COVID-19 burden, author affiliation and women’s well-being: A bibliometric analysis of COVID-19 related publications including focus on low- and middle-income countries

Lotus McDougal,* Nabamallika Dehingia Wendy Wei Cheung Anvita Dixit and Anita Raj

Center on Gender Equity and Health, Department of Infectious Diseases and Global Public Health, School of Medicine, University of California San Diego. 9500 Gilman Dr, La Jolla, CA 92093, United States

Summary

Background Published literature documents tremendous gender inequities in the social, economic and health effects of the COVID-19 pandemic, but less evidence has come from low- and middle-income countries (LMICs) and even less from LMIC-based authors. We examine whether a) COVID-19 burden and b) LMIC-based authorship were associated with academic publications related to COVID-19 and women’s well-being in LMICs.

Methods We reviewed academic articles on COVID-19 and women’s well-being in LMICs published between February 2020 and May 2021 (n=1076 articles), using six electronic databases (PubMed, Web of Science, PsycInfo, EconLit, RePeC, NBER). Multilevel, mixed effects linear regressions assessed the relationships between each of our independent variables - a) COVID-19 burden (cases/100 population, deaths/100 population, deaths/cases) and b) author’s country of primary affiliation, with publications related to COVID-19 and women’s well-being, both overall and stratified by country income group.

Findings Eight-eight percent of articles had lead and/or senior authors affiliated with in-country institutions. Linear mixed effect models indicate that COVID-19 cases and case fatality ratios in a country were significantly and positively associated with the number of publications related to COVID-19 and women’s well-being, though these relationships were significant only in upper-middle income group countries in stratified analyses. LMIC lead and senior authorship were also significantly and positively associated with our outcome, after adjusting for COVID-19 burden.

Interpretation While the majority of COVID-19 research examining women’s well-being in LMICs in the first year and a half of the pandemic included country-affiliated author leadership, there were important gaps in representation. Findings highlight the importance of LMIC-based scholars to build local and gendered research in crises.

Funding Bill and Melinda Gates Foundation (INV-018007).

Copyright © 2022 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/)

Keywords: COVID-19; Gender; Bibliometric; LMIC; Authorship

Introduction

As of early March 2022, the COVID-19 pandemic has killed more than 5.9 million people worldwide, and infected more than 437 million.1 The social, economic and health effects of this pandemic are profound, far-reaching, and highly gendered in nature.2–10 COVID-19 infection rates and mobility reductions are associated with increased depression and anxiety, with more pronounced effects among women.11 Mobility restrictions have also placed women at more pronounced risk for gender-based violence, particularly from intimate partners, as well as inhibited access to key sexual, reproductive, and maternal health services.12–14 These access barriers are compounded by severe COVID-19-related contraceptive supply chain disruptions, restricting women’s access to family planning care and essential contraceptive commodities.7,13 Women have been more impacted by job and wage loss due to their overrepresentation in heavily impacted industries such as tourism and hospitality, and face heavy burdens of unpaid care and childcare.15

*Corresponding author.
E-mail address: lmcdouga@health.ucsd.edu (L. McDougal).
Research in context

Evidence before this study

We searched for articles indexed in PubMed (pubmed.gov), Web of Science (Clarivate), PsycINFO (ProQuest), EconLit (EBSCO), NBER (nber.org) and RePeC (repec.org) for articles indexed by March 30, 2022 including “COVID-19” AND “gender” AND “bibliometric” AND (“LMIC” OR “low and middle income”). No papers were identified which looked at the relationship between COVID-19 burden and author affiliations with publications related to COVID-19 and women’s well-being.

Added value of this study

Despite growing evidence that the COVID-19 pandemic has serious and detrimental gendered effects, there has been no comprehensive assessment to date of the ways in which publications related to COVID-19 and women’s well-being vary across low and middle-income countries, what topics are being most commonly published on, and how COVID-19 burden and author affiliations relate to those publications. This bibliometric analysis fills these gaps by providing a statistical overview and assessment of publications related to COVID-19 and women’s well-being including focus on low and middle-income countries over the first 16 months of the pandemic.

Implications of all the available evidence

While publications related to COVID-19 and women’s well-being were generally reflective of COVID-19 burden in low and middle-income countries, these relationships were driven by upper-middle income countries, and were lacking in low-income and lower-middle income countries. Involvement of lead and/or senior authors affiliated with institutions in article focal countries was not associated with publications related to COVID-19 and women’s well-being focused on economic impacts. There is a need for greater involvement of in-country authors on research examining a wider range of gendered COVID-19 impacts, as well as increased representation of diverse topics and publications related to COVID-19 and women’s well-being focused on lower income countries.

These impacts are exacerbated in low- and middle-income countries (LMIC), where higher levels of existing gender inequalities, power imbalances, and regressive gender norms compound pandemic challenges. While LMICs bear a greater burden of gendered COVID-19 impacts, prior studies have indicated relatively lower representation of these regions in health-sciences related publications. The misalignment between disease burden and health research efforts is well-documented, with a disproportionate focus on high-income countries and their health needs and disease burdens. Scientific publication disparities also exist within LMICs, with upper-middle income countries generally more represented than low-income countries despite substantial disease burdens and adverse health outcomes in these less resources settings. Disparities in research efforts may be driven by a multitude of factors including, but not limited to, capacity of healthcare systems and National Statistical Offices, and environmental and economic conditions. Research productivity may also be influenced by support from development assistance funding, which has increased during the COVID-19 pandemic. Identifying the ways that these research publication disparities may have been impacted by the COVID-19 pandemic is an important opportunity to identify potential imbalances in research priorities and efforts, and to advocate for shifts, if necessary. While there have been many bibliometric studies of the influence of the COVID-19 pandemic on health topic-specific research trends, no studies to date have focused on shifts in women’s well-being related publications during the pandemic. A 2021 review of the literature on COVID-19 found very low representation of LMIC-focussed and non-medical research, or research on social and economic aspects of the pandemic. Considering scientific publications as a marker of research efforts, our study examines trends in research efforts for gendered impacts of the pandemic in LMICs, in the context of varying COVID-19 burden across countries.

Authorship is another important marker of representation in research efforts. Multiple empirical studies and opinion pieces by experts have pointed to the low representation of researchers from LMICs in research concerned with these regions. While a recent analysis of over 700,000 health science-related publications that focused on LMICs found an increase LMIC-affiliated authorship from 2000 to 2017, this change was driven mainly by increase in authorship from upper-middle income countries. The inclusion of local experts and diversity of scientists is a central component of efforts to decolonize global health, and critical to making science more culturally sensitive, pragmatic, and actionable, and to be able to move away from a ‘foreign gaze’. Particularly in the context of gendered impacts of the pandemic, which have manifested in different forms across regions, it is important that local voices are highlighted and heard within the scientific community for effective policy action.

