MIC countries.

Focus Stratified by Neurosurgical Subspecialty

Of the 334 studies reported with affiliation to an LMIC or LIC neurosurgical department, most had discussed topics of tumor (24.85%; divided into brain tumor [20.66%] and spine tumor [4.19%]) and trauma (15.87%; divided into TBI [11.08%] and spine injury [4.79%]), followed by spine (15.27%), miscellaneous (14.37%), and vascular (8.98%). The relative contribution of each country to the productivity according to each subspecialty is listed in **Table 3**. We found that India was the leading contributor for reports about TBI, spinal injury, brain tumors, spine tumors, vascular neurosurgery, spine surgery, and infections (51.4%, 43.8%, 59.4%, 78.6%, 43.3%, 68.6%, and 89.5%, respectively). In contrast, the leading contributor for the topic of functional neurosurgery and hydrocephalus in adults was Egypt, accounting for 52.6% and 55.6% of reports. Ethiopia was the greatest contributor in the field of pediatric neurosurgery, accounting for 22.7% of studies, followed by India (18.2%), Egypt (13.6%), and Mozambique and Uganda (9.1% each), with the most discussed topic hydrocephalus in children.

DISCUSSION

The Lancet Commission on Global Surgery issued a report in 2015, which reported that 5 billion people do not have access to safe, affordable, surgical and anesthetic care in LICs and LMICs, where 9 of 10 people cannot access basic surgical care.[1] The Commission's key findings showed that the human and economic consequences of untreated surgical conditions in LMICs and LICs are large and for many years have been unrecognized. The report concluded that surgery and anesthetic care should be an integral part of a national health system and that urgent investment in human and physical resources for surgical and anesthesia care is needed. Park et al.[8] showed that the worldwide deficits in neurosurgical care are profound and the global effort to ensure safe surgery to all who need it must include the neurosurgical community. The allocation of resources for research in neurosurgery has a direct effect on the progress of health science and the distribution of health. Neurosurgery requires a specific approach that reflects the different realities in LICs and LMICs, including those at the local health system level.[9] This understanding is fundamental to the development of both appropriate health policy and clinical practice. Studies reported in leading journals for neurosurgical practice could help to highlight needs and priorities and demonstrate the effectiveness and, thus, help to implement and develop neurosurgical care in LICs and LMICs. Publications are an indicator of scientific activity in the international scientific community. The number of reported studies and their citations (indirectly reflected in the impact factor) are a useful indicator for assessing the quality and quantity of research and to place them in an international context.[10]

Our analysis showed a clear underrepresentation of LMICs and LICs in the neurosurgical data and, more specifically, in the high-impact neurosurgical journals. Of a total of 6708 printed studies reported by investigators self-identified as members of neurosurgery departments in 17 journals, only 4.5% had been reported with an LMIC affiliation, despite the population of LMICs (3.5 billion) constituting 46% of the global population. These countries have ~7000 neurosurgeons, of whom 3500 are in India. However, this is only 15% of the 50,000 neurosurgeons

