Aims and scope

Science Editing (Sci Ed) is the official journal of the Korean Council of Science Editors (https://kcse.org) and Council of Asian Science Editors (https://asianeditor.org). It aims to improve the culture and health of human beings by promoting the quality of editing and publishing scientific, technical, and medical journals. Expected readers are editors, publishers, reviewers, and authors of the journals around the world; however, especially focused to those in Asia. Since scholarly journals in Asia are mostly published by the academic societies, universities, or non-profit organizations, Sci Ed is sought to play a role in journal development. The number of publications from Asia is increasing rapidly and surpass that of other continents; meanwhile, the number of international journals highly appreciated journals is yet to be coming forward. It is task of Asian editors to pledge the journal quality and broaden the visibility and accessibility. Therefore, its scope includes the followings in the field of science, technology, and medicine:

- Policy of journal editing
- Data mining on the editing and publishing
- Systematic review on medical journal publishing and editing
- Research ethics and medical ethics including clinical registration, statement of human and animal health protection, and conflict of interest
- Publication ethics: fabrication, falsification, plagiarism, duplicate publication, and authorship
- CrossRef
- Legal issue in journal publishing
- Peer review process
- Reporting guidelines for medical journals
- Medical and scientific literature databases
- Advanced information technology applicable to journal editing and publishing including PubMed Central schema, journal article tag suite schema, Digital Object Identifier, CrossMark, ORCID, datacite, QR code, and App
- International standard of journal editing and publishing including International Committee of Medical Journal Editors’ Recommendations
- Reference styles including Vancouver (NLM) style, APA style, IEEE style, and ACS style
- Digital publishing in the web and App
- Education and training of editors, reviewers, and authors
- Manuscript editing
- Journal evaluation
- Bibliometrics and scientometrics
- Finance of journal publishing
- History of scholarly journal
- Copyright and Creative Commons License
- Open access and public access approaches
- CrossCheck

Its publication type includes original articles, reviews, case studies, essays, editorials, meeting reports, book reviews, announcement, correspondences, and video clips. Other types are also negotiable with the editorial board. All unsolicited articles are subject to peer review. Commissioned articles are reviewed by the Editorial Board.

About the journal

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Presidential address: the Korean Council of Science Editors as a board member of Crossref from March 2021 to February 2024

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I heard the news that the Korean Council of Science Editors (KCSE) was elected as a board member of Crossref at Crossref Live 2020 at 2:00 a.m. on November 11, 2020. The representative of KCSE to Crossref was chosen to be Prof. Kihong Kim, vice-president of the KCSE (2020–2023) and the next president (2023–2026). Four members of the KCSE attended Crossref Live 2020 through Zoom online. In this address, I aim to present the process of the election and the history of the introduction of digital object identifiers (DOIs) in Korea.

On June 30, 2020, I received an email from the Crossref Nominating Committee stating that if any members of Crossref would be interested in serving on the Crossref Board starting in 2021, they should submit an expression of interest. I asked Prof. Kim to send an expression of interest in serving as a delegate from the KCSE. After doing so, Prof. Kim was interviewed by two nominating committee members of Crossref. I then learned that the KCSE became one of five candidate board members for Tier 1 (small and mid-sized members) on October 1, 2020. Out of the five candidates, KCSE was the only editors’ organization. On the ballot, four out of the five candidates were elected. We, as Korean and Asian science editors, should take pride in this achievement.

The suggested roles of a board member of Crossref are as follows: “To provide strategic and financial oversight of the organization, as well as guidance to the Executive Director and the staff leadership team, with the key responsibilities being: setting the strategic direction for the organization; providing financial oversight; and approving new policies and services.” Each board member also serves on at least one committee.

Crossref is one of ten DOI registration agencies, which deal with scholarly publications including books and journals. The DOI is the unique identifier on a website that directs to the full-text document of each article or book even if its URL is changed. It launched in 2000. This 20-year-old organization has now broadened its scope to services like Event Data [1] and the funder registry. Its scope will be extended to support the Research Organization Registry, an initiative that Crossref runs as part of collaboration [2]. Crossref is now a mainstay of scholarly publishing, as many services provided by Crossref are essential for journal publishing. Although other agencies of the DOI Foundation may resolve DOIs themselves, Crossref also provides other journal publishing services to help ensure journals’ scientific integrity, such as
Crossmark and the registration of funding metadata. Crossref conducted a survey and interviews to hear members’ voices to prepare developmental strategies for 2040. I am confident that Crossref will continue to provide services for scholarly journals, especially for local journals, because of its contribution to the academic journal network [3].

In Korea, only some journals published by large commercial companies were equipped with DOIs as of the early 2000s. At that time, many society journal editors had not heard of DOIs because they did not have the opportunity to find out about such innovations by communicating with international editors or publishers. The International Federation of Library Associations and Institutions held a conference in Seoul from August 20 to 24, 2006. Prof. Ian M. Johnson from the Robert Gordon University, United Kingdom mentioned DOIs in his presentation as follows [4]: “to meet the growing demands of users for links to cited papers, CrossRef was developed to enable publishers to provide reference linking between electronic journals, using a Digital Object Identifier system to provide permanent online access to the full text of identified documents.”

His presentation might have been the first introduction of DOIs in Korea. The late Prof. Seung-Yull Cho [5] attended that conference. He said to me that he heard that DOIs would be useful for journal publication at the conference. At that time, I was serving as the chair of the Information Management Committee of the Korean Association of Medical Journal Editors. It was possible to produce Crossref XML to deposit DOIs. In August 2007, the first Crossref XML file deposition was done for a society journal, the Journal of the Korean Ophthalmological Society, which has been published since 1958. Until 2011, many science journal editors in Korea were still not familiar with DOIs. A turning point was a change in the journal support policy of the Korean Federation of Science and Technology Societies, which provides funding for science society journals annually. In January 2012, the Korean Federation of Science and Technology Societies announced a new journal evaluation tool [6], in which one of the minimum conditions was the existence of a DOI for each article. Subsequently, most scientific, technological, and medical journals began to deposit Crossref XML files for DOIs. This policy change dramatically increased the number of journals with DOIs from 256 (47.1%) in 2011 to 536 (98.5%) in 2019, out of 544 journals [7]. The DOI has also become a prestigious component in journal publishing in the humanities and social sciences because, in 2020, the National Research Foundation of Korea started to add 1 point (out of 100) in their journal evaluation score for funding if a journal is equipped with DOIs [8]. Although it is still not mandatory, as has been the case for science journals since 2012, this DOI policy will give the editors of humanities and social science journals an incentive to add DOIs to their journals. I hope that all scholarly journals from Korea will be equipped with DOI so that they can be included in the international scholarly journal network. The adoption of DOIs will be the best chance for local journals to expand their audience to readers around the world.

Many scholarly journals from Korea have been treated as local journals for a long time, meaning that authors, readers, and editors are primarily from Korea. Journals should be included in international databases, including Scopus, Web of Science, CAS, Biosis Preview, Agricola, ERIC, and PubMed, to overcome this limitation. Another good solution is to link references through DOIs. Through the cited-by function, if a local journal cites other articles, the citing journal can be identified from the cited article. This function can facilitate an appreciation of the work done by local journals.

KCSE is the first board member of Crossref from the Asian continent since Crossref’s establishment in 2000. It may reflect the rapid increase of scholarly publications from Asia. Of particular note, beyond scholarly activity in East Asia, the number of journals from Southeast Asia has exploded. In China, the number of scholarly journals in 2003 exceeded 8,000, of which more than 4,600 could be considered scientific [9]. In Indonesia, there were 5,900 scientific journals in 2014 [10]. In Korea, there are 5,822 scholarly journals as of January 2021, according to the KCI database [11]. However, some of these journals still have not adopted the DOI system. To provide DOIs for articles, publishers in Korea should contact either Crossref, an agency for scholarly publishing, or the Korea Institute of Science and Technology Information, as the DOI agency in Korea.

As a delegate from Asia to Crossref, the KCSE will continue to pay close attention to the concerns of editors and publishers in Asia through the Council of Asian Science Editors.

Conflict of Interest

Sun Huh has been the president of the Korean Council of Science Editors since January 2020, but had no role in the decision to publish this editorial. No other potential conflict of interest relevant to this article was reported.

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Korean editors’ and researchers’ experiences with preprints and attitudes towards preprint policies

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Abstract

Purpose: This study investigated editors’ and researcher’s experiences with preprints and their attitudes towards preprint policies in Korea.

Methods: From December 30, 2019 to January 10, 2020, a Google Forms survey was mailed to members of the Korean Council of Science Editors and the Korean Federation of Science and Technology Societies. The 16 survey items included two demographic items, six items on experience with preprints, five 5-point Likert-scale items on attitudes towards preprints, and three items on advantages and disadvantages.

Results: Out of 365 respondents, 56 had deposited their manuscripts on preprint servers, while 49 stated that they allowed preprints in their journals. More than half of the respondents expressed favorable attitudes towards prioritizing preprint deposition, promotion of open access, rapid feedback on preprints, earlier citations, and evidence of research work. Responders in engineering had more experience with the concept of preprints, and were more likely to have heard about preprint servers and preprint deposition by other researchers, than those in medicine. Half of the editors disagreed with the need for preprints, for reasons including a lack of scientific integrity, stealing ideas/scooping data, priority issues regarding research ideas, and copyright problems.

Conclusion: The above results showed that preprints are still not actively used in Korea. Although experiences with preprints were not widespread, more than half of the respondents showed favorable attitudes towards preprints. More of a consensus should emerge for preprint policies to be accepted by editors in Korea.

Keywords

Attitude; Editor; Journal publishing; Preprint policy; Republic of Korea
Introduction

Background/rationale: Preprints refer to pre-published papers uploaded to a public server by the author. The first preprint server, arXiv (https://arxiv.org/), appeared in 1991 as a repository of physics manuscripts. After arXiv, preprint servers expanded to other subject areas, including biomedicine, mathematics, social sciences, nutrition, and agriculture. The Center for Open Science established Open Science Framework (OSF) Preprints in 2016 (https://osf.io/preprints), as an open source-based preprint server. The OSF Preprints infrastructure collects data from preprint servers and provides integrated search services. As of July 2020, 26 preprint servers have provided records for 2.2 million registered records. When publishing a preprint, the author retains copyright on the paper and expects it to be submitted as a paper. However, this is not always the case. It is estimated that approximately 20% of the preprint published in arXiv are not published in journals [1]. It is not uncommon for preprints deposited in preprint servers to be cited before they are published in a journal [2].

Several articles have described the introduction of preprint policies by editors, and 60.8% of 171 major academic journals were found to have a stated preprint policy [3]. Of the top 100 journals in clinical medicine, 86 permitted preprints, while 13 journals permitted separate screening and one journal rejected preprints [4]. Of the 383 SCIE-listed academic journals in Asia, 30 (7.8%) described preprint policies and 28 (7.3%) received preprint submissions. Of the 76 SCIE journals in Korea, 10 (13.1%) currently describe preprint policies, and 10 (13.1%) receive preprint submissions [5]. As shown by these findings, many Korean editors have not yet introduced preprint policies.

Objectives: This study investigated editors’ and researchers’ experiences with preprints and attitudes towards preprints through a survey questionnaire, with a particular focus on the proportion of editors and researchers with experiences of preprints and their attitudes toward preprints. Differences in responses were analyzed according to respondents’ research field and role in journal publishing. Perceived advantages and disadvantages of preprints were also identified.

Methods

Ethics statement: This survey was anonymous. Individuals’ sensitive information was not included, so the requirement to obtain written informed consent was waived. Subjects were not vulnerable individuals such as students.

Study design: This was a survey-based descriptive study.

Setting: For 12 days from December 30, 2019, to January 10, 2020, a survey was sent through Google Forms to a total of 1,201 people whose e-mails were listed as members of the Korean Council of Science Editors (KCSE) and the Korean Federation of Science and Technology Societies. Email recipients were asked to resend the survey to the members of each society. Therefore, the total number of targeted individuals could not be estimated.

Participants: Participants were editors, society members, or staff of the two organizations. Because the number of respondents could not be estimated in advance, the response rate could not be calculated. Only the response data from 365 respondents were analyzed.

Variables: The survey included two demographic items (academic field and role in journal publishing), six nominal items on experiences with preprints, five 5-point Likert scale ordinal items measuring attitudes towards preprints, and three items on preprint needs. The questionnaire is presented in Suppl. 1. Of the six nominal items, five were included as variables. One item (B4_1) was a supporting item for another (B_4). Validity and reliability test of the measurement tool: Except for the categories of research field and role in journal publishing, all items elicited information on experiences with or attitudes towards preprints. The item content was discussed with three board members of the KCSE (Kihong Kim from Ajou University, Soo-Young Kim from Hallym University, and Tae-Seol Seo from the Korea Institute of Science and Technology Information). They agreed with the validity of these items for the survey on preprints. Reliability was tested for the five items of 5-point Likert scale using DBSTAT ver. 5.0 (DBSTAT Co., Chuncheon, Korea). The Cronbach alpha coefficient was 0.8576 (df = 360, significance level |α| = 0.05, t = 1.9666).

Data source: Data were responses from participants to the survey form.

Bias: There was no bias in the selection of participants. Participation was strictly voluntary, and that aspect of the sampling was outside the authors’ control.

Study size: This was not an experimental study. The sample size could not be estimated before the survey. For the comparative analysis based on journal category and participants’ role, a post hoc analysis was done. G*Power was used for the post-hoc analysis, using the generic chi-square test [6]. The power (1-β error probability) was 0.985, given α = 0.05, df = 2, and the noncentrality parameter λ = 20.

Statistical methods: A frequency distribution analysis of responses to each item and a comparative analysis of experiences with and attitudes towards preprints were done according to participants’ research fields and roles. DBSTAT ver. 5.0 (DBSTAT Co., Chuncheon, Korea) was used for the statistical analysis. To compare experiences with preprints according to research field, an analysis was conducted using the chi-square
test or log-likelihood test (for the item of having heard of preprint deposition by others). For the chi-square test of the item on whether society journals allowed preprint submissions, responses of “do not know” were removed. Attitudes towards preprints according to research field were compared using the Kruskal-Wallis test. The chi-square test was used to compare experiences with preprints according to participants’ role. Because there were few participants outside of the fields of medicine and engineering, participants from other fields were integrated into the natural science group. Therefore, three research fields were used for the comparative analysis. Missing values were excluded from the statistical analysis.

Results

Participants’ characteristics
A total of 365 people responded to the survey. Respondents’ research fields were divided into eight areas: medicine accounted for 202 (55.3%), followed by 117 in engineering (32.1%), 26 in natural sciences (7.1%), eight in agricultural and fisheries research (2.2%), two in humanities, seven in the social sciences, one in artistic and sports research, and two in interdisciplinary science. Regarding roles in journal publishing, there were 118 editors, including editors-in-chief and editorial board members (32.3%), 229 researchers (62.7%), and 18 staff who worked in journal publishing, including manuscript editors, society staff, and company employees (4.9%). The distribution of respondents according to research field and role is available in Suppl. 2. Raw response data from respondents are available in Dataset 1.

Main outcomes

Experience with preprints: The responses to questionnaire items about experiences with preprints were as follows: 243 respondents (66.6%) stated that they were familiar with the concept of preprints, 127 (34.8%) had heard about preprint servers such as arXiv or bioRXiv, 56 (15.3%) had deposited a manuscript on preprint server, 49 (13.4%) said that their society journals allowed preprint submissions, and 122 (33.4%) had heard of preprint deposition by other researchers (P = 0.0195). However, no significant association was found between research field and deposition of manuscripts to preprint servers (P = 0.6761); and society journals’ allowance of preprint submissions (P = 0.2912).

The chi-square test showed associations between participants’ role and the deposition of manuscripts to preprint servers (P = 0.0309). More researchers than editors and staff stated that their society journals allowed preprint submissions (P = 0.0004). However, no significant association was found between participants’ role and the deposition of manuscripts to preprint servers (P = 0.1704). The same was found for having heard about preprint deposition by other researchers (P = 0.5603).

Attitudes towards preprints: Five items identified attitudes towards preprints. Respondents showed markedly more positive attitudes towards three items (prioritizing preprint deposition [62.7%], promotion of open access [63.6%], and counting preprints as evidence of research work [60.1%]) than towards two other items (rapid comments from researchers [51.5%] and earlier citations than non-preprint articles [53.2%]) (Fig. 2).

The Kruskal-Wallis test showed no association between research field and prioritizing preprint deposition (P = 0.6409), promotion of open access (P = 0.994); and earlier citations than non-preprint articles (P = 0.547). However, respondents in engineering and medicine showed more positive attitudes towards rapid comments from researchers (P = 0.0060) and preprints counting as evidence of research work (P = 0.0057).

The Kruskal-Wallis test showed no significant difference in the median values of the following three items dealing with attitudes towards preprints according to participants’ role: prioritizing preprint deposition (P = 0.2351), promotion of open access (P = 0.994), and earlier citations than non-preprint articles (P = 0.547). However, respondents in engineering and medicine showed more positive attitudes towards rapid comments from researchers (P = 0.0060) and preprints counting as evidence of research work (P = 0.0057).
access (P = 0.0994), and earlier citations than non-preprint articles (P = 0.0547). However, researchers and staff had more favorable attitudes towards researchers’ rapid comments than editors (P = 0.0060), and researchers and staff had more favorable attitudes towards preprints counting as evidence of research work than editors (P = 0.0057).

The necessity of accepting preprints in journal publishing: Of the 365 respondents, 230 persons (63.8%) responded “yes” regarding the necessity of accepting preprints in journal publishing, while 132 (36.2%) replied “no.” No significant association was found according to respondents’ research field (P = 0.7760) (Fig. 3). A higher proportion of researchers than editors or staff responded positively towards the necessity of accepting preprints (P = 0.0012) (Fig. 4). The reasons given were as follows: “I have already acknowledged the need for preprints” (n = 102) and “I can acknowledge the need for preprints during this survey” (n = 137).

Out of 132 responders who said that preprints were not acceptable, 73 provided reasons for not accepting preprints (Dataset 2). The responses were classified into the following five categories: scientific integrity (31), stealing ideas/scoping data (19), priority of ideas (11), copyright issues (6), and others (12). The most frequent concern was scientific integrity. These respondents worried about manuscripts not undergoing peer review. In the physical sciences, incorrect results may not be harmful to people’s health. However, in the medical field, information from clinical trials without peer review may be harmful if the information is not sound. The second concern was stealing ideas or scooping data. The third was disputes regarding the priority of ideas. If an author insists on the priority of an idea after depositing a preprint without concrete evidence, it might hinder the publication of data with the same idea. The fourth issue was copyright problems. Insisting on copyright over preprint content may cause difficulties for other researchers who deal with the same content. Other opinions were as follows: confusion in citing work, causing trouble in the publishing ecosystem, difficulty in peer review, duplicate publications, no change or information on journals’ preprint policies in Korea, and preprints not being necessary due to online publishing.

**Discussion**

**Key results**: Fewer than half of participants had experience with preprints, except for familiarity with the concept of preprints. There was a low acceptance of preprint submissions by society journals (13.4%). Differences were found according to the research field for three items regarding experience: the concept of preprints, having heard about preprint servers, and having heard about preprint deposition by others. More participants from engineering and other fields had experience with these items than those from medicine. More editors and staff than researchers were familiar with the concept of preprints and had heard about preprint servers. More than half
of the participants showed a positive response to all five items on attitudes towards preprints. Researchers and staff had more favorable attitudes than editors towards preprints receiving immediate comments and counting as evidence of research work. Editors were more likely to be against accepting preprints than researchers and staff.

**Interpretation:** The above results may provide basic data on experiences with and attitudes towards preprints among editors, researchers, and staff who work in journal publishing. However, it is difficult to conclude from the above results whether participants’ level of experience and attitudes were high or low because no comparative studies have been conducted in other countries. The finding that participants from engineering and other fields had more experience with preprints than those from medicine can be explained by the active use of preprint servers in the physical sciences, including physics, chemistry, and engineering. In the medical field, preprint servers are still not popular, especially among the society journals in Korea [5]. MedRXiv (https://www.medrxiv.org/) was launched in June 2019 and bioRXiv (https://www.biorxiv.org/) began in November 2013, whereas arXiv (https://arxiv.org/) started in August 1991.

Researchers in the engineering and natural science fields are believed to have already encountered preprints, although no significant difference was found in the proportion of researchers who had deposited manuscripts to preprint servers. More editors and staff than researchers were familiar with the concept of preprints and preprint servers. This may have resulted from their attendance at the editors’ workshop held by the KCSE. The KCSE recently presented a training course on preprints in January 2020. Furthermore, preprints have been introduced through the official journal of the KCSE, *Science Editing*, which is distributed to member editors.

Participants’ attitudes towards preprints were more favorable than the levels of experience with preprints. An interesting question is why researchers and staff had more favorable attitudes than editors towards preprints enabling colleague researchers’ immediate comments and towards preprints counting as evidence of research work. This finding is difficult to interpret, and it may have been just a phenomenon. Out of 365 participants, 132 (36.2%) did not want to accept the submission of preprints, and editors were more reluctant to accept preprints as a matter of policy. Out of the 117 editors, 58 (50.0%) did not express favorable attitudes towards accepting preprints, and this might be the key finding of this survey. Journal policies usually depend on the editor’s decisions. It is challenging to adopt a preprint policy that accepts preprint submissions. Many reasons for non-acceptance were presented. In particular, out of 74 medical editors, 40 (54.1%) were against accepting submissions of preprints. Many concerns were raised about preprints, primarily including scientific integrity, stealing and scooping ideas, and priority of ideas.

**Comparison with previous studies:** Chiarelli et al. [2] examined the behavior of researchers, including various perspectives, in interviews based on a sampling approach between October 2018 and January 2019. That study conducted detailed interviews with 38 stakeholders in the United States. In their work, they agreed with the broad definition that preprints are the result of peer review and research that can be submitted before publication. However, significant disagreement was found regarding the details of preprints’ meaning and effectiveness. Since the study of Klebel et al. was a qualitative study based on structured interviews, it is challenging to compare their findings to those of the present study. According to Klebel et al., the main concerns were related to the lack of quality assurance and the “Ingelfinger rule,” which prohibits the earlier announcement of article content in mass media before publication in a journal. A common concern identified by Klebel et al. and in the present study was scientific integrity, or the quality of content. Many editors surveyed in this study worried about the scientific integrity of preprints.

