Scopus Indexing Delays of Articles Published in Major Pharmacy Practice Journals

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Abstract
Background: Authors of bibliometric studies often wait for an arbitrarily prolonged period to allow for complete indexing of documents in the Scopus database after the end of the period to be studied (period-of-interest), thus negatively affecting recency (interval between publication date the date of the latest data reported) in bibliometric studies. *Objective*: The goal of this study is to determine the indexing delays in Scopus following online publication, to provide evidence-based recommendations for when data collection in Scopus should start after the end of the period-of-interest. *Methods***:** Scopus indexing dates were prospectively collected for documents published in 2022 in 7 major pharmacy practice journals (aim 1). A time-to-event analysis was done on all documents published online from August to October 2022 (aim 2). Indexing delays and Kaplan-Meier curves of indexing delays were also compared between Scopus and PubMed using Wilcoxon signed-rank and Log-Rank tests, respectively. *Results***:** All 7 journals (843 documents) and 4 journals (212 documents) were included in aims 1 and 2, respectively. Indexing delay was significantly longer in Scopus versus PubMed (median = 36 vs. 3 days). The Kaplan-Meier curves were also significantly different; with median survival time of indexing in Scopus and PubMed being 4 and 2 weeks, respectively. Notably, 91% of the subset studied have been indexed in Scopus (versus 97% in PubMed) by 10 weeks after online publication. *Conclusion***:** Scopus indexing delays do not support the arbitrarily prolonged wait for bibliometric data to accumulate. A 10-week wait time provides a reasonable balance between the recency and completeness of published data. This evidence-based recommendation would improve recency without sacrificing data completeness in bibliometric studies.

Keywords: Bibliometric, Scopus, Indexing delay, Pharmacy practice, PubMed

BACKGROUND

Publishing peer-reviewed articles is a complex multi-step process with delays at each step. The delays (lags) that have been studied, especially in PubMed include acceptance lag (submission to acceptance), lead lag (acceptance to online publication), total lag (submission to online publication)[1–3], indexing or entry lag (online publication to bibliographic database indexing/entry date) and Medical Subject Heading (MeSH) indexing lag (bibliographic database indexing/entry to MeSH allocation date)[4,5]. These delays are grouped into editorial (submission-to-acceptance) and technical (acceptance-to-publication) delays[6,7]. Thus, indexing delay represents the temporal barrier between the online availability of an article and when the article/document becomes available in the bibliographic database to be included in bibliometric studies.

Because of the retrospective nature of bibliometric studies[8], the recency of data published in bibliometric studies is important. Consequently, failure to report search/data collection dates, or including incomplete years are considered as methodological flaws[9], and a preliminary guideline for bibliometric studies require reporting of the search date[10]. Recency is closely related to the search date, and it is the time between the most recent document in the corpus of the studied period (period-of-interest) and the publication of the study (shorter is better)[11]. Because authors have no control over the submission-to-publication delays in bibliometric studies, and because new data accumulates during the intervening period, aiming for the shortest possible hiatus between the end of the period-of-interest and the beginning of data collection is a strategy that can improve the recency of data published in bibliometric studies. This hiatus varies from weeks to years in current bibliometric literature. When the hiatus is short, recency is better, but this may be at the expense of the completeness of the data for the study period, since the indexing delay (of included documents) is unknown. On the other hand, when authors allow for a longer hiatus to ensure complete accumulation of the data for the period-of-interest, recency suffers. For example, a bibliometric study reported data on articles published from 2009 to 2018 and started data collection in January 2020[12]. This means that in the process of ensuring that a complete set of data was published, the data included was already at least 1 year old at the start of data collection and new, accumulated data for 2019 was not included in the study. With the same data-collection date, a hiatus-reduction strategy would instead study the period 2010 to 2019, but with the assumption that 1 month (January) is long enough to index the last 2019 publications (in December).

