The Impact of the COVID-19 Pandemic on Journal Scholarly Activity Among Female Contributors

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DESCRIPTION OF THE PROBLEM

As a result of the coronavirus disease 2019 (COVID-19) pandemic, faculty members in medicine shifted their academic work to the home environment. Simultaneously, schools and childcare facilities closed, resulting in increased responsibilities and competing demands on working parents. Before the pandemic, women in academic medicine reported spending 8.5 more hours per week on domestic tasks and childcare than their partners and were more likely to take time off because of childcare needs if their partners worked full-time [1]. The disruptions created by the COVID-19 pandemic may amplify gender differences, resulting in a loss of academic productivity among women with consequences to their career advancement [2].

Our study objective was to review peer-reviewed journal scholarly activity among male and female contributors to *JACR* during the first 7 months of the COVID-19 pandemic and to compare it with scholarly journal activity during the comparable months in the year prior. We hypothesized that the proportion of female contributors both submitting manuscripts and accepting peer review invitations decreased during the COVID-19-affected months of 2020 compared with the same months in 2019.

WHAT WE DID

We obtained manuscript submission and peer review data from ScholarOne (Clarivate, London, United Kingdom), the editorial manager for the *JACR*, for April to October of calendar years 2019 and 2020. For every journal submission during the study period, we recorded the date of submission, manuscript title, manuscript type (original article, brief communication, opinion, or letter to the editor), full author names (first author, corresponding author, and senior author), and institution of the corresponding author. For each peer review invitation, we recorded the date of invitation, the peer reviewer's full name, the response to the invitation (agreed, declined, unavailable, did not respond), and whether the review was ever returned.

We assigned gender (female or male) to each first, corresponding, and senior author and each invited peer reviewer. When the gender was unknown to the study team, internet searches were performed to obtain gender assignments. For our study population, we excluded authors or reviewers with primary institutions outside the United States (as our study period matched the United States' acute COVID-19 pandemic period but not necessarily the acute periods in other countries). We also excluded standing monthly editorials and columns, ACR Appropriateness Criteria documents, and patient summaries, as all are solicited or preinvited manuscript types. In subanalyses, we divided manuscript types into two major categories: (1) original articles and studies (both full-length original articles and shorter original case studies) and (2) opinions and letters (editorials, commentaries, and letters to the editor). For analyses regarding senior authorship, only manuscripts with more than one author were included.

Data categorization and descriptive statistics were obtained using Microsoft Excel (Microsoft, Redmond, Washington). Our primary outcomes were relative year-to-year differences in first authorship and corresponding authorship by female gender for manuscripts submitted from April to October 2020 compared with April to October 2019. Secondary outcomes included relative differences in the proportion of female senior authorship and peer review acceptances for manuscripts in the same study periods. We performed a subanalysis of 2020 manuscript submissions by gender by further categorizing manuscripts as COVID-19-related or non-COVID-19-related on the basis of the full manuscript title. We used the z test as our two-sample test of independence to determine if changes in proportions

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Table 1. First authorship by gender for manuscripts submitted April to October 2019 versus April to October 2020

Article Types and Dates	Female First Author, n (Row %)	Male First Author, n (Row %)	All First Authors, n (Row %)	Female First Authorship Relative % Change/ Difference From 2019 to 2020	*z*-Test *P* Value
Manuscripts, April to October 2019					
All manuscripts	140 (45.0)	171 (55.0)	311 (100)	—	—
Original articles and studies	111 (46.1)	130 (53.9)	241 (100)	—	
Opinions and letters	29 (41.4)	41 (58.6)	70 (100)	—	
Manuscripts, April to October 2020					
All manuscripts	172 (39.0)	269 (61.0)	441 (100)	−13.4	.12
Original articles and studies	128 (40.6)	187 (59.4)	315 (100)	−11.8	
Opinions and letters	44 (34.9)	82 (65.1)	126 (100)	−15.7	
COVID-19 manuscripts, April to October 2020					
All manuscripts	33 (32.7)	68 (67.3)	101 (100)	−27.4	**.04**
Original articles and studies	24 (34.3)	46 (65.7)	70 (100)	−25.6	
Opinions and letters	9 (29.0)	22 (71.0)	31 (100)	−29.9	
Non-COVID-19 manuscripts, April to October 2020					
All manuscripts	139 (40.9)	201 (59.1)	340 (100)	−9.2	.32
Original articles and studies	104 (42.4)	141 (57.6)	245 (100)	−7.8	
Opinions and letters	35 (36.8)	60 (63.2)	95 (100)	−11.1	

Note: Relative percentage differences based on similar article types of manuscripts submitted in 2019; *z* test for significance for proportion of all 2020 manuscripts submitted for each category compared with proportion of all 2019 manuscripts submitted, $P < .05$ considered significant (in boldface type). COVID-19 = coronavirus disease 2019.

of female contributors from year to year were statistically significant ($P < .05$).

OUTCOMES

We were able to assign a binary gender (female or male) to 100% of the first, corresponding, and senior authors involved in the 752 manuscripts included in our analysis. Among *JACR* manuscripts submitted during the 7-month COVID-19 pandemic study period compared with the same time period in the year prior, we found that unsolicited manuscript submissions increased by 41.8% (311 versus 441 overall submissions in 2019 versus 2020, respectively) (Table 1). This increase was driven by the heavy influx of time-sensitive, COVID-19-related articles during the 2020 study period (22.9% [101 of 441] of all 2020 articles submitted).

