



Resilient women scientists and the COVID-19 pandemic: an OWSD analysis

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Received: 9 August 2021 / Accepted: 11 December 2021 / Published online: 8 March 2022
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Abstract

Pandemics tend to have disruptive and uneven impacts on different population subgroups and across sectors. This paper investigates the impact of the COVID-19 pandemic on women scientists from the Global South to understand their resilience and adaptation strategies, utilising data from a survey of women in STEM fields, who are members of the Organization for Women in Science for the Developing World (OWSD). We employ a mixed-methods approach to examine the effects of the pandemic on the respondents' work and employment, home and family lives, and mental well-being. We find that the impact of the COVID-19 pandemic and the requirement to change practices in academia, indeed in all spheres of social and economic life, have provided a unique and most timely opportunity to observe, evaluate and revise what might be termed the current gender-limited environment for career progression for researchers in STEM subjects and instead create a gender-transformative environment that will have a profound effect on how scientific research is managed and undertaken in the world.

Keywords Gender Inequality · Covid-19 · OWSD · Resilience · STEM

JEL Classification A20 · I10 · J16

Organization for Women in Science for the Developing World (<https://www.owsd.net/>).

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1 Introduction

The COVID-19 pandemic has had massive disruptive effects on health, healthcare and economic systems around the globe, adversely affecting billions of lives. The health consequences and economic impact have strained systems and further exacerbated the frailties of developing countries. Multiple studies have been carried out on the effects of COVID-19: its origins, economic impact, weaknesses of healthcare systems around the world and the differential effects on men and women's health and career progression (Agarwal, 2021a, 2021b). Since explicit data from specific countries are still very limited, reliable comparisons are difficult to undertake.¹ Initial data shows that one of the early consequences of COVID-19 was that more women than men lost jobs, took deeper pay cuts or left the workforce altogether (Zarrilli & Luomaranta, 2021). The social and economic fallout could have a long-term impact by potentially pushing an additional 47 million women and girls into poverty worldwide, as well as shifting funds away from women's ongoing health needs toward a response to the pandemic (Azcona et al., 2020).

Preliminary results show that, while early on in the pandemic there were signs that older men were physiologically the most vulnerable to the disease, women are far more vulnerable to the most severe economic and health consequences of COVID-19 due to the existing gendered inequalities in job security and career progression. They are significantly more likely to be in the line of fire: they make up 70% of the global medical workforce (WHO Advocacy Brief, 2020) and 76% in the EU (European Parliament, 2021). They are more exposed to COVID-19 since they constitute the majority of carers for the sick, elderly and vulnerable, yet they are often without contracts or health insurance. Women are the most severely hit economically, socially and psychologically. Furthermore, too few women have a voice in decision making or in managing responses to the pandemic (Dhatt, 2020).

The impact of the COVID-19 pandemic on male and female scientists and scholars has also been felt worldwide, as universities and industries have closed their campuses, along with a slowing down or shift in priorities of standard funding and publishing. In the developed world, transferring meetings online and being forced to work from home has led to a steep learning curve, and many personal and professional adjustments have needed to be made (some negative, some positive). Evidence suggests that women scientists not only in the Global South, but in Europe and the USA as well, have disproportionately taken on the added burden of home-schooling, home care and housework, while continuing to strive to reach important results in their scientific research. The trends in preprint servers are consistent with the hypothesis that the pandemic is disproportionately hurting the productivity of female scholars. How long this effect will persist, and what its downstream consequences might be for journal publications and academic careers, are open questions. In a 'publish or perish' world, it seems this pandemic could be setting back the hard-won progress of women in STEM (King and Frederickson, 2021).²

¹ Several notable attempts have been undertaken on this front, for instance, see <https://ourworldindata.org/coronavirus-testing>, but we need to better understand what the published numbers on testing signify.

² See also Bea Mass et al. (2021), Squazzinioni et al. (2020) and Inno et al. (2020).

While for many men the enforced time at home has enhanced their productivity (concentration uninterrupted for hours on end), women have found the opposite. Their caregiving role has increased (World Bank 2020) from meeting the constant demands of small children no longer at day-care, responding to the anxieties and frustrations of cooped up adolescents, visiting and comforting sick and elderly relatives, in addition to trying to support their children in following distance learning. While this is highly challenging for women the world over, in developing countries these issues are especially magnified. Going online is not just a question of having an internet connection and an operative mobile phone (a laptop is only a dream for many), it also requires a regular (and affordable) supply of electricity (which numerous homes in developing countries do not have). While many women in the North may face difficulties and inconveniences in sharing their living quarters with homeschoolers, many women in developing countries may have one space for cooking, sleeping, laundry and studying. It is also not uncommon to find several members of extended families living together in a very limited space that requires additional careful cleaning and supervision, adding on to the already existing challenging situation. Aware of the likely extra challenges that many women in developing countries in STEM fields may face, OWSD decided to undertake a survey to gauge the impact of the COVID-19 pandemic on the lives of its members. This paper presents the results of that survey.³

The paper is organized as follows: Sect. 2 below describes the gender inequalities for women in STEM careers, Sect. 3 presents the framework in which to situate the gender-related questions. Section 4 discusses the findings of the OWSD survey, with a focus on the effects of the pandemic on the individual, domestic and professional spheres of the respondents. And Sect. 5 offers some conclusions. The Appendix provides a collection of comments by OWSD members of the contributions they have made to relieving some of the effects of the pandemic in their countries.

2 Women's career paths in STEM fields

The pipeline metaphor is often used to describe an ideal career development model for STEM researchers: they enter universities at one end of the pipe (as undergraduates) and ideally flow inexorably and steadily through the system, through masters, PhDs and postdocs, until they come out the other end as internationally recognised and respected scientists or science administrators, with a platform and influence. At the end of the pipeline, they will ideally be considered international experts and be consulted and listened to when natural disasters strike, or an epidemic occurs.

That this pipeline is 'leaky' for women is repeatedly referred to in poster and conference presentations, keynote talks and published articles. A selection of the top articles that come up in a google search for 'leaky pipeline', for example show the breadth and frequency of such citations: See: Barma (2020), Pittwire (2020),

³ The full detailed survey can be found at: <https://owsd.net/news/news-events/impact-covid-19-women-scientistsdeveloping-countries-results-owsd-member-survey>.

