Benchmarking open access publication rates for the pharmaceutical industry and research-intensive academic institutions

Tomas Rees,[1] Valérie Philippon,[2] Andrew Liew,[1] Slávka Baróniková,[3] William T Gattrell,[4] Jo Gordon,[1] Taija S Koskenkorva,[5] Santosh Mysore,[6] Joana Osório,[1] Tim J Koder[1]

[1]Oxford PharmaGenesis, Oxford, United Kingdom
[2]UCB Inc., Cambridge, MA, USA
[3]Galapagos NV, Mechelen, Belgium
[4]Bristol Myers Squibb, Uxbridge, United Kingdom
[5]Novartis, Basel, Switzerland
[6]GSK, Wavre, Belgium

*Corresponding author: Tomas Rees
Email for correspondence: tomas.rees@pharmagenesis.com

Word count: 4252
Article type: original research
Main subject area: medical humanities

Author	ORCID
Tomas Rees	0000-0003-0221-0098
Valérie Philippon	0000-0002-7444-6027
Andrew Liew	0000-0003-4792-9637
Slávka Baróniková	0000-0001-8072-5690
William T Gattrell	0000-0002-9733-6330
Jo Gordon	0000-0002-1461-5714
Taija S Koskenkorva	0000-0002-7349-2435
Santosh Mysore	0000-0002-9305-3966
Joana Osório	0000-0003-2713-5370
Tim J Koder	0000-0001-6152-7365

Abstract [286 words]

Objective

In biomedical and health sciences, many articles are published open access (OA). Rates of OA publications continue to grow, including for research carried out by pharmaceutical companies. To help drive more openness in the pharmaceutical industry, we aimed to compare the OA publication rates of pharmaceutical companies with those of academic institutions.

Methods

We assessed OA publication rates from the 40 largest pharmaceutical companies by earnings and 40 comparator academic institutions that publish the largest number of medical research articles in their geographical region. Using the Lens, we built a live public dashboard that presents the OA publication rates for articles with authors affiliated to the pharmaceutical companies and comparator academic institutions of interest, detailed by OA model and licence, and by medical therapy area. We performed further analysis on data downloaded from the dashboard.

Results

In our primary analysis of articles 12–24 months since publication date, 76.6% of pharmaceutical company (pharma) and 69.5% of academic institution (academia) publications were OA. The most common OA models were gold (pharma, 37%; academia, 41%) and hybrid (pharma, 22%; academia, 11%). Oncology had lower rates of OA publications than other therapy areas. Growth in the OA publication rate was generally more rapid for pharmaceutical companies than for academic institutions, regardless of field.

Conclusions

The OA publication rate was higher for pharmaceutical companies than for academic institutions and continues to increase. With the pharmaceutical industry focused on encouraging authors to publish OA and increasingly aware of the different types of OA licences, we expect and welcome further changes. Our new report provides data on pharmaceutical company and academic institution publications that are updated every 2 weeks. We encourage others to use this open resource and report their results.

Key messages

What is already known on this topic

Open access (OA) publication rates for pharmaceutical companies have been steadily growing. However, previous methods for analysing pharmaceutical company OA publication rates have not been conducive to automation and have not facilitated easy comparison between pharmaceutical companies and other research-intensive environments, such as academic institutions.

What this study adds

We built an online dashboard that presents continually and automatically updated OA publication rates for articles with authors affiliated to several large pharmaceutical companies and academic institutions. We found that the OA publication rate was higher for pharmaceutical companies than for academic institutions and that growth in OA publications was generally more rapid for pharmaceutical companies than for academic institutions.

How this study might affect research, practice or policy

Our dashboard allows ongoing monitoring, and we encourage the use of this free tool to capture evolving OA publishing behaviours and the disclosure of these results to help drive greater adoption of OA publishing practices.

Strengths and limitations of this study

- As expected with large-scale bibliometrics sampling, there are various points at which error and/or information loss may have entered this analysis, for example, during the parsing of author affiliations or categorisation of topics and article types.
- The comparator set (a globally representative group of research-intensive academic institutions) may not represent academic institutions in general because it includes only the largest academic institutions (in terms of publication counts) from each global region.
- There is overlap between the pharmaceutical company and academic institution analysis sets because first, pharmaceutical company publications often include academic authors, and second, academic institution publications may include pharmaceutical company authors. Hence, some individual publications may have been included in both analysis sets.
- The analysis does not account for studies that are led by authors at academic institutions but funded by pharmaceutical companies. These investigator-sponsored studies typically do not have pharmaceutical company authors, and pharmaceutical companies have no influence over decisions relating to publications resulting from these studies, including target journal, OA status and license type.

Keywords

Open Access Publishing; Benchmarking; Dashboard Systems; Drug Industry; Copyright

Plain Language Summary [230 words]

Biotechnology and pharmaceutical companies develop and deliver most of the world's new medicines. To ensure important information about these medicines is shared transparently with audiences across the world, more and more often, pharmaceutical companies are choosing to publish their research open access. Open access publishing allows anyone to read and, in some cases, reuse the contents of research publications for free. In medical journals, an increasing proportion of articles are published open access every year. However, at the moment, we don't understand how the open access publication rates of medical publications from pharmaceutical companies compare with those of medical publications from academic institutions. Understanding this could help the scientific community assess how open access publication practices are changing over time.

We made an online platform that provides a free, live report of the open access publication rates for pharmaceutical companies and academic institutions. We found that 77% of pharmaceutical company research publications and 70% of academic institution research publications were published open access. Open access publication rates increased each year for both pharmaceutical company and academic institution research publications, but the rates were increasing faster for pharmaceutical companies.

Our results are similar to those from other studies of open access publication rates. We encourage users to explore our free online live report and share their results publicly. The live report can be accessed using the following link: https://www.lens.org/lens/report/view/Open-access-dashboard/14572/page/14573.

INTRODUCTION

The global pharmaceutical industry is a major funder of healthcare research, with a $238 billion spend on research and development (R&D) in 2021.[1] Pharmaceutical companies, which develop and manufacture most of our medicines, are increasingly interested in having their roles as research funders recognised and to develop trusted reputations similar to those of public and philanthropic funders.[2]

OA refers to the practice of making research outputs, including peer-reviewed publications and data, freely available to everyone. By increasing their OA publication rate, research producers, including the pharmaceutical industry, can build trust in their research by allowing scrutiny of its outputs and contributing to onward knowledge generation. OA publications can also help make access to the scientific literature more equitable for medical professionals, scientists, patients, caregivers and other stakeholders outside the privileged circle of people with access to comprehensive journal subscriptions. In the Edelman Trust Barometer, lack of health information was the second most common reason for people to feel unable to improve their health.[3] In an era of an increasing volume of poor-quality information online, OA publications can provide access to credible science to all.

