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ORIGINAL RESEARCH

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Female and low- and middle-income authorship trends in high-impact ENT journals (2011–2020)

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Abstract

Introduction: Despite a recent drive to increase diversity, the global academic workforce is skewed in favor of authors from high-income countries, and women are under-represented in the published medical literature.

Objectives: To explore the trends in authorship of three high-impact otolaryngology journals over a ten-year period (2011–2020).

Methods: Journals selected: *JAMA Otolaryngology–Head and Neck Surgery*, *The Laryngoscope* and *Rhinology*. Articles were reviewed from four issues per journal per year, and data was collected on: time of publication; subspeciality; number of authors; sex of first and last authors; country of practice of first author and country where each study was conducted. Trends were examined though univariate and multivariate logistic regression models.

Results: 2998 articles were included. 93.9% of first authors and 94.2% of studies were from high-income countries.

Women were first authors in 31.5% ($n = 912$) and senior authors in 18.4% ($n = 524$) of articles. Female first authorship significantly increased between 2011 and 2020 however female senior authorship remained the same. There have been no significant changes in the proportion of published articles from low-and middle-income countries (LMIC) over time ($p = .65$). Amongst the LMIC articles, 72% came from Brazil, Turkey or China and there were no published papers from countries with a low-income economy (gross national income per capita of $1085 or less).

Conclusions: Although female first authorship has increased in the last decade, there has been minimal other demographic change in authorship over this time. High-impact otolaryngology journals poorly represent academia in low-and-middle income countries. There is a need for increased advocacy promoting gender and geographical research equity in academic medicine.

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Level of Evidence: III.

KEYWORDS
authorship, equity, global surgery, otolaryngology, representation

1 | INTRODUCTION

In recent years, the field of academic medicine has focused on improving diversity. There has been an increase in the geographic, ethnic and socioeconomic diversity of authors publishing in the literature, and this has been encouraged by nearly all academic medical institutions and professional associations.[1]

Despite this, underrepresented minority (URM) individuals and women are still present in lower proportions compared to the general population,[1] and the academic workforce remains skewed in favor of authors from high-income countries.[2–5] In the field of otolaryngology, women are disproportionately under-represented in leadership roles.[5,6] However, although the evidence is limited, it has been suggested that this may be changing in recent years.[7] Additionally, a bibliometric analysis by *Djoutsop* et al. examined otolaryngology research published between January 2020 and May 2021 and concluded there is a concerning disparity between the research output of high-income country (HIC) and low-and-middle-income country (LMIC) institutions.[8]

Improving both female representation in academic literature and encouraging more research from LMICs are crucial steps towards achieving research and gender equity globally and further characterization of the academic workforce.[9]

This study aims to explore these themes within the context of otolaryngology and head and neck surgery by analyzing trends in authorship of three high-impact otolaryngology journals: *JAMA Otolaryngology–Head and Neck Surgery* (*JAMA*), *The Laryngoscope* and *Rhinology* over a ten-year period (2011–2020).

2 | METHODS

This study was deemed exempt for *Institutional Review Board Review* review by the Mayo Clinical Institutional Review Board.

TABLE 1 Summary of journals and issues included

Journal	Impact Factor	Issues included per year
JAMA Otolaryngology–Head and Neck Surgery	6.223	March, June, September, December
Laryngoscope	2.442	March, June, September, December
Rhinology	3	Issue 1, Issue 2, Issue 3, Issue 4

2.1 | Data collection

The three high impact journals selected for analysis were *JAMA Otolaryngology–Head and Neck Surgery*, *The Laryngoscope* and *Rhinology*. Data were collected for four issues per journal per year (Table 1). All published articles within these issues were reviewed for inclusion. All *original research articles*, *reviews*, *case reports* and *quizzes* were included. The following types of articles were excluded: *highlights*, *editorial*, *letters*, *corrections*, *patient advice leaflets* and *mastheads*.

