RESEARCH NOTE

In the emerging evidence base on coronavirus disease 2019 and loss of smell, how many preprint papers are subsequently published?

Maia E. Walsh BSc, MBBCh | Claire Hopkins FRSC(ORLHNS), DM

Guy’s Hospital, Guy’s and St Thomas National Health Service (NHS) Foundation Trust, London, UK

Correspondence
Maia Walsh, BSc, MBBCh, Guy’s Hospital, Guy’s and St Thomas NHS Foundation Trust, Great Maze Pond, London, SE1 9RT, UK.
Email: Maia.walsh@gstt.nhs.uk

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1 | INTRODUCTION

Traditional medical publishing involves a process of peer review prior to acceptance and publication, with manuscripts often embargoed prior to publication. Preprint servers have emerged since the 1990s, but have played little part in medicine prior to the onset of the coronavirus disease 2019 (COVID-19) pandemic. In 2017, the UK’s Medical Research Council announced it was actively encouraging researchers to share research on preprint servers ahead of publication. The British Medical Journal, in collaboration with Yale University and Cold Spring Harbor Laboratory, launched the first preprint server for medical research, MedRxiv, in June of 2019, noting that “there is some evidence that pre-prints can accelerate progress in handling outbreaks of infectious disease.” The need for rapid dissemination of COVID-19-related research has led to a surge in the use of preprint servers. An online report “How COVID-19 is changing research culture” has highlighted the emergence of the use of preprints in the response to the pandemic, with preprints accounting for one-quarter of research output by the beginning of May 2020. The value of preprints is under debate, with concern that they are being used to circumvent formal peer review and little understanding of how widely their findings are disseminated.

The first reports of a link between COVID-19 and anosmia emerged in late March 2020, followed by a rapid growth in associated publications. We set out to evaluate what proportion of papers posted on MedRxiv subsequently appear in peer-reviewed journals and how frequently they were cited.

2 | METHODS

MedRxiv was searched for the terms COVID and anosmia, restricting the search to the period April 1, 2020, to May 31, 2020. Abstracts were screened and included if the paper reported on the prevalence of olfactory dysfunction relating to COVID-19, its role in predicting results of COVID-19 testing or prognosis, or if the study evaluated underlying pathophysiology. Studies were rejected if they did not report on any aspect relating to olfactory dysfunction.

MedRxiv states whether a paper has been published and reports metrics such as tweets. The digital object identifier (DOI) was used to search Google scholar for the number of citations. The title was used to check if the publication had been missed. Abstracts of the preprint and peer-reviewed version were compared for significant differences, which included a significant change to the results, subject numbers, authorship, or title. A Student t test was used to compare the mean number of citations between published and preprint papers.

3 | RESULTS

Eighty five papers were identified, of which 39 were included after screening abstracts.