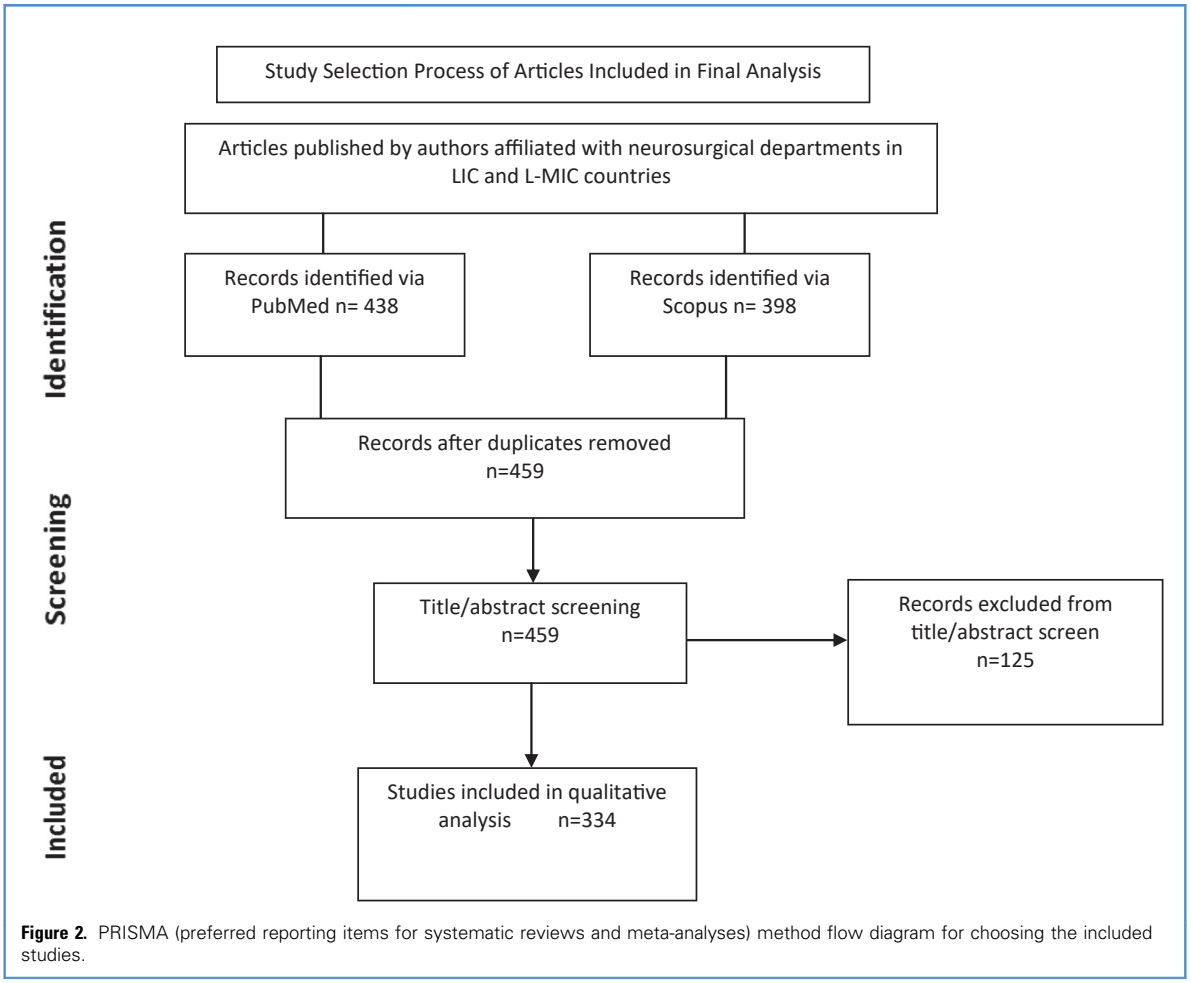

Figure 2. PRISMA (preferred reporting items for systematic reviews and meta-analyses) method flow diagram for choosing the included studies.

worldwide.[3] The situation is even worse for LICs, because only 0.5% of all reports had such an affiliation. This imbalance has been reported in other aspects of biomedical studies, such as the composition of editorial boards of peer-reviewed journals,[11]

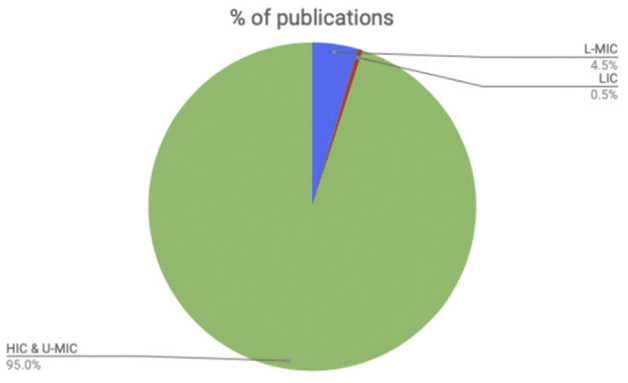

Figure 3. Percentage of publication for high-income countries (HIC) and upper middle income countries (U-MIC), low-income countries (LIC), low- to middle-income countries (L-MIC).

