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Shifting landscapes of gender equity in oncology journals: a decade of authorship trends

Hang Yi[1†], Mingzhong Wan[2†], Xu Ou-Yang[2†], Yang Wang[3], Yan Wang[4], Yinyan Gao[5], Qihao Leng[6], Shuangping Zhang[7*], Yousheng Mao[1*] and Guochao Zhang[1*]

Abstract

Background Gender disparities persist in academic oncology, particularly in authorship and senior academic roles. This study evaluates trends in authorship gender representation over the past decade across top oncology journals, focusing on regional, journal-specific, and citation-based disparities.

Methods A cross-sectional analysis was conducted on 29,005 articles published between 2014 and 2023 in the top 20 oncology journals, identified through the Web of Science database. Author gender was determined using the NamSor tool. Temporal trends were analyzed using linear regression, and multivariate logistic regression identified factors contributing to gender disparities. Regional and citation analyses explored geographic variations and citation count differences.

Results Among analyzed articles, 41.81% of first authors and 29.93% of last authors were female. Female first authorship showed a significant upward trend ($P < 0.01$), with gender parity projected by 2034, while parity for last authors is expected by 2055. Regional differences were notable, with North America and Europe leading in female representation. Certain journals, such as CA: A Cancer Journal for Clinicians and Molecular Cancer, exhibited higher female authorship proportions, while Journal of Clinical Oncology had the lowest. Citation analysis revealed female-authored articles received significantly fewer citations than male-authored ones ($P < 0.01$).

Conclusions Although female authorship in oncology journals has increased over the past decade, disparities remain, particularly in senior roles and citation impact. Addressing these issues requires targeted strategies, including mentorship programs, greater female representation in editorial boards, and institutional policies promoting gender equity.

[†]Hang Yi, Mingzhong Wan and Xu Ou-Yang contributed equally to this work.

*Correspondence:
Shuangping Zhang
zsp5500@163.com
Yousheng Mao
youshengmao@gmail.com
Guochao Zhang
18801038718@163.com

Full list of author information is available at the end of the article

Introduction

Gender equity has become a pivotal concern globally, including within academic medicine, where disparities notably hinder the recognition and advancement of women. Despite an increasing presence of women in medical academia, they continue to face significant barriers. Women are underrepresented as keynote speakers at international conferences [1] and are less likely to receive prestigious awards [2]. The scholarly publishing landscape, particularly in high-impact journals, reflects these inequities with a stark underrepresentation of women in roles as authors, reviewers, and editors [3]. Manuscripts authored by women are disproportionately rejected during peer reviews, and the prevalence of male reviewers exacerbates this bias, despite evidence suggesting that increasing female editorial presence could mitigate such disparities [4, 5]. Additionally, biases extend to peer review processes and funding decisions [6], further disadvantaging women. Compounding these challenges, research articles by women receive fewer citations than those by men, leading to citation disparities that adversely affect career progression and perpetuate gender imbalances within the field [7].

Despite the recognized issues across various medical specialties, the extent and specifics of gender disparities within oncology journals remain underexplored. This study aims to fill this gap by analyzing the publication patterns of male and female authors in leading oncology journals over the past decade. We will assess the state of gender equality, explore its temporal trends, and investigate differences in regional distributions and citation biases. Additionally, this study will consider the broader impacts of these disparities on scientific content and research outcomes in oncology. Through comprehensive analysis, we aim to understand the underlying causes of these disparities and propose actionable strategies to promote gender equity within the oncology community and even across the broader academic landscape.

Results

Main characteristics

This study analyzed 29,005 articles published in the top 20 oncology journals, and detailed journal information is provided in Supplementary Table 1. After excluding articles with missing or incomplete author data and single-author papers, 23,915 original research articles and 5,090 reviews met the inclusion criteria, as illustrated in Supplementary Fig. 1. Among these, female first authors accounted for 41.81% of all articles, while female last authors comprised 29.93% (Supplementary Table 2). An analysis of the top 100 most prolific authors revealed significant gender disparities, with only 27 female first authors and 30 female last authors, as shown in Supplementary Fig. 2.