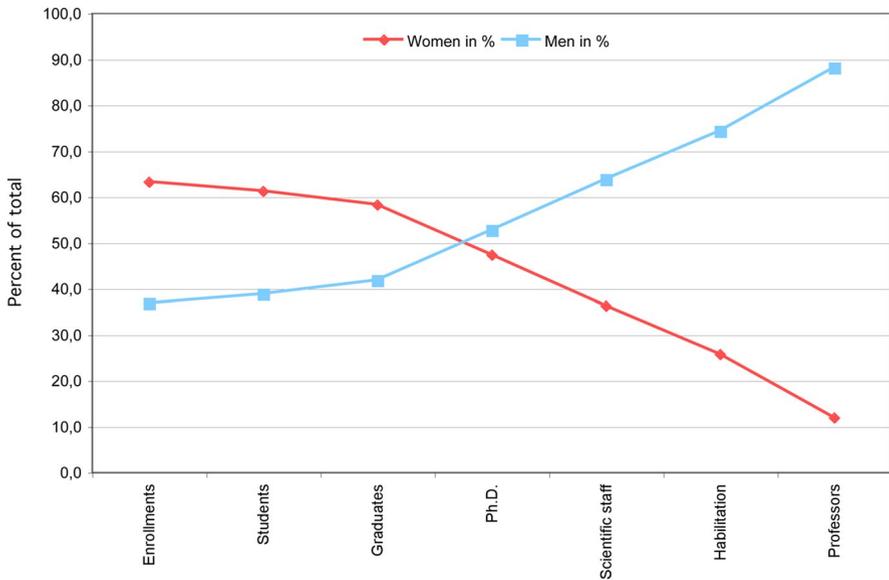


Fig. 1 Scissors Diagram; *Source:* Neugebauer (2006)

Overholtzer and Jalbert (2021) and Sato et al. (2021).⁴ The data shows that there will be numerous ‘pinch points’ or perhaps rusty holes (to continue the metaphor), where women, despite their own investments and those of others, will drop out. Thus their knowledge, experience, perspective and creativity will no longer circulate in the pool of ambitious researchers asking questions and finding solutions, designing research projects and implementing them in the field. There is also significant evidence to suggest that when women are not included in research, real world outcomes suffer: scientific research is less relevant to the needs of specific communities, and less readily implemented by the users who can benefit from it.⁵ As a result of the attrition of women scientists, priorities will be set and research will be carried out more and more by men as they go further up the career ladder (Fig. 1).

Another much-used metaphor is the ‘scissors’ effect. The diagram above (taken from Neugebauer, 2006) shows that more women enter STEM fields at the undergraduate level than men, but the numbers steadily decline in inverse proportion to greater remuneration, status and influence (Neugebauer, 2006).

A recent paper (April 2021) by Batchelor, et al. 2021 referred to a new (always water-based) metaphor of the ‘braided river’. We use it here to describe the course of a woman’s career in STEM, arguing that it is much more likely to meander and

⁴ Additional academic articles include: Blickenstaff (2005), Buckles (2019), Gasser and Shaffer (2014) and Resmini (2016).

⁵ Also see *Gendered Innovations 2: How Inclusive Analysis Contributes to Research and Innovation*, (Schiebinger & Klinge, 2020), with a foreword by Mariya Gabriel, the European Commissioner for Innovation, Research, Culture, Education and Youth.

be set off course by life events and challenges. Yet, these meanderings themselves should be considered *as* valuable if not *more* valuable than the straightforward, prescribed and expected course through a rigid pipeline: “Today’s science careers look less like a structured pipeline and more like a collection of paths that change and adapt to the needs of the individual. [...]”

“People take many paths through school and weave careers around an assortment of circumstances such as rearing families, serving in the military or volunteer corps, fulfilling caregiving responsibilities, or reengaging with formal education. These experiences bring new ideas that are more creative, practical, and interdisciplinary solutions to science.” (Batchelor et al., 2021).

Meandering can be a response to community needs and women often choose to take detours to serve the needs of others. Thus, rather than following the standard pipeline model of ‘excellent’ scientific careers characterized by chronological increments and based on competition, they follow a path based more on inclusiveness and cooperation, which can enrich their approach to research.

This new model captures the opportunity, variability, and responsiveness of a modern STEM career. It embraces the diversity and experiences of the people who engage in it, recognizing the many pathways and career pivots induced by real life and providing a framework in which there is a place in STEM for everyone. The braided river model recognizes that barriers create different degrees of challenges for each person, which require flexible and adaptable solutions, and assigns real value to the skills, tenacity, and insights needed to overcome challenges. The model accommodates and empowers people to stay in their scientific field through support structures, given that the ‘pathways’ do not solely represent careers—they also represent the relationships that enrich scientific work (see Batchelor et al. 2021).

These qualities have been demonstrated again and again in women scientists’ responses to the OWSD survey questions: identifying needs, mentoring, providing information, raising awareness, diverting and reassigning their own precious research resources in order to contribute to the greater need of the community, informing, reassuring, and providing guidelines. Unfortunately, these qualities rate very low on indices of scientific excellence. Yet, they are essential for ensuring that the full impact of scientific knowledge and expertise reaches where it is most needed and responds to global remits such as the Sustainable Development Goals whenever possible. OWSD has developed programmes for over 30 years designed to increase opportunities, visibility and recognition for women from the Global South in STEM. Including and empowering women in science means embracing the potential for increasing the positive impact on the overall output for human progress (Quadrio Curzio et al., 2020).

3 The framework

The approach mentioned above can be seen in the context of Amartya Sen's and Martha Nussbaum's work on identifying key development indicators in a more holistic way. The process used to assign the development status of countries remains a hotly debated topic. The consequences of being categorised as, for example, 'highly developed' or 'middle income' or 'least developed' can have massive economic, social and cultural impacts, as those designated the richest in terms of such indicators are in a position to then preside over the countries 'below' them, assigning 'handouts' according to base indicators of need. However, as scholars like Sen and Nussbaum have elaborated⁶ (and whose work continues to be developed in the Human Development and Capability Association⁷), the base economic indicators of prosperity ignore many variables which have a direct impact on an individual's access to and experience of wealth in any given country. While an indicator of high unemployment levels certainly reflects a level of poverty, discomfort and low status, it is not the case that every individual who is unemployed will have the same experience of that status, or access to the same opportunities and support.

