

BRIEF REPORT

Will COVID-19 result in a giant step backwards for women in academic science?

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Accepted 2 March 2021; Available online 8 March 2021

Abstract

COVID-19 has disproportionately placed women in academic science on the frontlines of domestic and clinical care compared to men. As a result, women in science are publishing less and potentially acquiring less funding during COVID-19 than compared to before. This widens the pre-existing gap between men and women in prevailing, publication-based measures of productivity used to determine academic career progression. Early career women and those with intersectional identities associated with greater inequities, are facing unique challenges during this time. We argue that women will fall further behind unless academic reward systems adjust how and what they evaluate. We propose several strategies that academic institutions, funders, journals, and men in academic science can take. © 2021 Elsevier Inc. All rights reserved.

Keywords: Women; COVID-19; Gender; Intersectionality; Productivity; Academic reward; Early career

What is new?

- COVID-19 continues to impact the careers of women in academic science.
- Data and targeted solutions are needed.

Key findings

- Prevailing measures of academic performance are inadequate for addressing the inequities underscored by COVID-19.
- Early career researchers and clinician scientists are facing distinct, compounded inequities in career progression.

What this adds to what is known:

- We demonstrate the link between the burden and consequence of COVID-19 on the careers/career progression of women in academic science.

What Is The Implication/what should change now

- Academic institutions, funders, journals, and men in academic science can help reduce further erosion of women's careers.

1. Introduction

International Women's Day 2021, marks 362 days since the World Health Organization declared the 2019 novel coronavirus (COVID-19) outbreak a global pandemic [1]. Aside from the urgent public health issues, the pandemic

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has had, and will continue to have, major impacts on how societies and economies function. For instance, when governments worldwide enforced lengthy closures of workplaces, childcare centers, and schools to control the virus, they impacted people's ability to work, with some groups being disproportionately affected. The socially constructed norms, roles, and behaviors associated with gender in our society have placed women in academic science (i.e., researchers and clinician scientists) as primary carers both in the home and on the frontlines of healthcare during this time [2]. For women in academic science (including the authors of this commentary) this is compounding pre-existing inequities they face in advancing their careers, and is particularly problematic for early career researchers and those with other intersecting identities (e.g., race, age, sexuality) that lead to being additionally affected [3,4]. Women are contributing less to science during COVID, and some had to halt their research. This is concerning since women's involvement in research yields more diverse research, as well as research that properly accounts for sex and gender [5]. Large amounts of COVID research have been shown to inadequately capture sex and gender differences in populations [6,7].

Women in science need to be supported as they carry the burden of the impact of COVID-19. This commentary focuses on the tension between society's reliance on women as carers and a career in academic science, underscored by COVID-19. We recognize here that gender is not binary, despite the majority of scientific literature heretofore representing it as such. We also recognize that we are privileged to represent the plight of gender across cohorts and to offer insight on potential solutions via this article.

2. The compounded inequity of academic reward in science, pre-COVID

Pre-COVID, it was well-known that more academic women carry the burden of domestic and care responsibilities than their male counterparts [8,9]. Additionally, men in academia are more likely to have stay-at-home partners than their female counterparts, while women are more likely to be in dual career relationships [10]. Women also tend to be tasked with or take on more academic service work (e.g., teaching, sitting on committees, providing emotional support to staff, trainees, and mentees) than men, further impacting their available research time [11]. Taken together, this translates into men having more time for scholarly activities (such as conducting and publishing research) and being more able to accommodate the travel and networking opportunities as well as potential relocation demands of an academic career than women. That women inherently have less time and flexibility due to competing responsibilities, puts us at an unfair disad-

vantage. The effect of this is that women scientists are underrepresented in both faculty and senior leadership positions in academic institutions, despite more women training as scientists than men [12,13]. That men in academic science advance their careers at a quicker pace and with greater ease than women is, in part, the result of implicit and systemic biases present in academic reward systems.

