

# Authorship Equity and Gender Representation in Global Oncology Publications

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**PURPOSE** Authorship gender disparities persist across academic disciplines, including oncology. However, little is known about global variation in authorship gender distribution.

**METHODS** This retrospective cross-sectional study describes the distribution of author gender as determined from the first name across variables such as authorship position (first, middle, and last), country region, and country income level. The 608 articles with 5,302 authors included in this analysis were published in the *Journal of Clinical Oncology Global Oncology*, from its inception in October 2015 through March 2020. Primary outcome measure was author gender on the basis of first name probabilities assessed by genderize.io. World Bank classification was used to categorize the country region and income level. Odds ratios were used to describe associations between female last authorship and representation in other authorship positions.

**RESULTS** Although female authors were in the minority across all authorship positions, they were more under-represented in the last author position with 190 (32.1%) female, compared with 252 (41.4%) female first authors and 1,564 (38.1%) female middle authors. Female authors were most under-represented among authors from low-income countries, where they made up 21.6% of first authors and 9.1% of last authors. Of all the regions, sub-Saharan Africa and South Asia had the lowest percentage of female authors. Compared with articles with male last authors, those with female last authors had odds ratios (95% CI) of 2.2 (1.6 to 3.2) of having female first authors and 1.4 (0.9 to 2.1) of having 50% or more female middle authors.

**CONCLUSION** There are wide regional variations in author gender distribution in global oncology. Female authors remain markedly under-represented, especially in lower-income countries, sub-Saharan Africa, and South Asia. Future interventions should be tailored to mitigate these disparities.

**JCO Global Oncol 8:e2100369. © 2022 by American Society of Clinical Oncology**

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## INTRODUCTION

In recent years, there has been increasing recognition of authorship inequity in academic medicine publications. A 2018 study of 54 prestigious scientific journals listed by the Nature Index, across multiple scientific disciplines, observed that 29.8% of all authors in a selection of 293, 557 articles were female.<sup>1</sup> In several medical specialty publications, female authors consistently comprise a minority of first authors and an even smaller percentage of last authors.<sup>2-4</sup> Although female authorship representation has increased in recent decades, change has been both slow and inconsistent across various scientific disciplines. A 2017 cross-sectional analysis of articles in five premier oncology journals demonstrated that female authors still comprised a minority of both first (36.6%) and last authors (28.5%).<sup>5</sup> Similar gender disparities in academic oncology leadership have also been described across multiple domains including on editorial boards and in cancer center leadership roles.<sup>6</sup> This imbalance in

gender representation risks the perpetuation of systemic bias in research priorities.<sup>7</sup>

With worldwide expansion of oncology scholarship and the emergence of global oncology as an academic field, we sought to investigate authorship gender representation in global oncology publications. Although there are complex arrays of factors that are associated with female authorship under-representation, the relationship between author gender and the respective country region and economic level has not been previously described. This study describes the variation in authorship gender distribution in global oncology publications across global regions and country economic levels.

## METHODS

This study analyzes data collected from articles published in the *Journal of Clinical Oncology Global Oncology (JCO GO)*, an open-access journal published by ASCO. *JCO GO* was selected for this analysis because

Author affiliations and support information (if applicable) appear at the end of this article.

Accepted on November 30, 2021 and published at [ascopubs.org/journal/go](https://ascopubs.org/journal/go) on January 11, 2022: DOI <https://doi.org/10.1200/GO.21.00369>

## CONTEXT

### Key Objective

Authorship gender equity is imperative to ensure that research conducted reflects diverse perspectives. Imbalance in gender representation risks the perpetuation of systemic bias in research priorities. With the emergence of global oncology as an academic field, we sought to investigate authorship gender representation in global oncology publication and to explore variations in gender representation across global regions and country economic levels.

### Knowledge Generated

Although female authors were in the minority across all authorship positions, they were most under-represented in the last author position. Female authors were most under-represented among authors from low-income countries, and countries in sub-Saharan Africa and South Asia.

### Relevance

There was a trend toward rising proportion of female authors in the first and last authorship positions in the most recent years, particularly among articles published in 2020. However, more studies are needed to better inform targeted mitigating interventions to improve authorship gender equity in the field.