2.2 | Variables of interest

For each article that met the inclusion criteria, data were collected on: journal; time of publication (year and month); subspeciality of article (cranial base/neuro-otology, general otolaryngology, head and neck, laryngology, otology, pediatrics, rhinology, other); sex of first author (female/male/unknown); sex of last author (female/male/unknown); total number of authors; country of practice of first author (grouped into either LMIC or HIC as per The World Bank and Lending Group Classification);[10] and country where the study was conducted.

The sex of first author was determined by inspection of first name. If this was unclear, internet search engines, social media and institutional websites to find photographs and/or biographies were used. If it was still difficult to determine sex, an email was sent to the corresponding author cited on the paper, and if no response was received within 6 weeks these authors were marked as "unknown."

2.3 | Reproducibility

All authors used a standardized data collection tool to collect data. To ensure reproducibility, data collection was duplicated by a second author for one issue per journal per year. Any discrepancies were resolved via group discussion amongst all the authors.

2.4 | Statistical analysis

All variables were tabulated, and a logistic regression model was used to model the association between:

- sex of first and last authors and time of publication
- sex of first and last authors and journal
- sex of first and last authors and subspeciality
- country of practice of first author and time of publication

- country of practice of first author and journal
- country of practice and subspeciality

Univariable and multivariable analyses were conducted to examine relationships for both first and last female authorship, as well as associations with authors publishing from LMICs while adjusting for other possible confounders.

Odds Ratios, 95% confidence intervals, and *p*-values were reported. Statistical analyses were performed using SAS version 9.4 (SAS Institute; Cary, NC). All tests were two-sided, and *p*-values <.05 were considered statistically significant.

3 | RESULTS

There were 2998 articles that met the inclusion criteria (Table 2). 59.8% ($n = 1792$) of articles reviewed were published in *The Laryngoscope*, with 22.8% ($n = 669$) and 17.9% ($n = 537$) published in *JAMA Otolaryngology - Head & Neck Surgery* and *Rhinology* respectively. The papers were equally distributed over the years.

Overall, the first author was female in approximately 31.5% ($n = 912$) of articles and male in 68.5% ($n = 1985$) of articles with female first authorship significantly increasing ($p < .001$) between 2011 to 2020. (Figure 1).

The senior author was female in 18.4% ($n = 524$) of articles and male in 81.6% ($n = 2326$) of articles with no significant change in this distribution over the 10 years. (Figure 1.)

The mean number of authors for the reviewed articles was 5.5. The majority of first authors were from HICs (93.9%). Similarly, the majority of studies were conducted in HICs (94.2%). More than half the articles examined focused on rhinology (28.1%) or head and neck surgery (25.2%).

3.1 | Trends in first and senior authorship

The proportions of male and female first and senior author publications per journal per year are shown in Table A1. Female first authorship has significantly increased over time ($p < .0001$, univariable analyses), with papers published in in 2020 twice as likely to have a female first author compared to papers published in 2011. In 2011, there were 3.7 male first-author papers published for every female first-author paper - by 2020, this had reduced to 1.7.

Whilst there were no changes in female senior authorship noted over time, it was shown that for papers with female senior authors, there was a 63% greater chance that the first author would also be female (OR 1.63, 95%CI 1.34–1.99, *p*-value <.0001). This finding persisted even when controlling for other variables (year of publication, journal, LMIC/HIC and subspeciality). Relationships between female/male first/last authorship overtime are displayed in Figure 2. Female first authorship appears to be increasing with senior authors of both sex (female $p < .000$, male $p = .0015$). There were no significant publishing trends of articles with a male first author and a female senior author ($p = .20$) however there was a decline in publishing over time for articles that included both male first and male senior authorship ($p = .0008$).

Multi-variable regression analysis demonstrated a strong association between female first authorship and subspeciality ($p = .001$). Female first authors were most likely to publish papers in pediatric otolaryngology (OR 1.7 [1.3–2.2], $p < .0001$) and least likely to publish papers in cranial base/neuro-otology (OR 0.7 [0.5–1], $p = .05$) and facial plastics (OR 0.6 [0.3–1.0], $p = .06$) (against general otolaryngology papers as a reference.) Female senior authors were also least likely to publish in cranial base/neuro-otology (OR 0.6 [0.4–1] $p = .04$). No other variables examined demonstrated an association with female first or last authorship.