Problematically, and nearly universally, career progression in academic science is heavily weighted on publication-based metrics/measures [14]. The top five academic performance criteria identified across biomedical faculties, globally, are: the number of peer reviewed publications; authorship order; journal impact factor; grant funding; and national or international reputation [14]. These measures have largely been recognized as problematic since they may incentivize bad behavior (i.e., salami slicing, selective reporting) thus compromising the integrity of scholarly record [15]. Less attention has focused on the problem that such metrics appear to favor men [16]. Globally, men dominate women in quantity of scientific output, papers with senior authorship positions, and international co-authorships [17]. This is unsurprising considering that men have more time to contribute to science and may have more opportunity to build an international network through travel. However, men are additionally overrepresented in the journal peer review process [18,19], are cited more in senior authorship positions [17], and systematically cite their own research more (thus boosting men's citation counts) [20]. Measuring productivity and impact through number and rank of publications offers a poor reflection of women's capabilities, productivity, and impact across their scholarly activities [4] and, further reinforces inequity in who is progressing through the ranks of academia.

Women in academic science have been rated lower and are less successful in grant competitions than their male counterparts [21,22]. This is hypothesized to be due to implicit bias by reviewers and systemic bias in the structure of funding competitions, which favors men (i.e., more publications in higher impact journals, more previous funding); less likely is the possibility that they are less capable than men [21]. Without funding, women have fewer resources to conduct impactful research, thus perpetuating one of their major disadvantages in funding competitions.

These systemic barriers in academia, publishing, and funding allocation are further amplified when race intersects with gender [23]. In a study that looked at publications as predictors of racial and ethnic differences in National Institutes of Health (NIH) research awards, black applicants reported fewer papers on their bio sketches, and were found to have fewer citations and publish in lower impact journals than white applicants [23]. For women, intersecting identities (e.g., gender, race, age, Indigeneity) puts them at an even greater disadvantage.

3. The burden of COVID-19 on women's productivity

Prior to COVID, it was estimated that women were responsible for 75% of unpaid caregiving and domestic work worldwide [24]. COVID-19 shelter-in-place orders have increased this responsibility, requiring that parents, namely women, take on full time childcare responsibility for younger children and facilitate virtual learning for school-aged children [25]. Some are additionally caring for older or sick family members. For women in academic science, particularly mothers or other caregivers, this has severely impacted the amount of time and focus they have for scholarly activities. With children and adolescents in the home, academic women's careers are being sidelined or halted. Further, we are currently in a holding pattern of repeated shutdowns as we await third, fourth, and fifth virus waves and virus variants to arrive. The unknown timing and duration of these interruptions makes it more difficult for women to plan their research and meet deadlines compared with men.

3.1. The early career conundrum

Critical career transition periods such as postdoctoral or early career stages, have become more challenging for women during COVID-19 since these career stages often align with the period of having young children [8]. Data are emerging that, across career stages, female postdoctoral scientists and early career scientists who are parents, have had their ability to work most compromised by the pandemic [26]. Additionally, among academic researchers, this group of women appear to be the most affected by mental health issues as a result of the pandemic [26]. We face the serious potential for a lost generation of women scientists in academia and the areas they investigate due to COVID [27].

These challenges are further exacerbated for early career women clinician scientists, many of whom have responded to the pandemic with increased clinical work (and corresponding reduced research activities) to ensure patient needs are met. The pandemic has produced an unprecedented period of moral distress for these women, which is having a profound impact on mental health and wellness [28,29]. This will impact their research productivity and thus career progression now and beyond pandemic recovery.

3.2. The consequences on careers and career progression

Just as science is a cumulative process, so is academic reward in science [30]. Career trajectories are determined on the basis of productivity. Surveys of published contributions demonstrate the difficulty women may be having keeping up with their previous productivity and with men [31,32].

A data monitoring site produced by bibliometric researchers is live-tracking authorship by gender across preprint servers (which have seen exponentially increased submissions rates during COVID) [31]. An analysis produced early in the pandemic revealed the pre-eminent preprint server in medicine, medRxiv (first launched in June 2019), saw a substantial drop in the proportion of women first authors from 36% in December 2019 to 20% in April 2020 (lowest level to date) [33]. By December 2020, this proportion had climbed to just fewer than 30% [31]. This is a strong indication that early career women are particularly falling behind since, as noted by the researchers, trainees (PhD students and postdoctoral researchers) typically hold first author positions and senior mentors retain last authorship in medicine. Several other studies of journal submission and publication rates, including one study across over 2000 Elsevier journals [34], demonstrated similar findings [35,36]. Such studies provide direct evidence of the detrimental and disproportionate impact that COVID has had on women's, and especially early career women's, publication rates.

