

Authorship Patterns in the Orthopaedic Journals of Low-Income and Lower-Middle-Income Countries

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Background: Extensive research collaborations exist between researchers from high-income countries (HICs) and those from low-income countries (LICs) and lower-middle-income countries (LMICs). Previous research has suggested that authors from LICs and LMICs are underrepresented as first and last authors in the orthopaedic literature on local populations, particularly in LICs. We present a bibliometric analysis of authorship solely in studies published in orthopaedic journals that are based in LICs and LMICs.

Methods: The Global Index Medicus was queried, and all articles published from January 1, 2010, to December 31, 2021, in journals with a focus on orthopaedic surgery that were based in an LIC or an LMIC were included. Logistic regressions were calculated to assess the predictors of local authorship.

Results: Over 92% of studies included in our analysis had first or last authors from LICs or LMICs. In terms of study type, the majority (89%) of studies were clinical, although largely of low-level evidence (78% of clinical studies were case reports, case series, or descriptive studies). None received funding. LIC or LMIC first authorship and last authorship were less likely for most types of nonclinical studies. LIC or LMIC first authorship was more likely when there were more study authors. LIC or LMIC first authorship and last authorship were less likely when there were more countries affiliated with the study authors. Finally, when compared with studies with only LIC or LMIC authors, those with a combination of HIC and LIC or LMIC authors had significantly lower rates of LIC or LMIC first authorship (93.3% versus 62.5%) and last authorship (97.7% versus 70.8%).

Conclusions: Our study presents one of the first analyses to assess authorship patterns in the orthopaedic literature of locally published journals in LICs and LMICs. Future studies are needed to contextualize our findings within a broader bibliometric landscape in order to better address the ongoing challenges to building research capacity in LICs and LMICs.

Clinical Relevance: Our study highlights important observations regarding authorship in international, collaborative research in orthopaedics.

In the past few decades, collaborative research between high-income countries (HICs) and low-income countries (LICs) and lower-middle-income countries (LMICs) has increased significantly¹. Prior work assessing internationally available, indexed journals has indicated that researchers from LICs and LMICs are underrepresented as first and last authors of orthopaedic studies pertaining to local populations, particularly in LICs². Several studies outside of orthopaedics have also raised concerns regarding the well-documented underrepresentation of local partners in research collaborations between HICs and LMICs and/or LICs³⁻⁵.

Previous studies have suggested various etiologies for the authorship underrepresentation of LMICs researchers⁶, such as language barriers or poor communication^{5,7}, lack of awareness among local researchers regarding how authors should be listed in academic studies⁸, inequities in funding⁹, a pressure to publish among HIC authors at the expense of LMIC or LIC authorship¹⁰, and a high burden of non-research-related activities among researchers from LMICs and LICs⁶. Although reviews of this topic exist in the indexed, international surgical and orthopaedic literature, a dedicated analysis of authorship patterns in locally

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based orthopaedic journals from LMICs or LICs has yet to be performed^{11,12}.

Herein, we present a bibliometric analysis evaluating authorship solely in studies published in orthopaedic journals from LMICs or LICs. Our goal was to better characterize authorship patterns pertaining to journals based locally in LICs and LMICs in order to determine the proportion of first and last authors from these countries and to identify factors associated with the lower levels of local first and last authorship. We hope that our findings can enable the research community to better assess local research capacity and to encourage equitable research practices in future global health collaborations.

