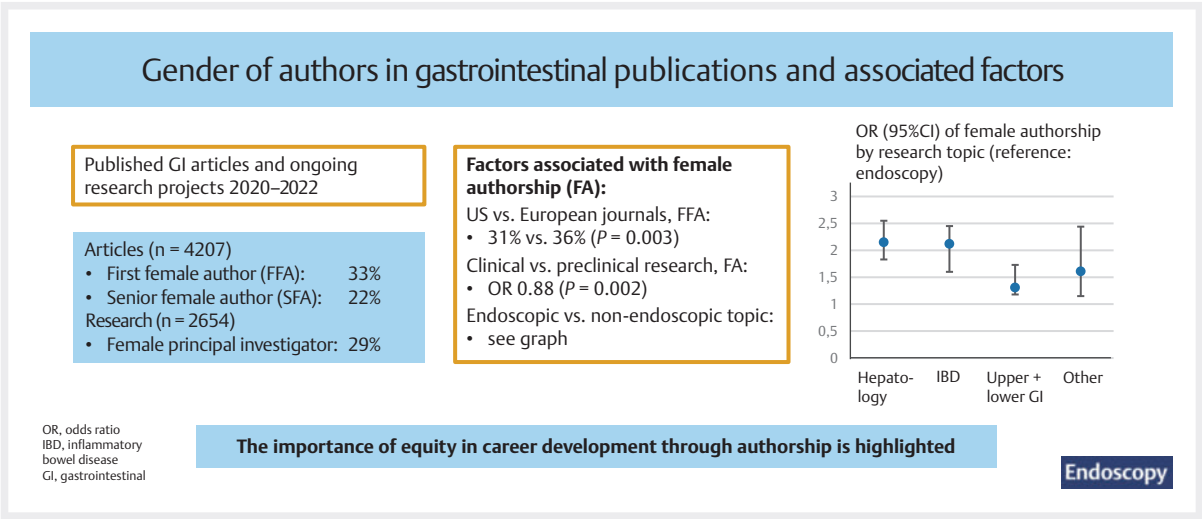
Gender authorship in major American and European gastroenterology journals: the gap is still unfilled

GRAPHICAL ABSTRACT



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ABSTRACT

Background The gender gap in the authorship of scientific research may affect career advancement. Our aim was to assess the potential gender gap in gastrointestinal (GI) journals.

Methods A systematic review was performed of the GI literature and ongoing research in the period 2020–2022. A total 10 GI journals and ongoing research on clinicaltrials.gov were selected for review. The gender gap in first and senior authorship was evaluated for each article and ongoing research project. Associations between the gender gap and possible predictors were measured and results are presented as odds ratios (ORs) with 95%CI.

Results The number of first female authors (FFAs) and senior female authors (SFAs) in published articles were 1408/4207 (33.5%) and 911/4207 (21.7%), respectively. There were 781/2654 (29.4%) female principal investigators (PI)s for the ongoing research. On comparison of non-endoscopic vs. endoscopic topics, the latter were associated with the gender gap (hepatology, OR 2.15 [95%CI 1.83–2.55]; inflammatory bowel disease, OR 2.12 [95%CI 1.60–2.45]; upper and lower GI, OR 1.31 [95%CI 1.18–1.73]); as well as the type of article (original article vs. editorial, OR 1.92 [95%CI 1.58–2.33]). The type of research was also associated with the gender gap (clinical vs. preclinical studies, OR 0.88 [95%CI 0.66–0.91]).

Conclusion Our results demonstrated a correlation between the gender gap and the design and topic of the research. Future strategies for improving equity in career development in GI endoscopy should focus on closing the gender gap in equity of authorship.