Ten papers had been published in peer-reviewed journals as of October 16, 2020 (Table 1). An additional 4 papers had been subsequently published (shown with *) but with substantial changes to the number of included subjects, analysis, and authorship in 1 paper. The mean ± standard deviation (SD) number of citations was higher for
| First author | DOI | Published | Journal | Metrics |
|--------------|-----|-----------|---------|---------|
| Menni | https://doi.org/10.1101/2020.04.05.20048421 | Yes | Nature Medicine ([https://doi.org/10.1038/s41591-020-0916-2](https://doi.org/10.1038/s41591-020-0916-2)) | 388 54 |
| Levinson | https://doi.org/10.1101/2020.04.11.20055483 | No | – | 12 20 |
| Olibris | https://doi.org/10.1101/2020.04.14.20065631 | No | – | 15 1 |
| Lechien | https://doi.org/10.1101/2020.04.15.20066472 | No | – | 17 13 |
| Sarker | https://doi.org/10.1101/2020.04.16.20068213 | Yes | Journal of the American Medical Informatics Association ([https://doi.org/10.1093/jamia/ocaa116](https://doi.org/10.1093/jamia/ocaa116)) | 21 7 |
| Borges do Nascimento | https://doi.org/10.1101/2020.04.16.20067421 | No | – | 6 2 |
| Fontanet | https://doi.org/10.1101/2020.04.18.20071134 | No | (Reported on local website) | 1654 56 |
| Aguilar | https://doi.org/10.1101/2020.04.19.20071548 | No | – | 19 1 |
| Williams | https://doi.org/10.1101/2020.04.22.20072124 | No | – | 155 23 |
| de Souza | https://doi.org/10.1101/2020.04.25.20077396 | a | – | 61 28 |
| Hornuss | https://doi.org/10.1101/2020.04.28.20083311 | Yes | Clinical Microbiology and Infection ([https://doi.org/10.1016/j.cmi.2020.05.017](https://doi.org/10.1016/j.cmi.2020.05.017)) | 13 79 |
| Tordjian | https://doi.org/10.1101/2020.04.28.20081687 | No | – | 12 0 |
| Borobia | https://doi.org/10.1101/2020.04.29.20080853 | Yes | Journal of Clinical Medicine ([http://doi.org/10.3390/jcm9061733](http://doi.org/10.3390/jcm9061733)) | 109 37 |
| Yin | https://doi.org/10.1101/2020.04.29.20085415 | No | – | 5 4 |
| Lechien | https://doi.org/10.1101/2020.05.02.20070581 | No | – | 5 3 |
| Mandić-Rajčević | https://doi.org/10.1101/2020.05.03.20082818 | No | – | 6 3 |
| Lechien | https://doi.org/10.1101/2020.05.03.20088526 | a | – | 6 1 |
| Coolen | https://doi.org/10.1101/2020.05.04.20090316 | No | – | 36 41 |
| Parma | https://doi.org/10.1101/2020.05.04.20090902 | Yes | Chemical Senses ([https://doi.org/10.1093/chemse/bjaa041](https://doi.org/10.1093/chemse/bjaa041)) | 155 40 |
| Iravani | https://doi.org/10.1101/2020.05.07.20094516 | No | – | 38 3 |
| Lombardi | https://doi.org/10.1101/2020.05.07.20094276 | Yes | Clinical Microbiology and Infection ([https://doi.org/10.1016/j.cmi.2020.06.013](https://doi.org/10.1016/j.cmi.2020.06.013)) | 7 2 |
| Asseo | https://doi.org/10.1101/2020.05.07.20093955 | No | – | 14 0 |
| Ortiz-Prado | https://doi.org/10.1101/2020.05.08.20099543 | No | – | 320 6 |

(Continues)
TABLE 1 (Continued)

| First author | DOI                              | Published | Journal                              | Metrics |
|--------------|----------------------------------|-----------|--------------------------------------|---------|
| Rivett       | https://doi.org/10.1101/2020.05.09.202082909 | Yes       | eLife (https://doi.org/10.7554/eLife.58728) | Tweets: 28, Citations: 102 |
| Almazeedi    | https://doi.org/10.1101/2020.05.09.202096495   | No        | –                                    | Tweets: 18, Citations: 11 |
| Ozturk       | https://doi.org/10.1101/2020.05.10.202097535   | No        | –                                    | Tweets: 11, Citations: 2 |
| Regina       | https://doi.org/10.1101/2020.05.11.202097741   | No        | –                                    | Tweets: 70, Citations: 6 |
| Qiu          | https://doi.org/10.1101/2020.05.13.2020100198   | No        | –                                    | Tweets: 7, Citations: 13 |
| McArthur     | https://doi.org/10.1101/2020.05.14.2020102475    | No        | –                                    | Tweets: 6, Citations: 1 |
| Basse        | https://doi.org/10.1101/2020.05.14.2020101576    | a         | –                                    | Tweets: 25, Citations: 4 |
| Olalla       | https://doi.org/10.1101/2020.05.18.2020103283    | Yes       | QJM: An International Journal of Medicine (https://doi.org/10.1093/qjmed/hcaa238) | Tweets: 19, Citations: 3 |
| Boddington   | https://doi.org/10.1101/2020.05.18.202086157     | No        | –                                    | Tweets: 9, Citations: 3 |
| Mei          | https://doi.org/10.1101/2020.05.19.202010702     | No        | –                                    | Tweets: 7, Citations: 0 |
| Fafi-Kremer  | https://doi.org/10.1101/2020.05.19.2020101832     | Yes       | EBioMedicine (https://doi.org/10.1016/j.ebiom.2020.102915) | Tweets: 247, Citations: 23 |
| Lechien      | https://doi.org/10.1101/2020.05.20.2020106633     | Yes       | Laryngoscope (https://doi.org/10.1002/lary.28993) | Tweets: 4, Citations: 2 |
| Izquierdo    | https://doi.org/10.1101/2020.05.22.2020109959     | No        | –                                    | Tweets: 90, Citations: 2 |
| Rojo         | https://doi.org/10.1101/2020.05.24.202011971      | a         | –                                    | Tweets: 185, Citations: 7 |
| Garibaldi    | https://doi.org/10.1101/2020.05.24.2020111864      | No        | –                                    | Tweets: 8, Citations: 2 |
| Sandri       | https://doi.org/10.1101/2020.05.24.2020111245      | No        | –                                    | Tweets: 44, Citations: 12 |