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Thus, the key limiting factor for implementing an effective hiatus-reduction strategy is the uncertainty surrounding the indexing delay. The indexing delay determines how long authors must wait to allow for the complete accumulation of the bibliometric data for the planned study period (period-of-interest) in bibliographic databases without jeopardizing

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recency. Studies analyzing articles in journals from various disciplines, including pharmacy practice, have reported indexing delays in PubMed and Web of Science (WoS)[2,7], but WoS and Scopus are the 2 major bibliographic databases used in bibliometric studies[13,14]. While PubMed focuses principally on life science and biomedical disciplines, Scopus and WoS are multidisciplinary. However, despite significant overlaps[15], Scopus has a wider journal coverage in general, with 40,385 indexed journals versus 13,610 in WoS as of June 2020[16]. Furthermore, for the broader field of biomedical research, like medicine, nursing, pharmacy, and health professions, Scopus provides better coverage and is therefore the preferred database for bibliometric studies[13,17]. However, to the best of my knowledge, no study has reported indexing delays in Scopus. This knowledge gap is not surprising because, unlike in PubMed, indexing dates are currently not available in the metadata obtainable in Scopus. Thus, the significance of this study is the novelty of the prospective data collection method and the never-before report of indexing delay in Scopus. The purpose of this study is to provide evidence-based recommendations for the optimal waiting period between the end of the studied period and the beginning of data collection in bibliometric studies using Scopus. The aims of this study are to determine (1) the Scopus indexing delays in days and (2) the proportion of articles indexed every week up to 10 weeks after online publications of articles using a time-to-event analysis. Using the same corpus, the indexing delays in Scopus and PubMed were also compared at the document level.

METHOD

Aim 1: On January 28, 2022, a search of 2022 publications in 7 previously studied major pharmacy practice journals was done in Scopus. These journals were selected based on publication destinations of pharmacy practice faculty, including education-related research that they often conduct[18–22]. The dates that each document appeared in the Scopus database (indexing date) were prospectively collected by setting up a Scopus search with daily alerts of new articles that meet the search criteria (Supplementary material S1). The alerts were monitored till January 31, 2023.

To obtain the date of electronic publication (available online), on August 11, 2023, PubMed was queried (Supplementary material S1). The needed information was extracted from the PubMed text format using a custom Python (version 3.10.11) function (available in this repository: https://github.com/SAdeosun/Scopus_Delays). The fields extracted included PubMed ID (PMID), title (TI), journal (TA), date of publication (DP), date of entry/addition into PubMed (Entrez Date; EDAT), and when available, the date of online/electronic publication (DEP) was also extracted. Exclusion criteria are as shown in Figure 1. Missing DEP information in some of the journals was expected as reporting rate of online publication dates in PubMed metadata of articles published in pharmacy practice journals was 36.1%[2]. Therefore, for journals for which most of the documents were missing DEP dates, or for which the DEP dates were *after* the EDAT dates (negative indexing delays), the journals' websites were searched for the "published" (*American Journal of Health Systems Pharmacy*; AJHP) or "first published" dates (*Pharmacotherapy*; PCOT), respectively. These dates were used as the DEP (online/electronic publication) dates for documents from these journals.

The alert list included document title, authors, year, and source (journal). All data wrangling was done in Python. For article titles in the alert list that could not be successfully matched with the titles in the PubMed corpus using the *pandas* (version 2.0.3) merge method, the *fuzzywuzzy* library (version 0.18.0) was used, followed by 2 independent, manual checks to ensure correct matches. Scopus indexing delay was the number of days between the DEP and the alert dates, and PubMed indexing delay was the number of days between DEP and EDAT[2]. To further verify the quality of the data received from the alerts, alert dates were cross-referenced with the dates (week) that the documents appeared in the manual weekly downloads (see Aim 2 below).

Statistical analysis

The summary of the overall Scopus and PubMed indexing delays for each article, and within individual journals were done with *Rstatix* library (version 0.7.2), with R (version 4.3.1) using paired Wilcoxon signed-rank tests. The indexing delays were summarized as medians. For the multiple (pairwise) comparisons, the *p*-values were adjusted using the Benjamini-Hochberg method. The Wilcoxon effect size was also calculated for each of the comparisons. The threshold for statistical significance was set at $p < 0.05$.