What has been learned about the gendered impacts of the COVID-19 pandemic in large part derived from scientific publications. To date, however, the volume and characteristics of publications related to COVID-19 and women’s well-being has not been comprehensively assessed. Published research is often not disaggregated by sex, may not include women participants, and may not adequately consider the ways that gender affects the mechanisms in question. In the absence of this information, there are barriers in understanding the gendered ways that COVID-19 affects different people.
in different circumstances. The objective of this paper is to address this gap by examining trends in academic publications related to COVID-19 and women’s well-being in LMICs as a body of work in itself, and by examining specific topics within these women’s well-being related publications. We use data generated from a large literature review to conduct bibliometric analyses assessing associations between our independent variables—COVID-19 burden and affiliations of authors in leadership roles, and our outcome, publications related to COVID-19 and women’s well-being in LMIC contexts. To the best of our knowledge, this is the first bibliometric analysis of this kind.

Methods

Data

We conducted a recurring literature review of academic articles related to COVID-19 and women’s well-being in LMIC. Six electronic bibliographic databases [PubMed (pubmed.gov), Web of Science (Clarivate), PsycINFO (ProQuest), EconLit (EBSCO), NBER (nber.org) and RePeC (repec.org)] were searched for peer-reviewed literature and working papers. The reviews were conducted every 1-2 weeks between June 2020 and May 2021, thus covering all relevant articles on COVID-19 and women’s well-being indexed in the selected databases through 28th May 2021. Our search criteria were developed by gender research experts, and included terms related to five broad thematic areas related to COVID-19 and women’s well-being: a) COVID-19 burden, and b) affiliations of authors in leadership roles, and our outcome, publications related to COVID-19 and women’s well-being in LMIC contexts. To the best of our knowledge, this is the first bibliometric analysis of this kind.

Table 1: Descriptive statistics on publications related to COVID-19 and women’s well-being with focus on low and middle income countries included in this review.

| Total | Women and girls’ health N (%) | Gendered social outcomes N (%) | Gendered economic impacts N (%) | Women’s leadership N (%) | Women’s collectives N (%) |
|-------|-------------------------------|-------------------------------|-------------------------------|------------------------|------------------------|
|       | N (%)                         | N (%)                         | N (%)                         | N (%)                  | N (%)                  |
| Number of publications | 1076 (100 %) | 975 (90.6 %) | 129 (12.0 %) | 57 (5.3 %) | 7 (0.7 %) | 1 (0.0 %) |

Lead or senior author affiliated with focal country

|          | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) |
|----------|-------|-------|-------|-------|-------|-------|
| Neither  | 134 (12.4 %) | 104 (10.7 %) | 29 (22.5 %) | 28 (24.1 %) | 4 (57.1 %) | 1 (100 %) |
| Lead only | 67 (6.2 %) | 63 (6.5 %) | 8 (6.2 %) | 1 (1.8 %) | 0 (0.0 %) | 0 (0.0 %) |
| Senior only | 41 (3.8 %) | 35 (3.6 %) | 9 (7.0 %) | 2 (3.5 %) | 1 (14.3 %) | 0 (0.0 %) |
| Lead and senior/Lead in single author papers | 834 (77.5 %) | 773 (79.3 %) | 83 (64.3 %) | 26 (45.6 %) | 2 (28.6 %) | 0 (0.0 %) |

Over 3800 articles were identified using our search criteria during the review period. Of these, 1123 studies were found to satisfy eligibility criteria (Figure 1). Data on date of publication, countries of focus for these eligible studies, and country of institutional affiliation of lead and senior authors were extracted and used for the current analysis. Thirty-three studies did not note their countries of focus, and fifteen studies did not provide date of publication (one study did not include both countries of focus and date of publication). These studies were excluded from the analysis. Data from a total of 1076 studies were thus included in the current analysis.

Four country-level variables were also included in this analysis. Country level data on COVID-19 cases and deaths were extracted from the WHO database. Countries were classified by income group (upper-middle income/ lower-middle income/ lower-income) using the World Bank income groupings. Gender Inequality Index (GII) 2019 rankings were obtained from the United Nations Development Program, and total development assistance received by countries from donors in 2019 was obtained from the Organization for Economic Co-operation and Development (OECD) database.

Over the course of the study period, searches were conducted reviews of included databases every 1-2 weeks throughout the study period. Search results were screened for eligibility and subsequently extracted. Study researchers met with study supervisors (LM, AR) every 2 weeks to review and validate all extracted data, as well as to resolve any queries.

Table 1: Descriptive statistics on publications related to COVID-19 and women’s well-being with focus on low and middle income countries included in this review.

Top rows were not exclusive; some studies had more than one women’s well-being related focal area.
From our literature review, we calculated the number of academic publications on COVID-19 and women’s well-being focusing on each LMIC for each of the 16 months of observation. These publications were further categorized by topical area of focus: women and girls’ health (inclusive of but not limited to COVID-19 infection), gendered social outcomes, gendered economic impacts, women’s leadership, and women’s collectives. Topical focal areas were not exclusive, thus articles could be noted as having two or more focal areas. We also reviewed the country of institutional affiliation for the lead and senior authors of each paper, and identified whether that country was the focal country of the article in question (or one of the focal countries, for articles which included more than one focal country). Authorship affiliations in the article focal country were categorized as neither lead nor senior author’s primary institutional affiliation was in the focal country, lead only, senior only, or both lead and senior. Articles with a single author whose primary affiliation was in the focal country were categorized as both lead and senior authors being affiliated in the focal country.

Study quality and risk of bias are important tools in understanding the quality and composition of research included in scientific reviews. While we considered an assessment of study quality and risk of bias based on existing guidance, the studies encompassed in this

**Figure 1. Study flow diagram.**

5,891 records identified through database searches:
- EconLit=15
- NBER=217
- PsycInfo=178
- PubMed=3,863
- RePec=564
- Web of Science=1,053

405 duplicates removed

5,486 records screened using eligibility criteria

4364 records removed:
- 31 not in English
- 956 not empirical studies
- 2,684 didn’t include a LMIC
- 37 no full text available
- 559 not related to COVID-19 and/or gender
- 97 missing information on methods and/or analysis

1,123 records full-text screened

47 records removed:
- 32 did not include details on specific countries covered by the sample
- 14 missing publication date
- 1 missing both publication date and did not include country details

1,076 records included in review
recurring review were of such a diverse range of methodologies and disciplines that reviewing their quality in a way that was both meaningful and comparable across manuscripts presented a substantial challenge in terms of concept and application (an issue which has been noted elsewhere). We thus opted not to analyze these assessments in this manuscript, instead focusing on a purely bibliometric lens; this is not meant to undermine the importance of study quality and risk of bias, which are essential components of many review structures.

