

Attitudes, behaviours and experiences of authors of COVID-19 preprints

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Abstract

The COVID-19 pandemic caused a rise in preprinting, apparently triggered by the need for open and rapid dissemination of research outputs. We surveyed authors of COVID-19 preprints to learn about their experience of preprinting as well as publishing in a peer-reviewed journal. A key aim was to consider preprints in terms of their effectiveness for authors to receive feedback on their work. We also aimed to compare the impact of feedback on preprints with the impact of comments of editors and reviewers on papers submitted to journals. We observed a high rate of new adopters of preprinting who reported positive intentions regarding preprinting their future work. This allows us to posit that the boost in preprinting may have a structural effect that will last after the pandemic. We also saw a high rate of feedback on preprints but mainly through “closed” channels – directly to the authors. This means that preprinting was a useful way to

receive feedback on research, but the value of feedback could be increased further by facilitating and promoting “open” channels for preprint feedback. At the same time, almost a quarter of the preprints that received feedback received comments resembling journal peer review. This shows the potential of preprint feedback to provide valuable detailed comments on research. However, journal peer review resulted in a higher rate of major changes in the papers surveyed, suggesting that the journal peer review process has significant added value compared to preprint feedback.

1. Introduction

The COVID-19 pandemic has arguably illustrated the value of open and rapid dissemination of scientific research on a global scale. All participants in scholarly communication systems, including research funders, publishers, infrastructure providers and research institutions, have been required to reconsider their policies to respond to the public crisis. One of the main challenges was to make COVID-19 research openly or freely accessible. Early in the pandemic, a statement on “Sharing research data and findings relevant to the novel coronavirus (COVID-19) outbreak” (“Coronavirus [COVID-19]: sharing research data”) was issued by Wellcome and signed by 160 organisations worldwide. The statement called on actors in the research system to implement a set of agreed principles. The statement included the following principle, designed to accelerate the dissemination of COVID-19 research and bypass the often-lengthy process of peer review carried out by journals:

“COVID-19 papers should be made available via open access preprint servers prior to publication in journals.”

A number of studies show that increasing attention was being given to preprints even before the pandemic, with new servers set up, and preprints seen as enabling early and rapid dissemination of research output (Vale, 2015; Polka, 2017; Chiarelli et al., 2019). From the early stages of the pandemic, many scholars actively responded by posting preprints relating to COVID-19, using preprint servers as a complement to peer-

reviewed journals (Porter & Hook, 2020; Callaway, 2020; Taraborelli, 2020; Fraser et al., 2021; Waltman et al., 2021). This prompted discussion regarding the quality of research posted on preprint servers – research that typically has not been peer reviewed (Carneiro et al., 2020; Nabavi Nouri et al., 2021; Smart, 2022). Addressing this, several recent studies have compared preprints with their final versions published in peer-reviewed journals. Brierley et al. (2022) compared abstracts of preprints and their counterparts published in journals, observing that many journal article abstracts did not significantly change compared to their preprint counterparts. Another study by Zeraatkar et al. (2022) compared the key methods and results between preprints and journal articles, finding “no compelling evidence that preprints provide less trustworthy results than published papers”.

In response to the pandemic, a group of publishers and related organisations came together and launched the COVID-19 Rapid Review Initiative in April 2020 “to maximise the efficiency of peer review, ensuring that key work related to COVID-19 is reviewed and published as quickly and openly as possible” (Hurst & Greaves, 2021). The group published an evaluation of its work in December 2021, which examined the extent to which the key commitments made at the beginning of the pandemic in the Wellcome statement have been realised (Waltman et al., 2021).

As part of this evaluation, we conducted a survey study aimed at developing a better understanding of the experience of COVID-19 preprint authors with respect to the following:

1. *Preprint posting.* When did the authors of COVID-19 preprints publish their first preprints, what were their primary motivations for preprinting their COVID-19 work and what were their intentions regarding preprinting future research outputs?
2. *Feedback on preprints.* What proportion of COVID-19 preprints received feedback? What were the main channels of feedback, and what was the nature and impact of the feedback?

3. *Journal peer review.* To what extent and in what ways did comments made by editors and reviewers of journals change papers? How did the effect of journal peer review differ from the effect of feedback on preprints?

2. Methods

2.1 Survey overview

To gather opinions on these issues, we surveyed authors of COVID-19 preprints posted on arXiv, bioRxiv, medRxiv and ChemRxiv in 2020. The survey was created using Qualtrics software. We presented the authors with 36 questions about their experience of preprinting and submitting their paper to a journal. However, the total number of questions answered by any individual participant varied depending on which ‘pathway’ they took through the survey based on several factors, such as whether or not their paper had been published in a journal.

The questions in the survey were grouped into three main sections:

- Demographic questions – including the country in which the authors’ were based, type of research institution, research experience, and gender.
- Experience with preprinting – including motivations and future intentions concerning preprinting, channels through which feedback on the preprint was received, and changes in preprints resulting from the feedback.
- Experience of journal submission and the journal peer review process – including the opinion of the authors about the differences in peer review of COVID-19 papers compared with their former experience of article publishing and changes made to the paper in response to journal peer review.

The survey was piloted by ten people: two individuals affiliated with journal publishers, two affiliated with preprint service providers and six researchers recruited by the project team. A copy of the questionnaire and survey data is available in figshare (Rzayeva et al., 2022). Ethical approval to carry out the survey was granted by the Ethics Review Committee of the Social Sciences at the Faculty of Social and Behavioural Sciences of Leiden University.

2.2 Data collection

The data containing the preprints' titles and author contact information was collected directly from the four preprint servers. We included preprints for the entire year 2020 from bioRxiv and medRxiv. These servers assigned COVID-19 preprints to the separate collection "COVID-19 SARS-CoV-2 preprints from medRxiv and bioRxiv". In the case of arXiv, we added preprints from the collection "COVID-19 SARS-CoV-2 preprints from arXiv" for the same year. Because ChemRxiv did not provide such a collection on its platform, we created a search query and added to our list all preprints posted in 2020 whose abstracts and titles included keywords "coronavirus", "covid-19", "sars-cov", "ncov-2019", "2019-ncov", "hcov-19" or "sars-2".

We collected all COVID-19 preprints from these servers and deduplicated the names of corresponding authors. If more than one preprint existed of the corresponding author in our list, we randomly selected one. Finally, we compiled a list of 12,230 COVID-19 preprint titles, names of the corresponding authors and their email addresses. Preprints from arXiv accounted for 12%, from bioRxiv 17%, from medRxiv 62% and from ChemRxiv 9% of the preprints in our final list. We then emailed the corresponding authors, inviting them to participate in our survey. They were sent a personalised email invitation to complete the survey regarding their COVID-19 preprint. Invitations were sent in batches between May 20, 2021, and May 26, 2021. Of the invitations, 305 bounced and 523 failed. The survey stayed open for 55 days and was closed on July 14, 2021. A total of 673 completed survey responses were received, a response rate of 6%. Of the 673 respondents, 18% had posted their preprint on arXiv, 14% on bioRxiv, 58% on medRxiv and 7% on ChemRxiv. 3% of the respondents answered that they had posted their preprint on a different platform. These respondents seem to have misunderstood the question, since their preprint had in fact been posted on one of the four preprint servers considered in our study.

