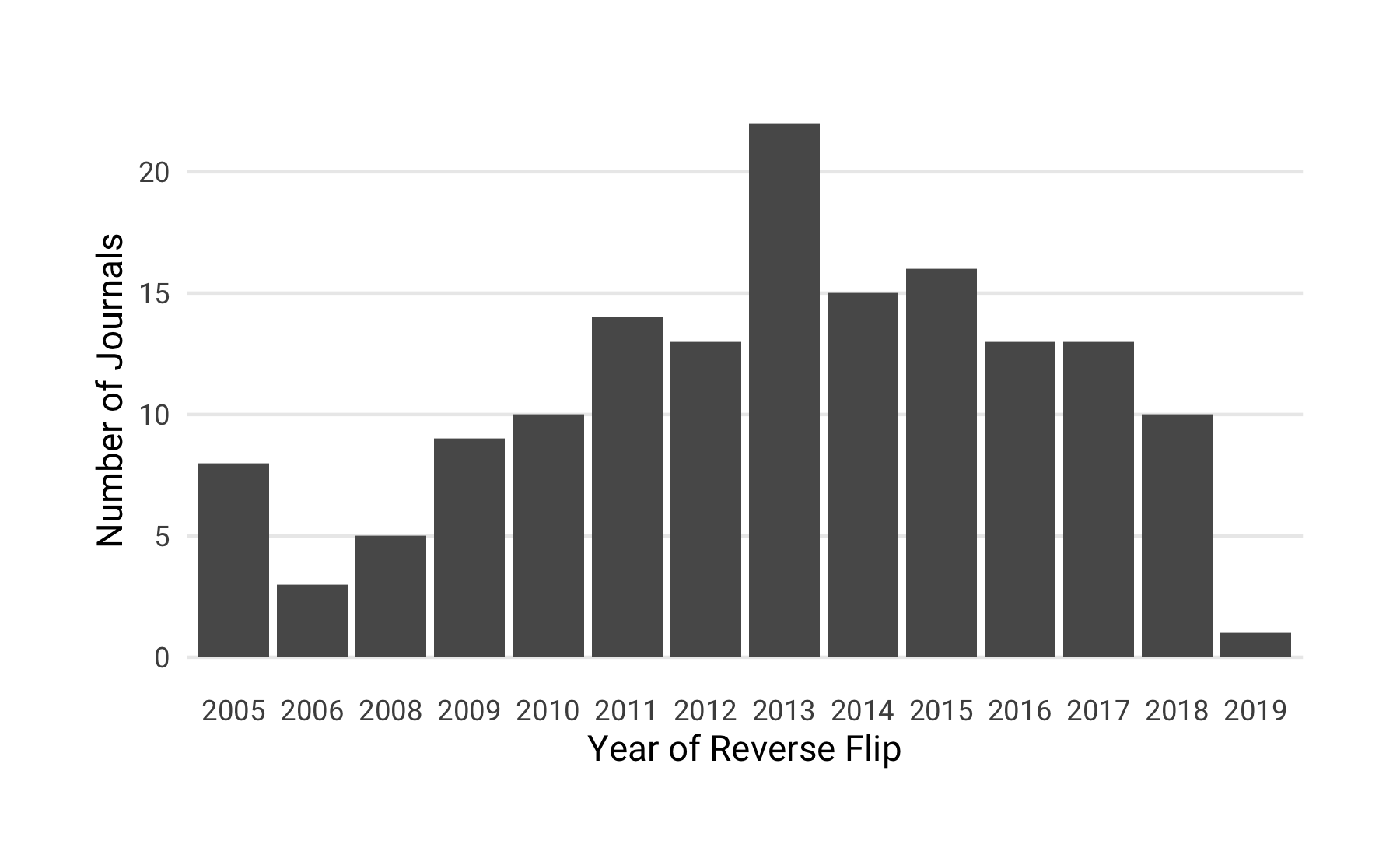
Results Reverse Flips

### Research Question 1: How many OA journals have reverse-flipped to a subscription model?

We identified 152 journals that converted from fully open access to a subscription model, including hybrid open access. While we discovered reverse-flips as early as 2005, the majority of journals 2005. While the earliest reverse flip happened in 2005, the majority of journals changed their business model from 2013 onward (see Figure 3).