Temporal changes in female authorship

The proportions of female first and last authors from 2014 to 2023 are shown in Fig. 1A. Before 2018, the proportion of female first authors was consistently below 26.68%. However, from 2014 to 2023, the proportion of female first authors showed a significant upward trend, with an average annual growth rate of 0.52% (95% CI: 0.27–0.78%, $P = 0.002$), reaching 45.83% in 2023. Similarly, female last authorship increased at an average annual growth rate of 0.55% (95% CI: 0.34–0.77%, $P < 0.01$), peaking at 32.67% in 2023.

Linear regression analysis predicts gender parity for first authorship by 2034 and last authorship by 2055 (Fig. 1B). Further analysis of gender pairings (male-male, male-female, female-male, and female-female) revealed significant shifts over the past decade (Fig. 1C). Male-male pairings decreased annually by 0.70% (95% CI: -0.96 to -0.45%, $P < 0.01$), while female-female pairings increased by 0.37% annually (95% CI: 0.18–0.57%, $P = 0.002$). Male-female pairings also increased (0.18% annually, 95% CI: 0.04–0.32%, $P = 0.02$), whereas female-male pairings showed no significant trend ($\beta = 0.15$, 95% CI: -0.06 to 0.36%, $P = 0.14$).

Geographic distribution of female authorship

Female authorship was predominantly concentrated in North America, Asia, and Europe, which together accounted for over 97% of all female authors (Fig. 1E and F). North America had the highest representation of female first (49.01%) and last authors (51.46%), followed by Europe (29.84% and 27.32%, respectively). Supplementary Fig. 3A presents the proportions of female first and last authors across different continents, as well as the overall averages for female authors. In Asia, female first and last authorship proportions were 42.73% and 32.27%, respectively, both exceeding the overall averages.

Representation from Oceania, Africa, and South America was limited (< 3%), reducing the generalizability of trends in these regions. Oceania showed relatively high proportions of female authorship (46.15% for first authors, 33.18% for last authors), while Africa (23.08% for first authors, 9.09% for last authors) and South America (39.76% for first authors, 30.00% for last authors) lagged significantly (Supplementary Fig. 4).