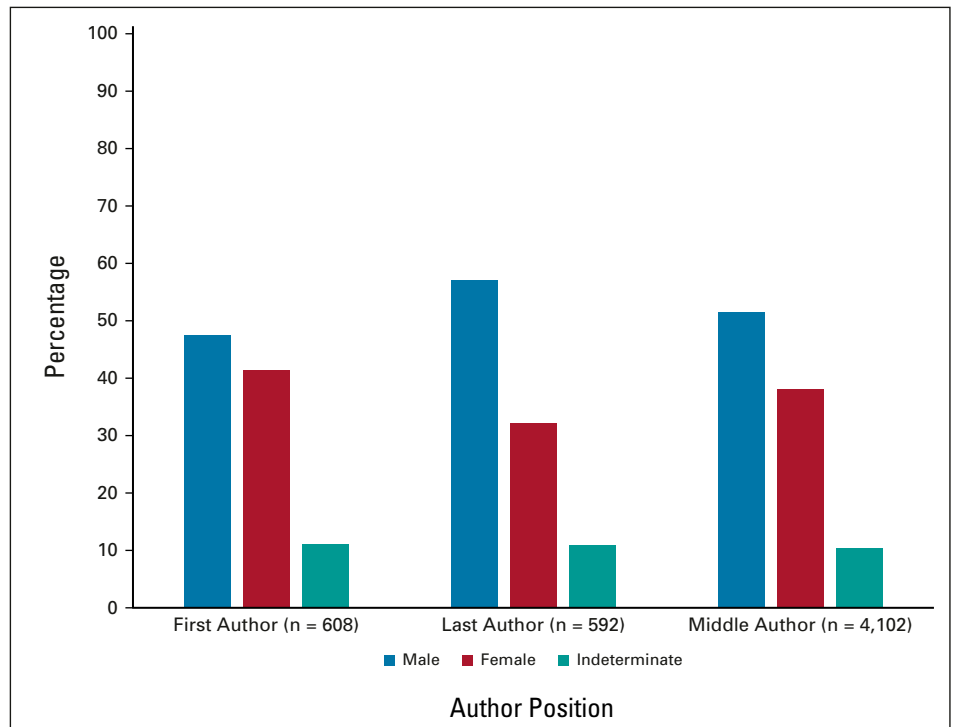
of its overarching global perspective and its discounted article charge policy, making it relatively more accessible to researchers from lower-resourced settings.<sup>8</sup>