In addition to quantitative data, the survey collected a substantial number of qualitative responses through open questions and comments boxes, which were analysed using

ATLAS.ti. Extracts from qualitative data quoted below have been lightly edited, e.g., to correct typographical errors.

2.3 Characteristics of respondents

Of the survey's respondents, 516 (77%) described their gender as "man", 137 (20%) as "woman", 16 (2%) responded "prefer not to say" and 4 (1%) responded "prefer to self-describe" (free-text responses included "non-binary" and "genderfluid"). Responses were received from researchers with different levels of experience in conducting research (Figure 1); 126 (19%) had up to 5 years of experience, 381 (57%) had 6–25 years of experience and 162 (24%) had 25 years or more experience (with four respondents answering "not applicable"). Responses were received from a total of 78 countries. The country with the most respondents was the USA, with 131 (19%) responses, followed by 93 (14%) responses from the UK, 70 (10%) from India and 33 (5%) from Brazil. A total of 283 (42%) responses were received from Europe, 169 (25%) from North America, 131 (19%) from Asia, 51 (8%) from South America, 21 (3%) from Africa and 15 (2%) from Australasia (with three not disclosing their country).

Most respondents, 424 (63%), were based in universities or colleges, with a further 91 (14%) in hospitals or medical schools. Smaller numbers were based in other organisation types, comprising public research organisations (56, 8%), governments (28, 4%), industrial or commercial organisations (27, 4%), non-governmental organisations (17, 3%) and "other" kinds of organisations (30, 4%).

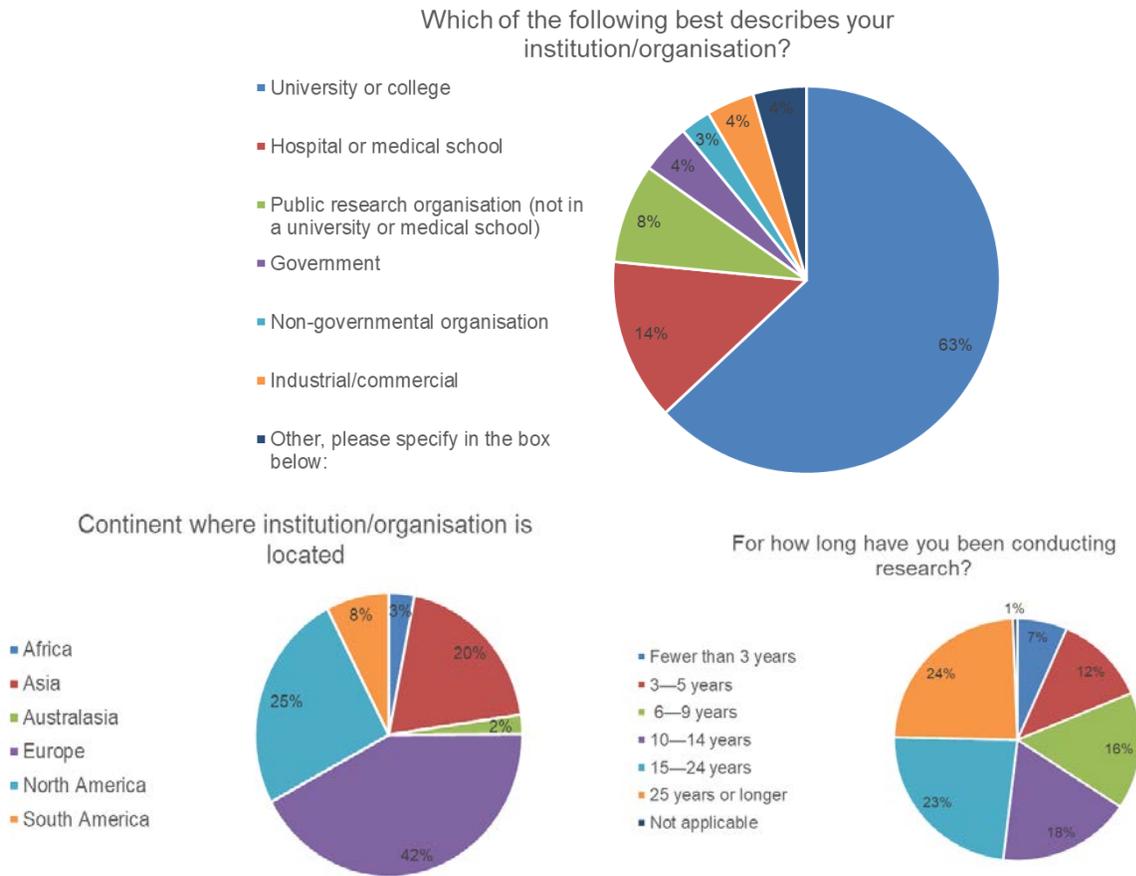


Figure 1. Characteristics of respondents (n=673).

3. Results

3.1 Preprint posting

Notably, the vast majority of the survey participants first engaged in preprinting during the pandemic: 67% first posted a preprint during 2020 or 2021, 15% between 2017 and 2019, and 18% before 2017. For each of the four preprint servers considered in our survey, Figure 2 shows the percentage of preprints posted by researchers who had not posted any preprints before 2020. Although only authors whose preprints were posted on the four preprint servers participated in our survey, some indicated other platforms where their preprint was located (such as SSRN, Research Square, etc.). We do not

know the reason for this, but it is possible that their preprint was deposited in more than one location.

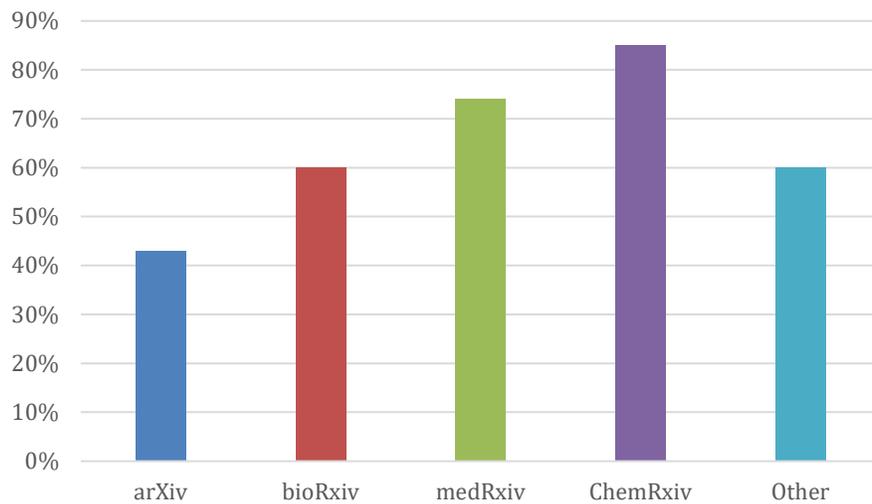


Figure 2. The percentage of preprints posted by researchers who had not posted any preprints before 2020, broken down by preprint servers (n=673).