*aIndicates that a paper has been published related to the preprint but with substantial changes.
COVID-19 = coronavirus disease 2019.

published papers (34.9 ± 34.8; 95% confidence interval [CI], 13.3–56.5), compared with those that had not (9.2 ± 13.2; 95% CI, 4.4–14), p = 0.002.

4 | DISCUSSION

The need for rapid dissemination of knowledge surrounding COVID-19 has led many researchers to utilize preprint servers. MedRxiv states that “pre-prints are preliminary reports that have not be certified by peer-review” and that inclusion on the site is not an endorsement of scientific quality. “Preprint” suggests an intention that “print” will follow through a conventional peer-review process. We looked at 39 papers and found that 1 in 4 had been published at the time of review, between 4.5 to 6 months after posting. Although some preprints likely remain under review and may still be published, at least some of these papers will remain available indefinitely in the public domain in the absence of any peer-review process.

The results show that papers published in peer-reviewed journals are more widely cited than those appearing only on preprint servers, suggesting that peer-reviewed publication remains the most effective avenue to widely disseminate information. Although less frequent citation of preprints may reflect caution, citations of preprints
that were subsequently published were often made before peer-review publication. Almost all non-published papers had also been cited, some many times. As shown in Table 1, Fontanet (https://doi.org/10.1101/2020.04.18.20071134) was the most widely cited preprint article, receiving more citations than 80% (8/10) of the peer-reviewed publications.

Four papers were identified through searching that clearly related to the original preprint but had been changed significantly at the time of publication, in terms of significantly increased numbers of included subjects or the analysis. Preprint servers allow preliminary findings of large studies to be published in “real-time,” whereas final results may take many months to obtain and publish in a peer-reviewed format; however, it risks premature dissemination of results that may change significantly in the final analysis and those citing the preprint may not be aware if substantial changes subsequently occur. This study provides an early perspective on what will be the evolving role of preprint servers. Further work over a longer time frame is important to understand how preprints are utilized, both by authors and the scientific community.

Preprint servers have played an important role is sharing early insights into COVID-19. Indeed, Bagheri et al.5 posted on MedRxiv on March 23, 2020, was 1 of the first written reports of the coincidence of COVID-19 cases and olfactory dysfunction, and has subsequently been published. However, preprints cannot provide the same level of scientific rigor as peer-reviewed publications, yet papers may still be highly cited. This highlights the potential pitfalls of preprint servers in which both poor quality or misleading information could become widely disseminated under the guise of rigorous scientific findings.

ORCID
Claire Hopkins FRSC(ORLHNS), DM © https://orcid.org/0000-0003-3993-1569

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