Amartya Sen's 'capabilities approach' has been highly influential in human development theories. It has led to the creation of the Human Development Index (HDI),⁸ and is one of the global development indicators⁹ along with the Inequality-Adjusted HDI (IHDI) and the Gender Inequality Index (GII), used by international organizations.

Numerous indicators are needed to evaluate the wellbeing of individuals in society. For women in science, these types of indicators are of utmost importance. They can help to better evaluate and understand women's opportunities in science in a holistic manner and assist in alleviating the challenges and roadblocks they currently face.

Amartya Sen's key concepts of capabilities and functionings are defined as:

"A functioning is an achievement whereas a capability is the ability to achieve. Functionings are, in a sense, more directly related to living conditions since they are different aspects of living conditions. Capabilities, in contrast, are notions of freedom, in the positive sense. What real opportunities you have regarding the life you may lead." (Amartya Sen, "The Standard of Living", 1987, 36).

⁶ Amartya Sen (1985). *Commodities and capabilities*. New York: Elsevier Science. Amartya Sen (2001). *Development as freedom*. Oxford: Oxford University Press. Martha C. Nussbaum (2011). *Creating Capabilities: The Human Development Approach*. Harvard University Press. Martha Nussbaum, Jonathan Glover (eds.) *Women, culture, and development: a study of human capabilities*: Oxford University Press.

⁷ Human Development & Capability Association Multi-Disciplinary and People-Centred: <https://hd-ca.org/>.

⁸ See the *Human Development Index* definition at <http://hdr.undp.org/en/content/human-development-index-hdi>, see also Sen, A. "Assessing human development"; <http://www.hdr.undp.org/en/content/assessing-humandevelopment>.

⁹ See *Global Human Development Indicators* at <http://hdr.undp.org/en/countries>.

Functionings can be likened to the base indicators traditionally used to indicate excellence in science (number of publications and citations in international peer-reviewed journals and/or h-index, keynote speaker at international conference, award winner, academy member, chair of board) whereas *capabilities* can be likened to those value-adding aspects that create a holistic scientific career based on community, e.g. mentoring, nurturing, awareness raising, explaining, informing.

This is not to suggest that traditional science does not have aspects of these qualities (tutoring, mentoring and supervising are key elements to the success of Oxbridge degrees, for example) but they tend to be assigned (one-on-one) and importantly, remunerated, recognised, and official. The crucial point is that women's work in science often goes far beyond this agreement, but it is rarely officially recognised or remunerated. Furthermore, it is important to recognise that the impact of events like pandemics on the household may not be symmetric or straightforward due to intrahousehold gender dynamics (Agarwal, 1997).

4 OWSD Survey on women in science and the impact of the pandemic

Early on in the pandemic, in June 2020, the Organization for Women in Science for the Developing World (OWSD) sent a survey to its (then) 6000+ members (women scientists based throughout the Global South) to determine the effects of the pandemic on their professional and personal lives. OWSD members belong to a network that links women scientists across the Global South.¹⁰ Full members have at least a master's degree in a science subject and live and work in a developing country. The countries with which it cooperates closely are predominantly the least developed in Africa, as well as other scientifically- and technologically lagging countries in Asia and Latin America. At the time of the survey, there was little information about the impact of the pandemic on women scientists from the countries with which OWSD works closely.

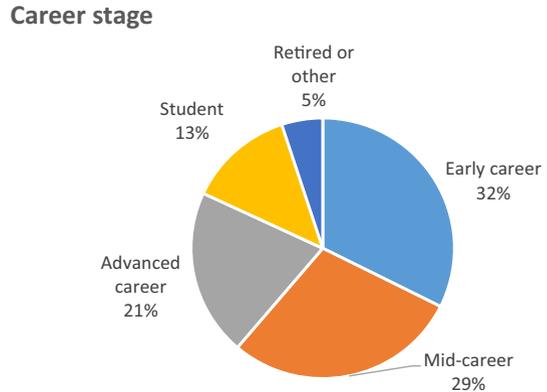
The purpose of the OWSD survey was to hear directly from women in as many different developing countries as possible. The survey aimed to understand how gender-differentiated treatment was impacting their lives (and potential) as scientists. To better understand several of these differences, questions covered the effects of the COVID-19 pandemic in three areas: work/studies; family and home lives; and mental wellbeing.

To obtain a clearer picture, a detailed primary survey was undertaken to collect both quantitative and qualitative data, which was then analysed. Qualitative feedback was analysed in depth to understand the nuances.

Several aspects became clear early on from the responses of the women scientists; these included: (1) *resilience* in the face of additional obstacles to the already enormous challenges that could have sent them over the edge; and (2) *adaptability*

¹⁰ For information on the OWSD's projects, goals and objectives visit their website at: <https://www.owsd.net/>.

Fig. 2 Career stage of respondents; Source: OWSD 2020 Survey



in adjusting their research content or working practices to ensure a contribution to the cause of relieving the effects of the pandemic in their countries.

The “[Appendix](#)” provides detailed comments from the OWSD survey responders on their contribution to alleviating the pandemic from both within and outside of the narrow confines of their professional scientific career trajectory. It is notable from the survey results that respondents often put their personal career development second to the needs of both their families and their wider communities.

4.1 The participants

The survey was conducted between June 16 and June 26, 2020. In total 1465 responses were received from women scientists from 80 developing countries. The large majority of the respondents, almost 80%, were primarily involved in either research (40%) or teaching (38%); another 10% were students, 7% worked in administration or industry; while 5% were currently unemployed, retired or working in other areas. More than half (57%) of the respondents were working or studying at a public university; 12% were working at a governmental research organization/agency and 11% at a private university.

As can be seen from Fig. 2, close to one third of the respondents were in their early career; another 29% in their mid-career, 21% in an advanced career and the rest were students, retired, or at another stage of their career.

The largest share of respondents (39%) was between the ages of 35–44, 29% were between the ages of 25–34, and 21% were between the ages of 45–54; the rest were either younger or older.

Geographically, just over half of the respondents were from Sub-Saharan Africa (49% of these from Nigeria); just under a quarter (21%) were from the Asia Pacific region, 15% from Latin America and the Caribbean, and 10% from the Arab region. After Nigeria, the countries with the most respondents were Guatemala, India, Kenya, and Bangladesh. Most of the respondents (90%) live in urban areas.