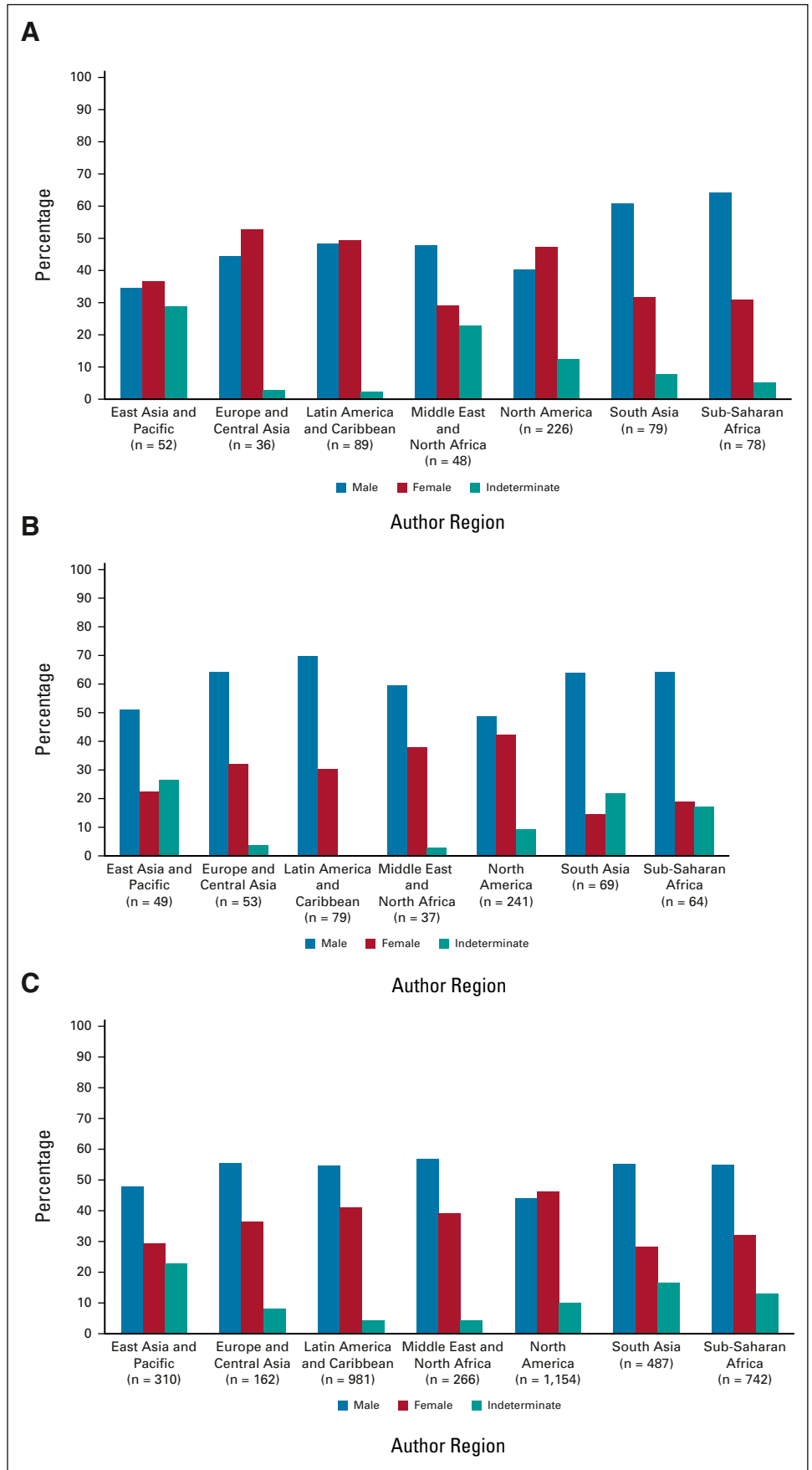
A PubMed search was conducted to identify articles published from the journal's inception from October 2015 through March 2020. Of the 645 articles identified, 608 matched the specified article type inclusion criteria representing editorials, commentaries, case reports, special articles, original reports, or reviews. Correspondences, replies, and other miscellaneous articles ( $n = 37$ ) were excluded. Data were collected for each article using the Research Electronic Data Capture tool.<sup>9,10</sup> Using dual data entry, H.T. and P.H. independently extracted data from 65

(10%) randomly selected articles. The percent discrepancy for dual data entry was 7.5%, under the predetermined threshold of 10% to proceed with single data entry. Data collection and analysis were performed from April 2020 to April 2021.