reports in psychiatry,[12-14] and hematology,[15] and in the overall contribution of studies reported in high-impact journals.[16] The volume of all neurosurgical reports from Asia, Latin America, and Africa had increased slightly from 2015 to 2017. However, the contribution of LICs and LMICs has remained minimal. In our analysis, the leading LMIC and LIC contributors were India (54.5%), followed by Egypt (19.8%), Uganda (2.7%), and Tunisia and Pakistan (2.4%) representing <5% of the worldwide productivity. A total of 54 LICs and LMICs did not have any reports in our analysis. In addition, without the contribution of Egypt and India, the studies reported by LICs and LMICs would have been less than 1% of the reported neurosurgical studies in the included journals.

From our personal experience, we can report that these disparities between LMICs and HICs are not related to the clinical, surgical, or intellectual capacities of our colleagues but to the lack of time and/or economical resources for any type of research. Whenever a microscope and basic instruments are available, the overwhelming number of patients treated will be an important tool to report the data from large surgical experiences such as in India.[17]

A content analysis of the main research topics showed that most reports had focused on tumors (24.8%), especially brain tumors (20,7%). In contrast, TBI was reported in only 11% of reports and

Table 1. List of 17 Journals Containing Reports by Investigators Affiliated with a Neurosurgical Department in Low- to Middle-Income Countries or Low-Income Countries and Their 2015 Impact Factor (Assessed Using the Journal of Citation Report)

Journal Title	Total Documents (*n*)	Reports From LICs or LMICs (*n*; %)	Main ISSN	eISSN	Impact Factor (2015)
J Neurol Neurosurg Psychiatry	93	2 (2.15)	0022-3050	1468-330X	6.431
J Neurosurg	900	31 (3.44)	0022-3085	1933-0693	3.443
J Neurotrauma	209	1 (0.48)	0897-7151	1557-9042	4.377
Neurosurgery	403	17 (4.22)	0148-396X	1524-4040	3.780
World Neurosurg	2564	186 (7.25)	1878-8750	1878-8769	2.685
J Neurosurg Spine	372	9 (2.42)	1547-5654	1547-5646	2.126
Spine (Phila Pa 1976)	260	5 (1.92)	0362-2436	1528-1159	2.439
Neurosurg Rev	198	11 (5.56)	0344-5607	1437-2320	2.166
Neurosurg Focus	451	15 (3.33)	1092-0684	1092-0684	2.546
Eur Spine J	234	13 (5.56)	0940-6719	1432-0932	2.132
Stereotact Funct Neurosurg	121	0 (0)	1011-6125	1423-0372	1.691
Acta Neurochir (Wien)	766	40 (5.22)	0001-6268	0942-0940	1.617
N Engl J Med	21	1 (4.76)	0028-4793	1533-4406	59.558
Lancet	16	0 (0)	0140-6736	1474-547X	44.002
JAMA	10	0 (0)	0098-7484	1538-3598	37.684
JAMA Neurol	53	3 (5.66)	2168-6149	2168-6157	8.230
Lancet Neurol	37	0 (0)	1474-4422	1474-4465	23.468

LICs, low-income countries; LMICs, low- to middle-income countries; ISSN, international standard serial number; eISSN, electronic international standard serial number.

Table 2. Contribution to Low- to Middle-Income Countries or Low-Income Countries Research Productivity in Reported Neurosurgical Data