It is not easy to find other country-level survey studies on preprints in the literature databases, including PubMed and the Web of Science Core Collection. A survey was conducted by 80 Sanofi-Synthelabo researchers on preprints and e-prints. The researchers regarded preprints or e-prints as unreliable, although they recognized the advantage of being able to modify their work through depositing it to preprint or e-print servers [7]. Soderberg et al. [8] surveyed 3,759 researchers across a wide range of disciplines in 2019 and showed that 69.8% of them had favorable attitudes towards preprints. However, 15.2% were opposed to preprints. Only 51% of respondents from the medical field were in favor of the use of preprints. Out of 3,759 respondents, 29.85% had submitted a preprint at least once. That survey primarily dealt with the use of cues on preprint services, but some basic data are comparable with the present survey. In the present study, 15.3% of the participants had deposited a manuscript to a preprint server, and more than 50% of the respondents showed favorable attitudes toward preprints. Thus, Korean researchers’ and editors’ experiences of depositing manuscripts to the preprint server are relatively inactive compared to researchers elsewhere in the world.

Penfold and Polka [9] also mentioned “getting scooped” as a reason for not accepting preprints. This opinion was also verified in the present survey as a major issue.

**Limitation:** This study was conducted to investigate the current perceptions of Korean editors and researchers regarding preprints. However, it was based on voluntary participation, not a random sampling, which may have adequately repre-
sent the whole population. Among the respondents, those in the medical field accounted for 55.3%, meaning that the findings predominantly reflect the opinions of researchers in the medical field. In the future, it is necessary to conduct a study with random sampling.

**Suggestion:** It is not mandatory for all journals to accept preprints—that is, depending on the journal's policy, editors may or may not receive preprint submissions. Large international commercial publishers usually allow preprint submissions and the citation of preprints, so it is time to think about what policies are needed in society journals in Korea. Editors should create a written preprint policy stating whether preprints are reviewed or rejected and whether preprints can or cannot be cited.

**Generalizability:** The results represent the opinions of Korean editors and researchers; as such, the findings are not expected to be generalizable to editors and researchers from other countries.

**Conclusion:** Only 15.3% of respondents reported having published preprints, which means that they are relatively inexperienced with preprints. Half of the editors had negative views about introducing preprinted policies. Respondents who were against the need for preprints were most concerned about scientific integrity, the theft of research ideas, or the possibility of scooping data. It is necessary to hold discussions at the editor's council level on how to address these concerns when introducing a preprint policy.

**Conflict of Interest**

Sun Huh has been the President of the Korean Council of Science Editors since January 2020, but has no role in the decision to publish this article. No potential conflict of interest relevant to this article was reported. This work was done as a research project of the Korean Council of Science Editors. However, this article's opinion is not the Korean Council of Science Editors' official opinion, but that of the authors.

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**Data Availability**

Dataset file is available from: the Harvard Dataverse at: https://doi.org/10.7910/DVN/KQLZNV

**Dataset 1.** Raw response data to survey questionnaire from participants

**Dataset 2.** Raw response data on the reasons for not accepting preprints and the categorization of responses

**Supplementary Material**

Supplementary file is available from: the Harvard Dataverse at: https://doi.org/10.7910/DVN/KQLZNV

**Suppl. 1.** The survey questionnaire including 16 items eliciting information on Korean editors and researchers' experiences with preprints and attitudes towards preprint policies

**Suppl. 2.** Distribution of respondents according to the research field and their roles in journal publishing

**References**


Preprint acceptance policies of Asian academic society journals in 2020

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Abstract

Purpose: In the current era of the coronavirus disease 2019 pandemic, the trend of sharing new research results through preprint platforms is receiving more attention from researchers than ever before. Preprints have been recognized as a primary and essential method to disseminate new findings faster than traditional publications. Therefore, it has become necessary for journals and editors to acknowledge these changes, prepare preprint policies, and notify authors accordingly. This study aimed to review the status of preprint policies of international publishers and Asian academic society journals.

Methods: In total, 383 Asian academic society journals registered in Science Citation Index Expanded were selected as a dataset for analysis between December 11, 2020 and January 8, 2021. Three different parameters were investigated whether each journal had a preprint policy, whether journals allowed preprint manuscripts to be submitted, and whether preprint articles were allowed to be included in the references.

Results: Among the 383 Asian academic society journals from 22 countries, only 28 journals accepted preprint manuscripts, and eight allowed the use of preprint manuscripts as references. Japan had the most journals that both had preprint policies and accepted preprint manuscripts, with 13 journals, followed by Korea with 10 journals.

Conclusion: Despite the limitations of this study, the results show that editors and journal staff should understand the current preprint trend and try to prepare preprint policies that best meet the journals’ and authors’ interests.

Keywords

Journal policy; Open science; Preprint; Preprint policy; Society journal

Introduction

Background/rationale: Most researchers generally do not share their studies with others until the studies are published. However, it can take at least a few months—and sometimes even years—before publication. To resolve this problem, in recent years, increasingly many re-
Researchers have used preprints, which allow them to upload studies online before peer review [1]. In particular, due to the coronavirus disease 2019 (COVID-19) pandemic, preprints have been recognized as a primary and essential research resource for the faster dissemination of results than is possible through traditional publications. This change has heightened the position of preprints among researchers. On June 1, 2020, preprints accounted for one-quarter of all research output among COVID-19–related studies, including over 42,700 scholarly articles, 3,100 clinical trials, 420 dataset, 270 patents, 750 policy documents, and 150 grants [2].

Preprints are defined as drafts of research papers shared before peer review. Most preprints are given digital object identifiers (DOIs), which can be cited in other research papers. The advantages of preprints include enabling faster distribution, giving feedback opportunities, publishing research results that would be difficult to publish in traditional papers, strengthening research experience among young researchers, preventing the theft of research ideas, and expanding the accessibility of academic research [3].

Some aspects of why preprints are attracting attention warrant a closer examination. First, by publishing a draft paper containing research results as a preprint, ownership of the findings and credits can be secured. If there is a dispute over who first discovered a particular result, the work published as a preprint can be a permanent part of the academic record that can furnish solid proof of the dispute. For this reason, the National Institutes of Health and Wellcome Trust allow researchers to use preprint articles as references when applying for research funds [1].

Second, in the traditional system, a manuscript goes through the process of receiving feedback from two to three peer reviewers after submission, but posting the manuscript as a preprint allows readers to point out major flaws or errors. Furthermore, new research or data strengthening the author’s argument may be proposed, and preprint publications can even lead to collaborations that can be published in more prestigious journals [1].

Third, a manuscript published as a preprint is not the final version of the research paper, but can be linked to the final published article through Crossref, thereby increasing the visibility and citation of the final published paper [1].

As such, researchers are becoming increasingly interested in preprints as a distribution channel of new research. In particular, more and more researchers are asking whether they can post their manuscripts on a preprint server before the official paper is submitted to an academic journal. Since authors usually refer to the authors’ guidelines on a journal’s homepage before submitting a paper, a detailed preprint policy should be clearly described on the journal homepage, specifying whether the journal considers manuscripts that have already been published as preprints, to reduce authors’ confusion.

Related studies: Klebel et al. [4] investigated the preprint policy status of 171 major academic journals, including commercial ones. Of the 171 journals, 120 (70.2%) allowed preprints, including 39.2% that allowed preprints before peer review, while 22.8% did not have a preprint policy. In general, natural science journals tended to allow preprints only for the first submission before peer review. Massey et al. [5] assessed the preprint policy of the 100 clinical journals with the highest impact factors. Most journals (86%) allowed authors to submit articles previously posted as preprints, and 13 journals made this decision on a case-by-case basis.

Vuong [6] suggested that by allowing authors to share working papers, preprints, postprints, or published articles economically, preprints can be a valuable contribution as an open platform to share raw data with a wider audience. Kirkham et al. [7] reviewed all biomedical preprint platforms to understand key characteristics and policies. Their results implied that authors now have the option to make their research publicly available at little or no cost and to take early ownership of their findings with the growing number of preprint platforms available in biomedical and medical research. Furthermore, on many preprint platforms, there are few limitations regarding authors’ future ability to publish the research in the peer-reviewed journal of their choice.

Large commercial publishers with sufficient personnel and budget have been able to adapt to the preprint trend well; however, small academic society journals have found it difficult to apply preprint policies quickly. According to the COPE (Committee on Publication Ethics) discussion document released in 2018, a preprint was defined as a “scholarly manuscript posted by the author(s) in an openly accessible platform, usually before or in parallel with the peer review process” [8].

A manuscript posted on a preprint server can potentially share false results because it does not go through peer review, which is why some researchers are reluctant to publish a manuscript in preprint out of fear that journal editors may not accept the submission of the draft. However, the traditional academic publishing process is perceived by researchers as very time-consuming, and the advantages of preprint have recently been highlighted. Most of researchers’ fears about preprints have been resolved because there are ethical and professional ways to deal with mistakes and errors at the academic level, and prominent journals such as Science and Nature, as well as many open access journals, allow manuscripts published as preprints [3]. A study by Serghiou and Ioannidis...
[9] found that both Altmetrics scores and citations were higher for articles that were originally published as preprints than for articles with no preprints. It has also been confirmed that preprint studies attract more attention from social media as well as traditional citations, which contributes to research influence at the author and article level.

With the proliferation of open science, the trend of sharing research results through preprints is increasing both in the field of energy physics and in various other fields where preprint culture was not originally popular [10]. Preprints are rapidly expanding to all academic fields for the prompt dissemination of research results. There is also a new publishing model that encourages journals to use AI programs to find and recommend the submission of appropriate papers from preprint servers [11].

Due to the ability of preprints to facilitate the rapid sharing of research results and to augment the influence of research results, the interest of researchers and research funding agencies in preprints is increasing. Therefore, it is necessary for academic societies that publish journals to pay attention to preprints and to clearly inform researchers about related preprint policies on the journal homepage. As such, the preprint policies of large international publishers and renowned academic journals were examined, as well as how small academic publishers are responding to them.

Sherpa Romeo’s publication policy statistics showed that 1,064 (42%) of 2,562 publishers allowed preprints and postprints for sharing [12]. Looking at the information required when entering new publisher policies on the Sherpa Romeo site, detailed policies can be entered regarding the linkage of preprints with final published articles [13].

**Objectives:** In this study, the preprint policies of large international publishers and renowned academic journals were examined, as well as how small academic publishers are responding to them.

**Methods**

*Ethics statement:* This study did not involve human subjects, so neither approval by the institutional review board nor obtaining of informed consent was required.

*Study design:* This bibliometric study based on journals’ policies investigated Asian academic society journals’ preprint acceptance policies in light of the preprint policies of international publishers.

*Background data:* First, the contents of preprint policies were divided into international commercial publishers, mega open access journals, and prestigious society journals. The present status of preprint policies from Asian academic society journals was then analyzed. Specifically, the following preprint policies were investigated: whether the journals 1) allowed the acceptance of preprint manuscripts, 2) linked preprints to the final published articles, 3) allowed the use of preprint manuscripts as references, 4) or had other preprint policies that did not fall into above categories [14]. The full results are presented as supplementary materials.

**Data sources/measurements:** To collect data, between December 11, 2020 and January 8, 2021, 551 journals published by academic societies from Asia that were listed in the 2019 Science Citation Index Expanded were directly accessed through journals’ websites to investigate the following parameters: 1) whether the journal had a preprint policy, 2) whether preprint manuscripts could be submitted, and 3) whether preprint articles could be included as references. As a result, 119 of 551 journals that were linked to commercial publishers were excluded from the analysis. Journals that did not provide information in English were excluded, as were journals for which the journal’s official site could not be accessed due to errors, leading to the inclusion of 383 journals in the final dataset for analysis (Dataset 1).

In order to increase the reliability of the study, three researchers conducted a preliminary survey of 30 journals’ websites to verify each other’s findings and try to produce the same results. In addition, after completing the survey of 551 journals, three researchers examined each other’s work for post-validation, and each person examined the contents of the journal again to verify that the survey was correct.

**Bias:** There was no bias in selecting the target journals. All eligible journals were selected.

**Statistical methods:** A descriptive analysis was done. There was no experimental analysis of data.

**Results**

**Journal count per country and region**

Table 1 presents a classification of the 383 journals according to the publishing countries and continents. The journals were published in 22 countries. The region of East Asia and Russia accounted for the most journals (n = 238), and Japan was the country that published the largest number of journals (n = 102).

**Presence of a preprint policy**

Thirty of the 383 journals had preprint policies, whereas the other journals did not provide information on their websites. The academic journals with policies are listed in Table 2. In terms of the subject areas, the journals with preprint policies were mostly in the medical field, although journals on biolo-
Asian society journals’ preprint policies

Some of these journals stated that they permitted the submission of manuscripts that are already posted on preprint servers; some others stated that they allowed authors to upload manuscripts that were submitted to the journals on preprint servers; and still others clarified that they would not allow the submission of duplicate studies to their journals. However, few of them provided detailed guidelines that authors could follow during the peer review process and after publication. A few journals described how they would handle preprint manuscripts leading to the publication of the final versions. For instance, Investigative and Clinical Urology recommended authors “to disclose it with DOI in the letter to the editor during the submission process.” Plant Biotechnology clarified that “At the time of submission to this journal, authors must inform the journal via a cover letter that the manuscript has been posted to a preprint server.”

Regarding the linkage between the final published article and the preprint, Plant Biotechnology journal stated that “Once the article has been published in its final form on the journal website, the preprint server must link to the article on the journal’s website.” The Journal of Poultry Science said, “Any version of a manuscript that has been revised in response to reviewers’ comments, accepted for publication or published in the journal should not be posted on a preprint server. Instead, forward links to the published manuscript may be posted on the preprint server.” The World Journal of Men’s Health (WJMH) stated, “If the preprint is accepted for publication, authors are recommended to update the info at the preprint with a link to the published article in WJMH, including DOI at WJMH. It is strongly recommended that authors cite the article in WJMH instead of the preprint at their next submission to journals.” These observations show that several journals try to systematically follow and manage the process of preprints and formal publishing.

### Preprint manuscript acceptance

Of the total of 383 journals, 30 had policies about the submission of preprint manuscripts. Specifically, 28 journals stated that they considered preprint manuscripts, while two indicated that they did not. The journals that accepted preprint manuscripts are listed in Table 2.

Among 28 journals, 14 were related to medicine. Other subject areas included space science, biology, and agriculture. Japan was the country with the most journals that had preprint policies, with 13 journals, all of which accepted preprint articles, followed by Korea with 10 journals that both had preprint policies and accepted preprint manuscripts. Both India and Iran had two journals with preprint policies, but one of the journals from Iran banned the submission of preprint studies. Lastly, Pakistan, Russia, and Turkey had one journal with a preprint policy each; however, the journal from Pakistan did not allow preprint articles.

### Allowance of preprint manuscripts as references

Among 383 journals, only 10 provided information on whether preprint manuscripts could be included in the references, even including some journals that did not provide any information about whether they allowed preprint submissions. Eight academic journals stated that it was acceptable to include preprints. The corresponding journals are listed in Table 3.

All eight journals that allowed the use of preprint manu-

<table>
<thead>
<tr>
<th>Region</th>
<th>Country</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Asia and Russia</td>
<td>Japan</td>
<td>102</td>
</tr>
<tr>
<td></td>
<td>Korea</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>China</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Hong Kong</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Taiwan</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Russia</td>
<td>10</td>
</tr>
<tr>
<td>Southeast Asia</td>
<td>Malaysia</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Thailand</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Philippines</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Singapore</td>
<td>3</td>
</tr>
<tr>
<td>Southern Asia</td>
<td>India</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Pakistan</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Bangladesh</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Sri Lanka</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Nepal</td>
<td>1</td>
</tr>
<tr>
<td>Western Asia</td>
<td>Turkey</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Iran</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Israel</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Kuwait</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Saudi Arabia</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Jordan</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>United Arab Emirates</td>
<td>1</td>
</tr>
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<td>Total</td>
<td></td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>383</td>
</tr>
</tbody>
</table>
Table 2. Journals that had a preprint policy and accepted preprint manuscripts

<table>
<thead>
<tr>
<th>Title</th>
<th>Subject category</th>
<th>Country</th>
<th>Presence of a preprint policy</th>
<th>Acceptance of preprints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal of Astrophysics and Astronomy</td>
<td>Astronomy &amp; Astrophysics; Space Science; Space Sciences</td>
<td>India</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Defence Science Journal</td>
<td>Multidisciplinary Sciences; Engineering</td>
<td>India</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Cell Journal</td>
<td>Cell Biology; Molecular Biology &amp; Genetics</td>
<td>Iran</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>International Journal of Health Policy and Management</td>
<td>Public Health &amp; Health Care Science; Health Care Sciences &amp; Services; Health Policy &amp; Services; Social Sciences, General</td>
<td>Iran</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Journal of Poultry Science</td>
<td>Agriculture, Dairy &amp; Animal Science; Agricultural Sciences</td>
<td>Japan</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Microbes and Environments</td>
<td>Biotechnology &amp; Applied Microbiology; Microbiology</td>
<td>Japan</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Plant Biotechnology</td>
<td>Biotechnology &amp; Applied Microbiology; Plant Sciences; Plant &amp; Animal Science</td>
<td>Japan</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Cell Structure and Function</td>
<td>Cell Biology; Cell &amp; Developmental Biology; Molecular Biology &amp; Genetics</td>
<td>Japan</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>IEICE Transactions on Fundamentals of Electronics Communications and Computer Sciences</td>
<td>Computer Science, Hardware &amp; Architecture; Computer Science, Information Systems; Electrical &amp; Electronics Engineering; Engineering; Engineering, Electrical &amp; Electronic; Electronics &amp; Electrical Engineer</td>
<td>Japan</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>IEICE Transactions on Information and Systems</td>
<td>Computer Science; Computer Science, Software Engineering; Computer Science, Information Systems; Information Technology &amp; Communication Systems</td>
<td>Japan</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>IEICE Transactions on Electronics</td>
<td>Engineering, Electrical &amp; Electronic; Electrical &amp; Electronics Engineering; Electronics &amp; Electrical Engineering; Engineering</td>
<td>Japan</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>IEICE Electronics Express</td>
<td>Engineering, Electrical &amp; Electronic; Electrical &amp; Electronics Engineering; Engineering; Electrical &amp; Electronics Engineering</td>
<td>Japan</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Anthropological Science</td>
<td>Evolutionary Biology; Anthropology; Plant &amp; Animal Science; Sociology &amp; Anthropology</td>
<td>Japan</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Journal of Agricultural Meteorology</td>
<td>Materials Science, Composites; Agriculture, Multidisciplinary, Agriculture/Agronomy; Meteorology &amp; Atmospheric Sciences; Agricultural Sciences</td>
<td>Japan</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>IEICE Transactions on Communications</td>
<td>Telecommunications; Engineering, Electrical &amp; Electronic; Computer Science; Information Technology &amp; Communication Systems</td>
<td>Japan</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Journal of Veterinary Medical Science</td>
<td>Veterinary Medicine/Animal Health; Veterinary Sciences; Plant &amp; Animal Science</td>
<td>Japan</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Experimental Animals</td>
<td>Zoology; Veterinary Sciences; Animal Sciences; Plant &amp; Animal Science</td>
<td>Japan</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>International Journal of Pharmacology</td>
<td>Pharmacology &amp; Pharmacy; Pharmacology &amp; Toxicology</td>
<td>Pakistan</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Acta Naturae</td>
<td>Cell Biology; Biochemistry &amp; Molecular Biology; Molecular Biology &amp; Genetics</td>
<td>Russia</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Allergy Asthma &amp; Immunology Research</td>
<td>Allergy; Immunology</td>
<td>Korea</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Journal of Advanced Prosthodontics</td>
<td>Dentistry, Oral Surgery &amp; Medicine; Clinical Medicine</td>
<td>Korea</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Journal of Periodontal and Implant Science</td>
<td>Dentistry, Oral Surgery &amp; Medicine; Clinical Medicine</td>
<td>Korea</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

(Continued to the next page)
scripts in the references were science and engineering-related journals, distributed in various subject areas, including genetic engineering, public health, cell biology, space science, mathematics, and zoology. Japan had three journals, followed by Iran with two journals and China, Russia, and Taiwan with one each.

Discussion

Comparison with previous studies

Clear and easy-to-find preprint policies are important for authors to choose the right journal for publication. Whether a journal considers preprints as prior publications or not is an important factor for authors, many of whom would like to post preprints as a way to disseminate research rapidly.

Compared to the proportion of 7.3% of Asian society journals surveyed in this study, Klebel et al. found that the percentage of preprint acceptances among the top 171 journals was much higher, at 70.2%. However, the majority of journals (57.3%) did not clearly indicate whether preprints could be cited. In the journals that allowed preprint citations, 78% limited those citations to the references section, while 14% of journals restricted the citations of preprints to the text [4].

Preprint policies vary considerably from subject to subject. In the life sciences and earth science, 91% of all journals allowed pre-prints in any way, but this was only the case for 45% of journals in the humanities [4]. According to Massey et al. and Kirkham et al., the usage of preprints has increased [5,7]; however, the findings of this study are not comparable to those obtained for social science journals because the study only focused on SCIE journals. The result of this study based on Asian academic journals, showed that Korea and Japan had more journals that allowed preprints and more journals that specified preprint policies than other countries, but no significant differences in preprint policies were found across different subject areas.

Suggestions for Asian society journal editors

As academic journal editors, various details must be considered to determine the preprint policy. It is recommended that publication policies, including those related to preprints, should be clearly described and posted on the journal homepage, including whether a manuscript can be posted on a preprint server during peer review, whether to allow revisions of a preprint manuscript during the peer review process, and whether to refer to comments from preprint server during peer review. Moreover, if the journal uses a double-blind review process, preprint servers can cause difficulties because the author who posted the manuscript on the preprint server...
Conclusion
The study concluded that, out of a total of 383 society journals published in Asia listed in the 2019 Journal Citation Ranking, only 28 (7.3%) indicated that they published preprint manuscripts. Only the author’s guidelines and ethics policies were analyzed to determine preprint policies, so a limitation is posed by the possibility that society journals might have preprint policies that are not specified on their websites.

With the arguments over preprints in various fields of study, this paper can provide an opportunity for Asian journal editors to have more active discussions about how to follow global trends in preprint policies.

Conflict of Interest
No potential conflict of interest relevant to this article was reported.