Materials and Methods

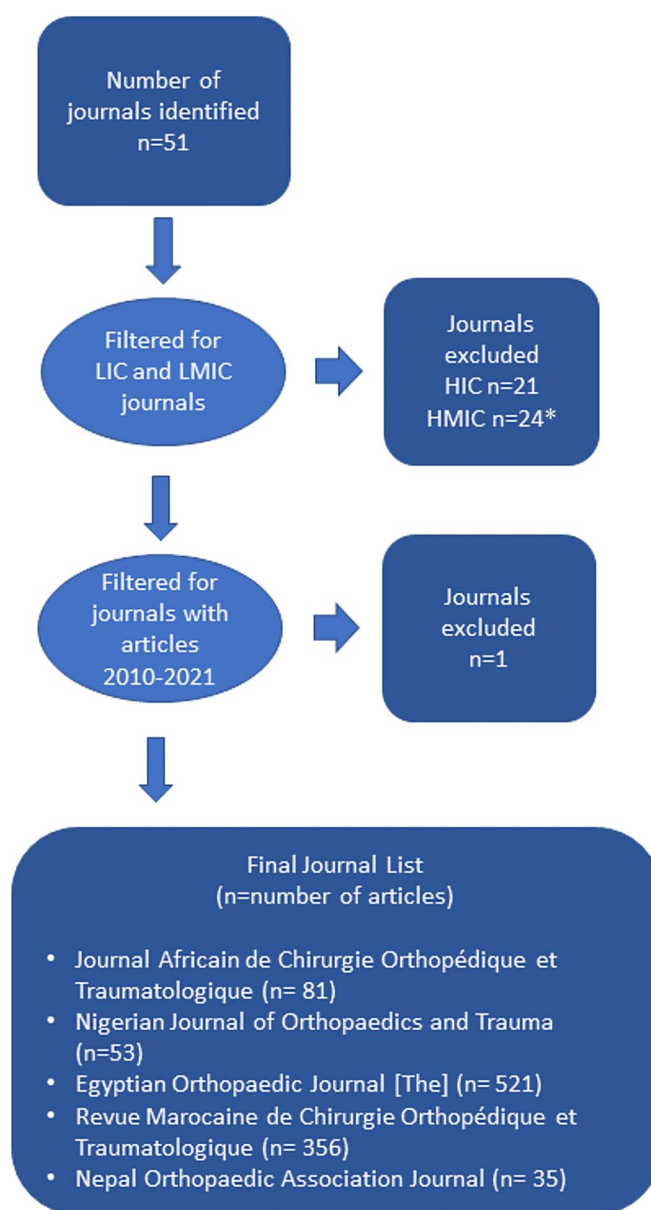
The Global Index Medicus is housed by the World Health Organization (WHO) and focuses on the cataloging and indexing of research articles produced by and within low and middle-income countries (<https://www.globalindexmedicus.net/about-gim/>). The Global Index Medicus is an agglomerated database of 6 individual WHO regional medical indices that catalog biomedical research on the basis of WHO geographic regions: Africa, Latin America and the Caribbean, the Eastern Mediterranean, South-East Asia, and the Western Pacific¹³. We elected to employ the Global Index Medicus on the basis of a report that traditional major medical databases, such as MEDLINE and Embase, had issues related to language and publication bias against non-English-language works, and because the Global Index Medicus included LIC and LMIC journals with limited representation in traditional databases¹⁴.

Each regional medical index was searched for all journals with a focus on orthopaedic surgery that were published in an LIC or LMIC, which were verified by 1 of 2 pairs of authors (M.X. and S.C., and I.O. and J.R.). Income status was assigned on the basis of the World Bank Country and Lending Groups¹⁵.

All journals published in LMICs and LICs from January 1, 2010, to December 31, 2021, were included in this study. Journals from upper-middle-income countries or HICs were excluded from the analysis. Journals from the Islamic Republic of Iran and Venezuela were excluded because of their predominant classification as higher-middle-income countries (HMICs) during most of the years (2010 to 2019) in the study period. In ambiguous cases, a second author (J.Y.) evaluated and confirmed the exclusion or inclusion of a journal. The journal selection process is detailed in Figure 1. All articles from the final set of journals were included in the final analysis.

Each author (M.X., S.C., I.O., and J.R.) was trained on a test data set that was evaluated by a second author (J.Y.), and appropriate adjustments were made to the data collection tool prior to formal data collection. The contents of each article abstract were evaluated by 1 of 2 pairs of authors (M.X. and S.C., and I.O. and J.R.) for the level of evidence and bibliometric information. Articles in French were also included in the analysis and were evaluated by authors with professional proficiency in French.

Subsequently, eligible studies were assessed for study content, author affiliation, funding information, study type,



*Journals from the Islamic Republic of Iran and Venezuela were excluded due to their predominant classification as HMICs during the time period of this analysis (2010-2019)

Fig. 1

Schematic diagram showing how the authors selected the journals and articles that were eventually chosen for data analysis.

and study country. If the country where a study was conducted could not easily be identified from the text, the country of affiliation was assumed from the author affiliations, provided that all authors had the same affiliation to a single country. For multinational studies in which the study location or author affiliation was not apparent, the corresponding author was contacted via email for clarification.