In Asia, female first authorship increased by 0.96% annually (95% CI: 0.24–1.69%, $P = 0.02$), while female last authorship grew by 1.53% annually (95% CI: 0.92–2.13%,
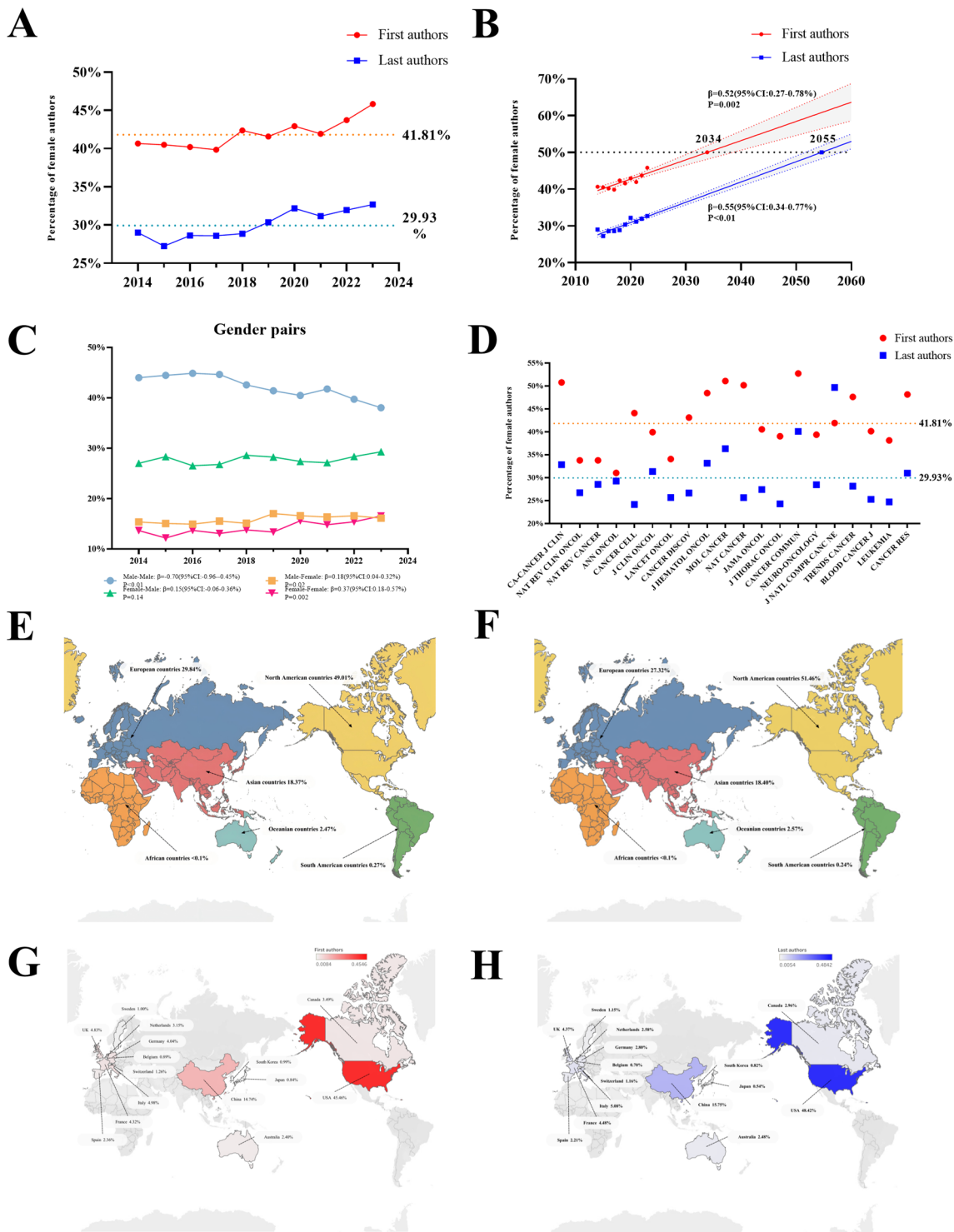
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Fig. 1 **A**-**D** Changes of female authorships over time from 2014 to 2023 and overall distribution in terms of journal differences. (**A**) Changes over time of female first (red) and last (blue) authorship from 2014 to 2023. (**B**) Evaluation and forecast of gender equity in first (red) and last (blue) authorship. (**C**) Changes over time and forecast of different gender pairs of first and last authors from 2014 to 2023 using 4 colors annotated to 4 gender pairs. (**D**) Proportion of female first (red) and last (blue) authorship in different journals. **E**-**F** Overall distribution of the percentage of female authors in terms of regional differences containing 6 color areas annotated to 6 continents. (**E**) first authorship; (**F**) last authorship. **G**-**H** Overall distribution of the percentage of female authors in terms of regional differences including top 15 countries with highest output. (**G**) first authorship; (**H**) last authorship

($P<0.01$). Europe showed modest annual increases in female first authorship (0.41%, 95% CI: 0.08–0.74%, $P=0.02$), and North America exhibited significant growth in female last authorship (0.51% annually, 95% CI: 0.16–0.85%, $P=0.01$).

