Trends in authorship demographics for manuscripts published in endocrine journals - A 70-year analysis [version 2; peer review: 1 approved with reservations]


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Abstract

Background: Over the previous few decades, trends in author demographics have significantly changed. Such trends have already been studied for many sub-specialties but endocrinology is among the few branches that are yet to see an analysis of such trends. This paper aims to fill this gap.

Methods: Journal of Endocrinology and General & Comparative Endocrinology are two landmark journals that publish articles from around the world. Each decade during the 70-year period from 1961 to 2021 has been examined in this study. Funding source, first author – senior author gender, their demographics and proportion of papers with at least one female author were the parameters considered while studying each publication. It was predicted that the number of female authors per paper would increase with time, as would the range of degrees held by the authors, demographical variations in authorship, and the funding source. The aim was also to determine the distribution of female first authors and senior authors in endocrinology journals over a 70-year period, as well as to check the gender combinations using the Punnett square.

Results: Female first authors rose from 7% to 29.6% (p<0.0006)
between 1961 and 2021, whereas female senior authors rose from 15.6% to 22.2%. Despite women's small contributions to first and senior authors, female participation rose from 17.48% (25/143) to 70% (170/250) between 1961 and 2021. Male-Female and Female-Male combinations rose with Chi-Square = 124.6, (p<0.0001). Europe and the Americas had the most female academic medical contributors (p<0.0001) Regardless of author status, female participation rose from 17.48% in 1961 to 68% in 2021.

**Conclusion:** In papers published in endocrinology journals, there was a rising trend in female contributions to academic medicine. Even with the large growth of female endocrinologists, there is still a disparity in why the increase in female authors is comparably fewer.

**Keywords**
endocrine, gender-gap, sex-ratio, demographics, bias, equity, medicine
Abbreviations

MM- Male-Male
MF-Male-Female
FM- Female-Male
FF- Female-Female
JOE-Journal of Endocrinology
GCE- General & Comparative Endocrinology

Introduction

Women confront a variety of challenges, and most of us are aware of the discrimination they suffer on a daily basis, whether in society, the job, schools, or the scientific community. Salaries and allowances are only a small part of the pay disparity. Women have experienced more hurdles than their male counterparts in obtaining support in the field of medical research, including but not limited to assets, funding, assistance, and the peer-review process, to name a few. In any type of study, motivation and the availability of resource reserves are crucial, and a lack of both might have a detrimental impact on the scientific advancement that the medical community is actively seeking. Such difficulties are replicated when female writers seek funding for their projects and research, resulting in a “gender pay gap” that often goes unnoticed and discourages women from pursuing research.

Women make up about half of the medical school students in the United States. This is a significant rise from less than 10% in 1965. The proportion of female physicians in endocrinology is 44%. The gender disparity is anticipated to narrow even more, as women made up three-quarters of endocrinology fellowship applicants in 2014.

Women remain underrepresented in senior academic positions including tenured faculty positions, though. While female physicians filled 38% of faculty positions in US medical schools in 2014, only 22% of tenured professors were female.

With numerous reforms and activism, the number of females active in delivering specialist healthcare in the field of endocrinology, or any other profession for that matter, has increased in recent decades. A similar pattern has emerged among females active in indirect health care, such as females with backgrounds in basic sciences, epidemiologists, and others. However, growth in the number of females working in these sectors does not always correspond to increased research possibilities.

A few papers in cardiology, gastroenterology, and pulmonology after analyzing the current literature were discovered by this study, however there was a noteworthy absence in endocrinology. Therefore this study plans to fill this gap and analyze part of the reality by individually assessing articles published in two major endocrinology journals to evaluate whether there has been a proportionate change in the number of articles published by female authors, and whether the female authors were funded by government bodies, educational institutions, or organizations, or if they were solely self-funded. Additionally, demographic analysis was included to comment on how well specific geographical regions have performed in terms of fostering gender equality during the 70-year timeframe of our research.

Methods

To find appropriate papers for this study, journal search engines such as PubMed, Scimago, Embase, OMICS, and Google Scholar were used. The two journals had to have a comparable number of articles in each, data available from at least 1961, and an h-index over 100 to be eligible. One journal was chosen from a publisher in the United Kingdom, while the other was chosen from a publisher in the United States to reduce the bias and diversify the pool of authors who are submitting the manuscript and for better randomization. Bioscientifica’s Journal of Endocrinology and General and Comparative Endocrinology were the two journals that met this study’s requirements. Any other journal that met the criteria but has already been examined in a similar study was ruled out. Other important endocrinology journals, such as the Journal of Clinical Endocrinology & Metabolism and Thyroid, had already been utilized to track demographics and female authorship trends.