Introduction

In the medical field, authorship is notably linked to career advancement, making gender equity in scientific authorship and equal opportunities in research a topic of great interest. When analyzing the medical profession, it is worth noting that over half of medical students are female; however, in the USA, the majority of admitted residents are men and, during their careers, they are more likely to obtain leadership positions endowed with decision-making and budget power [1]. In fact, according to a recent review, in 2018, women represented 29% of division and section chiefs, and 18% of department chairs [2]. Furthermore, a recent study published in the *Journal of the American Medical Association* demonstrated that women receive fewer awards and, as a result, have access to less funding [3].

With regard to academic medicine, women have been found to be less likely to secure senior faculty positions and to experience slower promotion [4, 5]. As a result, gender-based disparities have been observed in the authorship of academic literature and medical education journals [6]. Furthermore, women remain under-represented on editorial boards of influential medical journals [7], and women with comparable experience and qualifications are less likely than men to be invited to publish editorials [8]. The specific field of gastroenterology and endoscopy is no exception.

An important descriptive study published in *Gastrointestinal Endoscopy* in 2015 assessed the situation by evaluating the percentage of female authors in the five most influential American gastroenterological journals during a span of 20 years (1992–2012) and demonstrated a slow increase in female authorship, with the proportion of first female authors (FFAs) rising from 9.1% to 29.3% and of senior female authors (SFAs) increasing from 4.8% to 14.5% [9].

Unfortunately, the absolute number of female and male gastroenterologists worldwide and their distribution among the specific subspecialities (e.g. endoscopy, gastroenterology, inflammatory bowel disease [IBD], hepatology, etc.) is not known. We believe however that analyzing authorship in scientific publications is important because it provides valuable insights into whether gender imbalance exists in the scientific community or not. There is a lack of recent studies, especially involving European countries and journals, that have tracked the latest developments in this area or offered more specific explanations for this phenomenon.

This observational retrospective study aimed to give a snapshot of the role and representation of women gastroenterologists in the field of science.

Methods

The authorship was evaluated in articles already published and in ongoing research over the last 3 years (2020–2022). The analysis focused on articles from ten high impact factor (IF) journals that specialize in gastroenterology and hepatology, five based in the USA and five based in Europe. US-based journals were labeled "Group 1" and were as per those in the previous article published by Long et al. [9]. The European-based group were labeled "Group 2." Both groups provided substantial representation of the subcategories in the field of gastroenterology (general gastroenterology, hepatology, endoscopy, and IBD).

Journals included in Group 1 were *Gastroenterology* (IF 33.88), *Hepatology* (IF 17.42), *American Journal of Gastroenterology* (AJG; IF 10.86), *Clinical Journal of Gastroenterology* and *Hepatology* (CGH; IF 11.38), *and Gastrointestinal Endoscopy* (GIE; IF 9.42). Group 2 included *Journal of Crohn's and Colitis* (JCC; IF 10.02), *Digestive and Liver Disease* (DLD; IF 5.16), *Journal of Hepatology* (IF 30.08), *Gut* (IF 31.79), and *Endoscopy* (IF 10.43). The articles included were editorials and original articles from authors from all countries; case reports, case series, meta-analyses, guidelines, and reviews were excluded.

Data extracted for each article included the first, second, and senior (last listed) authors' gender and institutional nationality, the type of article (editorial/original article), study design (retrospective/prospective), type of research (clinical/preclinical), and topic (endoscopy, hepatology, upper and lower GI, IBD, and other). The parameter "study design" was applied only for original research. The author's gender was first determined on the basis of the name, with further verification made

by visiting the institutional website and performing Google search engine research.

For the ongoing research, the data were collected from clinicaltrials.gov, searching "gastrointestinal" and applying as filters "recruiting" and eligibility criteria "adult" and "old adult." Data extracted for each ongoing research project were the gender of the principal investigator (PI) and the country of their institution, the topic (diagnostic/therapeutic endoscopy, upper GI/lower GI, IBD/hepatology/biliopancreatic tract/cancer/other), study design (retrospective/prospective), and type of research (clinical/preclinical).