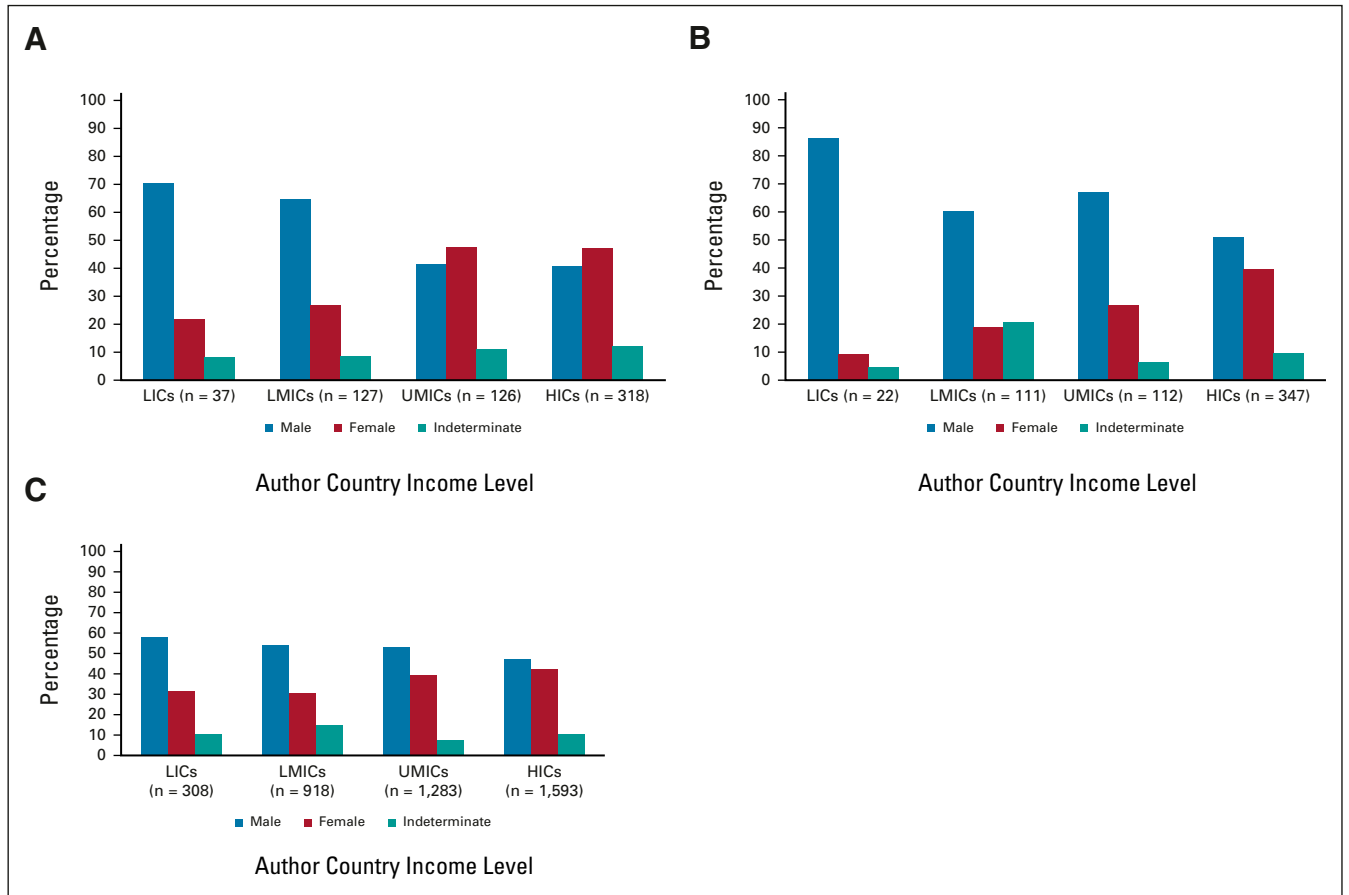
Author gender was categorized as male, female, or indeterminate on the basis of first name probability assessed by genderize.io, a validated and widely used instrument.<sup>11</sup> Gender categorization used a threshold probability of 0.8 on the basis of previous studies.<sup>11,12</sup> Author primary country affiliation was categorized on the basis of World Bank (WB) designations for the 2020 fiscal year.<sup>13</sup> The country region was classified by the standard seven WB regions, and country income level

FIG 1. Gender distribution by author position.





**FIG 2.** Author gender distribution by region: (A) first authors, (B) last authors, and (C) middle authors.



**FIG 3.** Author gender distribution by the country income level: (A) first authors, (B) last authors, and (C) middle authors. HICs, high-income countries; LICs, low-income countries; LMICs, lower-middle-income countries; UMICs, upper-middle-income countries.

classified by WB per-capita thresholds as low-income countries (LICs), lower-middle-income countries (LMICs), upper-middle-income countries (UMICs), or high-income countries (HICs).

### Statistical Analysis

Descriptive statistics using percentages and proportions were used to report gender distribution and variations on the basis of the variables of interest. The odds ratio was used to describe the association between female authorship representation in the first and middle author positions with last author gender. Analyses were completed in SAS version 9.4 (SAS Institute, Cary, NC).

### Reporting and Ethical Considerations

This study was designated as exempt by the Dana-Farber Cancer Institute Institutional Review Board. The report follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies.<sup>14</sup>

## RESULTS

Overall, 2,006 (37.8%) of 5,302 total authors were female. Female authors accounted for 252 (41.4%) first authors, 1,564 (38.1%) middle authors, and 190 (32.1%) last authors

(Fig 1). Gender distributions by region and country economic level are shown in Figures 2 and 3, respectively. Among the first authors, females accounted for a higher proportion than males in Europe and Central Asia (52.8% v 44.4%), and North America (47.3% v 40.3%), whereas they were notably under-represented in North Africa and the Middle East (29.2% v 47.9%), South Asia (31.6% v 60.8%), and sub-Saharan Africa (30.8% v 64.1%). Similarly, female first authors accounted for a higher proportion than males in HICs (47.2% v 40.6%) and UMICs (47.6% v 41.3%), but the converse was seen in LMICs (26.8% v 64.6%) and LICs (21.6% v 70.3%). Among the last authors, females were consistently under-represented across all regions and all country economic strata. The lowest proportions of female last authors were in South Asia (14.5%) and sub-Saharan Africa (18.8%) and among the LIC (9.1%) and LMIC strata (18.9%). Similar trends were observed among middle authors, where females were under-represented across all economic strata and most regions.