Aim 2: With an audit of the Scopus search alert in July 2022, it was discovered that alerts were not received for *all* newly added articles. Therefore, for the time-to-event analysis, Scopus indexing was tracked by manual, weekly downloads of all articles that met the search criteria. These were done on Saturdays from August 6, 2022, through January 7, 2023. The subset of documents included and analyzed were from the previously described corpus from the PubMed search string above with DEP dates August-October 2022. Journals with no, or low sample of documents (relative to other journals) in the subset were excluded from this analysis (Figure 1). This subset was also chosen to be able to track all included documents for up to 10 weeks without going too far beyond the end of 2022. Thus, the last manual weekly download was on January 7, 2023. To determine when documents were indexed in Scopus, a custom *Python* code was used to extract newly added documents by comparing the latest download with that of the previous week. The Scopus indexing delay was the number of weeks from the DEP week to the week that the document first appeared in the weekly Scopus downloads (i.e., week indexed). The PubMed indexing delay was the difference in the week

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number of the DEP and EDAT in the PubMed corpus. Documents were censored if the indexing delay was greater than 10 weeks, or if they were not found in the weekly Scopus downloads.

Statistical analysis
The time-to-event survival analysis was done in R using the *survival* and *survminer* libraries. The overall, and individual journals' Kaplan-Meier curves were plotted with *survminer*::*ggsurvplot*. Pairwise comparisons of the curves were done with Log-Rank test, which tests the null hypothesis that there are no differences in the probability of indexing of an article in Scopus versus PubMed at any time point[23]. This was done using the *survminer*::*pairwise_survdiff* function. For the pairwise comparisons, *p*-values were adjusted with the Benjamini-Hochberg method, and $p<0.05$ was considered statistically significant.

RESULTS
The inclusion and exclusion criteria for each of the study aims are shown in Figure. 1. The alerts were monitored for 368 days (January 28, 2022, to January 31, 2023). The first alert was received on January 29, 2022, and the last was received on January 8, 2023. There were 151 alert days, constituting 41% of the 368 days of monitoring. A total of 944 documents were in the alerts received during the 151 alert days, with an average of 6.3±5.9 documents received per alert day. The number of documents per alert day ranged from 1 to 20, with a median of 4 documents. The final manual weekly Scopus download (on January 7, 2023) closest to the last alert day (on January 8, 2023) had 1,756 documents. Thus, the 944 alerts received based on the same Scopus search string constituted a 53.8% sample of the 1,756 documents that have been indexed.

The corpus from the PubMed search returned 1,921 documents, 1,505 (78.3%) of which had DEP dates. DEP dates were available in 96.9–100% of documents published in the journals except for AJHP, which had DEP dates for only 10 (2.4%) of the 411 in the corpus. After the exclusions (Figure 1), DEP and EDAT were found for 843 of the 944 documents received in the alerts (89.3%). This 843 also constituted 43.9% of the possible 1,921 documents from the PubMed search.

Overall, indexing delay was longer in Scopus than in PubMed (Table 1; $p<0.0001$), and there was no correlation between Scopus and PubMed indexing delays (r = -0.05 (95% CI = -0.12–0.02), $p=0.134$). The Scopus indexing delays were significantly longer than PubMed indexing delays in 6 of the 7 journals ($p<0.0001$; CPTL being the exception). The effect size in all cases was large (r>0.5).

The time-to-event analysis overall and when subset by the 4 included journals is as shown in Figure 2A and B, respectively. The number by DEP months were 80 (37.7%), 77 (36.3%), and 55 (25.9%) for August, September, and October respectively. Fourteen (6.6%) documents were not found in Scopus. The median survival time (weeks since online publication when 50% of the samples have *not* been indexed) overall was 2 weeks earlier in PubMed versus Scopus (2 versus 4 weeks). There were significant differences between the Kaplan-Meier survival curves for Scopus and PubMed, overall (Figure 2A, $p<0.0001$) and for the subset to individual journals (Figure 2B i-iv; $p<0.0001$, except for CPTL where $p=0.0464$). Also, all pairwise comparisons of Scopus indexing delay curves for all journals were significantly different from each other ($p<0.001$, except for ANNPT versus CPTL, $p=0.619$). By week 10, 193 (91.0%) and 207 (97.6%) of the 212 documents had been indexed in Scopus and PubMed, respectively. In an extended follow-up, 8 of the censored documents were indexed from week 11-20. Of the 14 censored documents (for not being found in Scopus), 7, 6 and 1 had DEP months of October, September, and August respectively. When these 14 documents were excluded, there was a significant correlation of the uncensored indexing delays (i.e., including delays >10 weeks) of the 198 documents in Scopus with uncensored indexing delays in PubMed, (r = 0.46 (95% CI = 0.34–0.56), $p<0.0001$).

