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**The impact of the COVID-19 pandemic on early career researcher activity, development, career, and well-being:
The state of the art**

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The impact of the COVID-19 pandemic on early career researcher activity, development, career, and well-being: The state of the art

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Abstract

Design/methodology/approach (limit 100 words)

This is a systematic literature review of English-language peer-reviewed studies published 2020–2021, which provided empirical evidence of the impact of the pandemic on early career researcher (ECR) activity and development. The search strategy involved (a) online databases (Scopus, Web of Science, and Overton); (b) well-established higher education journals (based on Scopus classification), and (c) references in the retained articles (snowballing). The final sample included 11 papers.

Purpose (limit 100 words)

The aim of this paper is to identify the documented effects of the COVID-19 pandemic on ECR activity, development, career prospects, and well-being.

Findings (limit 100 words)

The evidence shows that ECRs have been affected in terms of (a) research activity, (b) researcher development, (c) career prospects, and (d) well-being. Although many negative consequences were identified, some promising learning practices have arisen; however, these opportunities were not always fully realised. The results raise questions about differential effects across fields and possible long-term consequences where some fields and some scholars may be worse off due to priorities established as societies struggle to recover.

Practical implications (limit 100 words)

There is a need for revised institutional and national policies to ensure that sufficient measures are implemented to support ECRs' research work in a situation where new duties and chores were added during the pandemic.

Originality/value (limit 100 words)

This paper provides insights into the impacts of the initial societal challenges of the pandemic on ECRs across disciplines that may have long-lasting effects on their academic development and well-being.

Introduction

Lockdowns and other pandemic restrictions have affected scholars' research activities in multiple ways, e.g., delays in data collection, data analysis, writing, and preparing grant applications. Access restrictions to research environments and reduced capacity levels have constrained the possibilities for engaging in research, especially in some sectors on campuses or in other shared research spaces (Termini and Traver, 2020; Wigginton *et al.*, 2020). Specialised technical equipment, software, and research materials have been rendered off limits as lockdowns and other restrictions have been implemented, and public health measures have led to prohibitions against many in-person interactions. Additional authorisation processes have been implemented in places where (limited) access is possible, which means more researcher time is spent filling forms and reviewing requests. When access is constrained in these various ways, it may not only delay research, but also disrupt research skill acquisition, hamper socialisation processes for newcomers, and shift scholarly identities (Wisker *et al.*, 2021). Academic conferences have been cancelled or shifted to virtual formats, which has redefined research communication strategies and reduced opportunities for networking and relationship building (Wang and DeLaquil, 2020). These major shifts in the research environment have made the ability and willingness to support people's well-being particularly critical in supervisory and similar positions (Cameron *et al.*, 2021).

The pandemic has forced many academics to modify their research goals (Termini and Traver, 2020), and career goals may likewise have been revised and postponed. Yet the situation has not affected all researchers equally. Women scientists, those working in "bench sciences", and those with young children appear to have been affected the most (Minello *et al.*, 2020; Myers *et al.*, 2020; Organization for Women in Science for the Developing World, 2020; Staniscuaski *et al.*, 2021). The reduced research productivity of women (in particular those with caring responsibilities) has thus far been evidenced through bibliographic analysis of submissions and publications of academic outputs (namely journal articles) where researchers use authorship position as a proxy for career stage (e.g., Vincent-Lamarre *et al.*, 2020). This evidence has been suggested to amount to an "early career bias" (Stanicuaski *et al.*, 2021, p. 10), with several authors suggesting that early career researchers (ECRs) have been hit the hardest by the lockdown closures of childcare facilities and schools,

because this stage in the academic career overlaps with the reproductive age of women (Andersen *et al.*, 2020; Krukowski *et al.*, 2021; Viglione, 2020). This is likely to have important short- and long-term effects on their careers, as predicted and explained by scholars in all corners of academia (e.g., Cardel *et al.*, 2020; Corbera *et al.*, 2020; Malisch *et al.*, 2020; Oleschuk, 2020; Wigginton *et al.*, 2020). Maranda and Yakubovich (2020) describe the “cascading effects” (p. 831) on the future careers of ECRs who have faced restrictions on access to their research laboratories. Indeed, it is not difficult to imagine that lockdowns, disruptions, and redirected research efforts undermine confidence and jeopardise productivity in ways that could have long-term effects on the potential futures for ECRs.

ECRs have reported that their supervisors are strained by the restrictions and demands placed on them during unusual times (Lambrechts and Smith, 2020). Although experiences of stress and not daring to ask for advice or help are negative, there is potential in the present situation to increase individuals’ understanding of each other and appreciation for the contributions of others (e.g., supervisors, peers and supervisees). Such recognition provides an opening for the compassion for self and others that Cameron *et al.* (2021) see as a critical aspect of mentors and protégés moving forward together through the pandemic.

As we, the authors, are all members of a Special Interest Group on Researcher Education and Careers, part of the European Association for Research on Learning and Instruction (EARLI), we met to discuss our own ongoing research in the area and set out to establish what is the ‘state of the art’ of research about the current and future impacts of the pandemic on ECRs. We adopt the definition of an ECR from the SIG’s mission statement, which is “individuals with up to 10 years’ research experience including their doctorate: doctoral students, post-PhD researchers, newly-hired lecturers as well as professionals in universities and beyond” (see <https://www.earli.org/node/47>). Specifically, in this review, we researched how the pandemic has influenced and is influencing *ECR activity and development*, and what impacts it has had on *researchers’ well-being*. Through this literature review, we seek to answer the following research question: *How has the COVID-19 pandemic affected ECR activity, development, career prospects, and well-being?*