It was a priority for us to understand the authors' motivations for preprinting their COVID-19 work. We listed motivations in the survey based on the findings of a previous qualitative study (Chiarelli et al., 2019). Authors were invited to choose one or more features that motivated them to preprint their COVID-19 work. The survey results showed that authors were primarily motivated to “achieve early and rapid dissemination” of their work (34%), make their work “openly available” (25%) and “increase opportunities for feedback from readers” (12%). Of all respondents, 97% chose at least one of these advantages of preprinting as their main motivation. Further details are provided in Figure 3.

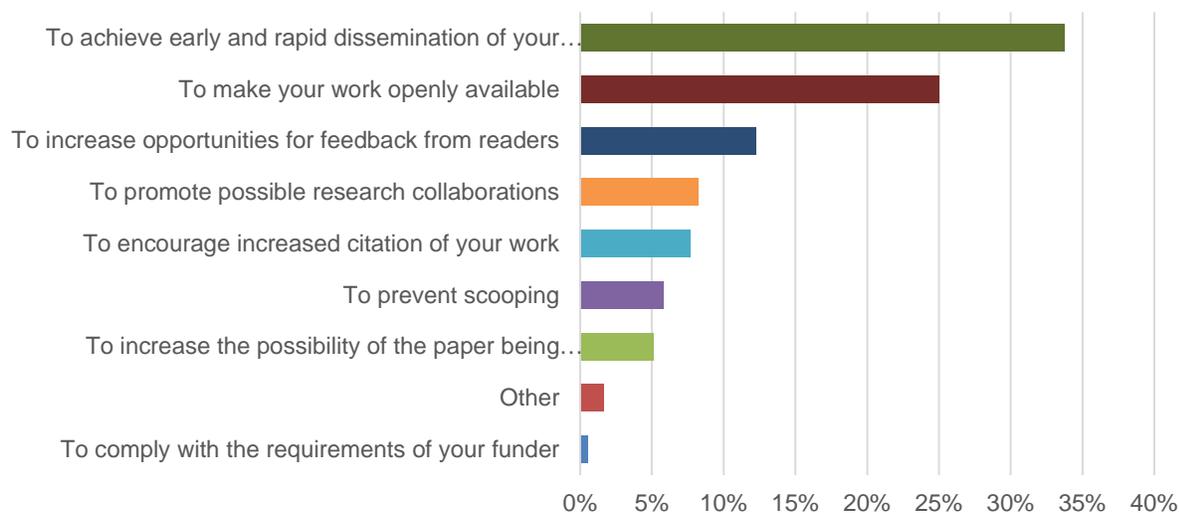


Figure 3. Motivations of survey respondents in preprinting their COVID-19 research (n=673).

Comments regarding the importance of achieving early and rapid dissemination during the pandemic provided by some respondents aptly summarise the sentiments expressed by many of the other survey participants:

“We felt it was important to make our research available in a timely manner as the peer-review process can be time consuming.” (Author with 3–5 years of research experience who first preprinted their work in 2020/2021.)

“Wanted to get this work on vaccine design disseminated as early as possible for further work in urgent vaccine development.” (Author with more than 25 years of research experience who first preprinted their work in 2020/2021.)

Remarkably, among all respondents, 83% declared that they intended to post at least some of their work on a preprint server in the future. Just 6% of respondents declared that they did not intend to post future work on a preprint server. We were also specifically interested in the future intentions of new contributors to preprint servers. We saw that among authors who first posted their work on a preprint server during the

pandemic (n=449), 78% also planned to preprint at least some of their future works. This suggests that the pandemic has led to long-term changes in authors' publication practices, also applying to future work unrelated to COVID-19.

3.2 Feedback on preprints

Since receiving feedback is often argued to be one of the key advantages of posting preprints, we asked authors of COVID-19 preprints about the feedback they received on their work after posting it on a preprint server. The survey specified that “by feedback, we mean comments or questions received in response to the preprint as posted on a preprint server” (excluding “any formal responses from peer reviewers received as part of the process of submitting the paper to a journal”). Of the respondents, 53% reported receiving feedback on their preprint. This high feedback rate seems surprising compared to an earlier study (Kodvanj et al., 2022), where only 18% and 12% of COVID-19 preprints posted on bioRxiv and medRxiv, respectively, had comments. However, this difference could be related to varying definitions of what constitutes feedback on a preprint. For example, our definition included a wide range of feedback channels, e.g., emails to the author, rather than just public comments on the preprint server. In contrast, Kodvanj et al. (2022) estimated the extent of the public peer review using the number of posted comments on Disqus and Altmetric data as proxies.

We analysed the breakdown of preprints that received feedback by preprint server. As Figure 4 illustrates, preprints posted on bioRxiv had a higher rate of received feedback, though the differences between platforms were minimal.

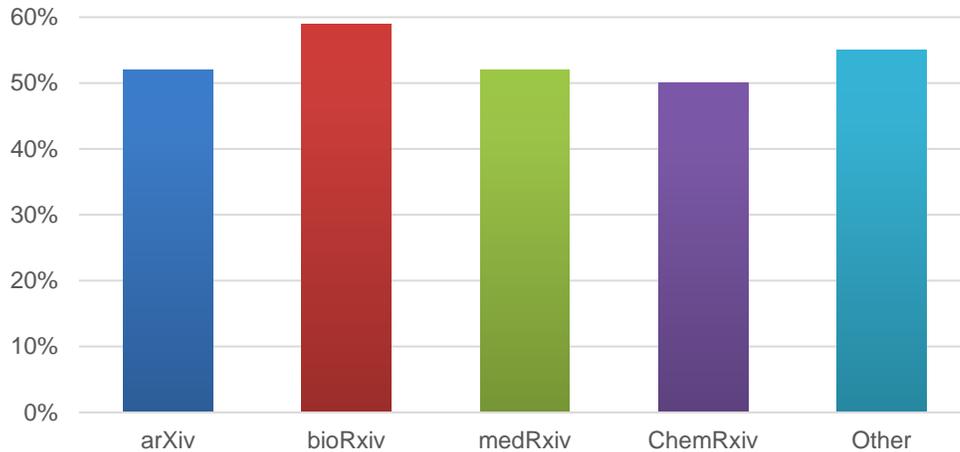


Figure 4. The percentage of preprints received feedback, broken down by preprint servers (n=673).

To learn more about the channels of receiving feedback, we asked authors how they received comments on their preprint. In our analysis, we grouped the channels into two groups – “open” and “closed” ways of receiving feedback. We determined feedback to be “open” when it was publicly available, e.g., given directly on a preprint server, peer review platform or social media. Feedback was classified as “closed” when it was given privately to the author, e.g., by email or during meetings with colleagues. As seen in Figure 5, around 55% of received feedback was given in a “closed” way - privately to the author, whereas 42% of received feedback was given in an “open” way.