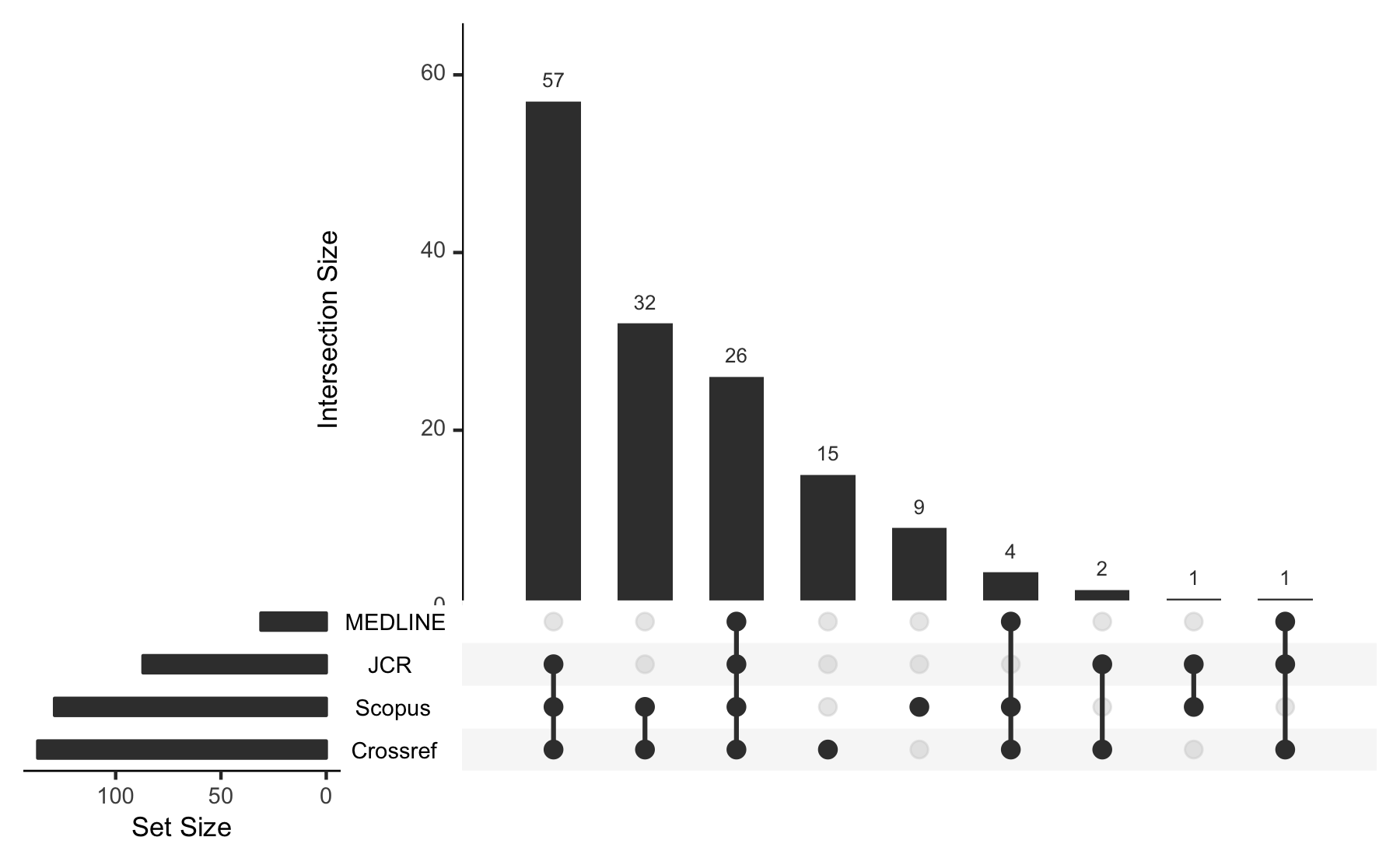
Number of journals converted from fully open access to a subscription-based business model per year.

### Research Question 2: To provide a general overview,

#### a) How thoroughly are these journals currently indexed in major bibliometric databases (Web of Science, Scopus, PubMed)?

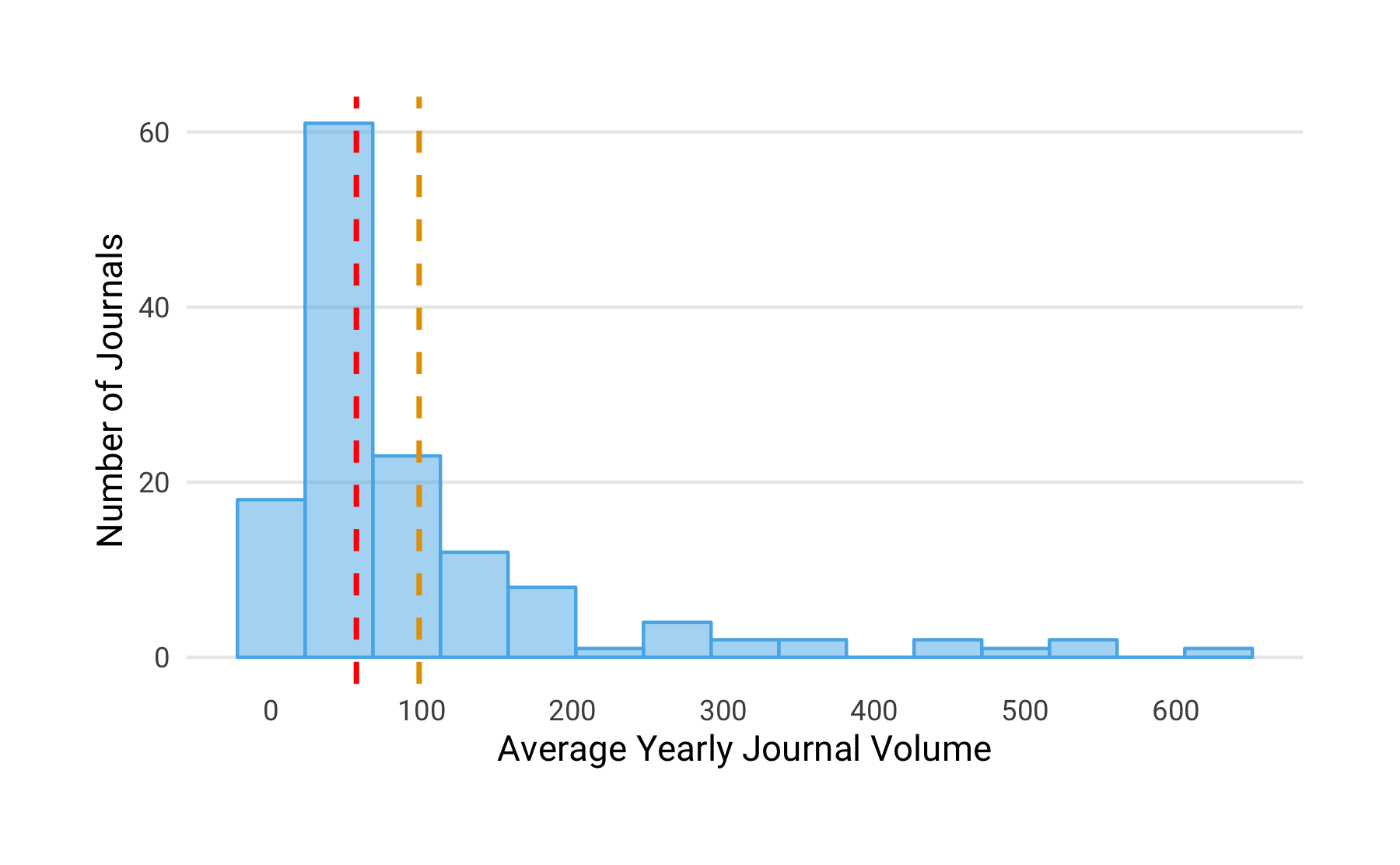
We investigated the coverage of reverse-flip journals in the following four major bibliographic databases: i) Crossref, a large DOI registration agency for scholarly works, ii) Scopus, iii) Journal Citation Report (JCR) listing journals indexed for the Web of Science, and iv) journals indexed in MEDLINE. This analysis is based at the journal-level by matching ISSN variants. We used the most current journal lists and search indexes from January 2019.