Method

We conducted a systematic literature review of studies published between January 2020 and May 2021 that examined the impact of the COVID-19 pandemic on ECR activity, development, career prospects, and well-being. In order to progress to the analysis of findings, we closed the search after May 2021, although we realise that the body of research will constantly accumulate. Our search was focused on three main themes: (a) ECRs, (b) research activities and development, and (c) the COVID-19 pandemic. Within each theme, we identified keywords that we used in the database searches: (a) ‘early career researcher’, ‘doctoral researcher’, ‘PhD student’, ‘post doc’, and ‘academic’; (b) ‘research’, ‘training and development’, ‘career’, and ‘well-being’, and (c) ‘pandemic’, ‘COVID-19’, and ‘coronavirus’. We followed the guidelines for

reporting systematic reviews and meta-analyses (PRISMA) to locate relevant literature in English (Moher *et al.*, 2009). Our search strategy included two stages (Figure 1):

insert Figure 1 about here

Stage 1: We searched three online databases: Scopus and Web of Science, which are considered the most comprehensive bibliographic databases suited for this review (Pranckutė, 2021; Zhu and Liu, 2020) and the Overton policy database, which contains a core set of policy documents with sufficient citation linkage to academic literature (Szomszor and Adie, 2022). Through the searches, we identified 242 publications from Scopus, 84 from Web of Science, and 0 from Overton. Having read the abstracts, we retained 28 publications that fit our focus from Scopus and 25 from Web of Science. At this point, we were inclusive, but in the next phase involving closer reading of the abstracts and initial reading of the methods section of the articles, we discarded contributions that did not fit the focus (e.g., teaching activities, undergraduate students), ending up with a final number of 17 across Scopus and Web of Science.

Stage 2: We were aware of additional publications that might be relevant considering our focus, but which had not come up in Stage 1. We then expanded our search to higher education journals, as journals particularly in this field may have published research related to the work and development of academics during the pandemic, and we, the authors, all work within the field of education. The additional publications that we were aware of, but which had not come up in the database searches were among well-established higher education journals according to Scopus: *Studies in Higher Education*, *Higher Education*, *Journal of Higher Education*, *Internet and Higher Education*, *Research in Higher Education*, *Assessment and Evaluation in Higher Education*, *Higher Education Research and Development*, *Review of Higher Education*, *International Journal of Sustainability in Higher Education*, and *Teaching in Higher Education*. Some of these were already included in our initial database searches.

We recognise that journal rankings can be critiqued (Tight, 2018). However, in this case we deemed it appropriate to use the Scopus ranking as well-established journals fulfil criteria of peer-reviewed scientific work coinciding with our selection criteria for pieces to be included in the review. This search resulted in an additional 12 articles. To further complement our search, we identified publications through the snowball method (Hiebl, 2021) based on relevant publications from the list of references in the retained articles. This process resulted in an additional 22 articles for consideration. Results of the searches were uploaded to Mendeley where we tagged all contributions with the following markers: type of contribution (empirical, review, narrative/anecdotal, report, commentary/opinion), and type of empirical research (qualitative, quantitative, bibliometric, review). We retained this information from abstracts, and if unclear, from the main text.

Each of us was responsible for reading through these articles, which were then collectively discussed in several meetings online. Through our discussions, we identified 28 publications that fulfilled all our search criteria (17 publications were retrieved from databases; four publications were retrieved from well-established higher education journals and seven publications from the reference lists). These were read in full. We created an extraction spreadsheet and documented the following information for each of the 28 articles based on the information that we could identify from the texts: (a) reference details; (b) method; (c) key findings; (d) limitations, recommendations and source of funding; and (e) quality. For our internal purpose, we utilised a quality framework (Critical Appraisal Skills Programme, 2019) addressing questions about the clarity of the aims of the research; appropriateness of the research design, methodology, and recruitment of participants; consideration of ethical issues; the rigour of data analysis; clarity of findings; discussion of findings in relation to prior research; value of the research; and recognition of limitations. Although this information has not been used directly as data in our review, it did help us to distinguish between the various types of contributions and identify the final set of research papers.

The collective decision-making process on what to include in our review resulted in deciding to focus specifically on (a) peer-reviewed published contributions and (b) empirical studies with a description of research methods. Reports (without a theoretical grounding and sufficient methodological detail), anecdotal or position papers (which did not describe a research method), news items, and solicited papers (that either did not fulfil the criteria of empirical research or peer review, or both) were excluded from the analysis. Not all papers that appeared in our searches were peer reviewed (e.g., so-called preprints), although they may have otherwise filled the criterion of empirical research. Therefore, several more papers were excluded at this point, resulting in a final selection of 11 scholarly articles describing empirical research about the impact of the pandemic on ECR experiences that was published in peer-reviewed outlets. To answer the research question of this study - '*How has the COVID-19 pandemic affected ECR activity, development, career prospects, and well-being?*' - we organised the findings from 11 published peer-reviewed empirical articles around four categories: research activity, researcher development, career prospects and well-being.

Results and Discussion

Our systematic review of the literature showed that there are still limited peer-reviewed empirical studies focusing on the impacts of the COVID-19 pandemic on ECR activity, development, career prospects, and well-being. Although some studies include ECRs in their samples, in the results section, the experiences of ECRs are not always differentiated from that of more established colleagues (e.g., Prieto *et al.*, 2021). We came across many reflective accounts and commentaries from individuals or small groups of ECRs; however, these were non-empirical in nature and thus, were not included in the analysis of the results.

Evidence

Most studies (10) reported on effects of the pandemic on ECR activity, including the nature of research, progress, and productivity, working hours and time allocations for research and other scholarly activities as well as inequalities (e.g., in relation to gender and/or caregiving responsibilities, sometimes overlapping with early career status). Other research outcomes for the studies included the effects of the pandemic on researcher development (6), career prospects (5), or well-being (8) (see Table 1).

insert Table 1 about here

Methods and participants in the studies

Across all articles reviewed, online questionnaires were the most commonly applied method of data collection. Online questionnaires were used (a) as a single data-collection method in eight studies (Adarmouch *et al.*, 2020; Aubry *et al.*, 2021; Camerlink *et al.*, 2021; Guintivano *et al.*, 2021; Kappel *et al.*, 2021; Myers *et al.*, 2020; Ramvilas *et al.*, 2021; Stamp *et al.*, 2021) and (b) in conjunction with other data sources in two studies that included email exchanges, mentor's notes, and papers co-authored by the mentor and doctoral researchers, as well as their perceptions of the effectiveness of the mentoring programme (Mullen, 2021) or website analytics and post-conference surveys (Raby and Madden, 2021). One of the papers involved data collection in the form of documents posted to an open-access preprint repository for social sciences (Cui *et al.*, 2021).