DISCUSSION
To the best of my knowledge, this study is the first to report indexing delays in Scopus in any field or subject area. These results show that indexing delays are generally longer in Scopus versus PubMed. The hiatus-reduction strategy will improve the recency of published bibliometric data, given that the current study shows that the median indexing delay in Scopus is 36 days, and 91% of published documents have been indexed by week 10 after the online publication date. This means that authors do not need to wait for a year or longer for bibliometric data to completely accumulate in Scopus before starting data collection, because hitherto, the optimal wait time is unknown. Thus, for periods-of-interest spanning calendar years (January to December), data collection in Scopus should begin as early as March of the following year.

As impactful as the proposed hiatus-reduction strategy could be on the recency of published studies, it may not always be possible to start data collection a few weeks after the planned study period. Authors may have intentionally targeted certain periods such as discrete decades (e.g., 2001-2020 versus 2003-2022). In addition, despite the use of retrospective data in bibliometric studies, data collection, analysis, and manuscript writing may take a long time, and may be further prolonged if revisions or resubmissions were necessary. While such prolonged delays do not eliminate the benefits of this strategy, the impact is reduced. Also, the most relevant period-of-interest may be specific and limited, for example, the COVID-19 pandemic[24,25]. Also, the study ideas may have been conceived many months or years after the last year of the relevant period-of-interest. These further underscore the importance of reporting data-collection dates to facilitate a more accurate assessment of the completeness of data included in bibliometric studies. Lastly, when the unit of measurement is citation counts, rather than publication counts[26], the hiatus reduction strategy would not be applicable since time is needed for citation to accumulate after online availability.

Other limitations in this study include a relatively small sample of pharmacy practice journals; therefore, the conclusions may not be generalizable. However, these journals were selected based on objective criteria described in a previous study[18]. Second, since alerts were not received for all documents, it was assumed that the alerts received are a representative sample of the indexed corpus, however, the quality of data from the alert system was verified by comparing with manual downloads that was done weekly. Thirdly, the current study is limited to 2022, such that multi-year comparisons could not be done. However, unlike most bibliometric studies, the data analyzed in this study was prospectively collected and would therefore take as many years as the number of years in a multi-year analysis.

Authors may be concerned about incomplete data by the 10-week time point suggested in the current study when 9% of the documents are yet to be indexed in Scopus, but this time point may be effectively the peak and plateau of indexing as an extended tracking of data showed that only 8 additional documents (3.8%) were indexed during the next 10 weeks. This suggests that a longer wait would provide negligible benefit to completeness, while negatively impacting recency. Furthermore, the impact and magnitude of a prolonged wait dissipates as the number of years of the period-of-interest increases since the potential benefit on completeness is limited to the last year of the period. Thus, for a study with a 1-year study period, the suggested 10-week wait period maximizes recency with minimal negative impact on the completeness of data published. However, for studies of longer period-of-interest, it would be reasonable to start data collection even much earlier, as was done within 1 week of the end of a study with a 20-year period-of-interest[27].

Although PubMed indexing delay has been previously reported[2], the current study is the first to determine and contrast the indexing delay in Scopus with those in PubMed. The current results are consistent with a previous study using keyword search that showed that while PubMed is updated daily, Scopus is updated only once or twice a week[28]. The minimum indexing delay of 0-1 days in four (vs. 0 in Scopus) of the seven studied journals, and the 21.7% indexing (versus 0% in Scopus) in week 0, support the automatic indexing system used in PubMed. Scopus on the other hand stated on its website that *"Once Scopus receives an article, it is usually indexed within four days"* [29]. The overall PubMed indexing delay of 3 days (IQR 1-23 days) in the current study is shorter than the 5 days (IQR 2-46 days) previously reported for 9189 documents from 22 pharmacy practice journals, but the study also showed that indexing lag decreased over time[2]. Considering the wide variability and differences in the indexing delays obtained for these journals which all belong to the same field, the indexing delay seems to depend more on individual journals than on the databases. Lastly, authors might consider using PubMed for bibliometric studies because indexing is faster, but this conclusion may not be generalizable as even among the seven journals, one (CPTL) had faster indexing in Scopus versus PubMed. In addition, the metadata available in both databases are different; for example, the authors' ID (Scopus ID) is unique to Scopus[13]. In addition, Scopus covers a larger number of journals, and it provides more detailed citation analysis compared to PubMed[28].