We used three variables to measure COVID-19 burden in a country: number of COVID-19 cases per 100 population, number of COVID-19 deaths per 100 population, and COVID-19 case fatality ratio. The case fatality ratio was defined as the number of COVID-19 deaths per 100 COVID-19 cases in each country. These three variables were estimated for the overall review period, as well as monthly (June 2020 – May 2021).

Information related to income groups for the LMICs was based on the World Bank classification for the financial year 2021-22, which categorizes LMICs as upper-middle income, lower-middle income, and low-income. Venezuela was unclassified in 2021-22 by the World Bank, hence its categorization for 2019 was used in this analysis.

The GII is an aggregate measure of gender inequality calculated at the country level by the United Nations Development Program. The GII measures gender inequalities across three aspects of human development: reproductive health, measured by maternal mortality ratio and adolescent birth rates; empowerment, measured by proportion of parliamentary seats occupied by females and proportion of adult females and males aged 25 years and older with at least some secondary education; and economic status, expressed as labor market participation and measured by labor force participation rate of female and male populations aged 15 years and older. We used the GII for 2019 for each LMIC, with values ranging from 0 (gender equality) to 1 (gender inequality).

Total development assistance captured the total amount of development assistance funds received by each LMIC in 2019, from private donors, official development assistance, and other official flows. This measure is designed to represent the volume of external funds aimed at promoting growth in economic, health and social systems, as a proxy for support to in-country research infrastructures.

**Statistical analysis**

This bibliometric analysis summarizes data from the 1,076 articles eligible for review, providing cross-sectional, article-level descriptive frequencies of author primary institutional affiliations with the number of publications overall, and across assessed focal areas. Country-level descriptive analyses summarize focal topics, author affiliations, COVID-19 burden (cases, deaths and case fatality ratios), GII, and total development assistance for the 137 LMICs included in this sample overall and stratified by income group.

Multilevel, mixed effects linear regression models were used to assess the relationship between our independent variables - COVID-19 burden and authorship affiliations in a given country, and our outcome variable- the number of publications related to COVID-19 and women’s well-being focusing on that same country. These models assessed these relationships by country using a longitudinal panel data structure to implement within-between models including time-varying effects (COVID-19 burden), time-invariant effects (country COVID-19 burden means, authorship affiliation means, income group, GII, and official development assistance) and random effects (country), while accounting for repeated (monthly) measures in each country over the study period. COVID-19 burden was modelled with a six-month lag to account for the delays between the effects of a given level of COVID-19 burden and publishing a scientific article about those effects. While scientific publications often take longer than six months to develop and publish, we used this shorter window given the accelerated peer review processes adopted by many scientific journals for COVID-19-related articles. The number of publications related to COVID-19 and women’s well-being, COVID-19 burden and official development assistance were all right-skewed and are thus presented as natural logs in all regression models.

To fully understand the effect of country income group on the relationship between COVID-19 burden and publications related to COVID-19 and women’s well-being, an additional exploratory analysis ran country income group-stratified iterations of the within-between models for each three COVID-19 burden predictors, again modeled using a six-month lag between COVID-19 burden.

A secondary analysis examined the relationship between our independent variables and the following outcomes- the number of women’s well-being related publications focusing on that same country in three primary focal areas: women and girls’ health, gendered social outcomes, and gendered economic impacts. Models adjusted for all factors included in the main regression models.

All regression models were also tested with no lag between COVID-19 burden and publication date, but model fits were worse than those with the six-month lag (data not shown). We also modeled three- and nine-month lags for comparative purposes, and results did not differ meaningfully from the six-month lag presented below (data not shown).

All analyses were conducted in R, version 4.0.4.

**Role of the funding source**

The funder had no role in manuscript writing, analysis, interpretation or submission. Authors were not
cent of articles focused on women’s leadership (29%) and women’s well-being related COVID-19 articles in this review (some articles focused on more than one LMIC). Women’s well-being related COVID-19 articles in this review include all LMICs with the exception of the Democratic People’s Republic of Korea (see Appendix Table 2). An average of 16 articles were indexed per country during the study review period, though this varied substantially by country income group (Table 2). Over the study period, an average of 21 articles/country were indexed with focus on upper-middle income countries, 15 articles per country with focus on lower-middle income countries, and eight articles per country with focus on low-income countries. More articles focused on women and girls’ health and gendered social outcomes in upper-middle income countries (an average of 18/country and 2/country, respectively), while more articles focused on gendered economic impacts in lower-middle income countries (an average of 1-2/country). In terms of authorship, more in-country affiliated lead authors published papers focused on lower-middle income countries (an average of 0-6/country), while in-country senior authorship, lead and senior authorship, and

### Results

The 1076 women’s well-being related COVID-19 articles reviewed and included in this analysis focus on 136 different LMICs. Three-quarters of reviewed articles (78%) were written by both first and senior authors with primary affiliations in the country (or one of the countries) of focus of that article; one in eight articles (12%) were neither lead- nor senior-authored by an individual with a primary affiliation matching that article’s focal country. The majority of reviewed articles (91%) focused on a primary affiliation matching that article’s focal country; one in eight articles (78%) were written by both first and senior authors with primary affiliations in the country (or one of the countries). Three-quarters of reviewed articles (78%) were focused on gendered economic impacts in lower-middle income countries, and eight articles per country with focus on low-income countries. More articles focused on women and girls’ health and gendered social outcomes in upper-middle income countries (an average of 18/country and 2/country, respectively), while more articles focused on gendered economic impacts in lower-middle income countries (an average of 1-2/country). In terms of authorship, more in-country affiliated lead authors published papers focused on lower-middle income countries (an average of 0-6/country), while in-country senior authorship, lead and senior authorship, and

### Table 2: Descriptive statistics on low- and middle-income countries include in this sample (n=136).

| Topic                                      | Total sample | Low       | Lower-middle | Upper-middle |
|--------------------------------------------|--------------|-----------|--------------|--------------|
| Publications related to COVID-19 and women’s well-being (mean) | 15 88        | 8.07      | 14.65        | 20.93        |
| Women’s well-being related focus*         |              |           |              |              |
| Women and girls’ health                    | 13 47        | 5.93      | 12.22        | 18.42        |
| Gendered social outcomes                   | 1.96         | 1.33      | 1.98         | 2.24         |
| Gendered economic impacts                  | 0.95         | 0.63      | 1.18         | 0.87         |
| Women’s leadership                         | 1.18         | 1.07      | 1.16         | 1.27         |
| Women’s collectives                        | 0.01         | 0.00      | 0.02         | 0.00         |
| Lead or senior author affiliated with focal country |           |           |              |              |
| Neither                                    | 9.25         | 6.41      | 9.12         | 10.76        |
| Lead only                                  | 0.53         | 0.30      | 0.60         | 0.56         |
| Senior only                                | 0.31         | 0.15      | 0.27         | 0.44         |
| Lead and senior/ lead in single-author papers | 5.79         | 1.22      | 4.65         | 9.16         |
| In COVID-19 cases per 100 population (mean) | 0.78         | 0.11      | 0.54         | 1.34         |
| In COVID-19 deaths per 100 population (mean) | 0.04         | 0.003     | 0.02         | 0.08         |
| In COVID-19 case fatality ratio (mean)     | 1.02         | 1.20      | 0.94         | 1.00         |
| Gender Inequality Index (mean)             | 0.43         | 0.60      | 0.47         | 0.32         |
| In development assistance (USD, millions) (mean) | 7.70         | 7.89      | 7.64         | 7.65         |

*Topics were not exclusive; some studies had more than one women’s well-being related focal area.
neither lead nor senior authorship focused on upper-middle income countries (an average of 0.4/country, 9.2/country and 10.8/country, respectively).