An HIC, LIC, or LMIC affiliation was assigned to each author on the basis of their published affiliation. If an author had affiliations with both an HIC and an LIC or LMIC, they were assigned an HIC affiliation on the basis of the presumed potential benefits in resources or access conveyed to that author from their HIC affiliation, as has previously been described¹⁶. If an author had affiliations with 1 or more countries that were all HICs or all LMICs or LICs, the first affiliation was assigned to the author. Studies with a single author were excluded from analyses involving last authorship.

Logistic regression models and chi-square (χ^2) analyses were performed with SAS (SAS Institute). Significance was set at 0.05.

Source of Funding

No funding was received for this investigation.

Results

In total, we identified 1,046 articles across our study period, of which 934 (89.3%) were clinical studies. Of the clinical studies, 157 were case reports; 661 were case series or descriptive studies; 87 were cohort, case-control, or cross-sectional studies; and 29 were randomized controlled trials. None of the articles specified funding of any kind. A total of 426 (40.7%) of the 1,046 studies had ≥ 5 authors, and 979 (93.6%) had authors from a single country (Table I). Similar characteristics were documented for LIC or LMIC last authorship (Table II). A full list of the country representation of the included studies, stratified by LIC or LMIC first and last authorship, is provided in the Appendix as Supplementary Table 1. Stratification of the studies by World Bank classification (LIC versus LMIC location of study) is presented in Appendix Supplementary Tables 2 and 3.

In our sample, 92.6% of studies (969 of 1,046) had LIC or LMIC first authorship, and 96.9% (754 of 778) had LIC or LMIC last authorship. Compared with studies with only LIC or LMIC authors, those with a combination of HIC and LIC or LMIC authors had significantly lower rates of LIC or LMIC first authorship (93.3% [954 of 1,022] versus 62.5% [15 of 24]; $\chi^2 = 32.7$; $p < 0.0001$) and last authorship (97.7% [737 of 754] versus 70.8% [17 of 24]; $\chi^2 = 56.3$; $p < 0.0001$).

Basic science and translational studies (odds ratio [OR], 0.03; 95% confidence interval [CI], 0.01-0.57; $p = 0.0054$), medical education studies (OR, 0.22; 95% CI, 0.07-0.70; $p = 0.0015$), and systematic reviews, meta-analyses, and bibliometric analyses (OR, 0.06; 95% CI, 0.01-0.32; $p = 0.0002$) were less likely than clinical studies to have LIC or LMIC first authorship (Table III). Similarly, noninvestigative reports (editorials, obituaries, and commentaries) (OR, 0.10; 95% CI, 0.01-0.99; $p = 0.0066$), medical education studies (OR, 0.22; 95% CI, 0.06-0.83; $p = 0.0053$), and systematic reviews, meta-analyses, and bibliometric analyses (OR, 0.07; 95% CI, 0.01-0.69; $p = 0.0028$) were less likely than clinical studies to have LIC or LMIC last authorship (Table III). Additionally, LIC or LMIC first authorship was more likely (OR, 1.27; 95% CI, 1.05-1.53; $p = 0.0133$) as the number of authors increased. However, LIC or LMIC first authorship (OR, 0.03; 95% CI, 0.01-0.08; $p < 0.0001$) and last

authorship (OR, 0.03; 95% CI, 0.01-0.09; $p < 0.0001$) were less likely as the number of countries affiliated with the authors increased (Table III).

Of the 1,046 clinical studies, 818 (78.2%) were case reports, case series, or descriptive studies, and 116 (11.1%) were comparative studies (cohort, case-control, or cross-sectional) or randomized controlled trials. No differences in the likelihood of LIC or LMIC first authorship or LIC or LMIC last authorship were found on the basis of the type of clinical study (see Appendix Supplementary Table 4).