Data were collected from diverse geographical regions, including the U.S., Europe, North Africa, India, and New Zealand. Participants were drawn from medical and health sciences (3 studies), animal behaviour (3 studies, one of which also included some participants from biology and social sciences), ecology (2), and 1 each from education, social sciences, and sciences. Cui *et al.* (2021) based their bibliometric analysis upon 41858 papers produced by 76832 authors. All other studies involved collecting data from human participants. The number of participants per study varied from small (e.g., 11 participants in Mullen, 2021) and medium (e.g., 55 participants in Adarmouch *et al.*, 2020) to large (e.g., 4535 in Myers *et al.*, 2020). The majority of the authors drew on data that were collected from researchers at different academic ranks but emphasising the experiences of ECRs (Aubry *et al.*, 2021; Camerlink *et al.*, 2021; Guintivano *et al.*, 2021; Kappel *et al.*, 2021; Stamp *et al.*, 2021). Other papers were focused on a specific group of participants. For example, Mullen (2021) collected empirical data from doctoral candidates in an educational leadership program; Raby and Madden (2021) collected data from the participants of an online conference. Ramvilas *et al.* (2021) distributed their survey to registrants in a webinar targeted toward ECRs and conservation professionals; most respondents were aged 18–30 years. All but one study (Raby and Madden, 2021) reported information from men and women; few trans or non-binary participants were included.

Key findings

Having identified the nature of evidence, the methods, and data analysis techniques, the next step was to explore the key findings in relation to ECRs. The summary of challenges and opportunities experienced by ECRs related to the ongoing pandemic crisis as reported in the studies described below, is included in Table 2.

insert Table 2 about here

1. Research activity

When discussing researcher activities, there was a tendency to draw mostly on the negative effects of the pandemic (e.g., Adarmouch, 2020; Mullen, 2021). There is evidence on the strategies that ECRs use to cope with existing challenges (e.g., adapting quickly to remote work and using communication technologies; Adarmouch *et al.*, 2020) and proposed policies that they perceived to be potentially effective in mitigating negative impacts now and in the future (Aubry *et al.*, 2021; Camerlink *et al.*, 2021; Guintivano *et al.*, 2021). The various disruptions to usual research practices represented a major emphasis across studies. Interruptions to laboratory research and fieldwork (Aubry *et al.*, 2021; Camerlink *et al.*, 2021; Ramvilas *et al.*, 2021; Stamp *et al.*, 2021) as well as human participant research on campus and in the community (Adarmouch, 2020; Mullen, 2021) affected the activities and progress of ECRs regardless of their status. The main issues examined included academic research productivity, proposal or dissertation progress, and access to data.

a. Academic research productivity

Cui *et al.* (2021) examined 41858 submissions to the largest open-access preprint repository for the social sciences, comparing the number of preprint papers deposited (a) 6 to 10 weeks after the lockdown to those deposited in the 14 weeks before lockdown and (b) across the comparable time frames one year earlier. Although their main analysis focused on preprints from authors in the U.S., comparative analyses were also provided for 24 other countries. They reported that during the first 10 weeks of the lockdown in the U.S., total research productivity increased by 35%, whereas women’s research productivity dropped by almost 14% relative to that of men. While not referring to ECRs per se, the authors used academic rank as a proxy of junior, pre-tenure status and found that this intensified productivity gap is especially pronounced for assistant professors. They found a similar gender gap in productivity for six countries beyond the U.S.: Japan, China, Australia, Italy, the Netherlands, and the U.K. The authors note, however, that most submissions to the repository are from the U.S.

Examining time available for research activities in a large-scale survey (among faculty/principal investigators, post-doctoral researchers, and doctoral students) in the U.S. and Europe (N = 4535), Myers *et al.* (2020) found an overall decline in average working hours per week, from 61 pre-pandemic to 54. Most respondents (55%) experienced a decline in working hours, but some (18%) experienced an increase. Time allocated to research was affected more (24% decline) than time allocated to other academic tasks (teaching, administration, grant writing, editorial work, clinical activities) (11% decline). The authors found that differential impacts of the pandemic

are predominantly based upon personal demographics (gender, caring responsibility for young children), with research area also being an important variable (e.g., limited access to laboratories led to 30–40% declines in time spent on research in bench sciences).

Guintivano *et al.* (2021) reported negative effects of the pandemic on research productivity in particular for women and also for ECRs (e.g., non-tenured staff, post-doctoral fellows, doctoral students). Findings from their survey of the members of the international Psychiatric Genomics Consortium (123 respondents) showed that ECRs in non-permanent positions (and women) were disproportionately more affected by having to work from home due to childcare, and other domestic issues. The results were statistically significant with small to medium effect sizes (Cohen's *d*) reported. These findings were corroborated by two other studies in the set (Aubry *et al.*, 2021; Camerlink *et al.*, 2021). Aubry *et al.* (2021) surveyed ecology and evolutionary biology academics in the U.S. They reported that “early-career assistant professors”—men and women—on somewhat precarious contracts, “are more negatively impacted by the pandemic than those with tenure” (p. 5). They further reported that women, especially those with children found it harder to maintain high productivity during the pandemic. A pause in the tenure and promotion clock was suggested as an effective mitigating policy by over 80% of assistant professors, including men; however, the authors point out that such policies could inadvertently increase inequalities by affecting tenure rates of women more than that of men.