Selected publications were examined, and data for this research was gathered for the first year of each decade, beginning in 1961. In total, data from seven decades were examined: 1961, 1971, 1981, 1991, 2001, 2011, and 2021. The data was collected between January 1st and December 31st of the following year. A total of 2432 articles in both journals (JOE – 1162, GCE – 1270) were discovered. Book reviews, author indexes, animal indexes, subject indexes, inaccessible articles, or articles where the gender couldn’t be determined were not included. Following the exclusion of articles, the total number of articles was estimated to be 2291 (See Underlying data). (JOE- 1115, GCE-1176).

In the manuscript, data was gathered for both the first and senior authors, and the categories assigned were further documented. A total of ‘n’ papers from both journals were independently evaluated. If they were book reviews, author indexes, or cumulative indexes, a ‘m’ number of articles had to be eliminated due to a lack of reasonable evidence on the
gender, demography, or funding of the paper. As a result, (n-m) papers in this research were included (Table 1). Using the aforementioned methodology, each item was immediately assessed in order to analyze the following variables:

1) **Biological gender of authors**

The following approaches were used to collect data, in order of preference based on availability: To gather information from University/Organization/LinkedIn pages, I) Google was used to search for writers by their names and departments. II) Assuming gender based on nomenclature conventions (e.g., John being the name of a male author; Christy being a female author). III) The biological genders of some authors who were registered on Scopus and Google Scholar were used to assign genders. In addition, in the event of a snag, https://gender-api.com was used to resolve the issue.

2) **Geographical demographics**

The following approaches were used to collect data, in order of preference based on availability: I) Data from University/Organization/LinkedIn/ORCiD pages; II) Author affiliations specified in the article; III) data from University/Organization/LinkedIn/ORCiD pages; IV) Based on regional nomenclature conventions and trends (e.g., Asian names being Raja Gopalchandra, Li-Hu Wang, BK Gupta, Chandragouda Patil, etc.). Author affiliation was one of the variables used to assign demographics to the authors, therefore a lot of focus was placed on where they were affiliated.

3) **Presence of at least one female author**

To include all other authors engaged in the study, the presence of at least one female author was determined using the same methods to determine the biological gender of the first and senior authors.

### Table 1. Inclusions and Exclusions.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Number of Articles</th>
<th>Excluded Articles</th>
<th>Included Articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961</td>
<td>144 JOE-90 GCE-54</td>
<td>1 Excluded 1 Undetermined Author Gender 0 Exclusions</td>
<td>143 JOE – 89 GCE – 54</td>
</tr>
<tr>
<td>1971</td>
<td>421 JOE-282 GCE-139</td>
<td>2 Excluded 0 Exclusions 1 Author Index + 1 Book Review</td>
<td>419 JOE – 282 GCE – 137</td>
</tr>
<tr>
<td>1981</td>
<td>477 JOE-218 GCE-259</td>
<td>68 Excluded (7 Undetermined Author Genders + 1 Inaccessible article) (1 Animal Index + 56 Book Reviews + 1 Undetermined Author Gender + 1 Author Index + 1 Subject Index)</td>
<td>409 JOE – 210 GCE – 199</td>
</tr>
<tr>
<td>1991</td>
<td>328 JOE-111 GCE-217</td>
<td>25 Excluded (8 Undetermined Author Genders + 1 Commentary + 1 Inaccessible article) (1 Summary + 1 animal index + 1 subject index + 3 author index + 9 Book Reviews)</td>
<td>303 JOE – 101 GCE – 202</td>
</tr>
<tr>
<td>2001</td>
<td>402 JOE-252 GCE-150</td>
<td>32 Excluded 25 Undetermined Author Genders 7 Undetermined Gender</td>
<td>370 JOE – 227 GCE – 143</td>
</tr>
<tr>
<td>2011</td>
<td>406 JOE-118 GCE-288</td>
<td>9 Excluded 2 Undetermined Author Genders 7 Undetermined Author Genders</td>
<td>397 JOE – 116 GCE – 281</td>
</tr>
<tr>
<td>2021</td>
<td>254 JOE-91 GCE-163</td>
<td>4 Excluded 1 Undetermined Author Gender 3 Undetermined Author Genders</td>
<td>250 JOE – 90 GCE – 160</td>
</tr>
<tr>
<td>Combined</td>
<td>n = 2432 JOE-1162 GCE-1270</td>
<td>m = 141 Excluded 44 Undetermined Author Genders + 2 Inaccessible articles + 1 Commentary 18 Undetermined Author Genders + 5 Author Index + 2 Animal Index + 2 Subject Index + 66 Book Reviews + 1 Summary</td>
<td>n-m = 2291 JOE – 1115 GCE – 1176</td>
</tr>
</tbody>
</table>
4) Author's qualifications
Because all qualifications overlap, authors were divided into broad categories. MBBS/MD/DM/DO was included in Category 1. Ph.D./MSc/MPH were placed in category 2, and other paramedical areas were placed in category 3. To prevent prejudice while reporting, authors were divided into groups that classified qualifications according to international criteria. UNESCO’s international standard classification of education was also used in this study.