The United States and China accounted for nearly 60% of all female first and last authors (Fig. 1G and H). Among the top 15 publishing countries (Supplementary Fig. 3B), China, Italy, the Netherlands, Australia, Spain, and Sweden exceeded the overall averages for female authorship. Conversely, Japan reported the lowest proportions, with only 13.51% female first authors and 6.28% female last authors. Over the past decade, significant increases in female authorship were observed in the United States (0.50% annually for first authors, $P=0.04$; 0.57% annually for last authors, $P=0.01$), Germany (2.04% annually for first authors, $P=0.001$), and China (0.78% annually for last authors, $P=0.01$) (Supplementary Fig. 5).

Journal-specific trends for female authorship

The highest proportion of female first authors was observed in Cancer Communications (52.71%), while Journal of the National Comprehensive Cancer Network (J NATL COMPR CANC NE) had the highest proportion of female last authors (49.67%). Journals exceeding the overall average for both female first and last authors included CA: A Cancer Journal for Clinicians (50.76% and 32.82%, respectively), Journal of Hematology & Oncology (48.44% and 33.14%), Molecular Cancer (51.07% and 36.32%), and Cancer Communications (52.71% and 40.06%) (Fig. 1D).

Significant increases in female first authorship were observed in Lancet Oncology ($\beta=1.90$, 95% CI: 0.94–2.87%, $P=0.002$), Blood Cancer Journal ($\beta=2.26$, 95% CI: 0.81–3.71%, $P=0.007$), and Leukemia ($\beta=2.62$, 95% CI: 1.33–3.91%, $P=0.002$). Significant increases in female last authorship were reported in Cancer Research ($\beta=0.42$, 95% CI: 0.07–0.78%, $P=0.03$), Journal of Clinical Oncology ($\beta=1.07$, 95% CI: 0.37–1.76%, $P=0.008$), and Neuro-Oncology ($\beta=0.51$, 95% CI: 0.14–0.89%, $P=0.01$) (Supplementary Fig. 6).

Citation analysis

Citation data were analyzed from three perspectives: first authors, last authors, and author pairings (male-male, male-female, female-male, and female-female) (Supplementary Table 3). The data showed significant differences between male and female authors in both first and last authorship ($P<0.01$). Additionally, significant differences were found among the different author pairings ($P<0.01$). Notably, Supplementary Table 4 indicates that, for first authors, there were significant differences between male and female authors, both in the overall data over the past ten years and in each individual year from 2014 to 2023

($P<0.01$). For last authors, although significant gender differences were observed overall ($P<0.05$), such differences were only noted in 2014 and 2016 ($P<0.05$).

Factors associated with gender disparities in authorship

Table 1 highlights the influence of region, journal, article type, funding support, publication year, and open access status on the gender distribution of authorship roles. For female first authors, Asia was used as the reference value. The likelihood of female first authorship was significantly lower in Europe (OR = 0.91, $P=0.013$) compared to Asia, while North America (OR = 1.20, $P<0.001$) and Africa (OR = 1.38, $P<0.001$) showed significantly higher probabilities than Asia. For last authors, Africa (OR = 1.24, $P=0.011$) also had a significantly higher likelihood than Asia, indicating regional disparities in gender representation in oncology research.