As well as having potential societal benefits, OA publishing may also have benefits for authors, and OA publications may have a greater measurable impact than non-OA publications. Some analyses have found that OA publications may be more likely to be cited than similar non-OA publications, particularly in medicine,[4] however, in a large randomised study, there was no difference in the number of citations between OA and non-OA publications.[5] Other studies have found that OA publications in hybrid clinical medical journals were more likely to be cited than paywalled publications in the same journals,[6] and OA healthcare publications were more likely to be cited in news media than paywalled publications.[7]

The method and degree to which research is made OA varies widely, with different norms, restrictions and financial arrangements, depending on the country, funder, research environment, discipline or institution. There are several models through which peer-reviewed publications can be published OA, including bronze, gold, green and hybrid. Additionally, some publications are more ‘open’ than others: a key aspect of OA is the right to reuse publication content, which is dictated by the Creative Commons (CC) licence (or equivalent) under which the publication is published. Different licences have different permissions and restrictions. For example, some licences allow anyone to reuse and modify content, while others restrict commercial use (e.g. CC BY-NC [Attribution-NonCommercial]). ‘Commercial use’ is often interpreted to include use by pharmaceutical companies, even if the work will be

used for non-promotional purposes. In such cases, commercial organisations may need to request copyright permission from the journal to reuse materials.

The proportion of articles published OA is growing: in 2021, almost half of publications were OA, up from 15% in 2000.[8] Across global regions, OA publication rates in 2015 were highest in sub-Saharan Africa, followed by North America and Latin America and the Caribbean.[9] Another analysis found that, between 2009 and 2016, articles from large pharmaceutical companies were increasingly being published OA.[10] The analysis also found that the gap between the proportion of articles from these companies published OA and the baseline proportion of articles from all types of funders published OA had been closing over time, with the proportion of company articles published OA surpassing the baseline in 2016.[10]

Funder strategies can have a key role in increasing OA publication rates, and many funders now have policies that encourage or mandate OA publishing. Under the OA mandate of Horizon 2020 (the European Union's research and innovation funding programme from 2014 to 2020), funding beneficiaries have to ensure that peer-reviewed publications arising from the funded work were published OA.[11] In the USA in 2023, The White House Office of Science and Technology Policy announced actions to advance open research.[12] Plan S is a consortium of non-commercial funding agencies, including national funding bodies and independent philanthropic organisations, who mandate that the research they fund must be published in OA journals, on OA platforms, or made immediately available through OA repositories without embargo.[13] Such mandates can instigate great changes in the adoption of OA practices.[14] Inclusion of publication policies in directories such as ROARMAP[15] and Sherpa Juliet[16] can be a prerequisite for journals to honour those policies, and funders with strong OA policies such as Plan S can benefit from more open publication licences than those without a strong public OA policy.

For academic and non-profit organisations, making publications OA means that the results of publicly funded research are publicly available. Given that the pharmaceutical industry manufactures medicines under licences granted by governments, it has been argued that the social contract between pharmaceutical companies and general society includes the responsibility for pharmaceutical companies to provide quality information about their products.[3] This includes transparently and promptly sharing the results of the extensive research and development they carry out throughout the drug candidate and product lifecycle, and, more specifically, publishing this information OA.[17] The good publication practice 2022 guidelines for company-sponsored biomedical research (GPP 2022) state that open access options should be prioritised when selecting target journals.[18] However, contrary to this goal, some journals do not allow pharmaceutical industry-funded research to be published OA in the same ways that they allow research funded by non-commercial

institutions to be published OA, and further evidence is needed to make the case for the changes to pharmaceutical company publication policies that may precipitate changes to journal polices.[19]

The pharmaceutical industry is increasingly supporting OA publishing, and at least three companies have made public commitments to publish exclusively OA: Takeda (at the time, Shire) in 2018;[20] Ipsen in 2019;[21] and Galapagos in 2020.[22] GSK[23] and Pfizer[24] have also publicly stated their aim to increase OA publication rates. Other companies in the Open Pharma collaboration[25] have internal policies recommending OA, but details of these policies are not publicly available.

OA publication rates of different pharmaceutical companies have previously been compared,[26 27] but the method used required substantial manual analysis that was not conducive to automation, and involved the use of proprietary information and a public analytics platform that is no longer available. Some pharmaceutical companies also analyse their own proprietary records to measure and drive improvement,[24] but methods differ, and most results are not public. Tools such the live Curtin Open Knowledge Initiative dashboard[28 29] and the STM OA dashboard[30] provide ongoing tracking and comparison of OA publication rates by country. However, to our knowledge, no study has compared the OA publication rates of pharmaceutical companies against those of research-intensive academic institutions.

Objectives

- To introduce a freely available dashboard designed to provide constantly and automatically updated live visualisations of OA performance to allow the benchmarking of OA publication rates over time.
- To assess trends in OA publications across a group of major pharmaceutical companies and view them in the context of a globally representative set of research-intensive academic institutions.
- To understand how OA publishing behaviours by these pharmaceutical companies and academic institutions have evolved over time according to OA model and therapy area.
- To use our findings to drive greater adoption of OA publishing practices.

METHODS

Selection of pharmaceutical companies and academic institutions

We selected the top 40 pharmaceutical companies by global R&D spending in 2021 (**supplemental table S1**).[31] The lowest-ranking company, Grifols, was substituted with Galapagos, a company with similar R&D spend[32] but which is also an Open Pharma Member.

We selected 40 top academic institutions by analysis of author affiliations in the Centre for Science and Technology Studies Leiden Ranking 2022 (**supplemental table S2**).[33] We analysed academic institutions with publications in the 'Biomedical and health sciences' field published in 2017–2020. Countries of affiliation were allocated to one of seven regions (i.e. Africa, Asia, Europe, Middle East, North America, Oceania, South America), and the institutions with the highest proportion of publications from each region were selected to give a total of 40 academic institutions that reflected the regional makeup of the full sample. A fully equivalent regional analysis for pharmaceutical companies is not possible because much of their research is not conducted in the country where the company is headquartered.

Assessment of OA

We used the Lens, an open, online patent and scholarly literature aggregator and search facility that includes major academic publication directories,[34] to search for journal publications by authors affiliated with the identified pharmaceutical companies and academic institutions. Publication count data were collected between 24 July 2023 and 4 August 2023 via the Lens application programming interface (API) [35] using the 'httr' and 'rjson' R packages. Sen's slope was calculated using the R 'trend' package to estimate the trends in overall and therapy area OA percentages between 2013 and 2023.[36] [37] OA percentages were based on total publication count, while OA model percentages were based on the total OA publication count. All analyses were conducted in R. The R code for the Lens API queries and slope calculations is available on GitHub: https://github.com/OxPG-Informatics-and-Data-Science-Team/open-pharma-open-access-analysis.

Where applicable, we used the 'primary' name of each company or academic institution and the common 'other name' from ROR.org, as well as the Research Organization Registry (ROR) IDs lineage ('author.affiliation.ror_id_lineage') and child organisation names for companies. We included journal publications with the following 'Field of study' tags: 'Medicine', 'Internal medicine' or 'Pharmacology'. These publications are defined hereafter as 'medical' publications. This resulted in the elimination of 34.0% of publications with pharmaceutical industry authors across the 10-year publication period sample (n=161 018) but also achieved the exclusion of many academic institution publications from fields that

were not comparable to pharmaceutical company research, such as materials science and ecology.