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The authors received no financial support for this article.

Data Availability
Dataset file is available from: the Harvard Dataverse at: https://doi.org/10.7910/DVN/URPWLC

Dataset 1. Status of preprint acceptance of Asian academic society journals in 2020

References
1. Mudrak B. What are preprints, and how do they benefit authors? [Internet]. Durham, NC: American Journal Ex-

Table 3. Journals that allowed preprint articles in the references

<table>
<thead>
<tr>
<th>Title</th>
<th>Subject category</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioimpacts</td>
<td>Molecular Biology &amp; Genetics; Pharmacology/Toxicology; Pharmacology &amp; Pharmacy; Medicine, Research &amp; Experimental; Pharmacology &amp; Toxicology</td>
<td>Iran</td>
</tr>
<tr>
<td>International Journal of Health Policy and Management</td>
<td>Public Health &amp; Health Care Science; Health Care Sciences &amp; Services; Health Policy &amp; Services; Social Sciences, General</td>
<td>Iran</td>
</tr>
<tr>
<td>Cell Structure and Function</td>
<td>Cell Biology; Cell &amp; Developmental Biology; Molecular Biology &amp; Genetics</td>
<td>Japan</td>
</tr>
<tr>
<td>Journal of the Physical Society of Japan</td>
<td>Physics; Physics, Multidisciplinary</td>
<td>Japan</td>
</tr>
<tr>
<td>Microbes and Environments</td>
<td>Biotechnology &amp; Applied Microbiology; Microbiology</td>
<td>Japan</td>
</tr>
<tr>
<td>Research in Astronomy and Astrophysics</td>
<td>Astronomy &amp; Astrophysics; Space Science; Earth Sciences</td>
<td>China</td>
</tr>
<tr>
<td>Markov Processes and Related Fields</td>
<td>Mathematics; Statistics &amp; Probability</td>
<td>Russia</td>
</tr>
<tr>
<td>Zoological Studies</td>
<td>Zoology; Animal Sciences; Plant &amp; Animal Science</td>
<td>Taiwan</td>
</tr>
</tbody>
</table>

can be easily identified; this issue should also be carefully considered. Therefore, it is necessary for each author to clarify what was posted as a preprint in the cover letter and to provide a detailed description of the reference format of preprint manuscripts if the journal allows citations of preprint manuscripts [15].

It is also crucial to consider the issues of duplication of information and long-term digital preservation due to the increase in preprint usage in the long term. Discussions should also be held on how long or on what level versions of a manuscript should be preserved if an author posts a manuscript as a preprint version and in an institutional repository at the same time, as the information may overlap, potentially affecting management capabilities and technology infrastructure costs.

Unlike commercial publishers, academic journal editors do not have many ways to find out about the latest publishing trends, so it is important to attend journal editor meetings such as those held by the Korean Council of Science Editors to learn the latest information. Therefore, it is important for associations such as the Korean Council of Science Editors to provide information on the latest publishing trends on the association’s website or through regular meetings to help editors acquire information on the latest publishing trends.

Limitation
Although the three authors double-checked each other’s work, it is possible that the information on the websites may have changed or been updated since the research was conducted between December 11, 2020 and January 8, 2021. Therefore, more in-depth research is needed on the preparation of preprint policies, encompassing an analysis of the difficulties in developing a preprint policy through surveys or interviews with the editors of academic journals.
Asian society journals’ preprint policies


Relationship between publication indicators and citation impact indicators for publications in business, management, and accounting listed in Scopus from 2015 to 2019

Hyunju Jang¹,²
¹Graduate School of Business, Sungkyunkwan University, Seoul, ²Research Intelligence, Elsevier Korea, Seoul, Korea

Abstract
Purpose: This study examined whether article-level publication indicators were related to citation impact indicators in the business, management, and accounting categories listed in Scopus. Article-level publication indicators included the number of authors, countries, and keywords, as well as title length, while citation impact indicators included the field-weighted citation impact (FWCI) at the article level and Scimago Journal Rank (SJR) at the journal level. The optimal values of four article-level publication indicators for maximizing the FWCI and SJR were calculated.

Methods: All publication and citation impact indicators were gathered for articles and reviews in the business, management, and accounting fields published from 2015 and 2019 and listed in Scopus and SciVal. Correlations between four article-level citation indicators and each citation impact indicator were analyzed.

Results: The number of authors was positively associated with the FWCI, while the number of countries and keywords was not associated with the FWCI or SJR. Title length was negatively associated with the FWCI and SJR. The optimal publication indicators to maximize the FWCI were four authors, three more countries, six keywords, and a title word count of 14 to 19. The optimal publication indicators to maximize the SJR were three to four coauthors, three to four countries of collaborators, five keywords, and a title word count of two to seven.

Conclusion: Authors aiming to get higher citations and publish in higher-ranking SJR journals in the business, management, and accounting categories are recommended to pay close attention to design of research team and the number of keywords and impactful title length so that the publication will have a higher likelihood of being accepted and receiving citations.

Keywords
Bibliometrics; Citation impact; Field-weighted citation impact; Publication indicator; Scimago Journal Rank
Introduction

Background/rationale: As the evaluation of research performance has shifted its focus from quantity to quality, citations have received considerable attention as an indicator of quality. Citation counts, as a way to measure impact, are widely acknowledged as the leading indicator used to assess the impact of scientific research, researchers, institutions, countries, and journals [1], although using citations to evaluate the quality of research has been criticized [2]. At many research institutions, citation impact has been linked with winning awards and professional recognition (e.g., recruitment, promotion, and incentives). Moreover, universities with a strong interest in university ranking have paid particular attention to citation impact, which has been employed as an evaluation indicators for the world, Asia, and subject rankings by QS (Quacquarelli Symonds), THE (Times Higher Education), and Academic Ranking of World Universities.

Citation impact is an indicator based on an analysis of the citations received by publications [3]. This indicator can be used to establish specific criteria for the performance of publications, researchers, and institutions compared to each other or a world average [4].

Over the years, empirical studies have attempted to determine publication indicators, including open access, international collaboration, number of authors, journal impact, reference impact, and view count. These are associated with citation impact and focus on specific journals or subject areas such as science, technology, and medicine in relation to countries [5-7].

Objectives: This study aimed to examine whether the number of keywords, title length, and the number of authors and their countries were related to citation impact indicators, including the field-weighted citation impact (FWCI) at the article level and the Scimago Journal Rank (SJR), in the fields of business, management, and accounting (BUSI) from 2015 to 2019 based on Scopus and SciVal.

We expect to provide researchers and publishers interested in the citation impacts of publications with valuable insights concerning strategic submissions, effective research team organization, and related decision-making.

Methods

Ethics statement: This study did not include human subjects, so neither approval by the institutional review board nor informed consent was required.

Study design: This was a bibliometric study based on a literature database.

Setting/data sources/variables: Literature data, including 206,819 articles or reviews from the BUSI fields published from 2015 to 2019, were extracted on September 30, 2020, from Scopus [8] and SciVal [9]. Data on the FWCI were collected from Scopus and SciVal (Dataset 1).

The publication indicators included the number of authors, the number of countries of collaborating authors, the number of authors’ keywords, and title length. The citation impact indicators included the article’s FWCI and the journal’s SJR. The FWCI is an indicator of mean citation impact that compares the actual number of citations received by a document with the expected number of citations for documents of the same document type (article, review, book, or conference proceeding), publication year, and subject area [3]. The SJR is a size-independent metric aimed at measuring the current average prestige per paper of journals for use in research evaluation processes [10]. The goal of this study was to provide evidence as to which of these variables are related to FWCI and SJR.

Bias: There was no bias in selecting the data for analysis.

Study size: All target journal articles in Scopus were included; therefore, there was no need for an estimate of the sample size.

Statistical method: The results are presented according to descriptive statistics. The relationship between publication indicators and citation impact indicators was investigated through a correlation analysis. IBM SPSS Statistics ver. 20.0 (IBM Corp., Armonk, NY, USA) was used for statistical analysis.

Results

Growth of publications and changes in the four indicators

The average annual growth rate of publications in BUSI from 2015 to 2019 was 13.3%. The number of articles per year was 32,875 in 2015, 36,007 in 2016, 39,598 in 2017, 44,117 in 2018, and 54,222 in 2019. The publication indicators such as the number of authors, countries, keywords, and title length per publication increased by an average of 2.8%, 1.9%, 2.9%, 1.0%, respectively, while the four indicators increased by 11.5%, 7.7%, 11.9%, and 4.2%, respectively, from 2015 to 2019 (Fig. 1, Table 1, Suppl. 1).

Relationships between publication indicators and FWCI

Number of authors: The proportion of articles with fewer than 10 coauthors was 99.8%. The most common number of coauthors per publication was two (29.4%), followed by three (27.7%), one (17.9%), and four (14.5%). The number of authors per article showed a positive correlation with the FWCI (r = 0.549, P = 0.002). The FWCI increased to 1.19 for two coauthors and rose linearly up to 1.53 for four coauthors, but then remained similar up to 10 coauthors. The highest FWCI (4.23) was found for articles with 11 or more coauthors, but this category only accounted for 0.2% of publications, so it...
was interpreted as an exceptional case. Therefore, in the case of four coauthors was found to have the most positive effect on the citation (Fig. 2, Suppl. 2).

**Number of countries:** The proportion of articles with international collaboration among researchers from up to 20 countries was 27.2%. The highest proportion of articles had authors from a single country (72.8%), followed by two countries (21.4%), three countries (4.7%), and four countries (0.9%). The FWCI increased by 51.3% if there was collaboration between authors from two more countries and by 100.6% when there were collaborators from three or more countries. The FWCI of papers with collaborators from seven to 20 countries was the highest, at 4.81, but the proportion of these collaborations was very low (0.04%), so it was difficult to interpret meaningfully. A positive, but non-significant correlation was found between the number of countries and the FWCI ($r = 0.483, P > 0.05$). As most papers were published by authors from a single country, and only 1.2% of articles were authored by collaborators from four or more countries the number of countries poorly predicted the FWCI of publications. Nonetheless, collaboration by authors from three or more countries was estimated to be relatively useful for citation impact (Fig. 3, Suppl. 2).

**Number of keywords:** The number of keywords ranged from 0 to 26. The most common number of keywords was five (30.5%), followed by four (21.7%) and six (19.0%), in an analysis limited to seven groups. There was no meaningful correlation between the number of keywords and the FWCI ($r = -0.055, P > 0.05$). The FWCI of articles with six keywords was the highest (1.47), followed by that of articles with seven to 10 keywords (1.35) or five keywords (1.34). Publications that provided six keywords attracted more attention and citations.
The title length by publication ranged from two to 39 words. The proportion of articles with a title length of fewer than 30 words was 99.9%. The proportion of articles with a title length of 11 or 12 words was the highest (9.6%), followed by that of articles with titles containing 13 words (8.7%) and nine or four words (8.0% each). Title length was negatively associated with the FWCI ($r = -0.587$, $P = 0.000$). When the title length was greater than 10 words, the FWCI increased to 1.27. If the title length consisted of 14 to 15 words or 16 to 19 words, the FWCI was highest (1.34). Therefore, a title length of 14 to 19 words is expected to be most effective for citations. Furthermore, not exceeding 19 words in the title will help articles receive more attention from researchers (Fig. 5, Suppl. 2).

**Fig. 2.** Correlation between the number of authors and field-weighted citation impact (FWCI). (A) Proportion of the articles by the number of authors, (B) correlation graph between the number of authors and the FWCI, and (C) proportion of the articles and FWCI value according to the number of authors.

**Fig. 3.** Correlation between the number of countries and field-weighted citation impact (FWCI). (A) Proportion of the articles by the number of countries, (B) correlation graph between the number of countries and FWCI, and (C) proportion of the articles and FWCI value according to the number of countries.

**Title length:** The title length by publication ranged from two to 39 words. The proportion of articles with a title length of fewer than 30 words was 99.9%. The proportion of articles with a title length of 11 or 12 words was the highest (9.6%), followed by that of articles with titles containing 13 words (8.7%) and nine or four words (8.0% each). Title length was negatively associated with the FWCI ($r = -0.587$, $P = 0.000$). When the title length was greater than 10 words, the FWCI increased to 1.27. If the title length consisted of 14 to 15 words or 16 to 19 words, the FWCI was highest (1.34). Therefore, a title length of 14 to 19 words is expected to be most effective for citations. Furthermore, not exceeding 19 words in the title will help articles receive more attention from researchers (Fig. 5, Suppl. 2).

**Number of authors:** As the number of authors of publications increased, there was a tendency for papers to be published in journals with higher SJR. However, the results were not statistically significant ($r = 0.264$, $P > 0.05$). Publications with a single author were published in journals with the lowest SJR (0.8). Publications with three authors tended to be published in the highest-impact journals (1.20). The SJR for articles with four authors was 1.19, that of publications with five or six authors was 1.08, and that of articles with 11 to 30 authors was
1.20, which was the same as for articles with three authors. However, as only 0.2% of publications had 11 to 30 authors, this finding is not considered meaningful. In short, articles with three to four authors had a more favorable distribution regarding the SJR (Fig. 6, Suppl. 2).

**Number of countries:** Papers written by authors from a single country had the lowest SJR (0.94), with the analysis limited to articles published by authors from seven or fewer countries. The SJR was higher (1.37) for articles with collaborators from two countries, and the highest SJR (1.80) was found for articles with authors from four countries. The SJR then decreased as the number of countries increased further. Thus, the SJR was highest for articles written by authors from three to four countries (Fig. 7, Suppl. 2). Nonetheless, the correlation was not statistically significant ($r = 0.436, P > 0.05$).

**Number of keywords:** As journals’ editorial policies state the number of author-provided keywords for a publication, authors should follow the guideline. The number of keywords was not meaningfully correlated with the SJR ($r = -0.019, P > 0.05$). Limiting the analysis to articles with seven or fewer authors had a more favorable distribution regarding the SJR (Fig. 6, Suppl. 2).
keywords, it was found that the SJR of journals with no keywords was 1.07, and the SJR was lowest (0.79) for those with one to three keywords. When there were five keywords, the SJR was 1.14, and it decreased to 1.07 when there were six keywords (Fig. 8, Suppl. 2). In other words, journals that included publications with five keywords showed the highest SJR. These high-quality journals manage and maintain the policy of allowing five keywords through their editorial policies.

**Title length:** Unlike keywords, title length can be decided by
the authors, although editorial policies also provide guidelines; thus, title length reflects both authorial intention and journal policy. The title length was negatively associated with the SJR. The SJR was 1.42 for journals with a title word count of two to seven ($r = -0.811$, $P = 0.000$). The SJR decreased for title word counts of eight or nine to 1.03. The SJR increased to 1.10 for journals with a title word count of 14 to 15. Journals with a high SJR were found to use impactful shorter titles with two to seven words (Fig. 9, Suppl. 2).

**Discussion**

**Interpretation:** This study measured publication indicators related to the citation impact of articles in the BUSI fields from 2015 to 2019. The number of authors per article was positively related to the FWCI; in contrast, the number of countries, the number of keywords and title length were negligibly or negatively related to the FWCI and SJR. Along with an annual growth rate of articles in BUSI of 13.3%, the number of authors, the number of countries, the number of keywords, and title length increased by 11.5%, 7.7%, 11.9%, and 4.2%, respectively from 2015 to 2019. The rise in the number of authors and participating in research teams, and the increasing diversity of those teams in terms of cross-national collaboration, may reflect an increasing number of researchers and closer collaboration between countries. It was also observed that the number of keywords and article length tended to increase, with the addition of subtitles following semicolons to differentiate articles from previous research, compete with similar articles, and increase articles’ visibility. However, a tendency was found for articles with longer titles to receive less interest and fewer citations. This result implies that authors should write articles with short and impactful titles.

**Limitation:** This research and results are limited to the specific fields of BUSI. Thus, future research should evaluate the citation impact of articles from different subject areas to determine the essential publication indicators for increasing the citation impact. Research should also investigate other diverse determinants, including new methodologies, while also incorporating interviews with researchers.

**Conclusion:** Researchers in the BUSI area should consider the design of the research team strategically in terms of the organization of the number of authors and countries to conduct research effectively and produce the best results. Moreover, researchers should try to seek opportunities to participate actively in international collaboration projects and maintain networks and receive strategic support from their institutions to organize research teams. Journals with a higher SJR index tend to have editorial policies regulating the number of keywords and title length. Therefore, when submitting papers to higher-SJR journals, authors should pay close attention to the number of keywords and impactful title length so that the publication will have a higher likelihood of being accepted and receiving citations. Authors who would like to publish papers in higher-ranking SJR journals in the business, management, and accounting categories are recommended to consider a research team of three more coauthors from multiple countries. To maximize the citation impact, four authors should be considered, with collaboration by researchers from at least two countries. The implication for authors or publishers in BUSI is that they need to properly understand citation impact indicators. Understanding the relationship between article-level publication indicators and citation impact indicators would assist in the development of plans to conduct more strategic research and increase their articles’ impact and visibility.
Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Data Availability

Dataset file is available from: the Harvard Dataverse at: https://doi.org/10.7910/DVN/0I1MVR

Dataset 1. Raw data of publication indicators of articles and citation impact indicators in the category of business, management, and accounting listed in Scopus from 2015 to 2019

Supplementary Material

Supplementary file is available from: the Harvard Dataverse at: https://doi.org/10.7910/DVN/0I1MVR

Suppl. 1. Growth percentage by publication indicators of articles in the category of business, management, and accounting listed in Scopus from 2015 to 2019

Suppl. 2. Relationship between article-level publication indicators and citation impact indicators

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Open access status of journals and articles in Journal Citation Reports

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Abstract
Purpose: There is somewhat of a difference between understanding the open access (OA) concept and practicing it by stakeholders. OA articles are mainly published by gold and hybrid OA journals, but the OA status may be confusing depending on the target databases. This study investigated the OA status of journals and articles and evaluated the extent to which OA2020 (publishing 90% of articles as OA) was achieved.

Methods: This study collected OA data by combining 2014-2019 data from Journal Citation Reports at the journal level with Web of Science at the article level. Finally, 12,449 journals were analyzed focusing on gold and hybrid OA journals, and progress towards the goal of OA2020 was evaluated.

Results: Even though 80.4% of Journal Citation Reports journals were gold and hybrid OA journals, only 20.9% of the articles were OA (gold OA journals, 16.6%; hybrid journals, 4.3%). The compound annual growth rate of the total articles was 4.7%, that of OA articles was 16.4%, and that of subscription articles was only 1.7%. Among the subscription journals, 77.4% had shifted to become hybrid journals, but only 5.2% of their articles were OA. Therefore, the hybrid journals were at the very early stage of OA publishing.

Conclusion: Considerable progress must still be made to achieve the goal of OA2020. The influence of OA publishing will eventually expand and therefore, librarians should take interest in OA publishing for the library services.

Keywords
Article processing charge; Gold open access journal; Hybrid journal; Journal Citation Reports; Open access

Introduction

Background/rationale: Competitive research activities and computer-aided publishing technology have led to explosive growth in e-journals over the past 20 years. This has led to steady increases in libraries’ budgets for journal subscriptions. The digital divide in e-journals has
resulted in the emergence of the open access (OA) concept, which allows anyone to freely access and reuse articles without any barriers. While print journals usually have limitations in the number of articles for each issue, there is no such limitation in e-journals, which are distributed on the internet. Therefore, e-journal publishers introduced a new publishing model, wherein an article processing charge (APC) is charged for authors instead of a journal subscription fee for readers. In APC-based OA publishing, the author owns the copyright for the article by paying an APC to the publisher directly, and determines the terms of use by applying a Creative Commons License. OA publishing is a new business model, and the global OA movement is developing in complex and diverse ways. Therefore, it is necessary to assess the progress that has been made towards achieving the goal of OA2020, which aims to convert more than 90% of the articles annually published worldwide (about 2 million) to OA [1].

As shown in Fig. 1, there are several variants of OA types at the journal level or the article level. Journal-based OA types can be divided into hybrid OA and gold OA, while article-based OA types are black, green, bronze, and gold OA. In an analysis of the status of OA articles as of June 2020 in Dimensions, Scopus, and Web of Science (WoS), gold and bronze OA articles comprised 18.4%, 13.7%, and 15.9% of articles, respectively. Most subscription journals are currently hybrid journals with an optional model in which the author can convert an article to OA by paying an APC. Therefore, hybrid journals are a mixture of open articles and closed articles. There are two types of gold OA journals: gold OA journals without APCs, which are mainly published by non-profit organizations that cover all the publication costs, and gold OA journals with APCs, where the authors bear the costs of APCs for each article.

Each bibliographic database contains articles with different document types, and there are also generally differences among databases in terms of the evaluation criteria for journals and the classification of OA types. Consequently, it is difficult to determine how global OA status should be assessed in terms of OA type and level. Some studies have investigated the status of OA publishing [2], but have not provided reliable information on OA status. Scopus does not subdivide its content by OA types, whereas WoS defines OA types at the journal and article levels. Journal Citation Reports (JCR) classifies journals by OA type, but it only provides the number of OA articles for the last 3 years and its data cannot be downloaded. Therefore, combining data from WoS at the article level and JCR at the journal level was chosen as the most appropriate method for reliable research on the current status of OA publishing.

**Objectives:** Librarians in charge of journal and article services need to grasp the current situation regarding OA accurately, and then prudently predict and prepare for the future of academic publishing and journal subscription. OA articles are mainly published in gold and hybrid OA journals. This study investigated the transition status of traditional subscription journals to the OA publishing model as well as the current status of gold OA journals. It also focused on their growth rate and the ratio of subscription articles to OA articles. We also analyzed the largest existing publishers, along with new OA publishers. This study’s ultimate objective was to evaluate the degree to which the goal of OA2020 has been achieved in JCR and to explore its feasibility for libraries facing the serials crisis. These results will provide useful information for librarians regarding OA status.

**Methods**

**Ethics statement:** This was not a study with human subjects, so neither institutional review board approval nor informed consent was required.