5) Source of funding
Data on funding was gathered by skimming through articles and looking for keywords such as ‘grant,’ ‘support,’ ‘fund,’ ‘acknowledgement,’ ‘thank,’ and so on.

The articles were divided into major groups such as government, university or organization, industry, self, other, and not stated. The majority of the available data came from the government, university, organization, or industry, with the exception of a few articles where funding was a problem, in which case the category ‘others’ was used, and for articles where funding was not available, the category ‘not mentioned’ was used. In research with several funding sources, government-based sources were given priority over other sources.

Companies/Industry/commercial sources were given preference over organizational or university financing in other multi-source sponsored studies without any government backing.

Statistical analysis
Data was incorporated in Microsoft Excel Sheet and further data was analyzed using GraphPad Prism Version 9.3.1., data was reported in tabular form. Unpaired t test (non-parametric, Kolmogorov-Smirnov test) was used to compare the outcomes with two variables, one way ANOVA (Kruskal Wallis Test) was used for comparison in places with three or more variables. Chi-Square was used for categorical variables.

Results
There was an increase in female first authors from 1961 to 2021. The contribution of females as first authors increased from 7% (10/143) in 1961 to 29.6% (74/250) in 2021 (p=0.0006). An unpaired, non-parametric t-test was employed to determine significance. Not only first authors, but participation from female senior authors grew as well, however, the rise in senior authors occurred between 1971 and 2021, whereas the rise in female first authors occurred between 1961 and 2021. The unpaired, non-parametric t-test was performed to correlate significance, in senior female authors rise was seen from 12.5 % (43/344) in 1971 to 22.2 % (48/245) in 2021 (p=0.0006). (Figure 1) Surprisingly, the senior female contribution was 15.6 % in 1961 (14/90) a bit more than expected. When the data was stratified by region, it was discovered that Europe was the leading contributor in terms of female involvement in research for both first and senior authors, followed by the Americas. Additionally, first authors and senior authors were viewed as having similar levels of involvement. The African and Australian continents made the least contribution. (Figure 2) Remarkably, a growing trend in which female engagement was included as a variable was noticed. All the writers in the paper were thoroughly assessed, and even if one of the authors was a woman, it was marked as yes and placed in a different category.

Although female involvement, with respect to all authorship orders, rose from 17.48% (25/143) in 1961 to 68% (170/250) in 2021, females continue to publish fewer manuscripts as first (29.6%) and senior (22.2%) authors.

Categories of first writers and senior authors were created using a new representation in which a mix of male and female authors were used to report the four possible results. The categories Male-Male, Male-Female, Female-Male, and Female-Female were used. Data evaluation resulted in Chi-Square = 124.6 with p<0.0001. (Figure 3 and Figure 4)
Calculations were made to examine the distribution of funding sources for submissions with female first authors, as well as the qualifications possessed by the writers at the time. This section contains related data as well as observations made for the core goals of this study (Table 2).