We used OA status, model (referred to as 'colour' in the Lens documentation), and licence types as reported by the Lens.[38] OA models/colours are defined as follows: bronze OA, journals make articles available to read immediately for free but without a clearly identifiable copyright licence; gold OA, journals make published articles available to read immediately without subscription, for which authors pay an article processing charge (APC); green OA, authors make accepted manuscripts available to read via a personal, funder-controlled or independent repository (immediately or after a defined period); and hybrid OA, articles are published in a subscription journal but authors can pay an APC to make their article available to read immediately without subscription. Each publication is listed with a single OA status (yes or no) and model (bronze, gold, green, hybrid or unknown) but can be listed with more than one licence type if the licence for a particular publication is reported differently in different sources. To simplify the analysis of licences, licence types were grouped into licence categories (**supplemental table S3**).

Timeframe

Our primary comparison between pharmaceutical companies and academic institutions looked at the 12-month period from 12 to 24 months before data acquisition. Some OA articles are embargoed for up to 12 months,[39] so this timeframe allowed a comparison of total OA publications, including both immediate and embargoed OA articles. Our secondary comparison looked at the 12-month period from 0 to 12 months before data acquisition. We also analysed publications over 10 years.

Definition of therapy areas

The top 1000 fields of study (by publication count) were identified from the medical-related pharmaceutical company publications 10-year subset. Fields of study were derived from Microsoft Academic and the OpenAlex taxonomy. Fields of study related to disease or pharmacology terms were identified and then assigned to 16 therapy areas (publications could be tagged with multiple therapy areas), of which the largest 10 were included as categories in this analysis (**supplemental table S4**). Top 5 journals for numbers of publications in each of the 10 therapy areas were identified for pharmaceutical companies and academic institutions.

Patient and public involvement

Patients were not involved in the conduct or dissemination of this research.

RESULTS

Live dashboard

We have created a live, free, OA dashboard that provides a visual presentation of most of the below data in a continuously updated form. The dashboard, called a 'Lens Report' by the Lens, also allows the user to reproduce most of the underlying searches that were developed for this analysis. The dashboard can be found at the following URL: https://www.lens.org/lens/report/view/Open-access-dashboard/14572/page/14573.

Sample

The pharmaceutical companies and academic institutions included in this analysis are listed in **supplemental table S1** and **supplemental table S2**, respectively, and the regional composition of academic institutions is shown in **supplemental table S5**. For the primary analysis set, there were approximately 20 times more publications from academic institutions (351 514) than from pharmaceutical companies (18 461) (**figure 1**). When filtered for 'Medicine', 'Internal medicine' or 'Pharmacology' fields of study, proportionally more pharmaceutical company (71.0%) than academic institution publications (52.5%) remained in the data sets for analysis.

Primary and secondary analyses

Pharmaceutical companies showed a slightly higher proportion of OA publications than academic institutions across both the primary (76.6% vs 69.5%) and secondary (74.4% vs 65.6%) analyses (**table 1**). A high proportion of publications from both pharmaceutical companies and academic institutions used the gold OA model, but a higher proportion of pharmaceutical company publications than academic institution publications used the hybrid OA model across both analysis periods (**figure 2**). In the primary analysis, unrestricted licences were the most frequently used licence category for academic institution publications, while restricted licences were the most frequently used category for pharmaceutical company publications. In both analysis periods, a greater proportion of academic institution publications had unrestricted licences than pharmaceutical company publications (**table 1**).

Table 1 Overall OA/non-OA status and licence categories used in pharmaceutical company and academic institution medical publications

OA status and licence category*	Pharmaceutical company	Academic institution
Primary analysis (publications 12–24 months old)		

Total, n (%)	13 107 (100.0)	184 672 (100.0)
Non-OA, n (%)	3066 (23.4)	56 355 (30.5)
OA (any licence), n (%)	10 041 (76.6)	128 317 (69.5)
OA, unrestricted licence, n (%)	2685 (20.5)	54 147 (29.3)
OA, restricted licence, n (%)	3757 (28.7)	29 929 (16.2)
OA, publisher licence, n (%)	2 (0.0)	122 (0.0)
OA, unknown licence, n (%)	3598 (27.5)	44 189 (23.9)
Secondary analysis (publications ≤12 months old)		
Total, n (%)	10 860 (100)	160 327 (100)
Non-OA, n (%)	2811 (25.9)	55 232 (34.4)
OA (any licence), n (%)	8049 (74.4)	105 095 (65.6)
OA, unrestricted licence, n (%)	2052 (18.9)	44 160 (27.5)
OA, restricted licence, n (%)	2113 (19.5)	20 514 (12.8)
OA, publisher licence, n (%)	2 (0.0)	89 (0.0)
OA, unknown licence, n (%)	3883 (35.8)	40 397 (25.2)

*Percentages indicate percentage of total counts for each analysis timeframe and comparison group. OA, open access.

Trends in OA publications

Over the period 2013–2023, 63.8% (n=106 329) of pharmaceutical company medical publications and 62.8% (n=1 335 346) of academic institution medical publications were published OA. Over the same period, academic institutions saw greater growth than pharmaceutical companies in the overall number of medical publications published (**figure 3**). For academic institutions, there was a year-on-year increase in the absolute numbers of both OA and non-OA publications per year, with OA publication numbers growing to a larger extent than non-OA publications (**figure 3**). Pharmaceutical company OA publications per year generally also increased over this period; however, numbers of non-OA publications per year decreased in absolute terms (**figure 3**). The numbers of publications for 2023 were lower than for previous years because data were extracted in July of that year and hence do not represent a full year, and the proportions of 2023 publications that were OA were likely underestimates because some publications were published under a 1-year embargo after which they will count as OA.

Regarding OA models, the greatest growth has been in gold OA for both pharmaceutical companies and academic institutions, with gold OA increasing approximately by 1.4% per year and 2.3% per year for pharmaceutical company and academic institution publications,

respectively (**figure 4** and **supplemental table S6**). Pharmaceutical companies also saw an increase in hybrid OA publications of 1.1% per year.

The growth in the proportion of publications that were OA was broadly similar across therapy areas (**supplemental figure S1, supplemental table S6** and **supplemental table S7**). Pharmaceutical companies had increases in the proportion of OA publications in all therapy areas, and growth in the OA publication rate was greater for pharmaceutical companies than for academic institutions in all fields, especially gastroenterology, genitourinary disorders, pharmacology and psychiatry. Oncology, a key research area for pharmaceutical companies, had lower OA publication rates than most other therapy areas, but rates grew year on year.

There is substantial divergence between pharmaceutical companies and academic institutions in journal choice. Notably, journals from the natively gold OA publisher Frontiers are popular choices for academic institution authors in several therapy areas, but they do not appear on the list of the top 5 most popular journals for pharmaceutical companies for any therapy area (**supplemental table S8**).