Statistical analysis

Statistical analyses were performed using STATA software. Categorical variables are expressed as absolute numbers and percentages.

The frequency of authorship stratified by the author's gender was calculated for Group 1 and Group 2. A chi-squared test was used to compare Groups 1 and 2 to evaluate a possible difference in publications among men and women based on the country of the journal (US- vs. European-based journals). The chi-squared test was also used to study the association of the first and senior authors' gender.

Univariable logistic regression analysis was performed to identify factors associated with female authorship as the primary outcome, defined as having an FFA and/or SFA, and results are presented in terms of odds ratios (ORs) with 95%CI. The factors analyzed were the journal, type of article (editorial as the reference), study design (retrospective study as reference), type of research (preclinical as reference), and topic of the research (endoscopy as reference). The same analysis was performed for ongoing research.

Results

The articles identified were US-based (Group 1) in 52.4% (n = 2205) and European-based (Group 2) in 47.6% (n = 2002).

Authorship per journal and type of article

Among published articles in Group 1, 496/2205 (22.5%) were editorials; in Group 2, editorials made up 295/2002 (14.7%).

The overall proportion of FFAs was 1408/4207 (33.5%) and of SFAs was 911/4207 (21.7%). In Group 1, we found 693/2205 (31.4%) FFAs and 457/2205 (20.7%) SFAs; in Group 2, we found 715/2002 (35.7%) and 454/2002 (22.7%), respectively. In the comparison between Groups 1 and 2, US-based journals showed a statistically significant lower percentage for FFAs ($P = 0.003$), but not for SFAs ($P = 0.12$).

In the analysis for single journals, the lowest percentage of FFAs was in GIE (23.05%; OR 0.55 [95%CI 0.45–0.67]; $P<0.001$), followed by *Endoscopy* (24.55%; OR 0.63 [95%CI 0.48–0.84]; $P = 0.001$) and *Gastroenterology*, but this last one was not statistically significant (31.0%; OR 0.92 [95%CI 0.76–1.11]; $P = 0.40$). The percentage of SFAs was 9.1% in CGH (OR 1.21 [95%CI 0.39–3.77]; $P = 0.73$), followed by 12.3% in *Endoscopy* (OR 0.48 [95%CI 0.33–0.70]; $P<0.001$) and 14.8% in GIE (OR 0.58 [95%CI 0.46–0.74]; $P<0.001$).

Univariable logistic regression found a statistical association between female authorship and the type of article (editorial or original article), with the percentage of editorials published by men being higher than by women (original article, OR 1.92 [95%CI 1.58–2.33]; $P<0.001$). Women were the first author in 35.8% of original articles and 23.4% of editorials.

Finally, a female physician had a higher likelihood of being the first author if the senior author was a woman rather than a man ($P<0.001$), both for the US-based and European-based journals. An FFA was found in 468/911 (51.4%) of articles with an SFA and in 934/3296 (28.3%) in articles with a male senior author.

Authorship and topic of the research

Out of 4207 articles, 1112 (26.4%) dealt with endoscopy, 1573 (37.4%) were focused on hepatology, 588 (14.0%) on IBD, 668 (15.9%) dealt with upper and lower GI disease, and finally 266 articles (6.3%) were focused on other topics not included in the previous categories. For this analysis, we considered "articles published by a female gastroenterologist" to be all articles in which there was an FFA, SFA, or both. Of the articles about endoscopy 348/1112 (31.3%) were published by a female gastroenterologist. For the non-endoscopic topics, the percentages were 792/1573 (50.3%) for hepatology, 281/588 (47.8%) for IBDs, 304/668 (45.5%) for upper and lower GI disease, and 127/266 (47.7%) for other topics, respectively.