Discussion

To our knowledge, this study is one of the first bibliometric analyses to assess the authorship solely in studies published in orthopaedic journals based in LMICs or LICs. Our findings showed that the majority (>92%) of studies in our analysis had LIC or LMIC first or last authors. In terms of study type, the majority (89%) of studies were clinical, although largely of low-level evidence (78% of the clinical studies were case reports, case series, or descriptive studies), and none received funding. LIC or LMIC first and last authorship were less likely for most types of nonclinical studies. We observed that a higher number of authors was associated with an increased likelihood of LIC or LMIC first authorship. However, a higher number of countries within the author affiliations of a study was associated with decreased likelihoods of LIC or LMIC first and last authorship. Furthermore, the rates of LIC or LMIC first authorship and last authorship among collaborative studies between HIC and LIC or LMIC authors were significantly lower than those among non-collaborative studies.

It is unclear if the preponderance of low-level studies (e.g., case reports and case series) found in our work substantially differs from the literature in journals based in HICs or LMICs, and, if so, if it reflects a discrepancy in the level of quality and the rigor of the research being produced and published in local journals as compared with that in HIC or LMIC journals. To our knowledge, no study has directly compared the quality of evidence between studies published in journals in LICs or LMICs and those published in journals in HICs or LMICs. However, according to work outside of the orthopaedic literature, there are several potential challenges to conducting research in LICs and LMICs that may contribute to this phenomenon⁶. These challenges include a lack of the following: the requisite experience and education for leading studies, large-scale initiatives to train and retain qualified researchers, funding avenues for researchers, necessary equipment (e.g., laboratory space, computers, and information technology support), and access to medical journals^{6,17-19}. Future work is needed to compare the level of evidence and the rigor of orthopaedic research coming from LICs and LMICs to that of orthopaedic research coming from HICs to better understand if there is indeed a differential level of research quality, and, if so, to identify potential opportunities for supporting LIC and LMIC researchers.

We also found that most genres of nonclinical studies were less likely than clinical studies to have LIC or LMIC first and last authorship. The reasons for this difference remain unclear but

TABLE I Study Characteristics by LIC or LMIC First Authorship

Study Characteristics	Articles with an LIC or LMIC First Author/All Articles (no.)	Percentage of Articles with an LIC or LMIC Author	χ^2	P Value
Total	969/1,046	92.6	—	—
Year of publication			27.7	0.1864
2010	40/42	95.2		
2011	21/21	100.0		
2012	63/68	92.6		
2013	97/109	89.0		
2014	77/82	93.9		
2015	47/51	92.2		
2016	81/91	89.0		
2017	116/128	90.6		
2018	151/159	95.0		
2019	126/137	92.0		
2020	96/104	92.3		
2021	54/54	100.0		
Study type			32.7	0.0003
Basic science or translational	1/2	50.0		
Clinical	871/934	93.3		
Burden of disease or epidemiologic	17/19	89.5		
Editorial, obituary, or commentary	15/18	83.3		
Medical education	57/63	90.5		
Systematic review, meta-analysis, or bibliometric analysis	8/10	80.0		
Type of clinical study			7.7	0.2595
Case report	143/157	91.1		
Case series or descriptive study	621/661	93.9		
Cohort, case-control, or cross-sectional study	83/87	95.4		
Randomized controlled trial	24/29	82.8		
Open access article	969/1,046	92.6	—	—
No funding	969/1,046	92.6	—	—
No. of authors per study			33.8	<0.0001
1	215/227	94.7		
2	191/197	97.0		
3	121/131	92.4		
4	58/65	89.2		
≥5	384/426	90.1		
No. of countries in the author affiliations			415.7	<0.0001
1	946/979	96.6		
2	22/61	36.1		
3	1/5	20.0		
4	0/1	0.0		

may be related to the potential problems of expertise, research resources, and funding listed above. Further work will be needed to investigate the causes and potential implications of this finding.