There was substantial variation in the relationship between COVID-19 burden and being a country of focus in publications related to COVID-19 and women’s well-being (Figure 2). Generally, as COVID-19 cases, deaths and deaths/cases increased, publications related to COVID-19 and women’s well-being also increased, though there were many outliers including China, Turkey, India and Brazil. These relationships were largely consistent across country income groups, with the exception of case fatality ratios in low-income countries (Appendix Figure 1).

The number of women’s well-being related COVID-19 articles published by May 2021 including focus on LMICs generally increased over time (Figure 3). On average over this time period, there were 67 women’s well-being related publications per month (media n=79), though these trends also varied by country income group, with greater representation of upper-middle income countries than lower-income countries (Figure 4). China had more publications related to COVID-19 and women’s well-being than any other country in this review, with 315 articles indexed between February 2020 and May 2021.

In multivariable linear mixed effect modelling, the number of COVID-19 cases per 100 population in a country was significantly and positively associated with the number of women’s well-being related COVID-19 academic publications during our study period. For every one unit increase in the natural log number of COVID-19 cases per 100 people in a country in a given month, there was a 0.02 increase in the natural log of women’s well-being related COVID-19 publications in that country six months later (p<0.001) (Table 3). COVID-19 deaths per 100 population were only marginally significantly associated with the natural log number of publications related to COVID-19 and women’s well-being in a country. However, for every one unit increase in the natural log of the COVID-19 case fatality ratio, there was a 0.05 increase in the natural log of publications related to COVID-19 and women’s well-being six months later (p<0.001).

All assessed author affiliation categories were significantly and positively associated with the number of publications related to COVID-19 and women’s well-being in models adjusting for COVID-19 cases, deaths and case-fatality ratio (Table 3). In all models, however, effect sizes were largest for senior author in-country affiliations, followed by neither lead nor senior author in-country affiliations, then lead author only affiliations, and finally lead and senior author in-country affiliations.

Income-group stratified analyses indicate that the positive association between COVID-19 burden and women’s well-being related publications six months later was significant only in upper-middle income countries (cases coefficient=0.3, p<0.001 [Appendix Table 3], deaths coefficient=5.0, p<0.001 [Appendix Table 4], case fatality ratio coefficient=0.1, p<0.001 [Appendix Table 5]). Authorship remained significantly and positively associated with publications in all income groups barring in-country affiliated lead authorship in upper-middle income countries (Appendix Tables 3-5).

Analyses exploring the relationship between our independent variables and specific topics of focus within publications related to COVID-19 and women’s well-being reveal more variable associations. The number of COVID-19 cases per 100 population in a country was significantly and negatively associated with the number of women’s well-being related COVID-19 academic publications focused on women and girls’ health during our study period (coefficient=−0.17, p=0.02) (Table 4). In contrast, the number of COVID-19 deaths per 100 population was significantly and positively associated with academic publications on gendered social outcomes (coefficient=7.7, p<0.001) (Table 5). There was no statistical association between COVID-19 case fatality ratio and publications focused on women and girls’ health, gendered social outcomes, or gendered economic impacts (Table 6). Having in-country affiliated lead and/or senior authors was associated with publications in women and girls’ health and gendered social outcomes, but not gendered economic impacts (Tables 4–6).

Discussion
This bibliometric analysis of publications related to COVID-19 and women’s well-being identified more than 1,000 peer-reviewed articles published between February 2020 and May 2021, exploring ways that gender and COVID-19 have intersected in LMICs. This work documents gendered impacts of the pandemic with regard to health as well as social and economic concerns in LMIC contexts, though the social and economic impacts have received less attention. Importantly, our analysis highlights that publication numbers on this topic were generally reflective of COVID-19 burden, but this was limited to upper-middle income nations, suggesting that lower-middle and low-income countries may be under-represented in our developing understanding of gender and the pandemic. Our findings correspond with data showing that pandemic-related publications were generally produced by authors in the most affected countries, though this early work was largely concentrated in upper-middle and high-income nations.37

There were important distinctions in the topical foci of publications related to COVID-19 and women’s well-being based on the nature of COVID-19 case burdens. Increases in COVID-19 cases in LMICs were associated with decreases in publications focused on women and...
Figure 2. Scatterplots of the natural log of cumulative of publications related to COVID-19 and women’s well-being with focus on LMICs and the natural log of cumulative COVID-19 cases per 100 individuals (A), deaths per 100 population (B), and case fatality ratios (C) over the study period.

Note: Lines are linear best-fit lines with shaded 95% confidence intervals.
girls’ health, while increases in COVID-19 deaths were associated with increases in publications on gendered social outcomes, including social norms. Nonetheless, we found no association between case fatality ratios and publications. Case fatality ratios represent a broader range of structural inequities and vulnerabilities, including health system access and infrastructure, and are thus a meaningful lens through which to examine pandemic response. Lack of effects may again point to infection burden indicators not being sufficient...
to build research response in low and strained resource contexts. Hence, we may least understand the gendered impacts of the pandemic in the most socially and economically vulnerable nations.