Similar results were evident in the study of the experiences of animal behaviour and welfare ECRs around the world (Camerlink *et al.*, 2021). Authors reported that doctoral students and ECRs (those up to seven years after obtaining their PhD degree) had lower self-perceived productivity than senior researchers, which was associated with higher self-perceived stress. Those with children saw a “more drastic impact on their work productivity” (p. 8), which the authors warned could lead to a “family gap” (p. 8) in the future, unless funders and employers adopt policies to account for the unequal circumstances faced by different groups during the pandemic. As suggested by Kappel *et al.* (2021), this can be attributed mainly to lack of peer support and a loss of focus due to worry or stress, but for some ECRs (e.g., doctoral students, research associates, non-permanent jobholders) also due to unsuitable working environments (found also by Stamp *et al.*, 2021); increased personal responsibilities, including those relating to caring for children or vulnerable adults, COVID-19 illness (or fear of becoming ill) for themselves or others within their households, and sometimes bereavement.

b. Proposal and dissertation progress

In a study reporting on a 4-month-long online mentoring intervention for doctoral candidates launched in January 2020, Mullen (2021) (who was also the mentor) reported negative effects on productivity due to personal, institutional, and administrative changes during the pandemic that had an impact on the degree of commitments and aspirations of some doctoral researchers. The author found, however, that many doctoral students surpassed productivity expectations, and all made clear progress on their proposals or dissertations. The online mentoring

programme, which offered “a flexible structure for Zoom meetings, [providing] a scheduled time to work with (...) mentor” (p. 148) allowed these educational leadership doctoral researchers to overcome challenges due to the pandemic. However, as the author noted, the mentoring programme may not have been a sufficient or appropriate option for those in some other disciplines (e.g., conservation studies where laboratory and field components are required to fulfil the study objectives of doctoral/postdoctoral researchers), necessarily affecting their opportunity to continue their studies according to original timelines (Ramvilas *et al.*, 2021). Delayed thesis submissions were reported by Stamp *et al.* (2021) who collected data via a qualitative survey completed by 15 doctoral students and another survey completed by 42 early and mid-career researchers in medical and health sciences, in New Zealand (while these categories are not separated in the discussion, this includes researchers and academics with fewer than ten years post PhD). The authors stressed that one negative effect for the doctoral researchers was that they had to acquire new funding to support themselves during the additional study period, as well international doctoral researchers had to apply for visa extensions (at additional cost).

c. Access to data

Regardless of the career stage, research productivity has been affected, among other issues (e.g., increase in non-research workload resulting in intellectual fatigue, difficulties in finding collaborators) by the limited opportunities to collect new data, including that caused by restricted possibilities to conduct field work (Ramvilas *et al.*, 2021), inability to conduct experimental work (Stamp *et al.*, 2021), or restricted access to human participants (Adarmouch *et al.*, 2020). Notably, in the study based on 55 survey responses from medical faculty in one institution in Morocco, Adarmouch *et al.* (2020) did not find statistically significant differences between academic rank or years of work experience as an academic (with assistant and associate professors identified as junior staff equalling 40% of the sample, and number of years as a faculty member at <5 years amounting to 27.3% - either of which could be used as proxy implying an early career stage); however, the lack of statistical difference could be ascribed to the small, non-representative sample size.

2. Researcher development

Researcher development was addressed less frequently in the studies than research activity. The main focus was on socialising and networking, including the benefits vs drawbacks of online scholarly events. Respondents from several studies reported fewer opportunities for informal interactions and socialising with colleagues in either virtual or face-to-face settings, which they perceived as having negative effects on their research and their well-being (Camerlink *et al.*, 2021; Kappel *et al.*, 2021; Stamp *et al.*, 2021). Conversely, Camerlink *et al.* (2021) demonstrated that doctoral students and ECRs (those up to seven years after obtaining their PhD degree) enjoyed increased networking opportunities due to the surge in online meetings and conferences, which they may not have been able to attend in the past (in-person) due to associated costs. Despite the expansion of online opportunities offered internationally, Stamp *et al.* (2021) noted that few such activities accommodate New Zealand time zones.

Conferences as a form for sharing research appear to function to some extent differently online compared to conferences attended in-person. Some studies suggest that participants may sign up for online events but not participate actively, as they would in face-to-face events or those for which registration costs were a consideration. For example, Raby and Madden (2021) found that of the 950 people who registered for the event, only 480 (51%) 'attended'. They looked specifically at sessions either designed for ECRs (e.g., the 'meet the editor' event) or those generally considered as outlets used most by junior scholars (e.g., poster sessions) and found low engagement, or low self-reported levels of enjoyment or perceived usefulness of the session. This finding raises questions about the nature of online conference experiences for ECRs who present their research output in poster formats, which is common for junior researchers when they first present their scholarly work. Raby and Madden also highlighted mixed responses to mentoring and networking opportunities in online conferences, with some delegates benefiting from these while others found it difficult to engage online. Indeed, not being able to interact in-person was reported as a negative experience by doctoral students and postdoctoral participants in a survey study (N = 565) by Ramvilas *et al.* (2021).

Lack of opportunities for professional development in general was cited as an issue for some doctoral students and research associates (Kappel *et al.*, 2021). However, the doctoral candidates in Mullen's (2021) study reported that the online mentoring programme provided opportunities for personal and professional development, which was further evidenced through the scholarly development demonstrated by the papers they co-authored with their mentor as they were simultaneously making progress on their dissertations or doctoral research proposals. The flexible structure for video meetings provided lengthy blocks of time to interact with their mentor, which proved motivating. The mentoring programme also promoted scholarly identity development.

3. Career prospects

The cancellation of scholarly events and disruptions to networking undermined future career prospects. Guintivano *et al.* (2021) revealed considerable concern about the impact of COVID-19 on career progression and the availability of funding, most commonly reported by ECRs and women. Similar findings were presented by Stamp *et al.* (2021) and Kappel *et al.* (2021), who reported statistically significant results in relation to doctoral students, research associates, and non-permanent job holders. Stamp *et al.* also identified concerns about delays and disruptions in starting postdoctoral positions, particularly given that in a small nation like New Zealand most graduates must travel internationally to pursue such opportunities. Two other studies identified logical extrapolations from the data they reported to possible impacts of the pandemic on future career prospects; specifically, Camerlink *et al.* (2021) suggested that there will be long-term consequences for career progression post pandemic and Ramvilas *et al.* (2021) predicted that conservation science was unlikely to be a major government priority for jobs and funding as nations focus upon recovery from the pandemic.