**Study design:** This was a literature database-based descriptive study.

**Data collection and analysis:** As this study aimed to assess the OA publication status from the library budget perspective,
gold and hybrid OA journals were analyzed at the journal level. JCR data from 2014 to 2019 and WoS were used to obtain up-to-date and exact information on OA status (Dataset 1). To obtain information about OA status, WoS was searched in June 2020 for SCIE and SSCI articles with the queries of “document type is article or review” and “year range is from 2014 to 2019,” which yielded 9,959,063 articles in 12,561 journals. Subsequently, the search results were limited by the OA type as “Directory of Open Access Journals (DOAJ)-Gold” and “Other Gold”, and were downloaded by year. The WoS data on OA articles were integrated with the JCR journal list. In this process, 1,600 journals whose journal names did not match each other were investigated manually. However, 69 journals not contained in the JCR journal list and 96 journals with no articles in WoS were excluded. Finally, 9,575,780 articles in 12,449 journals were acquired, and this study analyzed 96% of the articles in the results of the WoS search. Therefore, there was no significant difference between this study, which combined JCR and WoS, and a study design that would be fully based on WoS.

In order to analyze the OA status more precisely, the OA type of journals based on WoS was redefined in this study. First, “DOAJ-Gold” journals were classified as gold OA journals and “Other Gold” as hybrid journals. Subsequently, gold OA journals were divided into gold OA journals without APCs and gold OA journals with APCs. The journals for which the APC was listed as free in DOAJ and determined to be 0 USD in the author’s previous study [3] were classified as gold OA journals without APCs, and the rest as gold OA journals with APCs. The final judgment was made through a comprehensive consideration of 6 years of OA articles in WoS and 3 years of OA articles in JCR. In this study, the number of articles per journal was based on the citable items in JCR 2014 to 2019, while the number of OA articles in each hybrid journal was determined by applying the search results of WoS.

**Statistical methods:** This study was based on gold and hybrid OA journals and only descriptive statistics were presented. Data were tabulated and the proportions of the cells were calculated. The compound annual growth rate (CAGR) was calculated.

**Results**

**The OA journals and articles in JCR**

The classification results of the JCR 2014 to 2019 journals by OA type are shown in Table 1. Gold OA journals accounted for only 13.2% of journals, while hybrid and subscription-only journals accounted for 67.2% and 19.6%, respectively. Regardless of the number of OA articles, OA publishing was an option for 80.4% of JCR journals, while only 19.6% strictly adhered to a subscription model. The gold OA journals were divided into 317 gold OA journals without APCs and 1,323 gold OA journals with APCs. The hybrid journals were subdivided into a large group of 4,462 journals that had published more than 10 OA articles over the course of 6 years and a small group of 3,907 journals that had published fewer than 12 OA articles. However, in the former group, the average number of OA articles per journal was only 15 articles annually. The latter group comprised hybrid journals in terms of the APC and the journal price in the previous study [3], but 589 of these journals had not published any OA articles in 6 years. Thus, most of the hybrid journals were at the early stage of OA publishing.

In the JCR 2014 to 2019, the total number of OA articles reached about 2 million, accounting for 20.9% of all articles (16.6% from gold OA journals and 4.3% from hybrid journals). In a comparison limited to the gold and hybrid OA types, the ratio of OA journals was 16:84, but that of OA articles was 79:21, showing the opposite tendency. Therefore, the gold OA journals published about four times more OA articles than the hybrid journals, and the majority of OA articles were from the gold OA journals.

**Annual growth of OA journals and articles**

The share of OA articles increased from 16.0% in JCR 2014 to 27.1% in JCR 2019. Over the past 6 years, the total number of articles increased at a CAGR of 4.7%. The CAGR of OA articles was 16.4%, while that of subscription articles was 1.7%, including hybrid and subscription-only journals (Table 2). Therefore, OA articles have contributed significantly to the growth of WoS and JCR. The gold OA journals increased more than the hybrid journals, but the subscription-only journals decreased. Finally, the total number of JCR journals increased at a CAGR of 1.8%. The CAGR of the OA articles was higher in the hybrid journals than in the gold OA jour-
OA publishing trends of the major publishers
To analyze the current status of OA journals and articles published by major publishers, this study defined Hindawi-Wiley journals as Hindawi journals and separated BioMed Central (BMC) from Springer. The top five subscription and OA publishers were selected based on the number of OA articles (Table 3). For 6 years, the top five subscription publishers accounted for 30.2% of all OA articles and the top five OA publishers for 35.3%. Therefore, the 10 major publishers accounted for the majority of OA publishing (65.5%). Nine publishers, excluding Taylor & Francis, published more than 10,000 OA articles annually. Elsevier and Wiley had more hybrid OA articles than gold OA articles. Some of the journals published by the top five OA publishers were mega-journals. Even though BMC was considered separately, Springer was still the top publisher in JCR with the highest number of OA articles. "Scientific Reports" and "Nature Communications" made

<table>
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<tr>
<th>Item</th>
<th>OA type</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>CAGR (%)</th>
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<tr>
<td>Journal</td>
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<td>240</td>
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<td>202,668</td>
<td>218,814</td>
<td>236,681</td>
<td>252,722</td>
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</table>

OA, open access; CAGR, compound annual growth rate; APC, article processing charge.

OA, open access; RSC, Royal Society of Chemistry; T&F, Taylor & Francis; BMC, BioMed Central; PLoS, Public Library of Science; CAGR, compound annual growth rate.

OA publishing trends of the major publishers
To analyze the current status of OA journals and articles published by major publishers, this study defined Hindawi-Wiley journals as Hindawi journals and separated BioMed Central (BMC) from Springer. The top five subscription and OA publishers were selected based on the number of OA articles (Table 3). For 6 years, the top five subscription publishers accounted for 30.2% of all OA articles and the top five OA publishers for 35.3%. Therefore, the 10 major publishers accounted for the majority of OA publishing (65.5%). Nine publishers, excluding Taylor & Francis, published more than 10,000 OA articles annually. Elsevier and Wiley had more hybrid OA articles than gold OA articles. Some of the journals published by the top five OA publishers were mega-journals. Even though BMC was considered separately, Springer was still the top publisher in JCR with the highest number of OA articles. "Scientific Reports" and "Nature Communications" made
outstanding contributions in this regard. Excluding these journals, Springer had a similar number of OA articles as Elsevier and Public Library of Science (PLoS). Among the 10 selected major publishers, after Springer, the number of OA articles was highest for MDPI, followed in order by BMC, PLoS, and Elsevier. The Royal Society of Chemistry (RSC), which ranked 10th in the total number of articles in a previous study [4], was included in the top five subscription publishers for OA articles, revealing that the RSC made a disproportionate contribution to OA publishing. Elsevier seemed to settle for OA publishing, passively focusing on conditional hybrid OA. Regarding the CAGR for OA articles, PLoS and RSC showed low rates due to the increase in publications by competing journals, while BMC and Hindawi showed relatively low growth rates compared to other publishers. The most active publishers was MDPI, followed in order by Wiley and Frontiers. The overall CAGR for OA articles of the 10 publishers was, on average, 18.0% over the past 6 years.

**Discussion**

**Progress towards achieving OA2020**

In some recent studies, the proportion of OA articles varied according to the year and database in terms of OA types (Table 4) [5-7]. Unlike other studies, this study investigated the number of OA articles over 6 years, limiting its scope to JCR journals. In JCR 2014 to 2019, the number of OA journals, including hybrid journals, was 80.4%, but the number of OA articles was still small (20.9%). Gold OA journals published disproportionately many OA articles relative to their share of journals, but hybrid OA journals showed the opposite tendency. The percentage of OA articles increased gradually, to the point that they now account for more than a quarter of JCR articles.

With respect to the transition of subscription journals to an OA model, which is of interest to librarians, 77.4% of journals had shifted to hybrid journals, but 22.6% continued to adhere to the subscription-only model. Despite the very high CAGR for OA articles (25.2%) in hybrid journals, OA articles accounted for only 5.2%, and the rest (94.8%) were still subscription articles.

Although commercial publishers had actively launched new APC-based gold OA journals and transformed their excellent subscription journals into hybrid journals, considerable progress must still be made for the goal of OA2020 to be achieved. However, the Plan S movement in Europe [8], which encourages research funded by the public grants to be published as OA articles, will accelerate progress towards OA2020.

**Characteristics of the major OA publishers**

The top five OA publishers led the growth of OA publishing, accounting for a higher share of OA articles than the top five subscription publishers. In the top five subscription publishers, the gold OA articles’ ratio to the hybrid OA articles was 58:42, indicating that the major commercial publishers made efforts for OA publishing. For the past 6 years, the number of gold OA articles was the highest for MDPI, followed in order by Springer, BMC, and PLoS, but the number of gold OA journals was highest for BMC, followed in order by Springer and Elsevier. Meanwhile, PLoS had the highest number of OA articles with the fewest journals. In all JCR journals, the number of articles grew annually at an average rate of 4.7%, but the CAGRs for OA journals and articles was much higher than those of subscription journals and articles. Therefore, OA articles primarily contributed to the recent growth of WoS and JCR. Although many authors publish their articles in gold OA journals due to the relatively inexpensive APCs and rapid publishing, they are not yet willing to pay APCs for hybrid journals.

**Limitation:** Even though JCR is produced based on WoS, we found differences between these two sources in terms of identifying the OA type of each journal and extracting the number of OA articles from WoS. As of June 2020, there were 1,652 DOAJ-Gold journals in JCR 2019, but 1,796 DOAJ-Gold journals were found in WoS. This study classified 1,640 journals as gold OA journals, which were duplicated in both JCR and WoS. The Korean branch of Clarivate Analytics reported that 7,487 hybrid journals were included in the recent-

**Table 4. Comparison of the share of OA articles in several studies**

<table>
<thead>
<tr>
<th>Study</th>
<th>Investigated DB</th>
<th>OA type</th>
<th>Investigated year</th>
<th>OA share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present study</td>
<td>JCR with WoS</td>
<td>Gold + hybrid</td>
<td>2019</td>
<td>27.1</td>
</tr>
</tbody>
</table>

OA, open access; WoS, Web of Science; JCR, Journal Citation Reports.
ly released JCR 2019, but 7,780 JCR journals had OA articles in WoS. Finally, this study classified 8,369 journals as hybrid journals, including 589 journals with no OA articles in WoS despite their hybrid type. In this study, the OA type of each journal was considered as having existed for 6 years, even if its OA type was changed or it was founded as a new OA journal in 2014 to 2019. Therefore, there may be inconsistencies in each journal’s OA type between the period encompassed in the study and 2020. Moreover, the number of hybrid OA articles reflected the WoS search results, but the number of gold OA articles was determined by analyzing the citable items in JCR. These important limitations should be kept in mind when interpreting this research.

**Conclusion:** As a result of this study based on JCR 2014 to 2019, considerable progress must still be made for OA2020 to be achieved. New OA publishers primarily contributed to the increase in OA articles. APC-based gold OA journals are springing up everywhere, giving rise to controversies regarding predatory publishing. Nonetheless, many authors prefer these new gold OA journals because of their rapid publication process compared to traditional journals. OA publishing will have a major influence on stakeholders. Therefore, librarians should take an active interest in OA publishing to appropriately predict and prepare for the library’s future in relation to journal services, including subscriptions.

**Conflict of Interest**

No potential conflict of interest relevant to this article was reported.

**Funding**

The authors received no financial support for this article.

**Data Availability**

Data are available from the author upon reasonable request.

**References**


**Dataset 1.** Collected data for OA journals and articles in WoS and JCR 2014 to 2019
Influence of open access journals on the research community in Journal Citation Reports

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Abstract
Purpose: The number of open access (OA) journals is rapidly increasing, and it is very important for librarians to understand the influence of OA journals on the research community. This study investigated the influence of the OA journals listed in Journal Citation Reports (JCR) based on various indicators.

Methods: The data for this study were prepared by combining the JCR 2014 to 2019 journal list with the number of hybrid OA articles obtained by searching the Web of Science. Each journal's JCR indicators and article processing charge were added. The influence of OA journals was compared according to OA type, whether they were published by large publishers, and whether they were top gold OA journals.

Results: Gold OA journals remained weaker in terms of JCR indicators than hybrid journals. However, the top 20 gold OA journals, accounting for 27.0% of all OA articles in JCR 2014 to 2019, were superior in all JCR indicators. The top three OA publishers (MDPI, BioMed Central, and Public Library of Science) showed potential for development despite concerns regarding poor journals. The top three subscription publishers were very active in OA publishing, but their actual share of hybrid OA articles (Elsevier, 5.1%; Springer, 10.1%; and Wiley, 12.4% in JCR 2019) was still insufficient.

Conclusion: Some gold OA journals showed high competitiveness and even the possibility for development beyond traditional journals. The transition of subscription journals to hybrid journals was found to be at the early stage. In light of these findings, librarians should continue monitoring the influence of OA journals.

Keywords
Gold open access journal; Hybrid journal; Journal Citation Reports indicator; Mega journal; Open access
Introduction

Background/rationale: As venues for scholarly communication, academic journals have contributed to the development of science and technology. In the traditional model, publishers sell journals to libraries for a subscription fee after acquiring the copyright of the article from the author, in exchange for publishing it in their journal and distributing it worldwide. Unlike traditional print journals, many e-journals have adopted the open access (OA) concept, allowing anyone free access and reuse of articles on the internet. The OA movement, which aims to promote OA to research, has been developed in two major directions: one is publishing articles that are OA from the time of initial publication (gold OA) with the author’s agreement, and the other is sharing the articles before or after publication through self-archiving or institutional repositories (green OA). From the user’s point of view, some articles are inside the paywall and require subscription fees, while others are outside the paywall and freely open to anyone.

Article processing charge (APC)-based gold OA journals published by new OA publishers are springing up everywhere, and even traditional subscription publishers are participating in this change with the new release of APC-based gold OA journals or the conversion of subscription journals to hybrid journals. Institutional budgets are increasing due to the APCs added onto the subscription fees. Many publishers have an opportunity to obtain more profits by combining the APC business model with the subscription business model. In this situation, librarians who are dissatisfied with high journal subscription fees have pushed for off-set agreements deducting the share of APCs already paid by authors from the subscription fee. In recent years, attempts have even been made to implement read-and-publish agreement, which based subscription fees combining APCs to expedite OA publishing [1]. Like this, authors, users, and publishers understand the OA movement from diverse aspects and put it into practice in specific ways.

OA journals are rapidly growing to a degree that may be sufficient to change the traditional academic publishing ecosystem. The OA movement is certainly a new change that librarians have experienced since the 2000s, when many print journals were converted to e-journals. Excellent gold OA journals are appearing despite controversies regarding the formal peer review system and several examples of predatory journals. Librarians need to investigate the real influence of gold and hybrid OA journals on the research community in order to provide better library services.

Objectives: After a previous study on the general status of OA at the journal and article level [2], we had several questions such as “How strong is the influence of gold OA journals?”, “Which are the most influential gold OA journals?”, “How many subscription journals have been converted to hybrid journals?”, and “Is there any difference in the influence of OA journals according to whether they are published by subscription or OA publishers?” To address these questions, this study conducted an in-depth analysis of OA journals in Journal Citation Reports (JCR) 2014 to 2019 based on JCR indicators and APCs. We compared OA journals’ influence by OA type, whether they were published by large publishers, and whether they were top gold OA journals. Types of OA were defined in the same way as in the author’s previous study [2]. The results of this study will provide useful information for librarians, researchers, and publishers who are interested in the future of OA publishing.

Methods

Ethics statement: This was not a study with human subjects, so neither institutional review board approval nor informed consent was required.

Study design: This was a literature database-based observational study.

Data collection: In the author’s previous study [2], the journal list in JCR 2014 to 2019 and the OA articles searched from the Web of Science were combined, and 9,575,780 articles in 12,449 journals were finally collected (Dataset 1). That is, the total number of articles in each journal was defined as the number of citable items in JCR, but the number of hybrid OA articles was defined based on the search results in Web of Science. To further investigate the influence of OA journals on the research community, this study added JCR indicators and the APC of each journal to the collected data. The JCR indicators used for the in-depth analysis were citations, the average journal impact factor percentile (AJIFP), impact factor, Eigenfactor score, and article influence score (AIS). However, the APC was collected for the top 10 subscription [3] and OA publishers [2] from February to April 2020, so the findings of this study do not reflect the APC of all JCR journals.

Statistical methods: This study was based on gold and hybrid OA journals and the articles therein; therefore, only descriptive statistics were presented. Data were tabulated and the proportions of the cells were calculated. The growth rate (%) was calculated in terms of the compound annual growth rate (CAGR).

Results

Characteristics of OA journals by OA type
As shown in Table 1, distinct patterns were found for the JCR indicators of journals by OA type. The annual number of arti-
cles per journal was 127 in JCR 2014 to 2018 [3], but increased to 128 in JCR 2014 to 2019. Most of the gold OA journals with APCs, which are published for commercial purposes, contained an average of 184 articles per year. However, it was interesting that large hybrid journals, which published more than 12 OA articles over the course of 6 years, published more articles than even the gold OA journals. In contrast, small hybrid journals that published fewer than 12 OA articles and subscription-only journals published fewer articles, corresponding to less than half of the annual articles per journal. All of the JCR indicators except for the AIS were higher for the gold OA journals without APCs, which are published for non-profit purposes, than for the subscription only journals; however, most of the indicators related to citations, including the number of articles per journal, were lower than those of other journal types and even lower than the overall average of JCR journals. Therefore, the gold OA journals without APCs had relatively low popularity. The average APC for the gold OA journals was lower than that of hybrid journals. Excluding the small hybrid journals, all JCR indicators in the large hybrid journals were significantly higher than those of other journal types, although the APC was expensive. With their relatively high popularity, they composed the core journals in the JCR. However, all JCR indicators were lower for the subscription-only journals than for the average of all JCR journals.

Table 1. Comparison of JCR indicators across journals by OA type

<table>
<thead>
<tr>
<th>OA type</th>
<th>Journal</th>
<th>APC(^a) (USD)</th>
<th>Average JCR indicator</th>
<th>Article(^b)</th>
<th>Citation(^b)</th>
<th>AJIFP (%)</th>
<th>IF</th>
<th>ES</th>
<th>AIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold OA</td>
<td>Without APC</td>
<td>317</td>
<td>68</td>
<td>363</td>
<td>31.9</td>
<td>1.365</td>
<td>0.00422</td>
<td>0.416</td>
<td></td>
</tr>
<tr>
<td></td>
<td>With APC</td>
<td>1,323</td>
<td>184</td>
<td>496</td>
<td>37.5</td>
<td>1.831</td>
<td>0.00821</td>
<td>0.521</td>
<td></td>
</tr>
<tr>
<td>Hybrid OA</td>
<td>Larger(^c)</td>
<td>4,462</td>
<td>201</td>
<td>1,647</td>
<td>59.1</td>
<td>2.944</td>
<td>0.01516</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Small(^c)</td>
<td>3,907</td>
<td>70</td>
<td>393</td>
<td>43.1</td>
<td>1.819</td>
<td>0.00359</td>
<td>0.667</td>
<td></td>
</tr>
<tr>
<td>Subscription only</td>
<td>2,440</td>
<td>-</td>
<td>66</td>
<td>247</td>
<td>28.7</td>
<td>1.288</td>
<td>0.00239</td>
<td>0.568</td>
<td></td>
</tr>
<tr>
<td>Total(^d)</td>
<td>12,449</td>
<td>2,886</td>
<td>128</td>
<td>820</td>
<td>45.0</td>
<td>2.102</td>
<td>0.00797</td>
<td>0.744</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Publisher</th>
<th>APC(^a) (USD)</th>
<th>Gold OA in 6 years</th>
<th>Average JCR indicator</th>
<th>Article(^b)</th>
<th>Citation(^b)</th>
<th>AJIFP (%)</th>
<th>IF</th>
<th>ES</th>
<th>AIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elsevier</td>
<td>1,928</td>
<td>97</td>
<td>52,473</td>
<td>229,011</td>
<td>90</td>
<td>37.3</td>
<td>2.186</td>
<td>0.00552</td>
<td>0.574</td>
</tr>
<tr>
<td>Springer</td>
<td>2,380</td>
<td>104</td>
<td>172,335</td>
<td>526,598</td>
<td>276</td>
<td>38.8</td>
<td>2.478</td>
<td>0.01806</td>
<td>0.776</td>
</tr>
<tr>
<td>Wiley</td>
<td>2,420</td>
<td>65</td>
<td>44,254</td>
<td>143,655</td>
<td>114</td>
<td>48.2</td>
<td>2.852</td>
<td>0.00628</td>
<td>0.974</td>
</tr>
<tr>
<td>MDPI</td>
<td>1,509</td>
<td>71</td>
<td>210,910</td>
<td>257,865</td>
<td>495</td>
<td>36.2</td>
<td>1.566</td>
<td>0.00733</td>
<td>0.249</td>
</tr>
<tr>
<td>BMC</td>
<td>2,450</td>
<td>226</td>
<td>166,351</td>
<td>682,478</td>
<td>123</td>
<td>50.4</td>
<td>2.535</td>
<td>0.00760</td>
<td>0.782</td>
</tr>
<tr>
<td>PLoS</td>
<td>2,506</td>
<td>20</td>
<td>148,196</td>
<td>705,664</td>
<td>3,529</td>
<td>90.0</td>
<td>6.451</td>
<td>0.32631</td>
<td>3.304</td>
</tr>
<tr>
<td>Total of gold OA</td>
<td>2,118</td>
<td>1,648</td>
<td>1,587,002</td>
<td>4,631,496</td>
<td>264,500</td>
<td>36.5</td>
<td>1.744</td>
<td>0.00745</td>
<td>0.502</td>
</tr>
</tbody>
</table>

JCR, Journal Citation Reports; OA, open access; APC, article processing charge; USD, US dollar; AJIFP, average journal impact factor percentile; IF, impact factor; ES, Eigenfactor score; AIS, article influence score.

\(^a\)APC per journal was based on the authors’ previous study [4] and some added journals;
\(^b\)The data were calculated per journal in JCR 2014 to 2019;
\(^c\)The large journals published more than 12 OA articles in JCR 2014 to 2019 and the small journals published fewer than 12 OA articles in 6 years;
\(^d\)Total journals in JCR 2014 to 2019.

