comment

Unequal effects of the COVID-19 pandemic on scientists

COVID-19 has not affected all scientists equally. A survey of principal investigators indicates that female scientists, those in the 'bench sciences' and, especially, scientists with young children experienced a substantial decline in time devoted to research. This could have important short- and longer-term effects on their careers, which institution leaders and funders need to address carefully.

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The COVID-19 pandemic has undoubtedly disrupted the scientific enterprise. Policymakers and institutional leaders have already begun to respond to mitigate the impacts of the pandemic on researchers. For instance, many universities are making accommodations for their researchers, and the US government has allowed temporary flexibility in grant conditions[1]. However, we lack evidence on the nature and magnitude of the disruptions scientists are experiencing.

To gain some insight into the extent of disruptions scientists are experiencing, we conducted a preliminary survey, which was distributed on 13 April 2020, approximately 1 month after the World Health Organization declared COVID-19 a pandemic. We reached out to US- and Europe-based scientists across a wide range of institutions, career stages and demographic backgrounds. Within a week, we received full responses from 4,535 faculty or Principal Investigators (detailed information on our survey is included in Supplementary Methods 1–3). Motivated by prior research on scientific productivity[2], we solicited information about scientists' working hours and how their time allocations have changed since the onset of the pandemic. We also asked scientists to report a wide range of individual and family characteristics (for example, field of study, career stage, demographic information, presence of partners or dependents), as these features may moderate the effects of the pandemic[3,4].

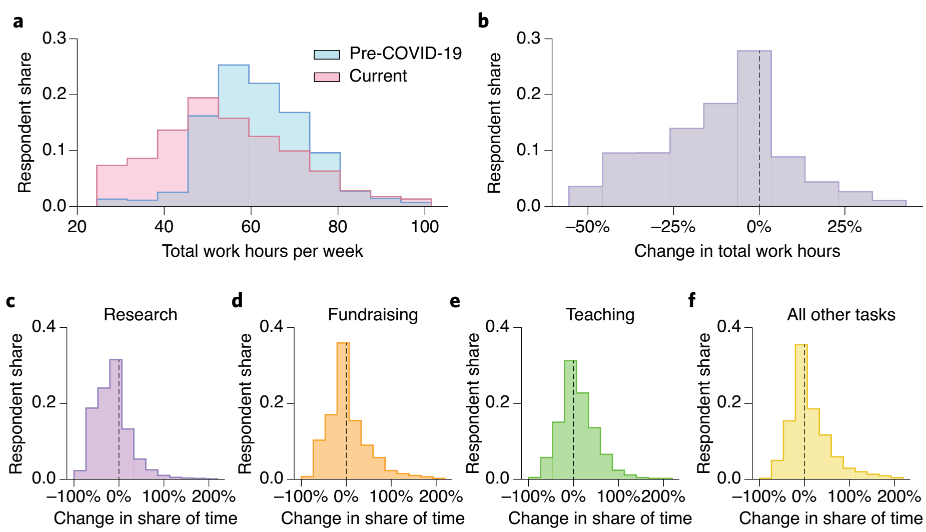

Fig. 1 | Changes in levels and allocations of work time. a, Distribution of total hours spent on work pre-pandemic and at the time of the survey. **b**, Distribution of changes in total work hours from pre-pandemic to time of survey. **c–f**, Distribution of percent changes in the share of work time allocated to research (**c**), fundraising (**d**), teaching (**e**) and all other tasks (**f**).

Varied effects of the pandemic

Overall, we found a decline in total working hours, with the average dropping from 61 h per week pre-pandemic to 54 h at the time of the survey (Fig. 1a). Although only 5% of scientists reported that they worked 42 h or less before the pandemic, this share increased nearly sixfold to 30% during the pandemic. However, the pandemic appears to have affected scientists in different ways. Although 55% reported a decline in total work hours, 27% reported no change, and 18% reported an increase in time devoted to work.

Scientists perform many different types of work: research (for example, planning experiments, collecting or analyzing data, writing), fundraising (for example, writing grant proposals) and teaching, as well as other tasks (for example, administrative, editorial or clinical duties). Among these different types of work, time devoted to research has changed the most during the pandemic. Whereas total working hours decreased by 11% on average, time devoted to research declined by 24%. In terms of the share of time allocated across the tasks (Fig. 1c–f), research is the only category that saw an overall decline. However, not all researchers reduced the time they devoted to research during the pandemic: 21% reported spending more time on research and 9% reported no change.