Overall, the proportion of female first authors submitting manuscripts during the 2020 COVID-19 period was lower compared with the proportion of female first authors submitting in the 2019 study period. This was true for overall submissions, original articles, and opinion pieces (39.0% versus 45.0%, 40.6% versus 46.1%, and 34.9% versus 41.4%, respectively); however, these year-over-year decreases in the proportion of female first authors did not meet statistical significance ($P > .05$). A statistically significant difference was noted with regard to COVID-19-related articles, with a −27.4% relative difference in the proportion of female first authors compared with the 2019 study period (32.7% versus 45.0%, $P = .04$).

Similar findings were noted for the proportion of female corresponding authors submitting manuscripts in the 2020 and 2019 study periods (Table 2). The proportion of female corresponding authors decreased in the 2020 study period for overall submissions, original articles, and opinion pieces (37.4% versus 42.4%, 38.7% versus 42.7%, and 34.1% versus 41.4%, respectively); however, these year-over-year changes did not meet statistical significance ($P > .05$).

Table 2. Corresponding authorship by gender for manuscripts submitted April to October 2019 versus April to October 2020

Article Types and Dates	Female Corresponding Author, n (Row %)	Male Corresponding Author, n (Row %)	All Corresponding Authors, n (Row %)	Female Corresponding Authorship Relative % Change/Difference From 2019 to 2020	*z*-Test *P* Value
Manuscripts, April to October 2019					
All manuscripts	132 (42.4)	179 (57.6)	311 (100)	—	
Original articles and studies	103 (42.7)	138 (57.3)	241 (100)	—	
Opinions and letters	29 (41.4)	41 (58.6)	70 (100)	—	
Manuscripts, April to October 2020					
All manuscripts	165 (37.4)	276 (62.6)	441 (100)	−11.8	.19
Original articles and studies	122 (38.7)	193 (61.3)	315 (100)	−9.4	
Opinions and letters	43 (34.1)	83 (65.9)	126 (100)	−17.6	
COVID-19 manuscripts, April to October 2020					
All manuscripts	30 (29.7)	71 (70.3)	101 (100)	−30.0	**.03**
Original articles and studies	21 (30.0)	49 (70.0)	70 (100)	−29.8	
Opinions and letters	9 (29.0)	22 (71.0)	31 (100)	−29.9	
Non-COVID-19 manuscripts, April to October 2020					
All manuscripts	135 (39.7)	205 (60.3)	340 (100)	−6.4	.53
Original articles and studies	101 (41.2)	144 (58.8)	245 (100)	−3.5	
Opinions and letters	34 (35.8)	61 (64.2)	95 (100)	−11.1	

Note: Relative percentage differences based on similar article types of manuscripts submitted in 2019; *z* test for significance for proportion of all 2020 manuscripts submitted for each category compared with proportion of all 2019 manuscripts submitted; $P < .05$ considered significant (in boldface type). COVID-19 = coronavirus disease 2019.

Similar to the change in proportion of female first authors, a statistically significant difference was noted with regard to COVID-19-related articles, with a −30.0% relative difference in the proportion of female corresponding authors compared with the proportion of female corresponding authors in the 2019 study period (29.7% versus 42.4%, $P = .03$).

Smaller, nonsignificant differences in the proportion of female senior authors were noted between the 2020 and 2019 study periods for all manuscripts, original articles, and opinion pieces (35.7% versus 36.5%, 35.5% versus 36.4%, and 36.6% versus 36.5%, respectively) (supplemental eTable 1). Moreover, there were no statistically significant differences in the proportion of female senior authors involved in COVID-19-related articles.

After assigning a binary gender (female or male) to 100% of the 913 peer review invitations during the study periods, we found lower, nonsignificant peer review agreement and return rates for both female and male reviewers during the COVID-19 study period (supplemental eTable 2). Female reviewers agreed to and returned 58.7% of reviews during the COVID study period versus 63.5% during the same months in the year prior (−7.6% relative change, $P = .38$). However, the proportion of male reviewers agreeing to and returning peer reviews also decreased during the

COVID-19 period compared with the same months in the year prior (57.7% versus 63.6%, −9.3% relative change, $P = .20$).

Overall, we found 13.4% and 11.8% relative reductions in female first and corresponding authorship submissions, respectively, to *JACR* from April to October 2020 compared with 2019, with a larger, statistically significant difference for COVID-19-related articles. Overall manuscript submissions to the journal increased by almost 42%, fueled by COVID-19-related submissions. This suggests that women were not able to participate in time-sensitive COVID-19-related research during the pandemic, potentially putting them at a relative disadvantage with regard to scholarly productivity. The negative gender effect was not seen in senior authorship submissions, suggesting that increased personal demands may have had the greatest impact on early-career women, who are also the most likely to have young children. In a recent survey, female scientists reported a decline in research time relative to male colleagues during the COVID-19 pandemic, but the most significant factor was having a young dependent <6 years of age [3]. Although overall acceptance and return rates for peer review at *JACR* were lower during the pandemic, there was no significant gender difference. Our findings are consistent with a growing body of literature reporting that women constitute a lower share of first authorship COVID-19-related articles across specialties in medicine, as well as in other academic fields [4-6]. Our results further support the suggestion that women in academic medicine are likely to experience a larger negative professional impact as a result of the COVID-19 pandemic than their male colleagues, potentially setting back recent progress reported with regard to increasing female radiology authorship over time [7]. The magnification of gender disparities by the pandemic could have longer term effects on career advancement and retention of women faculty members, particularly if supportive institutional policies are not put in place [8].

This study had several limitations. We looked only at first, corresponding, and senior authorship roles and not all authorship roles; however, first and corresponding authors tend to have the most responsibilities in both manuscript writing and submission and revision tasks. We examined gender as binary (male versus female), and some contributors may identify differently. We had a relatively small sample size from one journal, leading to statistical nonsignificance in many comparisons. Future studies should be performed by publishers (who hold data on submissions to multiple journals) over longer study periods to determine if lower female scholarly journal activity is widespread and persists throughout the pandemic.

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