Table 2. Comparison of the six major publishers of gold OA journals with JCR indicators

<table>
<thead>
<tr>
<th>Publisher</th>
<th>APC(^a) (USD)</th>
<th>Gold OA in 6 years</th>
<th>Average JCR indicator</th>
<th>Article(^b)</th>
<th>Citation(^b)</th>
<th>AJIFP (%)</th>
<th>IF</th>
<th>ES</th>
<th>AIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elsevier</td>
<td>1,928</td>
<td>97</td>
<td>52,473</td>
<td>229,011</td>
<td>90</td>
<td>37.3</td>
<td>2.186</td>
<td>0.00552</td>
<td>0.574</td>
</tr>
<tr>
<td>Springer</td>
<td>2,380</td>
<td>104</td>
<td>172,335</td>
<td>526,598</td>
<td>276</td>
<td>38.8</td>
<td>2.478</td>
<td>0.01806</td>
<td>0.776</td>
</tr>
<tr>
<td>Wiley</td>
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<td>65</td>
<td>44,254</td>
<td>143,655</td>
<td>114</td>
<td>48.2</td>
<td>2.852</td>
<td>0.00628</td>
<td>0.974</td>
</tr>
<tr>
<td>MDPI</td>
<td>1,509</td>
<td>71</td>
<td>210,910</td>
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<td>1.566</td>
<td>0.00733</td>
<td>0.249</td>
</tr>
<tr>
<td>BMC</td>
<td>2,450</td>
<td>226</td>
<td>166,351</td>
<td>682,478</td>
<td>123</td>
<td>50.4</td>
<td>2.535</td>
<td>0.00760</td>
<td>0.782</td>
</tr>
<tr>
<td>PLoS</td>
<td>2,506</td>
<td>20</td>
<td>148,196</td>
<td>705,664</td>
<td>3,529</td>
<td>90.0</td>
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<td>0.32631</td>
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<td>264,500</td>
<td>36.5</td>
<td>1.744</td>
<td>0.00745</td>
<td>0.502</td>
</tr>
</tbody>
</table>

OA, open access; JCR, Journal Citation Reports; APC, article processing charge; USD, US dollar; AJIFP, average journal impact factor percentile; IF, impact factor; ES, Eigenfactor score; AIS, article influence score; BMC, BioMed Central; PLoS, Public Library of Science.

\(^a\)APC per journal was based on the authors’ previous study [4] and some added journals;
\(^b\)The data were calculated per journal in JCR 2014 to 2019.

Influence of gold OA journals by publishers

Based on the number of gold OA articles [2], the top three publishers with a subscription model or an OA model were selected. Hybrid OA articles were counted together in the selection of the top three subscription publishers, but only gold OA journals were used to compare JCR indicators. Among the top three subscription publishers, Springer was the most active in OA publishing, while Elsevier remained relatively inactive (Table 2). Although Elsevier offered low APCs, it published the fewest OA articles per journal. Elsevier and Spring-
had a comparable average AJIFP to that of MDPI, so the largest three publishers did not yet have as favorable a reputation in gold OA journals as they had in subscription journals. Public Library of Science (PLoS) had the highest average number of OA articles and citations per journal with the fewest journals, even though it had the most expensive APC among the six publishers. PLoS also overwhelmed the other publishers regarding the remaining four JCR indicators, suggesting the success of its OA journals. MDPI and Springer had the next highest average numbers of OA articles and citations per journal. MDPI published the largest amount of OA articles with the lowest APC, and was the least competitive in the four JCR indicators excluding Eigenfactor score.

### Mega-gold OA journals in OA publishing

The top 20 gold OA journals, which published more than 10,000 OA articles over the course of 6 years, were as follows, in descending order: PLoS One, Scientific Reports, RSC Advances, Nature Communications, IEEE Access, and Optics Express, and so on (Table 3). These journals, which exert a major influence on the research community, are mega-OA journals that were newly created for OA publishing, and accounted for 27.0% of all OA articles in JCR 2014 to 2019. In particular, the top 20 gold OA journals were superior in all JCR indicators.

### Table 3. Comparison of the top 20 mega-OA journals with JCR indicators

<table>
<thead>
<tr>
<th>Journal</th>
<th>APC(^a) (USD)</th>
<th>In 6 years</th>
<th>Average JCR indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Article</td>
<td>Citation</td>
<td>Article(^b)</td>
</tr>
<tr>
<td>PLoS One</td>
<td>1,695</td>
<td>129,682</td>
<td>531,391</td>
</tr>
<tr>
<td>Scientific Reports</td>
<td>1,870</td>
<td>96,924</td>
<td>175,381</td>
</tr>
<tr>
<td>RSC Advances</td>
<td>958</td>
<td>50,375</td>
<td>102,302</td>
</tr>
<tr>
<td>Nature Communications</td>
<td>5,380</td>
<td>24,357</td>
<td>162,206</td>
</tr>
<tr>
<td>IEEE Access(^d)</td>
<td>1,750</td>
<td>24,164</td>
<td>13,394</td>
</tr>
<tr>
<td>Optics Express</td>
<td>1,842</td>
<td>18,959</td>
<td>100,455</td>
</tr>
<tr>
<td>International Journal of Molecular Sciences</td>
<td>1,987</td>
<td>18,300</td>
<td>37,347</td>
</tr>
<tr>
<td>Sensors</td>
<td>1,987</td>
<td>18,049</td>
<td>32,264</td>
</tr>
<tr>
<td>Medicine</td>
<td>1,800</td>
<td>17,820</td>
<td>16,617</td>
</tr>
<tr>
<td>Sustainability</td>
<td>1,789</td>
<td>17,004</td>
<td>11,996</td>
</tr>
<tr>
<td>Molecules</td>
<td>1,987</td>
<td>14,507</td>
<td>29,823</td>
</tr>
<tr>
<td>Biomed Research International</td>
<td>2,200</td>
<td>14,134</td>
<td>25,230</td>
</tr>
<tr>
<td>BMJ Open</td>
<td>2,806</td>
<td>13,403</td>
<td>17,561</td>
</tr>
<tr>
<td>Frontiers in Microbiology</td>
<td>2,950</td>
<td>12,705</td>
<td>25,217</td>
</tr>
<tr>
<td>Energies</td>
<td>1,789</td>
<td>12,685</td>
<td>12,183</td>
</tr>
<tr>
<td>International Journal of Environmental</td>
<td>1,987</td>
<td>12,475</td>
<td>14,226</td>
</tr>
<tr>
<td>Research and Public Health</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Journal of High Energy Physics</td>
<td>Free</td>
<td>12,202</td>
<td>79,538</td>
</tr>
<tr>
<td>Frontiers in Psychology</td>
<td>2,950</td>
<td>12,008</td>
<td>18,680</td>
</tr>
<tr>
<td>Oncotarget(^d)</td>
<td>3,400</td>
<td>10,808</td>
<td>7,434</td>
</tr>
<tr>
<td>Materials</td>
<td>1,987</td>
<td>10,292</td>
<td>12,839</td>
</tr>
<tr>
<td>Average(^b)</td>
<td>2,269</td>
<td>27,043</td>
<td>71,304</td>
</tr>
<tr>
<td>20 gold OA journals</td>
<td>2,118</td>
<td>968</td>
<td>2,824</td>
</tr>
<tr>
<td>All gold OA journals</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OA, open access; JCR, Journal Citation Reports; APC, article processing charge; USD, US dollar; AJIFP, average journal impact factor percentile; IF, impact factor; ES, Eigenfactor score; AIS, article influence score.

\(^a\)APC per journal was based on the authors’ previous study [4] and some added journals; \(^b\)The data were calculated per journal in JCR 2014 to 2019; \(^c\)IEEE Access was based on JCR 2016 to 2019 since it was listed in JCR; \(^d\)Oncotarget was based on JCR 2014 to 2016 as it was excluded from JCR.
overwhelming all other gold OA journals, and even had higher values for these indicators than the large hybrid journals, which were traditional journals with high authority and a long reputation. Table 3 shows the influence of the 20 mega-gold OA journals, which lead the domain of OA publishing, based on JCR indicators. Some of the APCs were somewhat expensive, but became cheaper (2,096 US dollars on average) when the exceptionally expensive Nature Communications was excluded. Therefore, the top 20 gold OA journals demonstrated excellence in both academic influence and economics. In terms of the average AJIFP, eight journals were ranked in Q1 and nine journals in Q2.

Regarding the challenges of gold OA journals published by subscription publishers, Springer tried a very expensive APC for Nature Communications; in contrast, society publishers such as the Royal Society of Chemistry, Institute of Electrical and Electronics Engineers, and Optical Society of America started carefully with lower APCs. Looking closely at the seven gold OA journals (excluding Oncotarget) ranked in Q1 in terms of their average AJIFP, six journals (excluding PLoS One) continuously remained in Q1 for 6 years (Table 4).

OA publishing of the top three subscription publishers

The top three subscription publishers, including Elsevier, Springer, and Wiley, were analyzed for 6 years (Table 5). For non-OA articles, which readers access through subscription fees, the CAGR of Elsevier and Springer was higher than that of all JCR journals, but Wiley had a lower CAGR. In contrast, for hybrid OA articles, the CAGR of Elsevier and Springer was lower than that of all JCR journals, but Wiley showed a very high CAGR, with an actively increasing number of hybrid OA articles even though it started slightly later. Among the top three subscription publishers, Wiley had the highest share of hybrid OA articles in 2019, whereas Elsevier remained passive, with the lowest share (Fig. 1).

Discussion

Key implications for gold and hybrid OA journals

OA publishing is proceeding in two main directions: gold OA journals as a new business model and hybrid journals combined with the existing subscription model. The JCR indicators were used for an in-depth analysis of the influence of these OA journals. Most old and well-known subscription journals have shifted to the hybrid model, while 23% of journals still remained subscription-only. The large hybrid journals showed excellent results for all JCR indicators, which is why authors were willing to pay a high APC to publish their articles in those journals. However, the large hybrid journals published more articles per journal than average, and it can be assumed that they were just adding the OA articles from a business perspective, rather than trying to convert subscription articles to the OA articles. Consequently, they were becoming somewhat mega-hybrid journals. Therefore, the publishers first converted highly influential journals into hybrid journals, for which authors were paying the APC as worthwhile.

Gold OA journals with a short publication history were still weaker in academic influence than hybrid journals. However, many top gold OA journals were superior in most JCR indicators and were in a higher position than even the large hybrid journals. These gold OA journals were favored by researchers and achieved a strong reputation in a short time through their enormous influence on the research community. If competitive gold OA journals continue to be launched, they may change the traditional journal ecosystem more quickly. Therefore, the journals of OA publishers showed both the potential for development beyond traditional peer-reviewed journals

Table 4. Articles and AJIFP of the seven gold open access journals in Journal Citation Reports’ rank Q1

<table>
<thead>
<tr>
<th>Journal a)</th>
<th>Article</th>
<th>AJIFP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLoS One</td>
<td>30,040</td>
<td>85.1</td>
</tr>
<tr>
<td>Scientific Reports</td>
<td>3,931</td>
<td>92.1</td>
</tr>
<tr>
<td>Nature Communications</td>
<td>2,788</td>
<td>95.6</td>
</tr>
<tr>
<td>IEEE Access b)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Optics Express</td>
<td>3,306</td>
<td>89.1</td>
</tr>
<tr>
<td>Frontiers in Microbiology</td>
<td>650</td>
<td>77.7</td>
</tr>
<tr>
<td>Journal of High Energy Physics</td>
<td>2,002</td>
<td>90.7</td>
</tr>
</tbody>
</table>

AJIFP, average journal impact factor percentile.

a) Oncotarget was not included as it was excluded since Journal Citation Reports 2017; b) IEEE Access began to be listed since Journal Citation Reports 2016.
Influence of OA journals on the research community

and concerns posed by poor-quality journals, besides their contribution to the growth of OA articles. If gold OA journals maintain the advantage of a traditional peer-review system with a long turnaround time, rather than a formal peer review system with a short turnaround time, their potential for development will be great. Gold OA journals have more advantages over traditional subscription journals in terms of the rapid circulation of research articles without any barrier to users, and the fact that they do not impose budgetary burdens on libraries.

Changing subscription agreements based on the growth of OA articles

Institutions sign subscription contracts for subscription journals, including hybrid journals. As the number of hybrid OA articles increases, it is time to reflect upon whether it makes sense for commercial publishers to raise their subscription prices every year. On the whole, the CAGR for hybrid OA articles was much higher than that of non-OA articles. The share of hybrid OA articles published by the top three publishers gradually increased over 6 years. This means that the share of non-OA articles decreased, undermining the purported rationale for the steep increase of journal subscription prices. Therefore, one may ask whether there was any other reason why the journal subscription prices of these publishers increased every year beyond the CAGR of JCR articles or the general inflation rate. Thus, the subscription agreement model needs to change, since double-dipping in the subscription prices provides support for off-set or read-and-publish agreements [1].

In OA publishing, the dominance of large journal publishers is also growing [5]; however, their influence remains limited. This trend has important implications for the negotiation of subscription prices with the top three publishers.

Conclusion: Librarians are involved in the entire process of journal use, including the rational use of the subscription

Table 5. Articles in the subscription journals of the top three publishers

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Article type</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>CAGR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elsevier</td>
<td>Hybrid-OA</td>
<td>10,270</td>
<td>11,779</td>
<td>13,470</td>
<td>14,897</td>
<td>17,535</td>
<td>22,236</td>
<td>16.7</td>
</tr>
<tr>
<td></td>
<td>Hybrid-subscription</td>
<td>333,023</td>
<td>347,923</td>
<td>360,162</td>
<td>372,530</td>
<td>401,139</td>
<td>413,415</td>
<td>4.4(^a)</td>
</tr>
<tr>
<td></td>
<td>Subscription only</td>
<td>3,018</td>
<td>2,247</td>
<td>2,396</td>
<td>2,619</td>
<td>2,772</td>
<td>2,695</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subtotal</td>
<td>346,311</td>
<td>361,949</td>
<td>376,028</td>
<td>390,046</td>
<td>421,446</td>
<td>438,346</td>
<td>4.8</td>
</tr>
<tr>
<td>Springer</td>
<td>Hybrid-OA</td>
<td>8,735</td>
<td>10,326</td>
<td>14,567</td>
<td>14,282</td>
<td>16,542</td>
<td>20,680</td>
<td>18.8</td>
</tr>
<tr>
<td></td>
<td>Hybrid-subscription</td>
<td>139,278</td>
<td>143,225</td>
<td>146,360</td>
<td>150,124</td>
<td>155,875</td>
<td>159,052</td>
<td>2.3(^a)</td>
</tr>
<tr>
<td></td>
<td>Subscription only</td>
<td>25,315</td>
<td>25,645</td>
<td>25,415</td>
<td>25,743</td>
<td>26,620</td>
<td>25,474</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subtotal</td>
<td>173,328</td>
<td>178,196</td>
<td>186,342</td>
<td>190,149</td>
<td>199,037</td>
<td>205,216</td>
<td>3.4</td>
</tr>
<tr>
<td>Wiley</td>
<td>Hybrid-OA</td>
<td>917</td>
<td>2,336</td>
<td>5,836</td>
<td>7,520</td>
<td>10,424</td>
<td>19,662</td>
<td>82.5</td>
</tr>
<tr>
<td></td>
<td>Hybrid-subscription</td>
<td>132,682</td>
<td>133,121</td>
<td>132,626</td>
<td>141,043</td>
<td>146,759</td>
<td>137,892</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subscription only</td>
<td>3,762</td>
<td>3,561</td>
<td>739</td>
<td>697</td>
<td>803</td>
<td>811</td>
<td>0.3(^a)</td>
</tr>
<tr>
<td></td>
<td>Subtotal</td>
<td>137,415</td>
<td>139,018</td>
<td>139,201</td>
<td>149,260</td>
<td>157,986</td>
<td>158,355</td>
<td>2.9</td>
</tr>
<tr>
<td>All JCR</td>
<td>Hybrid-OA</td>
<td>37,239</td>
<td>45,143</td>
<td>63,043</td>
<td>69,796</td>
<td>82,952</td>
<td>114,887</td>
<td>25.2</td>
</tr>
<tr>
<td></td>
<td>Hybrid-subscription</td>
<td>1,044,272</td>
<td>1,064,530</td>
<td>1,080,155</td>
<td>1,109,276</td>
<td>1,156,331</td>
<td>1,158,155</td>
<td>1.7(^a)</td>
</tr>
<tr>
<td></td>
<td>Subscription only</td>
<td>161,254</td>
<td>164,254</td>
<td>161,250</td>
<td>160,537</td>
<td>160,720</td>
<td>155,184</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1,242,765</td>
<td>1,273,927</td>
<td>1,304,448</td>
<td>1,339,609</td>
<td>1,400,003</td>
<td>1,428,026</td>
<td>2.8</td>
</tr>
</tbody>
</table>

CAGR, compound annual growth rate; OA, open access; JCR, Journal Citation Reports.

\(^a\)The data were calculated by adding hybrid-subscription and subscription only.
budget, delivering articles to researchers, and recommending appropriate journals for submitting articles. In this study based on JCR indicators, the actual influence of OA journals on the research community was documented. Some gold OA journals were highly competitive in terms of JCR indicators, and even showed the potential to develop beyond traditional journals with high authority and a long reputation. Moreover, the top three subscription publishers published a rapidly increasing number of hybrid OA articles during the 6-year period analyzed in this study. In this situation, librarians need to expand journal services to include valuable OA journals by specifically grasping the trends and influence of OA journals.

**Conflict of Interest**

No potential conflict of interest relevant to this article was reported.

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**Data Availability**

Data are available from the author upon reasonable request.

**Dataset 1.** List of journal type with the APC and number of articles in Journal Citation Reports 2014 to 2019

**References**

2. Kim SJ, Park KS. Open access status of journals and articles in Journal Citation Reports. Sci Ed 2021;8:26-31. https://doi.org/10.6087/kcse.226
Comparison of length limits and the actual length of abstracts in pharmacology, oncology, and neurology journals listed in PubMed

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Abstract
Purpose: This study aimed to compare the length limits specified in the author guidelines with the actual length of abstracts in 90 journals in the fields of pharmacology, oncology, and neurology. Specifically, the following parameters were examined: abstract formats among the three subject areas; the relationship between the length limit and the actual length of abstracts; and actual abstract length according to the number of subheadings, the length of structured abstract subheadings, the length of frequently used subheading sets, and clinical trial registration information.

Methods: Thirty journals from each of three medical fields (pharmacology, oncology, and neurology) were selected from Elsevier's Scimago Journal Rank. This included the journals indexed in PubMed from 2018 to 2019 that published the most articles. Article abstracts from these journals were used to create a dataset for this study. Descriptive, comparative, and correlational analyses of data for the three fields were conducted.

Results: The number of subheadings and abstract length increased in parallel. The Results component was the longest, suggesting that authors tended to use longer text to report results than for other structural abstract components. Authors generally utilized the length limit to a full extent without exceeding it.

Conclusion: The traditionally used 250-word length limit should be reconsidered for pharmacology, oncology, and neurology journals because it disregards the distinctive characteristics of abstracts and length differences between structured and unstructured abstracts. Various characteristics of abstract lengths presented in this study should be considered to establish more justifiable policies.

Keywords
Bibliometrics; Publications; PubMed
Introduction

Background/rationale: Along with adhering to other guidelines, an abstract should not exceed the number of words specified by the editorial policy of a journal. Abstracts can be broadly classified into two major formats: unstructured and structured. The major difference between the two formats is that unstructured abstracts (UAs) do not use subheadings and are typically written in a single-paragraph format, while structured abstracts (SAs) use pre-defined subheadings. SAs are more commonly used in medical research [1] and various subheadings are used for SAs based on the introduction, methods, results, and discussion (IMRaD) structure [2]. For example, Background is more commonly used than Introduction. It is generally believed that an appropriate abstract limit is 250 words or fewer [3]. Although several empirical studies have revealed that SAs are longer than UAs on average [4], abstract length has not been examined thoroughly regarding adherence to the length limit. Linder [5] pointed out that length limits vary substantially across disciplines. Silverberg and Ray [6] showed that most published abstracts exceeded the established length limit in the top five medical journals.

In this study, we examined 90 pharmacology, oncology, and neurology journals indexed in PubMed from 2018 to 2019, focusing on the journals that published the most articles, since these three areas had the highest output in the medical field and thus could provide a comprehensive and representative sample of medical journal abstracts, the analysis of which would yield insights applicable to medical abstracts in general. Objectives: Based on abstracts from pharmacology, oncology, and neurology journals, we aimed to examine the following parameters: abstract formats among the three subject areas; the relationship between the length limit and the actual length of abstracts; and actual abstract length according to the number of subheadings, the length of the SA subheadings, length of the frequently used subheading sets, and clinical trial registration information.

Methods

Ethics statement: This study was conducted through a database-based, bibliometric search and analysis of the literature. Neither institutional review board approval nor informed consent was required.

Study design: This quantitative descriptive analysis was conducted to compare the length limits specified in journals’ author guidelines with the actual length of abstracts.

Data sources/measurement: We selected three distinctive medical subject areas (pharmacology, oncology, and neurology) from Elsevier’s Scimago Journal Rank. These subject areas shared the common characteristic of having more than 250 listed journals. To consistently ensure a sufficient number of articles across all journals, the top 30 journals indexed in PubMed (i.e., those that published the most articles in each subject area) were selected. The details of the dataset and all 90 journals (30 journals for each of the three subject areas) used in this study are shown in Dataset 1 and 2. Journal article abstracts from 2018 to 2019 were downloaded from PubMed. An equal number of abstracts from journals in each subject area was obtained by identifying the journal with the smallest number of abstracts. To create a dataset for this study, we selected the same number of abstracts from the rest of the journals. For example, Brain Pathology had the lowest number (140) in neurology; thus, 140 abstracts were randomly selected from the rest of the journals in neurology. When performing frequency counts of subheadings, words in the singular form were changed to the plural (e.g., “Method” to “Methods”).

Statistical methods: The descriptive, comparative, and correlational analysis was done with Excel (Microsoft, Redmond, WA, USA).

Results

Comparison of abstract formats among the three subject areas: Table 1 shows the frequency count of abstract formats based on the editorial policy. A considerable number of journals could be described as mixed, since many journals did not require exclusively one form of abstracts. In the dataset, more UAs than SAs across all subject areas were present; in total, only 26 (28.9%) journals exclusively used UAs and 10 (11.1%) journals exclusively used SAs. Thus, most journals were mixed—that is, they contained both UAs and SAs (n = 54, 60%)—although most editorial policies specified the usage of exclusively one type of abstract. Thirty-four (37.8%) journals had editorial policies specifying the use of UAs, while 43 (47.8%) journals had policies requiring SAs. Only two (2.2%) journals used semi-SAs. Eight journals (8.9%) did not specify the abstract format, despite having statements on the abstract length limit. For the journals that specified the required range of abstract length, rather than the maximum length, the upper bound was used as the length limit (e.g., a 200-word length limit for a required range of 100 to 200 words).