Respondents came from all disciplines, as can be seen from Fig. 3. Three disciplines (15% for each) accounted for almost 45%: medical and health sciences

Respondents by STEM field

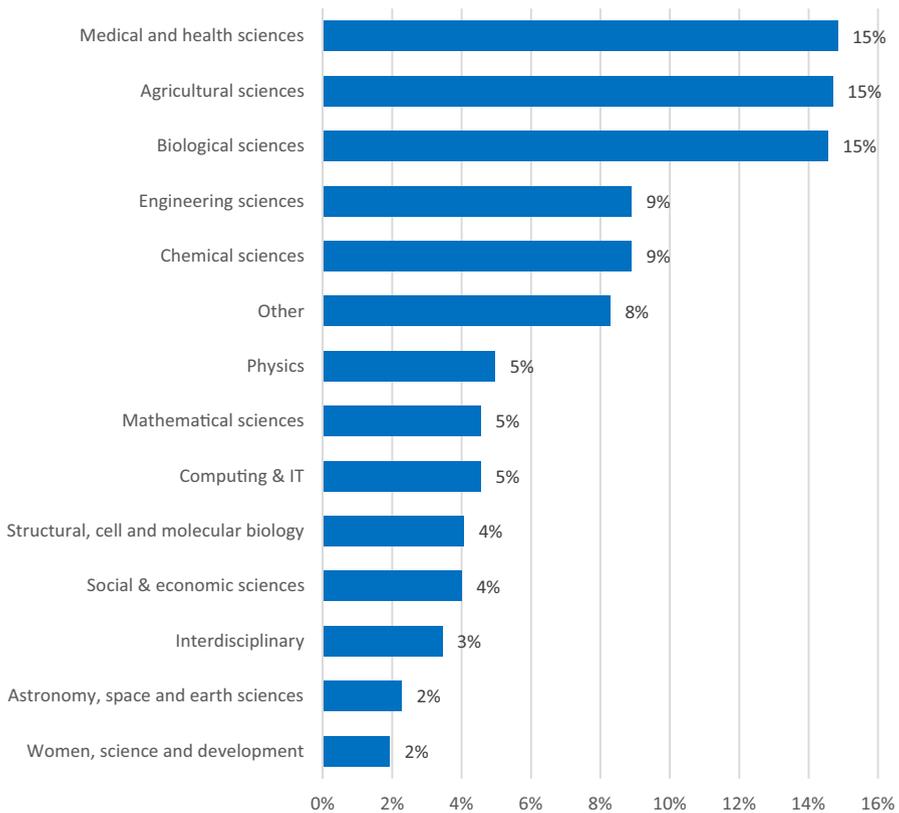


Fig. 3 Respondents by STEM field; Source: OWSD 2020 Survey

(including neuroscience); agricultural sciences; and biological systems and organisms. Chemical sciences and engineering sciences were the next most common disciplines, each making up 9%. All other disciplines (astronomy, space and earth sciences; computing and information technology; mathematical sciences; physics; social and economic sciences; structural, cell, and molecular biology; women, science and development; interdisciplinary) had less than 5%.¹¹

¹¹ Where possible, we have provided data disaggregated by career stage, discipline, and region. However, when comparing the differences across these variables, it is important to note that the number of responses in some categories varied significantly—we had 215 responses from women in medical and health sciences, compared to only 33 in astronomy, space, and earth sciences; 786 responses came from Sub-Saharan Africa compared to 148 from the Arab region. Hence, these data should be taken only as a starting point for further inquiry and for raising some interesting hypotheses, rather than as definitive evidence.

Negative impact of Covid-19 on work and education

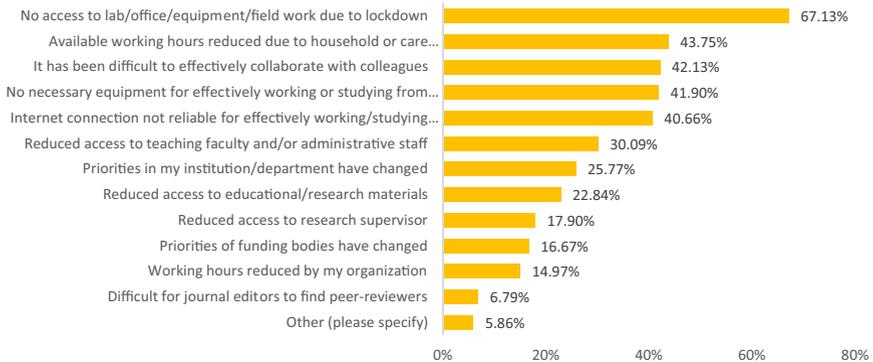


Fig. 4 Negative impact of Covid-19 on work and education; Source: OWSD 2020 Survey

4.2 Impact on work/education

The first set of survey questions addressed how the pandemic has changed OWSD members' work or studies, the challenges they faced and the consequences of those challenges. The respondents were also asked about their involvement in any response to the pandemic (see [Appendix](#) for details).

To better understand the impact of the pandemic, a differentiation was made between the causes of the impact (i.e., lack of a reliable internet connection at home) and the outcomes (i.e., inability to perform experiments).

As summarized in [Fig. 4](#), the most common negative effects on work, research and studies were being unable to travel to conferences or other important work events, being unable to perform experiments or do field work, being unable to follow courses or teach, as well as the delay of pending publications. Other negative impacts included the delay or suspension of ongoing funding, difficulty in finding collaborators, being unable to submit funding proposals or research for publication, missing out on business opportunities or clients and being unable to take exams as scheduled.

Responses varied significantly by career stage, discipline and region. The inability to travel to conferences was perceived to be more of a problem for women advanced in their careers, while being unable to perform experiments or field work affected students and scientists in their early careers more. The inability to perform experiments and field work was far less of a problem for mathematicians, computer scientists, and social and economic scientists than for those in other fields.

The most common factors contributing to the negative effects were the inability to access the lab/office/necessary equipment/field work locations as a result of lockdowns, reduced available working hours due to household or care responsibilities, difficulty in effectively collaborating with colleagues, lack of the necessary equipment or a reliable internet connection for effectively working or studying from home, reduced access to teaching faculty and/or administrative staff, and

Positive impact of Covid-19 on work and education



Fig. 5 Positive impact of Covid-19 on work and education; Source: OWSD 2020 Survey

changes in institutional/departmental priorities. Among the negative effects cited by respondents under the category ‘other’, many noted salary cuts or delays in payments.