CONCLUSION

Scopus indexing delays are generally longer than PubMed indexing delays, but 91% of documents have been indexed in Scopus (compared to 97% in PubMed) by the tenth week following online publication. This study provides novel evidence that Scopus indexing delays are not long enough to warrant the arbitrarily prolonged wait for bibliometric data to accumulate. Therefore, authors of bibliometric studies should start data collection as close as possible to the end of the planned period to be studied. This approach will improve both the recency and completeness of data published in bibliometric studies.

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Disclaimer: The statements, opinions, and data contained in all publications are those of the authors.

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Scopus Indexing Delays of Articles Published in Major Pharmacy Practice Journals
Supplementary Material S1

Database	Search Strings
Scopus	*(SRCID (21200) OR SRCID (19443) OR SRCID (19500157042) OR SRCID (19444) OR SRCID (4700151922) OR SRCID (19464) OR SRCID (19447)) AND (LIMIT-TO (SRCTYPE,"j")) AND (LIMIT-TO (PUBYEAR,2022)) AND (LIMIT-TO (LANGUAGE,"English"))*
PubMed	*("res social adm pharm"[Journal] OR "curr pharm teach learn"[Journal] OR "j am pharm assoc 2003"[Journal] OR "American journal of pharmaceutical education"[Journal] OR "Pharmacotherapy"[Journal] OR "Ann Pharmacother"[Journal] OR "am j health syst pharm"[Journal] AND 2022/01/01:2022/12/31[Date - Publication]*

The source IDs for journals in the Scopus search strings are for: *Pharmacotherapy* (21200), *American Journal of Health Systems Pharmacy (19443), Currents in Pharmacy Teaching and Learning* (19500157042), *American Journal of Pharmaceutical Education* (19444), *Research in Social and Administrative Pharmacy* (4700151922), *Annals of Pharmacotherapy* (19464), *Journal of American Pharmacists Association* (19447).