4. Well-being

Negative impacts on the well-being of doctoral students were reported long before the pandemic began (e.g., Cornér *et al.*, 2017; Pyhältö *et al.*, 2012; Stubb *et al.*, 2011). Not surprisingly, several papers considered in this review addressed the well-being concerns of ECRs. A major challenge for the medical and health researchers was that they were called upon to provide care in an “unusual, risky, and stressful environment” (Adarmouch *et al.*, 2020, p. 2), including managing COVID-19 patients. Participants emphasised the “physical and intellectual fatigue” resulting from their workload changes. There were no distinctions in their study, however, between early career and more established researchers. Camerlink *et al.* (2021) also reported on the challenges of heightened workloads under pandemic conditions, especially for those with dependent care responsibilities. Fatigue was likewise an issue that arose across studies (Camerlink *et al.*, 2021; Raby and Madden, 2021; Stamp *et al.* 2021).

Guintivano *et al.* (2021) found that non-tenured staff/researchers (and women) reported higher stress levels caused by the pandemic. Camerlink *et al.* (2021) also reported higher perceived stress levels among doctoral students and ECRs (those up to seven years after obtaining their PhD degree), which, as noted above, have been associated with lower productivity levels. However, in Camerlink *et al.*'s (2021) study, the participants reported receiving more social support during the pandemic, which would help reduce the risk of stress and burnout. These results were supported by Kappel *et al.* (2021) who found that ECRs (doctoral students, research associates, non-permanent jobholders) experienced more worry or stress, but many interacted with family and friends more than usual, and engaged in outdoor activities, reported as coping strategies for dealing with difficulties during lockdowns.

Just over one quarter of the respondents in Kappel *et al.*'s (2021) study reported on improved work–life balance during the pandemic, and more than half expressed an intention to consciously focus on maintaining this balance into the future. Others reported imbalances either toward more work (30%) or to more personal responsibilities (24%) (e.g., caring for children or vulnerable adults, own illness, illness within their household, and sometimes bereavement) while some reported a balance shifting toward personal activities (21%) (e.g., interacting with family or friends). Aubry *et al.* (2021) reported stark differences in work–life balance for early-career assistant professors compared to more senior scholars. Women and those with childcare responsibilities, likewise, reported poor work–life balance. In contrast, respondents in Stamp *et al.*'s (2021) study appreciated the opportunity that uninterrupted flexible time provided for them to focus on a chosen task.

Various other measures of well-being were evident across the studies. Stamp *et al.* (2021) reported that their participants (junior researchers who obtained their PhD within the last five years) experienced financial strains and “zoom fatigue” and felt stressed, unsettled, and isolated. Aubry *et al.* (2021) reported negative effects with respect to life satisfaction and anxiety about health amongst early-career assistant professors, while Camerlink *et al.* (2021) noted mental health challenges amongst doctoral students and ECRs (those up to seven years after obtaining their PhD degree). In addition, unsuitable working environments could cause stress for ECRs (Guintivano *et al.*, 2021; Kappel *et al.*, 2021; Stamp *et al.*, 2021). However, others

reported developing new styles of working, post-pandemic solidarity, and opportunities to work in more creative ways which, in the future, may lead to increased productivity and well-being.

Conclusions

What evidence did the reviewed studies provide?

The systematic literature review resulted in the analysis of 11 published peer-reviewed empirical articles. Empirical evidence has been published showing that ECRs have been affected by the COVID-19 pandemic in four different areas: (a) research activity, (b) researcher development, (c) career prospects, and (d) well-being. Research activity further illuminated academic research productivity, proposal and dissertation progress, and access to data.

Overall, ECRs generally reported that the pandemic had primarily impacted their research activities, but there were slight differences depending on their specific status. For instance, doctoral students were particularly concerned about limited access to funding and delays in submitting their theses. Postdoctoral researchers worried more about delayed or interrupted employment or postdoctoral opportunities (Guintivano *et al.*, 2021; Kappel *et al.*, 2021; Stamp *et al.*, 2021) and disruptions to laboratory activities and fieldwork (Aubry *et al.*, 2021). Those in non-tenured positions were more concerned about reduced time spent on research (Myers *et al.*, 2020; Stamp *et al.*, 2021). Furthermore, the possible negative effects of the pandemic were accentuated for early career women with family responsibilities (Aubry *et al.*, 2021; Camerlink *et al.*, 2021).

Beyond the negative consequences of the pandemic, there is some evidence of promising learning and new ways of working that have arisen as a result of lockdowns and restrictions, such as improved opportunities to attend virtual conferences and networking (Camerlink *et al.*, 2021) and online mentoring programmes (Mullen, 2021). Nevertheless, those opportunities were not always fully realised (e.g., low attendance and limited interaction with presenters at conferences; Raby and Madden, 2021), and it remains to be seen which practices prove sustainable and helpful for ECRs in the long run.

Even if the number of studies is limited, the outcome of this literature review points to the need for revised institutional policies to support ECRs post pandemic in the areas of research activity, researcher development, career prospects, and well-being. In light of prior research (e.g., Devos *et al.*, 2017; Vekkila *et al.*, 2013; Virtanen *et al.*, 2017) indicating that doctoral student stress is related to an increased likelihood for attrition, a strengthened focus on supporting ECRs' well-being (regardless of their specific status) is likely to be crucial in post-pandemic academia. The results also raise questions about differential effects across fields (Ramvilas *et al.*, 2021) and the possible long-term consequences in post-pandemic academia and policy making where some fields may be worse off in the future due to priorities established for

societies struggling to recover. Given such a scenario, ECRs in certain fields (women in particular) may struggle even more than their colleagues in fields deemed important in recovery and policy making for post-pandemic societies.

What is missing from the systematic review?

The database and journal hand searches for this systematic literature review were conducted in April and May 2021, which is 13 to 14 months after the global pandemic was declared on March 11, 2020. This is a relatively short time frame for researchers to design and implement a research study, collect and analyse the resulting data, write up the results, submit the work for publication, receive and respond to peer review comments, and await the appearance in print of the final paper. Research about the effects of the COVID-19 pandemic on researchers and research activity will continue to be published for some time to account for publication lags and to capture the enduring effects of the pandemic. We are aware of preliminary results (e.g., Lambrechts and Smith, 2020; Lokhtina and Tyler, 2021; van der Weijden and Bergmans, 2021) and pre-print studies (e.g., Bilas *et al.*, 2020; Johnson *et al.*, 2020; Muric *et al.*, 2020; Stuart *et al.*, 2020), which had not been published at the time of our searches. Some of these sources are cited in the introduction to this paper but did not meet the inclusion criteria for the systematic review.