Discussion
This study focused on the articles published from 1961 to 2021 (Seven-decades), in two major endocrinology journals i.e. Bioscientifica’s Journal of Endocrinology and General and Comparative Endocrinology, though there are more landmark journals in the field of endocrinology they were excluded because they were already used in the study by El Hakimi et al. showing authorship trends in major endocrinology journals. Although El Hakimi et al. analyzed four prominent endocrinology journals (Thyroid, Journal of Clinical Endocrinology & Metabolism, Journal of Bone and Mineral Research, and Diabetes Care), each journal’s purpose and scope were distinct, resulting in a bias when comparing them.

El Hakimi et al. found that the overall percentage age of female authors increased from 23.3% in 1991 to 39.2% in 2015, but in this study, female contributions as first author increased from 7% (10/143) in 1961 to 29.6% (74/250) in 2021. Female qualification was one of the key reasons for limited female involvement from 1961 to 2021, as discovered in this study, making it one of the most significant factors to keep in mind as the increasing trend in female contribution is observed. This has to do with the fact that the number of females involved is proportional to their qualifications.

Despite the fact that, according to the American Association of Medical Colleges, there were 51.3% female endocrinologists compared to 48.3% males in the United States in 2019, there is still a mystery as to why there are still so few female authors in scientific literature. Female first authors made up 3.0% of all publications in 1958, compared to 23% in 2016, according to Amankwah et al. In other specialties, such as cardiology, female first authors made up 3.0% of all publications in 1958,
<table>
<thead>
<tr>
<th>Year</th>
<th>Male</th>
<th>Female</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961</td>
<td>133/143 (93%)</td>
<td>10/143 (7%)</td>
<td>0.0006</td>
</tr>
<tr>
<td>1971</td>
<td>387/419 (92.36%)</td>
<td>32/419 (7.64%)</td>
<td>0.0006</td>
</tr>
<tr>
<td>1981</td>
<td>347/409 (84.85%)</td>
<td>62/409 (15.15%)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>1991</td>
<td>259/303 (85.47%)</td>
<td>44/303 (14.53%)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>2001</td>
<td>287/370 (77.56%)</td>
<td>83/370 (22.44%)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>2011</td>
<td>277/397 (77.56%)</td>
<td>120/397 (30.33%)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>2021</td>
<td>176/250 (70.4%)</td>
<td>74/250 (29.6%)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

**Table 2. Combined table for funding sources, author gender distribution, demographics, and qualification.**
compared to 23% in 2016. Similarly, in 1958, female senior authors accounted for 5.2% of all publications, compared to 20% in 2016. There was also a rise in the number of articles from Europe and Asia compared to this study where an increase in articles from Americas and Europe was observed.

Despite the overwhelming positive findings, the studies also point to several potential areas of concern. Although the percentage age of female authors has increased over time, the data show that there was a lack of momentum among both first and senior authors between 1981 and 1991. Expanding and combining ideas from various articles published in major journals such as Endocrinology, Cardiology, and Gastroenterology, additional factors such as qualifications, funding source and further stratified, and female involvement as any co-author were considered.

Several studies have looked into gender inequalities in medicine, such as Sidhu et al. work in the United Kingdom, or Mehran et al. works in Cardiology where Data from randomized
controlled trials was investigated to assess gender gap. However, there was still a need to look into a way to assess the outcomes over a longer period of time. Because, in order to see the change, a long-term strategy must be implemented across several years to obtain more precise findings. The aim was to assess the same in this study by including 70 years of data, resulting in a more skewed conclusion. Researchers have incorporated data indicating trends over 20 or 30 years in the past or recently, but this is the first research of such kind, with articles gathered over 70 years.

Several combinations of male-female First and Senior Authors were employed, resulting in four possible scenarios of MM, MF, FM, FF, where a decline in MM combination of authors and an increase in MF or FM from 1961 to 2021 was noticed (Figure 3 and Figure 4).

This was unique because, whereas other authors identified patterns in sole females, this study viewed this as a fact that needed to be addressed. In a cross-sectional study published by Gayet-Ageron et al., a similar combination was employed, although the major focus was on author contribution rather than gender inequality.

This study employed methods to determine the gender of first and senior authors that were similar to those previously reported in studies on gender and authorship. As a result, the findings of this study provide a more accurate and comprehensive picture of change over time than a sample consisting exclusively of original research articles published in the included journals in a single year per decade, for example. Qualification, continent, and female participation in all the authors present were also factored in this study.