Comparison between the length limit and actual abstract length: The length limit was compared with the actual length of abstracts based on the journals that exclusively used SAs or UAs. Excluding the mixed abstracts allowed us to examine authors’ tendencies regarding individual journals’ abstract limits. Fig. 1 shows the lengths of UAs and SAs, excluding subheadings, for the journals that had statements on the ab-
Comparison of length limit and actual length of abstracts

Table 1. Comparison of abstract formats among the three subject areas

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Abstract format</th>
<th>Oncology (n = 30)</th>
<th>Neurology (n = 30)</th>
<th>Pharmacology (n = 30)</th>
<th>Total (n = 90)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Editorial policy (abstract type)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unstructured</td>
<td>14 (46.7)</td>
<td>13 (43.3)</td>
<td>7 (23.3)</td>
<td>34 (37.8)</td>
<td></td>
</tr>
<tr>
<td>Structured</td>
<td>14 (46.7)</td>
<td>13 (43.3)</td>
<td>16 (53.3)</td>
<td>43 (47.8)</td>
<td></td>
</tr>
<tr>
<td>Semi-structured&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0 (0.0)</td>
<td>1 (3.3)</td>
<td>1 (3.3)</td>
<td>2 (2.2)</td>
<td></td>
</tr>
<tr>
<td>Not specified</td>
<td>2 (6.7)</td>
<td>2 (6.7)</td>
<td>4 (13.3)</td>
<td>8 (8.9)</td>
<td></td>
</tr>
<tr>
<td>Mixed&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0 (0.0)</td>
<td>1 (3.3)</td>
<td>2 (6.7)</td>
<td>3 (3.3)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>30 (100)</td>
<td>30 (100)</td>
<td>30 (100)</td>
<td>90 (100)</td>
<td></td>
</tr>
<tr>
<td><strong>Dataset (actual length)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unstructured</td>
<td>12 (40.0)</td>
<td>8 (26.7)</td>
<td>6 (20.0)</td>
<td>26 (28.9)</td>
<td></td>
</tr>
<tr>
<td>Structured</td>
<td>2 (6.7)</td>
<td>5 (16.7)</td>
<td>3 (10.0)</td>
<td>10 (11.1)</td>
<td></td>
</tr>
<tr>
<td>Mixed&lt;sup&gt;c&lt;/sup&gt;</td>
<td>16 (53.3)</td>
<td>17 (56.7)</td>
<td>21 (70.0)</td>
<td>54 (60.0)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>30 (100)</td>
<td>30 (100)</td>
<td>30 (100)</td>
<td>90 (100)</td>
<td></td>
</tr>
</tbody>
</table>

Values are presented as number (%).
<sup>a</sup>Semi-structured abstracts have a single-paragraph format, with each sentence corresponding to a section in the paper. When calculating the abstract length, semi-structured abstracts were counted as unstructured abstracts due to missing subheadings; <sup>b</sup>Journals allowing both unstructured and structured abstracts; <sup>c</sup>Journals containing both unstructured and structured abstracts.

Fig. 1. The abstract lengths of selected journals. The names of the journal index numbers are given in Dataset 1. (A) Oncology, (B) neurology, and (C) pharmacology.

Abstract length limit and exclusively used either UAs or SAs. The journals shown on the left side of Fig. 1 exclusively used SAs (more than 99%), while those on the right side exclusively used UAs (more than 99%). The Cerebellum (J38) was excluded from this figure, as the journal required SAs, but mostly consisted of UAs in the dataset. As shown, the range of length limits varied widely (150 to 400 words). Slightly below the length limits, a wide range of actual lengths (98 to 387 words)
could also be noticed. By and large, SAs were longer than UAs. The actual length exceeded the length limit in some journals (e.g., J44, J49, J50).

The overall line patterns show that the actual length fluctuated slightly along with the length limit. Furthermore, we found positive correlations between the length limit and actual length in all subject areas: oncology \((r = 0.83)\), neurology \((r = 0.76)\), and pharmacology \((r = 0.67)\).

In addition, the length limit was compared with the actual length regardless of the abstract format. Unlike Fig. 1, where the result was produced based on only selected journals, Fig. 2 was produced using all 90 journals (i.e., 30 journals in each subject area). This figure indicates that the actual lengths were mostly below the length limits in all subject areas. Furthermore, SAs were longer than UAs in all subject areas, particularly in terms of actual length as opposed to length limits. SAs in neurology showed the smallest difference between the length limit and actual length \((3.5\text{ words})\), whereas UAs in neurology showed the greatest difference between the length limit and actual length \((45.8\text{ words})\). The difference between the length limit and actual length for all subject areas was greater in UAs than in SAs. For UAs, the average length limit \((258.7\text{ words})\) was greater than the actual length \((203.5\text{ words})\) by only 6.6%.

**Actual abstract length according to the number of subheadings:** Journals used a varying number of subheadings. Table 2 shows that the number of SA subheadings in abstracts from the sampled journals ranged from one to nine. SAs having less than four or more than five subheadings were less common, and most SAs used three to five subheadings. In oncology, a substantial number of abstracts contained only one subheading, such as **Significance**. The length generally increased with the number of subheadings. However, this occurred only when a sufficient number of abstracts was used to obtain the abstract length. For all three medical subject areas, the length increased steadily as the number of subheadings increased from three to five. Within this number of subheadings, oncology journals showed the highest number of abstracts with the greatest length: 233 words for three subheadings and 310 words for five subheadings. The overall average length was 216.3 words for three subheadings, 256.2 words for four subheadings, and 285 words for five subheadings. On average, the length increased by 39.9 words \((18.0\%)\) when the number of subheadings increased from three to four. The length increased by 28.8 words \((11.3\%)\) when the number of subheadings increased from four to five. The length of UAs is

---

**Table 2. Number of subheadings and actual abstract length**

<table>
<thead>
<tr>
<th>Subject area</th>
<th>No. of unstructured abstracts (average word count)</th>
<th>No. of structured abstracts (average word count)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oncology</td>
<td>4,532 (195.8)(^\text{a}) 578 (233.5)(^\text{a}) 2 (210) 114 (233.2)(^\text{a}) 3,162 (259.9)(^\text{a}) 368 (310.8)(^\text{a}) 2 (276) 2 (280) Null Null</td>
<td></td>
</tr>
<tr>
<td>Neurology</td>
<td>2,167 (211.9)(^\text{a}) 144 (255)(^\text{a}) 7 (297.7) 201 (196.9)(^\text{a}) 1,114 (258.8)(^\text{a}) 426 (281.9)(^\text{a}) 73 (372.6) 42 (397.3) 26 (398.1) Null</td>
<td></td>
</tr>
<tr>
<td>Pharmacology</td>
<td>2,775 (202.6)(^\text{a}) 37 (234.5) 12 (240.3) 321 (218.8)(^\text{a}) 2,498 (249.8)(^\text{a}) 542 (262.3)(^\text{a}) 90 (301.1) 228 (716.1)(^\text{a}) 3 (365.7) 4 (630.8)</td>
<td></td>
</tr>
</tbody>
</table>

Null indicates that no case was found for the particular cell.

\(^\text{a}\)Instances with sufficiently large numbers of abstracts (100 or more).
also displayed in Table 2. As shown, UAs were overall shorter than SAs.

**Lengths of SA subheadings:** As expected, there was considerable variability in the occurrence and length of SA components. Table 3 shows the top 10 most used SA components and their lengths. Plotting the frequency count of subheadings would suggest an exponential distribution. **Results** (ranked 1st) was used approximately 22 times more than **Significance** (ranked 10th). On average, **Results** was the most frequently used subheading among the subject areas, and it was the longest (101.0 ± 37.5 [standard deviation]). In contrast, **Significance** was the shortest (33.5 ± 14.5 [standard deviation]), although it did not appear in all subject areas. This suggests that authors tended to use a higher number of words to describe their findings than for other components.

**Lengths of the frequently used subheading sets:** Table 4 shows the details of the top 10 most frequently used subheading sets. The information on subheading sets is divided into two groups: journal abstracts and editorial policy requirements. As shown in Table 4, the most frequently used subheading set was **Background, Methods, Results, Conclusions** (27.4%). In terms of editorial policy, this structure was used in eight out of 90 journals (8.9%). In terms of abstract length, the length limit of abstracts using the **Background, Methods, Results, Conclusions** subheading set was higher (300.0 words) than the actual length (265.7 words) by 12.9%. The **Purpose, Methods, Results, Conclusions** subheading set was also widely used in both groups. If normalization was applied by combining **Objectives** with **Purpose**, the combined subheading set would rank the highest in both groups. The average length limit of SAs in terms of subheading sets was higher than the overall average length limit of SAs.

**Abstract length and clinical trial registration information:** Papers involving clinical trials are often required to disclose clinical trial registration information. This study's results showed that most journals required authors to specify the trial registration number or include the phrase “retrospectively registered” in the abstract, although the inclusion format varied among journals. Most journals instructed authors to include statements concerning the clinical information at the end of the abstract, either as a separate subheading (“trial registration”) or without the subheading. The required statements were relatively short compared to other information. Out of 18,557 abstracts, 225 UAs (1.2%) and 668 SAs (3.6%) had clinical trial information.

Fig. 3 portrays the relationship between trial registration information and abstract length. This figure shows that, regardless of whether clinical trial information was present, the actual length was less than the average length limit. This inclusion of clinical trial information affected the actual length of SAs more than that of UAs since they contained this information more frequently. SAs containing trial registration information had 39.4 words (17.6%) more than those without this information. UAs followed the same pattern, with abstracts containing trial registration information having 56.3 words (28.0%) more.

**Discussion**

**Interpretation:** We empirically compared abstract limits with abstract lengths, taking into account the number of elements, specifically required items, and standard forms (UAs and SAs).

First, a considerable number of journals contained both UAs and SAs despite specific requirements for the form of abstracts in the author guidelines. This indicates that some jour-
nals may have loosely enforced their editorial policies regarding the abstract format. Moreover, editorial policies regarding the abstract format may have changed since the publication period of 2018. For instance, The Cerebellum required SAs for new manuscript submissions, but UAs were mostly present in the dataset. Second, using more subheadings increased the overall lengths of abstracts. The most commonly used numbers of subhead-

Table 4. Top ten frequently used subheading formations and their abstract lengths

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rank</th>
<th>Subheading set</th>
<th>No. of papers (%)</th>
<th>No. of journals appearing at least once</th>
<th>Average no. of words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on journal</td>
<td>1</td>
<td>Background, Methods, Results, Conclusions&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2,741 (27.4)</td>
<td>45</td>
<td>265.7</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Purpose, Methods, Results, Conclusions&lt;sup&gt;a&lt;/sup&gt;</td>
<td>960 (9.6)</td>
<td>21</td>
<td>239.9</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Objectives, Methods, Results, Conclusions&lt;sup&gt;a&lt;/sup&gt;</td>
<td>782 (7.8)</td>
<td>38</td>
<td>259.2</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Background, Objectives, Methods, Results, Conclusions&lt;sup&gt;a&lt;/sup&gt;</td>
<td>398 (4)</td>
<td>23</td>
<td>235.3</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Implications</td>
<td>270 (2.7)</td>
<td>1</td>
<td>229.6</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Background and purpose, Methods, Results, Conclusions</td>
<td>261 (2.6)</td>
<td>5</td>
<td>258.2</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Objectives, Materials and methods, Results, Conclusions&lt;sup&gt;a&lt;/sup&gt;</td>
<td>257 (2.6)</td>
<td>7</td>
<td>279.0</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Significance</td>
<td>256 (2.6)</td>
<td>2</td>
<td>222.1</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Purpose, Experimental design, Results, Conclusions</td>
<td>220 (2.2)</td>
<td>6</td>
<td>246.4</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Objectives, Methods, Results, Interpretation&lt;sup&gt;a&lt;/sup&gt;</td>
<td>215 (2.2)</td>
<td>4</td>
<td>776.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>9,996 (100)</td>
<td>Average</td>
<td>269.8</td>
</tr>
</tbody>
</table>

Based on editorial policy

<table>
<thead>
<tr>
<th>Rank</th>
<th>Subheading set</th>
<th>No. of papers (%)</th>
<th>No. of journals appearing at least once</th>
<th>Average no. of words</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (tie)</td>
<td>Background, Methods, Results, Conclusions&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8 (12.5)</td>
<td>-</td>
<td>243.8</td>
</tr>
<tr>
<td>3</td>
<td>Objectives, Methods, Results, Conclusions&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5 (7.8)</td>
<td>-</td>
<td>275.0</td>
</tr>
<tr>
<td>4</td>
<td>Objectives, Materials and methods, Results, Conclusions&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4 (6.3)</td>
<td>-</td>
<td>275.0</td>
</tr>
<tr>
<td>5</td>
<td>Background, Objectives, Methods, Results, Conclusions&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3 (4.7)</td>
<td>-</td>
<td>250.0</td>
</tr>
<tr>
<td>6</td>
<td>Purpose, Materials and methods, Results, Conclusions</td>
<td>2 (3.1)</td>
<td>-</td>
<td>250.0</td>
</tr>
<tr>
<td>6 (tie)</td>
<td>Objectives, Methods, Results, Interpretation&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2 (3.1)</td>
<td>-</td>
<td>250.0</td>
</tr>
<tr>
<td>6 (tie)</td>
<td>Introduction, Methods, Results, Conclusions</td>
<td>2 (3.1)</td>
<td>-</td>
<td>275.0</td>
</tr>
<tr>
<td>9</td>
<td>Study design, Results, Conclusions</td>
<td>1 (1.6)</td>
<td>-</td>
<td>200.0</td>
</tr>
<tr>
<td>9 (tie)</td>
<td>Statement of problem, Purpose, Materials and methods, Results, Conclusions</td>
<td>1 (1.6)</td>
<td>-</td>
<td>250.0</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>64 (100)</td>
<td>Average</td>
<td>296.2</td>
</tr>
</tbody>
</table>

<sup>a</sup>The subheading sets that appear in both groups.

Fig. 3. Clinical trial information and the abstract length of structured and unstructured abstracts.
ings was four and five, and abstract length increased steadily as the number of subheadings increased from three to five. Similarly, a wide range of subheadings was found by a study conducted by Eid et al. [7].

Third, the longest SA component was Results. This suggests that authors generally tended to use longer text to report results. The Results subheading also was the most frequently appearing component in language and literature journals that used the IMRaD structure [8].

Fourth, positive correlations between the abstract length and the actual length, along with the differences between required and actual lengths, suggest that authors generally utilized the length limit to a full extent without exceeding it.

Fifth, requiring clinical trial information in the abstract affected the abstract length of UAs more than that of SAs, but the overall length increase was minimal due to the limited numbers of abstracts that had clinical trial information.

Lastly, authors generally followed the journal’s editorial policies regarding abstract length by keeping the length slightly below the specified length limit. Overall, the authors utilized the maximum allowed length for SAs. At the same time, there was leeway in terms of accepting journal abstracts that exceeded the specified abstract length. The overall abstract lengths obtained in this study were longer than those reported in previous studies. Atanassova et al. [9] showed an average abstract length of 185.1 words based on seven PLOS journals. PLOS journals presumably use SAs, although the authors did not explicitly state the abstract form. The present study’s results showed 203.5 words for UAs and 228.7 for SAs. In contrast to the findings of Silverberg and Ray [6], most abstracts kept their length below the allowable length limit.

**Limitation:** The actual length and the length limits were taken from slightly different periods. The actual length was based on research articles published from 2018 to 2019, whereas the editorial policies were more up-to-date since they were collected at the time of conducting this study (September 2020). Furthermore, this study was limited to three subject areas and journals selected from each subject area. The results of this study should be interpreted in the context of these limitations.

**Conclusion:** The traditionally used 250-word length limit should be reconsidered for pharmacology, oncology, and neurology journals because it disregards the distinctive characteristics of abstracts and length differences between SAs and UAs. For new journals in particular subject areas, a pragmatic, yet more systematic approach for establishing a length limit would be to use a certain tolerance level over the empirically obtained average abstract length in the subject area. Furthermore, various characteristics of abstract lengths presented in this study should be taken into account in establishing more justifiable policies.

**Conflict of Interest**
No potential conflict of interest relevant to this article was reported.

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The authors received no financial support for this article.

**Data Availability**
Dataset file is available from: the Harvard Dataverse at: https://doi.org/10.7910/DVN/JKY2YI

**Dataset 1.** Journal titles with percentages of structured and unstructured abstracts
**Dataset 2.** Journal titles and the PubMed ID of the abstracts downloaded

**References**

doi.org/10.1108/NLW-09-2013-0069
Network of institutions, source journals, and keywords on COVID-19 by Korean authors based on the Web of Science Core Collection in January 2021

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Abstract
Purpose: The aim of this study was to characterize the network of institutions, journals, and topics of coronavirus disease 2019 (COVID-19) literature by Korean authors in the Web of Science Core Collection. The specific goals were to identify the collaborative relationships between Korean authors and international authors and to explore clusters of institutions, journals, and topics.

Methods: Literature was searched in the Web of Science Core Collection on January 30, 2021. The search terms were “SARS-CoV-2” or “COVID” or “novel coronavirus” in the subject field. The search results were limited again to “South Korea” as the country and the publication type of “article.” The measurement tool was Biblioshiny, an app version tool for Bibliometrix.

Results: Korean authors published 3.2 times more COVID-19–related articles in journals outside of Korea than in Korean journals. The journals showed three clusters by bibliographic coupling. In contrast, the co-citation network showed four clusters. Only a few journals were included in the clusters in both analyses. The conceptual structure of Keywords Plus by factorial analysis showed two clusters: “pathology and clinical treatment” and “knowledge and attitudes.” Institutions’ collaborative network consisted of four clusters. Korean researchers actively collaborated with international researchers, especially those in the United States.

Conclusion: Because only a few Korean journals were included in the journal clusters by both coupling and co-citation network, more active citation of Korean journals is recommended. The identification of human behavior as a distinct theme in COVID-19 research suggests a different focus in this area besides clinical studies.

Keywords
Bibliometrics; Coronavirus; COVID-19; Journal publishing; Republic of Korea
Introduction

**Background/rationale:** After the first report of an imported case of coronavirus disease 2019 (COVID-19) in January 2020 in South Korea (hereafter, Korea), infections have continued for a year, although there have been daily fluctuations in the number of reported cases. Korean researchers have also published papers on COVID-19 to provide information on this condition, with topics including its biology, diagnosis, treatment, prevention, prognosis, and epidemiology. Some studies have presented bibliometric analyses of the COVID-19-related literature, including networks of authors, affiliations, countries, source journals, and keywords. The analysis methods have included citation analysis, clustering by coupling, co-occurrence networks, co-citation networks, and collaboration networks. Bibliographic coupling occurs when two articles cite a third article together, indicating that both articles are likely to address the same topic [1].

The bibliometric analysis of COVID-19 has usually focused on global research in a specific field [2], and little data have been published on country-level analyses, except Iran [3], Peru [4], and India [5,6]. Therefore, we conducted a bibliometric analysis of COVID-19–related literature authored only by Korean researchers. The results of this analysis will provide insights into the diversity of research topics related to COVID-19, as well as networks of institutions, journals, and countries.

**Objectives:** This study investigated the networks of institutions, source journals, and keywords of COVID-19 literature published by Korean authors based on the Web of Science Core Collection on January 30, 2021. Bibliographic coupling and conceptual, intellectual, and social structures were analyzed using Biblioshiny. Furthermore, the topics of the literature were grouped into clusters to clarify trends in research. The specific goals were as follows: first, to identify collaborative relationships between Korean authors and authors in other countries; second, to compare the number of articles that Korean authors have published in Korean and international journals; third, to identify the cluster of Korean institutions that published numerous COVID-19 articles; fourth, to explore the Korean journal clusters that published numerous COVID-19 papers; and fifth, to identify topics primarily covered by Korean researchers and clusters of research areas.

The following hypotheses were set: first, there is a concentration effect among the institutions in Korea related to COVID-19 research; and second, Korean researchers have published more articles in international journals than Korean journals if the target journals are limited to those in the Web of Science Core Collection.

**Methods**

**Ethics statement:** This study did not involve human subjects, so neither approval by the institutional review board nor obtaining informed consent was required.

**Study design:** This was a bibliometric study based on the literature in the Web of Science Core Collection.

**Setting:** On January 30, 2021, the literature was searched from the Web of Science Core Collection. The search term was “SARS-CoV-2” OR “COVID” OR “novel coronavirus” in the subject field. The search results were limited to authors from South Korea and publications from 2020 to January 2021. The number of results was 1,082, out of which only the publication type “article” was selected. The number of studies was 727, which included 667 articles, 59 early-access articles, and one proceedings paper. Data in plain text format were downloaded for analysis. There was no need for data cleaning. The downloaded plain text format data were converted to the R data format by the Biblioshiny app.

**Variables:** Variables were not required.

**Data sources/measurement:** Articles were selected after searching the Web of Science Core Collection as described above. The measurement tool was Biblioshiny, an app version tool of Bibliometrix (an R tool for comprehensive science mapping analysis available at https://bibliometrix.org/Biblioshiny.html) [7]. This tool was used because it is freeware, and it provides various analysis methods.

**Selection of target and analysis methods through the Biblioshiny function interface menu:** Biblioshiny provides a multifunctional interface according to the tutorial available from the above website. The following functions were selected for the present data analysis: first, the main information and three-fields plot from the Dataset menu; second, the most relevant source journals from the Sources menu; third, the most relevant affiliation (institution) from the Authors menu; fourth, the most frequent word and word cloud from the Document menu; fifth, clustering by coupling from the Coupling menu; sixth, the co-occurrence network and factorial network for Keywords Plus from the Conceptual Structure menu; seventh, the co-citation network for source journals from the Intellectual Structure menu; and eighth, the collaborative network of institutions and collaborative world map from the Social Structure menu. Only institutions, journals, and keywords were included in the analysis.

**Bias:** There was no bias in searching and selecting the target literature.

**Study size:** The sample size could not be estimated before the study. It was not required to estimate the sample size.

**Statistical methods:** Descriptive statistics were applied.
Results

Dataset 1 is the exported bibliometric file of the 727 articles used for the Biblioshiny.