Country	Reports (*n*) 2015	2016	2017	Documents Worldwide (%)	Reports From LICs and LMICs (%)
Armenia	0	0	1	0.02	0.30
Bangladesh	1	2	2	0.08	1.50
Bolivia	0	2	0	0.03	0.60
Cambodia	1	1	2	0.06	1.20
Egypt	16	25	25	0.98	19.76
Ghana	1	1	0	0.03	0.60
Guatemala	1	0	0	0.02	0.30
India	41	69	72	2.71	54.49
Indonesia	0	2	3	0.08	1.50
Kenya	0	2	1	0.05	0.90
Moldova	1	0	2	0.05	0.90
Nigeria	0	0	3	0.05	0.90
Palestine	0	1	2	0.05	0.90
Pakistan	0	4	4	0.12	2.40
Papua New Guinea	0	0	1	0.02	0.30
Philippines	2	0	0	0.03	0.60
Sudan	0	0	1	0.02	0.30
Tunisia	2	4	2	0.12	2.40
Ukraine	0	2	0	0.03	0.60
Uzbekistan	0	0	1	0.02	0.30
Benin	1	0	0	0.02	0.30
Chad	0	1	0	0.02	0.30
Ethiopia	2	3	2	0.10	2.10
Haiti	0	1	0	0.02	0.30
Mozambique	1	0	1	0.03	0.60
Nepal	2	1	0	0.05	0.90
Rwanda	0	1	2	0.05	0.90
Tanzania	0	3	0	0.05	0.90
Togo	0	1	0	0.02	0.30
Uganda	1	2	6	0.13	2.69

LICs, low-income countries; LMIC, low- to middle-income countries.

pediatric neurosurgery, including hydrocephalus, in 9%. Data from the recently reported survey by Dewan et al.[3] have shown that most of the neurosurgical workload in the LICs and LMICs has concerns trauma and pediatric patients. Therefore, a discrepancy exists between the actual workload and publication output. The only exception was the pediatric reports from Uganda and Ethiopia, which were probably driven by collaboration with American[18] and Norwegian[19] universities. Various reasons could be responsible this, including a perception of "what is important." In general, the neurosurgical data have been dominated by the description of sophisticated surgical techniques and diagnostic modalities. Such studies certainly have a role to play in advancing neurosurgery, especially in advanced healthcare systems, although they will not necessarily advance the care of patients in need of neurosurgery in LMICs. However, it is often the case that what is considered "obvious" or "mundane" will not be reported. In the guidelines for surgery for TBI,[20] no high-quality evidence for large hematoma evacuation is available. We realized that the surgical indications in these countries might be quite different from those in HICs, such as cranial decompression,[21] skull base tumors,[22] and, in general,

Table 3. Contribution of Each Country for Different Neurosurgical Topics

	Trauma (%)		Tumor (%)								
Country	Brain	Spine	Brain	Spine	Vascular (%)	Functional (%)	Pediatrics (%)	Hydrocephalus (%)	Spine (%)	Infection (%)	Miscellaneous (%)
Armenia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.08
Bangladesh	5.41	0.00	0.00	0.00	0.00	0.00	4.55	11.11	1.96	0.00	0.00
Bolivia	0.00	0.00	0.00	0.00	3.33	0.00	0.00	0.00	0.00	0.00	2.08
Cambodia	5.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.17
Egypt	8.11	18.75	30.43	0.00	36.67	52.63	13.64	55.56	9.80	0.00	10.42
Ghana	0.00	0.00	0.00	0.00	0.00	0.00	4.55	0.00	1.96	0.00	0.00
Guatemala	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.08
India	51.35	43.75	59.42	78.57	43.33	42.11	18.18	33.33	68.63	89.47	50.00
Indonesia	2.70	6.25	0.00	0.00	0.00	0.00	0.00	0.00	1.96	0.00	4.17
Kenya	0.00	6.25	0.00	0.00	0.00	0.00	0.00	0.00	1.96	0.00	2.08
Moldova	2.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.17
Nigeria	0.00	6.25	0.00	0.00	0.00	0.00	4.55	0.00	0.00	5.26	0.00
Palestine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.96	0.00	4.17
Pakistan	2.70	0.00	0.00	0.00	3.33	0.00	4.55	0.00	7.84	0.00	2.08
Papua New Guinea	0.00	0.00	0.00	0.00	3.33	0.00	0.00	0.00	0.00	0.00	0.00
Philippines	0.00	0.00	0.00	0.00	3.33	0.00	0.00	0.00	0.00	0.00	2.08
Sudan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.96	0.00	0.00
Tunisia	2.70	0.00	4.35	21.43	0.00	0.00	4.55	0.00	0.00	0.00	0.00
Ukraine	0.00	6.25	0.00	0.00	0.00	5.26	0.00	0.00	0.00	0.00	0.00
Uzbekistan	0.00	0.00	1.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benin	2.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chad	0.00	0.00	0.00	0.00	0.00	0.00	4.55	0.00	0.00	0.00	0.00
Ethiopia	0.00	6.25	0.00	0.00	0.00	0.00	22.73	0.00	0.00	0.00	2.08
Haiti	0.00	0.00	1.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mozambique	0.00	0.00	0.00	0.00	0.00	0.00	9.09	0.00	0.00	0.00	0.00
Nepal	2.70	0.00	1.45	0.00	3.33	0.00	0.00	0.00	0.00	0.00	0.00
Rwanda	2.70	6.25	0.00	0.00	3.33	0.00	0.00	0.00	0.00	0.00	0.00
Tanzania	5.41	0.00	1.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Togo	2.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uganda	2.70	0.00	0.00	0.00	0.00	0.00	9.09	0.00	1.96	5.26	8.33

