



# Trends in women's representation as lead authors in high impact journals of lung cancer

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**Background:** Women's participation in the clinical oncology practice has increased over the past decade. There is a need to investigate whether women's participation in academia, as reflected by publication activity, increased over the time. This study aimed to investigate trends in female authorship in top journals of lung cancer in the past ten years.

**Methods:** In this cross-sectional study of all original research and review articles published in lung cancer journals including *New England Journal of Medicine*, *Lancet* journals, *JAMA* journals, *Journal of Clinical Oncology*, *Annals of Oncology*, *Cancer Discovery*, *Journal of Thoracic Oncology*, and *Translational Lung Cancer Research (TLCR)* between 2012 and 2021, the sex composition of lead authors were analyzed. The sex of the author was confirmed by internet searching for photographs, biographies, and gender-specific pronouns from journal or personal websites. The time-trend of female authorship was determined using Join-Point Regression (JPR) analysis.

**Results:** A total of 3,625 first authors and 3,612 corresponding authors were identified in the journals during the years studied. The sex of the author was revealed for 98.5%. Among 3,625 first authors with the sex being revealed, 1,224 (33.7%) were women. The proportion of female first authors increased remarkably from 29.4% in 2012 to 39.8% in 2021. The annual percentage change (APC) in female first authorship took place in 2019 [APC for 2019–2021, 37.03, 95% confidence interval (CI): 18.0–59.1, P=0.003]. The proportion of first authors in *TLCR* increased from 25.9% in 2012 to 42.8% in 2021 and showed the greatest rise in female first authorship. There were significant discrepancies in the female first authorship across the journals and regions. Among the 3,612 corresponding authors whose sex were determined, 884 (24.5%) were female. There is no significant increasing trend in female corresponding authorship.

**Conclusions:** The sex gap in the first authorship of lung cancer research articles has improved markedly in the recent years, however, sex imparities persist especially in corresponding authorship. There is an urgent need to proactively support and promote women in taking the leadership roles, thereby increasing their contributions to and influence on the development or advancement for future healthcare policies and practices.

**Keywords:** Sex gap; women's representation; first author; corresponding author; lung cancer

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## Introduction

The representation of women in the medical profession across major specialties including oncology has risen substantially from the past decades. Nowadays, women accounted for approximately half of all licensed doctors in United Kingdom in 2020, in contrast to 27% a decade ago (1). According to the most recent report of oncologist demographics and statistics in the US, 57.6% of oncologists were female (2). Nevertheless, there is reliable evidence that women continue to be under-represented in the top tiers of academic medicine (3-6). Advancement for health practices and academic medicine is largely driven by peer-reviewed original research articles. Academic publication in prominent journals is a critical measure of academic productivity. The representation of women among the authors of publications in high-ranking journals reflects the participation and contribution of female physician-investigators in academic medicine.

Inevitably, academia and academic publishing are parts of gendered system of social practices (7). There are some factors that may be related to the under-representation of women in the authorship of prestigious medical journals including getting less opportunities to be offered tenure and promotion, research grants and funding, designation as lead authors of top journals (8-19). Sex diversity of research team is crucial for collective innovations and discoveries and can enhance knowledge outcomes (20).

Lung cancer has been the leading cause of cancer-related deaths worldwide and is associated with the highest health and economic burden compared to other tumor types (21).

The research of lung cancer is the key to improvements in research and clinical practice, and refining strategies and outcomes. It is crucial to study the sex distribution in authorship of research articles in journals of lung cancer. Such studies can raise broad awareness for gender equity and provide clearer insight into the assessment of research output and publication quality. Identifying the trends in sex equality in authorship can help determine strategies and practices to increase women's representation among scientists who are most influential on health policies and practice. Whether there are sex disparities and trends over time in the authorship of scientific literature of lung cancer, especially in highly ranking journals in which most influential studies are published in the field, is the area in need of exploration. Therefore, this study investigated the prevalence of female first and corresponding authorship of original research and review articles in prominent journals of lung cancer, *New England Journal of Medicine*, *Lancet* journals, *JAMA* journals, *Journal of Clinical Oncology*, *Annals of Oncology*, *Cancer Discovery*, *Journal of Thoracic Oncology*, and *Translational Lung Cancer Research (TLCR)*, looking at both differences between journals and changes over time. This publication provided figures and changes over time of the female authorship in lung cancer research and provided insights on addressing gender gap in academia. This article was presented in accordance with the STROBE reporting checklist (available at <https://tlcr.amegroups.com/article/view/10.21037/tlcr-22-770/rc>).