These factors again varied by career stage, discipline and region. For example, 54% of the respondents from Sub-Saharan Africa said they did not have a reliable internet connection at home compared to 20% from Latin America and the Caribbean, 27% from the Asia Pacific region, and 33% from the Arab region.

Many respondents also reported positive outcomes, as shown by Fig. 5. Most notably, more than half reported enjoying the more flexible working hours. Another large group stated they were able to expand their professional skills or experience. Others welcomed having more time available for their research. In some cases, it was notable that their organization or institution had invested in new technologies for working/studying remotely. Others appreciated the opportunity to broaden their public engagements or increase their scientific publications.

Positive effects differed somewhat across career stage, discipline and region. Physicists and computer scientists reported having more time available for research, compared to those working in the natural sciences like biological systems and organisms, or structural, cell and molecular biology.

One positive outcome from the pandemic commonly cited in the media is that it has provided universities and other institutions the impetus to put in place the administrative procedures and the technological capacity to support distance learning and/or teleworking. Members were asked to describe the level of preparation of their institutions for these activities before the pandemic, and how prepared they expected them to be following the pandemic. Their responses (on a scale from 1 to 5) indicated that most expect the conditions for remote learning and working to improve; from an average technological preparedness of 2.23 out of 5 before the

pandemic, they predicted an increase to 3.3; and from an average administrative preparedness of 2.12 they predicted an increase to 3.24.

4.3 Impact on home and family life

A second set of survey questions addressed how the pandemic has changed OWSD members' family dynamics. Data show that even before the pandemic, across cultures, women were doing the bulk of unpaid domestic labour,¹² varying from 1.5 h more than men per day for Canadian women¹³ to 5 h more per day for women in India.¹⁴ Women worldwide performed more than twice the hours of unpaid labour (4.1 h) compared to men (1.7 h). While unpaid work has increased for both men and women since the pandemic, women continue to shoulder the bulk (UN Policy Brief 2020). Since a broadening of the disparity during the pandemic was predicted (and demonstrated by early global figures), OWSD wanted to investigate and understand the experience of its members regarding having their children home from school, their restricted access to other sources of either paid or unpaid domestic help and additionally, whether the pandemic had brought about any unexpected positive outcomes for their home and family lives.

4.3.1 Impact on time spent on household work (excluding childcare)

Over half of the respondents reported spending much more time than usual on household chores—not including childcare—during the pandemic and more than a quarter stated they spent somewhat more time than usual. The remaining stated spending the same, somewhat less or much less time than usual. The answers were fairly consistent across career stage (i.e., students, early career scientists, senior scientists), discipline, and region. The women most likely to report that they spent much more time than usual on household work were in social and economic sciences, while female physicists and medical and health professionals reported it the least.

Women in the Arab region were slightly more likely to report they spent much more time than usual, and slightly less likely to state they spent somewhat more than usual on household work, than those in other regions.

Respondents were asked to estimate the share of labour that fell to the various parties before and during the pandemic. On average, respondents indicated that the share of household chores falling to them rose more for them than for their partners. The share of household work done by both male and female children rose slightly

¹² Schiebinger and Gilmartin (2010) argue in an article by the same name that 'housework is an academic issue': "Scientists wear clean clothes to the lab (at least from time to time), eat food procured and prepared by someone, and live in reasonably clean houses. This labour used to be done by stay-at home wives. The single-earner wage of the 1950s, for example, covered the cost of unpaid services that wives performed." (p 39).

¹³ Source: Canadian statistics at <https://www150.statcan.gc.ca/n1/pub/89-503-x/2015001/article/54931-eng.htm>.

¹⁴ Source: OECD statistics at <https://www.oecd.org/gender/balancing-paid-work-unpaid-work-and-leisure.htm>.

Table 1 Comparison of share of household work and childcare pre- and during the pandemic; Source: OWSD 2020 Survey

	Pandemic	
	Pre (%)	During (%)
<i>Estimated share of household work</i>		
OWSD respondent	52	58
Partner	19	21
Female children	8	10
Male children	6	8
Domestic help	25	16
<i>Estimated share of childcare</i>		
OWSD respondent	51	66
Partner/family	23	24

Please note that the responses provided were estimates made by OWSD members and therefore do not in all cases add to 100%

but equally, though female children remained responsible for 2% more household work than male children. Work done by domestic help dropped from 25% of total labour to 16%.

4.3.2 Impact on time spent on childcare and home-schooling

The change in time spent on childcare was even more dramatic than the change in time spent on household chores. Of those for whom the question was applicable, 61% said that they were spending much more time than usual on childcare during the pandemic, while 24% said they were spending somewhat more time; 12% about the same time; and 3% were spending either somewhat less or much less time than usual.

Respondents who were more likely to report spending much more time than usual on childcare were students (69%) and scientists in their early careers (67%), compared to scientists advanced in their careers (52%). This result is not surprising since the children of senior scientists would presumably be older on average and require less care. Some differences were also found by discipline. Scientists in physics, engineering, social and economic sciences, computing and information technology were the least likely to report spending much more time than usual on childcare during the pandemic. Regionally, respondents from Sub-Saharan Africa were the most likely to report spending much more time on childcare (64%), while those from the Asia–Pacific region were the least (53%).

As with household chores, OWSD asked respondents to estimate the change in childcare responsibilities, between the various parties, before and during the pandemic. Before the pandemic, OWSD members were on average responsible for half (51%) of the after-school childcare; during the pandemic, it increased to 66%. In comparison, the increase in the share of other parents or partners, who held the next greatest share of responsibility, was only one percent (from 23 to 24%). All other

types of care provided by grandparents, other family members, babysitters, domestic help, day-care, or afterschool programmes, decreased (Table 1).

Next, respondents were asked to estimate the extent to which they and other parties were responsible for home-schooling their children during the pandemic due to school closures. Respondents oversaw the majority (69%) of home-schooling. Other parents or partners took care of 25%, while older siblings, grandparents, and other parties helped with smaller amounts.