Significant differences were also observed among journals. Using Annals of Oncology as the reference, the following journals had significantly higher odds of female first authorship: Blood Cancer Journal (OR = 1.52, $P<0.001$), CA: A Cancer Journal for Clinicians (OR = 2.53, $P<0.001$), Cancer Cell (OR = 1.79, $P<0.001$), Cancer Communications (OR = 2.77, $P<0.001$), Cancer Discovery (OR = 1.73, $P<0.001$), Cancer Research (OR = 2.19, $P<0.001$), Journal of Clinical Oncology (OR = 1.56, $P<0.001$), Journal of Hematology & Oncology (OR = 2.26, $P<0.001$), Journal of the National Comprehensive Cancer Network (OR = 1.81, $P<0.001$), Journal of Thoracic Oncology (OR = 1.54, $P<0.001$), JAMA Oncology (OR = 1.58, $P<0.001$), Lancet Oncology (OR = 1.16, $P=0.041$), Leukemia (OR = 1.37, $P<0.001$), Molecular Cancer (OR = 2.52, $P<0.001$), Nature Cancer (OR = 2.2, $P<0.001$), Neuro-Oncology (OR = 1.49, $P<0.001$), and Trends in Cancer (OR = 1.98, $P<0.001$). For female last authors, the following journals had significantly higher odds compared to Annals of Oncology: Cancer Communications (OR = 1.41, $P=0.007$), Journal of the National Comprehensive Cancer Network (OR = 2.34, $P<0.001$), and Molecular Cancer (OR = 1.28, $P<0.001$). Conversely, the odds of female last authorship were significantly lower in the following journals: Blood Cancer Journal (OR = 0.77, $P=0.007$), Cancer Cell (OR = 0.74, $P<0.001$), Cancer Discovery (OR = 0.83, $P=0.028$), Journal of Thoracic Oncology (OR = 0.76, $P<0.001$), Lancet Oncology (OR = 0.85, $P=0.037$), Leukemia (OR = 0.79, $P<0.001$), and Nature Cancer (OR = 0.75, $P=0.031$).

There was no significant gender disparity observed based on article type. However, female first authors with funding support (OR = 1.14, $P<0.001$) had significantly higher odds compared to those without funding. Regarding publication years, using 2014 as the reference, the odds of female first authorship significantly increased in 2022 (OR = 1.12, $P=0.043$) and 2023 (OR = 1.25,

Table 1 Multivariate binary logistic regression analysis to identify factors associated with gender authorship disparities