## Methods

### Data collection and crosscheck

The representation of women as first and corresponding authors of original research and review articles published in high impact journals of lung cancer for the period 2012 to 2021 were analyzed, differences between journals as well as changes over time were examined. Some journal recruited in this study was first published in 2012, so the decade from 2012 to 2021 was selected. The journals with high 2021 Journal Citation Reports impact factors in the category of "lung cancer" were selected. The recruited journals were *New England Journal of Medicine*, the *Lancet*, *Lancet Oncology*, *Lancet Respiratory Medicine*, *JAMA*, *JAMA Oncology*, *JAMA Internal Medicine*, *JAMA Surgery*, *Journal of Clinical Oncology*, *Annals of Oncology*, *Cancer Discovery*, *Journal of Thoracic Oncology*, and *Translational Lung Cancer Research (TLCR)*. Data collection was restricted to original

### Highlight box

#### Key findings

- This cross-sectional study revealed that women constituted about 34% of first authors and 24% of corresponding authors during the past decade in top lung cancer journals. There was an increasing trend in female first authorship during recent years.

#### What is known and what is new?

- Women's participation in clinical oncology practice has increased during the past decade.
- Women's representation as lead authors in top lung cancer journals has increased during the time period.

#### What is the implication, and what should change now?

- The sex discrepancies were still pervasive especially in corresponding authorship. More vigorous efforts are needed to promote women's representation as lead authors.

research and review articles which were the most common and influential types of papers in the top journals. The representation of women among authors of papers was the subject of investigation. Patient involvement was not applicable. As the study was based on publicly available data, the requirement of ethical approval and informed consent were waived by the institutional review board of Peking University Cancer Hospital & Institute.

The journal websites were searched for data of original research articles (including meta-analyses) and review papers published in the journals from January 2012 to December 2021. A standardized data collection procedure was applied and data for all issues and years and all authors of articles were collected. For authors, the first and last names and the affiliations of first authors and corresponding authors were recruited, and only authors with an assignable sex were counted. The sex of the recruited authors was confirmed by internet searching for photographs, biographies, and sex-specific pronouns from journal or personal websites, as of June 2022. Authors with the sex not clearly identifiable were excluded. The sex of the author was revealed for 98.5 percent. The excluded authors were from first author byline of recruited articles, co-first authors of these articles with identifiable sex were included. One possible reason for unclear sex was that the authors were graduate students or early career physician-researchers with no personal profiles or publicity.

### Statistical analysis

The percentages of female first and corresponding authors were analyzed. Statistical analysis was performed with the IBM SPSS Statistics, version 21. The enumeration data were analyzed by the chi-square test or Fisher's exact test, and the nonparametric Kruskal-Wallis H test was used for the one-way sequential data. The analyses of time trend of sex composition of lead authors were calculated using the Join-Point Regression (JPR) Program, version 4.9.1.0 (Statistical Research and Applications Branch, National Cancer Institute, Bethesda, USA). In the JRP model, the crude rates of female and male first and corresponding authors were used as dependent variables and the publication year was used as independent variables. It was assumed that data could be assigned into subsets with unique linear trend and when there were trend changes the period could be identified. The percentage change (PC) in rates between trend change points and the APC were calculated. The join-point year was selected and the 95% CI was calculated for

every join-point year when APC changed significantly. The correlations of women's representation with journal and the author's region were tested by Spearman rank correlation test or partial correlation analysis. A P value less than 0.05 indicated statistical significance, with a two-sided test.