Upper-middle income countries are most represented in this body of literature, influenced in particular by China, which was a focal country in more than one in three articles published during this period. As the country where the first COVID-19 outbreak was identified, this volume of research represents a rapid production of research aimed at understanding the characteristics and manifestations of this virus, despite a low level of population-adjusted COVID-19 cases and deaths, relative to many other countries. However, the association between COVID cases and women’s well-being related COVID publications in upper-middle income countries was present even after excluding China (results not shown), indicating that this relationship is reflective of a broader spectrum of characteristics of upper-middle income countries. Upper-middle income countries tend to have stronger existing data infrastructures than lower-income counterparts, and thus an ability to more rapidly pivot epidemiologic data systems, including well-functioning Civil Registry and Vital Statistics systems, to capture information on COVID-19. Indeed, the World Health Organization found that 72% of upper-middle income countries had well-developed or sustainable capacities to survey public health threats, in comparison to only 41% of low-income countries. Countries with less robust existing infrastructures had less capacity to track, identify and report COVID-19 cases and deaths through national statistical offices, particularly early on in the pandemic, and there were pronounced differences across income strata. Responsive gender data systems able to pivot across data collection modalities and track key data are lacking in many countries, and a key area for augmentation moving forward.

| Within effects | Estimate | SE  | p-value | Estimate | SE  | p-value | Estimate | SE  | p-value |
|----------------|----------|-----|---------|----------|-----|---------|----------|-----|---------|
| In COVID-19 cases per 100 population | 0.17 | 0.05 | <0.001 | In COVID-19 deaths per 100 population | 2.89 | 1.49 | 0.05 | In COVID-19 case fatality ratio | 0.05 | 0.01 | <0.001 |
| Author affiliations with focal country | | | | | | | | | |
| Neither lead nor senior | 0.26 | 0.01 | <0.001 | 0.26 | 0.01 | <0.001 | 0.25 | 0.01 | <0.001 |
| Only lead | 0.16 | 0.04 | <0.001 | 0.17 | 0.04 | <0.001 | 0.16 | 0.04 | <0.001 |
| Only senior | 0.32 | 0.05 | <0.001 | 0.32 | 0.05 | <0.001 | 0.32 | 0.05 | <0.001 |
| Both lead and senior/Lead author in single-author paper | 0.08 | 0.01 | <0.001 | 0.09 | 0.01 | <0.001 | 0.09 | 0.01 | <0.001 |
| Between effects | | | | | | | | | |
| In COVID-19 cases per 100 population (mean) | 0.23 | 0.12 | 0.06 | In COVID-19 deaths per 100 population (mean) | 0.90 | 2.94 | 0.76 | In COVID-19 case fatality ratio (mean) | 0.02 | 0.02 | 0.47 |
| Author affiliations with focal country | | | | | | | | | |
| Neither lead nor senior (mean) | 0.51 | 0.04 | <0.001 | 0.52 | 0.04 | <0.001 | 0.53 | 0.04 | <0.001 |
| Only lead (mean) | 0.73 | 0.16 | <0.001 | 0.72 | 0.17 | <0.001 | 0.73 | 0.18 | <0.001 |
| Only senior (mean) | 0.08 | 0.29 | 0.77 | 0.09 | 0.29 | 0.77 | 0.05 | 0.32 | 0.87 |
| Both lead and senior/Lead author in single-author paper (mean) | 0.00 | 0.01 | 0.83 | 0.00 | 0.02 | 1.00 | 0.00 | 0.02 | 0.83 |

| Income group | REF | Reference | Reference |
|--------------|-----|-----------|-----------|
| Low          |      |           |           |
| Lower-middle | 0.01 | 0.03 | 0.87 | 0.01 | 0.03 | 0.84 | 0.01 | 0.04 | 0.78 |
| Upper-middle | -0.02 | 0.04 | 0.69 | 0.01 | 0.04 | 0.87 | 0.01 | 0.04 | 0.86 |
| Gender Inequality Index | 0.12 | 0.10 | 0.22 | 0.07 | 0.10 | 0.51 | 0.05 | 0.11 | 0.66 |
| In development assistance (USD, millions) | 0.02 | 0.02 | 0.32 | 0.01 | 0.02 | 0.43 | 0.01 | 0.02 | 0.58 |

| Random effects | Country | Residual |
|----------------|---------|----------|
| 0.08 | 0.08 | 0.09 |
| 0.30 | 0.30 | 0.30 |

| Model fit | AIC | BIC |
|-----------|-----|-----|
| 821.84 | 819.56 | 809.52 |

Table 3: Linear mixed effect models examining the relationship between COVID-19 burden in a country and the natural log of the number of publications related to COVID-19 and women's well-being including focus on that country six months later.

Note: Outcome is natural log of the number of publications.
Research leadership from a more diverse array of scientists, particularly those from LMICs, is widely recognized as an area in need of expansion. While collaboration is an important factor in global health research, including COVID-19 research, leadership by authors in LMICs is needed to appropriately reflect local context in the interpretation of research results, as well as to address pervasive power imbalances. To that end, this study offers important support. We find that the majority of both lead and senior authors had their primary institutional affiliation within a focal country of their research article. Further, such authorship positioning for in-country authors was associated with a higher number of women’s well-being and COVID-19 publications. However, one in eight papers had neither lead nor senior author affiliated with an in-country institution, and this affects the focus of the COVID-19 publications. However, one in eight papers

The table below shows the linear mixed-effect models examining the relationship between COVID-19 cases in a country and the number of publications related to COVID-19 and women’s well-being, focusing on women’s health, gendered social outcomes, and gendered economic impacts associated with COVID-19 publications. The models indicate that having neither lead nor senior authors affiliated with in-country institutions had an approximately 2.5 times larger coefficient size for the number of publications related to COVID-19 and women’s well-being compared to having both lead and senior authors affiliated with in-country institutions. Furthermore, having a body of researchers in-country able to produce published research on topics such as the gendered effects of COVID-19 is critical to ensure that governments, aid organizations, and other stakeholders can learn more about the effects of this pandemic and design appropriately targeted and responsive policies, programs, and research initiatives. These levels of affiliation within countries are similar to those seen in prior research, but the sharp drops in in-country affiliated authors in leadership positions for scientific research on gendered social outcomes and gendered economic impacts highlight ongoing gaps in representation. Prior research shows that COVID-19 publications are more than thrice

Table 4: Linear mixed-effect models examining the relationship between COVID-19 cases in a country and the number of publications related to COVID-19 and women’s well-being, focusing on women’s health, gendered social outcomes, and gendered economic impacts associated with COVID-19 publications.
as likely to focus on health rather than social issues, an understandable prioritization given that this is an infectious disease. It is, however, worrisome that LMIC-affiliated leadership authors are under-represented in research production due to the potentially prohibitively high publication costs, or other factors. 