The distribution of authors by publication year is shown in Figure 4. There appears to be a trend toward higher proportion of female first authors in the most recent years. Although the proportion of female first authors in 2015 and

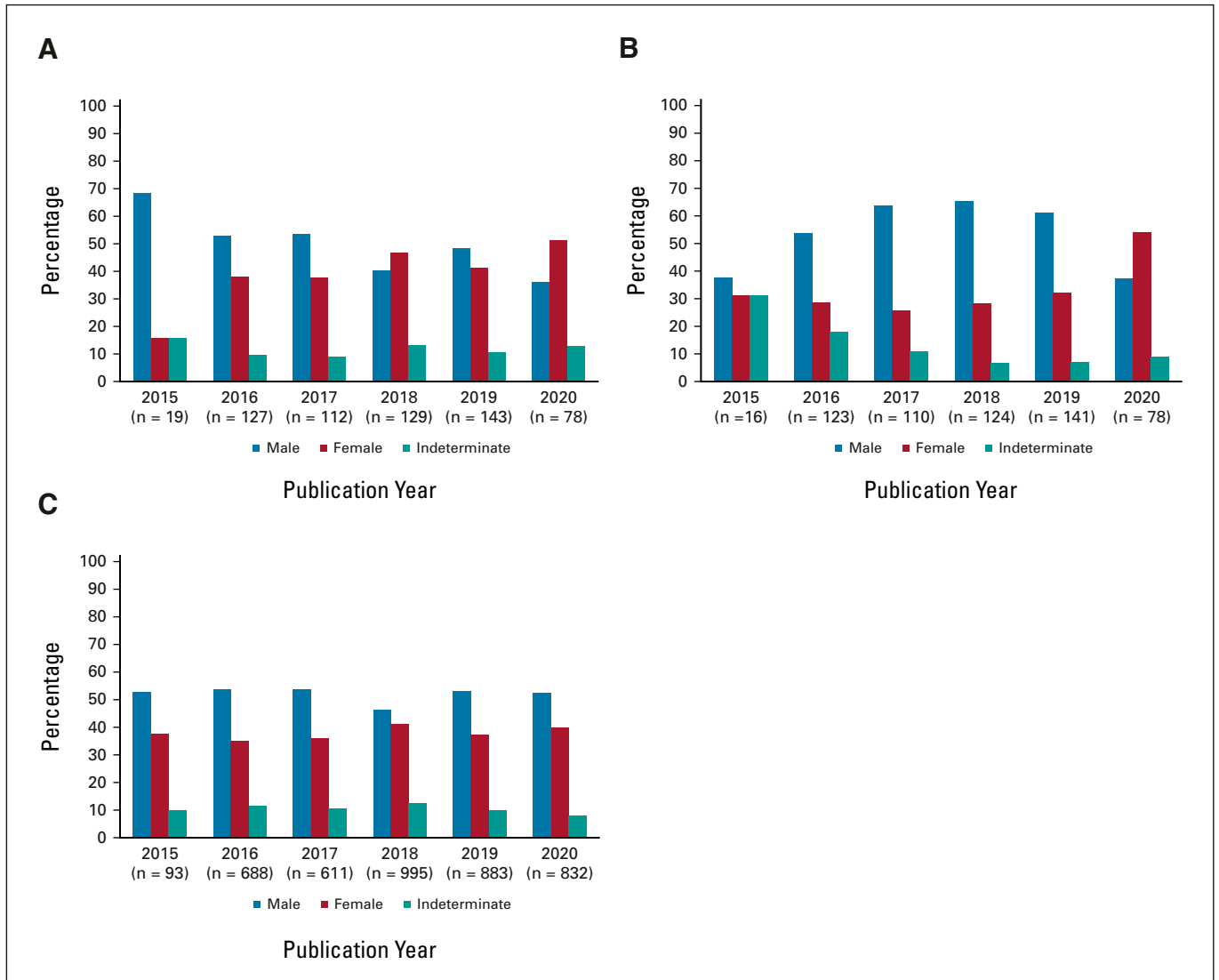


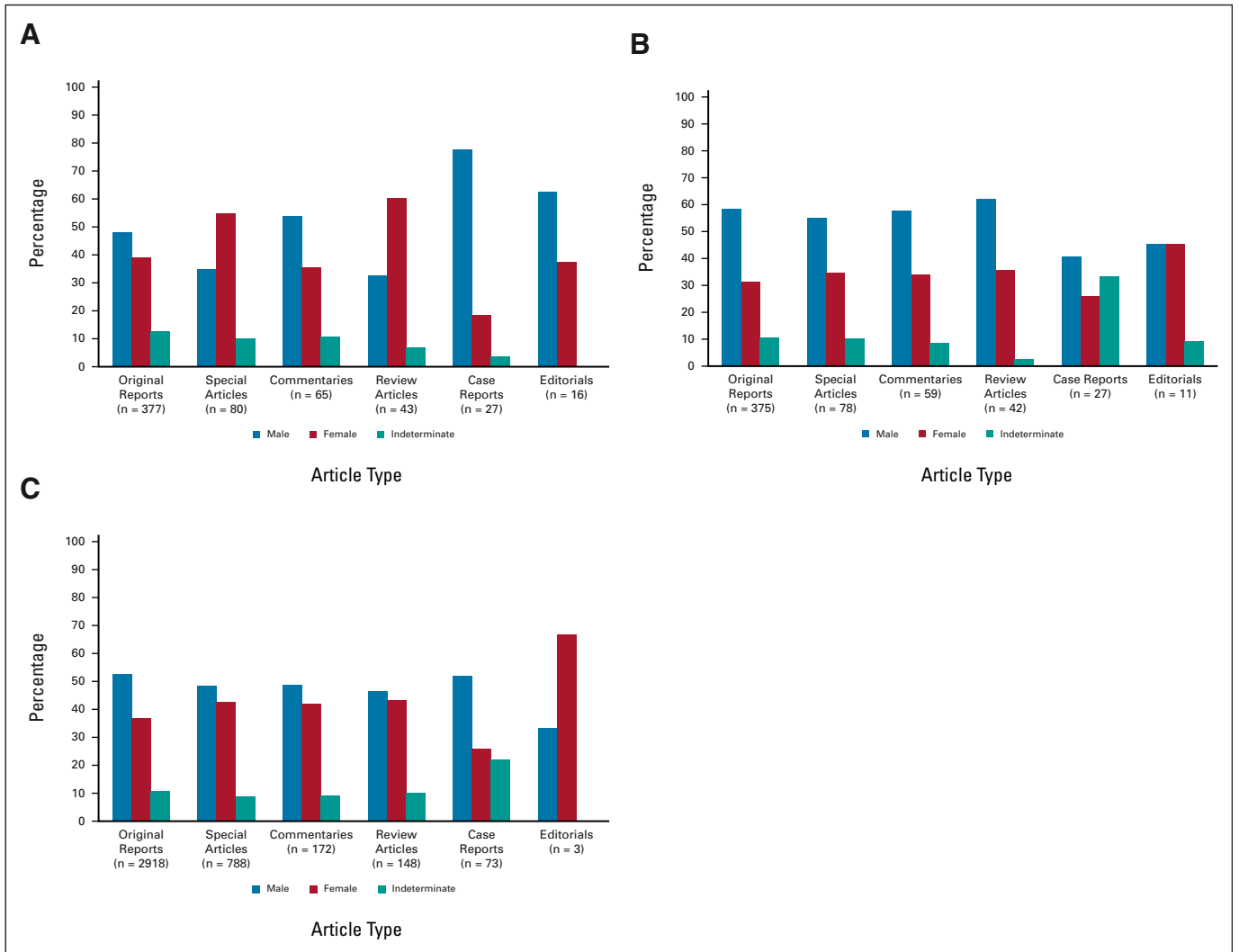
FIG 4. Authorship gender distribution by year: (A) first authors, (B) last authors, and (C) middle authors.