### Results

The data for 3,625 first authors of research or review articles were recruited and the sex of the author was identifiable for 98.5%. In sum, across the full 10 years period and all journals, 1,224 (33.7%) first authors were female, and an approximate 10 percentage point increase in female first authorship of original research and review articles from 2012 to 2021 (218/548, 39.8% vs. 96/326, 29.4%). When looking at change over time, the proportion of female first authors plateaued and hovered between 30% and 35% from 2012 to 2019, and increased to 37% and 40% in 2020 and 2021. JPR analysis indicated that the increase of representation of female first authorship took place in 2019 (APC for 2019–2021, 37.03, 95% CI: 18.0–59.1,  $P=0.003$ , *Figure 1*). The average annual percentage change (AAPC) for 2012–2021 was 9.3% (95% CI: 6.1–12.6%,  $P<0.001$ ). The increase of male first authors appeared in 2016, which was three years earlier than the female counterpart (APC for 2016–2021, 10.8, 95% CI: 4.1–17.9,  $P=0.008$ , *Figure 2*).

For all years, there were significant disparities in the proportion of female first authors across the journals (Pearson's chi-squared test,  $r^2=21.122$ ,  $P<0.001$ ). The proportion of first authors in *Translational Lung Cancer Research* increased from 25.9% (7/27) in 2012 to 42.8% (122/285) in 2021 and showed the greatest rise in female first authorship with the highest average percentage of female first authorship (38.5%). The number of female first authors doubled in 2020 in *TLCR* when compared to that of 2019 (*Table 1*).

Subgroup analysis revealed that women's representation as first authors showed significant discrepancies between America (35.9, 541/1,507) or Europe (36.2%, 358/990) and Asia/Oceania (28.8%, 325/1,128,  $r^2=18.422$ ,  $P<0.001$ ). The representation of female first authors of Europe and Asia/Oceania showed increase in recent three years which was the main cause of the increase in the overall female first authors from 2019 to 2021 (*Figure 3*).

Among the 3,612 corresponding authors with the sex being revealed, 884 (24.5%) were female. The representation of female corresponding authors showed increase trend in 2012–2013 and 2016–2018, decrease in

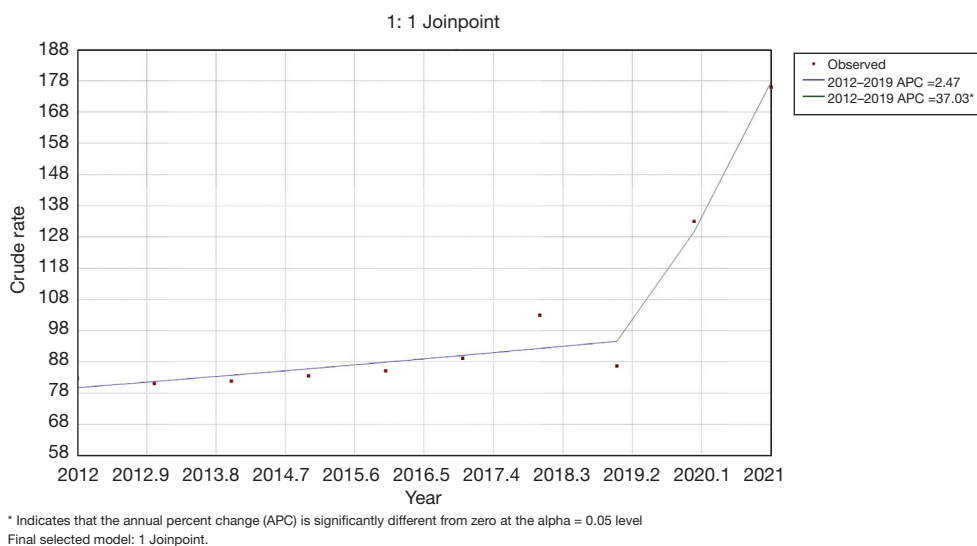


Figure 1 The Join-Point Regression analysis of the time trend of female first authors.