Despite evidence of shortened timelines for publishing coronavirus-related medical studies (Horbach, 2020), publication lags continue to exist, especially outside the medical field. Anecdotal reports from journal editors suggest that they have experienced greater than usual challenges securing timely peer review for articles submitted during the pandemic. Impassioned pleas and supportive statements have become common on journal websites and in manuscript review requests. For example, the journal *Higher Education Research and Development* (HERD) provides the following message at the top of all review invitations:

HERD is aware of the significant impact that the COVID-19 pandemic is having on many in our community. While HERD normally aims for a 4-week turnaround on reviews, we recognise that this is not always possible, particularly given the current pandemic.

Some papers about COVID-19 pandemic effects on researchers and research activity have been written and published extremely quickly. For example, Weissgerber *et al.* (2020) released their recommendations about conference cancellations one week after the global pandemic was declared (18 March 2020), and the final version of record was released just 9 days later. The timing for that paper means that it is based upon the first days of the pandemic only. Furthermore, such early papers consist of author reflections, not analyses of empirical data. In contrast, Raby and Madden (2021) gathered data from an online conference that was launched as a replacement for the regular in-person conference. Participant responses to survey questions were gathered at the time of the conference (mid-July 2020). Raby and Madden submitted their paper just two weeks after the conference they studied, but their paper was not accepted until December 2020 and was then published in February 2021. More extensive data collection across multiple days and from less captive audiences (i.e.,

individuals who are not already gathered together for a shared purpose, such as these one-day conferences) would necessarily require longer data collection and analysis timelines, making it less likely that such publication would have been captured in this systematic review.

Studies of the impact of the pandemic on researchers and research activities tend to involve collecting human participant data. For many researchers (potential authors and potential participants in studies of the pandemic effects), the shift to remote teaching and supervision has occupied considerable attention, especially during the earliest phases of the pandemic. Researchers with dependent care responsibilities have likewise found it challenging to focus attention on conducting or participating in research studies. Some scholars have expressed reticence to add to the burden of other researchers by inviting their participation in studies while juggling pandemic effects. Adarmouch *et al.* (2020) attributed the low response rate for their online survey (21.2%) to the fact that many of the medical and health researchers in their study experienced a stressful work environment as they managed COVID-19 patients and may have had “less interest in research” (p. 5).

The pandemic itself affected the ability of doctoral students and academic staff (in particular, women) to conduct research studies. Some institutions halted all human participant research studies that were unrelated to the pandemic, which might be seen to provide an opening for studies that would meet the inclusion criteria for our systematic literature review. Typically, in-person interaction was allowed only if required; thus, online studies would be expected to be most common. The final set of 11 papers was consistent with this assumption: 8 were based upon online surveys while 2 combined online surveys with website analytics or other documentation gathered from a distance (e.g., email exchanges, notes from online meetings); the remaining study (Cui *et al.*, 2021) involved bibliometric data gathered without interaction with human participants. Given the differential effects of the pandemic based upon demographics, it is important to question which researchers have had time and opportunity to respond to online survey invitations throughout the pandemic.

Likewise, our searches revealed a number of bibliometric studies (e.g., Andersen *et al.*, 2020; Ipe *et al.*, 2021), yet these studies do not distinguish the effects for ECRs. It is indeed a complex process to link bibliometric analyses with demographic information for the authors, including their current career stage. It is therefore possible that such studies are still in progress and have not yet been published.

Practical and social implications

In many parts of the world, societies are gradually preparing for a return to “normal”. New policies and practices related to distance and face-to-face work may be of concern as organisations prepare for employees to return. These are important considerations, and the solutions bear consequences for all employee groups and career levels. Based on the results of this review, we identify the need to proactively take steps and direct resources towards enhanced support for ECR activity, development, career prospects and well-being. Measures need to be put in place to alleviate challenges concerning grant applications (e.g., make use of mentoring) and

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3 delayed thesis submissions (e.g., the provision of extensions for doctoral students).
4 ECRs (in particular academics with caring responsibilities who may face career
5 setbacks) should have access to sabbatical or pre-tenure research leave (e.g.,
6 adjusting promotion metrics, extending or pausing the tenure clock). It is necessary to
7 respond to gender disparities and pay attention to the opportunities for women
8 researchers at an early career stage to continue or resume their research work in a
9 situation where additional chores accumulated during the pandemic may to some
10 extent continue to burden them even after the most imminent threats of the pandemic
11 have passed (e.g., on-campus childcare support programmes; psychological support
12 systems). The provision of networking opportunities (e.g., writing groups, regular
13 videoconference discussions) may have an impact on researcher development as
14 ECRs continue advancing their involvement in scientific communities. It is important
15 to build a sense of a learning community among ECRs through virtual or face-to-face
16 events, including follow-up activities and nuanced discussions on their learning needs
17 that may allow them to address their concerns about their development and knowledge
18 transfer.
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24 Fully comprehending the consequences of the pandemic for ECRs will require that
25 their situation is monitored for a number of years and their voices are heard.
26 Furthermore, we remind readers of the necessity of paying attention to the support of
27 research in different fields. Research in fields deemed important in recovery from the
28 pandemic is absolutely vital. However, it is important to continue to recognise the role
29 of a broad range of academic fields in order to ensure the holistic development and
30 thriving of societies.
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34 **Limitations**