2016 was 15.8% and 37.8%, respectively, this proportion was notably higher in 2020 at 51.3%. In the last author position, female authors were a minority from 2015 through 2019 with a proportion ranging from 25.5% to 31.9%; however, they made up higher proportion in 2020 compared with male authors (53.8% female v 37.2% male). Overall, the proportion of female middle authors remained relatively stable from year to year, ranging from 35.0% to 41.2%.

Figure 5 shows variation in author gender distribution by article type. In the first author position, female first authors were in the minority for original reports (39.0% female v 48.3% male). However, female first authors made up a higher proportion of authors for special articles (55.0% female v 35.0%) and review articles (60.5% female v 32.6% male). In the middle and last author positions, female authors were more consistently in the minority across all article types, except for editorials. Of note, there were

only 16 editorials, of which 11 had more than one author and only three had middle authors.

We explored the association between having a female last author and overall author composition; after excluding those with indeterminate gender classification, we found that compared with articles with male last authors, those with female last authors had odds ratios (95% CI) of 2.2 (1.6 to 3.2) of having female first authors and 1.4 (0.9 to 2.1) of having 50% or more female middle authors. On average, articles with female last authors had a higher percentage of female middle authors compared to those with male last authors, 42.8% versus 36.7% (Fig 6). Of note, indeterminate gender classification accounted for 560 (10.6%) of the total authors, with similar proportions in all the author positions (Fig 1). However, the distribution of indeterminate authors varied by region, with East Asia and Pacific demonstrating almost 25% indeterminate probability.

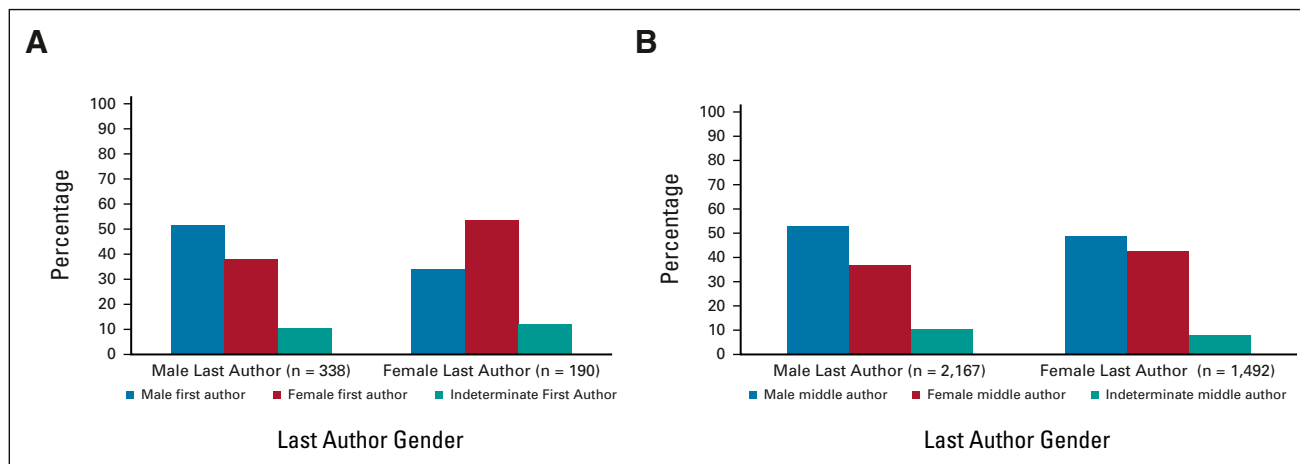


**FIG 5.** Authorship gender distribution by article type: (A) first authors, (B) last authors, and (C) middle authors.

## DISCUSSION

In this study of gender distribution in global oncology publications, in aggregate, female authors were in the minority across all authorship positions, especially in the last author position. However, there was a substantial variation across regions and economic strata. Although female first authors outnumbered male first authors in UMICs and HICs, particularly from Europe and North America, female authors remained markedly under-represented especially in the middle and last author positions across LICs and LMICs. Female first authors were in the minority for original report articles but made up a higher proportion of first authors on review and special articles. In addition, there appears to be a trend toward increasing female authorship representation in the more recent years, with articles in 2020 having the highest proportion of female first and last authors. We also showed that having female last authors, who typically represent the research team leaders, was associated with a higher proportion of female first authors and middle authors.

