



The perennial issue of gender discrepancy in publications on chest diseases

To the Editor:

Scientific research, academic presentations and academic publications are demonstrators of success, enabling career progression, administrative promotions including departmental chairs and national/international recognition. However, maternity, housework, family responsibilities and other gender issues may force females to allocate only a limited time for academic practice.

Females seem to be underrepresented in first authorship, senior authorship and guest editorial authorship across a range of specialties including internal medicine, obstetrics and gynaecology, surgery, and ophthalmology [1, 2]. However, the proportion of female first authorship is growing in some areas including pulmonology, dermatology, emergency medicine and gastroenterology [3–5]. In high-impact journals, the percentage of publications with a first female author increased from 27% in 1994 to 37% in 2014; while in pulmonology research, this positive trend was interrupted between 2009 and 2014 as no appreciable improvement in female first authorship was observed in this period [2].

Despite special efforts to prevent gender inequality, women are underrepresented in senior academic roles [6]. In the USA, although 40% of academic physicians are female, this rate falls to 16–24% when we look at the proportion of females as division chiefs, department chairs and deans [1, 7, 8].

In this study, the *status quo* of gender equilibrium in the publications of the *European Respiratory Journal (ERJ)* is investigated and some explanatory factors of gender discrimination are proposed.

All papers published in the *ERJ* between 1 January, 2012 and 1 December, 2019, in total 3202 papers, were retrospectively reviewed. Full names of the authors, titles of the manuscripts, the country of the first author, and the total number of the authors were obtained *via* PubMed API (Application Programming Interface) from the website of the *ERJ*. The first, second, third and last author genders were investigated using the website www.genderize.io. For each name, gender information and the probability (%) of an accurate estimation were recorded. All computer codes for the data extraction were written with Python.

Author genders coded *via* [genderize.io](http://www.genderize.io) were re-evaluated according to the probability rates. If gender probability was lower than 85%, the author's full name was subjected to a manual search on the internet to identify his/her gender. We failed to accurately identify authors' gender in a total of 51 publications, which we have excluded from the study.

The first three authors' and last author's gender rates were analysed according to year, author number, first author's country, and the subject of the publication. For the analysis of gender discrimination according to author number, papers were categorised into five groups as one, two, three, four and more than four author papers.

Data are expressed as mean \pm SD frequency. Chi-squared and t-test were used to evaluate the data obtained from inter-group comparison. All statistical analysis was carried out using SPSS for Windows version 16.0 (SPSS Inc., Chicago, IL, USA). A p value of <0.05 was considered significant.

Among all 3151 papers, the highest number of publications in total was recorded in 2012 (15%, 472 publications) and the lowest was in 2013 (9%, 285 publications). Single, double, three and four author



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This letter gives a concrete picture of the lack of equal opportunities for women in academia, and raises awareness for professionals and policy makers to level the playing field and to enable women to contribute more to the accumulation of knowledge. <https://bit.ly/2UumeNK>

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paper rates were 2% (n=57), 4% (n=139), 5% (n=172), and 7% (n=226), respectively. While 49% (n=1556) were written by 5–10 authors, the rest of the papers were written by more than 11 authors. The countries with most frequent first-author publications were the UK, the USA, France, the Netherlands and Germany (15%, 12%, 10%, 9% and 7%, respectively). The three most frequent themes of the publications were COPD, tuberculosis and asthma (15%, 13% and 11%, respectively). In terms of gender distribution of the first authorship, 1261 (40%) of papers were written by a first female author. For female second, third and last authors, the rates were 39%, 39% and 22%, respectively. The rate of co-authorship by a female first author and a male senior (last) author was significantly lower than the co-authorship rate by a male first author and a senior male author (73 *versus* 81%, respectively, $p<0.0001$).