In total, we found 147 being indexed by at least one bibliometric databases examined, covering 97% of the journals in our study. Figure presents the number of reverse-flip journals that are indexed by each database and the intersection with other databases. Of the 147 indexed journals, Crossref and Scopus are the most frequent sources which cover reverse-flip journals. Together with the Web of Science (JCR) they share the largest number of journals (N = 83), of which 26 journals are also covered by MEDLINE.



#### b) How many articles did these journals publish between 2000 and 2018?

To obtain the journal publication volume, we retrieved the metadata for all articles indexed in Crossref from the year 2000 onwards. Specifically, Crossref provided the metadata for 137 out of 152 journals (90% of our sample). Our analysis shows that between 2000 and 2018, these journals published 190,951 articles, yet the yearly article volume varies considerably (see Figure 4), ranging from 10 to 638 with half of the journals publishing 56 or fewer articles per year (see Table 1).



Histogram of average journal size in terms of yearly article volume published. Red dashed line represents the median, yellow dashed lined the mean value of the distribution.

#### c) Which academic disciplines do the journals belong to?

Table presents a breakdown by top-level discipline, highlighting that reverse flipped journal are not limited to one field, but can be found across various disciplines.

Breakdown of reverse flip journals by discipline

|  |  |  |
| --- | --- | --- |
| Discipline | Number of Journals | Proportion (in%) |
| PSM | 52 | 34 |
| Health | 39 | 26 |
| SSH | 38 | 25 |
| LS | 23 | 15 |
| Total | 152 | 100 |

#### d) How many journals have been associated with scholarly societies or academic institutions?

Our dataset contains information about whether reverse-flipped journals were related to scholarly societes and academic institutions. We obtained 107 (70 %) reverse-flip journals that were either published together with a scholarly society (N = 59) or at an academic institution (N = 48).

#### e) Under which publisher did the reverse-flip occur? Who does currently publish the journals?

To investigate the extent of reverse flips across different publishers, we acquired the publisher names for every journal at the time of the reverse flip and for the most current publisher. Table x shows the post-flip and current top publishers based on the number of journals that were converted from fully OA to subscription access. These six publishers - Elsevier, Springer Nature, Taylor & Francis, De Gruyter, Brill and Wiley - comprised 105 journals at the time of the reverse-flip. 104 reverse-flip journals did belong to the most current journal portfolio investigated. In both cases, these journals represent around 70% of all reverse-flips found. The remaining publishers are categorized as “Other.” The distribution of reverse flips across publishers resembles the general conditions of the scholarly publishing market at-large, which is also dominated by large commercial publishers like Elsevier, Springer Nature, Taylor and Francis, and Wiley.

They represent around 70% of all journals in our sample.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Publisher | OA Journals converted to Toll-Access | Proportion | Current number of reversely-flipped journals | Proportion |
| Springer Nature | 45 | 29.6 | 41 | 27.0 |
| Elsevier | 35 | 23.0 | 34 | 22.4 |
| Taylor & Francis | 12 | 7.9 | 14 | 9.2 |
| De Gruyter | 5 | 3.3 | 7 | 4.6 |
| Brill | 4 | 2.6 | 4 | 2.6 |
| Wiley | 4 | 2.6 | 4 | 2.6 |
| Other | 47 | 30.9 | 48 | 31.6 |
| Total | 152 | 100.0 | 152 | 100.0 |