LIC or LMIC first authorship was found to be more likely as the number of authors increased. The reasons for this finding are unknown. We reported similar findings in a previous analysis of orthopaedic literature published in internationally indexed

databases². Likewise, in their work examining the authorship of research on community health workers in LMICs, Schneider and Maleka reported that the proportion of local coauthors was strongly associated with the affiliation of the last author, with higher rates of local authors found when the last author was from an LIC or a middle-income country²⁰. Ultimately, it is unknown whether this trend is a reflection of local collaboration

TABLE II Study Characteristics by LIC or LMIC Last Authorship

Study Characteristics	Articles with an LIC or LMIC Last Author/All Articles (no.)	Percentage of Articles with an LIC or LMIC Last Author	χ^2	P Value
Total	754/778	96.9	—	—
Year of publication			11.0	0.4457
2010	40/41	97.6		
2011	21/21	100.0		
2012	48/50	96.0		
2013	72/76	94.7		
2014	49/51	96.1		
2015	24/24	100.0		
2016	64/68	94.1		
2017	100/106	94.3		
2018	125/126	99.2		
2019	103/105	98.1		
2020	72/74	97.3		
2021	36/36	100.0		
Study type			8.8	0.1189
Basic science or translational	1/1	100.0		
Clinical	669/687	97.4		
Burden of disease or epidemiologic	17/17	100.0		
Editorial, obituary, or commentary	7/8	87.5		
Medical education	53/57	93.0		
Systematic review, meta-analysis, or bibliometric analysis	7/8	87.5		
Type of clinical study			2.2	0.5315
Case report	144/148	97.3		
Case series or descriptive study	453/467	97.0		
Cohort, case-control, or cross-sectional study	59/59	100.0		
Randomized controlled trial	13/13	100.0		
Open access article	754/778	96.9	—	—
No funding	754/778	96.9	—	—
No. of authors per study			0.3	0.9688
1	—	—		
2	191/196	97.4		
3	121/125	96.8		
4	59/61	96.7		
≥5	383/396	96.7		
No. of countries in the author affiliations			159.2	<0.0001
1	731/741	98.7		
2	21/33	63.6		
3	2/4	50.0		
4	—	—		

or, perhaps, a reflection of the authorship needs of studies with greater numbers of authors and researchers, and future work will be needed to assess the etiologies of this finding.

We found that, compared with studies without HIC authors, those with both HIC and LIC or LMIC authors had significantly lower rates of LIC or LMIC first authorship (93.3% versus 62.5%) and last authorship (97.7% versus 70.8%). Additionally, we found

that LIC or LMIC first authorship was less likely as the number of countries affiliated with the authors increased (Table III). This finding is concordant with that reported in the broader global health literature. Chersich et al. found that the proportion of maternal health studies with local first authorship was lower when the study included multiple countries, with a decreasing trend in local first authorship from 2000 to 2012¹⁰. Similarly, Modlin et al.

TABLE III Predictors of LIC or LMIC First and Last Authorship

Variable	Predictors of LIC or LMIC First Authorship (N = 1,046)		Predictors of LIC or LMIC Last Authorship (N = 778)	
	aOR* (95% CI)	P Value	aOR* (95% CI)	P Value
Year	1.12 (0.97-1.29)	0.1301	1.1 (0.93-1.30)	0.2758
Study type				
Clinical	1.0 (reference)		1.0 (reference)	
Basic science or translational	0.03 (0.01-0.57)	0.0054	—	—
Burden of disease or epidemiologic	0.15 (0.02-1.32)	0.8915	—	—
Editorial, obituary, or commentary	0.43 (0.05-3.57)	0.3447	0.10 (0.01-0.99)	0.0066
Medical education	0.22 (0.07-0.70)	0.0015	0.22 (0.06-0.83)	0.0053
Systematic review, meta-analysis, or bibliometric analysis	0.06 (0.01-0.32)	0.0002	0.07 (0.01-0.69)	0.0028
No. of authors per study	1.27 (1.05-1.53)	0.0133	1.01 (0.82-1.23)	0.9560
No. of countries in the author affiliations	0.03 (0.01-0.08)	<0.0001	0.03 (0.01-0.09)	<0.0001

*aOR = adjusted odds ratio derived from logistic regression.