Development assistance was not associated with publications related to COVID-19 and women’s well-being in any income group, or in any focal topic. This may in part be due to the fact that these figures represent total development assistance; only 4% of these monies are dedicated primarily to gender programming, and a smaller portion still is dedicated to gendered health responses. Low-income countries received less absolute development assistance funding than lower-middle or upper-middle countries in this sample (an average of USD$1.97 million per low-income country in this sample in 2019 vs. an average of USD$2.63 million per lower-middle income country and USD$2.57 million per upper-middle income country). These lower levels of development assistance, paired with substantially higher average levels of gender inequalities in lower-income countries, echo the well-recognized need for increased investment in gender programming, research, and resources in lower-income countries. The research to publication pipeline is intensive in terms of intellectual, human and financial resources, as well as specialized expertise for gender-focused research; these disparities may be jointly

| Within effects | Women and girls’ health | Gendered social outcomes | Gendered economic impacts |
|----------------|-------------------------|--------------------------|---------------------------|
| In COVID-19 deaths per 100 population | -3.76 | 2.04 | 0.07 | 7.69 | 2.10 | <0.001 | 1.15 | 1.44 | 0.42 |
| Author affiliations with focal country | | | | | | | | | |
| Neither lead nor senior | 0.83 | 0.01 | <0.001 | 0.12 | 0.01 | <0.001 | 0.09 | 0.01 | <0.001 |
| Only lead | 1.04 | 0.05 | <0.001 | 0.14 | 0.05 | 0.01 | -0.07 | 0.04 | 0.07 |
| Only senior | 0.79 | 0.06 | <0.001 | 0.23 | 0.07 | <0.001 | -0.02 | 0.05 | 0.59 |
| Both lead and senior/Lead author in single-author paper | 0.94 | 0.01 | <0.001 | 0.12 | 0.01 | <0.001 | 0.01 | 0.01 | 0.21 |
| Between effects | | | | | | | | | |
| In COVID-19 deaths per 100 population (mean) | 2.19 | 2.77 | 0.43 | -1.95 | 3.09 | 0.53 | -0.62 | 1.95 | 0.75 |
| Author affiliations with focal country | | | | | | | | | |
| Neither lead nor senior (mean) | 0.66 | 0.04 | <0.001 | 0.34 | 0.04 | <0.001 | 0.19 | 0.03 | <0.001 |
| Only lead (mean) | 1.08 | 0.16 | <0.001 | -0.09 | 0.18 | 0.61 | 0.11 | 0.11 | 0.33 |
| Only senior (mean) | 0.66 | 0.28 | 0.02 | 0.22 | 0.31 | 0.47 | 0.16 | 0.20 | 0.42 |
| Both lead and senior/Lead author in single-author paper (mean) | 1.07 | 0.02 | <0.001 | -0.04 | 0.02 | 0.02 | -0.06 | 0.01 | <0.001 |
| Income group | | | | | | | | | |
| Low | | | | | | | | | |
| Lower-middle | | | | | | | | | |
| Upper-middle | | | | | | | | | |
| Gender Inequality Index | | | | | | | | | |
| In development assistance (USD, millions) | -0.01 | 0.02 | >0.99 | 0.02 | 0.02 | 0.29 | 0.01 | 0.01 | 0.30 |
| Random effects | | | | | | | | | |
| Country | | | | | | | | | |
| Residual | | | | | | | | | |
| Model fit | | | | | | | | | |
| AIC | 1752 | 3 | 1850 | 6 | 626 | 8 |

Table 5: Linear mixed effect models examining the relationship between COVID-19 deaths in a country and the number of publications related to COVID-19 and women’s well-being focused women and girls’ health, gendered social outcomes, and gendered economic impacts including focus on that country six months later.
The COVID-19 pandemic has adversely impacted the lives of millions of people around the world, and research has been foundational in understanding the health, social and economic consequences of crisis. Many of these consequences manifest in gendered health, gendered social outcomes, and gendered economic impacts including focus on that country six months later.

| Within effects | Women and girls’ health | Gendered social outcomes | Gendered economic impacts |
|----------------|-------------------------|--------------------------|--------------------------|
|                | Estimate | SE | p-value | Estimate | SE | p-value | Estimate | SE | p-value |
| In COVID-19 case fatality ratio | 0.02 | 0.02 | 0.29 | 0.02 | 0.02 | 0.37 | 0.01 | 0.01 | 0.41 |
| Author affiliations with focal country | | | | | | | | | |
| Neither lead nor senior | 0.83 | 0.01 | <0.001 | 0.12 | 0.01 | <0.001 | 0.09 | 0.01 | <0.001 |
| Only lead | 1.04 | 0.05 | <0.001 | 0.14 | 0.06 | 0.01 | -0.07 | 0.04 | 0.08 |
| Only senior | 0.80 | 0.07 | <0.001 | 0.23 | 0.07 | <0.001 | -0.03 | 0.05 | 0.59 |
| Both lead and senior/Lead author in single-author paper | 0.93 | 0.01 | <0.001 | 0.12 | 0.01 | <0.001 | 0.01 | 0.01 | 0.13 |
| Between effects | | | | | | | | | |
| In COVID-19 case fatality ratio (mean) | 0.05 | 0.02 | 0.03 | -0.06 | 0.03 | 0.03 | -0.02 | 0.02 | 0.21 |
| Author affiliations with focal country | | | | | | | | | |
| Neither lead nor senior (mean) | 0.66 | 0.04 | <0.001 | 0.36 | 0.04 | <0.001 | 0.20 | 0.03 | <0.001 |
| Only lead (mean) | 1.06 | 0.17 | <0.001 | -0.06 | 0.18 | 0.72 | 0.13 | 0.12 | 0.27 |
| Only senior (mean) | 0.71 | 0.29 | 0.02 | 0.16 | 0.32 | 0.62 | 0.13 | 0.21 | 0.53 |
| Both lead and senior/Lead author in single-author paper (mean) | 1.07 | 0.01 | <0.001 | -0.05 | 0.02 | <0.001 | -0.07 | 0.01 | <0.001 |
| Income group | | | | | | | | | |
| Low | REF | 0.05 | 0.03 | 0.17 | -0.01 | 0.04 | 0.69 | 0.02 | 0.02 | 0.32 |
| Upper-middle | REF | 0.08 | 0.04 | 0.06 | -0.00 | 0.05 | 0.93 | 0.01 | 0.03 | 0.85 |
| Gender Inequality Index | REF | 0.01 | 0.10 | 0.92 | 0.11 | 0.11 | 0.33 | 0.08 | 0.07 | 0.25 |
| In development assistance (USD, millions) | REF | -0.01 | 0.02 | 0.49 | 0.03 | 0.02 | 0.16 | 0.01 | 0.01 | 0.22 |
| Random effects | | | | | | | | | |
| Country | 0.00 | 0.03 | 0.03 | 0.00 | 0.03 | 0.00 | 0.04 | 0.04 | 0.04 |
| Residual | 0.42 | 0.44 | 0.30 | 0.42 | 0.44 | 0.30 | 0.42 | 0.44 | 0.30 |
| Model fit | AIC | 1738.3 | 1846.6 | 721.41 |

Table 6: Linear mixed effect models examining the relationship between COVID-19 case fatality ratio in a country and the number of publications related to COVID-19 and women’s well-being focused women and girls’ health, gendered social outcomes, and gendered economic impacts including focus on that country six months later.

hindering the production of women’s well-being related COVID-19 research in low-income countries.