	First authorship		Last authorship	
	OR (95%CI)	*P*	OR (95%CI)	*P*
Region				
Asia	1.00 (Reference)		1.00 (Reference)	
Europe	0.91 (0.85~0.98)	**0.013**	1.05 (0.97~1.14)	0.227
North America	1.20 (1.13~1.27)	**<0.001**	0.98 (0.92~1.05)	0.587
South America	0.49 (0.13~1.80)	0.283	0.22 (0.03~1.69)	0.145
Oceania	0.94 (0.60~1.47)	0.789	1.04 (0.62~1.74)	0.889
Africa	1.38 (1.17~1.62)	**<0.001**	1.24 (1.05~1.47)	**0.011**
Journal				
ANN ONCOL	1.00 (Reference)		1.00 (Reference)	
BLOOD CANCER J	1.52 (1.28~1.80)	**<0.001**	0.77 (0.64~0.93)	**0.007**
CA-CANCER J CLIN	2.53 (1.94~3.28)	**<0.001**	1.14 (0.86~1.50)	0.37
CANCER CELL	1.79 (1.54~2.09)	**<0.001**	0.74 (0.62~0.88)	**<0.001**
CANCER COMMUN	2.77 (2.17~3.53)	**<0.001**	1.41 (1.10~1.80)	**0.007**
CANCER DISCOV	1.73 (1.47~2.02)	**<0.001**	0.83 (0.70~0.98)	**0.028**
CANCER RES	2.19 (1.97~2.44)	**<0.001**	1.05 (0.94~1.18)	0.371
J CLIN ONCOL	1.56 (1.39~1.75)	**<0.001**	1.11 (0.98~1.24)	0.098
J HEMATOL ONCOL	2.26 (1.95~2.63)	**<0.001**	1.11 (0.95~1.29)	0.208
J NATL COMPR CANC NE	1.81 (1.56~2.11)	**<0.001**	2.34 (2.01~2.72)	**<0.001**
J THORAC ONCOL	1.54 (1.35~1.76)	**<0.001**	0.76 (0.65~0.88)	**<0.001**
JAMA ONCOL	1.58 (1.37~1.83)	**<0.001**	0.87 (0.75~1.02)	0.096
LANCET ONCOL	1.16 (1.01~1.34)	**0.041**	0.85 (0.73~0.99)	**0.037**
LEUKEMIA	1.37 (1.21~1.55)	**<0.001**	0.79 (0.69~0.90)	**<0.001**
MOL CANCER	2.52 (2.20~2.89)	**<0.001**	1.28 (1.11~1.47)	**<0.001**
NAT CANCER	2.20 (1.74~2.78)	**<0.001**	0.75 (0.57~0.97)	**0.031**
NAT REV CANCER	1.10 (0.88~1.38)	0.402	0.93 (0.74~1.18)	0.566
NAT REV CLIN ONCOL	1.14 (0.91~1.43)	0.24	0.88 (0.69~1.11)	0.275
NEURO-ONCOLOGY	1.49 (1.30~1.70)	**<0.001**	0.92 (0.80~1.07)	0.28
TRENDS CANCER	1.98 (1.61~2.43)	**<0.001**	0.87 (0.70~1.09)	0.226
Document Type				
Review	1.00 (Reference)		1.00 (Reference)	
Article	0.95 (0.88~1.02)	0.151	0.94 (0.87~1.02)	0.118
Funding Support				
No	1.00 (Reference)		1.00 (Reference)	
Yes	1.14 (1.07~1.23)	**<0.001**	1.05 (0.97~1.13)	0.246
Publication Year				
2014	1.00 (Reference)		1.00 (Reference)	
2015	1.01 (0.92~1.12)	0.795	0.93 (0.84~1.04)	0.222
2016	1.00 (0.91~1.11)	0.933	1.01 (0.91~1.13)	0.797
2017	0.97 (0.88~1.08)	0.614	1.00 (0.90~1.11)	0.967
2018	1.07 (0.97~1.18)	0.189	1.01 (0.90~1.12)	0.891
2019	1.03 (0.93~1.15)	0.529	1.07 (0.96~1.20)	0.229
2020	1.08 (0.98~1.20)	0.126	1.18 (1.05~1.32)	**0.004**
2021	1.03 (0.93~1.15)	0.528	1.13 (1.01~1.26)	**0.033**
2022	1.12 (1.01~1.24)	**0.043**	1.16 (1.04~1.30)	**0.009**
2023	1.25 (1.12~1.39)	**<0.001**	1.25 (1.11~1.40)	**<0.001**
Open Access				
No	1.00 (Reference)		1.00 (Reference)	
Yes	1.05 (0.97~1.14)	0.229	1.13 (1.04~1.23)	**0.005**

Abbreviations: OR, Odds Ratio; CI, Confidence Interval; Ann Oncol, Blood Cancer J, Ca-Cancer J Clin, Cancer Cell, Cancer Commun, Cancer Discov, Cancer RES, J Clin Oncol, J Hematol Oncol, J Natl Compr Canc NE, J Thorac Oncol, Jama Oncol, Lancet Oncol, Leukemia, Mol Cancer, Nat Cancer, Nat Rev Cancer, Nat Rev Clin ONCOL, Neuro-Oncology, Trends Cancer. Variables with a p-value less than 0.1 in univariate logistic regression were included in the multivariate binary logistic regression model

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$P < 0.001$). Similarly, for female last authors, significant increases were observed from 2020 to 2023, with the odds increasing in 2020 (OR = 1.18, $P = 0.004$), 2021 (OR = 1.13, $P = 0.033$), 2022 (OR = 1.16, $P = 0.009$), and 2023 (OR = 1.25, $P < 0.001$).

Discussion

Our systematic analysis of high-impact oncology journals from 2014 to 2023 has uncovered persistent gender disparities in authorship, notably with women accounting for 41.81% for first authors and only 29.93% for last authors. This disparity underscores not only the ongoing issue of gender inequality within academia but also suggests that female scholars continue to face significant obstacles in attaining senior academic positions.