brain tumors.[23] Moreover, some aspects of neurosurgery in LMICs cannot be compared with those in HICs, simply because of the substantial cost of devices (e.g., a flow diverter),[24,25] making their use prohibitive in LMICs.

After analyzing our results and the reported data, we can suggest several hypotheses for the very low representation of reports from LMICs and LICs. As reported by Servadei et al.,[9] neurosurgical diseases have an enormous effect on society but have not been a priority for governmental or private support. A general obstacle in the research by LMICs and LICs has been the restricted research capacity, including limited institutional and regulatory frameworks, limited infrastructure, low funding, and limited numbers of personnel trained to conduct and report research.[8,9,26] Moreover, it is possible that the themes selected by investigators in LMICs and LICs do not attract interest and might be considered irrelevant to readers who do not work in LMICs or LICs. It is also possible that investigators from LMICs and LICs prefer to report in local and/or regional journals. However, our analysis did not include such neurosurgical journals, because we chose to focus on the "higher impact" journals.

We believe that no intervention is possible without available data; therefore, if we need to improve the quality of care for neurosurgical patients in LMICs, it will be fundamental to better develop and consolidate their research capacity. A series of experiences have been reported after data collection with the help of associated American universities, such as the Cornell University in Tanzania,[27] Duke University in Uganda,[25,26,28] and Harvard University in Cambodia.[29,30] Also studies were reported in collaboration with European universities such as Norwegian universities in Ethiopia[19] and Italian and/or Spanish universities in East Africa.[31] Moreover, China also has African collaborations, such as in Ghana.[32] These are only a few examples of the work performed in Africa by many institutions. These studies represent the result of voluntary-based collaboration between academic neurosurgical institutions from HICs and universities in Africa and Asia. In all these cases, neurosurgical data collection was promoted mainly in the context of an exchange of surgeons who had been primarily focused on implementing on-site surgical activities. The data were jointly reported by the 2 institutions but often with a limited number of investigators from the LMIC. Obviously, important exceptions exist[33]; however, the overarching principle should be the increase in the local research capacity.

We believe that neurosurgeons and researchers in HICs should be seeking to develop equitable partnerships with neurosurgeons and researchers from LMICs to strengthen the research capacity in the LMICs. Policy makers, funding agencies, and universities in HICs can help by creating a healthy environment for such collaborations by recognizing the role of HICs in advancing the care for patients in LMICs, directing the necessary funds, and overcoming institutional barriers.[34] For example, in 2017, the UK Department of Health funded the establishment of multicountry groups and units, with a total of £162 million to stimulate healthcare research that should directly benefit patients in LMICs. Approximately, £1.8 million was awarded for the establishment of the National Institute for Health Research Global Health Research Group on Neurotrauma, which brings together clinicians and researchers from 11 LMICs and 3 HICs. The group has mainly sought to build high-quality, sustainable, research programs in the participating LMICs, because these are considered necessary to address the reported disparities in neurosurgical care.[34] To achieve this, the group has partnered with the British Medical Journal Research to Publication program[35] and is offering education for online research methods for the staff in all participating institutions. We believe that a multifaceted approach will be required to improve the situation; some suggestions are listed in Table 4.

