Gender Differences in First and Corresponding Authorship in Public Health Research Submissions During the COVID-19 Pandemic

Michelle L. Bell, PhD, and Kelvin C. Fong, PhD

See also Pinho-Gomes, p. 15.

Objectives. To investigate the rate of manuscript submission to a major peer-reviewed journal (*American Journal of Public Health*) by gender, comparing periods before and during the pandemic.

Methods. We used data from January 1 to May 12, 2020, and defined the start of the pandemic period by country as the first date of 50 or more confirmed cases. We used an algorithm to classify gender based on first name and nation of origin. We included authors whose gender could be estimated with a certainty of at least 95%.

Results. Submission rates were higher overall during the pandemic compared with before. Increases were higher for submissions from men compared with women (41.9% vs 10.9% for corresponding author). For the United States, submissions increased 23.8% for men but only 7.9% for women. Women authored 29.4% of COVID-19–related articles.

Conclusions. Our findings suggest that the pandemic exacerbated gender imbalances in scientific research. (*Am J Public Health*. 2021;111:159–163. https://doi.org/10.2105/AJPH.2020.305975)

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Gender imbalance in child care, elder care, and housework is well documented, including in families where women work outside the home,[1–4] and can contribute to work–family conflict.[5] In academic households, division of housework by gender persists, with findings similar to those of other dual-career couples.[6,7] Female scientists perform twice as much work as male scientists at household tasks such as laundry, cleaning, food preparation, and grocery shopping, whereas male scientists perform more work related to some other tasks (e.g., yardwork, vehicle maintenance).[6,7] The least amount of core housework was conducted by male scientists with stay-at-home partners. Disparities differed by academic rank (e.g., full professor vs assistant professor), yet female scientists performed more housework than male scientists at all ranks. The net disparity equated to an additional 14.6 hours per week of housework for female scientists.[7]

The COVID-19 pandemic has altered the nature of work, including for the scientific community. Scientists at all career stages have had to shift and adapt to online teaching, videoconferencing, and lack of access to laboratories and other critical professional resources. Researchers who are also clinicians or public health practitioners face the additional burden of caring for COVID-19 patients and safety concerns. Scientists at government agencies may need to develop guidance for their own agency as well as society. These challenges are in addition to strained institutional finances, which negatively affect scientists' income and job security as well as emotional well-being. Some universities have already implemented financial measures such as layoffs, furloughs, frozen or reduced benefits, hiring freezes, and pay cuts.[8,9] Surveys of college and university presidents indicate serious immediate concerns regarding short-term unbudgeted financial costs and long-term concerns of financial stability affecting the ability to employ staff and faculty.

The pandemic's far-reaching effects could widen preexisting gender imbalances in academia and at home, with potentially more responsibilities for women with school-age children and their needs for at-home schooling, ill family members to care for, financial stressors, and other factors. Commentaries and editorials have noted how the pandemic's impacts on academic work and scientific research differ by gender and have given anecdotal evidence of declines in submission of articles from women, and in some cases increases in submissions from men.[10,11]

We investigated gender differences in the rate of manuscript submissions to a major public health journal, comparing periods before and during the COVID-19 pandemic. Our hypothesis was that when we compared these 2 periods, the change in rate of submissions would be lower for women than for men because of the gender imbalances described here.

METHODS

We evaluated data for manuscripts submitted to the *American Journal of Public Health* from January 1 to May 12, 2020, to assess differences by corresponding and first authors' gender, comparing time periods before and during the COVID-19 pandemic. We obtained data for all submissions during this time period from the Journal. Defining the date used to distinguish the prepandemic and pandemic periods poses a challenge, because the pandemic's impacts are progressive and not clearly defined by a specific date. For consistency in analysis across countries, we considered the start of the pandemic period as the first date of 50 or more confirmed cases.[12] For the United States, this was February 25, 2020. More submissions originated from the United States than from other countries; we performed separate analyses for all locations, the United States, and non-US locations.

We classified the genders of the corresponding author and first author using an algorithm (by Gender API) that accounts for nation of origin (over 200 countries considered) and provides an uncertainty estimate of the assigned gender.[13] Gender API, a pay-for-service company, is one of the largest online platforms for identifying gender. The company developed its algorithm using data from multiple publicly available government and social network data sources. Currently, the database has over 800 000 unique names. On the basis of first-name and country-of-origin inputs from each manuscript, the algorithm generated an estimate of whether the author was male or female, along with a measure of uncertainty. For example, the input of "Karen" and "United States" provides an estimate of female with estimated 99% accuracy, whereas "Taylor" and "United States" provides an estimate of female with 60% accuracy. Gender classifications with accuracy of less than 50% were categorized by the algorithm as unknown. Our primary analysis considered authors with gender identified with an accuracy of 95% or more; we included a sensitivity analysis comprising all authors whose gender could be determined with an estimated accuracy of 50% or more.