Study findings must be interpreted in light of known limitations. This is an ecological, bibliometric analysis of English-language publications, and is neither able to make causal assumptions nor able to draw conclusions about individual countries or health systems. It is possible that some literature related to women’s well-being and COVID-19 was not identified using the study search terms, though we attempted to be as comprehensive as possible. Further, consideration of the impact of non-empirical pieces was outside of the scope of the analysis and may merit further review elsewhere. Our data on COVID-19 cases and deaths relies on numbers reported to the World Health Organization, and thus represents primarily lab-confirmed cases and deaths, not total cases and deaths. COVID-19 excess mortality is now being estimated using statistical modelling techniques, efforts to date primarily target deaths, rather than cases, and thus do not allow for estimation of all outcomes used in this analysis. In addition, data on COVID-19 cases and deaths was not available disaggregated by sex, a known data gap. Importantly, studies needed to include gendered findings to be eligible for inclusion in this analysis, but gender did not need to be the primary analytic aim, thus these papers do not represent comprehensive gender analyses. While women’s well-being related publications should include perspectives of gender beyond the binary man/woman, this review identified only two studies that focused on gendered social outcomes for transgender persons; this limited sample size precluded detailed analysis of this population. Finally, our measure of lead and senior author affiliations is limited to their institutional affiliations at the time of article publication. This does not necessarily correspond with their nationality, or even long-term residence, and should not be interpreted as such.

The COVID-19 pandemic has adversely impacted the lives of millions of people around the world, and research has been foundational in understanding the health, social and economic consequences of crisis. Many of these consequences manifest in gendered
Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.eclinm.2022.101606.

References

1 World Health Organization. WHO coronavirus (COVID-19) dashboard. August 2021. Available at: https://covid19.who.int/. Accessed 3 August 2021.
2 Abou Ghaida R, Li H, Lee KH, et al. COVID-19 and adverse pregnancy outcome: a systematic review of 104 cases. J Clin Med. 2020;9(11):1–15.
3 Center on Gender Equity and Health. COVID-19 and Gender Research in LMICs. October–December 2020 Quarterly Review Report. La Jolla, CA, USA: University of California San Diego; 2021.
4 Global Health 50/50. COVID-19 sex-disaggregated data tracker. August 2021. Available at: https://globalhealth5050.org/the-sex-gender-and-covid-19-project/. Accessed 3 August 2021.
5 ILO Monitor. COVID-19 and the World of Work. 5th Ed. International Labor Organization; 2020.
6 McDougall L, Raj A, Yore J, et al. Strengthening Gender Measures and Data in the COVID-19 era: An Urgent Need for Change: Center on Gender Equity and Health at UCSD. Data 22, Bill and Melinda Gates Foundation, Global Center for Gender Equality at Stanford University, Global Health 1050, Seattle, Washington, USA: International Labor Organization, PARIS21, UN Women, World Bank; 2021.
7 Awodeo A, McDougall L, Chi Y-L, et al. COVID-19 and women and girls’ health in low and middle-income countries: an updated review of the evidence. Washington, DC: Center for Global Development; 2021.
8 O’Donnell M, Bourgault S, McDougall L, Dehingia N, Chesson W, Raj A. The impacts of COVID-19 on women’s social and economic outcomes: an updated review of the evidence. CGD Policy Paper. 2021;2021.1–21.
9 Azcona G, Bhatt A, Encarnacion J, et al. From Insights to Action: Gender Equality in the Wake of COVID-19. New York, USA: UN Women; 2020.
10 Flor LS, Friedman J, Spencer CN, et al. Quantifying the effects of the COVID-19 pandemic on gender equality on health, social, and economic indicators: a comprehensive review of data from March, 2020, to September, 2021. Lancet. 2022;399(10344):2385–2397.
11 Santomauro DF, Mantilla Herrera AM, Shadid J, et al. Global prevalence and burden of depressive and anxiety disorders in 204 countries and territories in 2020 due to the COVID-19 pandemic. Lancet. 2021;398(10287):1700–1712.
12 Agüero JM. COVID-19 and the rise of intimate partner violence. World Development. 2021;151:104217.
13 van Gelder N, Peterman A, Potts A, et al. COVID-19: reducing the risk of infection might increase the risk of intimate partner violence. EClinicalMedicine. 2020;21:100438.
14 Riley T, Sully E, Ahmed Z, Biddlecom A. Estimates of the potential impact of the COVID-19 pandemic on sexual and reproductive health in low- and middle-income countries. Int Perspect Sexual Reproductive Health. 2020;46:71–76.
15 International Labour Organization (ILO). A Gender-Responsive Employment Recovery: Building Back Fairer. Geneva, Switzerland: ILO; 2020.
16 Weber AM, Cislaghi B, Meausoone V, et al. Gender norms and health: insights from global survey data. Lancet. 2019;393(10189):2455–2468.
17 Heise L, Greene ME, Opper N, et al. Gender inequality and restrictive gender norms: framing the challenges to health. Lancet. 2019;393(10189):2440–2454.
18 Dimitris MC, Gittings M, King NB. How global is global health research? A large-scale analysis of trends in authorship. BMJ Global Health. 2021;6(1):e002075.
19 Yergos-Yergos A, Van de Klippe W, Abad-Garcia MF, Rafols I. Exploring why global health needs are unmet by research efforts: the potential influences of geography, industry and publication incentives. Health Res Policy Syst. 2020;18(1):1–14.
20 Evans JA, Shim J-M, Ioannidis JPA. Attention to local health burden and the global disparity of health research. PLoS One. 2014;9(4):e930127.
21 Hagenaars N, Kruijf Td, Lzar L, et al. The relationship between publication volume of biomedical research and burden of disease, 2019. https://doi.org/10.31219/osf.io/yeur.

Contributors

LM, ND and AR contributed to study design and conceptualization. LM, ND, WWC and AD contributed to data collection. LM and ND contributed to data analysis and figure and table creation. LM wrote the original manuscript, all authors contributed to manuscript review and editing.

Data sharing statement

No individually identifiable information is included in the studies included in this review. All extracted data have been made publicly available at Mendeley Data (doi: 10.17632/yhcfcsbstk.1).

Declaration of interests

All authors report funding support in the form of a grant from the Bill and Melinda Gates Foundation to their institution to conduct this research (PI: AR). All authors have nothing else to disclose.

Acknowledgements

This research was support by a grant from the Bill and Melinda Gates Foundation (INV-018007).
22 Micah AE, Cogswell IE, Cunningham B, et al. Tracking development assistance for health and for COVID-19: a review of development assistance, government, out-of-pocket, and other private spending on health for 204 countries and territories, 1990–2020. *Lancet*. 2021;398(10309):117–143.

23 Bell A, Jones K. Explaining fixed effects: random effects modeling. *Int J Environ Res Public Health*. 2021;18(11):1–15.

24 Monzani A, Tagliaferri F, Bellone S, Genoni G, Rabbone I. A global overview of COVID-19 research in the pediatric field: bibliometric review. *JMIR Pediatr Parent*. 2021;4(1):e24779.