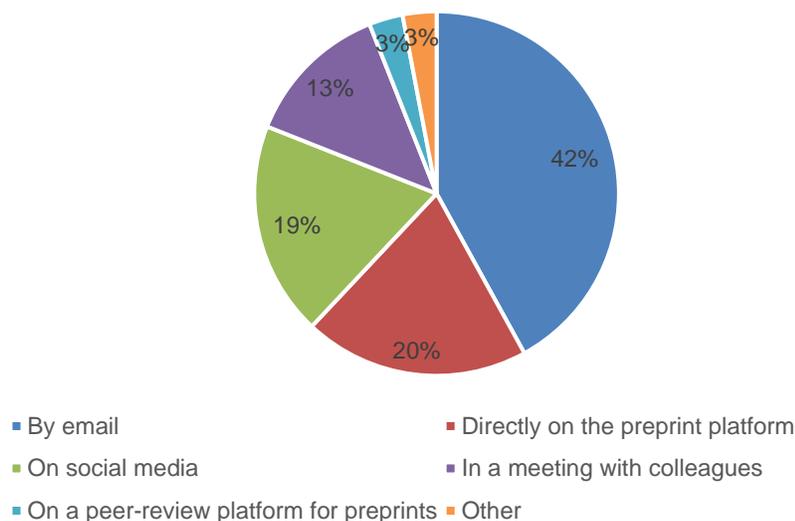


Figure 5. Main channels of receiving feedback by authors of COVID-19 preprints.

Notably, bioRxiv authors reported that 50% of feedback received on their preprint was given directly on the preprint server, while for medRxiv authors, this proportion accounted for 39%. These results suggest the significant value of the functionality to leave feedback on a preprint directly on a preprint server. arXiv and ChemRxiv do not provide the possibility to leave feedback on preprints.

We were also interested in the nature of the feedback given, particularly if it had elements similar to the feedback received in a journal peer review process. In the survey, we asked authors to report whether they received feedback that resembled peer review performed by a journal, which we defined as “detailed feedback on the research presented in the preprint”. Conversely, we defined feedback not resembling peer review as including “brief feedback (e.g., correcting a mistake)”, “comments with thanks for the paper, retweets, etc.”, “suggestions on extending the research in new areas for further research”, and “requests from other authors to cite their work”. Again, the authors could choose more than one option. We found that 77% of all cases where feedback was received did not resemble journal peer review. However, 23% of the feedback contained elements resembling journal peer review.

We analysed the percentage of feedback resembling journal peer review by preprint server. Figure 6 illustrates that medRxiv had the highest rate of feedback with elements of journal peer review, at 32%.

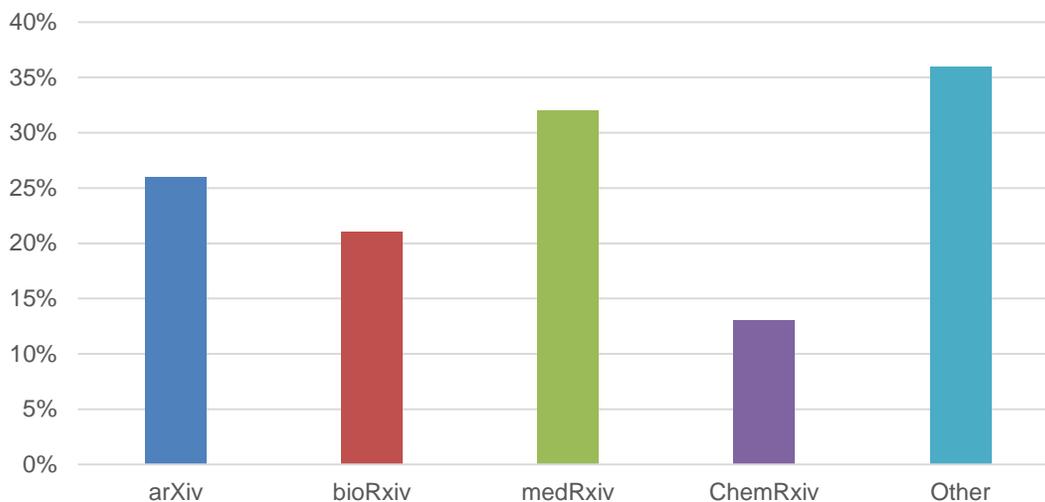


Figure 6. The percentage of detailed feedback on research presented in a preprint (n=355).

The final issue related to feedback in the survey was the extent to which authors made changes to their preprints after receiving feedback. We asked authors to indicate to what extent changes had been made as a result of feedback to the different sections of their preprint. We listed the main sections and asked authors to indicate whether “minor changes” or “major changes” had been made. We did not define the terms “minor” and “major”, instead relying on participants’ perceptions and interpretations of the terms since they are commonly used in journal peer review processes. Figure 7 shows that major changes to preprints were uncommon. Only 8% and 5% of respondents who received feedback and answered this question declared that they had made major changes to the “Discussion/Conclusion” and “Results” section of their preprint, respectively. For other sections, this percentage was even lower. As seen in Figure 7, it was much more common for authors to make changes that they considered minor.

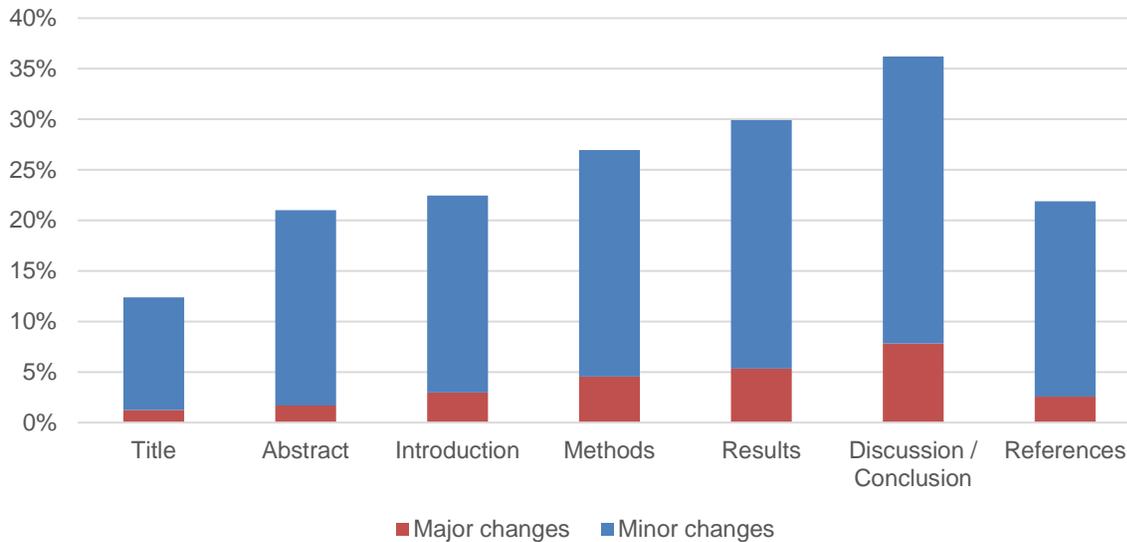


Figure 7. Major and minor changes in preprints after feedback, broken down by different sections of the paper.