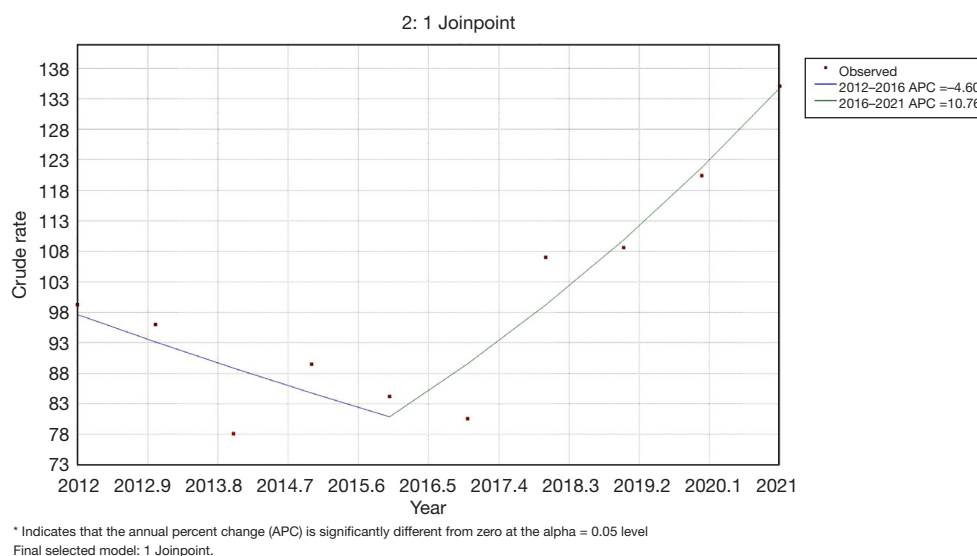


Figure 2 The Join-Point Regression analysis of the time trend of male first authors.

2013–2016, and the annual change in 2019–2021 was 4.53% (Figure 4, APC for 2020–2021, 11.0, 95% CI: -21.4 to 56.7, P=0.471). The representation of male corresponding authors experienced an increase in 2017 (Figure 5, 2017–2021, APC =16.0, 95% CI: 5.5–27.5, P=0.010). The proportion of female corresponding author in *Translational Lung Cancer Research* increased from 15.4% in 2012 to 22.5% in 2021, and reached 35% and 37.5% in 2013 and 2016 respectively, while other journals did not show similar trends (21% in both 2012 and 2021).

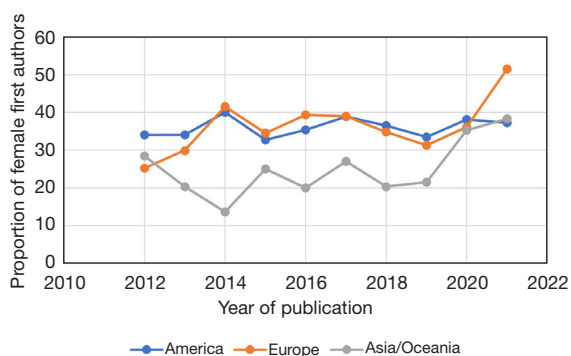
### Discussion

The results of this study demonstrated significant increase of women’s representation in first authorship of research and review papers in high impact journals of lung cancer in recent three years. Nevertheless, the increase of women’s representation as corresponding authors was sluggish. The sex diversity in corresponding author decreased in recent two years. These results indicated that although the representation of female specialists in lung cancer has

**Table 1** Numeric analysis of first and corresponding authors in all journals and *TLCR*

Time of publication	Female first authorship in all journals	Female corresponding authorship in all journals	Female first authorship in <i>TLCR</i>	Female corresponding authorship in <i>TLCR</i>
2012	96/326	67/323	7/27	4/26
2013	100/333	84/331	22/60	21/60
2014	101/291	82/291	18/42	13/42
2015	100/322	81/320	20/53	15/53
2016	105/308	71/306	23/40	15/40
2017	108/303	87/302	27/59	20/59
2018	127/389	102/380	49/133	37/133
2019	107/366	81/371	38/136	26/139
2020	162/439	108/435	86/234	55/241
2021	218/548	121/553	122/285	64/285

*TLCR*, *Translational Lung Cancer Research*.