The general distribution of author genders did not vary significantly by year (for the first, second and last authors, $p=0.840$, $p=0.552$ and $p=0.265$, respectively). As publishing with multiple authors is more a rule than an exception and an implicit hierarchy exists in the order of authors in a given publication, we sought how frequently female authors were ranked in initial ranks in this order. Among single, double, three, four and more than four author papers, first author female gender rates were 16%, 23%, 39%, 43% and 42%, respectively ($p<0.0001$). Second author female gender rates in two, three and more than three author papers were 26%, 40% and 40%, respectively ($p=0.002$). Third author female gender rates in four and more than four author papers were 29%, and 40%, respectively ($p=0.003$). Finally, in two, three, four and more than four author papers, the last (senior) female authorship rates were 14%, 19%, 27% and 23%, respectively ($p=0.017$). As these percentages show, women's first and last authorships are consistently low regardless of the total number of authors. In parallel, women's participation in publishing increases only with an increase in number of authors, and women authors tend to be relegated to ranks of lower visibility.

First authors were more often female in the Netherlands, Switzerland and Belgium (57%, 55% and 52%, respectively). According to the first author's study department country, the highest proportion of female gender amongst last authors was found in Japan, South Africa and Sweden (44%, 41% and 38%, respectively) (table 1). As these countries are all advanced economies, their superiority in higher proportion of visible women's authorship compared with their peers (other countries with the same level of economic and social development) could explicate some policy responses for this perennial issue of gender discrepancy.

Papers on cystic fibrosis (CF) and primary ciliary dyskinesia (PCD) were more dominantly written by females (52%). First and second authors' genders did not differ significantly according to the subject of the paper. Last authors were most frequently female in papers on asthma and CF/PCD (33% and 27%, respectively). The least frequent female last authors were recorded in papers on lung cancer and sleep disorders (16% for both) ($p<0.0001$). Here, if we acknowledge the last authors as the ones with the most

TABLE 1 Author gender rates according to the first author's country [countries are listed with respect to the frequency of publications in the journal]

	First author ($p<0.0001$)	Second author ($p=0.006$)	Third author ($p=0.027$)	Last author ($p<0.0001$)
UK	41/59	43/57	39/61	23/77
US	38/62	35/65	38/62	22/78
France	38/62	41/59	43/57	18/82
The Netherlands	57/43	42/58	42/58	28/72
Germany	33/67	37/63	41/59	20/80
Italy	30/70	42/58	47/53	17/83
Spain	35/65	39/61	42/58	17/83
Australia	40/60	43/57	39/61	17/83
Belgium	52/48	24/76	39/61	17/83
Switzerland	55/45	33/67	31/69	24/76
Sweden	39/61	38/62	31/69	38/62
Denmark	24/76	50/50	35/65	32/68
China	9/91	16/84	16/84	17/83
Japan	41/60	39/61	28/72	44/56
Norway	47/53	39/61	27/73	16/84
Greece	33/67	42/58	33/67	13/87
South Africa	38/62	22/78	27/73	41/59

Data are presented as female/male %.

input into the publication, again, the lack of equilibrium in female first authorship and in female last authorship indicate an alarming lack of appreciation of women in the academic world in terms of career prospects. The materiality that last authorship is of critical value for career advancement to senior positions reveals that overcoming women's participation/visibility in publications, especially as last authors, could pave the way for women to hold leadership positions and contribute more to the scientific knowledge on an equal par with their fellows. It should also be pointed out that women specialists in paediatric respiratory diseases may have contributed to the aforementioned dominance of women in publishing on CF and PCD. This is a ripe question for further research to better understand the trends in gender distribution/representation in contiguous specialties.