3.3 Journal submission

In our survey, we found that 87% of COVID-19 preprint authors had submitted their articles to a peer-reviewed journal. The remaining 13% reported various reasons that their papers had not been submitted to a peer-reviewed journal. Among these reasons, the authors reported that their article had not yet been completed (20%), that they had not yet decided whether to publish their article in a peer-reviewed journal (19%) and that their article required more feedback (14%). However, the most common reason reported by authors whose article had not been submitted to a peer-reviewed journal is that they had decided not to do so (27%). Some commented that the preprint was sufficient to draw attention to the study and noted shortcomings in the journal publication process, such as a long peer review time and expensive article publication charges:

“I do not intend to publish a paper; the intention was purely to attract the attention of public opinion and authorities for the importance of good practices like contact tracing to contain the pandemic.” (Author who first preprinted a work in 2020/2021, “the preprint was an individual action, the work is not connected to any institution/organisation”.)

“The peer-review process is so long that the paper would no longer be timely by the time it was completed.” (Author who first preprinted a work before 2017, retired academic worker.)

“I have no possibility to pay for that. It was my own project.” (Author who first preprinted a work in 2020/2021, affiliated with university or college.)

Among authors who submitted their articles to a peer-reviewed journal, 62% reported that their paper had already been published by the journal. For authors whose articles had not yet been published in a peer-reviewed journal, the most common reason, reported by 46%, was that the article was still under review. The second most common reason, accounting for more than 30%, was rejection by the journal. The main reasons given for rejection were low quality and scope. At the same time, more than half of the authors who reported that their article was rejected stated that they intended to resubmit their article to another peer-reviewed journal.

Asking the authors about the order in which they had submitted their COVID-19 paper to a preprint server and a journal, we found that 53% first posted their work on a preprint server and then submitted it to a journal. A further 35% reported that posting the preprint and submitting the article happened at the same time. This aligns with an earlier survey conducted by Sever et al. (2019), covering authors of more than 4,000 bioRxiv preprints in 2019, which found that 42% of authors had posted their preprints before journal submission and 37% had posted concurrently with journal submission, which might be considered ‘conventional’ practices in relation to preprints, and is consistent with motivations reported by our respondents (e.g. early dissemination).

In the survey, we asked about the main features to which authors paid attention when choosing the journal to submit their manuscript. Figure 8 shows the proportion of respondents who selected “extremely important” or “very important” for each journal feature listed in the survey.

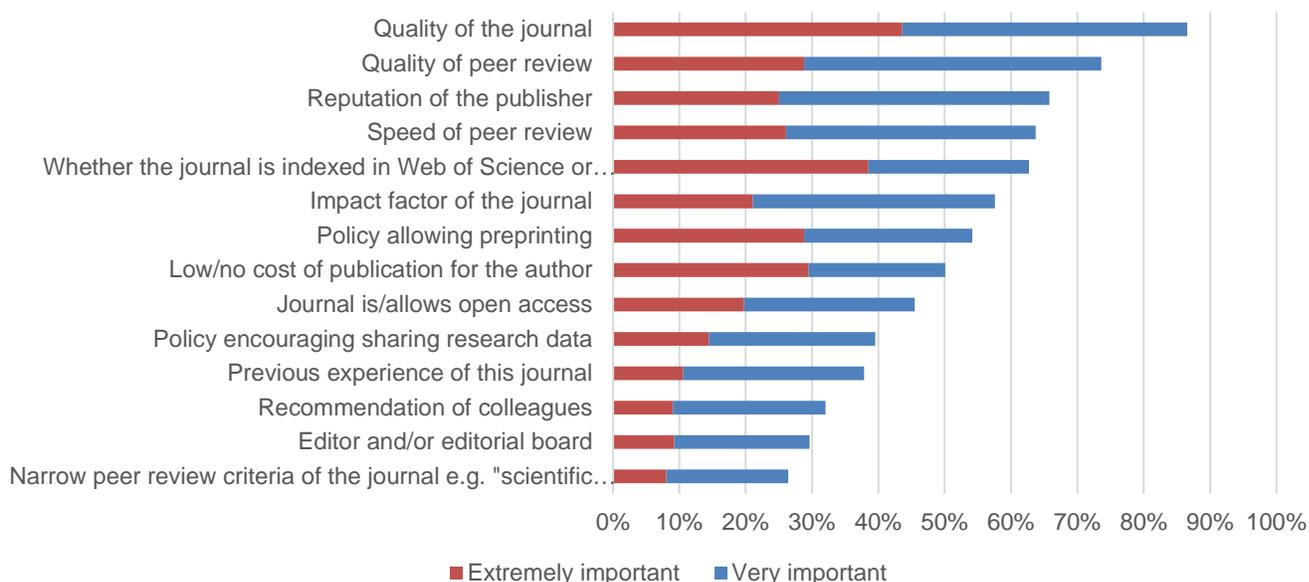


Figure 8. Journal features rated as “very important” or “extremely important” by authors in the choice of the journal for their COVID-19 papers.

The factors in this question were based on earlier research that reported the results of an international survey of authors publishing in different types of journals, mega-journals and conventional journals (Wakeling et al., 2019). The findings from that study and the results of our survey are similar. Both groups of authors were primarily interested in publishing their works in what they saw as high-quality journals with a high-quality peer review process. The reputation of the publisher and the speed of peer review were also among the five most important journal features to the participants of both surveys. The comparison with Wakeling et al. (2019) illustrates that authors of preprints in our survey did not report noticeably different motivations in selecting journals.

3.4 Journal peer review

For preprints submitted to a journal, we further examined how the comments of reviewers invited by the journal prompted changes in the article. Therefore, we asked authors whose COVID-19 articles went through a journal peer review process to what extent they had changed each section of their paper as a result of reviewers' and/or editors' comments. Answers to this question are presented in Figure 9.