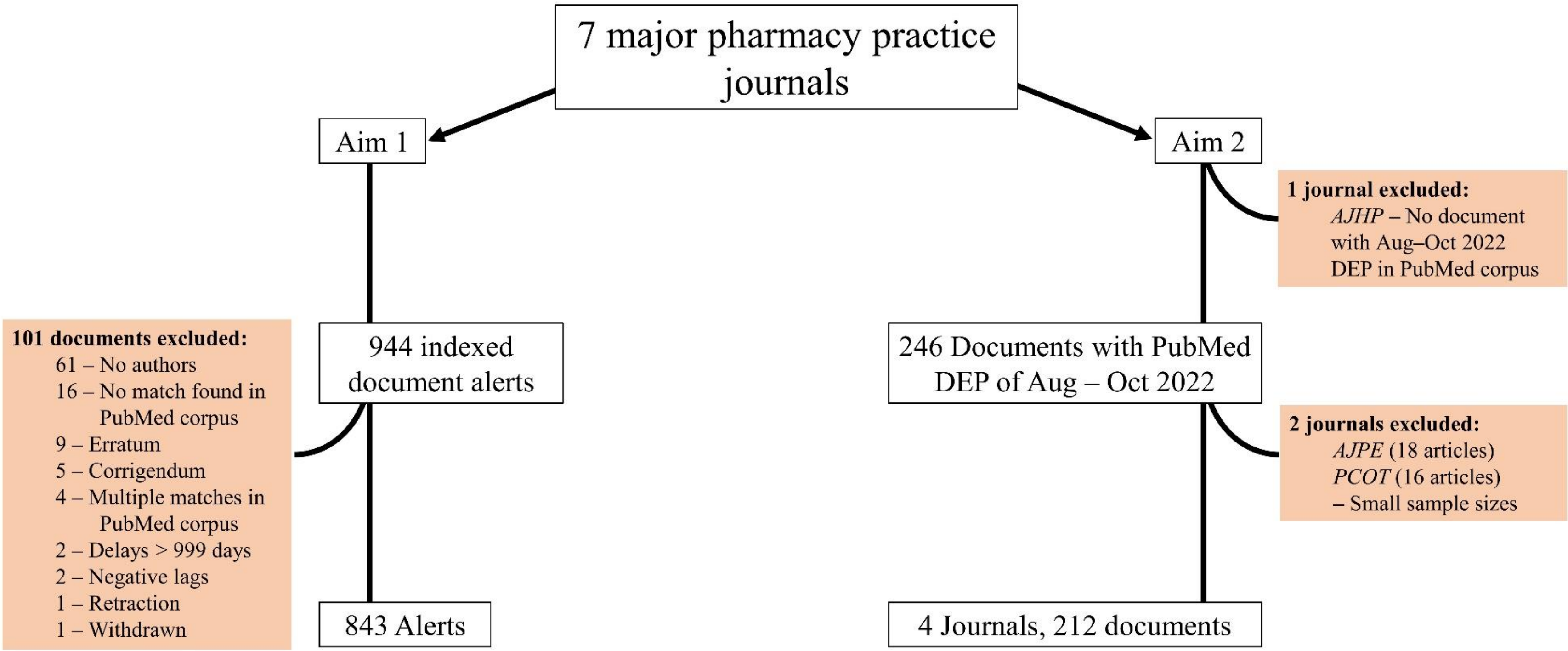

Figure 1. Aims of the Study and their Inclusion and Exclusion Criteria The 7 major pharmacy journals include *Journal of American Pharmacists Association* (JAPhA), *Annals of Pharmacotherapy* (ANNPT), *Research in Social and Administrative Pharmacy* (RSAP), *Currents in Pharmacy Teaching and Learning* (CPTL), *American Journal of Pharmaceutical Education* (AJPE), *Pharmacotherapy* (PCOT) *and American Journal of Health Systems Pharmacy* (AJHP). DEP in PubMed metadata is the electronic publication or "date available online" or "online publication date". Aim 1 was to obtain the median indexing delays, which is the number of days from DEP to indexing (Scopus alert received) date for Scopus, or to EDAT date (entry date) in PubMed, respectively. Aim 2 was to obtain the proportion of documents indexed within 10 weeks of the week of online publication. Journals were excluded based on either having no or low samples among documents with online publication dates (DEP) of August to October 2022 in the PubMed 2022 corpus.

		Scopus		PubMed		
Journals	**n (%)**	**Range**	**Median (IQR)**	**Range**	**Median (IQR)**	**Effect size**
All	843 (100)	2 - 456	36 (18 - 116)	0 - 329	3 (1 - 23)*	0.7
AJHP	230 (27.3)	24 - 258	116 (90 - 137)	0 - 46	1 (1 - 1)*	0.9
AJPE	88 (10.4)	193 - 456	319 (254 - 336)	1 - 329	2 (2 - 3)*	0.9
ANNPT	120 (14.2)	5 - 171	15 (11 - 18)	1 - 5	2 (1 - 2)*	0.9
CPTL	116 (13.8)	2 - 65	12 (9 - 17)	3 - 66	41 (23 - 46)*	0.7
JAPhA	147 (17.4)	19 - 137	37 (32 - 47)	4 - 81	27 (23 - 33)*	0.9
PCOT	47 (5.6)	9 - 53	21 (19 - 26)	1 - 14	1 (1 - 2)*	0.9
RSAP	95 (11.3)	9 - 295	22 (18 - 29)	4 - 58	11 (8 - 15)*	0.9

Table 1. Indexing Delays in Scopus versus PubMed

Indexing delay is the number of days from online publication to indexing. Median delays in Scopus and PubMed compared using Wilcoxon signed rank test (paired). *Denotes $p<0.0001$. Pairwise p-values (for individual journals) were adjusted using Benjamini-Hochberg method. Effect size is Wilcoxon effect size. IQR=Interquartile range. AJHP=*American Journal of Health Systems Pharmacy*, AJPE=American Journal of Pharmaceutical Education, ANNPT=*Annals of Pharmacotherapy*, CPTL=*Currents in Pharmacy Teaching and Learning*, JAPhA = *Journal of American Pharmacist Association*, PCOT = *Pharmacotherapy*, RSAP =*Research in Social and Administrative Pharmacy.*

