RESEARCH ARTICLE

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

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Abstract

Background
Over the previous few decades, demographics, gender, and the number of papers published have all changed considerably. One of the fields of medicine that has yet to be extensively investigated is endocrinology.

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 – last 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 initial 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
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 last 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 last authors.

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.18

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### Table 1. Inclusions and Exclusions.

| Year | Total Number of Articles | Excluded Articles | Included Articles |
|------|--------------------------|-------------------|------------------|
| 1961 | 144 JOE-90 GCE-54        | 1 Excluded        | = 143 JOE – 89   |
|      |                          |                   | GCE – 54         |
| 1971 | 421 JOE-282 GCE-139      | 2 Excluded        | = 419 JOE – 282  |
|      |                          |                   | GCE – 137        |
| 1981 | 477 JOE-218 GCE-259      | 68 Excluded       | = 409 JOE – 210  |
|      |                          |                   | GCE – 199        |
| 1991 | 328 JOE-111 GCE-217      | 25 Excluded       | = 303 JOE – 101  |
|      |                          |                   | GCE – 202        |
| 2001 | 402 JOE-252 GCE-150      | 32 Excluded       | = 370 JOE – 227  |
|      |                          |                   | GCE – 143        |
| 2011 | 406 JOE-118 GCE-288      | 9 Excluded        | = 397 JOE – 116  |
|      |                          |                   | GCE – 281        |
| 2021 | 254 JOE-91 GCE-163       | 4 Excluded        | = 250 JOE – 90   |
|      |                          |                   | GCE – 160        |
| Combined | n = 2432 JOE-1162 GCE-1270 | m = 141 Excluded | = n-m = 2291 JOE – 1115 |
|      |                          |                   | GCE – 1176       |
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. 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). 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, initial writers and senior authors were viewed as having similar levels of involvement. The African and Australian continents made the least contribution. 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. 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).
Figure 2. Author demographics - first authors (left) and senior authors (right).

Figure 3. Gender combinations over the years.

Table 2. Combined table for funding sources, author gender distribution, demographics, and qualification.

|          | 1961     | 1971     | 1981     | 1991     | 2001     | 2011     | 2021     | p-value |
|----------|----------|----------|----------|----------|----------|----------|----------|---------|
| **First Author** |          |          |          |          |          |          |          |         |
| Male     | 133/143 (93%) | 387/419 (92.36%) | 347/409 (84.85%) | 259/303 (85.47%) | 287/370 (77.56%) | 277/397 (69.77%) | 176/250 (70.4%) | 0.0006  |
| Female   | 10/143 (7%)  | 32/419 (7.64%)  | 62/409 (15.15%) | 44/303 (14.53%) | 83/370 (22.44%) | 120/397 (30.33%) | 74/250 (29.6%)  |         |
| **Senior Author** |          |          |          |          |          |          |          |         |
| Male     | 76/90 (84.4%) | 301/344 (87.50%) | 322/365 (93.1%) | 262/292 (93.7%) | 298/356 (83.7%) | 298/376 (79.26%) | 197/245 (78.8%) | 0.0006  |
| Female   | 14/90 (15.6%) | 43/344 (12.5%)  | 43/365 (6.9%)  | 30/292 (10.3%)  | 58/356 (16.3%)  | 78/376 (21.74%)  | 48/245 (22.2%)  |         |
### First Female Author Demographics

|        | 1961 | 1971 | 1981 | 1991 | 2001 | 2011 | 2021 | p-value |
|--------|------|------|------|------|------|------|------|---------|
| **Americas** | 6/10 (60%) | 7/32 (21.87%) | 26/62 (41.93%) | 11/44 (25%) | 31/83 (37.34%) | 49/120 (40.83%) | 32/74 (43.24%) | <0.0001 |
| **Asias** | 0/10 (0%) | 4/32 (12.5%) | 9/62 (14.51%) | 9/44 (20.45%) | 11/83 (13.25%) | 17/120 (14.16%) | 14/74 (18.91%) |          |
| **Europe** | 4/10 (40%) | 16/32 (50%) | 23/62 (37.09%) | 22/44 (50%) | 38/83 (45.78%) | 48/120 (40%) | 20/74 (27.02%) |          |
| **Africa** | 0 (0%) | 1/32 (3.125%) | 2/62 (3.22%) | 0 (0%) | 0 (0%) | 0 (0%) | 3/74 (4.05%) |          |
| **Australia** | 0 (0%) | 4/32 (12.5%) | 2/62 (3.22%) | 2/44 (4.55%) | 3/83 (3.61%) | 0 (0%) | 5/74 (6.76%) |          |