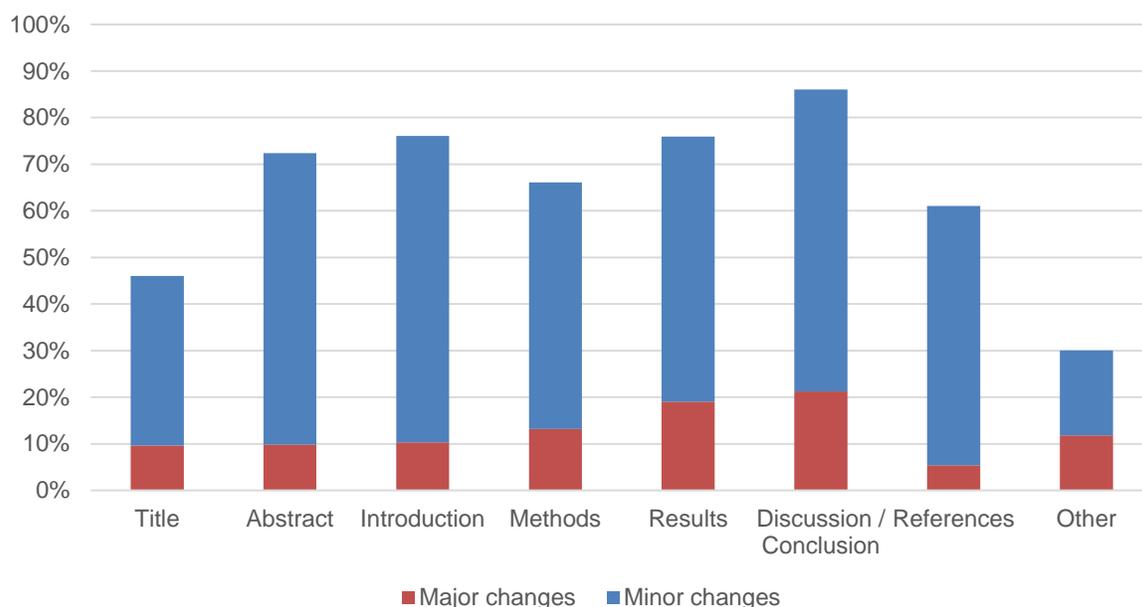


Figure 9. Proportion of respondents who made major or minor changes to different sections of their article in response to comments provided by reviewers and/or editors.

The authors reported major changes to approximately the same extent for the title, abstract and introduction sections of the article, accounting for around 10% of responses. For the methods section, it was 13%. Around 20% of authors indicated making major changes to their article’s results and discussion/conclusion sections in response to comments of peer reviewers and/or editors. The proportion of minor changes reported by authors varied between 50% and 65% for most sections.

Our results with regard to abstracts are reasonably aligned with earlier research by Brierley et al. (2022), who compared abstracts between preprints and the corresponding journal articles for COVID-19 research in the first four months of the pandemic. According to the results of their study, 17% of journal article abstracts underwent major changes and over 50% minor changes compared with their preprint counterpart (compared with 10% and 63% in our survey).

In the cases of both feedback on preprints and journal peer review, authors indicated that the results and discussion/conclusion sections were most subjected to major changes. We therefore compared the effect of preprint feedback and journal peer review on these two sections. Figure 10 shows that, according to the responses of surveyed authors, the journal peer review process resulted in a much higher rate of changes in the articles than feedback on preprints.

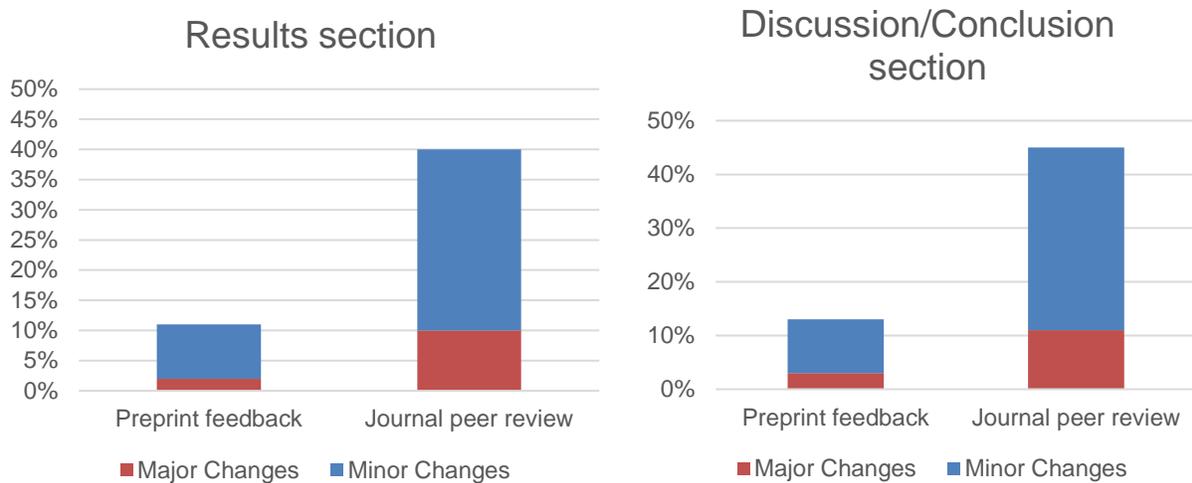


Figure 10. Proportion of respondents who made major or minor changes to results and discussion/conclusion sections of their article in response to feedback and comments provided by reviewers and/or editors.

We then asked the authors to what extent they had made specific types of changes to their papers to address comments made by peer reviewers and/or editors. The results are shown in Figure 11. The authors reported that, in the case of journal peer review, major changes mainly consisted of further analysis, the inclusion of results from additional data collection, and improving the presentation and readability of the article.