DISCUSSION

In this analysis, we show that the OA publication rates of pharmaceutical companies are generally similar to or higher than those of academic institutions. We also show that the total number of publications has grown year on year for both pharmaceutical companies and academic institutions, especially OA publications, and that the number of non-OA publications has decreased year on year for pharmaceutical companies but not for academic institutions. Our findings reflect those of Piwowar and Priem,[40] who found that the proportion of journal articles published OA each year increased steadily between the 1990s and 2017. More recently, this trend has been confirmed by Seo.[8]

The median proportion of academic institution articles (all subjects) published OA during the period 2014–2017 has previously been reported as 43%,[41] which is lower than the proportion we report for academic institution medical publications (62.8% OA over the period 2013–2023). Yegros and van Leeuwen also found that just over 40% of publications from 2016 with authors affiliated with 23 large pharmaceutical companies were OA,[10] whereas our result for 2016 is higher at 54.7%. Additionally, Yegros and van Leeuwen found that publications from pharmaceutical companies were more likely to be published as green OA and less likely to be published as gold OA than publications from all sources.[10] This is different to our findings, potentially because we also include bronze and hybrid models in our analysis and potentially also due to the different data sources available in the Lens compared with those used by Yegros and van Leeuwen. However, in agreement with our

results, Yegros and van Leeuwen found that the proportion of publications published as green OA decreased between 2009 and 2016, while the proportion published as gold OA increased.[10]

Why are OA rates growing relatively faster for the pharmaceutical industry?

Academic institutions were pioneers in the OA movement. Several large funding bodies have supported and advocated OA for some time, including organisations such as Wellcome, the Howard Hughes Medical Institute and the Max Planck Society, which collectively established the not-for-profit journal *eLife*, further enabling OA publishing. However, in contrast to these large funding bodies, there is likely to be a large amount of academic research funded by smaller organisations for which additional funding for APCs is not readily available. This also contrasts with research funded by pharmaceutical companies. Publications arising from pharmaceutical company research are typically coordinated by specialised publication professionals, a group who are becoming increasingly aware of the benefits of OA and the options for OA publications, and who are increasingly setting and strengthening company OA policies.[42] The inclusion in GPP 2022 of guidance about prioritising OA options when selecting target journals is likely to also influence the choices of pharmaceutical company authors and publication professionals.[18] Public scrutiny may encourage further adoption of OA practices, and our analysis suggests that pharmaceutical companies are keen to increase their OA publication rates, especially considering the prospect of having the freedom to reuse material from published articles about the studies they fund without needing to seek copyright permission from journals (although this is only possible with permissive copyright licences such as CC BY).

Despite the movement to reduce the reliance on journal prestige for research assessment,[43] having their research published in journals with high impact factors is still a goal for many academic authors given that academic career progression is usually based on an individual's publication record. Many of these prestigious journals are subscription journals with limited or no OA options, and academic grants may not cover the higher APCs that are often demanded from more prestigious journals to publish OA.[44]

In the present analysis, we find that OA trends by disease area are similar between pharmaceutical companies and academic institutions, including notably fewer OA publications in oncology than in other therapy areas. This may be because oncology publications reporting key efficacy outcomes from clinical trials are often likely to be targeted to prestigious journals that have more restrictions on OA than other journals. Therapy area may therefore affect the feasibility of implementing OA mandates within pharmaceutical companies, which could be perceived as restricting the authors' choice of target journals.

Proportionally more pharmaceutical company than academic institution articles are published in hybrid journals, and proportionally fewer pharmaceutical company than academic institution articles are published as gold OA, that is, in fully OA journals. We find that, in some individual journals, the OA publication rates for pharmaceutical companies are lower than those for academic institutions, and we also find that the most permissive copyright licences are seen less often in pharmaceutical company publications. The lower rates of unrestricted licences across pharmaceutical company publications is likely to not be a result of author or company choice but reflects journals not offering those options for pharmaceutical company research articles.[19] These trends can change if journals and publishers choose to allow pharmaceutical companies to publish their articles OA, particularly under the fully open CC BY licence allowed to some institutional funders, such as the members of Plan S. Such changes in journal policy are not unprecedented; for example, after engagement with the pharmaceutical industry, the American Society of Clinical Oncology decided in 2018 to allow industry-sponsored research to be published in the *Journal of Clinical Oncology* under a CC BY-NC-ND (Attribution-NonCommercial-NoDerivs) licence after previously not allowing industry research to be published in the journal under any OA licence.[45] In turn, several journals base their OA offer on the public availability of an organisation's statement of publication policy that includes their policy on OA, and few pharmaceutical companies have made their OA commitments public. Pharmaceutical companies may be in a stronger position than academic institutions to cover the cost of APCs more routinely; however, the increased adoption of read-and-publish agreements may make hybrid OA more attractive for academic institutions in the future.[46]

Limitations of this analysis

As expected with large scale bibliometrics sampling, there are many points at which error and/or information loss enter this analysis, including automated affiliations and grey areas on categorising topics and article types. Inclusion of abstracts wrongly labelled as articles, for example, may underestimate the true volume of OA publications. One journal that was found to be a popular submission target for academic institution publications at the time of the present analysis, *SSRN Electronic Journal*, is in fact a preprint repository, not a peer-reviewed journal. Preprints on *SSRN Electronic Journal* are not persistent and are deleted from the repository following peer-reviewed publication in an Elsevier journal. Our previous OA benchmarking analysis used a more accurate method for article type screening, but it was less conducive to automation than the current method and therefore not suitable for the development of a live dashboard.[26 27] The proportion of publications in *SSRN Electronic Journal* was low, and so this is unlikely to have affected our overall conclusions.

Our set of pharmaceutical company publications essentially includes all publications with a pharmaceutical company author (as the number of publications from companies at the tail end of our list is very small). While we have attempted to create a comparator with a globally representative group of research-intensive academic institutions, our design of a comparator set may not represent academic institutions in general because it includes only the largest academic institutions (in terms of publication counts) from each region. There is also overlap in our pharmaceutical company and academic institution analysis sets because most pharmaceutical company publications include academic authors (but not necessarily from the institutions in our academic institution analysis set). Hence, some individual publications may have been included in both analysis sets. Academic publications may also include pharmaceutical company authors (although in our analysis, over 90% did not). We also rely on accurate parsing of author affiliations by the Lens to identify pharmaceutical company and academic institution publications. Finally, there is a grey area consisting of publications that are based on studies initiated by academic institutions and funded by grants from pharmaceutical companies. Pharmaceutical companies, though providing financial support for such research, have no influence over publication decisions, such as target journals or whether to publish OA, and the publications typically do not have pharmaceutical company authors. Additionally, the funding provided usually does not cover publication costs such as APCs, and authors of these publications may face challenges to publish OA.