TABLE 2 Demographic factors of included articles

		Totals
Included articles		2998
Journal, *n* (%)	JAMA O-HNS	669 (22.3%)
	Laryngoscope	1792 (59.8%)
	Rhinology	537 (17.9%)
Year of issue, *n* (%)	2011	303 (10.1%)
	2012	302 (10.1%)
	2013	318 (10.6%)
	2014	315 (10.5%)
	2015	293 (9.8%)
	2016	314 (10.5%)
	2017	287 (9.6%)
	2018	298 (9.9%)
	2019	257 (8.6%)
	2020	311 (10.4%)
Sex of first author, *n* (%)	Female	912 (31.5%)
	Male	1985 (68.5%)
	Unknown	101
Sex of last author, *n* (%)	Female	524 (18.4%)
	Male	2326 (81.6%)
	Unknown	148
Number of authors	Total	2966
	Mean (SD)	5.5 (3.22)
	Median (IQR)	5.0 (3.0, 7.0)
	Range	0.0, 78.0
LMIC[a]/HIC[b] of first author, *n* (%)	HIC	2809 (93.9%)
	LMIC	184 (6.1%)
	Unknown	5
LMIC/HIC of country conducted, *n* (%)	HIC	2706 (94.2%)
	LMIC	166 (5.8%)
	Unknown	126

[a]Low-and-middle income county.
[b]High-income country.

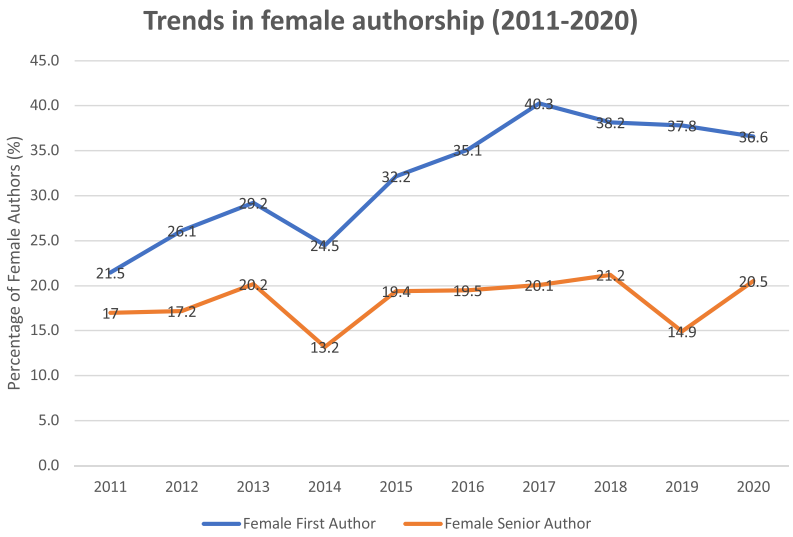

FIGURE 1 Trends in female authorship (2011–2020). Female first authorship observed in 31.5% of articles with a significant increase over time ($p < .001$). Female senior authorship observed in 18.6% of articles with no significant change over time ($p > .05$).