25 Malekpour M-R, Abbas-Kangavari M, Azadnejadah S, et al. How the scientific community responded to the COVID-19 pandemic: a subject-level time-trend bibliometric analysis. *PLoS One*. 2021;16(6):e025604.

26 Chacour J. Authorship trends in The Lancet Global Health: only the tip of the iceberg? *Lancet Global Health*. 2018;6(5):e497.

27 Shumba CS, Lasambali AM. Not enough traction: barriers that aspiring researchers from low-and-middle-income countries face in global health research. *J Global Health Econ Policy*. 2021;1(1):1–4.

28 Iyer AR. Authorship trends in Lancet global health. *Lancet Global Health*. 2018;6(6):e1242.

29 Kham M, Alimbola S, Aloudat T, Caballero E, Hawkes S, Rahman-Mothemod, A. Decolonising global health in 2021: a roadmap to move from rhetoric to reform. *BMJ Global Health*. 2021;6(3):e009504.

30 Alimbola S. The foreign gaze: authorship in academic global health. *BMJ Specialist J*. 2019;4:e020628.

31 Mohdad ME, Boukhelene B, Saifi S. Bibliometric method for mapping the state of the art of scientific production in Covid-19. *Chaos, Solitons Fractals*. 2020;139:109052.

32 Palmer-Ross A, Ovseiko PV, Heidari S. Inadequate reporting of demographic and socioeconomic influencers: worldwide spatial regression analysis based on country-level data. *BMJ Open*. 2020;10(6):e041560.

33 Liang L, Tseng C-H, Ho W, Wu C-Y. COVID-19 mortality is negatively associated with test number and government effectiveness. *Sci Rep*. 2020;10:12367.

34 Davis JT, Chinazzi M, Perra N, et al. Cryptic transmission of SARS-CoV-2 and the first COVID-19 wave. *Nature*. 2021;590(787):127–131.

35 Shapiro JR, Klein SL, Morgan R. “Controlling” for sex and gender in global health research. *BMJ Global Health*. 2019;4(5):e002068.

36 Parker M, Bull S. Ethics in collaborative global health research networks. *Ethical. Clinics*. 2009;4(4):165–168.

37 Tindana FO, Singh JA, Tracy CS, et al. Grand challenges in global health: community engagement in research in developing countries. *PLoS Med*. 2007;4(9):e273.

38 Olufadewa I, Adesina M, Ayorinde T. Global health in low-income and middle-income countries: a framework for action. *Lancet Global Health*. 2021;9(7):e893–e906.

39 Gupta A, Reddy V, Solanki H. Cost in high impact journals: the problem for researchers from low-and middle-income countries. *Int J Public Health Res*. 2018;5(1):45–49.

40 Görlücek D, Li Y. Reducing open access publication costs for biomedical researchers in the USA. *MIT Science Policy Review*. 2021.

41 OECD DAC Network on Gender Equality (GENDERNET). Aid Focused on Gender Equality and Women’s Empowerment: A Snapshot of Current Findings and Trends Over Time in Support of the Implementation of the Beijing Declaration and Platform for Action. Paris, France: OECD; 2020.

42 Commission on the Status of Women. Review and Appraisal of the Implementation of the Beijing Declaration and Platform for Action and the Outcomes of the Twenty-Third Special Session of the General Assembly: Report of the Secretary-General. New York, USA: UN General Assembly; 2020.

43 Oshiro J, Caubet SL, Viola KE, Huber JM. Going beyond “not enough time”: barriers to preparing manuscripts for academic medical journals. *Teach Learn Med*. 2020;32(1):71–81.

44 Smith AC, Merz L, Borden JB, Gulick CK, Khitsagar AR, Bruna EM. Assessing the effect of article processing charges on the geographic diversity of authors using Elsevier’s “Mirror Journal” system. *Quart Sci Stud*. 2022;42(1):1129–1143.

45 World Health Organization. Methods for Estimating the Excess Mortality Associated with the COVID-19 Pandemic. Geneva, Switzerland: WHO; 2022.

46 The Sex, Gender and COVID-19 Project. Issue Brief: Gender and sex-disaggregated data: vital to inform an effective response to COVID-19. Global Health 50/50. 2020. Available at: https://globalhealth50/50/wp-content/themes/global-health-covid/media/ISSUE%20BRIEF%20-%20Sex%20Disaggregated%20Data%20%20COVID-19%20%20Sep%202020.pdf.

47 Else H. How a torrent of COVID science changed research publishing in seven charts. *Nature*. 2020;588(7839):553.

48 Akyil FT, Saygili E, Erikan A, Akyil M, Karadogan D. Country-based analysis of COVID-19 publications in the first few months of the pandemic. *Populat Med*. 2021;43(June):1–4.

49 Dehingia N, Raj A. Sex differences in COVID-19 case fatality: do we know enough? *Lancet Global Health*. 2021;9(3):e84–e85.

50 Green MS, Nitzan D, Schwartz N, Nir-Y, Peer V, Peer V. Sex differences in the case-fatality rates for COVID-19—a comparison of the age-related differences and consistency over seven countries. *PLoS One*. 2021;6(4):e245523.

51 Sorci G, Faivre B, Morand S. Explaining among-country variation in COVID-19 case fatality rate. *Sci Reports*. 2020;10:18909.

52 Cao Y, Hiyoshi A, Montgomery S. COVID-19 case-fatality rate and demographic and socioeconomic influencers: worldwide spatial regression analysis based on country-level data. *BMJ Open*. 2020;10(6):e041560.

53 Shaikh N, Zou F, Yang W, et al. COVID-19 mortality is negatively associated with test number and government effectiveness. *Sci Rep*. 2020;10:12367.

54 Oshiro J, Caubet SL, Viola KE, Huber JM. Going beyond “not enough time”: barriers to preparing manuscripts for academic medical journals. *Teach Learn Med*. 2020;32(1):71–81.

55 Smith AC, Merz L, Borden JB, Gulick CK, Khitsagar AR, Bruna EM. Assessing the effect of article processing charges on the geographic diversity of authors using Elsevier’s “Mirror Journal” system. *Quart Sci Stud*. 2022;42(1):1129–1143.

56 World Health Organization. Methods for Estimating the Excess Mortality Associated with the COVID-19 Pandemic. Geneva, Switzerland: WHO; 2022.

57 The Sex, Gender and COVID-19 Project. Issue Brief: Gender and sex-disaggregated data: vital to inform an effective response to COVID-19. Global Health 50/50. 2020. Available at: https://globalhealth50/50/wp-content/themes/global-health-covid/media/ISSUE%20BRIEF%20-%20Sex%20Disaggregated%20Data%20%20COVID-19%20%20Sep%202020.pdf.