Different fields are affected differently

The pandemic appears to have affected scientists working in different disciplines unevenly (Fig. 2a). Scientists working in fields that tend to rely on physical laboratories and time-sensitive experiments—bench sciences such as biochemistry, biological sciences, chemistry and chemical engineering—reported the largest declines in research time, in the range of 30–40% below pre-pandemic levels. Conversely, fields that are less equipment-intensive—such as mathematics, statistics, computer science and economics—reported the lowest declines in research time. The difference between fields can be as large as fourfold.

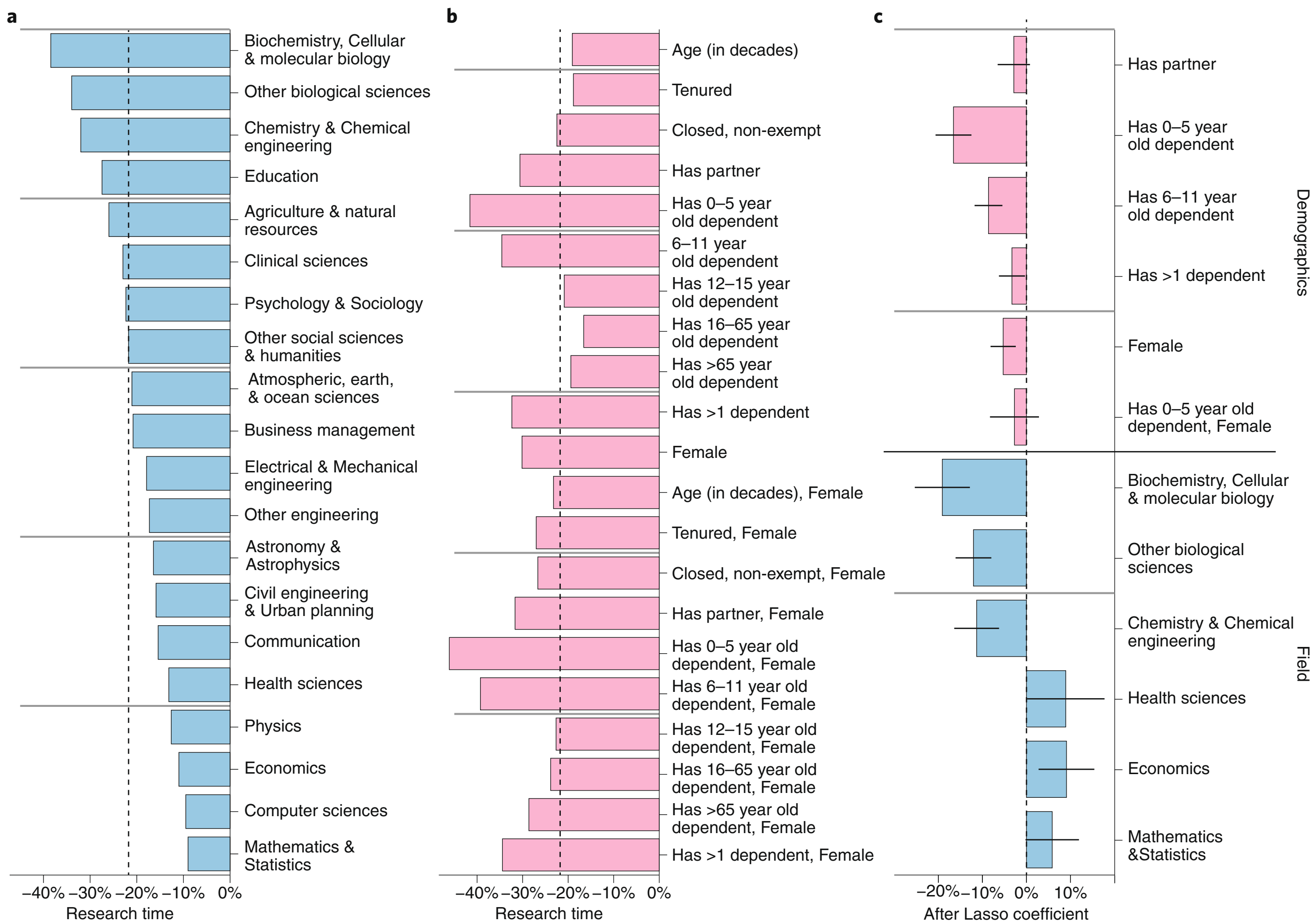

Fig. 2 | Field and group-level changes in research time. **a**, Field-level average changes in research time. **b**, Group-level average changes in research time. **c**, Changes in research time associated with important features of scientists or their fields, after controlling for other factors. To untangle different factors, here we use a Lasso regression approach to select features that are most predictive of declines in research time (see Supplementary Methods 4 for more). Variable names with 'Female' suffix indicate that the variable is interacted with a female indicator; otherwise the variable describes the average change for all scientists. Error bars indicate 95% confidence intervals.

Female scientists and those with young dependents are disproportionately affected

There is a well-documented, persistent gender gap in science[5,6]. We find that there are indeed substantial differences between our male and female respondents in how the pandemic has affected their work. Female scientists and scientists with young dependents reported that their ability to devote time to their research has been substantially affected, and these effects appear additive: the impact is most pronounced for female scientists with young dependents.

Digging deeper

These field- and individual-level differences may be due to the nature of work common to a field, or they may be due to circumstances unique to individuals (for example, changes in home life due to school closings, social pressures unique to genders, etc.).

In further analyses (Supplementary Methods 4), we find that, except for the case of the bench sciences, it is the individual circumstances of researchers that can best explain changes in the time devoted to research during the pandemic (Fig. 2). Specifically, although career stage and facility closures seem to play virtually no role in changes to time allocated to research when everything else is held constant, gender and young dependents play a major role. All else being equal, female scientists reported a 5% larger decline in research time. But the most important variable of all appears to be having a young dependent: scientists with at least one child 5 years old or younger experienced a 17% larger decline in research time, all else being equal. Having multiple dependents is associated with a further 3% reduction in time spent on research, and scientists with children aged 6–11 years were also affected, but to a lesser extent than those with very young children. Our survey results overall indicate that at least some of the gender discrepancy can be attributed to female scientists being more likely to have young children as dependents.