In the comparison of endoscopic vs. non-endoscopic topics, logistic regression (endoscopic topic as reference) found an association between female authorship and publications about hepatology (OR 2.15 [95%CI 1.83–2.55]; $P<0.001$), IBD (OR 2.12 [95%CI 1.60–2.45]; $P<0.001$), upper and lower GI (OR 1.31 [95%CI 1.18–1.73]; $P = 0.003$), and others (OR 1.61 [95% CI 1.15–2.44]; $P = 0.002$) (▶ **Table 1**).

In the analysis of the authorship position of the female author, the highest rate of FFAs was seen in hepatology (594/1573; 37.8%) and IBD (220/588; 37.4%); the highest rate of SFAs was seen in hepatology (391/1573; 24.9%) and upper and lower GI (141/668; 21.1%). The lowest rate of FFAs was seen in endoscopy (262/1112; 23.6%); the same topic also showed the lowest rate for SFAs (170/1112; 15.3%).

▶ **Table 1** Female authorship stratified by the topic of the research.

	Odds ratio	95%CI	*P* value
Endoscopy	1	1	
Hepatology	2.15	1.83–2.55	<0.001
Inflammatory bowel disease	2.12	1.60–2.45	<0.001
Upper and lower GI disease	1.31	1.18–1.73	0.003
Others	1.61	1.15–2.44	0.003

GI, gastrointestinal.

Authorship and design of the research

In the analysis of research design, the parameter "prospective vs. retrospective" was evaluated only for original articles and was collected for 3088/3416 articles (90.4%). The type of research defined as "preclinical vs. clinical" research was applied for all of the published articles and information was collected for 4107/4207 published articles (97.6%). For this analysis, we considered "articles published by a female gastroenterologist" to be all articles in which there was an FFA, SFA, or both.

A significant association with the type of research was found, showing an inverse association between female gender and publication of clinical studies (clinical studies, OR 0.88 [95%CI 0.66–0.91]; $P=0.002$). In contrast, the gender gap was not associated with the research design (prospective studies, OR 1.15 [95%CI 0.93–1.42]; $P=0.18$).

In the analysis of the authorship position of the female author, among clinical studies, the percentages published by a female gastroenterologist were 1019/3097 (32.9%) for FFA and 642/3097 (20.7%) for SFA; in preclinical studies, they were 360/1010 (35.6%) and 245/1010 (24.3%), respectively. In the analysis of "prospective vs. retrospective", among prospective studies, the percentages of female gastroenterologists were 713/1942 (36.7%) for FFA and 425/1942 (21.9%) for SFA; in retrospective studies, the percentages were 389/1144 (34.0%) and 252/1144 (22.0%), respectively.

Authorship stratified by the country of the institution

Because of the very different number of published articles coming from different countries, the results are presented only as the percentage of FFAs and SFAs per country. The highest percentage of FFAs was found for Brazilian institutions (9/16 articles [56.3%]). European institutions show high percentages of FFAs (Sweden 23/49 [46.9%]; Belgium 24/53 [45.3%]; Spain 68/145 [46.9%]; the Netherlands 70/151 [46.4%]; and France 95/207 [45.9%]). The lowest percentage of FFAs was found for Japanese institutions (17/168 articles [10.1%]). For SFAs, the highest percentage reported was for Belgium (16/39 articles [41.0%]) and the lowest were for India (2/38 [5.3%]) and Japan (11/160 [6.9%]) (▶ **Table 2**; ▶ **Fig. 1**).

▶ **Table 2** Female authorship stratified by the country of the institution.