#### f) How old were the journals at the time of the reverse flip?

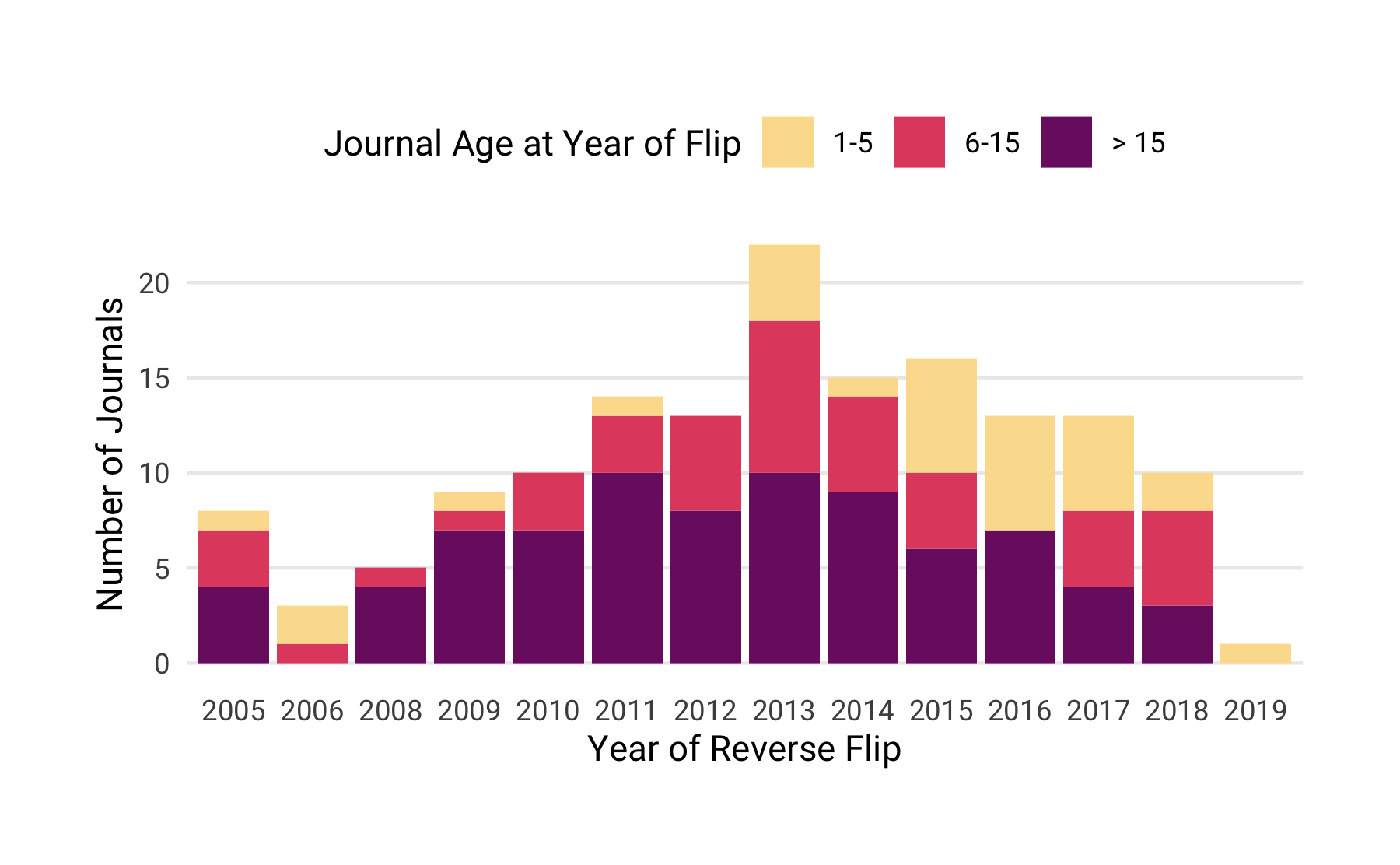
### Research Question 4: How old were the journals when the reverse flips happened?

Table provides summary statistics about the journal age at the year of the reverse flip. Large age differences can be observed, ranging from one year of existences to 124 years. Around 43% (N = 66) of all journals found started before 1990. These findings suggest that not all journals in our sample were born fully open access or online journals, but some might underwent more than one business model change in the course of history.

Summary statistics for journal age at time of reverse flip

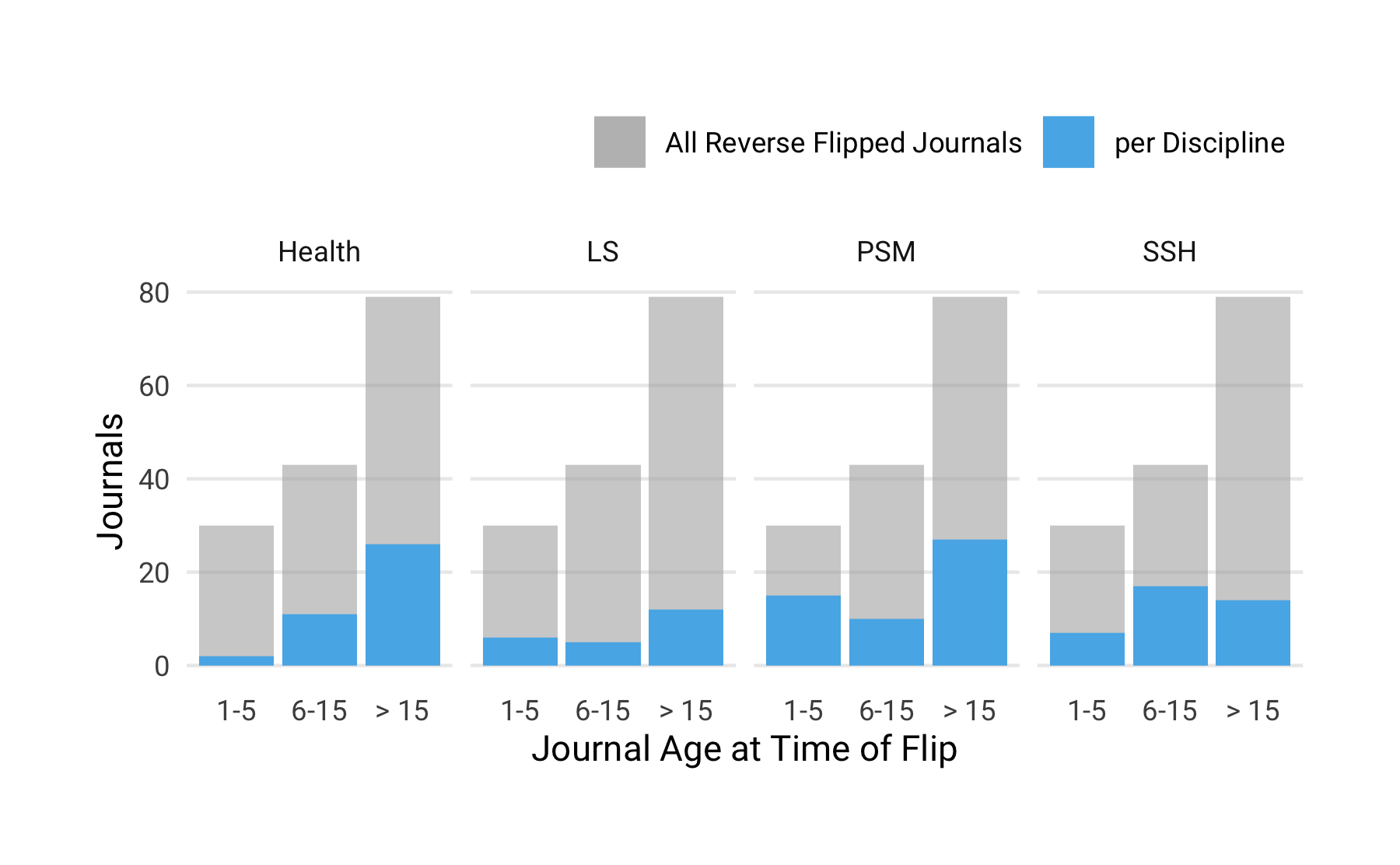
|  |  |
| --- | --- |
|  | Journal Age in Years |
| Mean | 25 |
| Median | 16 |
| Standard Deviation | 22 |
| Minimum | 1 |
| Maximum | 124 |
| Q1 | 7 |
| Q3 | 39 |