Taking action

Our survey was limited in scale and scope and cannot be used to draw general conclusions. Only 1.6% of the scientists we contacted responded to our survey. Our sample was self-selected and it is likely that scientists who felt strongly about sharing their situation, whether they experienced large positive or negative changes, chose to respond. Our sample mainly applies to US and Europe-based academic researchers. It is also possible that at least some of the gender differences we found arose due to differences in reporting, rather than differences in outcomes[7,8]. Nevertheless, comparing our sample with the Survey of Doctoral Recipients[9] suggests that we oversampled on some of the attributes one might hypothesize to be more relevant to disruptions—namely, female gender and the presence of child dependents (Supplementary Methods 3).

Anecdotal accounts of the impact of the pandemic on scientists have been discussed extensively over the past few months on social media and the popular press. Our survey provides quantitative evidence that highlights disparities in how the pandemic has affected the scientific workforce.

The findings regarding the impact of childcare reveal a specific way in which the pandemic is impacting members of the scientific community differently. Indeed, 'shelter at home' is not the same as 'work from home' when dependents are also at home and need care. Because childcare is often difficult to observe and rarely considered in institutional research policies (aside from parental leave related to birth or adoption), addressing this issue may be an uncharted—but important—new territory for institutional leaders. Furthermore, it suggests that unless adequate childcare services are available, researchers with young children may continue to be affected regardless of the reopening plans of institutions. And since the need to care for dependents is not unique to the scientific workforce, these results may also be relevant for other labour categories.

Our female respondents reported larger declines in the time they could devote to research than their male colleagues. And scientists with young children appear to have been particularly hard-hit, especially women, who remain primarily responsible for childcare. Understanding the degree to which these changes in time allocations may translate into changes in their scientific output (i.e., funding, publications) will be extremely important to track, especially given that gender is a variable relatively accessible in data-driven studies[10]. The pandemic will likely have longer-term impacts that are essential to monitor and address disparities, and further efforts to track the effects of the pandemic on the scientific workforce should clearly take into account household circumstances.