Conclusion
This research found a statistically significant rise in the number of female authors participating in endocrinology research, both as first and senior authors. Despite the increase in female engagement, it was discovered that it still falls short of male participation. Female involvement had previously increased sharply, but it plateaued in the 2000s, remaining significantly below 50% and consequently less than male participation. Female contribution increased initially in the Americas and then on the European continent. Female authors from Europe contributed the most, followed by those from the American continent, both of which are high-income regions of the world. The rise in female contributions was not restricted to affluent countries; the Asian continent, which still contains many low-income regions, had a similar upward trend. Despite a large rise in female participation, changes for females and gender equality are still needed to boost female empowerment and the scientific community.

Data availability

Underlying data
Dryad: Trends in authorship demographics for manuscripts published in endocrine journals - A 70-year analysis
https://doi.org/10.5061/dryad.rjdfn2zdhl17

This project contains the following underlying data:
Data-Sheet.csv. (Data were collected from two major journals and analyzed for individual parameters as mentioned in the first row of the excel sheet. The first row describes all the numeric coding used to allot different categories to the study parameters.)

Data are available under the terms of the Creative Commons Zero “No rights reserved” data waiver (CC0 1.0 Universal (CC0 1.0) Public domain dedication).

Author contributions
Arpit Jain: Methodology, Data curation, Writing- original draft
Hritik Madan: Data curation, Writing- review & editing
Kamaldeep Singh: Methodology, Project administration, Writing- original draft
Yash Agarwal: Data curation, Writing- review & editing
Bharat Midha: Data curation, Writing- review & editing
Shreya Gulati: Methodology, Project administration, Writing- review & editing
Priyanka Batra: Project administration, Supervision, Writing- review & editing
Ankur Batra: Conceptualization, Project administration, Supervision
Priyanshu Jain: Supervision, Visualization, Writing- review & editing
Ipsa Arora: Conceptualization, Supervision, Validation
Madhav Prabh: Supervision, Visualization
Shreyas Arya: Formal Analysis, Supervision, Validation
Yashasvi Chugh: Formal Analysis, Validation
Shobhit Piplani: Conceptualization, Data curation, Formal Analysis, Methodology, Writing- original draft

References
3. Waisbren SE, Bowles H, Hasan T, et al.: Gender Differences in Research Grant
Open Peer Review

Current Peer Review Status:  ?

Version 1

Reviewer Report 12 September 2022

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Kunal Mahajan
Himachal Heart Institute, Mandi, Himachal Pradesh, India

The authors have done a good quality analysis of the gender trends along with inclusion of other variables but a few vague terms in the manuscript make it difficult for a reader to comprehend the true meaning of the sentence as intended by the authors. I recommend rectification of the following points:

1. Result sections in ‘Abstract’ & in complete ‘Results’: The use of words ‘initial authors’ provides an ambiguous meaning to the reader. Please clarify whether initial authors is the first author or the first few authors, etc.

2. ‘Background’ section of ‘Abstract’: It would be nice to paraphrase this section of the abstract as it provides an unclear meaning and warrants a further reading to decipher the purpose of this article.

3. ‘Methods’ section of the ‘Abstract’: The authors have mentioned the use of Punnett square for depiction of gender combinations, but such an illustration has not been included in their paper. Authors are encouraged to provide a 2x2 table as it will further enhance their results by including number and gender distribution trends of lone authors i.e. papers having a single author.

Rectification of these minor inconsistencies will allow a reader to better comprehend the article and further enhance this much needed article in the field of Endocrinology and in a world where gender equality should matter.

Is the work clearly and accurately presented and does it cite the current literature? Yes

Is the study design appropriate and is the work technically sound? Yes

Are sufficient details of methods and analysis provided to allow replication by others?


Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**
Yes

**Are all the source data underlying the results available to ensure full reproducibility?**
Yes

**Are the conclusions drawn adequately supported by the results?**
Yes

**Competing Interests:** No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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**Author Response 12 Sep 2022**

**Shobhit Piplani, Jawaharlal Nehru Medical College, Belgaum, India**

Thank you for your valuable response and review of our article. In the revised version of our paper, we have included a Punnett Square (Figure 4) depiction of our trends to facilitate the visualization of gender combinations as well as the inclusion of solitary authors. Additionally, the abstract has been rewritten to eliminate any ambiguity that may have arisen from differing viewpoints. While describing authors, the word 'initial' has been replaced with 'first', which defines the order of authorship more precisely.

**Competing Interests:** No competing interests were disclosed.
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