Future prospects

The OA publication rates for medical research publications are likely to continue to rise, both for pharmaceutical companies and academic institutions, but especially for pharmaceutical companies, which we believe will be beneficial to healthcare practitioners and patients. The continued increase in OA publication rates will likely be driven by growing awareness of the benefits of and options for OA, and by changes in policy at the journal and research funder (including pharmaceutical companies) levels. For example, journal policies that allow pharmaceutical company research to be published OA and under non-restrictive CC licences could help incentivise authors of pharmaceutical company publications to choose OA publishing by giving them a wider range of target journals to choose from. The appetite among pharmaceutical company authors to publish their articles OA may be greater than the observed OA publication rates, given that the journals frequently targeted by pharmaceutical company research often do not allow industry-funded research to be published OA. Research funders could introduce OA mandates that oblige authors to publish OA and use certain licences.

Our dashboard allows ongoing monitoring, and any individual is free to use this tool in the future. Measurement and competition are strong drivers for change and, although we have

used pooled data here, it is possible to extract data for individual pharmaceutical companies and academic institutions. Combined with the ability to compare the OA publication rates by therapy area, the up-to-date tracking of OA publishing performance provided by the dashboard will help to identify and address concerns and bottlenecks that may hinder the ongoing adoption of OA publication practices. We welcome more research on this topic, and ever greater openness in the publication and dissemination of medical research.

Contributors

- Tomas Rees: conceptualisation, methodology, project administration, supervision, writing original outline, review and editing.
- Valérie Philippon: conceptualisation, review and editing.
- Andrew Liew: data curation, formal analysis, investigation, methodology, project administration, resources, validation, visualisation, review and editing.
- Slávka Bróniková: conceptualisation, review and editing.
- William T Gattrell: conceptualisation, review and editing.
- Jo Gordon: validation, writing original poster predating this manuscript, review and editing.
- Taija S Koskenkorva: conceptualisation, review and editing.
- Santosh Mysore: conceptualisation, review and editing.
- Joana Osório: conceptualisation, funding acquisition, review and editing.
- Tim J Koder: conceptualisation, funding acquisition, methodology, project administration, supervision, writing original first draft, review and editing.

Funding

This analysis and manuscript were supported by Open Pharma. Open Pharma is a multi-sponsor collaborative project at and facilitated by Oxford PharmaGenesis. At the time of this work (2023), Open Pharma received sponsorship funding from AstraZeneca Pharmaceuticals LP, Boehringer Ingelheim International GmbH, Bristol Myers Squibb, F. Hoffmann-La Roche AG, Galapagos NV, Gilead Sciences, Inc., GSK, Ipsen Biopharm Ltd, Janssen Scientific Affairs, LLC, a Johnson & Johnson Company, Novartis Pharma AG, Novo Nordisk A/S, Pfizer Inc., Takeda Development Center Americas, Inc., Taylor & Francis (part of Informa PLC) and UCB Biopharma SRL. The dashboard is supported by Oxford PharmaGenesis.

Competing interests

AL, JG and JO are employees of Oxford PharmaGenesis Ltd, Oxford, UK. TR is an employee of Oxford PharmaGenesis Ltd, Oxford, UK and Chair Elect of the Board of Trustees of the Internation Society of Medical Publication Professionals (ISMPP). VP is an employee and shareholder of UCB. SB is an employee and shareholder of Galapagos NV, Mechelen, Belgium. WTG is an employee and shareholder of Bristol Myers Squibb and was an employee of Ipsen at the outset of this study. TSK is an employee of Novartis AG and receives both stocks and stock options from Novartis AG. SM is an employee of GSK, Belgium and holds company stocks. TJK is an employee and shareholder of Oxford PharmaGenesis Ltd, Oxford, UK.

Acknowledgements

The authors are grateful to the following people for their support in this work: Hollie Rawlings, MSc, of Oxford PharmaGenesis, Oxford, UK, for providing technical assistance with the dashboard; Aaron Ballagh, BASc, of the Lens, Canberra, Australia, for providing technical support with the Lens API and dashboard; Caitlin Edgell, PhD (: https://orcid.org/0000-0003-0448-122X), of Oxford PharmaGenesis, Oxford, UK, for providing medical writing support, which has been co-funded by Oxford PharmaGenesis, Oxford, UK, and the Open Pharma Members and Supporters in accordance with Good Publication Practice 2022 (GPP 2022) guidelines (https://www.ismpp.org/gpp-2022); Velissaria Vanna, PhD, of Oxford PharmaGenesis, Oxford, UK, for providing editorial support, which has been co-funded by Oxford PharmaGenesis, Oxford, UK, and the Open Pharma Members and Supporters; Kim Johnson, MScPH, of Oxford PharmaGenesis, Oxford, UK, for providing project management; and the Members, Supporters, Advisers and Followers of Open Pharma.

Data availability statement

Data are provided as an online supplementary file to this manuscript under a CC BY licence.

Ethics board approval

This study did not require ethics board approval because it did not involve human participants.

REFERENCES

1. Statista. Total global spending on pharmaceutical research and development from 2014 to 2028 2022 [Available: https://www.statista.com/statistics/309466/global-r-and-d-expenditure-for-pharmaceuticals/ accessed 7 September 2023.
2. Smith R. Time for pharmaceutical companies to help improve the publishing of science: The BMJ Opinion; 2017 [Available: https://blogs.bmj.com/bmj/2017/01/31/richard-smith-time-for-pharmaceutical-companies-to-help-improve-the-publishing-of-science/ accessed 28 September 2023.
3. Edelman. 2022 Edelman Trust Barometer Special Report: Trust and Health 2022 [Available: https://www.edelman.com/trust/22/special-report-trust-in-health accessed 7 September 2023.
4. Yan E, Li K. Which domains do open-access journals do best in? A 5-year longitudinal study. *J Assoc Inf Sci Technol* 2018;69 doi: https://doi.org/10.1002/asi.24002
5. Davis PM, Lewenstein BV, Simon DH*, et al.* Open access publishing, article downloads, and citations: randomised controlled trial. *BMJ* 2008;337:a568. doi: 10.1136/bmj.a568 [published Online First: 2008/08/02]
6. Saravudecha C, Thungfai DN, Phasom C*, et al.* Hybrid Gold Open Access Citation Advantage in Clinical Medicine: Analysis of Hybrid Journals in the Web of Science. *Publications* 2023;11(2):1–9.
7. Schultz T. All the research that's fit to print: Open access and the news media *Quant Sci Stud* 2021;2(3):828–44. doi: https://doi.org/10.1162/qss_a_00139
8. Seo J-W. Changes in the absolute numbers and proportions of open access articles from 2000 to 2021 based on the Web of Science Core Collection: a bibliometric study. *Sci Ed* 2023;10(1):45–56. doi: https://doi.org/10.6087/kcse.296
9. Iyandemye J, Thomas MP. Low income countries have the highest percentages of open access publication: A systematic computational analysis of the biomedical literature. *PLoS One* 2019;14(7):e0220229. doi: 10.1371/journal.pone.0220229
10. Production and uptake of Open Access publications involving the private sector: the case of big pharma. International Conference on Science and Technology Indicators; 2018; Leiden, The Netherlands.
11. European Commission Open access & Data management [Available: https://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-dissemination_en.htm accessed 13 December 2023.
12. White House Office of Science and Technology Policy FACT SHEET: Biden-☐Harris Administration Announces New Actions to Advance Open and Equitable Research 2023 [Available: https://www.whitehouse.gov/ostp/news-updates/2023/01/11/fact-sheet-biden-harris-administration-announces-new-actions-to-advance-open-and-equitable-research/ accessed 7 September 2023.
13. cOAlition S PLAN S: Making full and immediate Open Access a reality: cOAlition S; [Available: https://www.coalition-s.org/ accessed 28 September 2023.
14. Huang CK, Neylon C, Hosking R*, et al.* Evaluating the impact of open access policies on research institutions. *Elife* 2020;9 doi: 10.7554/eLife.57067 [published Online First: 2020/09/15]
15. ROARMAP The Registry of Open Access Repositories Mandatory Archiving Policies [Available: https://roarmap.eprints.org/ accessed 28 September 2023.
16. Jisc. Sherpa Juliet [Available: https://www.sherpa.ac.uk/juliet/ accessed 2 January 2024.
17. Doctorow C. Why all pharmaceutical research should be made open access. *The Guardian* 2012.
18. DeTora LM, Toroser D, Sykes A*, et al.* Good Publication Practice (GPP) Guidelines for Company-Sponsored Biomedical Research: 2022 Update. *Ann Intern Med* 2022;175(9):1298–304. doi: 10.7326/M22-1460 [published Online First: 2022/08/30]
19. Ellison TS, Koder T, Schmidt L*, et al.* Open access policies of leading medical journals: a cross-sectional study. *BMJ Open* 2019;9(6):e028655. doi: 10.1136/bmjopen-2018-028655 [published Online First: 2019/06/23]