To our knowledge, our report is the first to describe the variation in authorship gender distribution in any medical specialty by region and economic status. Gains in authorship gender parity are occurring in oncology publications and our findings indicate that these gains are largely occurring in UMICs and HICs in North America and Europe, whereas significant disparities persist in many regions.<sup>5</sup> Authorship representation offers a window into the historical systemic issue of female under-representation in academic oncology. For example, although the proportion of US female graduates of hematology and oncology fellowship programs now approaches 50%, female department leaders and full professors remain under 30%.<sup>15,16</sup> Achieving authorship gender parity will require concerted efforts such as active recruitment of trainees, fostering engagement in research, facilitating mentorship, and supporting advancement up the academic ladder. The trend toward higher female authorship representation in 2020, the most recent year in the study, is encouraging and may be an early indication of the impact of ongoing efforts.



**FIG 6.** Author gender distribution by gender of the last author:<sup>a</sup> (A) first authors by last author gender and (B) middle authors by last author gender. <sup>a</sup>Sixty-four articles with indeterminate last authors were omitted.

This study also highlights the important role of female leadership in fostering greater gender diversity across academic teams.<sup>3</sup> This positive effect, which has been described in other fields, may be related to effective mentorship and sponsorship for women in earlier career stages.<sup>17</sup> Although earlier studies have described that women in academic medicine noted less access to career mentorship, the development of formal mentorship programs has been shown to be associated with increased career satisfaction.<sup>17-19</sup> The higher proportion of female first authors in HICs and UMICs provides hope that progress toward equitable representation in academic research is possible.

There are emerging programs in LICs and LMICs focused on academic research mentorship of women; one such example is a recent initiative by the Pan-African Women's Association of Surgeons that targets female surgeons across Africa for mentorship in research methodology and project management.<sup>20</sup> Such initiatives hold the potential to increase the pipeline of female researchers and the scope of scholarly output by female authors from these regions.

Further study is needed to better understand the various barriers that women face in pursuing academic medical careers. These factors may include societal contextual factors, such as perceptions of the role of women in leadership and expectations of family responsibilities. These studies will help inform the design and evaluation of future tailored interventions to improve academic engagement and authorship participation of women in regions with the most profound under-representation. In addition, systematic collection and reporting of self-reported gender identity by oncology journals will be important to measure future progress and promote accountability toward gender parity.

This study has some limitations. There is potential for gender misclassification using first name probabilities for ascertainment. To limit this bias, we used a stringent probability threshold of 80%, which resulted in 10.5% of the authors being classified as indeterminate. However, given variation in naming practices and the use of gender-neutral names around the globe, the proportion of indeterminate genders was not evenly distributed across regions. The higher proportion of indeterminate gender in East Asia and Pacific, and South Asia may limit the generalizability of the findings. It is also important to acknowledge the fluidity of gender identification, which is not fully reflected using male or female binary.

Another limitation is that the study involves publications from one journal, in which North American and European authors are over-represented. Hence, the reported findings may not represent authorship distribution in other oncology journals. Finally, the study was conceived before the COVID-19 pandemic and only includes articles published up to March 2020. Therefore, the results do not reflect the potential differential impact of the COVID-19 pandemic on academic productivity. Future studies should explore changes in productivity and academic engagement of clinicians and researchers in the COVID-19 era and beyond and explore the impact on authorship equity.

In conclusion, our analysis shows that authorship gender inequities persist in global oncology publications. Female authors from lower-income countries and regions in sub-Saharan Africa and South Asia remain markedly under-represented. Moreover, the higher proportions of female first authors in HICs and UMICs are promising signs of progress toward more equitable representation. Future investigation and interventions should be tailored especially to regions with the greatest disparities.

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## PRIOR PRESENTATION

Presented as a poster at the 2021 ASCO Annual Meeting, June 4-8, 2021, virtual.

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**Data analysis and interpretation:** All authors

**Manuscript writing:** All authors

**Final approval of manuscript:** All authors

**Accountable for all aspects of the work:** All authors

## AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

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### Miriam Mutebi

This author is a member of the *JCO Global Oncology* Editorial Board. Journal policy recused the author from having any role in the peer review of this manuscript.

### Temidayo Fadelu

**Research Funding:** Celgene (Inst), Cepheid (Inst)

No other potential conflicts of interest were reported.

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