	Percentage of FFAs (n/N)	Percentage of SFAs (n/N)
Norway	38.9 (7/18)	12.5 (3/24)
Sweden	46.9 (23/49)	18.2 (10/55)
Netherlands	46.4 (70/151)	29.1 (48/165)
Belgium	45.3 (24/53)	41.0 (16/39)
Denmark	33.3 (15/45)	31.6 (12/38)
UK	33.5 (89/266)	21.0 (57/271)
France	45.9 (95/207)	30.0 (64/213)
Germany	37.7 (83/220)	18.8 (39/207)
Switzerland	36.7 (11/30)	18.5 (5/27)
Italy	35.0 (103/294)	20.1 (57/284)
Spain	46.9 (68/145)	24.7 (39/158)
Portugal	47.1 (8/17)	33.3 (4/12)
Canada	39.5 (47/119)	33.7 (35/104)
USA	28.9 (408/1413)	19.4 (256/1320)
Brazil	56.3 (9/16)	18.8 (3/16)
Israel	26.1 (12/46)	36.8 (14/38)
China	34.5 (152/441)	24.8 (108/436)
Japan	10.1 (17/168)	6.9 (11/160)
India	20.0 (8/40)	5.3 (2/38)
Australia	31.2 (29/78)	15.5 (11/71)

FFA, first female author; SFA, senior female author.