found a decrease in the proportion of LIC-affiliated lead authors in the infectious disease literature from 1998 to 2017²¹. Schneider and Maleka reported a predominance of HIC authors among LIC-based or multinational studies of community health workers in LMICs²⁰. Mbaye et al. found a disproportionately low rate of local first and last authors of infectious disease research from Africa⁵. Hedt-Gauthier et al. found that, in the broader sub-Saharan African health literature, authors from LMICs were less likely to be first or last authors when collaborating with authors from HIC-affiliated institutions (local first authorship rates of 23.0% in LMIC-HIC collaborations versus 52.9% in non-HIC collaborations), with local authorship at its highest when collaborations were performed with authors from other African countries¹¹. The reasons for this trend remain unclear, but several hypotheses have been proposed. One hypothesis is that, compared with their LIC counterparts, HIC investigators benefit from technical, resource, economic, or cultural advantages that better position them to lead research studies^{11,22}. LIC authors may similarly be disadvantaged as a result of language barriers, lack of access to academic literature, inability to pay for submission and publication fees, and a lack of representation among the editorial boards of academic journals²¹. Additional challenges for LIC authors include the greater academic pressure among HIC authors to publish and lead studies at the expense of lower LIC and LMIC authorship¹⁰. LIC and LMIC researchers may also be burdened with non-research-related responsibilities, such as teaching⁶. These challenges represent opportunities to empower local authors, who often have a better understanding of the local research context, may have research agendas that are better aligned with local needs, and may be better positioned to navigate the local sociopolitical climate to enable the application of locally produced research and evidence²³. Other researchers have proposed that this trend of lower numbers of LMIC first and last authors among multinational studies may suggest an implicit bias within global health research in which HIC researchers are associated with “generalizable” insights from larger

cross-national studies but LMIC researchers are perceived as generating more local, “contextual” knowledge with limited applicability and translatable insights²⁰. Various strategies have also been proposed to address these potential challenges¹¹, although there remains a lack of research assessing their efficacy and impact²³. Additional empirical studies within the orthopaedic literature will be needed to clarify the etiologies of this phenomenon and its trend over time.


This study was not without limitations. We chose to evaluate all journals available through the Global Index Medicus that were published in LMICs and LICs in order to mitigate the problems of publication bias and limited overlapping representation associated with traditional major medical databases, as demonstrated in previous research¹⁴; however, this search strategy yielded only 5 journals to include in our analysis, with >80% of studies coming from journals from 2 countries. It is likely that our search using the Global Index Medicus underestimated the number of orthopaedic journals from LICs and LMICs globally. This limited quantity of journals may also reflect the fact that only a fraction of local journals are available online. Furthermore, it is possible that the search methods utilized may have introduced a risk of English-language bias in our study³. As such, we acknowledge the challenge of generalizing our findings to the broader landscape of orthopaedic literature coming from LICs and LMICs. However, in the absence of a reported, validated method for comprehensively capturing orthopaedic literature published in local journals, much of which may not be available online, we believe that our work represents a rigorous first assessment and presentation of the local orthopaedic literature. Future work is needed to develop more comprehensive methodology to capture journals from LICs and LMICs that are not indexed. Additionally, as has previously been reported, the use of first and last authorship as indicators of study leadership and the use of author affiliation to ascribe resource status (HIC versus LMIC or LIC) are imperfect proxies^{3,21}. They may ultimately not

be applicable in all research settings, and further work in this area will be needed to provide a more holistic understanding of how authorship trends fit into a complete, contemporary understanding of research capacity in diverse settings. Finally, our analysis did not include orthopaedic articles published in journals without an orthopaedic focus or orthopaedic articles published in more general medical journals, which may be an area of future study.

Conclusions

To our knowledge, this study represents the first assessment of authorship patterns in locally published orthopaedic journals in LICs and LMICs. Although the vast majority of studies examined were clinical and had first authors from LICs or LMICs, most of the studies had low-level evidence. Studies with more authors were more likely to have first authors from an LIC or LMIC; however, studies with more countries affiliated with the authors were less likely to have LIC or LMIC first and last authors. Furthermore, studies with a combination of HIC and LIC or LMIC authors had significantly fewer LIC or LMIC first and last authors. Future studies will be needed to contextualize the hypothesis-generating findings reported in this study within a broader global orthopaedics landscape in order to better identify and address ongoing challenges to building research capacity in LICs and LMICs.

Appendix

 Supporting material provided by the authors is posted with the online version of this article as a data supplement at [jbjs.org \(http://links.lww.com/JBJSOA/A573\)](http://links.lww.com/JBJSOA/A573). ■

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