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Gender Disparity in Surgical Research: An Analysis of Authorship in Randomized Controlled Trials



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ABSTRACT

Introduction: Despite increasing female representation in medical fields, women remain underrepresented in high-impact authorship positions. This study examines gender disparities in authorship of randomized controlled trials in general surgery journals over the past 20 y.

Methods: Utilizing PubMed and the Journal Citation Reports (Clarivate, 2023), we identified 8810 randomized controlled trials from 117 surgery journals, filtering down to 5694 studies for final analysis. Gender identification was performed using Genderize.io.

Results: Results indicate that women accounted for 26.4% of first authorships and 18.7% of last authorships. Logistic regression revealed that a male last author significantly increases the likelihood of a male first author (odds ratio 2.68; 95% confidence interval 2.18–3.32). Over time, there is a positive trend in female authorship, with high correlation coefficients for both first (Spearman's correlation coefficient 0.916, $P < 0.005$) and last (Spearman's correlation coefficient 0.878, $P < 0.005$) authors. Interestingly, journal quartiles did not significantly influence the gender of first authors.

Conclusions: These findings suggest persistent gender inequity in surgical research authorship, influenced by mentorship dynamics. The study underscores the need for strategies to enhance female representation in academic leadership to foster a more equitable scholarly environment. Limitations include reliance on Genderize.io for gender determination and the focus on general surgery journals, which may omit relevant studies from other domains. Overall, this research highlights incremental progress toward gender equality in surgical academia, advocating for continued efforts to close the gender gap.

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Introduction

The 'glass ceiling' and 'invisible work' concepts provide crucial frameworks for understanding the multifaceted challenges faced by women in professional contexts. While the 'glass ceiling' describes the intangible barrier hindering women's career advancement,¹ 'invisible work' highlights essential yet undervalued labor, disproportionately carried out by women even within professional roles.² Within the medical domain and also in the field of general surgery, gender disparities persist³ with a mere 22% of surgeons being women.⁴

The motivations driving women toward surgical careers mirror those of their male counterparts: intellectual stimulation and technical challenge.⁵ However, despite possessing self-confidence and robust surgical skills, women exit the field at higher rates than men. The persistence of the "old boys' club" and the inadequacies of maternity-leave policies further contribute to the gender gap within the surgical profession. In addition, women surgeons frequently encounter overt sexual harassment and discrimination from patients.^{3,4,6-8} Given the above, within academic circles, drawing attention to gender equality issues assumes paramount importance.^{9,10} Since Benedek *et al.*'s pioneering report on female representation in medical publications in 1976,¹¹ scholarly interest in gender representation has surged.¹² Despite the increasing presence of women in medical specialties, their authorship in medical journals has not consistently mirrored this trend.^{13,14}

Based on these findings, the aim of this study was to explore the gender issue in relation to authorship of scientific papers in the field of general surgery by analyzing the gender trend of first and last authors of randomized controlled trials (RCTs) over the last 20 y.

Materials and Methods

Search strategy

Using the *Journal Citation Reports* (Clarivate, 2023) category 'Surgery' as a reference, three authors (GB, SF, and IG) retrieved a list of journals pertaining to general surgery. This involved examining each journal's scope and objectives, irrespective of publisher, ranking quartile, or language.

After creating such a list, the authors queried PubMed to retrieve all RCTs for each journal published in a 20-y period (2003-2023) using the following string: "Journal Title"[ta] and applying the randomized control trial filter provided by PubMed. From each selected article, the article name, year of publication, journal name and ranking (quartile), and the full names of the first and last authors were extracted.

A quartile is a measure of a journal's impact, provided by Clarivate, based on its Impact Factor. Journals are ordered by Impact Factor and divided into four groups: the top 25% of journals are in the first quartile (Q1), journals from the 26th to 50th percentile are in the second quartile (Q2), journals from the 51st to 75th percentile are in the third quartile (Q3), and the

bottom 25%, from the 76th percentile to the journal with the lowest Impact Factor, are in the fourth quartile (Q4).

Either studies authored by a single author were excluded, and studies where first names of authors were not disclosed were excluded from the final analysis.

To determine the gender of an individual based on their first name, we used the web service *genderize.io* (<https://genderize.io/>). This tool implements machine learning algorithms to estimate the probability of a name belonging to a particular gender. Using this tool, we were able to assign the labels "male," "female," or "unknown" to each first name, along with the corresponding probability. Given the scientific nature of the study, the institutional review board approval was not required for this study.

Statistical analysis

Categorical variables are presented as numbers and percentages; comparisons for these variables were made using the chi-squared test or Fisher's exact test, as appropriate. The Spearman correlation test was used to determine the strength and direction of association between two variables.

We used logistic regression analysis to determine the relationship between a dependent categorical variable (male first author) and one or more independent variables to determine odds ratios (ORs) with 95% confidence intervals (CIs). All statistical analyses were performed using R (version 3.4.0; 2017-04-21). *P* values <0.05 were considered statistically significant.

