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## Viewpoint

## Gender inequality in publishing during the COVID-19 pandemic

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The 2020 SARS-CoV2 (COVID-19) pandemic has had devastating primary effects on mortality and ongoing health across the globe. By the end of June 2020, more than 503,000 people had died of SARS-CoV2 (WHO, 2020b) and by four months later this figure was at 1.18 million globally, with more than 45 million infected (WHO, 2020a). In addition to these primary effects, secondary impacts are also being felt worldwide, such as on mental health, employment and education (Chen et al., 2020; Kim and Su, 2020; Nicola et al., 2020). Notably, these secondary effects may be disproportionately affecting certain societal groups, including those from low socio-economic backgrounds and women (Findlay et al., 2020; Özdin and Bayrak Özdin, 2020).

Since the start of the COVID-19 pandemic and the lockdowns and social distancing policies most countries have implemented to try to curtail it, anecdotal (social media), submissions, and pre-print evidence has suggested that women in science have been submitting fewer manuscripts than their male counterparts (Cui et al., 2020; McCormick, 2020; Viglione, 2020). Recently published articles and editorials from a handful of journals in the biological sciences now show that this gendered detrimental impact on publishing capacity is being reflected in peer reviewed publication rates in some journals as well (Pinho-Gomes et al., 2020), although Neuropsychopharmacology had seen no change by June 2020 (Jordan and Carlezon, 2020). To determine if this apparent trend is applicable to the neuroimmune and psychiatry fields, we assessed the genders of first and senior (last) authors publishing in BBI between July 2019 and January 2020 relative to the equivalent months in 2020 and 2021.

Available data restricted us to surmising a person's gender based on the usual gender of their first name, an internet search for their professional website bearing a sex-specific pronoun, or, failing that, author appearance. We assessed all published articles for the months indicated, including commentaries, research articles, and reviews. Author name information for these articles is publicly available (<https://www.journals.elsevier.com/brain-behavior-and-immunity>).

The data demonstrate that there were slightly more female than male first authors (62%) and slightly fewer female last authors (42%) across the July, August, October and November volumes of 2019 and the January volume of 2020 (265 papers total). These percentages are reflected in the submissions data (not shown) and, for the last authors, are approximately equivalent to the percentage of women academics in the "biological psychiatry" field (<https://biaswatchneuro.com/2018/08/06/2019-society-of-biological-psychiatry-annual-meeting/>). It is notable that the percentage for each month is somewhat variable, particularly for senior authorship, fluctuating between 31 and 53% for these volumes (Fig. 1). However, these pre-COVID-19 data, at least, are generally encouraging for women in the BBI and neuroimmunology/psychiatry fields.

When considering the early post-COVID-19 period (July 2020–January 2021), the proportion of female first authors was slightly reduced relative to the previous year, but remained at around 50%. However, the impact upon female last authors was more notable, with substantial differences between the July and November 2019 volumes and their corresponding editions in 2020, and the January 2020 relative

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to January 2021 volume. Notably, the August and October volumes had relatively few female senior authors in 2019 (31 and 39% respectively) and an overall effect of the COVID-19-related lockdowns was not seen in these months in 2021 (Fig. 1).

The July, August and October 2020 volumes of BBI are particularly telling, however (<https://www.journals.elsevier.com/brain-behavior-and-immunity>). These volumes contain a high proportion of articles devoted to a COVID-19 Special Issue, made up entirely of articles featuring COVID-19-related research. The announcement of requests for submission to this issue was made in March 2020 and the review process expedited to allow rapid publication. As such, the articles in this Issue were entirely conceived, researched, written, and revised after commencement of the lockdown period. It is notable, then, that only 32% of first author contributors and 20% of last author contributors to this Special Issue were female.