**Figure 3** The proportion of female first authors across different regions during the decade.

increased over recent years, the prevalence of primary research articles authored by women and female principal clinical trialists has not. The low representation of first and corresponding female authors may reflect the under-representation of women in leadership and supervisory roles in lung cancer research communities. To the best of our knowledge, this study recruited, up until now, the largest number of lead authors of lung cancer original articles published in a wide range of high-impact lung cancer journals.

The under-representation of women in authorship has been reported and indicated in journals of many medical specialties (22-31). Studies have revealed that the proportion of articles authored by women is lower than those by men

in journals of some sub-specialties in oncology. Even in specialties such as gynecologic oncology journals, men constituted the majority of clinical trialists and authored in major articles (23,28). The representation of women authors in this current study was broadly consistent with the under-representation of women in other medical specialties and in oncology subspecialties, and the results represent the present circumstances and trends over time of sex disparity in authorship of top lung cancer journals.

According to the annual report of International Association for the Study of Lung Cancer (IASLC) in 2021, 37% of IASCL members were women (32). Only the proportion of female first authors in 2020 and 2021 in the recruited journals was comparable to the ratio, while the representation of women in corresponding authorship was far below. These results verified that there were prejudices and biases against women's presence on author byline and holding leadership positions in the scientific fields of lung cancer.

It is encouraging that female first authors showed increased representation from 2019 to 2021 in lung cancer journals. According to the Global Gender Gap 2021 report, COVID-19 pandemic may prolong the time to bridge global gender gap from 99.5 to 135.6 years (33). A questionnaire of European Society for Medical Oncology members which focused on the working lives of oncologists during and after COVID-19 related lockdown revealed that in contrast with their male contemporaries, female oncologists had reduced research time and therefore sex

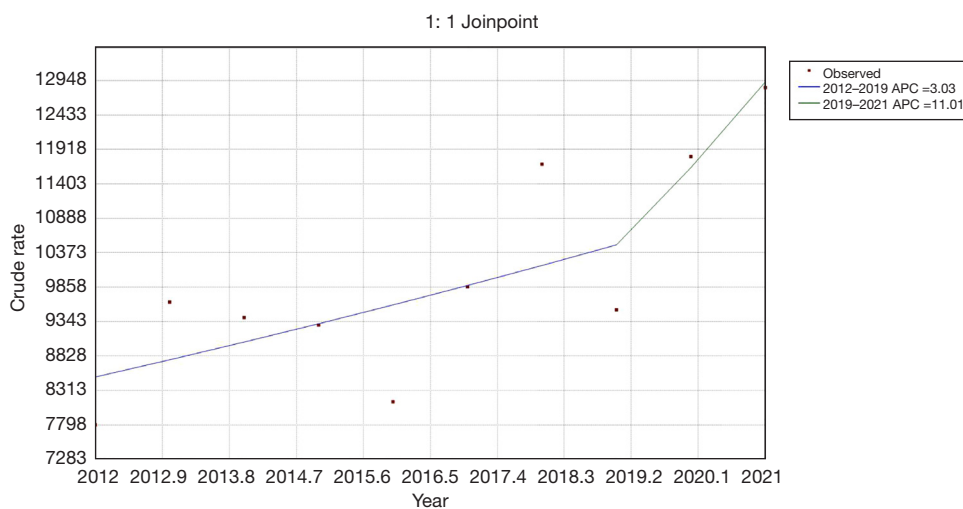
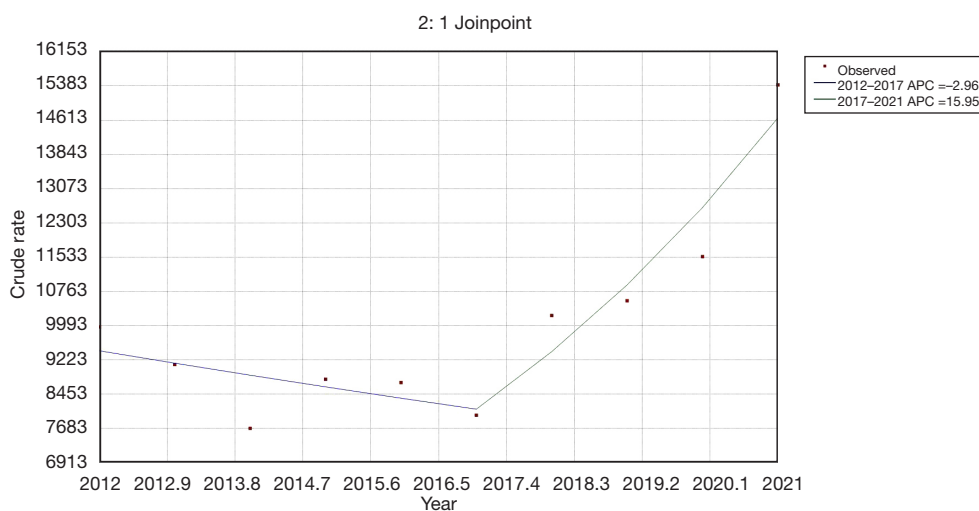