Figure presents the number of journals converted from fully open access to a subscription-based business model per year grouped by journal age when the reverse flip happened.



Number of journals converted from fully open access to a subscription-based business model per year, grouped by journal age at time of reverse flip.

Figure presents a breakdown of discipline by journal age at the time of the reverse flip, shown as proportion of the total number of reverse flip journals in the dataset. The colored areas represent the distribution of journals per discipline.



Discipline by journal age at the time of reverse flip, shown as proportion of the total number of reverse flip journals in the dataset. The colored areas represent the distribution of journals per Discipline.

It seems that for health and life sciences journals (Health) the majority of flips only happened after a period of establishing the journal (>15 years). However, for the physical sciences and mathematics (PSM) as well as the social sciences and humanities (SSH) this process of reconsidering the publishing model seems to have started earlier. For PSM journals about one third already flipped within the first five years of the journal’s lifetime.

### Research Question 5: What publishers are now publishing the reverse-flipped journals?

To investigate the extent of reverse flips across publishers, publisher names for every journal were obtained using Crossref, and if not available, added manually. In case of a change of publishing house, which is the case for over 74% (N = 112) journals in our sample, the current publisher name was used. In total, 43 different publishing houses with reversely flipped journals are included in our dataset.

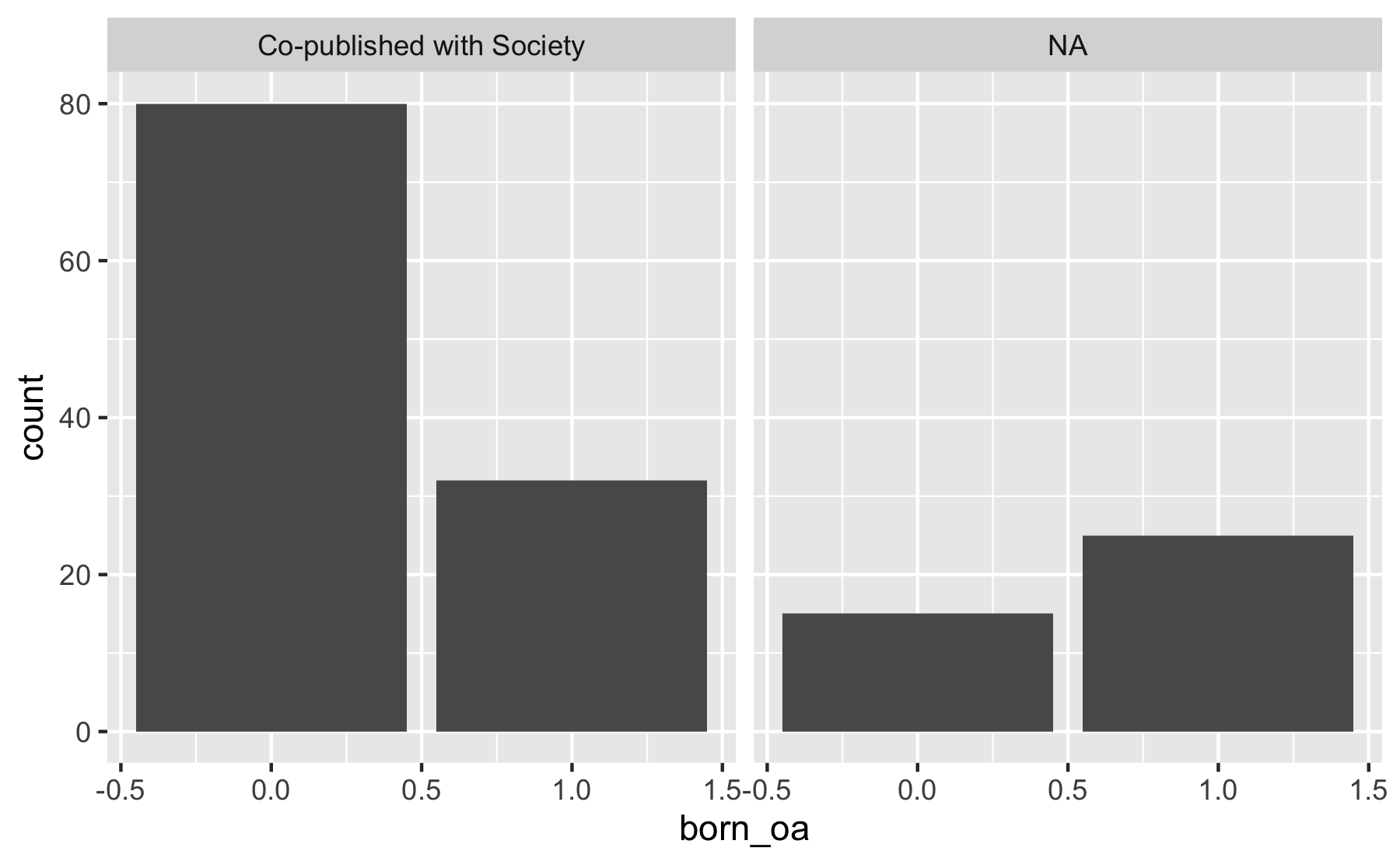
Table shows the top 5 publishers based on the number of journals in their subscription-based portfolio that were converted from fully open access. These five publishers comprise a total 104 journals, representing 68% of all journals found. The remaining 37 publishers are represented in the category “Other”. The extent of reverse flips across publishers reflects roughly the general market shares in scholarly publishing where the large commercial publishers Elsevier BV, Springer Nature, Informa UK Limited and Wiley also dominate.