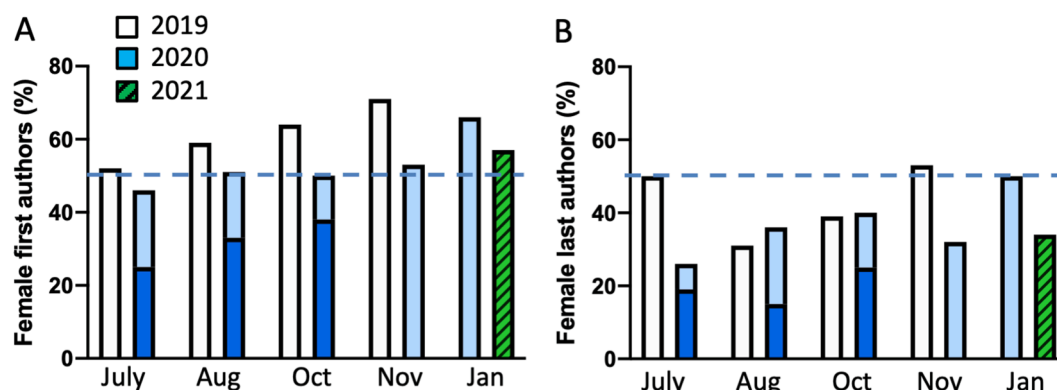
Together, these data reveal a COVID-19-lockdown-related effect on women's capacity to publish in this field and suggest there is a disadvantage to women at this time that could damage careers going forward. It will be important to determine if the findings from the COVID-19 Issue and that from November 2020 and January 2021 will be seen into the coming months of 2021. Since the majority of the articles published in BBI's January 2021 volume were first submitted in April and May 2020, the full gender impact on project inception and data collection may not yet be reflected in the publication record.

Reasons behind a possible female disadvantage in the scientific publishing arena have not yet been fully established. Submissions data suggest that proportions of articles accepted for publication for BBI reflect the proportions of those submitted, indicating this COVID-19-lockdown effect on publications is not likely due to a change in the standard of the work submitted by either sex. We cannot at this time eliminate the possibility that our data represent a shift in publication sources to countries where women have a less prominent role in science. However, an alternative explanation lies in increased care-giver responsibilities falling to women as childcare and schools below the tertiary level have closed and children have required home-schooling and full-time care (Viglione, 2020). Alternatively, changed teaching arrangements at universities may have led to women accepting increased teaching-related responsibilities than their male counterparts or, potentially, being less efficient at adopting these rapidly (Viglione, 2020). There is some evidence to suggest women are more likely than men to agree to perform additional service-related or other unpromotable tasks (Babcock et al., 2017; Guarino and Borden, 2017),

which may be compounded at this time when universities have been scrambling to adapt to the situation. Currently data are lacking to suggest which, if any, of these explanations contributes to this gender disparity in publishing and it is imperative that we investigate the causes further.

Data are also lacking on how this COVID-19-lockdown effect impacts scientific outputs beyond publishing. Clearly the output of published work is only one measure of productivity in research, and it remains to be seen if a similar reduction in outputs by women is also evident in grant submissions and awards, promotions, uptake of new techniques and technologies in research and teaching, networking and public research dissemination. Early data from Nature Index suggest women are registering fewer clinical trials and other registered research projects than in previous years (Viglione, 2020), suggesting several aspects of the research process have been affected. It also remains to be seen how long such an effect will last. As the world returns to a "new normal", will this impact appear as an anomalous blip in the record as women strive for equality with their male counterparts in the scientific arena? Or will it have a notable effect for some time to come? And what can we do now to prevent the latter?

We appreciate the limitations of surmising gender based on name and appearance and suggest there is a strong need for a database where self-declared gender information can be collected for each journal. We acknowledge that the reasons behind any gender-based publishing disadvantage are currently unclear, and research is urgently needed to determine the causes. These findings of a disproportionate impact of COVID-19's secondary effects on women in research in 2020 are very likely present for subgroups in science that are less readily identified: early career researchers, those with young families, people with health vulnerabilities, and, clearly, people who have been directly impacted by the virus. How we ensure career progression opportunities are distributed to the best people despite these challenges and interruptions in trajectory has become an important question going forward at the level of the journal and publisher, but also of the individual universities and countries. Existing policies that encourage continual institutional improvement to eliminate gender and diversity bias, such as the Athena Swan and SAGE awards, likely need to include further COVID-19-related targets to address a dynamic and fluid employment state for women in academia.



**Fig. 1.** Percentage of female authors publishing in BBI for late 2019, and 2020 and early 2021. A). First authors. For 2020, light blue indicates all articles in the volume, dark blue indicates articles in the 2020 COVID-19 Special Issue. Chi-squared analysis revealed a significant reduction in the number of female authors, relative to males, for July, August, and October using the data from the COVID-19 Special Issue and for November using all data.  $P < 0.01$  in each case. B) Last or single authors. There was a significant reduction in the number of female authors, relative to males, for the July, August, and October volumes using the data from the COVID-19 Special Issue and for the November and 2020/21 January volumes using all data.  $P < 0.05$  in each case. Gender-unidentified authors (<5% of total in all months) were not included. Each month contained between 40 and 136 articles. Data follow the same trends with omission of brief communications and correspondence. Note: there was no September or December issue in either year. Data for January 2021 are complete as of November 08, 2020. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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