Author gender distribution may vary according to the proportion of male and female fellows and specialists in the concerned area. The gender distribution for individual countries or for European Respiratory Society members is not available for the present study. In Turkey, the majority gender of Turkish Thoracic Society membership is female (57.5%). The total number of publications from Turkey in the *ERJ* is inadequate to perform a meaningful statistical analysis. However, we see that in the official journal of the Turkish Thoracic Society (*Turkish Thoracic Journal*) among publications in 2018 and 2019, the female first author rate was 39% [9]. The reasons behind such low participation of women despite their being a majority in a profession could give important insights. One reason behind this discrepancy may be that the gender distribution in Turkey is simply not representative for the distribution of specialists in the same area in other countries. Secondly, an incentive problem may exist for women's promotion to the high-level administrative positions. A third explanation may be that women are precluded from pursuing additional career-related responsibilities due to home-related duties. Motherhood and family responsibilities may both prolong and diminish the chances of promotion for women in their careers. Assuming a similar general gender distribution in the overall demographics, social policies and professional incentives seem to be the main pillars of a more equitable gender representation. As the CF and PCD research data above show, only when women dominate in number could they have an opportunity to alleviate the representation problem. More research may cast light on the policy and incentive causality by comparing countries with better women's representation and countries with worse representation.

The present study revealed higher male authorship in single- and double-authored papers. These papers may provide the author(s) with shorter time frames in terms of promotion prospects. The causal relationship also works the other way. The scale of male positioning in higher echelons of professional and administrative hierarchy causes them to publish papers in a prompt manner (publication eases with the number of previous publications) with their male co-author(s). This begets both a virtuous and vicious cycle: a virtuous cycle for males and vicious for women. Higher male authorship in papers with fewer authors could also signify that male academics tend to prefer individualism and/or take more responsibilities in their studies and that women's authorship is favoured in research by rather crowded teams. We also believe that this could indicate female inclination to cooperation and collaboration. It should be pointed out that the larger the number of authors the less visible women become in the descending order of authors exacerbating the lack of promotion women suffer from.

In the present study, male senior (last) authors are found to co-publish less with first-author females. The underlying reason for this is not yet understood. Newly designed studies analysing the distribution of registered juniors' genders in publications may enlighten the issue of whether the junior females are not given the equality of opportunities. Apart from the underlying reason; it seems safe to predict that because the male senior authors constitute the majority and because these males publish less with first-author females, the rate of first-author female publications has been stable for the past several years.

The literature reports that women are awarded with a lower amount of research funds from the US National Institutes of Health and are less likely to be refunded [8, 10, 11]. We think that a fairer allocation of research funds, fairer supportive procedures and opportunities for gender leadership could lead women to take more active roles in the scientific world. In order to compensate for the extant inequalities and in order to prevent the vicious cycle for women from perpetuating, policy support from health and social ministries as well as from the medical community is required. Business as usual, in this respect, is to no avail.

Female author rates vary according to countries. Working conditions and academic/administrative prospects may be behind this country-female first authorship causality. Also, demographics, the economic development level of these countries and the general social policies implemented (policies regarding paid leave, maternity leave, social security conditions, etc.) to encourage women's participation in high-quality academic work could be contributing factors. In this respect, the present study may be an initiator of further research and could guide policy makers/leaders. While culture is an undeniably important factor,

its being a meta-variable and the difficulty of its quantification may favour other explanatory factors, although culture's primary importance and other explanatory factors' potential intervening roles need to be recognised. Policies thus adopted can take account of rather long-term and ingrained cultural factors while targeting quantifiable variables and achieving concrete results. In conclusion, in terms of pulmonology, first-female authorship rates have been stagnant over the past 8 years. Furthermore, compared with male first authorship, female authorship remains remarkably lower. Exceptions with a higher share for female authors are the Netherlands, Switzerland and Belgium. Male senior authors have been publishing academic work with male first authors more frequently. Males dominate the authorship in single-author and two-author studies. Particular topics have a higher proportion of female authors, which may be explained by the predominantly paediatric input. Country-specific cultural and social factors may influence gender equality of opportunities in respiratory medicine science and academia. Further research is needed to guide policies in the quest to achieve a gender equilibrium in representation and to mitigate the barriers to women's professional advancement.

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