Table 4. Suggestions to Improve Access to Journals by Low- to Middle-Income Country Neurosurgeons

Suggestions to Improve Access to Journals
An agreement by neurosurgery journal editors that to advance neurosurgery worldwide, a commitment to publish methodologically sound reports from LMICs is needed; novelty should not be a prerequisite
Broadening of participation of surgeons from LMICs on editorial boards
Online research method training for neurosurgeons from LMICs
Development of a system of "research mentors" specifically for surgeons from LMICs

LMICs, low- to middle-income countries.

Study Limitations

When interpreting the results of the present study, several limitations should be remembered. First, the present study was limited to studies reported within 3 years (2015–2017) indexed within the PubMed and Scopus databases, which do not encompass all types of research. Specifically, meeting abstracts, letters, comments, and unpublished halted and/or terminated studies would not have been captured, representing a potential source of bias. Second, using the departmental affiliation and country of origin represents another consideration. Cases in which neurosurgeons were involved but whose department was not reported would not have been included. This could be of particular concern in multidisciplinary areas of neurosurgery. We are aware that many humanitarian initiatives have not been included in our report, which was intended to raise awareness of the magnitude of the problem and not to be a comprehensive review of neurosurgery practice in LMICs. We also did not include in our review the smaller local and regional neurosurgical journals and non-English journals, because we had chosen to assess the footprint of LMICs and LICs in the higher impact journals. This choice could have been a limitation of our study; however, our aim was not the revision of every reported study but to determine the influence of these countries on the best international neurosurgical data.

CONCLUSIONS

The fast development of neurosurgery in high-income settings has not been followed by the same rate of growth in middle- or poor-income settings. Research studies from a major part of the global population have remained underrepresented in the higher impact neurosurgical journals. Understanding and discussing the reasons for this underrepresentation are necessary to start addressing the

disparities in neurosurgical research capacity and care. New strategies should be developed to resolve this vicious circle in which poor outputs results from and contributes to limited support for research. The development of appropriate practices in neurosurgical care in LMICs and LICs requires research and, hence, resources and engagement from international journals, partnership collaborations from HICs, and tailored funding to support investigators, collaborations, and networks.

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SUPPLEMENTARY APPENDIX 1

We searched Scopus using the following string: (AFFILCOUNTRY (country name) AND AFFILORG (neurosurgery) AND DOCTYPE (ar) AND PUBYEAR = 2015). We changed the country name (checking all the countries listed as affiliated to the low-income country [LIC] and low- to middle-income country [LMIC] on the World Bank website) in the field AFFILCOUNTRY and the years 2015, 2016, and 2017 in the PUBYEAR field. Only documents from the 17 journals of interest were included among the overall results.

We searched PubMed using the following string: ((((((((((((((((((("Journal of neurology, neurosurgery, and psychiatry"[Journal])) OR "Journal of neurosurgery"[Journal]) OR "World neurosurgery"[Journal]) OR "Neurosurgery"[Journal]) OR "Journal of neurosurgery, Spine"[Journal]) OR "Spine"[Journal]) OR "Journal of neurotrauma"[Journal]) OR ("European spine journal: official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society"[Journal])) OR "Neurosurgical review"[Journal]) OR "Neurosurgical focus"[Journal]) OR "Acta neurochirurgica"[Journal]) OR ("Stereotactic and functional neurosurgery"[Journal])) OR "The New England journal of medicine"[Journal]) OR "JAMA neurology"[Journal]) OR "The Lancet Neurology"[Journal]) OR "JAMA"[-Journal]) OR "Lancet (London, England)"[Journal]) AND neurosurgery[Affiliation]) AND country name [Affiliation]). The filters used were journal article and customized year.