We calculated the average number of submissions per day for men and women based on number of days in the prepandemic and pandemic periods using country-specific start dates of the pandemic. We coded publications during the pandemic period as related to COVID-19 based on searches for the terms "COVID," "pandemic," or "nCOV" in manuscript titles. We conducted analyses in R Statistical Software 4.0.2 (R Foundation for Statistical Computing, Vienna, Austria) and Excel (Microsoft, Redmond, WA).

RESULTS

We analyzed a total of 1767 manuscripts from 60 countries and territories. Table A (available as a supplement to the online version of this article at http://www.ajph.org) provides the number of manuscripts submitted by continent and gender (male, female, unknown), by categories of estimated accuracy of gender prediction, for the prepandemic and pandemic periods. The gender of the first author matched that of the corresponding author for 74.6% of manuscripts.

We categorized the gender of 97.7% of corresponding authors and 99.3% of first authors. Of those whose gender was predicted, estimated accuracy averaged 94.0% for corresponding authors and 93.5% for first authors. Our primary analysis considered the subset of observations with an estimated accuracy of 95% or more (1341 manuscripts for corresponding author, 1307 for first author). We predicted gender with an estimated accuracy of 50% or more for 92.3% to 100% of corresponding authors by continent. For our primary analysis, which considered only authors whose gender could be estimated with at least 95% accuracy, the algorithm fared better for submissions from Europe, North America, and South America, and least well for Asia. Figure A (available as a supplement to the online version of this article at https://www.ajph.org) shows the number of weekly submissions by gender for all locations, the United States only, and non-US locations. Most submissions were from the United States (68.6%).

Overall, more manuscripts per day were submitted during the pandemic period than previously, with an increase of 25.1%. However, the pattern of manuscript submissions differed by gender. For men, the rate of submissions (manuscripts/day) for corresponding authors went up 41.9%, whereas for women they increased 10.9%, indicating an almost 4-times-higher increase in productivity for men compared with women ($P < .05$). Among manuscripts from the United States, when we compared the pandemic with the prepandemic period, submissions by corresponding author increased 23.8% for men but only 7.9% for women. For non-US authors, submissions from the prepandemic to the pandemic period also increased more for men than women, although submissions increased more for both men and women from non-US countries than from the United States (e.g., for corresponding author, increase of 23.8% for US men and 113% for non-US men). Limited numbers of submissions hindered separate analysis by country other than the United States. Sensitivity analyses considering all observations with gender identified (i.e., including those with estimated certainty of ≥ 50%) or for first authors rather than corresponding authors showed similar general trends, with submissions by men increasing far more than those by women (Table 1).

We also evaluated submissions from the United States using a different definition of the prepandemic and pandemic periods. Here, we defined the start of the pandemic as March 13, 2020, the date the US federal government declared a state of emergency.[14] With this categorization of the pandemic period, rates of submission increased for both men and women, but more so for men (35.0% and 21.6% for men and women, respectively, for corresponding author; online Table B).

TABLE 1— Percentage Change in Manuscript Submission Productivity (Manuscripts/Day) Comparing Prepandemic Period to Pandemic Period, by Gender: *American Journal of Public Health*, January 1–May 12, 2020

	Gender Identified With ≥ 95% Estimated Accuracy, %		Sensitivity Analysis (All Gender-Identified Data), %	
	Men	Women	Men	Women
Corresponding author				
Overall	41.9	10.9*	47.9	12.4*
United States	23.8	7.9	26.3	9.7
Non-US country	113	27.1*	185	94.4
First author				
Overall	35.6	12.1	38.8	17.5
United States	18.1	8.6	19.0	13.3
Non-US country	114	31.1	177	105

Note. The analysis considering "all data" with gender identified includes those with estimated accuracy of 50% or greater. If estimated accuracy is less than 50%, the value for gender is set to unknown and not included in this analysis. The start of the pandemic period differed by country. These percentages relate to changes in the rate of submission (manuscripts/day), not number of manuscripts, as the number of days prepandemic and during the pandemic differed by country.

*For comparisons between men and women, $P < .05$ for χ^2.

Of the articles submitted during the pandemic period, 34.4% were related to COVID-19. The majority of COVID-19 articles were submitted by men. Of COVID-19 manuscripts, 29.4% of corresponding authors were women, compared with 54.2% of articles prior to the pandemic.

DISCUSSION

During the COVID-19 pandemic, submission rates to a major public health journal were higher overall compared with before the pandemic. However, the increase in submission rates differed by gender for both corresponding and first authors. Women had lower increases to their submission rates compared with men. Most articles related to COVID-19 were authored by men.

In academia, disparities by gender are well documented. Among faculty, men spend more of their professional time on research and activities related to service and administration, whereas women spend more time teaching and performing service to the university.[6,15] Women, especially mothers, who receive doctoral degrees are more likely than their male counterparts to be adjunct faculty or to leave the academic labor force.[16] At the Massachusetts Institute of Technology (MIT), a committee, formed in 1994 at the request of 16 of the 17 MIT tenured women faculty members in science, identified systematic gender discrimination, including differences in salary, access to space, resources, and leadership positions.[17] Female junior faculty perceived motherhood as a career obstacle that differed from that faced by male faculty with children.