Encouragingly, our findings also reveal a positive trend: the proportion of female authors has steadily increased over the past decade, particularly evident in the rise of female first authors. Moreover, the incidence of female-female pair authorships has seen a significant increase. These trends reflect the beneficial effects of heightened global focus on gender equality and the implementation of targeted policies. According to our predictive models, we anticipate achieving gender parity for first authors by 2034, though parity for last authors is not expected until 2055. This disparity highlights the dynamic challenges women face at different career stages. The rise in female first authors likely results from recent initiatives aimed at promoting gender equality, such as gender quotas in recruitment, career development, and research funding, which have been increasingly adopted across various countries and institutions [8]. Nevertheless, the lag in equivalent growth among female last authors indicates ongoing systemic barriers that maintain the "glass ceiling" in academia [9, 10].

To effectively tackle gender equality challenges, academia must implement comprehensive strategies that recognize and address regional cultural differences. Establishing clear gender equality indicators within research funding and academic review processes is essential, ensuring these criteria are integral to evaluations [11]. Academic institutions need to support female scholars throughout their careers by offering flexible career pathways, which might include extended maternity leaves, enhanced childcare support, and the establishment of gender equality initiatives. Furthermore, academic journals and conferences should increase female scholars' participation by expanding their roles in editorial, review, and speaker activities [12]. By reforming academic culture to embrace diversity and inclusiveness, we can create equitable development opportunities for female scholars, thereby driving academic progress and innovation [13, 14].

Abbreviations

CA-CANCER J CLIN	CA-A Cancer Journal for Clinicians
NAT REV CLIN ONCOL	Nature Reviews Clinical Oncology
NAT REV CANCER	Nature Reviews Cancer
ANN ONCOL	Annals of Oncology
CANCER CELL	Cancer Cell
J CLIN ONCOL	Journal of Clinical Oncology
LANCET ONCOL	Lancet Oncology
CANCER DISCOV	Cancer Discovery
J HEMATOL ONCOL	Journal of Hematology & Oncology
MOL CANCER	Molecular Cancer
NAT CANCER	Nature Cancer
JAMA ONCOL	JAMA Oncology
J THORAC ONCOL	Journal of Thoracic Oncology
CANCER COMMUN	Cancer Communications
NEURO-ONCOLOGY	Neuro-Oncology
J NATL COMPR CANC NE	Journal of the National Comprehensive Cancer Network
TRENDS CANCER	Trends in Cancer
BLOOD CANCER J	Blood Cancer Journal
LEUKEMIA	Leukemia
CANCER RES	Cancer Research
JCR	Journal Citation Reports
API	Application Programming Interface
CI	Confidence Interval
OR	Odds Ratio

Supplementary Information

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Supplementary Material 1

Data availability
All data used in our research are publicly accessible and obtained from the Web of Science Core Collection database, available at https://www.webofscience.com/wos.

Declarations

Ethics approval and consent to participate
This study did not require ethical approval as it exclusively utilized fully anonymized data from public databases, involving no identifiable patient information.

Consent for publication
Not applicable.

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Author details
[1]Department of Thoracic Surgery, National Cancer Center/National Clinical Research Center for Cancer/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing 100021, China
[2]Shantou University Medical College, Shantou 515041, China
[3]Xiangya School of Medicine, Central South University, Changsha, Hunan Province 410013, China
[4]Bloomberg School of Public Health, The Johns Hopkins University, Epidemiology, Baltimore, MD, USA
[5]Department of Epidemiology and Biostatistics, Xiangya School of Public Health, Central South University, Changsha, Hunan, China
[6]Department of Urology, Xiangya Hospital, Central South University, Changsha, China
[7]Department of Thoracic Surgery, Shanxi Province Cancer Hospital, Shanxi Hospital Affiliated to Cancer Hospital, Chinese Academy of Medical Sciences, Affiliated Tumor Hospital of Shanxi Medical University, Taiyuan 030013, China

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