Although OWSD members did report spending greater amounts of time during the COVID-19 pandemic on unpaid labour (household work, childcare, and home-schooling), their responses indicate there were also some positive effects on their family and home lives. The most reported positive outcome was having more time available for their families (83%). Next was an improved relationship with their children (41%); slightly over a third noted an improved relationship with their partner. Slightly less than a third reported enjoying being actively involved in their children's education, and 29% believed their children had matured and taken on more responsibilities.

In general, members from Sub-Saharan Africa tended to report many positive effects, including being more involved in their children's education, improved relationships with their children and partners, a more equitable distribution of household chores and/or childcare, and greater maturity acquired by their children. Some small differences were also seen across different career stages and disciplines.

4.4 Effects of the pandemic on mental wellbeing

The third and final set of survey questions addressed how the COVID-19 pandemic was affecting OWSD members' mental wellbeing, how members were coping overall and what were the main factors influencing their mental wellbeing, for better or for worse. The pandemic has been for many people a source of acute and prolonged stresses, often unforeseen and never experienced before.

More than a third of the members said that the impact on their wellbeing has been mixed. Around a quarter said their wellbeing has been somewhat negatively impacted, while 10% said it has been severely impacted. A small percentage reported that their mental wellbeing has improved during the pandemic, with 6% saying that it improved somewhat and another 6% saying it improved significantly. For 18% of respondents, there was no significant change in their mental wellbeing.

In general, respondents in their early careers were more likely to state that their mental wellbeing was severely or somewhat affected negatively by the pandemic: 15% of students and 11% of early career researchers were severely impacted, for example, compared to 7% of scientists in advanced careers. Regionally, respondents from the Arab region were more likely to say their mental wellbeing was severely impacted, those from Latin America and the Caribbean were more likely to say it was somewhat impacted, while those from Sub-Saharan Africa were somewhat more likely to say their mental wellbeing had somewhat or significantly improved.

Respondents rated several factors potentially contributing to a negative impact on their mental wellbeing on a scale of 0–10. As can be seen in Fig. 6, of highest

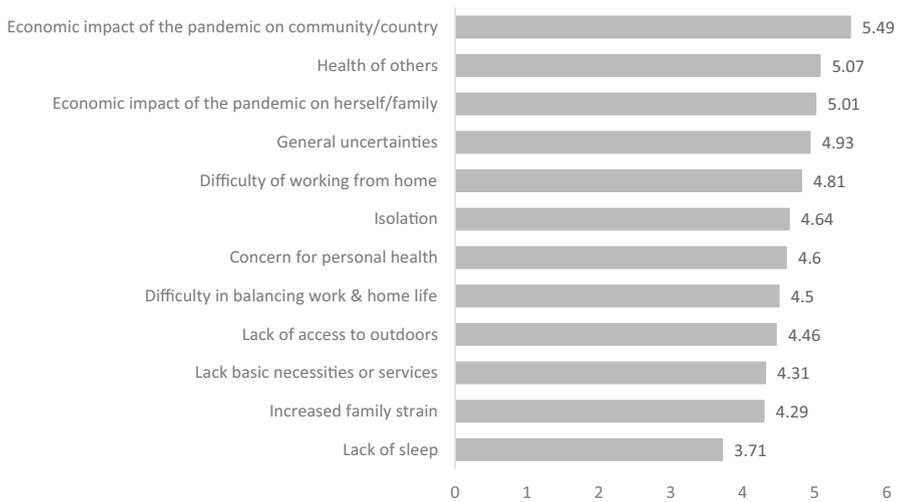
Negative factors influencing mental wellbeing (0-10 scale)

Fig. 6 Negative factors influencing mental wellbeing; *Source: OWSD 2020 Survey*

concern was the economic impact of the pandemic on respondents' communities/countries, with an average score of 5.49. Other top concerns were uneasiness for the health of others, anxiety over the direct economic impact of the pandemic on themselves or their families, and general uncertainty. Additional concerns regarded the logistic difficulty of working from home, concern for their own health, difficulty in balancing work and home life, increased family strain, and lack of sleep. Social isolation, lack of access to the outdoors or "cabin fever" and lack of access to basic necessities or services were also concerns (Fig. 6).

Respondents also rated factors that were potentially contributing to a positive impact on their mental wellbeing, again on a scale of 0–10. Having more time available to spend with their families was by far the most significant factor. More flexible working hours also scored highly, followed by more time available for self-care e.g., getting more sleep, cooking better meals, and more time available for personal projects/hobbies. The ability to connect with family/friends remotely using technology was also considered an important factor. Factors that ranked slightly lower included a sense of solidarity or support from the community, greater productivity while working from home, and greater recognition and appreciation for their work/research (Fig. 7).

4.5 The overall results

The results underline the considerable extent to which the pandemic has disrupted the lives and careers of the OWSD respondents. It has obstructed these women in their efforts to reach important professional milestones, in submitting graduate

Positive factors influencing mental wellbeing (0-10 scale)

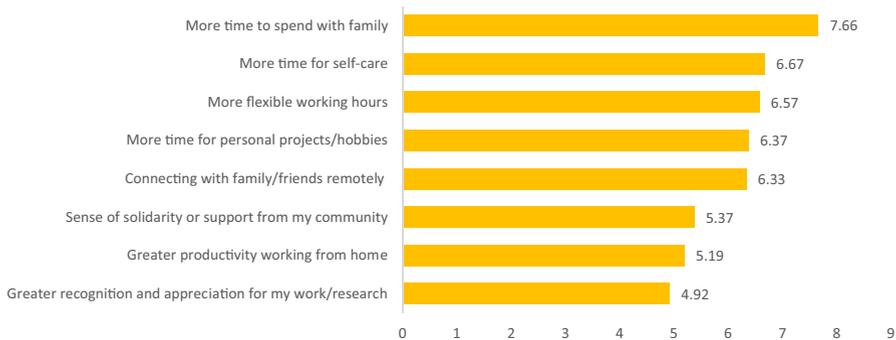


Fig. 7 Positive factors influencing mental wellbeing; *Source: OWSD 2020 Survey*

theses, starting new jobs, and traveling to fellowships and residencies. It has interrupted experiments in progress and halted field work. It has also forced them to find new ways of remote teaching and learning with little training or support.

While the pandemic has impacted all professions globally, to greater or lesser degrees, institutions and individuals in developing countries often have fewer resources to support remote learning and working, and women frequently have multiple responsibilities that make working from home a greater challenge than for men.