**Main information and three-fields plot:** The corresponding data are presented in Suppl. 1. The number of authors was 3,473. The number of single-authored documents was 46. The average number of authors per document was 4.78. Relationships among the top 20 institutions (intellectual root), top 20 journals, and top 20 Keywords Plus (research content) were summarized by a Sankey plot (a diagram used for the flow of input and output of given characteristics or objects) (Fig. 1).

**Top 20 most relevant source journals:** The most relevant journal title was *Journal of Korean Medical Science*, succeeded by *International Journal of Environmental Research and Public Health*, *Sustainability*, *International Journal of Infectious Diseases*, and *Journal of Clinical Medicine* (Fig. 2, Suppl. 2). In the top 20, *Journal of Korean Medical Science*, *Korean Journal of Internal Medicine*, *Epidemiology and Health*, *Infection and Chemotherapy*, and *Journal of the Korean Medical Association* were included as Korean journals.

**Most relevant affiliations:** The top 25 most relevant affiliations are presented in Fig. 3 (Suppl. 3). Seoul National University, Yonsei University, Kyungpook National University, Korea University, and Sungkyunkwan University were the top five most relevant institutions (Fig. 3, Suppl. 3).

**Most frequent words and word cloud:** The most frequent word list is given in Suppl. 4. The word cloud generated from this list is presented in Fig. 4. “Pneumonia,” “outbreak,” “risk,” “models,” “China,” “health,” and “Wuhan” were the most frequent words besides “coronavirus,” “COVID-19,” and “SARS.”

**Clustering and coupling of source journals:** Given that the number of units was 250, the minimum cluster frequency per 1,000 units was 10, and the number of labels for each cluster was five, source journals’ coupling map measured by references and local citation score formed three clusters (Fig. 5, Suppl. 5). Out of the three clusters, *Annals of Laboratory Medicine*, *Korean Journal of Radiology*, and *Diabetes & Metabolism Journal* were in the same cluster. *Epidemiology and Health* was in another cluster. No other journal was included in the third coupling clusters.

**Co-occurrence network and factorial network for Keywords Plus for the conceptual structure:** The Keywords Plus co-occurrence network in conceptual structure is presented in Fig. 6 (Suppl. 6) under the following options: Keywords Plus field, automatic layout for network layout, association for normalization, no node color by year, Louvain for the clustering algo-

---

**Fig. 1.** Affiliation-journal-keyword flow of COVID-19–related articles of Korean authors in the Web of Science Core Collection generated from the Dataset menu of Biblioshiny on January 30, 2021.
algorithm, 50 nodes, removal of isolated nodes, a minimum number of edges of 3, and a number of labels of 50. Six clusters are shown in Fig. 6. The main keywords of the three principal clusters were “pneumonia,” “coronavirus,” and “risk.”

The factorial analysis map of Keywords Plus in conceptual structure is presented in Fig. 7 under the following options: multiple correspondence analysis, 50 terms, an automatic number of clusters, and 5 documents. Fig. 7 shows two clusters: one relates to pathogenesis and clinical care; the other is knowledge and attitudes (Suppl. 7). The dendrogram also

---

**Fig. 2.** Top 20 most relevant journal titles of the COVID-19–related articles of Korean authors in the Web of Science Core Collection on January 30, 2021.

<table>
<thead>
<tr>
<th>Sources</th>
<th>No. of documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal of Korean Medical Science</td>
<td>67</td>
</tr>
<tr>
<td>International Journal of Environmental Research and Public Health, Sustainability</td>
<td>52</td>
</tr>
<tr>
<td>International Journal of Infectious Diseases</td>
<td>44</td>
</tr>
<tr>
<td>Journal of Clinical Medicine</td>
<td>40</td>
</tr>
<tr>
<td>Journal of Medical Internet Research</td>
<td>38</td>
</tr>
<tr>
<td>Korean Journal of Internal Medicine</td>
<td>35</td>
</tr>
<tr>
<td>Epidemiology and Health</td>
<td>32</td>
</tr>
<tr>
<td>PLoS One</td>
<td>29</td>
</tr>
<tr>
<td>Infection and Chemotherapy</td>
<td>27</td>
</tr>
<tr>
<td>Scientific Reports</td>
<td>26</td>
</tr>
<tr>
<td>Emerging Infectious Diseases</td>
<td>25</td>
</tr>
<tr>
<td>IEEE Access Healthcare</td>
<td>24</td>
</tr>
<tr>
<td>Journal of the Korean Medical Association</td>
<td>21</td>
</tr>
<tr>
<td>Applied Sciences-Basel</td>
<td>19</td>
</tr>
<tr>
<td>Current Issues in Tourism</td>
<td>19</td>
</tr>
<tr>
<td>Electronics</td>
<td>18</td>
</tr>
<tr>
<td>Frontiers in Public Health</td>
<td>18</td>
</tr>
<tr>
<td>Journal of Biomolecular Structure &amp; Dynamics</td>
<td>18</td>
</tr>
</tbody>
</table>

---

**Fig. 3.** Top 20 most relevant affiliations of the COVID-19–related articles of Korean authors in the Web of Science Core Collection on January 30, 2021.

<table>
<thead>
<tr>
<th>Affiliations</th>
<th>No. of documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seoul Natl Univ</td>
<td>117</td>
</tr>
<tr>
<td>Yonsei Univ</td>
<td>71</td>
</tr>
<tr>
<td>Kyungpook Natl Univ</td>
<td>51</td>
</tr>
<tr>
<td>Korea Univ</td>
<td>50</td>
</tr>
<tr>
<td>Sungkyunkwan Univ</td>
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</tr>
<tr>
<td>Yeungnam Univ</td>
<td>42</td>
</tr>
<tr>
<td>Keimyung Univ</td>
<td>40</td>
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<tr>
<td>Univ Ulsan</td>
<td>38</td>
</tr>
<tr>
<td>Catholic Univ Korea</td>
<td>37</td>
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<tr>
<td>Hallym Univ</td>
<td>35</td>
</tr>
<tr>
<td>Pusan Natl Univ</td>
<td>35</td>
</tr>
<tr>
<td>Hanyang Univ</td>
<td>35</td>
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<tr>
<td>Kyung Hee Univ</td>
<td>35</td>
</tr>
<tr>
<td>Seoul Natl Univ Hosp</td>
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</tr>
<tr>
<td>Chonnam Natl Univ</td>
<td>33</td>
</tr>
<tr>
<td>Chungbuk Natl Univ</td>
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<td>Sejong Univ</td>
<td>31</td>
</tr>
<tr>
<td>Soonchunhyang Univ</td>
<td>31</td>
</tr>
</tbody>
</table>
showed the same pattern (Fig. 8).

**Co-citation network for source journals for the intellectual structure:** Journals were clustered into four groups by the co-citation network of intellectual structure, given the options of an automatic layout, Louvain for the clustering algorithm, 50 nodes, no removal of isolated nodes, a minimum of two edges, and 50 labels (journals) (Fig. 9, Suppl. 8). Three Korean journals were included in one cluster, including the *Journal of Korean Medical Science*, *Osong Public Health and Research Perspectives*, and *Epidemiology and Health*. No other Korean journals were included in other three clusters.

**Collaborative network of institutions and collaborative world map for the social structure:** The collaborative network of institutions showed four main clusters given no normalization, an automatic network layout, Louvain clustering algorithm, removal of isolated nodes, and a minimum of two edges (Fig. 10, Suppl. 9). The main universities of each cluster were Yonsei University, Kyungpook National University, Korea University, and Seoul National University.

The collaborative world map showed that internationally

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**Fig. 4.** Word cloud based on the most frequent words of the COVID-19–related articles of Korean authors in the Web of Science Core Collection on January 30, 2021.

**Fig. 5.** Clustering and coupling of source journals measured by references and the impact measure of the local citation score of the COVID-19–related articles of Korean authors in the Web of Science Core Collection on January 30, 2021.

**Fig. 6.** Conceptual structure map of Keywords Plus based on the co-occurrence network of the COVID-19–related articles of Korean authors in the Web of Science Core Collection on January 30, 2021.
Fig. 7. Conceptual structure map of Keywords Plus based on the factorial analysis of the COVID-19–related articles of Korean authors in the Web of Science Core Collection on January 30, 2021.

Fig. 8. Topic dendrogram of Keywords Plus based on the factorial analysis of the COVID-19–related articles of Korean authors in the Web of Science Core Collection on January 30, 2021.
co-authored works were mainly done with the United States (126), China (73), United Kingdom (56), India (54), Italy (41), Japan (39), Spain (35), Australia (31), Canada (27), and France (27). The social structure of the authors’ countries was analyzed through a collaborative network given a minimum of 10 edges (Fig. 11, Suppl. 10). Out of 349 journals, the number of journals published in Korea was 39. In total, 172 articles were published in 39 Korean journals, while 555 articles were published in 310 international journals.

Discussion

Key results
Korean authors published 3.2 times more COVID-19–related articles in journals outside Korea than in Korean journals in this analysis of data from the Web of Science Core Collection. The coupling of source journals showed three clusters, and the major journal of one cluster was *Annals of Laboratory Medicine* (local citation score 5.99). In contrast, the co-citation network showed four clusters of journals. The conceptual

Fig. 9. Co-citation network for source journals of the COVID-19–related articles of Korean authors in the Web of Science Core Collection on January 30, 2021.

Fig. 10. Collaborative network of institutions of the COVID-19–related articles of Korean authors in the Web of Science Core Collection on January 30, 2021.

Fig. 11. Country collaboration map with Korea of the COVID-19–related articles of Korean authors in the Web of Science Core Collection on January 30, 2021.
structure of Keywords Plus by factorial analysis showed two clusters: one was pathogenesis and clinical care, and the other was knowledge and attitudes. The collaborative network of the institutions consisted of four clusters. The United States was the country with the most collaborations with Korean researchers for COVID-19 studies.

**Interpretation**

**Network of institutions:** The relevance was reflected in four institutional clusters. Yonsei University, Kyungpook National University, and Yeungnam University were in the same cluster (Fig. 10). Sungkyunkwan University, Soochunhyang University, and Hanyang University were in the same cluster. Korea University and the University of Ulsan were in the same cluster. Seoul National University, Hallym University, and the Catholic University of Korea were in the same cluster. Those clusters reflect collaborative work between institutions. The cluster containing Korea University and the University of Ulsan showed stronger collaboration with international institutions, including the University of Toronto, Stanford University, Harvard University, the University of California at Los Angeles, and the University of Michigan. The three-field plot also showed flow from the most relevant institutions to the most relevant journals and to the most frequent Keywords Plus (Fig. 1).

**Network of source journals:** The most relevant journals from Korea were *Journal of Korean Medical Science, Korean Journal of Internal Medicine, Epidemiology and Health, Infection and Chemotherapy,* and *Journal of the Korean Medical Association* (Fig. 2). Two of these are general medicine journals, and the other two are journals in the category of epidemiology and infections. This finding reflects the fact that COVID-19 is an infectious and transmissible disease. Out of the top seven most relevant international journals, four were large journals, with 10,000 or more early-access publications: *International Journal of Environmental Research and Public Health, Sustainability, PLoS One,* and *Scientific Reports.* Korean authors published more articles in journals outside Korea than those published in Korea in this analysis limited to the Web of Science Core Collection. In Korean journals, 172 articles were published, while 555 articles were published in international journals.

The coupling of source journals showed three clusters. The journals with a high impact measure through the local citation score in each cluster were ranked as follows: first, *Annals of Laboratory Medicine;* second, *Disaster Medicine and Public Health Preparedness;* and third, *Computational Structural Biotechnology Journal* (Fig 5). This result is different from the most relevant journals (Fig. 2), because it reflects the citation score from 727 articles. In the first cluster, the *Korean Journal of Radiology and Diabetes & Metabolism Journal* were included. In the second cluster, *Epidemiology and Health* was included. In the third cluster, no Korean journal was included in the top five ranking. Although there were other Korean journals with a higher number of articles, the citations were focused on the above-mentioned journals.

The co-citation network analysis of source journals for the intellectual structure generated four other clusters (Fig. 9). These findings are based on a co-citation network, and are therefore different from those obtained by coupling through a measure of high impact (Fig. 5). *Journal of Korean Medical Science, Osoong Public Health and Research Perspectives,* and *Epidemiology and Health* were in the first cluster, and no Korean journals were in the second, third, and fourth clusters when the top-ranking 50 source journals were labeled. Those three journals dealt with the same topics. Both results showed that there were insufficient citations among articles published in Korean journals.

**Keywords Plus network:** In this analysis, Keywords Plus was used. This method is different from an analysis of the author's keywords, as described as follows: “The data in Keywords Plus are words or phrases that frequently appear in the titles of an article’s references but do not appear in the title of the article itself. Based upon a special algorithm that is unique to Clarivate Analytics databases, Keywords Plus enhances the power of cited-reference searching by searching across disciplines for all the articles that have cited references in common” [8]. The Keywords Plus word cloud showed that besides the search terms—COVID-19, coronavirus, and SARS—"pneumonia," "outbreak," "risk," "model," and "China" frequently appeared. The word cloud presents terms in an easy-to-visualize format (Fig. 4). The conceptual structure of Keywords Plus based on the co-occurrence network showed 14 clusters (Fig. 6); however, the structure based on the factorial analysis showed two clusters (Figs. 7, 8). In the factorial analysis, multiple correspondence analysis was used as a dimensionality reduction technique. It has been described as follows: “Multiple correspondence analysis (MCA) is a data analysis technique for nominal categorical data, used to detect and represent underlying structures in a data set. It does this by representing data as points in a low-dimensional Euclidean space” [9]. The conceptual structure of Keywords Plus based on the factorial analysis indicated that the content of the COVID-19 studies focused primarily on the disease process. Nonetheless, there were research clusters that focused on human behavior, including intentions, attitudes, risk perception, information, knowledge, and the epidemic (Fig. 7). The elucidation of those two clusters were possible because dimensionality reduction technique is used in factorial analysis.

**Comparison with previous country-level studies:** No studies have yet presented bibliometric analyses of Korean research-
ers’ publications on COVID-19, although country-level bibliometric analyses have been published for Iran, Peru, and India. The analysis of research from Iranian institutions comprised 849 papers on COVID-19 published in the Web of Science, Scopus, and PubMed until July 10, 2020. The number of papers by country ranked 13th in Scopus and 12th in Web of Science. An analysis of the co-authors’ matrix showed that they frequently collaborated with researchers in the United States, Italy, United Kingdom, and Canada in descending order. Five clusters were identified in the co-occurrence network of keywords, indicating that “epidemiological studies and public health” and “clinical studies” were the largest clusters [3].

Twenty-four Peruvian authors’ COVID-19 papers were selected from the PubMed/MEDLINE and SciELO databases and a direct search of the Revista Peruana de Medicina Experimental y Salud Pública archives up to May 21, 2020. Out of them, 29.7% were original articles or brief reports. The topic was primarily epidemiology. The articles were mainly published by researchers at an institution located in Lima, the capital city of Peru. Therefore, it was deemed necessary to conduct COVID-19 research in collaboration with other institutions [4].

The COVID-19 papers published in India from March 2 to May 12, 2020 were selected from the World Health Organization COVID-19 database. The papers on virology, diagnosis and treatment, and clinical features were more cited than papers dealing with epidemiological or pandemic-related topics [5]. On May 10, 2020, Indian authors’ literature was searched from Google Scholar, Microsoft Academic, Lens, Dimensions, Scopus, PubMed, and Web of Science. The number of articles from India was within the top 10 ranking countries. India’s top-ranking institutions, journals, and authors were listed. The keywords of the Indian authors could be grouped into 22 clusters [4].

The keyword analysis in India did not provide detailed data other than the keyword network diagram, which was not suitable for comparison with the present study. The co-occurrence network for author keywords from Iran showed five clusters: epidemiological and public health studies, clinical studies, signs and symptoms of the disease, the virus, and underlying diseases. It is difficult to compare those findings directly with present Keywords Plus clusters, which were grouped into disease processes and human behavior.

Limitations: The literature was limited to the Web of Science Core Collection. There were 2,301 articles on COVID-19 listed in the Korea Citation Index, the main scholarly journal abstract database in Korea, on February 2, 2021 (https://www.kci.go.kr). Therefore, the above results do not reflect the entire spectrum of Korean researchers’ achievements on COVID-19. In particular, there are many articles on social science and humanities topics.

Suggestions on COVID-19 bibliometric studies in Korea: Analyses of articles in local journals not indexed in international databases may provide information on the conceptual, intellectual, and social structures of literature on COVID-19. Furthermore, KoreaScience (https://www.koreascience.or.kr/) and KoreaMed (https://koreamed.org/) can serve as other excellent abstract databases for bibliometric analysis. Analyses of the literature in the above local databases will provide new information for bibliometric studies of the COVID-19 literature.

Generalizability: This study identified research topics related to COVID-19 in studies published by Korean researchers. These results may inspire researchers to engage with less frequently addressed research topics in the future. The presentation of a three-fields plot also makes it easy to understand the clustering of research topics among research institutions (Fig. 1).

Conclusion: The results provided sufficient answers for the research objectives. Korean researchers engaged in active collaborative work with international researchers, especially with those in the United States. The result of journal clusters by coupling was different from the journal clusters by the co-citation network. In both analyses, only a few Korean journals were included. Therefore, more active citations among Korean journals is recommended. The topics clustered by factorial analysis into two groups: disease processes and human behavior. The cluster of human behavior studies was small, but could be differentiated from other biomedical topics. Finally, two hypotheses set were accepted. First, the institutions that produced COVID-19 research in Korea were centralized among top-ranking institutions and grouped in four clusters. Second, Korean researchers published 3.2 times more articles in international journals than in Korean journals in the Web of Science Core Collection.

Research on COVID-19 will continue until the end of the pandemic. It is difficult to estimate when this pandemic will end completely, although vaccination and chemotherapies may be urgent solutions. Further regular follow-up studies on the conceptual, intellectual, and social structures of the literature will be necessary as research topics change.

Conflict of Interest
No potential conflict of interest relevant to this article was reported.

Funding
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Fund 2020 (HRF-202010-008).

Data Availability

Data are available from the author upon reasonable request.

Dataset 1. Exported bibliometrix data file of the 727 articles used for the Biblioshiny

Supplementary Material

Supplementary file is available from: the Harvard Dataverse at: https://doi.org/10.7910/DVN/BKSGHR

Suppl. 1. Main data of COVID-19–related articles of Korean authors in the Web of Science Core Collection generated from the Dataset menu of Biblioshiny on January 30, 2021.

Suppl. 2. Most relevant source journals of the COVID-19–related articles of Korean authors in the Web of Science Core Collection generated from the Sources menu of Biblioshiny on January 30, 2021.

Suppl. 3. Most relevant affiliation (institution) of the COVID-19–related articles of Korean authors in the Web of Science Core Collection generated from the Authors menu of Biblioshiny on January 30, 2021.


Suppl. 7. Factorial network for Keywords Plus of the COVID-19–related articles of Korean authors in the Web of Science Core Collection generated from the Conceptual Structure menu of Biblioshiny on January 30, 2021.


Suppl. 10. World collaboration of the COVID-19–related articles of Korean authors in the Web of Science Core Collection generated from the Social Structure menu of Biblioshiny on January 30, 2021.

References


A bibliometric and co-occurrence analysis of COVID-19–related literature published between December 2019 and June 2020

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Abstract
Purpose: The main purposes of this study were to analyze the document types and languages of published papers on coronavirus disease 2019 (COVID-19), along with the top authors, publications, countries, institutions, and disciplines, and to analyze the co-occurrence of keywords and bibliographic coupling of countries and sources of the most-cited COVID-19 literature.

Methods: This study analyzed 16,384 COVID-19 studies published between December 2019 and June 2020. The data were extracted from the Web of Science database using four keywords: “COVID-19,” “coronavirus,” “2019-nCoV,” and “SARS-CoV-2.” The top 500 most-cited documents were analyzed for bibliographic and citation network visualization.

Results: The studies were published in 19 different languages, and English (95.313%) was the most common. Of 157 research-producing countries, the United States (25.433%) was in the leading position. Wang Y (n = 94) was the top author, and the BMJ (n = 488) was the top source. The University of London (n = 488) was the leading organization, and medicine-related papers (n = 2,259) accounted for the highest proportion. The co-occurrence of keywords analysis identified “coronavirus,” “COVID-19,” “SARS-CoV-2,” “2019-nCoV,” and “pneumonia” as the most frequent words. The bibliographic coupling analysis of countries and sources showed the strongest collaborative links between China and the United States and between the New England Journal of Medicine and the JAMA.

Conclusion: Collaboration between the United States and China was key in COVID-19 research during this period. Although BMJ was the leading title for COVID-19 articles, the co-author link between New England Journal of Medicine and JAMA was the strongest.

Keywords
Bibliometric analysis; COVID-19; Publications
Introduction

Background/rationale: The first coronavirus disease 2019 (COVID-19) case was identified on November 17, 2019, in Wuhan, the capital of Hubei Province in China [1]. The virus reached at least 25 countries as of February 6, 2020, and became global soon after [2].

This pandemic led researchers from various disciplines to produce a huge number of papers: some are medicine-related, while some are healthcare- and virology-related. Understanding ongoing COVID-19–related research trends has become essential, and a bibliometric analysis of the relevant published literature may be able to provide some insights in this respect. Meanwhile, several COVID-19–related bibliometric papers have added some relevant findings to the international scholarly. Some researchers took only recent publications into account [3-5], while others analyzed publications from a longer time span [6,7]. A few common measurements of these studies were top journals, authors, publication types, countries, institutions, and languages, publication citations, and bibliographic coupling analyses. These studies found English to be the top language [4,8]; human studies [8] and epidemiology [4] to be the top focuses; the BMJ [8,9], the Journal of Virology [7], Viruses [1], The Lancet [9], and the Journal of Medical Virology [4] to be the top journals; original articles [1] and review articles [8] to be the top publication types; Memorial ZA [1] and Yuen KY [7] to be the top authors; the University of Hong Kong [1,7,9] to be the top institution; and China [1,9] and the United States [7] to be the top countries.

Some other relevant bibliometric studies [3,5,6,10-14] analyzed similar indices, having one or more of the following limitations: they only mentioned the most productive country and the most common language, type, and source, but did not extend the results and explanation, such as the number of countries, types, and languages of the publications; they often did not mention the data collection period, which makes it difficult to understand the context; most of their data and extent were small and limited, failing to produce a broader and representative picture of COVID-19 research trends; and they were likely to produce contradictory results, although different research aims of the papers also could be responsible for such different results.