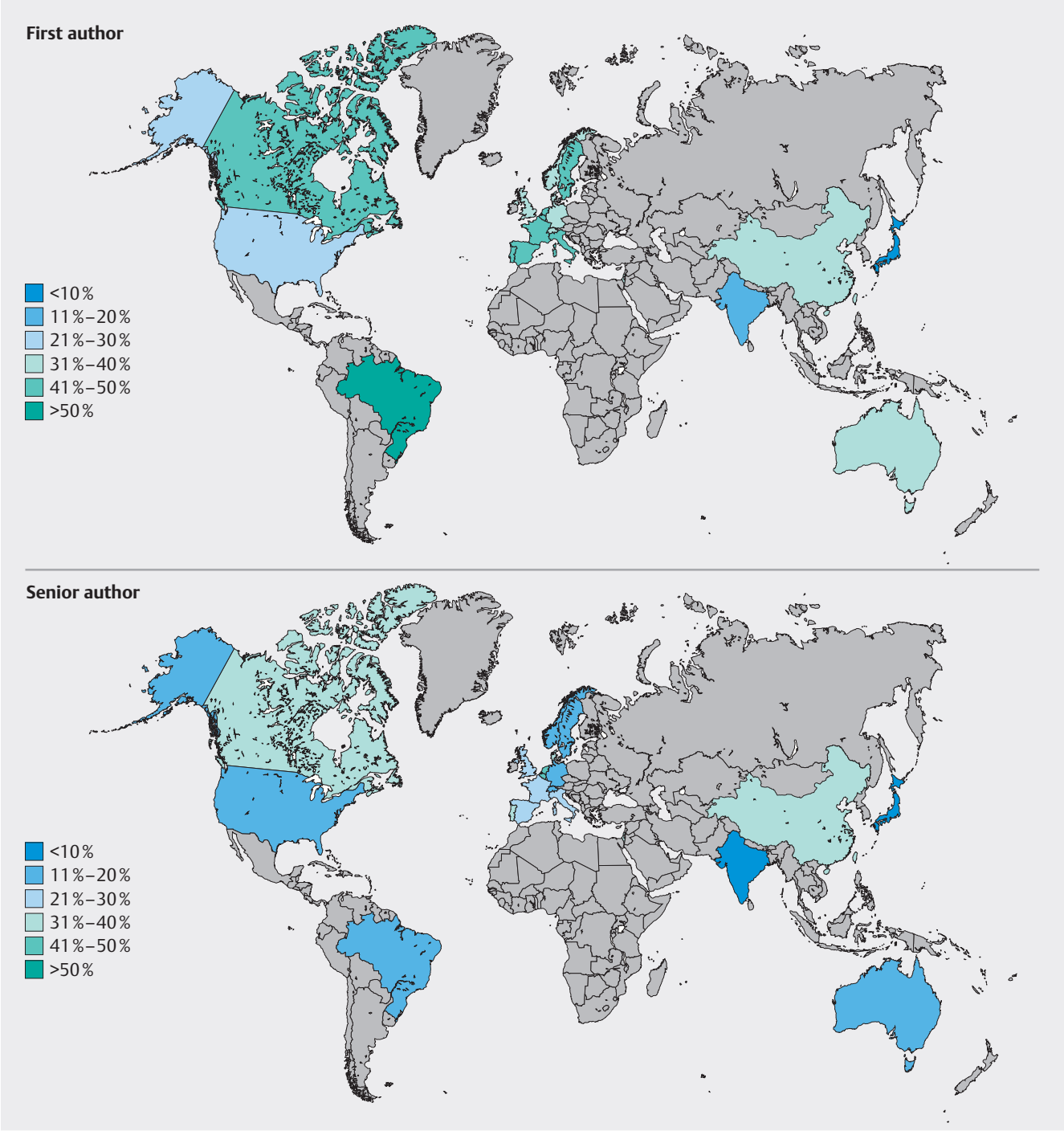
Ongoing research

The number of ongoing research projects identified was 2654, split across 856 in 2020, 865 in 2021, and 933 in 2022. Stratified for the PI's gender, 1873/2654 projects (70.6%) were directed by a male PI, 781/2654 (29.4%) by a female PI.

Of these new research projects, 2575/2654 (97.0%) were prospective studies. Among the retrospective studies, 28/79 projects (35.4%) were directed by a female PI; among the prospective studies, a female PI was identified in 753/2575 (29.2%). For stratification by type of the research, 2466/2654 (92.9%) were clinical projects, with 717/2466 (29.1%) directed by a female PI. Preclinical studies made up 185/2654 (7.0%), with 63/185 (34.1%) directed by a female PI. There was no association between female gender of the PI and the design and type of research ([reference preclinical] clinical, OR 0.79 [95% CI 0.57–1.08; $P=0.15$]; [reference retrospective] prospective, OR 0.75 [95%CI 0.47–1.20; $P=0.23$]).

In the analysis of topics, a female PI was identified for 66/240 projects dealing with endoscopy (27.5%), 140/493 about hepatology (28.4%), 88/255 about IBD (34.5%), 119/350 about upper and lower GI diseases (34.0%), 306/1126 about tumors (27.2%), and 62/190 about other topics not included in previous categories (32.6%). No relationship was found between the PI's gender and the topic of the project in the comparison between endoscopic vs non-endoscopic topics ([reference endoscopy] hepatology, OR 1.04 [95%CI 0.74–1.47; $P=0.79$]; IBD, OR 1.38 [95%CI 0.94–2.03; $P=0.09$]; upper/lower GI, OR 1.35 [95%CI 0.94–1.94; $P=0.09$]; tumors, OR 0.98 [95%CI 0.71–1.34; $P=0.91$]; other, OR 1.27 [95%CI 0.84–1.93; $P=0.24$]).

The increase in the representation of women was not equally distributed across the world: we found countries with a significant gap in female representation compared with others. The lowest percentages of female PIs were found in Germany (10.0%) and Japan (11.1%), far away from the highest percenta-



▶ **Fig. 1** Percentages of first and senior female authors around the world.

ges (Portugal 66.7%, Poland 56.3%, Spain 47.99%, and Switzerland 46.7%) (▶ **Table 3**).

Discussion

This study analyzed the gender of physicians actively engaged in scientific research in the field of gastroenterology, by assessing the relationship between the gender of the authors of scientific papers and PIs for ongoing research. The main limitation of this study is the lack of knowledge about the percentage composition of currently employed gastroenterologists (i.e. the total numbers of female and male gastroenterologists). According to the OECD (health statistic), from 2000 to 2019, the percentage of female physicians increased from 40% to 49% [10] (▶ **Fig. 2**). While there are no data about the percentage of female gastroenterologists across the world as a whole, some data have been reported for a few countries, like the USA, in which female gastroenterologists made up 17.6% in

▶ **Table 3** Female principal investigators (PIs) stratified by the country of the institution.