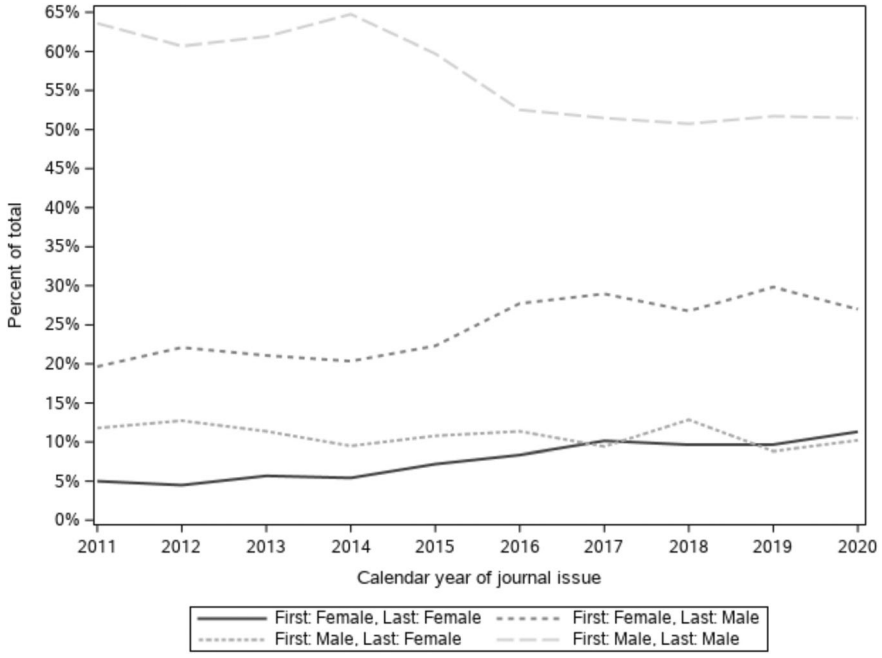

FIGURE 2 Plot of percent of female/male first/last author combinations over time. Female first authorship appears to be increasing, both with female senior authors ($p < .0001$) and with male senior authors ($p = .0015$). There was no significant trend of publishing in journals with male first author and female senior author ($p = .20$). There was a decline in publishing over time for articles that included male first and senior authorship ($p = .0008$).

3.2 | HIC/LMIC authorship

The 6.1% ($n = 184$) of first-authors were from LMICs and 5.8% of papers were based in LMICS. There was no change observed in these publishing trends between 2011–2020 (Figure 3.) Almost half the papers (49%) were in the subspeciality of rhinology. This was followed by head and neck (14%), otology (10%) laryngology (9%) and pediatrics (4%) with only one paper published about cranial base. The percentage of female first and senior authors was 22% ($n = 41$) and 18% ($n = 33$) respectively; although this did not change over time ($p = .79$ and $p = .62$ respectively) changes may be difficult to detect due to the small number of LMIC papers.

A country by country breakdown of LMIC-based articles is shown in Figure 4.

The 184 LMIC papers originated from 17 different countries, with the most representation from Turkey ($n = 48$), China ($n = 39$) and Brazil ($n = 24$.) Together, articles from these three countries represented 72% of LMIC-based papers and 73% of LMIC female-authored papers. Articles were further stratified by region (Figure 4) and by income-group (Figure 5) according to the World Bank Country and Lending Groups (upper middle income; lower middle income; low income).[10] Only one article originated from Sub-Saharan Africa (South Africa) and there were zero papers published from low-income countries. The majority of papers (82%) were published by authors in upper-middle income countries.

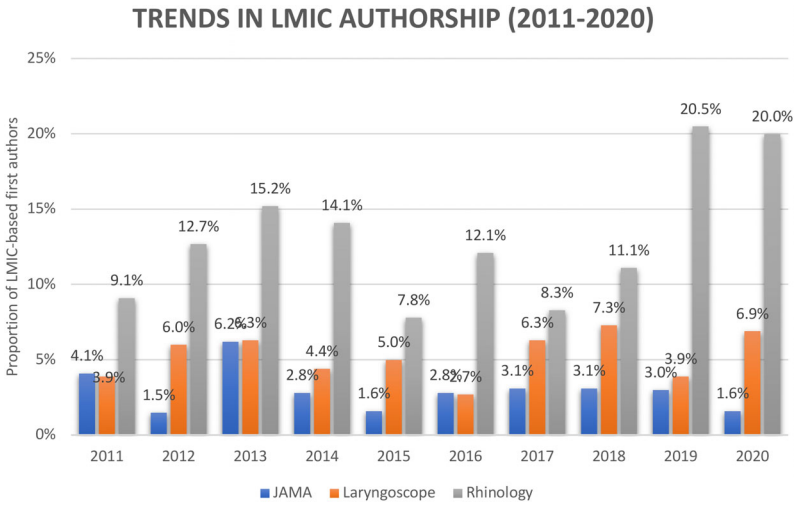

FIGURE 3 Trends in LMIC Authorship (2011–2020). LMIC-based first authors were identified in 6.1% with no significant change observed over time. The mean percentage of LMIC first authors per journal was 3% (JAMA OHNS) 5.3% (Laryngoscope) and 13.1% (Rhinology).