### Senior Female Author Demographics

|        | 1961 | 1971 | 1981 | 1991 | 2001 | 2011 | 2021 | p-value |
|--------|------|------|------|------|------|------|------|---------|
| **Americas** | 5/14 (35.71%) | 12/43 (27.90%) | 18/43 (41.86%) | 14/30 (46.67%) | 23/58 (41.38%) | 35/78 (44.87%) | 17/48 (35.42%) | <0.0001 |
| **Asias** | 2/14 (14.28%) | 2/43 (4.65%) | 7/43 (16.27%) | 6/30 (20%) | 8/58 (13.79%) | 8/78 (10.26%) | 7/48 (14.58%) |          |
| **Europe** | 7/14 (50%) | 25/43 (58.13%) | 16/43 (37.20%) | 9/30 (30%) | 24/58 (41.38%) | 32/78 (41.03%) | 18/48 (37.50%) |          |
| **Africa** | 0 (0%) | 2/43 (4.65%) | 1/43 (2.32%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |          |
| **Australia** | 0 (0%) | 1/43 (2.32%) | 1/43 (2.32%) | 1/30 (3.33%) | 3/83 (3.61%) | 3/78 (3.85%) | 6/48 (12.50%) |          |

### Whether Female was involved or not? (Yes/Total Papers)

|        | 1961 | 1971 | 1981 | 1991 | 2001 | 2011 | 2021 | p-value |
|--------|------|------|------|------|------|------|------|---------|
| **Americas** | 25/143 (17.48%) | 73/419 (17.50%) | 98/411 (23.84%) | 102/303 (33.66%) | 162/370 (43.78%) | 247/397 (62.22%) | 170/250 (68%) |          |

### Funding to papers with female first authors

|        | 1961 | 1971 | 1981 | 1991 | 2001 | 2011 | 2021 | p-value |
|--------|------|------|------|------|------|------|------|---------|
| **Government** | 6/10 (60%) | 14/32 (43.75%) | 45/62 (72.58%) | 21/44 (47.72%) | 54/83 (65.06%) | 59/120 (49.16%) | 28/74 (37.84%) |          |
| **University or Organization** | 4/10 (40%) | 13/32 (40.65%) | 8/62 (12.90%) | 12/44 (27.27%) | 25/83 (30.12%) | 58/120 (48.33%) | 43/74 (58.11%) |          |
| **Industry** | 0 (0%) | 1/32 (3.1%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |          |
| **Self** | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 1/74 (1.35%) |          |
| **Others** | 0 (0%) | 0 (0%) | 1/62 (1.61%) | 5/44 (11.36%) | 1/83 (1.21%) | 1/120 (0.83%) | 0 (0%) |          |
| **Not mentioned** | 0 (0%) | 4/32 (12.5%) | 8/62 (12.90%) | 6/44 (13.63%) | 3/83 (3.61%) | 2/120 (1.67%) | 2/74 (2.70%) |          |

### Current Qualifications (First Female Author)

|        | 1961 | 1971 | 1981 | 1991 | 2001 | 2011 | 2021 | p-value |
|--------|------|------|------|------|------|------|------|---------|
| **MBBS/MD/DO/Fellow** | 0 (0%) | 5/32 (15.63%) | 9/62 (14.52%) | 1/44 (2.27%) | 15/83 (18.07%) | 18/120 (15%) | 7/74 (9.46%) |          |
| **Ph.D./MSc/MPH** | 10/10 (100%) | 26/32 (81.25%) | 52/62 (83.87%) | 43/44 (97.73%) | 68/83 (81.92%) | 96/120 (80%) | 57/74 (77.03%) |          |
| **Others** | 0 (0%) | 1/32 (3.1%) | 1/62 (1.61%) | 0 (0%) | 0 (0%) | 6/120 (5%) | 10/74 (13.51%) |          |
### 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\(^{14}\). 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\(^{14}\). 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\(^\text{20}\). Female first authors made up 3.0 % of all publications in 1958, compared to 23 % in 2016, according to Amankwah et al.\(^{21}\). In other specialties, such as cardiology, female first authors made up 3.0 % of all publications in 1958, compared to 23 % in 2016\(^{21}\). Similarly, in 1958, female last 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).

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 contributors 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

| 1961 | 1971 | 1981 | 1991 | 2001 | 2011 | 2021 | p-value |
|------|------|------|------|------|------|------|---------|
| **Current Qualifications (Senior Female Author)** | | | | | | | |
| MBBS/MD/DO/Fellow | 5/14 (35.71%) | 7/43 (16.28%) | 3/43 (6.98%) | 30/30 (100%) | 10/58 (17.24%) | 13/78 (16.67%) | 11/48 (22.92%) | 0.049 |
| Ph.D./MSc/MPH | 9/14 (64.29%) | 30/43 (69.77%) | 40/43 (93.02%) | 0 (0%) | 48/58 (82.76%) | 63/78 (80.77%) | 26/48 (54.17%) | |
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 endodontology journals - A 70-year analysis

https://doi.org/10.5061/dryad.rjdfn2zd17

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).

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