Top 5 publishers based on number of journals converted from from fully open access to a subscription-based business model

|  |  |  |
| --- | --- | --- |
| Publisher | Number of reverse-flipped journals | Proportion (in%) |
| Springer Nature | 41 | 27.0 |
| Elsevier BV | 34 | 22.4 |
| Informa UK Limited | 14 | 9.2 |
| Walter de Gruyter GmbH | 7 | 4.6 |
| Brill | 4 | 2.6 |
| Wiley | 4 | 2.6 |
| Other | 48 | 31.6 |
| Total | 152 | 100.0 |

### Research Question 6: How many of these journals a) had been subscription journals in the past, b) had been APC-based prior to the reverse-flip, and at what price levels, c) are associated with scholarly societies?

We manually checked the past business models of every journal in our sample. As the journal age suggests, not all were born digital and underwent several business changes. In total, around 62% had been subscription-based in the past.

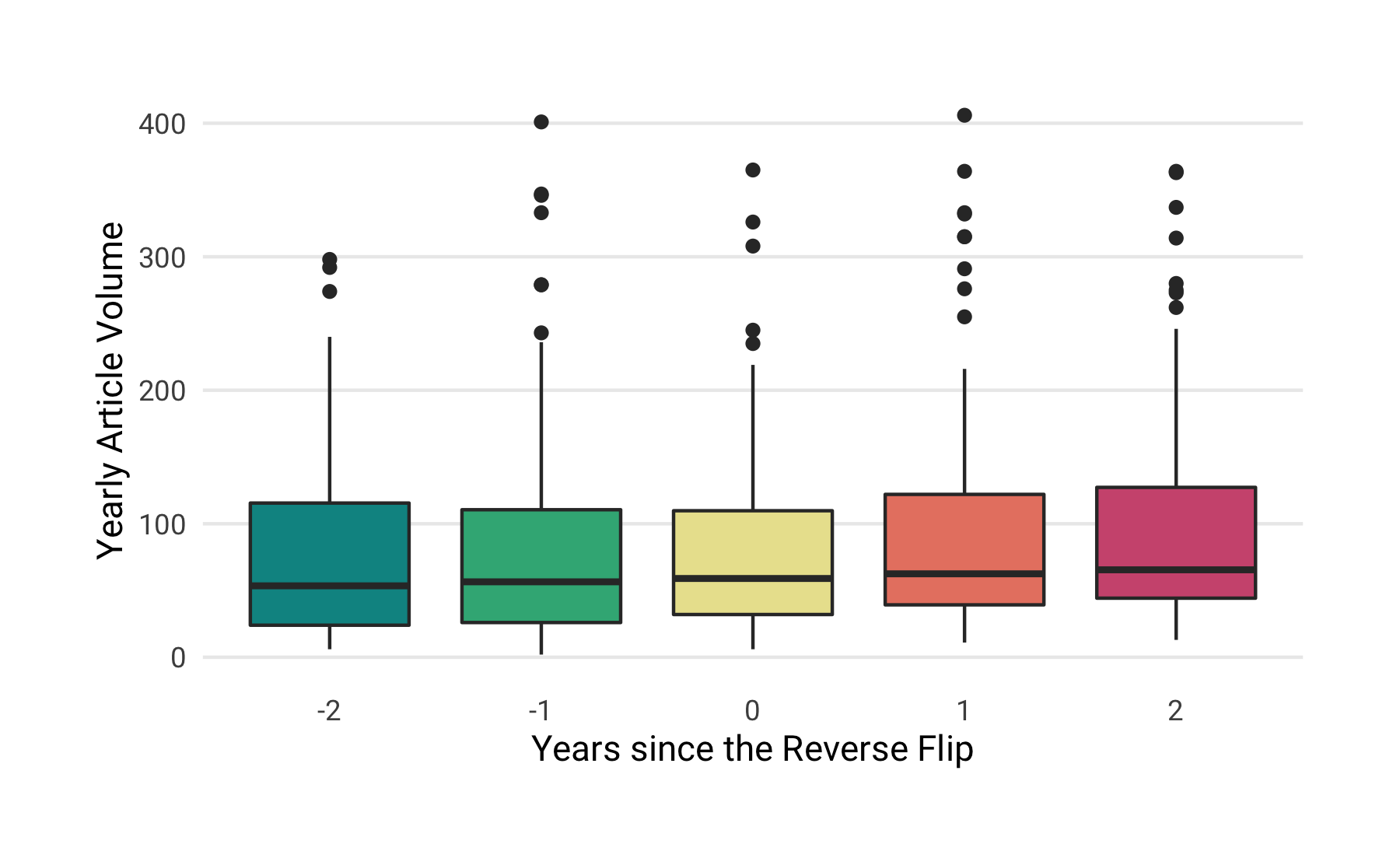


(unsure about how to answer this question using our dataset, help is very much appreciated!)

### Research Question 7: Is there significant variation in a) publication volume before and after the reverse flip and b) journal-level citation metrics before and after the reverse flip?

To determine the variation in publication volume, we studied all journals that had converted until 2016 and for which Crossref provides article metadata two years before and after the reverse flip. We were able to obtain the publication volume of 94 journals for this five-year period.