With respect to peer-reviewed journal articles—a key metric of academic success and productivity—authorship by women has increased in recent decades, but has consistently lagged behind that of men.[18,19] For 6 top medical

journals, the percentage of articles by women grew from 5.9% in 1970 to 29.3% in 2004 for first authors, and from 3.7% to 19.3% for senior authors.[18] A study of 2459 medical journals found that the odds of authoring an invited commentary were 21% lower for women than men, accounting for field of expertise, seniority, and publication metrics.[20] Work by women is cited less often,[21–23] and men are more likely to self-cite.[24–26] Women are less represented as peer reviewers[23,27,28] and members of the editorial boards of journals.[28] Data on whether acceptance of a submitted manuscript differs by the author's gender are inconsistent, with several studies of individual journals identifying no bias and others finding higher acceptance rates for men.[23,28,29] Our findings on journal submission data indicate that the COVID-19 pandemic has aggravated the disparities by gender by which women remain at a disadvantage compared with men.

Our study had some limitations. For assigning gender to the authors of each submission, the algorithm used was unlikely to be fully accurate. Further, gender categorization was limited to "male" or "female" and did not consider the many other categories, including gender nonbinary and others. Our data provide no way of distinguishing these genders and do not provide information on how authorship changed beyond the broad and incomplete categories of male and female. The estimated date used to define the pandemic is country-specific, but substantial heterogeneity exists within countries regarding the pandemic's progression. Policies such as school closures, stay-at-home orders or guidance, and child care assistance provided by universities may also affect productivity and differ within countries. Further, the analysis is based on first and corresponding authors only, and patterns of authorship by gender may differ for other forms of authorship (e.g., third author). Submissions were primarily from the United States, with limited submissions in many regions (e.g., 13 submissions from Africa). Authorship trends by gender may differ by region. This work did not distinguish between junior and senior researchers, and the authorship trends may differ by the scientists' level of experience. Data were restricted to a single journal and are most representative of research in public health. Yet even within public health, and trends in relation to the pandemic, authorship may differ by subdiscipline, such as social epidemiology versus biostatistics. Similar research in other disciplines, using data from other journals, is warranted. Gender differences in the fraction of submitted articles that are accepted may also be affected by the pandemic. Further research is needed on trends in increased submissions during the pandemic compared with the prepandemic period, such as how this differs by gender with respect to position (e.g., junior vs senior researchers, tenured vs untenured professors) and contributing factors (e.g., more research on the pandemic, different child care).

This research is consistent with other analyses on trends in academic authorship by gender during the pandemic for other disciplines. Other work indicates that manuscript submissions are increasing faster for men than women based on preprint articles[30,31] and fewer submissions from women in economics.[32] However, analysis of data from March 15 to April 15, 2020, for the *American Journal of Political Science* observed a slight increase in female authorship; women made up 33% of authors for submitted manuscripts during this period compared with 25% previously, although submissions for articles in which first authors were women were down.[33] A gender gap in submissions also was not observed for *Research and Practice in Thrombosis and Haemostatis*.[34]

Our results about COVID-19 articles are consistent with other work finding that women contribute less to COVID-19 preprints than to preprints on other topics.[31] A recent study analyzed 1370 articles related to COVID-19 and found that 34% of authors were women, with lower representation for first author (29%) and last author (26%).[35] Critically, this means that women's perspectives are underrepresented in COVID-19 research.

The COVID-19 pandemic disrupted many areas of society, with larger impacts in some demographic groups. In analyzing journal submissions data, we found differences in manuscript submission rates by gender with higher increases in productivity for men than women. Our findings likely reflect gender work–life imbalances that predate the COVID-19 pandemic and go beyond the scientific community. In response to the pandemic, many universities have begun to enact policies to increase family leave (including for men), provide child care resources, and extend time to tenure review. Such policies and more recognition of gender disparities are necessary to address the gap between women and men in science and require investment in long-term solutions to increase equity during the recovery from and beyond the pandemic. AJPH

ABOUT THE AUTHORS

Michelle L. Bell and Kelvin C. Fong are with the School of the Environment, Yale University, New Haven, CT.

CORRESPONDENCE

Correspondence should be sent to Michelle L. Bell, Yale University, 195 Prospect St, New Haven, CT

06511 (e-mail: Michelle.Bell@yale.edu). Reprints can be ordered at http://www.ajph.org by clicking the "Reprints" link.

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CONTRIBUTORS

M. L. Bell designed the overall concept and hypothesis of the study and completed the analysis. M. L. Bell and K. C. Fong contributed to the overall conceptual framework, interpretation of results, conclusions, and manuscript.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to report.

HUMAN PARTICIPANT PROTECTION

Institutional review board approval was not needed for this study as data were obtained from secondary sources.

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