20. Takeda. Shire Continues to Uphold High Standards of Ethics and Transparency with Adoption of Open Access Policy for Publication of Shire-Supported Research 2018 [Available: https://www.takeda.com/newsroom/shire-news-releases/2018/xajhds/ accessed 7 September 2023.
21. Page S, Buck J, Gothard D*, et al.* Open sesame! Evaluation of an open access commitment on Ipsen-sponsored publications. European Meeting of International Society for Medical Publication Professionals. London, UK, 2020.
22. Galapagos. Galapagos commits to open access policy 2020 [Available: https://www.glpg.com/our-story/story-overview/590 accessed 7 September 2023.
23. GSK. Our position on Disclosure of Clinical Research 2023 [Available: https://www.gsk.com/media/10585/gsk-position-on-disclosure-of-clinical-research-sept-2023.pdf accessed 16 January 2024.
24. Skobe C, Meloro JR, Watson A. Green Open access for the manuscript: Achieving Equity and Transparency by Advancing Accessibility to Medical Research Through Open Access Publishing 2023 [Available: https://pfizer.figshare.com/articles/journal_contribution/Green_Open_access_for_the_manuscript_Achieving_Equity_and_Transparency_by_Advancing_Accessibility_to_Medical_Research_Through_Open_Access_Publishing/22130456 accessed 7 September 2023.
25. Open Pharma Driving positive change in the communication of pharma-sponsored research [Available: https://www.openpharma.blog/ accessed 28 September 2023.
26. How open are pharma publications? European Meeting of International Society for Medical Publication Professionals; 2020; London, UK.
27. How openly accessible is pharma-sponsored research? An informatics approach. European Meeting of International Society for Medical Publication Professionals; 2021.
28. Curtin Open Knowledge Initiative Open Access Dashboard [Available: https://open.coki.ac/ accessed 28 September 2023.
29. Wilson K, Montgomery L, Neylon C*, et al.* The Curtin Open Knowledge Initiative: Sharing data on scholarly research performance. *LIBER Q* 2022;32(1):1–22. doi: https://doi.org/10.53377/lq.11544
30. STM. OA Dashboard: Open Access Data and the Publishing Industry [Available: https://www.stm-assoc.org/oa-dashboard/ accessed 2 January 2024.
31. Statista. Leading 50 global pharmaceutical companies by prescription sales and R&D spending in 2022 2023 [Available: https://www.statista.com/statistics/273029/top-10-pharmaceutical-companies-sales-and-rundd-spending-in-2010/ accessed 7 September 2023.
32. Galapagos. Annual Report 2021 2021 [Available: https://reports.glpg.com/annual-report-2021/en/ accessed 7 September 2023.
33. Leiden University Centre for Science and Technology Studies CWTS Leiden Ranking 2022 2022 [Available: https://www.leidenranking.com/ranking/2022/list accessed 7 September 2023.
34. The Lens What is the Lens [Available: https://about.lens.org/ accessed 28 September 2023.
35. The Lens Aggregations [Available: https://docs.api.lens.org/aggregations.html accessed 3 January 2024.
36. Sen PK. Estimates of the Regression Coefficient Based on Kendall's Tau. *J Am Stat Assoc* 1968;63:1379–89
37. R Documentation Sen's slope [Available: https://search.r-project.org/CRAN/refmans/trend/html/sens.slope.html accessed 28 September 2023.
38. The Lens Open Access License Types [Available: https://support.lens.org/knowledge-base/open-access/#open-access-license-types accessed 28 September 2023.
39. Khoo SY-S, Lay BPP. A Very Long Embargo: Journal Choice Reveals Active Non-Compliance with Funder Open Access Policies by Australian and Canadian Neuroscientists. *LIBER Q* 2018;28(1):1–19. doi: https://doi.org/10.18352/lq.10252

40. Piwowar H, Priem J, Lariviere V*, et al.* The state of OA: a large-scale analysis of the prevalence and impact of Open Access articles. *PeerJ* 2018;6:e4375. doi: 10.7717/peerj.4375 [published Online First: 2018/02/20]
41. Robinson-Garcia N, Costas R, van Leeuwen TN. Open Access uptake by universities worldwide. *PeerJ* 2020;8:e9410. doi: 10.7717/peerj.9410 [published Online First: 2020/07/28]
42. The International Society for Medical Publication Professionals Open Access and Medical Publishing White Paper: A Multistakeholder Discussion on Open Access and Medical Publishing 2019 [Available: https://www.ismpp.org/open-access-white-paper accessed 2 October 2023.
43. DORA San Francisco Declaration on Research Assessment 2012 [Available: https://sfdora.org/read/ accessed 2 October 2023.
44. Budzinski O, Grebel T, Wolling J*, et al.* Drivers of article processing charges in open access. *Scientometrics* 2020;124:2185–206. doi: https://doi.org/10.1007/s11192-020-03578-3
45. Ellison T. Perspectives on open access from the 14th Annual Meeting of ISMPP: Open Pharma, 2018.
46. Wenaas L. Choices of immediate open access and the relationship to journal ranking and publish-and-read deals. *Front Res Metr Anal* 2022;7:943932. doi: 10.3389/frma.2022.943932 [published Online First: 2022/11/08]

FIGURES

Figure 1 Number of pharmaceutical company and academic institution publications included/excluded in (A) the primary analysis (publications 12–24 months old) and (B) the secondary analysis (publications ≤12 months old).