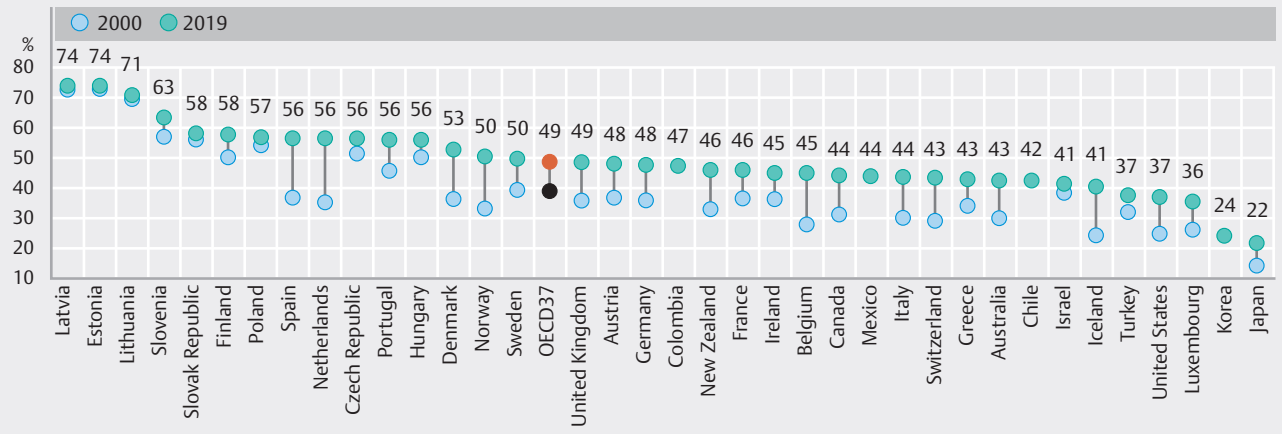
Country	Percentage of female PIs (n/N)
Norway	21.4 (3/14)
Sweden	32.4 (12/37)
Netherlands	38.3 (18/47)
Belgium	38.2 (13/34)
Denmark	41.8 (28/67)
UK	32.7 (16/49)
France	39.6 (55/139)
Germany	10.0 (7/70)
Switzerland	46.7 (7/15)
Italy	16.9 (14/83)
Spain	47.9 (34/71)
Portugal	66.7 (8/12)
Canada	43.9 (18/41)
USA	33.3 (274/822)
Brazil	33.3 (3/9)
Israel	25.0 (5/20)
China	21.8 (143/655)
Japan	11.1 (2/18)
India	23.2 (13/56)
Australia	30.8 (4/13)

2017 [11], and the UK, with 21% female gastroenterologists in 2019 [11]. However, these data are older than the period analyzed in our work and only partially represent the sample under study.

Nevertheless, this study reveals that, for some subspecialties and journals, there is a higher likelihood of encountering articles published by male gastroenterologists than by female gastroenterologists. The first part of the study focused on articles already published, divided into editorials and original articles. An initial descriptive analysis of the data demonstrated female representation to be 33.4% for FFAs and 21.7% for SFAs. These data suggest a consistent trend with that reported by Long et al. [9], and show a slight increase. We can speculate about this encouraging trend representing an increase in the general representation of women in science and medicine in most of the fields of specialization. The percentage of SFAs experienced slower growth, which can be attributed to the longer time required for academic advancement. Female physicians are still less inclined to choose gastroenterology as their field of residency, perhaps owing to the long shifts; high risk operative procedures with biological and radiological hazards limiting women's involvement, especially during pregnancy; slow learning curve for therapeutic procedures, which does not fit with family life; and finally a shortage of female mentors [12].