The pandemic has isolated many women far from their homes and families, unable to travel back. And for those who are at home, the survey results confirm what many predicted and what had already been heard anecdotally: women scientists have taken on a disproportionate share of increased household work, childcare and home-schooling during the pandemic. The crisis has taken an undeniable toll on their mental wellbeing, leading many to feel anxious, overwhelmed, lonely, or unmotivated.

Yet there are also silver linings to be found in the responses received. Many welcomed a change in their routine and the opportunity to refocus their priorities. A large majority of respondents enjoyed having more time available to spend with their families, and many reported improved relationships. Others found opportunities to forge better connections with their communities or with nature, or simply enjoy more time for themselves.

The change in normal routines and the absence of a commute allowed many to have more flexible work schedules and freed up time for writing proposals or delving deeper into unexplored avenues of research; for working on more intensive projects such as books; or for improving and expanding their skills through online courses and webinars. Many respondents expected the institutions to be better prepared for remote work or education after the pandemic.

Overall, OWSD members' responses highlighted the importance of identifying needs, mentoring, providing information, raising awareness, and the willingness to divert and reassign their own precious research resources in order to contribute to the greater needs of the community, demonstrating their resilience, adaptability, and social conscience.

5 Conclusion

The COVID-19 pandemic has impacted individuals, groups, institutions and forced a global change in practices in all spheres (economic, social, political, environmental, etc.). For academia, it is a unique and timely opportunity to observe, evaluate and revise what might be termed gender-limiting practices and introduce gender-opening/transformational practices. Gender equality in the field of science will have a profound effect on the performance and management of scientific research around the world.

The examples and data provided by OWSD members, through this survey, reveal the holistic effectiveness of women's behaviour and responses to the pandemic, and suggest the importance of re-positioning and reconfiguring how scientific excellence should be determined. The key notion is that the emergency measures put in place to alleviate the global impact of the pandemic may provide us with the opportunity to rewrite the indicators of excellence so that they are more aligned with the contributions women make to science. These results identify closely with the Scientific Excellence Working Group of the Global Young Academy which argues that scientific excellence “not only includes excellence in scientific research, but also excellence in connecting science to society, in teaching and mentoring scientists, in science management, and in science advice to policy makers [...]”¹⁵

UN Women Director, Phumzile Mlambo-Ngcuka, told The Associated Press in March 2021 that the pandemic has left women facing increasing domestic violence and being laid off from two-thirds of the jobs lost during the crisis. In addition, 11 million girls are at risk of never returning to school, child marriage has increased, and there are more orphans and child-headed homes. “So whatever you touch, women are in a bad space, as a result of the pandemic” and the underlying discrimination “that has always been there [...] suggests that building back better is about gender equality, just as it's about green economies and any equitable sharing of resources.” (Lederer, 2021). Building back better for women must include ensuring that they have equal representation in COVID-19 response planning and decision making, changing the existing gender culture for the care economy (paid and unpaid), and focusing on the needs of women and girls when addressing the socio-economic impact of COVID-19 (UN Policy Brief 2020).

Appendix

OWSD respondents' contributions to overcoming COVID-19 in the Global South: a selection of responses

Women scientists' contributions to overcoming COVID-19 in the developing world can be linked to overall goals of capacity-building (in terms of sustainable economic

¹⁵ See Global Young Academy, Scientific Excellence: Aims and Objectives at <https://globalyoungacademy.net/activities/optimising-assessment-promoting-excellence/> (June 2021).

development), including the 17 United Nations sustainable development goals (SDGs), and towards a necessary re-definition of excellence in science.

Many OWSd members have been involved in some capacity with a response to the pandemic, whether at the institutional, local, or national level. While a small number were performing research on COVID-19 directly (4%) or treating COVID-19 patients (1%), great numbers were involved in raising awareness or disseminating information about the virus (26%), or in performing research related to its more indirect effects (14%). A more intimate look at how some OWSd members developed innovative responses to the pandemic is available through a prior survey published on the OWSd website.¹⁶

Involvement with pandemic response varied, unsurprisingly, to the greatest extent by discipline; differences among scientists in different career stages and in different regions were quite small, except in a few instances. Mathematical scientists reported the highest percentage of their discipline performing research directly on COVID-19—11% of all respondents in that discipline—followed by those in medical and health sciences (9%), and computer science (7%).¹⁷

Respondents told us some of the specific ways they were responding to the pandemic:

Direct research on COVID-19 and vaccines/treatments

“I am a virologist and working on COVID-19 theoretically right now.”

“I am now involved in a global sub-committee for COVID-1718 diagnostics.”

“I am participating in computer-aided drug design and pharmacogenomics.”

“I am going to be involved in a COVID-19 DNA vaccine in Korea, as a post doc.”

“Exploring the evidence based studies on medicinal plants to combat COVID-19.”

“I am involved in providing an artificial based intelligence solution for COVID-19, using neural networks, Random Forest and molecular docking.”

“I collaborated with some colleagues to write a manuscript on drug development using computational approaches.”

Participation in treatment and diagnosis of COVID-19 patients

“I’m involved in telemedicine and giving treatment, counselling and advice to the patient in this situation.”

“I have been a frontline health worker during this period as a medical laboratory scientist involved in direct sample collection. This has enabled me to gain the requisite practical experience in the areas of epidemiologic surveillance, community testing and other related activities.”

¹⁶ <https://owsd.net/sites/default/files/Responding%20to%20COVID>.

¹⁷ [_Women%20scientists%20from%20developing%20countries%20tell%20their%20stories_2.pdf](#).

¹⁸ It is worthy of note that only 55 mathematicians responded, compared to 195 respondents from medical and health sciences. Structural, cell, and molecular biologists were the most involved in testing and diagnostics for the virus. Biologists, medical scientists, and scientists working in the fields of women, science, and development, were the most active in raising awareness.

“I have been volunteering at the testing centre; mostly returning results and sick certificates and completing testing information on a national government surveillance database.”

“I am a nasopharyngeal swab collector in two isolation centres in Sudan and participate in many different ways in the ministry of health response to COVID.”

“I was involved with agricultural viral research, but I volunteered technical support to the COVID-19 testing lab in my region.”