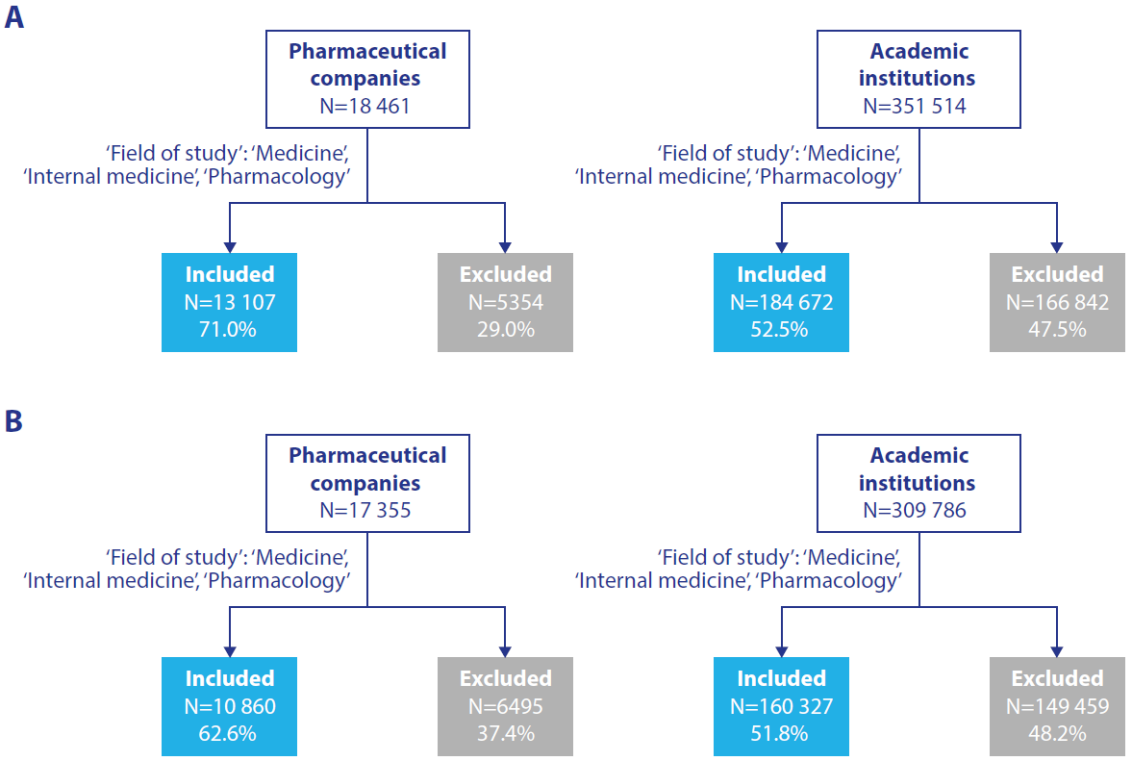
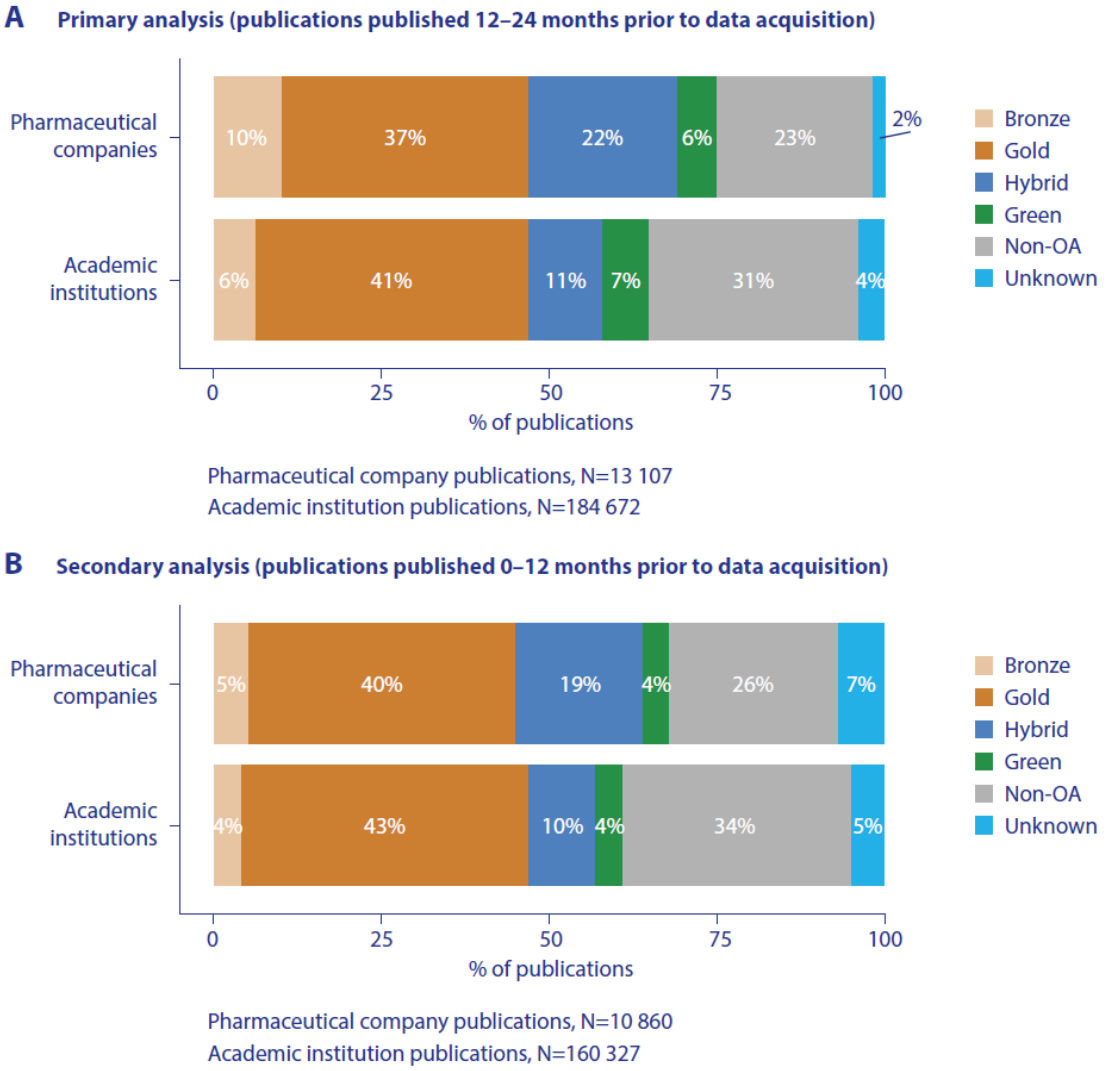
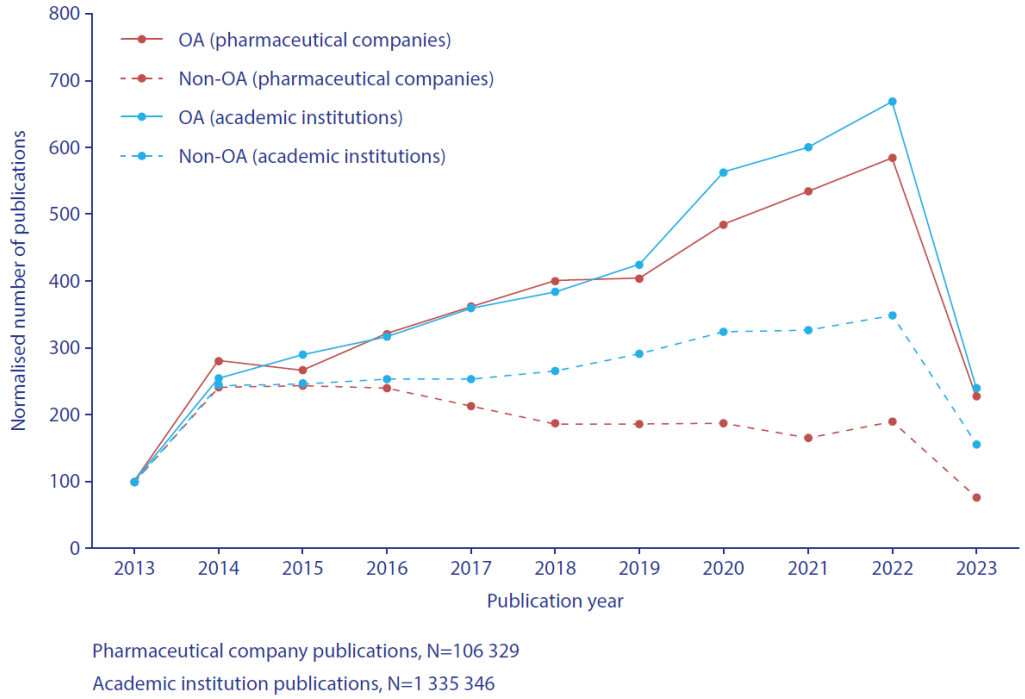