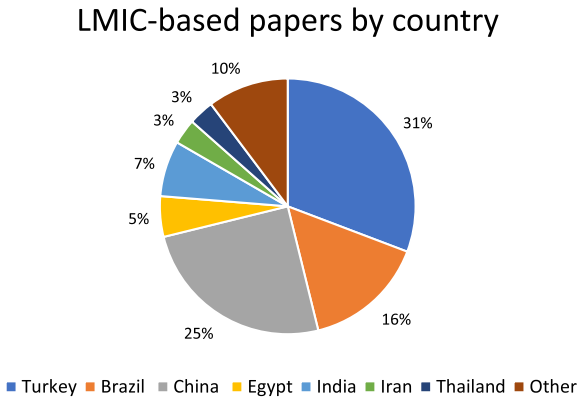

FIGURE 4 Low-and-middle-income based papers by country. Countries with less than five publications between 2010–20 were grouped as "other". These include (*n*): Colombia (3), Georgia (2), Lebanon (1), Malaysia (3), Mexico (2), Nepal (1), Philippines (1), Serbia (1), South Africa (1), and Tunisia (1).

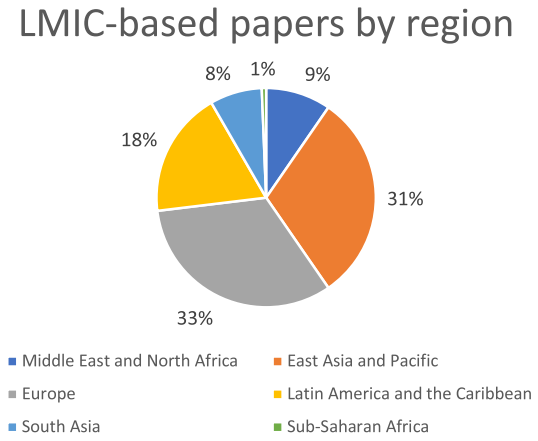

FIGURE 5 Low-and-middle-income based papers by region. Distribution of LMIC papers by region according to the World Bank.[10]

Between 2010 and 2020, *Laryngoscope* published more than half (52%) of the total LMIC-authored papers between the three journals, however as a proportion of the total papers published by *Laryngoscope* during this time this comprised only 5.3%. *Rhinology* had the highest LMIC to HIC first author ratio with 18.6% of publications written by an LMIC first author. *JAMA* published the fewest LMIC-authored articles and had smallest LMIC to HIC first author ratio with only 2.8% of all its publications written by an LMIC first author. This was significant after adjusting for time and we found that *JAMA* was 80% less likely to publish papers with LMICs first-authors than *Rhinology* (OR 0.2, CI0.1, 0.4, $p < .001$).

4 | DISCUSSION

This study demonstrates that whilst female first authorship in high-impact otolaryngology journals has increased to 31.5% over the last decade there has been little other demographic change in authorship over this time. Female senior authorship has not increased from 18.4%, LMIC authors still comprise only 6.1% of first authors, and only 5.8% of work published in high-impact ENT journals is conducted in LMICs. Furthermore, there is very little representation from Sub-Saharan Africa and no representation from low-income countries.

With 94% of the authorship originating in HICs, the findings of this paper allow us to draw reasonable conclusions about who is publishing in high-impact journals in these regions. Unfortunately, for the same reason, very few assumptions can be made about the make-up of LMIC authors and focused studies investigating not only this, but the causative factors are warranted.