Results

From the initial list of 284 journals categorized in the category "Surgery" in the *Journal Citation Reports* (Clarivate, 2023) we selected 117 journals, see [Supplementary Material 1](#), yielding a comprehensive dataset of 8810 RCTs. Among these studies, 76 were authored by a single individual, while in 2249 studies the first name of the authors was not disclosed, leaving 6561 included studies. Moreover, in 867 studies it was not possible to identify the gender leaving a total of 5694 studies included in the final analysis (2777 in Q1 journals, 2062 in Q2 journals, 365 in Q3 journals, and 490 in Q4 journals).

When considering time of publication, 930 (16.3%) studies were published in 2003-2007, 1235 (21.7%) were published in 2008-2012, 1584 (27.8%) were published in 2013-2017 and 1945 (34.2%) were published in 2018-2023. [Figure 1](#) depicts distribution of included articles sorted by journal quartile, showing that most of the RCTs were published in the Q1-Q2 journals for all of the considered periods with a constant distribution over time. Women comprised 26.4% of the total first authorships and 18.7% of the total last authorships. These percentages remained consistent even when authors were analyzed by journal quartile ([Table 1](#)).

Over the years, we observed a positive trend in the progression of female gender in both first and last authorship with a high correlation degree for both first (Spearman's correlation coefficient 0.916, *P* < 0.005) and last (Spearman's

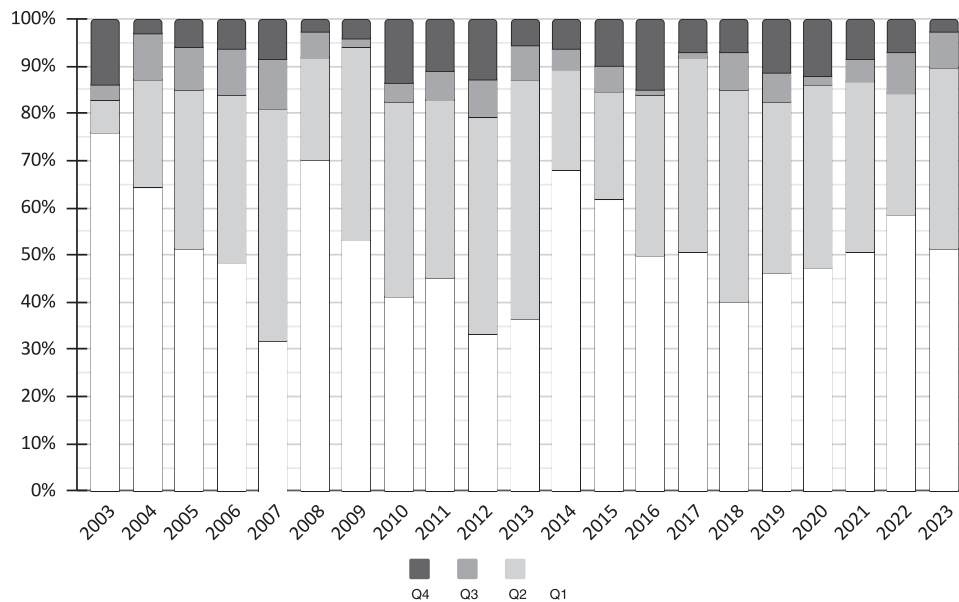


Fig. 1 – Included articles sorted by journal quartile.

correlation coefficient 0.878, $P < 0.005$) authors (Fig. 2). Table 2 shows the results of the logistic regression where the dependent variable is the presence of a male as first author. We considered the following variables in the analysis: last author (male), journal quartile (Q1, Q2, Q3, Q4), year of publication (i.e., 2003-2007, 2008-2012, 2013-2017, 2018-2023). We identified that a man as last author (OR 2.68; 95% CI 2.18-3.32) is independently associated with a man as first author (OR 2.68; 95% CI 2.18-3.32), while year of publication (categorized in five years-span) is negatively associated with man as first author for the 2013-2017 and for the 2018-2023 y. No significant correlation was found with the journal ranking.

Discussion

In this study women were underrepresented as both first and last authors. This trend echoes findings from other specialties investigations¹⁵ underscoring that gender inequity extends beyond the confines of surgery.

Interestingly, our analysis reveals that a male last author is more likely to mentor a male first author. As scientific publications significantly shape career trajectories, this

interplay between gender and authorship could perpetuate a vicious circle, ultimately contributing to lower metrics and underrepresentation of women in leadership positions.^{16,17} In the same framework, as more women ascend to leadership positions in academic surgery, a positive ripple effect ensues, contributing to the gradual closure of the gender gap.^{18,19} Our study also reveals an upward trajectory in both first and last authorship over time, showing an almost perfect linear correlation, aligning with the findings of Tran et al.'s.²⁰

Surprisingly, our study finds no correlation between the journal quartile (used as a proxy for journal influence and prestige) and the gender of the first authors, suggesting that both larger multicentric studies and smaller single-center studies have an equal likelihood of featuring a female first author.