“Working at helping my institute upgrade laboratory safety level to help us participate in the testing since we have some equipment and expertise.”

“We donated all our protective equipment from the laboratory to the hospitals. So, after the opening of the labs we had to ration the use of masks, suits, etc.”

“The public health research institution where I work has paralyzed most of the ongoing research and has focused its efforts on tackling the pandemic on all possible fronts (including building an exclusive hospital for COVID-19 care and a testing centre).”

“My partner is also a scientist and has been involved in the development of a massive screening test, so I tried to support him by taking care of everything at home during quarantine.”

Participation in policy response to COVID-19 pandemic

“I have contributed to the conceptualization of the COVID-19 Africa Rapid Grant Fund to address research questions and implement science engagement activities associated with the pandemic, with a focus on 17 countries in sub-Saharan Africa.”

“I am coordinating the Virus Outbreak Data Network for Africa.”

“I collaborated in research at the early stage of COVID-19 in Nigeria on Guidelines on Preventive Behaviour Adherence.”

“I am an editor of a science digest of multidisciplinary science, in which I am communicating the efforts being carried out by different countries to combat COVID-19.”

“I am involved in a multidisciplinary team working on a project to analyse and assess privacy and security risks regarding the design, implementation and use of digital applications for contact tracing, to assist in the process of finding COVID-19 transmission risks.”

“We are analysing possible compulsory licencing for patents related to the COVID-19 response.”

“Discussing the post-pandemic food security situation and how to strategize adequate responses to mitigate hunger and nutritional insecurity in my country.”

“As the Agribusiness Chamber and Banking Association and at the bank I work for, we have provided information on how COVID impacts the sector. Agbiz contributed extensively to the government’s response to COVID and now as a sector we’re developing recovery and post recovery plans.”

Research on wider impacts of COVID-19 pandemic

“Through writing a paper on COVID-19 waste management.”

“Monitoring statistical data for disabled persons during COVID-19.”

“I am working online with my postgraduate students on the impact of COVID-19 on the educational system and stakeholders.”

“I am involved in assessing the effect of COVID-19 on small-scale fishers.”

“I am conducting research on how women-owned MSMEs will be able to survive and grow during the pandemic in our city.”

Awareness raising and information dissemination

“Our team developed a web-based personal and regional risk assessment tool (COVIRA). Users can calculate their own or family members’ personal risk; the regional risk of any place in Nepal up to municipal level can also be visualised in the tool.”

“I am doing peer review of articles related to the pandemic in the local language, to reach the otherwise unreached.”

“I’ve become involved in a research project with collaborators in different countries in Africa, the US and Europe, aiming to provide credible information to African youth by assessing the COVID-19 response in African countries and sharing this information through social media channels most accessible to African youth.”

“I am presently working with my team members on misinformation and disinformation about COVID-19. We are harvesting tweets within the country and across countries.”

“I am involved in producing jingles for television. This was aimed at disseminating information to the populace on the impact of coronavirus.”

“I have been involved in designing and disseminating information to manage the adverse effects of quarantine in children and families.”

“I organized virtual events in Panama to create awareness about COVID-19 and share real scientific data about the pandemic with the Panamanian population.”

“I generated translated infographics for COVID-19 awareness through my membership in the Uganda National Young Academy.”

“Bringing out a weekly newsletter on science and technology efforts against COVID-19.”

“I talk to people one-on-one, especially in the market, telling them that COVID-19 is real.”

Hygiene and sanitation

“I am involved in preparing new designs for passenger flow in airports to reduce conflict amongst passengers.”

“I am currently working on antimicrobial and antifungal activities of citrus peel extracts and juice. We can use these properties in the manufacture of effective hydro-alcoholic solutions and soaps for handwashing.”

“I am involved in the design and construction of mechanical leg-operated water and soap dispensing hand washing equipment for prevention of COVID-19 transmission in my organization.”

“As an industrial chemist, I started small scale soap, detergents, and sanitizers production and distribution to people in the rural areas, soaps, detergents and sanitizers being the major products for fighting and prevention of COVID-19.”

Community activism to combat impacts of COVID-19 pandemic

“I have written a proposal to the commissioner of education to help reduce the widening education gap between rural and urban, rich and poor that has resulted from disruption of education due to COVID-19.”

“I am volunteering on several teams to raise funds and bring ventilators to my country.”

“I have been able to help organize and canalize aid from Germany to Guatemala, in the form of tests and economical aid to elderly and other vulnerable populations.”

“I have participated in virtual conferences where I have talked about stress management skills to prevent the adverse mental health effects of the pandemic.”

“Through Rwanda Association for Women in Science and Engineering (RAW-ISE), we are elaborating messages that would help young students from primary, secondary and undergraduate students to not be frustrated by COVID-19, instead use their free time to keep themselves mentally, intellectually and physically fit.”

“I am helping some urban dwellers establish backyard vegetable gardens and also help in distributing organic fertilizers to some rural farmers to help them combat the pandemic effect on food supply.”

“I opened a forum on WhatsApp for women in my circle to provide support during the difficult times. The women I engaged were based in several countries including Canada, USA, Switzerland, Kenya, South Africa and Botswana. We covered topics from COVID-19 to just how people were coping.”

“I organised a feeding project to reduce poverty associated with COVID-19 among rural villages.”

Research on viral diseases more generally

“Working on a study on how to use big data analytics for early prediction of infectious diseases such as COVID-19 for improved health outcomes.”

“Currently, I have a collaboration with a UK university for an antiviral drug delivery system from waste-originated materials to fight against virus crises, including COVID-19.” “Working with traditional knowledge and cures for respiratory disease and studying the immunomodulatory effects of wild macro-fungi

and other plants for curing viral diseases traditionally used by ethnic tribes in India.”

Acknowledgements The authors would especially like to thank Micaela Tavasani whose edits and comments were deeply appreciated. Alexandra Cussianovich (OWSD) also provided the charts and doublechecked all numbers and data from the survey. Lucia Fanicchi and Evgenia Markvardt (OWSD) contributed to the survey questions. Finally, we are very appreciative of the substantial and detailed comments provided by the journal’s associate editors and anonymous reviewers, which greatly helped us improve the paper.

Funding This research was supported by the Swedish International Development Cooperation Agency, the International Development Research Centre (Canada), the Elsevier Foundation, and the Aspen Institute.

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