Figure 2 Proportions of pharmaceutical company and academic institution medical publications using different OA models in (A) the primary analysis (publications 12–24 months old) and (B) the secondary analysis (publications ≤12 months old). Percentages may not sum to 100 due to rounding.



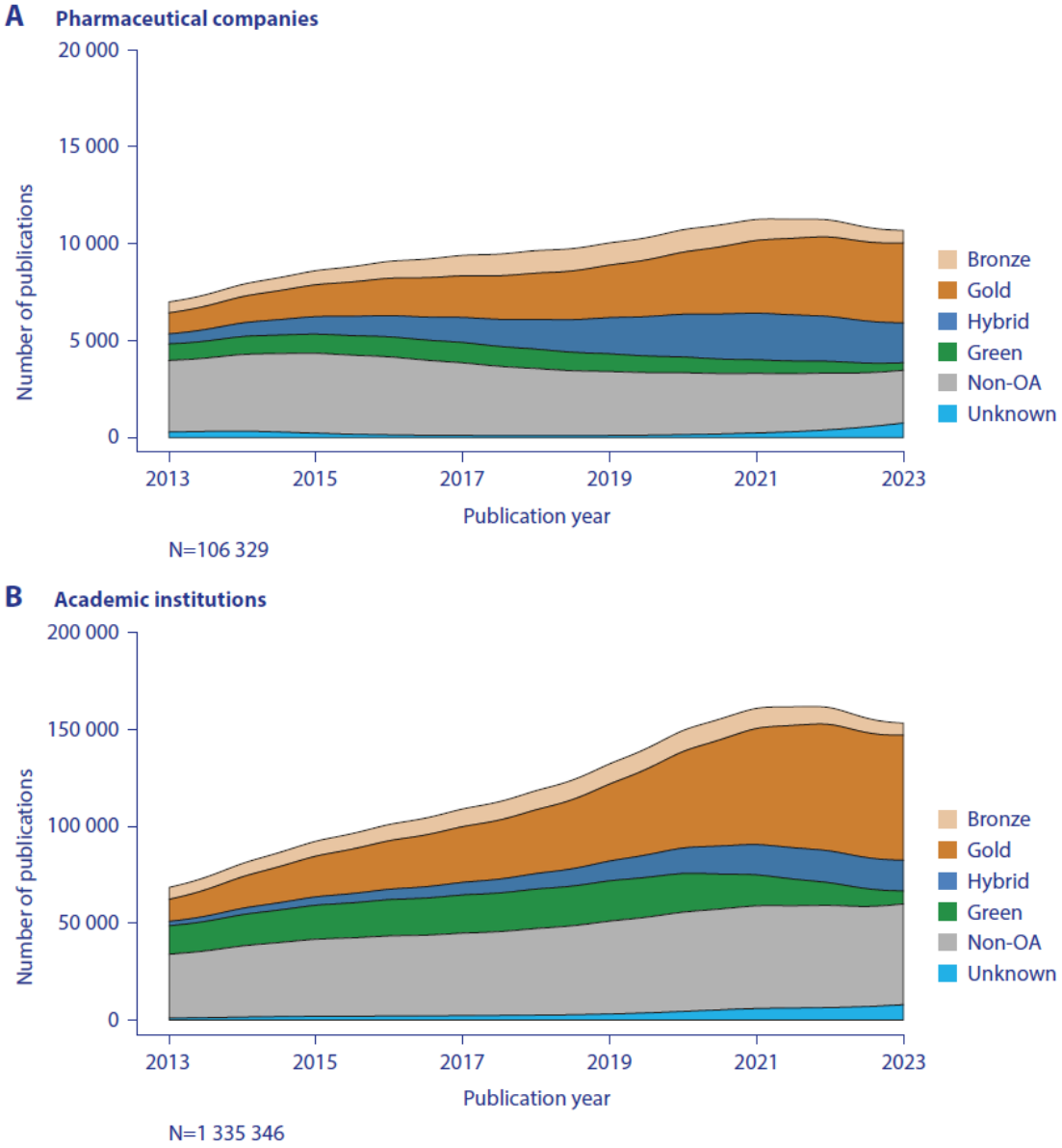
OA, open access.

Figure 3 Normalised number of OA/non-OA pharmaceutical company and academic institution medical publications over 10 years (2013–2023). Numbers of publications were normalised to the number of non-OA publications for pharmaceutical companies and academic institutions in 2013.



OA, open access.

Figure 4 Number of medical publications by OA model over 10 years (2013–2023) from (A) pharmaceutical companies and (B) academic institutions. Data were smoothed in R.



OA, open access.