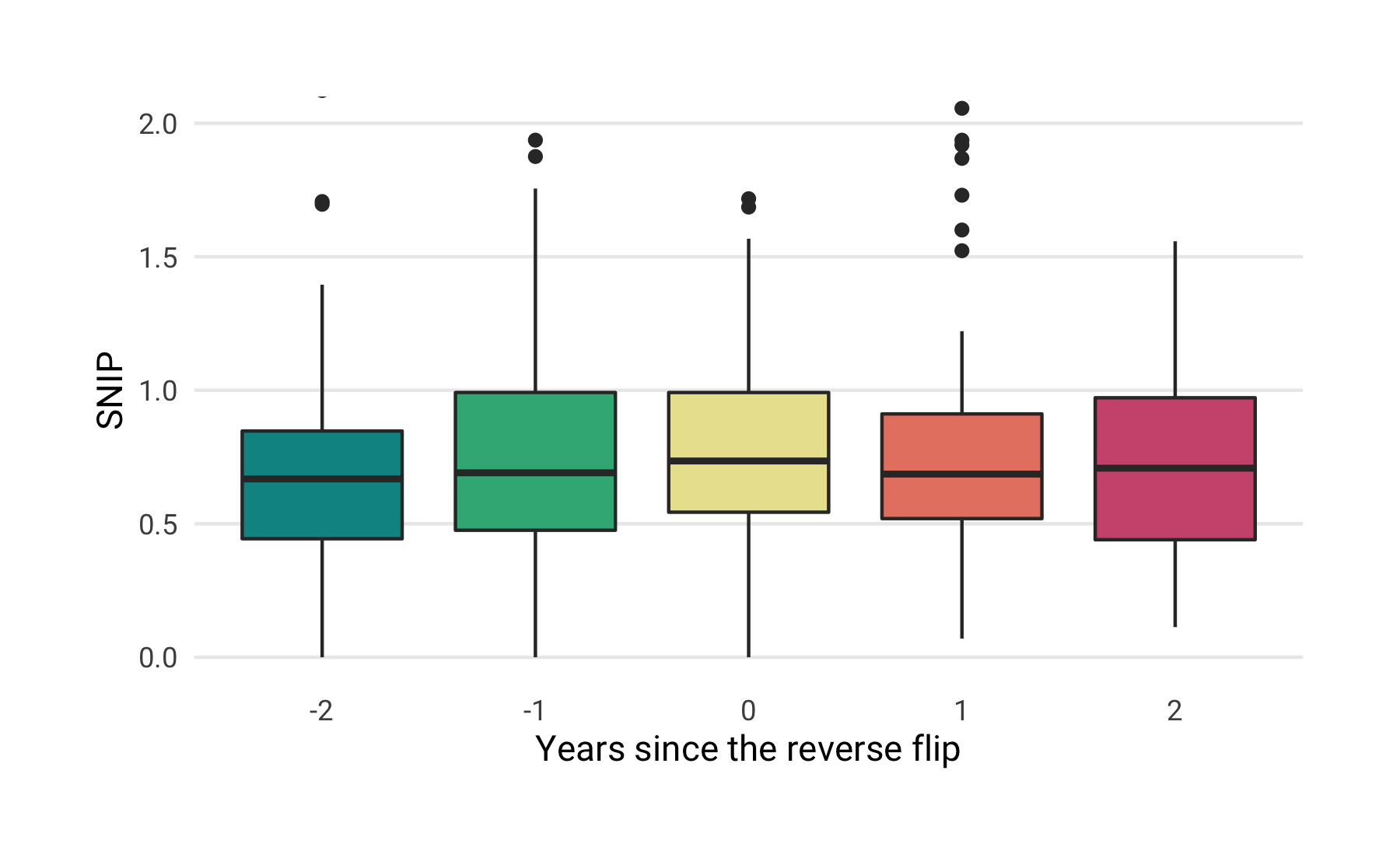
Comparing the yearly article volumes over the period from two years before to two years after the flip reveals little change. The median article volume increased marginally from 53 to 62 articles. Figure illustrates the distribution before and after the flip.



Density plot of publication volume two years before and after the reverse flip. Dotted line represents the median annual article volume.

There are, however, some cases were article volume increased noticeably. One example is the journal *Meta Gene* launched by Elsevier BV in 2013. Its article volume grew from 86 articles published in the year of the reverse flip (2016) to 201 articles published two years after (2018).

To investigate whether the citation impact changed after the journal converted to a toll-access business model, we used the Source Normalized Impact per Paper (SNIP) indicator from the Centre for Science and Technology Studies (CWTS) at Leiden University, matching 117 journals from our sample. Figure illustrates the SNIP distribution of reverse-flip journals two years before and after the conversion. The most recent SNIP values were reported for 2017; accordingly, we only included journals that flipped until 2015 (N = 82). Our analysis suggests that there is no statistical difference in SNIP values before and after the business model change.



Development of source normalized impact per paper (SNIP) value between two years before and after the reverse flip. Coordinate system limited to SNIP value 2.5