Women are also disproportionately underrepresented as authors of COVID-related research [31]. This possibly points to the difficulty, inability, or exclusion some are experiencing in pivoting towards this high impact and important research area. In Canada for instance, women scientists and sex-and-gender inclusive research were severely underrepresented in applications of funds in the first round COVID-specific grant competitions the Canadian Institutes of Health Research [37]. This prompted the agency to introduce measures to improve equity funding allocation [38], which resulted in an increase in applications from women from 29% to 39% and an increase in successful applications in women from 22% to 45%, between the first and second COVID grant competitions [37]. Pivoting to COVID research from a different focus requires time to develop new ideas and collaborations. Scientists who are also balancing other care demands (at home, clinical, etc) are at a great disadvantage.

COVID research is certain to be published in higher impact journals and accrue more citations than non-COVID research. Not only are women missing out on this opportunity, but our society, overall, is failing to benefit from more relevant research including sex and gender considerations, as well as research examining questions that are uniquely relevant to women (e.g., the effect of COVID, treatments and vaccines on breastfeeding mothers). As different jurisdictions worldwide cycle in and out of stay-at-home orders, reduced publication rates for women can be expected to continue as the pandemic continues. Women may never "catch-up" on productivity due to the ultimate catch-22; while women are falling behind, men (particularly non-caregivers) are getting ahead from having more dedicated, undisturbed time. The result will be a cumulative advantage for academic men in science.

4. Solutions: How can academic rewards address inequities?

Solutions towards gender equity in medicine have previously been suggested and are applicable here and more broadly across academia [4]. These include: quantifying inequities, systemic and behavioral change, career flexibility, increased representation, creating opportunities for mentorship, and financial support [4].

Standard measures of academic performance must be adjusted to account for disparities all groups, including women, are facing. It is imperative that academic and affiliated institutions, scientific funders, and journals collectively prioritize initiatives to ensure that women in academic science sustain their growth trajectory and potential impact permanently and reduce further attrition. We propose the following actions in support of this:

4.1. Funders and institutions

- Funders and institutions ought to jointly *collect national and local data on researchers' experiences, circumstances, using an intersectionality lens* to understand which populations are facing disparities at particular moments in time. Such data ought to be collected on an ongoing basis so solutions can be sensitive to changes. Some funders are doing this [26,39] and we encourage others to follow suit. This will provide an indication of where resources ought to be focused.
- Institutions and funders could *target equity-fostering initiatives* (such as grant extensions, salary supplements) *at groups experiencing acute disparities*. Applying interventions such as pausing-the-clock or universally providing top-up funding without a targeted approach may work to further inequities. For example, universally extending the duration of early career by 1 year, means the gap between men and women will grow wider during that period. Those who predominantly do not have family and household responsibilities will be able to accomplish more compared to those who do. Some funders and institutions have processes or dedicated programs in place to support the success of disadvantaged groups such as those with competing roles as caregivers [38] or front line workers [40], who take career breaks or require flexibility work patterns [41], postdocs and early career researchers restarting academic careers after periods of leave [42].
- *Create opportunities for the work of women in academic science to be recognized*. Representation matters and promoting women in academia should be an active process. At a global level, women deliver health, but men lead [43]. In response to the lack of female leadership in initial COVID-19 responses, women's advocacy group, *Women in Global Health* launched a tool (Operation 50/50) that provides journalists with 100 female clinicians, specialist and experts in COVID-19 [44]. The

creation of these and similar opportunities are critical for women to maintain their visibility to further ensure gender-responsive approaches.