In HICs, female first authorship in otolaryngology has increased over time and has surpassed other surgical specialities such as urology (25%)[11] and thoracic surgery (20%).[12] This rise in first authorship may be explained by the growing female otolaryngology workforce, which is currently estimated at 37% female in the U.S.[13] and 43% female in the UK[14] (this includes both residents/trainees and fully qualified otolaryngologists). Whilst these figures are lower for fully qualified otolaryngologists (17% in the US in 2017[13] and 26% in the UK in 2018)[14] and provide some explanation for the comparatively lower rates of

female senior authorship, the lack of change over time is not accounted for and must be questioned.

A previous study by Arrighi-Allisan et al.[15] exploring gender trends in otolaryngology authorship between 2000 and 2015 also reported similar findings. They too found that female first authorship almost doubled during the course of their study from 11.9% to 20.5%, and that female senior authorship in high-impact factor journals did not significantly increase over time. 19.4% of the articles they reviewed were found to have a female senior author, which is not dissimilar to the 18.6% documented in this study. This suggests that trends in female senior authorship have remained stagnant since 2000. Their analysis however, also included lower impact-factor journals, and they observed a rise in female senior authorship over time in journals with an impact factor of 1–2, but not in journals with an impact factor of greater than 2. Whilst this study does not examine the associations of female authorship with multiple variables such as first/senior author, subspecialty, journal and year it does provides an excellent benchmark for early research in this field, helps to validate the findings of our own study and reinforces the lack of change over time.

Barriers to publishing in high-impact factor journals for women have been well documented across surgical specialities and academic medicine.[16] This can in part be explained by "the gendered system of academic publishing"[17]- a self-perpetuating cycle in which women receive less research funding, publish fewer articles, receive fewer citations and therefore, less recognition as an academic. They subsequently receive fewer invitations to be a peer-reviewer or editor and finally, are less likely to receive research funding. It has also been reported that women are less likely to submit articles to the highest-impact journals compared to their male counterparts.

Other barriers exist at a much earlier stage and discourage entry into academia from the outset. These include a lack of female mentors in surgery, the association of surgery with predominantly masculine traits, perceived poor work-life balance, and experiences with gender discrimination or harassment.[18] However, Okafor et al, report that as more women are pursuing careers in otolaryngology, this academic gender gap, at least in the U.S. is closing. They suggest that women otolaryngologists in some subspecialities are currently matching their male counterparts more closely in research output,[19] and it is possible that this current study does not yet reflect the progression of this generation into senior research roles.

Interest must be taken to further dissect the workforce and understand if and where the research barriers lie at subspeciality level. Our study suggested that women are significantly most likely to publish in pediatric otolaryngology and least likely to publish in cranial base/neuro-otology. Whilst this must be interpreted with caution as we did not include a skull-base focussed journal, the findings are reinforced by Halderman et al. They examined authorship in rhinology papers published between 2011 and 2018 across 4 american journals.[20] and describe women publishing "more than expected in basic science and allergy and significantly less than expected in skull base compared to their male counterparts." To draw meaningful conclusions, further work should include a greater range of high-impact journals across all the subspecialities.

Our study also suggests that an element of female mentorship is at play, with a female first author 63% more likely if the senior author is also a woman, a finding that has also been observed in other specialties.[21] With the number of female first authors has increasing over time, we have seen a resultant decline in male–male authored papers. These relationships need further examination in the context of mentoring in academic otolaryngology before cause and effect conclusions can be drawn.

With limited existing data about the number of otolaryngologists world-wide, it is difficult to comment on how the 6.1% of authors publishing in high-impact ENT journals from LMICs compares to the global ENT workforce.

Our analysis by country, region and income group provides some granularity on the distribution of LMIC authors across geographic and economic regions (Figures 4–6).

The world-bank classifies countries by economy into four groups based on gross national income per capita: low-income $1085 or less; lower middle-income $1086 to $4255; upper middle-income $4256 to $13,205 and high-income economies are $13,205 or more.[10] We highlight that the majority (82%) of the LMIC papers originated from upper-middle income countries, predominantly from Brazil, China and Turkey, and that there were no papers from low-income countries. By grouping together all low-and-middle income countries, this important distinction can be missed leading to generalization and neutralization of differences across countries. What is evident through the lack in change of LMIC authorship over time and the limited geographic distribution of the authors, is that research in ENT has not caught up with the global surgery movement. Possible explanations for this are manifold.