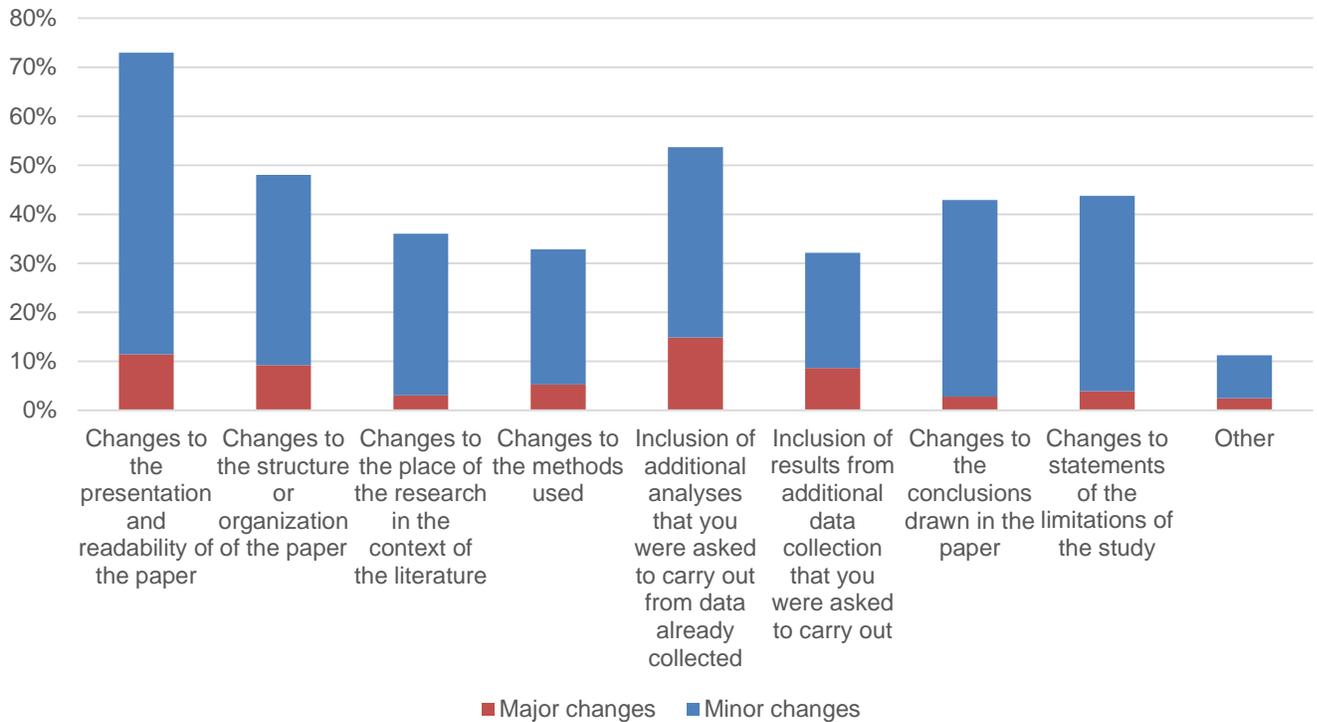


Figure 11. Proportion of respondents who made specific types of changes (major or minor) in their article in response to comments of reviewers and/or editors.

Following existing initiatives of publishers to accelerate the publication process for COVID-19 papers (Horbach, 2020, 2021), we also analysed whether notable differences existed in the speed, quality and constructiveness of the journal peer review process for COVID-19 research from the point of view of the authors compared with their prior experience in scientific publishing. Figures 12 and 13 show that, on average, no strong agreement or disagreement existed among authors that publishers sped up or improved the peer review process for COVID-19 research.

For a better understanding, we divided the article-processing time into three stages: the time of peer review, the time between submission of the revised version and acceptance, and the time of publishing following acceptance. Of the respondents, 40% agreed with the statement that “the time between submission of the revised version and acceptance was shorter than normal” for their COVID-19 paper, while 29% disagreed.

The process of publishing an article after it was accepted was assessed as shorter than prior experiences by 47% of respondents, while 22% assessed it as longer (Figure 12).

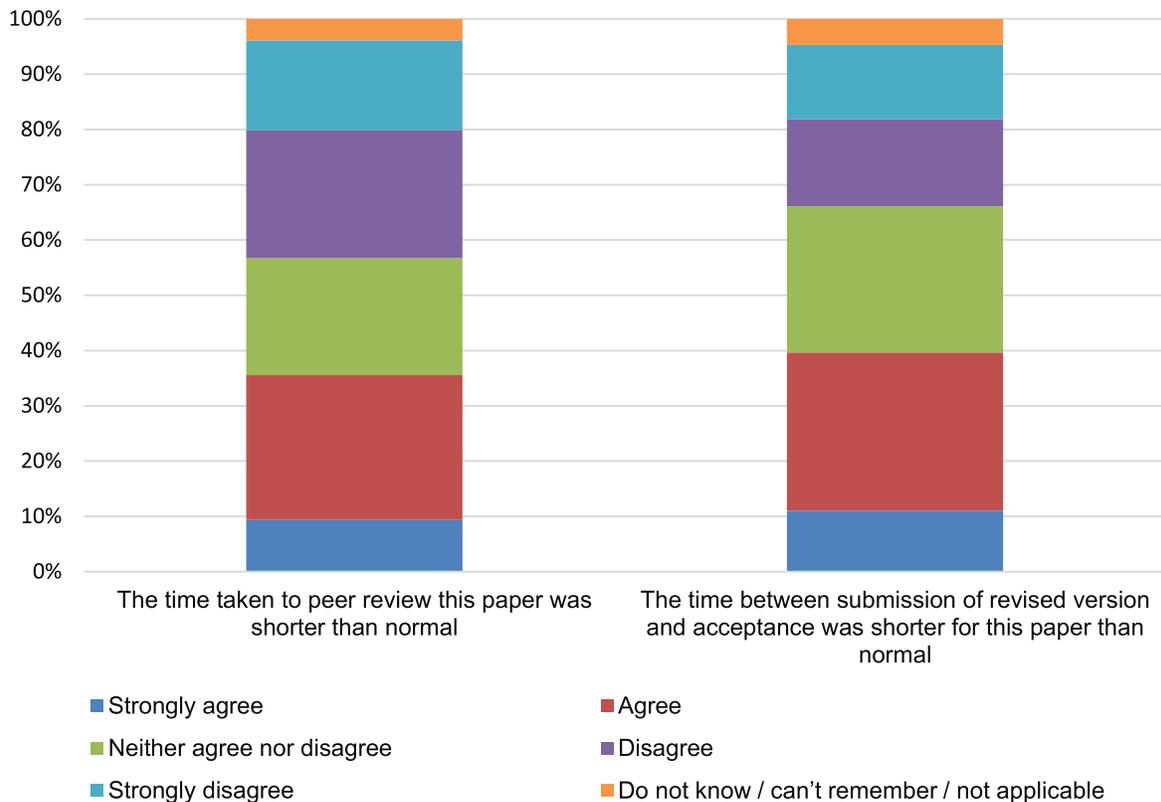


Figure 12. Rated speed of article-processing time of COVID-19 papers according to the surveyed authors' former experience of publishing.

As for the quality and constructiveness of the journal peer review, as shown in Figure 13, on average, our respondents experienced peer review of their COVID-19 research to be slightly more constructive than peer review of other articles, but the difference was small. On average, they found the journal peer review of their COVID-19 articles to be of similar quality to the peer review of other articles.

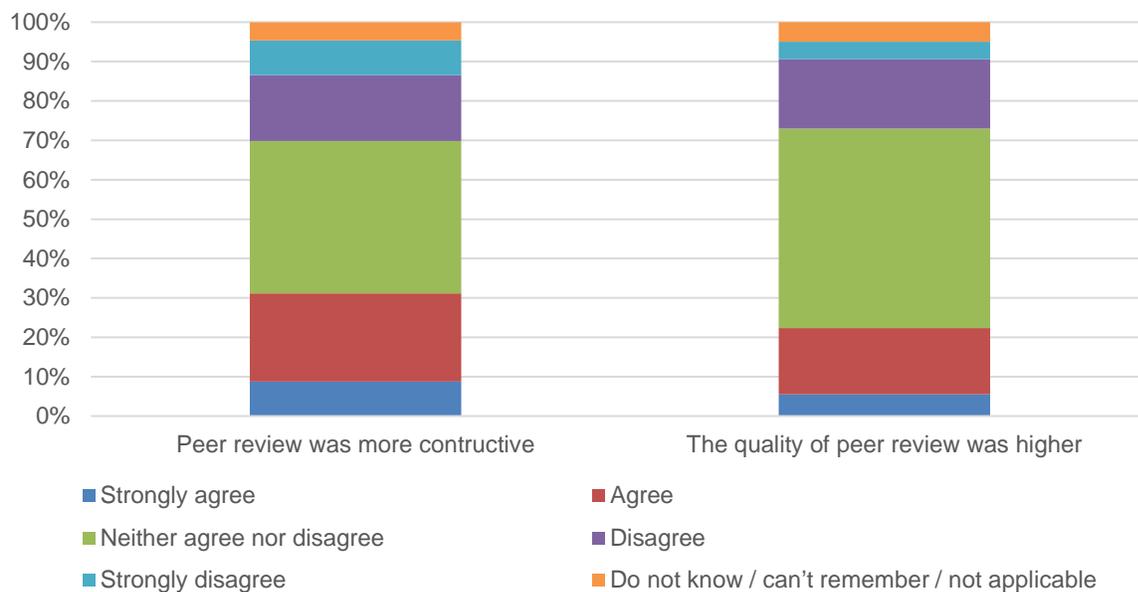


Figure 13. Constructiveness and quality of journal peer review of COVID-19 papers compared to the surveyed authors' former experience of publishing.