- Institutions can introduce *equitable and inclusive performance measures*. Institutions ought to reconsider the purpose of performance evaluation in meeting organizational strategic goals. The global shift toward more equitable, diverse, and inclusive organizations [45] has inevitably been set back by COVID. In addition to setting hiring targets and quotas for hiring minority groups, institutions must simultaneously ensure they are attracting and promoting the most capable researchers. To do this, the research ought to be equally evaluated for its diversity/inclusion (of authorship and of research), integrity, and real-world impact. Candidates ought to be evaluated using equitable, well-rounded assessments. The Performance Promoter Score aims to efficiently capture input from a broad range of sources in order to provide a 360 degree review of candidates [46]. Such approach may work to reduce the implicit bias present in hiring decisions and in performance appraisal.
- *Consider rewarding alternative research outputs* that reduce focus on the number of journals publications (where implicit bias may select against women) including contributions to trusted preprint servers (which aim to vet only on the basis of integrity and ethics) [47]. While potentially being more inclusive, preprint servers also offer a quicker mechanism to make research publicly available. Emerging data show that preprints undergo minimal, nonsubstantive changes during peer review indicating they may be representative of their eventual journal publications [48,49]. As such, preprints may offer a better mechanism for quantifying and examining women's contributions.

4.2. Journals

- Journals ought to *prioritize women-authored papers and women led teams*. For example, in 2019, the Lancet journal published a women-focused issue [50,51]. Similarly, to address a lack of racialized women authored publications, editors could do the same with a focus on under-represented racial and minority groups. In early 2020, the editor in chief of *Cell Reports* introduced a question on gender in the journals' editorial process to gain insight on the gender and potential biases of editors and peer reviewers, after recognized problem of disparities in female first authorship [52]. Earlier this year, the journal's publisher, Cell Press, introduced the option to include a statement about a study's inclusion and diversity efforts (with respect to authorship and study design) across all of its journals [53]. Similar data collection strategies using an intersectional lens should be used to track intersection of gender, race, and ethnicity for example and these results should be publicly available on journal websites.

- Journals can *ensure women are represented among authors, editorial boards, peer reviewers, and journal staff*. The data-collection efforts by *Cell Reports* have resulted in the journal setting targets of commissioning papers by women and having at least one woman review every paper [52]. They have amplified women's voices and they have an editorial board consisting of 40% women with a target of 50% in sight. There are ongoing initiatives across scholarly publishing to ensure equitable and diverse representation across all levels of publishing [54,55].

4.3. Men in academic science

- Stakeholders must *encourage male allyship in academic science*. Attitudes among academic men interacting with women on a day-to-day basis may be less considerate of the plight that women are facing, highlighting how critical the role of allyship and mentorship is. For example, one of us had a male superior remark on the “disappointing” productivity in the year following the birth of a child. In another instance, a male superior remarked on an early career woman being ‘distracted’ during a period that included 6-months without childcare during COVID. These statements and the dynamic of them are counterproductive to correcting existing gender inequity in academia and can erode the confidence of early career and trainee women in academic science, particularly during the overwhelming stressful time that we are experiencing. They also demonstrate that, despite society's expectations of mothers as primary caregivers, having and raising a child/children may be viewed as something of a ‘side hustle’ in academia – a secondary job, that, while enjoyable, ought not be the main focus of one's life.

5. Conclusion

This commentary was written in recognition of International Women's Day 2021. We have attempted to highlight the unique impacts that COVID is having on the careers and career progression of women in academic science. Existing inequities in academia and academic reward have been aggravated by COVID and are at risk of persisting beyond the pandemic. We believe this situation presents a critical opportunity for academic institutions, funders, and scholarly journals, among others, to introduce innovative measures, resources and opportunities to ensure that women's careers in academic science will thrive now and beyond COVID.

Author contributions

Larissa Shamseer and Andrea Tricco conceived of the idea for this manuscript. Larissa Shamseer wrote the first

draft of the manuscript. All of the authors revised it critically for important intellectual content, gave final approval of the version to be published and agreed to be accountable for all aspects of the work.

Funding

Ivy Bourgeault is funded from the University of Ottawa through the Research Chair in Gender, Diversity and the Professions and from Status of Women Canada, ON 16255, Empowering Women Leaders in Health. Eva Grunfeld is funded by a physician scientist award from the Ontario Institute for Cancer research and by the Giblon Chair in family medicine research. Sharon Straus is funded by a Tier 1 Canada Research Chair in Knowledge Translation. Andrea Tricco is funded by a Tier 2 Canada Research Chair in Knowledge Synthesis.

Declaration of Interest

None.

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