Firstly, in regions such as sub-Saharan Africa with estimates of 1.2 million people per ENT surgeon,[22] it is likely that the demands of clinical work may take priority over research. For those wanting to engage in research and publishing there are numerous hurdles to overcome prior to acceptance of the article. Next, the subject matter must be deemed relevant and align with the research priorities of the journal and the interests of its majority readership. Most high-impact journals also require a high quality of written English, and although some offer a language editing service this is not widely known and incurs additional cost. Furthermore, researchers in LMICs have less access to mentorship and training in the level of scientific rigor desired for publication in high-impact journals.

Another commonly cited barrier for publishing in high-impact ENT journals is cost; in particular the article processing charge (APC) required for open access publishing. For *JAMA-Otolaryngology Head and Neck Surgery* this is $5000; for *The Laryngoscope* this is $4840 and for *Rhinology*, this is $1700 per article. However, as all three journals offer a complete waiver for many LMICs, and *JAMA-Otolaryngology Head and Neck Surgery* and *The Laryngoscope* both offer a free no-fee public access option, it is unlikely that this is the largest barrier to LMIC authorship.

Finally, we must question the continued relevance of impact factor in the web-based era of publishing. The internet provides huge access to a number of local, regional, national and international

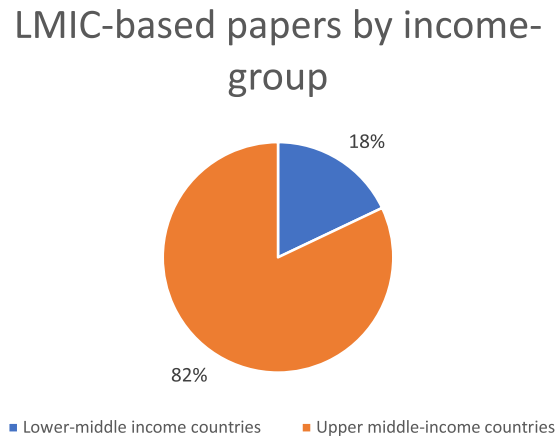

FIGURE 6 Low-and-middle-income based papers by income-group. Distribution of LMIC papers by income-group according to the World Bank:[10] Low-income ($1085 or less); lower middle-income ($1086 to $4255); upper middle-income ($4256 to $13,205); high-income economies ($13,205 or more).

publishing opportunities which may be more relevant for the researcher and their intended audience whilst constructing fewer barriers. Further work should certainly be done exploring the perceived importance of impact factor to clinicians and academics globally, as well as investigating differing motivations for choice of journal.

4.1 | Limitations

This study is subject to a number of limitations which should be considered when interpreting the results. We acknowledge that as data collection was performed manually by multiple collaborators there is room for error in the application of the inclusion/exclusion criteria, determining the subspecialty of the article and country of practice of the author and also the data-recording. Particular scrutiny must be given to the methodology used to determine sex of author although multi-staged efforts were made to improve this accuracy, and similar methodology has been described in other studies.[12,21,23] The World Bank classifies countries into four income groups (low-income countries, lower-middle-income countries and upper-middle income countries and high-income countries) yet in the bulk of this study we have simplified this into two categories: LMIC and HIC. Whilst this is common in global health research, there is a growing movement to use more "targeted categorization."[24] Without stratifying into the four income groups as per Figure 6 we would not be able to appreciate the significant skew towards upper-middle income countries in LMIC group and the absence of any low-income countries. Ideally, we would have been able to conduct further analysis on the LMIC population, however we were limited by the statistical significance of such a small cohort. We also acknowledge that each subspeciality within otolaryngology has a dedicated journal which is often the preferred site of publication. Without including each of these journals in our analysis it is not possible to draw comparative conclusions about authorship at a subspeciality level. Finally, as all of the journals included were based in HICs with two of the journals (*JAMA and The Laryngoscope*) based in the U.S., and 60% of the articles extracted from *Laryngoscope* we must accept that there may not be a true representation of otolaryngology research world-wide.