4. Discussion and Conclusion

Compared with physics and mathematics, the adoption of preprinting in the biomedical sciences has been a slow process and has taken different turns (Delfanti, 2016; Chung, 2020). The COVID-19 pandemic has demonstrated the importance of rapidly sharing research outputs globally. As means of ensuring swift open access to and feedback on research, preprints were embraced by many authors of COVID-19 research. From the early stages of the pandemic, a rising uptake and growing awareness of preprints in the scientific community has been observed (“All that’s fit to preprint,” 2020; Fraser et al., 2021). Our survey shows that the primary motivation for researchers to preprint their COVID-19 research was to disseminate their research through quick, open channels. The report evaluating the COVID-19 Rapid Review Initiative (Waltman et al., 2021) shows that almost 40,000 COVID-19 preprints were posted between January 2020 and April 2021. It also shows that, in the early months of the pandemic, the number of COVID-19 preprints that were posted exceeded the number of COVID-19 publications in peer-reviewed journals. However, notably, preprints still constitute only a relatively small portion of overall output of COVID-19 research (between 5% and 10%).

In our study, we analysed the results of a survey disseminated among corresponding authors of COVID-19 preprints posted on arXiv, bioRxiv, medRxiv and ChemRxiv in 2020. Two thirds of our survey participants reported that they posted their first preprint during the pandemic. Notably, more than 80% of the surveyed authors expressed the intention to continue preprinting in the future, at least for some of their work. This result suggests that the pandemic has caused structural changes in the scholarly publishing process, indicating that the rising uptake of preprints in this period may not be a temporary trend but rather an integral part of this process in the coming post-pandemic period.

The main factors that motivated surveyed authors to post their COVID-19 articles on preprint servers were the opportunity to rapidly (34%) and openly (25%) disseminate their research and receive feedback (12%). These results align well with previous studies. In an earlier study, Fraser, Mayr & Peters (2021) compared results obtained from a survey of authors of bioRxiv preprints with previous studies that investigated the factors that motivate authors to post their preprints. They found alignment between the strongest motivations reported by participants of their survey with previous studies. The preprint authors' leading motivations were to increase awareness of their research and to share their findings more quickly. They also found that early career researchers were more motivated to publish their preprints to receive feedback compared to late-career researchers. The same trend can be observed among researchers who participated in our survey: 36% of those with fewer than five years of research experience responded that receiving feedback was their primary motivation for publishing their preprint, and this proportion decreased for each subsequent group of more experienced researchers. Chiarelli et al. (2019) presented the results of interviews conducted with research funding representatives, research-conducting organisations, preprint services, other related service providers and researchers before the pandemic. They reported that interviewed participants also mentioned “early and rapid dissemination of research” and “increased opportunities for feedback” as the main benefits of preprints.

Our research shows that preprints have been useful for prompting feedback on COVID-19 research: more than half of the survey respondents reported that they received feedback on their preprint. However, most of the feedback was received by authors in a “closed” way. Only 20% of the feedback was given directly on preprint servers. Surveyed authors who posted their COVID-19 preprints on bioRxiv and medRxiv reported that, respectively, 50% and 39% of the feedback on their work was received directly on the preprint server. arXiv and ChemRxiv do not offer the possibility to receive feedback directly on the preprint server. The result for bioRxiv and medRxiv suggests significant value in offering a commenting option directly on the preprint server to stimulate open feedback on preprints. Preprint servers that do not have this function might usefully consider adding it. However, considering the challenges mentioned by Ginsparg (2016) regarding “human labor to moderate the comments” and a preference for “drama-free minimalist dissemination” of preprints, preprint servers might also encourage the development and use of other open channels for feedback on preprints (e.g., platforms for preprint peer review).

We asked the surveyed authors about the nature of the feedback given on the preprint to evaluate the potential of preprint peer review to provide valuable comments and improve the research outcomes. The nature of the comments on bioRxiv was earlier analysed for non-COVID-19 research (Malički et al., 2021), where only 12% of the comments were classified as “full review reports traditionally found during journal review” by a group of independent coders. In our research, we also see that most of the feedback did not contain elements characteristic of journal peer review.

According to the responses of the surveyed authors, the results section of their papers was majorly altered in 2% of cases as a result of preprint feedback and in 10% of cases as a result of journal peer review. In the discussion/conclusion sections of their papers, major changes occurred in 3% of cases as a result of feedback on a preprint and in 11% of cases as a result of journal peer review. This suggests a greater added value of journal peer review compared to feedback on preprints. It also might indicate that making changes as a result of peer reviewer comments when submitting to a journal is less ‘optional’ than making changes in response to feedback on a preprint.

There are a variety of approaches to preprint peer review (Polka et al., 2022), but they are in an early stage of development. Nevertheless, our study showed the potential of preprint feedback to provide valuable comments on the research. One could imagine a future in which preprint servers offer alternatives to peer-reviewed journals, but this requires significant further developments in preprint feedback and preprint peer review.

Our study was restricted to four preprint servers, arXiv, bioRxiv, medRxiv and ChemRxiv, representing around 55% of all COVID-19 preprints posted during 2020. Our study did not consider the remaining 45% of the COVID-19 preprints. COVID-19 research in the social sciences is probably underrepresented. Our research has a self-selection bias since corresponding authors of COVID-19 preprints who received email invitations to participate in the survey chose whether to participate. The focus of the survey was on authors of COVID-19 preprints and did not include a control group of researchers who did not preprint their COVID-19 research.

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Competing interests

The authors have no competing interests.

Data availability

The data that support the findings of this study are openly available in figshare (Rzayeva et al., 2022), except for the free-text responses, which may contain sensitive information.

Author contributions

Conceptualization: NR, SOH, SP, LW; Data curation: NR; Formal Analysis: NR (quantitative data), SOH (qualitative data); Funding acquisition: SP, LW; Investigation: NR; Methodology: NR, SP, LW; Project administration: NR, SP, LW; Supervision: SP, LW; Validation: NR, SOH, SP, LW; Visualization: NR; Writing – original draft: NR; Writing – review & editing: NR, SOH, SP, LW

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