Figure 4 The Join-Point Regression analysis of the time trend of female corresponding authors.



\* Indicates that the annual percent change (APC) is significantly different from zero at the alpha =0.05 level  
Final selected model: 1 Joinpoint.

Figure 5 The Join-Point Regression analysis of the time trend of male corresponding authors.

gap for holding leadership positions may be widened further (34). The increased representation of female first authors in lung cancer journals in this current study is encouraging as it indicates that at least in the field of lung cancer research, female scientists were increasingly represented as lead researchers and designated as lead authors. The narrowing of sex gap in lung cancer research communities was slow but progressive.

It is of utmost importance to raise widen awareness of the sex disparities and foster gender diversity in female lead authorship in top lung cancer journals. As shown in the

current results, the presentation of female corresponding authors did not show significant increase in recent years. It has been well documented that there are sex discrepancies in scientific research including successfully receiving leading positions, research funding, retention and promotion (35-40). Sex diverse research teams facilitate excellence in research and wider application of research findings to scientific and policy progress. Increasing sex diversity among scientists holding senior or managerial positions in academic organizations can give rise to greater representation of female researchers as lead authors in



professional journals. Increasing the representation of female editors and the invitation of female reviewers will help confront sex stereotyping and alleviate sex disparity. Academic organizations and publishers need to collaboratively support and promote women in holding leadership positions, thereby increase their contributions to and influence on the evidence determining future healthcare policies and practices.

This study aimed to clarify the representation of women as first and corresponding authors in prominent journals of lung cancer. One limitation of this study is that it selected journals according to impact factors, the widely acknowledged, yet faultiest scientometric parameter to identify the foremost journals in each specialty. It is unclear whether women's under-representation was generalizable to a wider range of journals especially in less cited publishing materials. Editorials and commentaries were not included in this study because evidence showed that female scientists had lower probability to be invited as author for commentaries or editorials than their male peers with approximate expertise and publication metrics (30). The results of this study only represented the sex proportion of authorship in original research and review articles, the most influential and common two types of articles, whether there is similar sex distribution in authorship of other types of articles needs further investigation.

## Conclusions

This study revealed that despite the feminization of medical workforce, women had lower prevalence of authoring original research and review articles than their male counterpart. Scholarly output of women scientists has risen in lung cancer research realm over recent three years. However, women continue to be underrepresented in the author byline of publications and the sex disparity was larger for prestigious author positions. These results provide requisite knowledge to guide future remedies and interventions addressing sex disparities in academia, which will help harness the strength of women in holding leadership roles and facilitate a just and diversified culture in the lung cancer research communities.

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## Footnote

*Reporting Checklist:* The authors have completed the STROBE reporting checklist. Available at <https://tclr.amegroupp.com/article/view/10.21037/tclr-22-770/rc>

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at <https://tclr.amegroupp.com/article/view/10.21037/tclr-22-770/coif>). The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. As the study was based on publicly available data, the requirement of ethical approval and informed consent were waived by the institutional review board of Peking University Cancer Hospital & Institute.

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