The aforementioned factors could also be the reason for the differing stratification of women's publications on the basis of topic. In the subanalysis of topic, when compared with publications on endoscopy, all other topics were found to have a higher likelihood of having a female author. As previously stated, we demonstrated a higher likelihood of publications by women in more clinically oriented issues, like hepatology, IBD, and upper and lower GI diseases. We can speculate that these results also represent the gender split in daily practice. Even in these clinical fields, the percentage of SFAs remained significantly lower than the percentage of FFAs. For example, in hepatology and articles dealing with IBD, female authors were approximately two times (OR 2.15 and 2.12, respectively) more likely than for those about endoscopy.

It is also interesting that the association between the genders of the first and senior authors was statistically significant: if the senior author was female, the first author was also female in 51.4% of publications, but if the senior was a male, the FFA



▶ **Fig. 2** Change in the percentages of women in medicine over the last two decades across the world. Source: OECD 2021 [10].

rate dropped to 28.4%. These results pose a challenge in interpreting these gender-based preferences, especially when considering that the association of FFAs and SFAs is higher (51.4%) than the estimated percentage of female gastroenterologists involved (17%–21%, according to the latest partial data).

Furthermore, the comparison of American and European journals showed a higher percentage of female publications in European-based journals than in a US-based ones. To corroborate these findings, it is notable that women practicing in European medical institutions exhibited a higher percentage of publications than those working outside of Europe. The highest percentages were observed in Sweden 46.9%, Belgium 45.3%, Spain 46.9%, the Netherlands 46.4%, and France 45.9%. In addition, Brazil had a high percentage of female publications, but these data are subject to bias from the very low number of articles to evaluate. The lowest percentages were seen in Japan (10.1% for FFAs and 6.9% for SFAs) and India (5.3% for SFAs). First female authorship was statistically more frequent in European-based journals than in the US-based journals (35.6% vs. 31.4%; $P = 0.003$); although the percentage of SFAs was higher in Group 2 than in Group 1 (22.7% vs. 20.7%), the difference was not statistically significant ($P = 0.12$). On the analysis of individual journals, some such as *Endoscopy* and GIE had percentages of FFAs and SFAs that were far below others such as *Hepatology* and JCC.

Editorials are typically the expression of expert opinions and the possibility of publication is almost double for male authors (OR 1.92 [95%CI 1.58–2.33]; $P<0.001$).

The percentage of female PIs closely mirrored the overall proportion of FFAs (29.4% vs. 33.1%) and significantly exceeded the overall proportion of SFAs (29.4% vs. 21.5%); however, the association between gender and topic was not confirmed.

Efforts aimed at achieving equal opportunities for both female and male physicians to ascend to become leaders in research are far from complete, as it is still strongly influenced by the country in which the institution sits. This is proved by a gap of almost 56 percentage points from the most female-inclusive country (Portugal, 66.7% of PIs are women) to the least (Germany, 10.0% of PIs are women).

Our study presents some limitations that need to be expressed. First, the method used to discriminate the author's gender was based on online research via the institutional website. Second, the absolute number of female gastroenterologists in the world and in individual countries is not known. The selection criteria for the journals analyzed started with the inclusion of the same journals that were evaluated by Long et al. For the European-based journals, we chose five journals with similar IFs [9]. Last, we have assumed an equal impact of the SARS-COV2 pandemic on male and female physicians in terms of scientific research.

In conclusion, this work analyzes female authorship in GI articles over a time-span of 3 years, from 2020 to 2022. Positive signals suggesting a smooth increase in female authorship over time came from the comparison of our results in the US-based journals with the previous results of Long et al. for the same journals (29.3% in 2012 vs. 31.4% from 2020 to 2022). Gender biases are still present, shown by the significant association of FFAs and SFAs, and by the correlation between the gender gap and the design/topic of the research. Future strategies aimed at improving equity in career development in gastroenterology should prioritize efforts to close the gap in equity in authorship, like encouraging female mentorship and ensuring transparency during grant selection and academic advances.

Conflict of Interest

The authors declare that they have no conflict of interest.

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