5 | CONCLUSIONS

This paper is one of the first to explore trends in LMIC and female authorship in otolaryngology. It is intended as an observation of the current demographics of academia within the speciality and we hope that the highlighted findings will open the debate on the importance of a diverse academic body within ENT and the lack of current representation in high-income journals.

Although female first authorship has increased to 31.5% in the last decade, there has been minimal other demographic change in authorship over this time. Female senior authorship has not increased from 18.4% and there is scanty published research from LMIC based authors in high-impact ENT Journals and zero publications from low-income countries.

There is ongoing work, however, to address these inequities. The Global OHNS Initiative is an international collaborative of over 250 members from over 40 countries with the aim of improving access to otolaryngology care around the world through research. The Global OHNS Research Equity Guidelines are designed to facilitate this mission by ensuring that the research questions and projects have strong input by historically underrepresented researchers. These study findings support the need for this effort and expand the mandate to include gender representation. We recommend that the Global OHNS Initiative, and organizations that similarly prioritize equity in research, explicitly include measures to promote gender representation in their goals and guidelines.

AUTHOR CONTRIBUTIONS

Farizeh Jashek-Ahmed: design, conduct, analysis, manuscript writing, presentation. **Davina Daudu**: design, conduct, analysis, manuscript editing. **Baveena Heer**: conduct, analysis, manuscript editing. **Hawa Ali**: conduct, analysis, manuscript editing, presentation. **Global OHNS Initiative**: manuscript editing. **Joshua Wiedermann**: design, manuscript editing. **Amina Seguya**: design, conduct, analysis, manuscript writing, presentation.

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CONFLICT OF INTEREST STATEMENT

The authors declare there is no potential conflict of interest.

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APPENDIX

TABLE A1 First and Senior Authors by sex per journal (2011–2020).

Journal		*JAMA*		*Laryngoscope*		*Rhinology*		*Combined*	
Sex of first Author		Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)
Year	2011	21.4	78.6	21.5	78.5	21.5	78.5	21.5	78.5
	2012	20.0	80.0	28.1	71.9	30.2	69.8	26.1	73.9
	2013	41.3	58.7	21.9	78.1	24.4	75.6	29.2	70.8
	2014	25.0	75.0	26.3	73.7	22.2	77.8	24.5	75.5
	2015	29.5	70.5	25.0	75.0	42.0	58.0	32.2	67.8
	2016	38.9	61.1	35.0	65.0	31.5	68.5	35.1	64.9
	2017	30.8	69.2	37.8	62.2	52.2	47.8	40.3	59.7
	2018	43.1	56.9	32.2	67.8	39.2	60.8	38.2	61.8
	2019	34.8	65.2	40.5	59.5	38.2	61.8	37.8	62.2
	2020	31.7	68.3	39.4	60.6	38.7	61.3	36.6	63.4
Sex of senior author		Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)
Year	2011	15.2	84.8	15.6	84.4	20.3	79.7	17.0	83.0
	2012	20.0	80.0	16.5	83.5	15.1	84.9	17.2	82.8
	2013	18.8	81.2	13.8	86.2	27.9	72.1	20.2	79.8
	2014	7.5	92.5	17.7	82.3	14.3	85.7	13.2	86.8
	2015	15.0	85.0	17.1	82.9	26.0	74.0	19.4	80.6
	2016	20.3	79.7	19.8	80.2	18.5	81.5	19.5	80.5
	2017	20.6	79.4	18.3	81.7	21.3	78.7	20.1	79.9
	2018	27.4	72.6	22.5	77.5	13.7	86.3	21.2	78.8
	2019	14.8	85.2	21.9	78.1	7.9	92.1	14.9	85.1
	2020	22.0	78.0	21.8	78.2	17.6	82.4	20.5	79.5