A number of institutions have announced policy responses such as tenure clock extensions for junior faculty. Of 34 US university policies we identified, 30 appeared to guarantee the extension for all faculty (see Supplementary Results 1 for more details). Institutions may favour such uniform policies for several reasons, such as avoiding legal challenges. But given the heterogeneous effects of COVID-19, these uniform policies that do not consider individual circumstances, while welcoming, may have unintended consequences and could exacerbate pre-existing inequalities[11].

While this survey provides a snapshot of the immediate impacts of the pandemic at a single time-point, circumstances will continue to evolve, and there will likely be other notable impacts to science. The disparities we observe may even be exacerbated. For example, as institutions begin the process of reopening, there may be different priorities for bench sciences versus work that involves human subjects or that requires field-work travel, which could lead to new disparities across scientists. The possibility of a resurgence of infections[12] may lead to institutions anticipating a reinstatement of preventative measures and directing their focus toward research projects that can be more easily stopped and restarted. Funders seeking to support high-impact programs may adopt a similar approach, favouring proposals that appear more resilient to uncertain future scenarios. Scientists with potential vulnerabilities to COVID-19 may prolong their social distancing beyond official guidelines. In particular, senior researchers may have incentives to continue avoiding in-person interactions[13], which historically facilitate mentoring and hands-on training of junior researchers. The impact of such changes on individual scientists and groups of scientists could be substantial, in both the short- and long-term, exacerbating negative impacts among those at a disadvantage. It is therefore important that institutions and funding bodies take into consideration the consequences of policies adopted to respond to the pandemic, as they may disproportionately disadvantage specific groups of scientists and worsen existing disparities.

Lastly, although our respondents were all based either in the US or in Europe, the pandemic is having a substantial impact on research worldwide, which we do not capture. In the coming years, researchers may be less willing or able to pursue positions outside of their home nation, which may deepen or alter global differences in scientific capacity. Future work expanding our understanding of how the pandemic is affecting researchers across different countries, at different institutions, in different points of their lives and careers, and belonging to different demographic groups will be needed to effectively protect and nurture the scientific enterprise. The disparities we observe and the likely surfacing of new impacts in the coming months and years argue for targeted and nuanced approaches as the world-wide research enterprise rebuilds.

Reporting Summary. Further information on research design is available in the Nature Research Reporting Summary linked to this article.

Data availability

Because of the sensitive nature of some of the variables collected, the institutional review board (IRB)-approved protocol does not permit individual-level data to be made unrestricted and publicly available. Researchers interested in obtaining restricted, anonymized versions of this individual-level data should contact the authors to inquire about obtaining an IRB-approved institutional data sharing agreement.

Code availability

Code necessary to reproduce all plots and statistical analyses is freely available at https://kellogg-cssi.github.io/covid_survey/. ❐

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Competing interests
The authors declare no competing interests.

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Study description	A study to quantify the impact of COVID-19 pandemics on scientists.
Research sample	We identified scientists in US and Europe with at least two scientific papers during the past decade. Further details available in Supplementary Information S1.
Sampling strategy	We collected a list of author email addresses from Web of Science. We then randomly shuffled and sampled roughly 280,000 email addresses from U.S.-based authors and 200,000 from Europe-based authors. Further details are available in Supplementary Information S1 and S3.
Data collection	We sent out email invitations with a link to an online survey form. The survey is hosted and collected through the Qualtrics platform.
Timing	The survey was performed in April 2020.
Data exclusions	For our analyses, we focus entirely on responses from the sample of faculty/Principal Investigators, excluding responses from individuals who report to work for a "For-profit firm". We restrict the sample to respondents whose IP address originated from the United States or Europe (dropping 1,049 responses from elsewhere) and drop observations that have missing data for any of the variables used in our analyses. Further details available in Supplementary Information S3.
Non-participation	We estimate a response rate of approximately 1.6%. Further details available in Supplementary Information S3.
Randomization	No randomization.

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Recruitment	We recruit individuals online. Further details on representativeness of our sample available in Supplementary Information S3.
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