Our study has some limitations that warrants discussion. We utilized the Genderize.io application to determine gender, recognizing that alternative tools or methodologies might yield divergent results. Also, our investigation focused exclusively on journals within the domain of general surgery. However, we acknowledge the possibility that additional journals may have published RCTs related to general surgery. Due to the international composition of research teams and the potential for introducing bias by attributing findings to the country of one author, we were unable to stratify our analysis by geographical location. This limitation restricts our ability to account for regional social and cultural differences that may influence gender roles and related efforts to address imbalances. Lastly, a portion of the articles analyzed had to be excluded due to the absence of a first name for authors, which likely introduces a systematic bias. This practice may be more prevalent in specific journals, leading to a potential overrepresentation or underrepresentation of certain publications in our final dataset. This limitation may affect the generalizability of our findings and should be addressed in future studies.

Table 1 – Gender distribution of first and last authors sorted by journal quartile.

Journal quartile	First authorship		Last authorship	
	Men	Women	Men	Women
Q1	2014	763 (27.5%)	2239	538 (19.4%)
Q2	1534	528 (25.6%)	1679	381 (18.5%)
Q3	281	84 (23.0%)	305	60 (16.4%)
Q4	362	128 (26.1%)	402	88 (18.0%)
Total	4191	1503 (26.4%)	4625	1067 (18.7%)

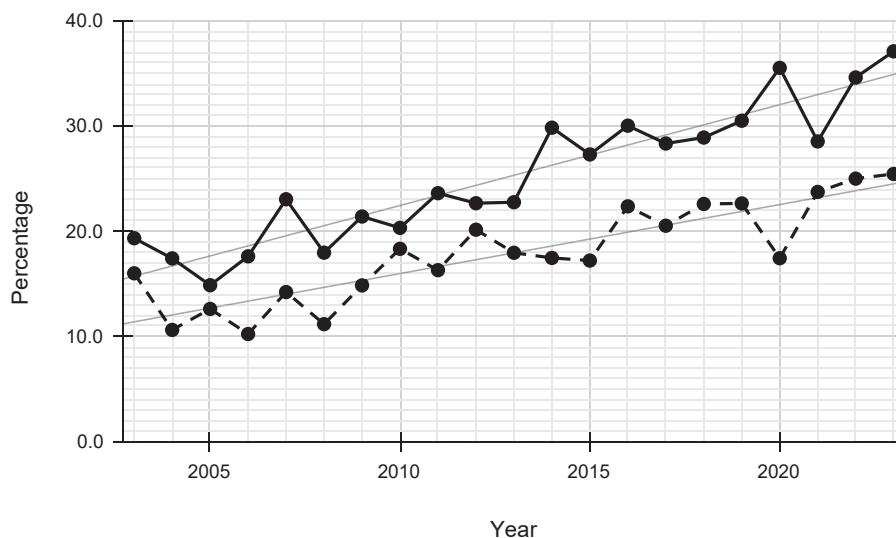


Fig. 2 – Trends in female first and last authorship over time Dotted line: female last authorship, continuous line: female first authorship.

Conclusions

While the underrepresentation of female surgeons and female authors remains a concern, it is encouraging to note the positive trend observed over the study period. If this trend continues, it is plausible that we may observe similar improvements in senior authorship. However, the persistent correlation between male first authors and male senior authors underscores the need for greater attention to gender parity in mentorship, highlighting the importance of fostering more equitable mentorship opportunities for women in surgery.

Supplementary Materials

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.jss.2024.10.033>.

Table 2 – Variables affecting the gender of the first author.

Variable	OR (95% CI)	P value
Last author (man)	2.68 (2.18-3.32)	<0.001
Q1	Reference	
Q2	1.11 (0.97-1.26)	0.119
Q3	1.26 (0.98-1.65)	0.077
Q4	1.08 (0.87-1.35)	0.505
2003-2007	Reference	
2008-2012	0.83 (0.67-1.03)	0.105
2013-2017	0.61 (0.49-0.74)	<0.001
2018-2023	0.49 (0.40-0.59)	<0.001

Logistic regression. Dependent variable (man as first author).

Disclosure

Authors have no conflict of interest to declare.

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Giulia Becherucci: Writing – review & editing, Writing – original draft, Formal analysis, Data curation. Alessandro De Cassai: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. Giulia Capelli: Writing – review & editing, Data curation. Stefania Ferrari: Writing – review & editing, Data curation. Ilaria Govoni: Writing – review & editing, Data curation. Gaya Spolverato: Writing – review & editing, Supervision, Conceptualization.

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