35 We recognise that there are limitations to this review. First, although we sought to
36 improve our review by supplementing the database searches with hand searches of
37 well-established journals in our field (higher education), this did not cover other fields.
38 In retrospect, it may have been worthwhile to expand the selection of journals to the
39 medical and natural sciences as the review showed that journals in these fields
40 actively published on the impact of the pandemic on researcher careers. Our final set
41 of 11 articles included just two publications from education journals, neither of which
42 were explicitly higher education journals. While researchers tend to have an interest
43 in investigating and reporting the circumstances in their own field (see e.g., Aubry *et al.*, 2021; Camerlik *et al.*, 2021; Guintivano *et al.*, 2021; Raby and Madden, 2021; Ramvilas *et al.*, 2021), this is not an unambiguous trend. Second, the time frame included publications from January 2020 to May 2021. This is a relatively short time frame for a systematic review. Relevant literature has indeed been published after that time (see, for example, Muric *et al.*, 2021, and Suart *et al.*, 2021, which are published versions of pre-print studies that appeared in our searches), and more will almost certainly be published in the future. Third, our search was limited to English language publications. We are confident that relevant research has been published in other languages.
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Future research

Due to timing and other research challenges, many of the reports published to date are reflective or anecdotal commentaries and thought pieces that did not meet the empirical criterion for a systematic literature review. However, we acknowledged these sources to advance our own argument in the introduction but excluded these texts from the systematic review. Given the breadth and richness of some of these commentaries, a synthesis of such publications may be warranted as a future research effort.

One important area of research that is evident in the published literature but not fully captured in this systematic review relates to the effects of the pandemic on academic productivity for those scholars with childcare responsibilities (e.g., Krukowski *et al.*, 2021; Staniscuaski *et al.*, 2021). These studies highlight differential effects of the pandemic for scholars, especially women (Yildirim and Eslen-Ziya, 2021). Such studies, however, tend not to distinguish the particular effects of the pandemic during the early career stage that often overlaps with the child-bearing years, yet this could not always be distinguished from the effects for ECRs (Myers *et al.*, 2020). We were unable to locate any empirical studies through our search techniques that focused specifically on the effects of the pandemic on the research and research activities of early career parents. This suggests a gap worthy of research effort.

While many of the studies were based on research participants' self-reported experiences, and as such provide insight into how individuals have experienced their work and well-being during the pandemic, longitudinal studies and studies that triangulate various data sources will be necessary in order to provide a fuller picture.

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Studies in Graduate and Postdoctoral Education

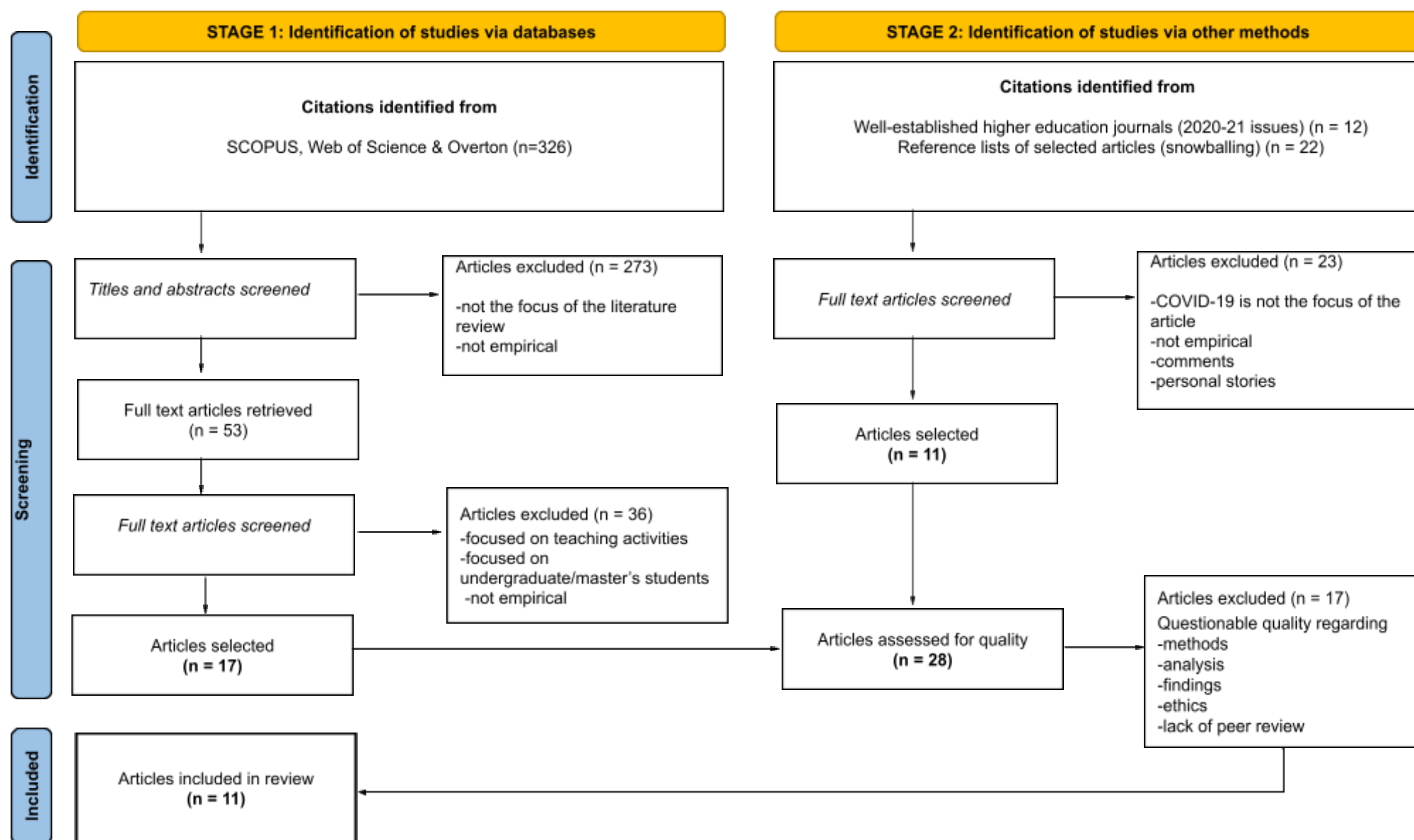


Figure 1. Flow chart of the filtering process

Inspired from The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.