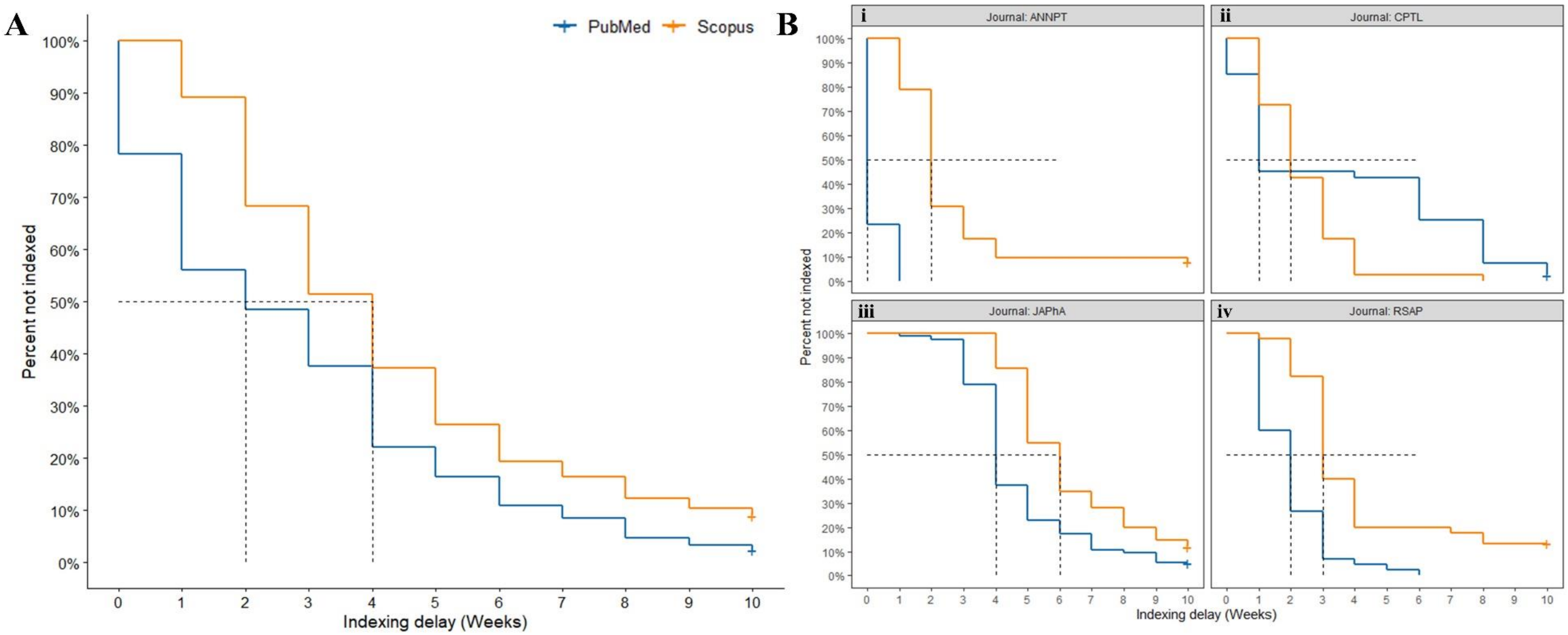

Figure 2. Kaplan-Meier curves of indexing delays in Scopus and PubMed The samples included 212 articles with online publication dates (DEP) of August-October 2022. Indexing delays are the intervals (in weeks) between the online publication date and date when documents were added into the databases. (**a**) Comparison of the Scopus and PubMed Kaplan-Meier curves overall (Log-Rank test $p<0.0001$) and (**b**) Subset by journals (i.) ANNPT=*Annals of Pharmacotherapy* (n=52 (24.5%), $p<0.0001$), (ii.) CPTL=*Currents in Pharmacy Teaching and Learning* (n=40 (18.9%), $p=0.046$), (iii.) JAPhA = *Journal of American Pharmacist Association* (n=75 (35.4%), $p<0.0001$), and (iv.) RSAP =*Research in Social and Administrative Pharmacy* (n=45 (21.2%), $p<0.0001$). The *p*-values in the subset by journals were adjusted using the Benjamini-Hochberg method. Dotted lines in A and B represent the median survival time of indexing in weeks for the respective Kaplan-Meier curves.