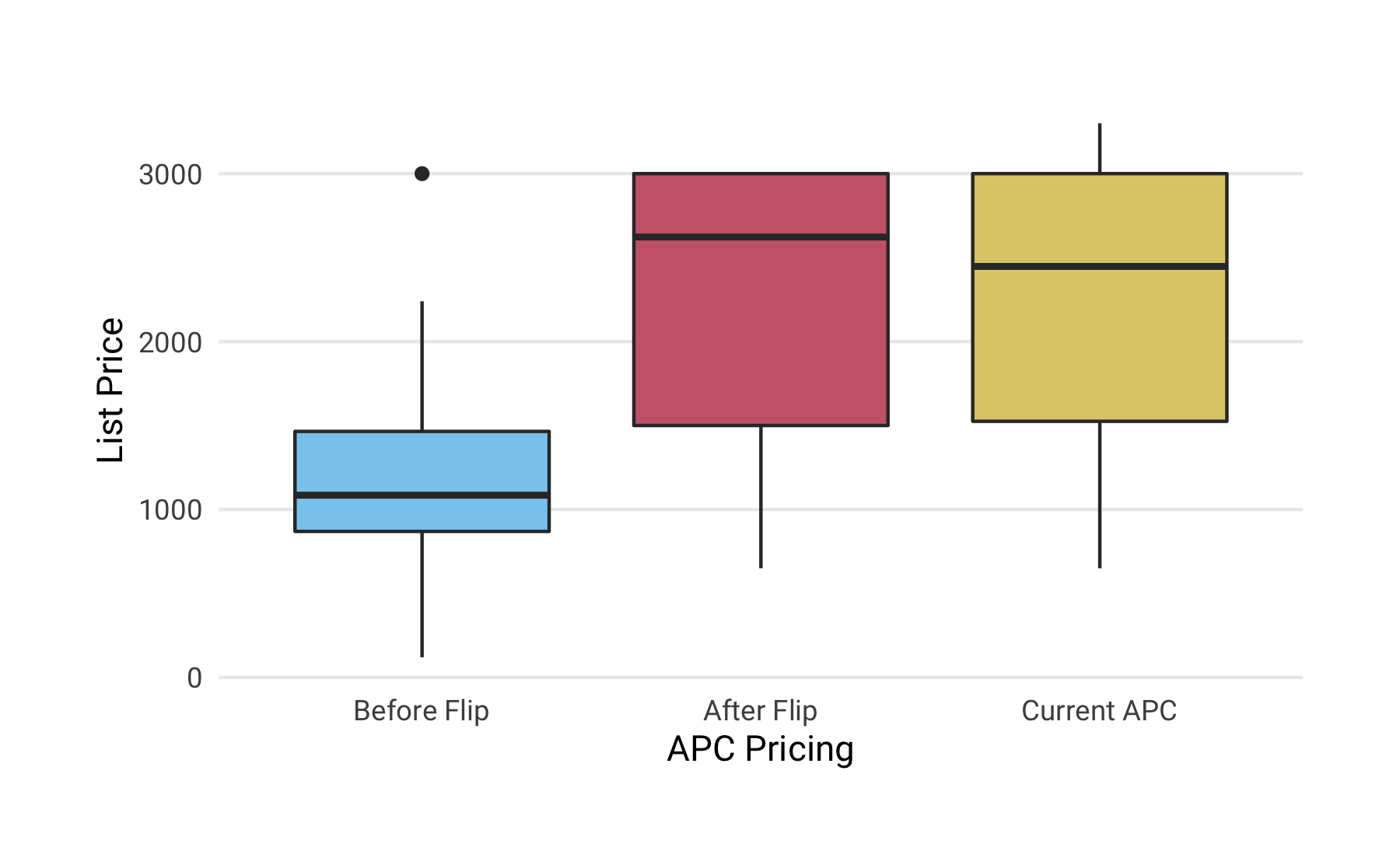
### Research Question 8: For the subset of journals that now offer hybrid OA, a) what is the difference in the APC before and after the flip among the journals, b) what is the uptake of hybrid OA in these journals, is it above average among hybrid OA journals?

Table presents the journal business model after the reverse flip. Our analysis shows that around 50 % (N = 76) of the journals offer options to make articles immediately available after a fee was paid, also known as hybrid open access. 76 or 50 % (N = 76) journals operated under a subscription-based model only.

Business model of journals after reverse flip

|  |  |  |
| --- | --- | --- |
| Business model | Journals | Proportion |
| Hybrid | 76 | 50 |
| Subscription | 76 | 50 |
| Total | 152 | 100 |

We were able to obtain publication fee list prices before and after the flip including the most recent level in 2018 for 30 journals. Figure compares them with each other, highlighting an considerable increase after the reverse flip.



APC list prices before and after the flip including most current level among reverse-flip journals.

Retrieving open content licenses including start date from Crossref, we were able to obtain 416 articles from 21 that were made available immediately as open access articles in the year or after the reverse flip. They represent 5.4% of the total article volume studied.

Using data from the Open APC initiative, we finally checked whether institutions have financed hybrid open access articles in reverse-flipped journals. We found evidence for institutional sponsorship for three individual articles in reverse-flip journals, and as part of a transformative agreement “Springer Compact” offered by Springer Nature to individual institutions and countries. Table summaries the total number of articles in reverse-flip journal that were made openly available under “Springer Compact” agreements, as well as its proportion per transformation contract. Although the proportion these articles is marginally, findings suggest that mechanisms were missing that would have helped institutions to prevent funding of open access publication in reverse-flipped journals.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| hybrid\_type | publisher.x | Sponsor | OA Articles in Reverse Flip Journals | All OA Articles | Proportion (in%) |
| Open APC (Offsetting) | Springer Nature | United Kingdom | 20 | 10289 | 0.19 |
| Open APC (Offsetting) | Springer Nature | Sweden | 10 | 3285 | 0.30 |
| Open APC (Offsetting) | Springer Nature | Austria | 5 | 1721 | 0.29 |
| Open APC (Offsetting) | Springer Nature | Germany | 3 | 621 | 0.48 |
| Open APC (Offsetting) | Springer Nature | Netherlands | 2 | 6085 | 0.03 |

#> # A tibble: 21 x 4  
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#> 1 3 Biotech 895 60 6.7   
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#> 3 Annals of Nuclear Medicine 273 53 19.4   
#> 4 Applied Nanoscience 292 11 3.77  
#> 5 Arabian Journal for Science and Engineering 2124 12 0.56  
#> 6 Brazilian Journal of Physics 85 1 1.18  
#> 7 Cancer Treatment Communications 34 1 2.94  
#> 8 Computational and Applied Mathematics 462 11 2.38  
#> 9 Gold Bulletin 41 2 4.88  
#> 10 Integrating Materials and Manufacturing Innovati… 41 4 9.76  
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