Table 1 Key features and outcome measures for the 11 research studies

Study #	Source	Discipline	Location	Timing	Status	Type of research outcomes measured			
						Research activity	Researcher development	Career prospects	Well-being
1	Adarmouch (2020)	medicine; surgery; lab/public health	Morocco	June 2020	Junior staff (assistant / associate professors)	✓			✓
2	Aubry <i>et al.</i> (2021)	ecology and evolutionary biology	U.S.	May–June 2020	Early-career assistant professors	✓			✓
3	Camerlink <i>et al.</i> (2021)	animal behaviour and welfare	Global (28 countries)	June–July 2020	Doctoral students; ECRs (obtained PhD within the last seven years)	✓	✓	✓	✓
4	Cui <i>et al.</i> (2021)	social sciences	Global (25 countries; U.S. predominant)	Dec 2018–May 2020	Junior, pre-tenure status	✓			
5	Guintivano <i>et al.</i> (2021)	psychiatric genomics	Global	April–June 2020	ECRs (faculty appointment up to five years post training, post-doctoral fellows, doctoral students)	✓		✓	✓
6	Kappel <i>et al.</i> (2021)	animal behaviour and welfare (mostly); biological and; social sciences	Global	July–August 2020	Doctoral students; Research associates; Non-permanent jobholders	✓	✓	✓	✓
7	Mullen (2021)	educational leadership	U.S.	Jan–May 2020	Doctoral candidates	✓	✓		✓
8	Myers <i>et al.</i> (2020)	Science	U.S.; Europe	April 2020	Faculty/Principal Investigators; post-doctoral researchers; Doctoral students	✓			

9	Raby and Madden (2021)	animal behaviour	U.K., E.U., North America	July 2020	Doctoral students		√		√
10	Ramvilas <i>et al.</i> (2021)	biodiversity conservation	India	July 2020	Doctoral students; postdocs	√	√	√	
11	Stamp <i>et al.</i> (2021)	health research	New Zealand	March–June 2020	ECRs (<five years post-PhD)	√	√	√	√

Table 2
Challenges and opportunities for early career researchers during the COVID-19 pandemic

	Outcome measure	Challenges	Opportunities	Mixed reactions	Neutral effects
Researcher activity	disruption of usual research practices	Adarmouch (2020); Aubry <i>et al.</i> (2021); Camerlink <i>et al.</i> (2021); Guintivano <i>et al.</i> (2021); Mullen (2021); Ramvilas <i>et al.</i> (2021); Stamp <i>et al.</i> (2021)			
Researcher activity	time for research	Camerlink <i>et al.</i> (2021); Myers <i>et al.</i> (2020); Stamp <i>et al.</i> (2021)			
Researcher activity	production of research papers	Stamp <i>et al.</i> (2021)		Cui <i>et al.</i> (2021); Aubry <i>et al.</i> (2021); Camerlink <i>et al.</i> (2021); Mullen (2021); Ramvilas <i>et al.</i> (2021)	Adarmouch (2020)
Researcher activity	self-perceived work productivity	Camerlink <i>et al.</i> (2021); Kappel <i>et al.</i> (2021)		Stamp <i>et al.</i> (2021)	
Researcher activity	new research foci	Aubry <i>et al.</i> (2021)	Adarmouch (2020)		
Researcher activity	access to data or participants	Guintivano <i>et al.</i> (2021) Ramvilas <i>et al.</i> (2021)			Adarmouch (2020)
Researcher activity	mentoring others			Aubry <i>et al.</i> (2021)	
Researcher development	informal interactions and socialising with colleagues	Camerlink <i>et al.</i> (2021); Kappel <i>et al.</i> (2021); Ramvilas <i>et al.</i> (2021); Stamp <i>et al.</i> (2021)		Raby and Madden (2021)	
Researcher development	online networking		Camerlink <i>et al.</i> (2021); Ramvilas <i>et al.</i> (2021)	Raby and Madden (2021); Stamp <i>et al.</i> (2021)	
Researcher development	professional and skills development		Camerlink <i>et al.</i> (2021); Mullen (2021)	Kappel <i>et al.</i> (2021)	
Researcher development	scholarly identity development		Mullen (2021)		

Career prospects	job opportunities	Camerlink <i>et al.</i> (2021); Guintivano <i>et al.</i> (2021); Kappel <i>et al.</i> (2021); Stamp <i>et al.</i> (2021)	Ramvilas <i>et al.</i> (2021)
Career prospects	research funding availability	Guintivano <i>et al.</i> (2021); Kappel <i>et al.</i> (2021); Stamp <i>et al.</i> (2021)	
Career prospects	postdoctoral opportunities	Stamp <i>et al.</i> (2021)	
Well-being	stress	Aubry <i>et al.</i> (2021); Camerlink <i>et al.</i> (2021); Guintivano <i>et al.</i> (2021); Kappel <i>et al.</i> (2021); Mullen (2021); Stamp <i>et al.</i> (2021)	
Well-being	fatigue	Adarmouch (2020); Camerlink <i>et al.</i> (2021); Raby and Madden (2021); Stamp <i>et al.</i> (2021)	
Well-being	home work environment	Guintivano <i>et al.</i> (2021); Kappel <i>et al.</i> (2021); Stamp <i>et al.</i> (2021)	Camerlink <i>et al.</i> (2021)
Well-being	isolation	Camerlink <i>et al.</i> (2021); Kappel <i>et al.</i> (2021); Stamp <i>et al.</i> (2021)	
Well-being	workload	Adarmouch (2020); Camerlink <i>et al.</i> (2021)	
Well-being	satisfaction with work–life balance	Aubry <i>et al.</i> (2021)	Kappel <i>et al.</i> (2021)
Well-being	mental health	Camerlink <i>et al.</i> (2021)	
Well-being	anxiety about health	Aubry <i>et al.</i> (2021)	
Well-being	life satisfaction	Aubry <i>et al.</i> (2021)	
Well-being	lack of focus	Kappel <i>et al.</i> (2021)	
Well-being	financial worry	Stamp <i>et al.</i> (2021)	
Well-being	physical health	Camerlink <i>et al.</i> (2021); Kappel <i>et al.</i> (2021)	

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Well-being	uninterrupted	Stamp <i>et al.</i> (2021)
	flexible time	
Well-being	enhanced social	Camerlink <i>et al.</i>
	support	(2021)