Objective: The present study aimed to present a comprehensive picture of COVID-19 research by analyzing all relevant published papers during the chosen time span. This study attempted to present both linear and graphical representations of the bibliometric data: document types and languages of the published papers, along with the top authors, publications, countries, institutions, and disciplines. Furthermore, it aimed to identify the co-occurrence of keywords and bibliographic coupling of countries and the sources of the most-cited documents.

Methods

Ethics statement: Neither approval by the institutional review board nor informed consent was required because this was a literature-based study.

Study design: This was a bibliometric study of a specific topic from a literature database.

Data sources/measurement: Bibliometric data were extracted from the Web of Science database. The data processing was conducted in three phases. First, the relevant literature was searched with four selected keywords, adding the Boolean operator “OR”; “COVID-19” OR “Coronavirus” OR “2019-nCoV” OR “SARS-CoV-2.” The search included the title, abstract, and author’s keywords. The keywords were determined based on previous studies. For example, some studies used “coronavirus” and “COVID-19” to search the literature [1], while others used “SARS-CoV-2” and “COVID-19” [8]. A study used the 23 most common keywords to search the Scopus database for available COVID-19–related literature [9]. From December 2019 to June 2020, 16,384 scholarly publications appeared in different sources. In December 2019, 793 papers were published, which was 4.84% of the total share. However, the publication number surged in 2020. From January to June 2020, 15,591 papers were published, accounting for 95.16% of the total share. Second, the data were downloaded from the database in the .txt file format. The downloaded file was transformed, restructured, and imported into a statistical program for the final analysis. Graphical illustrations of the co-occurrence of keywords and bibliographic coupling analysis were produced with VOSviewer 1.6.15 (https://www.vosviewer.com/), based on the data of 500 most-cited publications from the total publications to provide some insights regarding trends in COVID-19 research. It should be noted that Web of Science gives access to citation data for up to 500 documents. Third, the data processing had three tiers: general analysis, top percentile analysis, and bibliographic and citation network analysis. The two indices in the general analysis were the types and languages of the published papers. The five indices in the top percentile analysis were the top 10 authors, sources, countries, organizations, and disciplines of the published papers. In the percentile indices, a total of 55,352 authors, 2,964 sources, 159 countries, 12,805 organizations, and 221 disciplines were found in the 16,384 published papers. The co-occurrence analysis focused on both authors’ and all keywords, while the bibliographic coupling analysis focused on countries’ and sources’ coupling.

Statistical methods: Descriptive statistics were applied. IBM
SPSS Statistics ver. 25 (IBM Corp., Armonk, NY, USA) was used for the analysis.

**Results**

**Document types:** Fifteen types of documents were found (Table 1). Of them, articles had the highest share (n = 6,556, 40.015%), followed by editorial material (n = 4,138, 25.256%). It is important to mention that many papers from certain categories often overlap, which may increase the sum of the papers. For example, an article or a review can also be an early access paper.

**Languages:** Papers were found in 19 different languages (Table 2). Of them, English was disproportionately common (n = 15,616, 95.313%), followed by German (n = 203, 1.239%) and Spanish (n = 196, 1.196%). Catalan, Croatian, Icelandic, and Indonesian were on the bottom of the list, with only 1 (0.006%) paper each.

**Top authors:** The top 10 authors accounted for 0.02% of the total authors who produced 5.663% (n = 928) of the total output (Table 3). A remarkable number of authors were anonymous (n = 282, 1.721%). Otherwise, Wang Y (n = 94) produced the highest number of papers, followed by Zhang Y (n = 88) and Li Y (n = 77).

**Top sources:** The top 10 sources of publications constituted 0.34% of the total sources. They published 1,974 papers, or 12.049% of the total (Table 4). Of them, the *BMJ* (n = 488) published the highest number of papers, followed by the *Journal of Medical Virology* (n = 303) and the *Journal of Infection* (n = 261).

**Top countries:** The top 10 countries constituted 6.29% of the total countries. Unlike the top 10 authors and sources, the top 10 countries produced the majority of publications, accounting for 89.312% (n = 14,633) of the total output (Table 5). The United States secured the leading position with 4,167 pub-

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### Table 1. Types of publications

<table>
<thead>
<tr>
<th>Rank</th>
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<th>No. of publications</th>
<th>% of total</th>
</tr>
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<td>Article</td>
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<td>Editorial material</td>
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### Table 2. Languages of publications

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### Table 3. Top 10 authors

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<tr>
<td>1</td>
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<td>Zhang L</td>
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<table>
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<th>Rank</th>
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<th>% of total</th>
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<tbody>
<tr>
<td></td>
<td>Total</td>
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</table>
lished papers, followed by China (n = 2,979) and Italy (n = 1,921). It should be mentioned that many publications may share two or more countries at the same time.

**Top institutions:** The top 10 organizations comprised 0.08% of the total organizations. They cumulatively produced 2,895 papers, which is 17.67% of the total output (Table 6). Of them, the University of London (n = 488) had the highest output, while Harvard University (n = 403) and the University of California system (n = 352) were in the second and third position in the list, respectively.

**Top focuses:** The top 10 disciplines accounted for 4.53% of the total disciplines. They produce 8,814 papers and 53.797% of the total output (Table 7). Medicine-related papers (n = 2,259) were most common, followed by public environment-related (n = 1,203) and infectious disease-related papers (n = 1,146).

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### Table 4. Top 10 sources

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<td>Journal of Medical Virology</td>
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<td>Journal of Infection</td>
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### Table 5. Top countries

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<td>25.433</td>
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<tr>
<td>2</td>
<td>China</td>
<td>2,979</td>
<td>18.182</td>
</tr>
<tr>
<td>3</td>
<td>Italy</td>
<td>1,921</td>
<td>11.725</td>
</tr>
<tr>
<td>4</td>
<td>United Kingdom</td>
<td>1,575</td>
<td>9.613</td>
</tr>
<tr>
<td>5</td>
<td>Germany</td>
<td>745</td>
<td>4.547</td>
</tr>
<tr>
<td>6</td>
<td>India</td>
<td>738</td>
<td>4.504</td>
</tr>
<tr>
<td>7</td>
<td>Canada</td>
<td>730</td>
<td>4.456</td>
</tr>
<tr>
<td>8</td>
<td>France</td>
<td>662</td>
<td>4.041</td>
</tr>
<tr>
<td>9</td>
<td>Australia</td>
<td>620</td>
<td>3.784</td>
</tr>
<tr>
<td>10</td>
<td>Spain</td>
<td>496</td>
<td>3.027</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>14,633</td>
<td>89.312</td>
</tr>
</tbody>
</table>

### Table 6. Top 10 organizations

<table>
<thead>
<tr>
<th>Rank</th>
<th>Organization</th>
<th>No. of publications</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>University of London</td>
<td>488</td>
<td>2.979</td>
</tr>
<tr>
<td>2</td>
<td>Harvard University</td>
<td>403</td>
<td>2.460</td>
</tr>
<tr>
<td>3</td>
<td>University of California system</td>
<td>352</td>
<td>2.148</td>
</tr>
<tr>
<td>4</td>
<td>Huazhong University of Science Technology</td>
<td>339</td>
<td>2.069</td>
</tr>
<tr>
<td>5</td>
<td>Harvard Medical School</td>
<td>238</td>
<td>1.453</td>
</tr>
<tr>
<td>6</td>
<td>Wuhan University</td>
<td>220</td>
<td>1.343</td>
</tr>
<tr>
<td>7</td>
<td>University College London</td>
<td>218</td>
<td>1.331</td>
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<td>8</td>
<td>Chinese Academy of Sciences</td>
<td>217</td>
<td>1.324</td>
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<tr>
<td>9</td>
<td>Inserm</td>
<td>216</td>
<td>1.318</td>
</tr>
<tr>
<td>10</td>
<td>University of Toronto</td>
<td>204</td>
<td>1.245</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>2,895</td>
<td>17.670</td>
</tr>
</tbody>
</table>

### Table 7. Top 10 disciplines

<table>
<thead>
<tr>
<th>Rank</th>
<th>Discipline</th>
<th>No. of publications</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Medicine, general/internal</td>
<td>2,259</td>
<td>13.788</td>
</tr>
<tr>
<td>2</td>
<td>Public, environmental, and occupational health</td>
<td>1,203</td>
<td>7.343</td>
</tr>
<tr>
<td>3</td>
<td>Infectious diseases</td>
<td>1,146</td>
<td>6.995</td>
</tr>
<tr>
<td>4</td>
<td>Surgery</td>
<td>827</td>
<td>5.048</td>
</tr>
<tr>
<td>5</td>
<td>Virology</td>
<td>733</td>
<td>4.474</td>
</tr>
<tr>
<td>6</td>
<td>Immunology</td>
<td>612</td>
<td>3.735</td>
</tr>
<tr>
<td>7</td>
<td>Cardiac, cardiovascular systems</td>
<td>531</td>
<td>3.241</td>
</tr>
<tr>
<td>8</td>
<td>Oncology</td>
<td>525</td>
<td>3.204</td>
</tr>
<tr>
<td>9</td>
<td>Medicine, research/experimental</td>
<td>497</td>
<td>3.033</td>
</tr>
<tr>
<td>10</td>
<td>Pharmacology pharmacy</td>
<td>481</td>
<td>2.936</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>8,814</td>
<td>53.797</td>
</tr>
</tbody>
</table>

---

Co-occurrence of keywords for 500 most-cited articles: In the analysis of co-occurrence of all keywords, 83 out of 1,003 keywords met the threshold of at least five occurrences, producing five clusters, 1,254 links, and a total link strength of 3,061 (Fig. 1). The top repetitions were: coronavirus (n = 105), COVID-19 (n = 96), SARS (n = 77), pneumonia (n = 77), SARS-CoV-2 (n = 57), acute respiratory syndrome (n = 53), infection (n = 40), and 2019-nCoV (n = 38). In the analysis of the co-occurrence of authors’ keywords, 51 out of 503 keywords met the threshold with a minimum of three occurrences, producing nine clusters, 304 links, and a total link strength of 724 (Fig. 2). The top repetitions were: COVID-19 (n = 95), coronavirus (n = 70), SARS-CoV-2 (n = 54), 2019-nCoV (n = 37), and pneumonia (n = 28).

Bibliographic coupling for the 500 most-cited articles: In the
A bibliometric and co-occurrence analysis of COVID-19–related literature

analysis of bibliographic coupling of countries, 24 out of 62 countries met the threshold with a minimum of five documents, producing four clusters (Fig. 3). The top countries were China (n = 275), the United States (n = 160), the United Kingdom (n = 68), and Italy (n = 37). The strongest collaborative link was found between China and the United States (35,811). In the analysis of bibliographic coupling of sources, 23 of 179 sources met the threshold with a minimum of five documents, producing three clusters (Fig. 4). The top sources were New England Journal of Medicine (n = 42), JAMA (n = 30), and The Lancet (n = 30). The strongest link was between New England Journal of Medicine and JAMA (267), followed by JAMA and The Lancet (249) and New England Journal of Medicine and The Lancet (238).

Discussion

Key results: This bibliometric study analyzed 16,384 Web of Science-indexed COVID-19 studies published between December 2019 and June 2020. The analysis presented some novel findings. First, the data contained 15 types of publications, of which articles were most common, followed by editorial materials. This finding indicates a surge in original COVID-19 research publications, most of which may be related to medicine and public health. Some previous studies also found similar results, but with articles followed by either re-
views and notes [1] or reviews and short commentaries [4], whereas some studies found that only reviews were the most popular type of publications [8]. Second, of the 19 different languages, English has the largest share, followed by German and Spanish. Two other studies produced almost the same results [4,8], except with Chinese in the second position after English [4]. Third, the 10 leading countries produced ninetenths of the total publications. The United States was found to be the leading country with the highest publications, followed by China, which is similar to a previous result [7]. However, two previous studies [1,9] produced contradictory results, showing China to be the leading country. Fourth, the 10 leading authors accounted for a small proportion of papers. Wang Y was found to be the leading researcher, whereas other studies found Memish ZA and Yuen KY to be the leading authors [1,7]. The list of the top researchers indicated that although the US produced the highest number of papers, Chinese researchers were in the leading position in terms of the number of publications. Fifth, the present study found that the BMJ was the source of the most COVID-19 studies, followed by the Journal of Medical Virology; this both supports [8] and contradicts [1,4] previous results. It should be kept in mind that the highest paper production does not guarantee the highest number of citations: therefore, this study also incorporated an analysis of the most-cited documents for better understanding the sources.

Sixth, the University of London produced the highest number of papers, followed by Harvard University. In contrast, three studies [1,7,9] found that the University of Hong Kong was the top-producing institute. The leading institutions also hint towards the existence of three contemporary research hotspots in the United Kingdom, the United States, and China. Seventh, medicine-related publications were the most common in terms of discipline, followed by environmental health- and infectious disease-related papers. This finding suggests that researchers are placing a strong emphasis on the medical aspects of COVID-19, whereas a previous result showed epidemiology in the leading position [4]. Eighth, the co-occurrence network analysis of the 500 most cited papers showed that the five most common repetitive keywords: “coronavirus,” “COVID-19,” “SARS-CoV-2,” 2019-nCoV,” and “pneumonia.” This result is similar to previous findings [9]. Ninth, the bibliographic coupling analysis of countries and sources showed the strongest collaborative links between China and the United States, and between New England Journal of Medicine and JAMA.

**Limitation:** The co-occurrence network analyses were done with only 500 most-cited articles. If the entire dataset had been included, the results may have been different.

**Conclusion:** This study offers a broader picture of COVID-19 research output for academics and researchers, presenting some novel results that both support and contradict previous studies. Moreover, the addition of the co-occurrence and bibliographic coupling analyses of the most-cited literature also helped to shed light on some trends in COVID-19 research.

**Conflict of Interest**

No potential conflict of interest relevant to this article was reported.

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**Data Availability**

Data are available from the author upon reasonable request.

**References**


COVID-19 research trends in the fields of economics and business in the Scopus database in November 2020

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Abstract
Purpose: This study explored the state of the literature on coronavirus disease 2019 (COVID-19) in two subject areas: (1) economics, econometrics, and finance, and (2) business, management, and accounting. The study focused on the most productive and influential journals, countries, institutions, documents, and clusters of keywords.
Methods: Data were retrieved from Scopus on November 21, 2020. The search term was the keyword “COVID-19” in the title, abstract, and author’s keywords, and the articles were limited to two subject areas. The data were analyzed using VOSviewer and Excel.
Results: In the analysis of 1,719 articles on COVID-19, the most productive journal that published these articles was Gender, Work, and Organization (n = 49). The most productive country and institutions were the United States (n = 526) and Universiteit van Pretoria (n = 16) and the University of Oxford (n = 16), respectively. Based on citations, the most influential authors, countries, and journals were Dmitry Ivanov (n = 233), the United States (n = 1,027), and Finance Research Letters (n = 326), respectively. The most cited article was authored by Stefan Gossling (n = 157) on the impact of COVID-19 on society, the economy, and tourism. The articles were from 111 countries, of which 85.6% had collaborations. The keywords of research on COVID-19 formed 14 clusters (e.g., small and medium enterprises, aviation, tourism, banking and finance, supply chain, economic growth, and the digital economy).
Conclusion: The number of COVID-19 articles related to economics and business is fairly large and is continuing to grow significantly. The keyword analysis showed that COVID-19 has had a tremendous impact on all economic sectors.

Keywords
Bibliometric analysis; Business and management; COVID-19; Economic impact; Economics and finance
Introduction

Background/rationale: The coronavirus disease 2019 (COVID-19) outbreak has become a pandemic, shocking the world. As of December 21, 2020, there were over 63 million confirmed cases and 1.47 million deaths worldwide (https://covid19.who.int). The rapid spread of the virus has forced countries to implement full or partial lockdowns. Various policies such as working from home and social distancing have been implemented. These circumstances placed businesses and the economy under pressure, requiring them to adapt quickly. Correspondingly, the field of research has also experienced rapid changes and adaptation, the most obvious of which is the widespread implementation of policies prioritizing the publication of research related to COVID-19 and providing free access to such research. As result, along with the rapid spread of COVID-19, research on COVID-19 is growing rapidly. Within 1 year, the total number of publications in the Scopus database dealing with COVID-19 exceeded 82,000 (https://www.scopus.com/).

Researchers in the fields of economics and business have certainly not been left behind in responding to this pandemic. With their subject-area expertise, they are examining and analyzing the impacts of COVID-19 on the economy in relation to various topics. Furthermore, given the rapid and vast publication of articles on COVID-19, some studies have been done on the bibliometric analysis based on subject areas in general [1] or specific areas such as sciences and the social sciences [2,3], business and management [4], and environmental studies [5,6]. However, bibliometric analyses of COVID-19 by subject area remain limited, especially in economics, business, and finance.

Objectives: This study aimed to fill a small part of this gap by analyzing the economic, business, and finance subject areas and shedding light on the recent state of COVID-19 documents published in these fields. To achieve this goal, this study focused on describing indicators that are relevant for understanding research production and influence, such as authors, journals, institutions, and countries. Furthermore, this study visualized the networks of co-authorship and co-occurrence of keywords and analyzed research streams. These research streams might spark interest among scholars and researchers to explore new directions for future research and discover solutions to current problems.

Methods

Ethics statement: This study did not involve human subjects; therefore, neither institutional review board approval nor informed consent was needed.

Study design: This study was a descriptive and bibliometric analysis based on a literature database.

Data collection: The data in this study were retrieved on November 21, 2020 from the Scopus database. To obtain the necessary data, this study used the keyword “COVID 19” in the title, abstracts, and author’s keywords. The results were restricted to documents listed in the following two subject areas: “economics, econometrics, and finance” and “business, management, and accounting”. The strategy used the following search option “TITLE-ABS-KEY (COVID 19) AND (LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA, "ECON")) AND (LIMIT-T (DOCTYPE, “ar” AND (LIMIT-TO (SRCTYPE, "J"))”. In this study, the metadata and refined Scopus result values were retrieved in the CSV dataset format. However, before the bibliometric analysis, the consistency and reliability of the data were checked to address issues such as a lack of consistency in country names and keywords. The data were also standardized to ensure consistency regarding keywords that sometimes appeared in singular or plural, abbreviations, or other forms.

Visualization and statistical methods: The data obtained from the Scopus database were analyzed using VOSviewer software, and simple statistics were calculated using Microsoft Excel.

Results

Based on a search with the keyword “COVID-19” on November 21, 2020, the results showed approximately 68,793 documents. Nevertheless, since this study was limited to journal articles in two subject areas, 1,979 articles were examined. Interestingly, these two subject areas intersected with 19 other subject areas. Most articles were listed under business, management, and accounting (n = 1,244, 30.9%), economic, econometrics and finance (n = 967, 24%), social sciences (n = 954, 23.7%), environmental sciences (n = 209, 5.2%), and engineering (n = 137, 3.4%). The full distribution of COVID-19 articles across the top 10 subject areas is shown in Fig. 1.

According to VOSviewer, the articles were published in 506 different journals. The highest number of articles was published in Gender, Work, and Organization, with 49 publications, followed by Finance Research Letters (n = 48), American Review of Public Administration (n = 43), Environmental and Resource Economics (n = 36), and the International Journal of Sociology and Social Policy (n = 34). The other most productive journals with the most publications are shown in Table 1.

The records in the Scopus database indicated that authors from 160 institutions and 111 countries published four or more articles. Table 2 shows the most productive institutions and countries related to COVID-19 papers. Universiteit van
Pretoria (n = 16), University of Oxford (n = 16), and University of Central Florida (n = 15) were the top three institutions publishing COVID-19 research in these fields. The most productive countries were the United States (n = 526), United Kingdom (n = 305), China (n = 147), India (n = 132), Australia (n = 130), and Germany (n = 102), which together published approximately 48.9% of all publications.

Table 3 lists the most influential authors based on citations recorded by the Scopus database. The most influential author was Ivanov D, with 233 citations, followed by Gossling S (n = 201), Hall CM (n = 196), Scott D (n = 196), and Zhang H (n = 141). However, none of these authors were listed among the top five productive authors in terms of publication volume. In the meantime, as shown in Table 3, the top five most influential countries were dominated by the most productive countries in Table 2, such as the United States (n = 1027), United Kingdom (n = 835), China (n = 637), and Australia (n = 430). However, India, which was the fourth most productive country, was replaced by Canada (n = 460) in terms of the number of citations.

Table 3 also presents the influential sources (i.e., journals) based on citations. Finance Research Letters (n = 326) was the most influential journal, followed by Tourism Geographies (n = 235), the Journal of Business Research (n = 179), the Canadian Journal of Agricultural Economics (n = 169), and the Journal of Sustainable Tourism (n = 162). Finance Research Letters was the only one of these journals that was also among the top five productive journals.

"Pandemics, tourism, and global change: a rapid assessment of COVID-19" published in the Journal of Sustainable Tourism by Gossling et al. [7] was the most frequently cited (n = 157) article. The second highly cited article (n = 114) was entitled, "Predicting the impacts of epidemic outbreaks on global supply chains: A simulation-based analysis on the corona-virus outbreak (COVID-19/SARS-CoV-2) case," by Ivanov [8], published in Transportation Research Part E: Logistics and Transportation Review. The other most influential documents are shown in Table 4 [7-16].

Fig. 2 shows collaboration among authors according to their country of affiliation. Large nodes represent the total links of each country. The links between nodes show collaborations between researchers from different countries, and the thickness of the links and distance between the nodes show the frequency of collaboration. Different colors represent 15 different clusters. The country with the most collaboration was the United Kingdom, with 55 links and a total link strength of 299, followed by the United States (n = 64, 291), Australia (n = 33, 117), China (n = 33, 115), Germany (n = 30, 100), France (n = 36, 95), Canada (n = 31, 83), Italy (n = 21, 77), New Zealand (n = 25, 70), and Finland (n = 25, 57).

Lastly, using VOSviewer software, this study recorded 4,737
Table 2. The most productive countries and institutions based on the number of publications

<table>
<thead>
<tr>
<th>Institution</th>
<th>No. of documents</th>
<th>Country</th>
<th>No. of documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universiteit van Pretoria</td>
<td>16</td>
<td>United States</td>
<td>526</td>
</tr>
<tr>
<td>University of Oxford</td>
<td>16</td>
<td>United Kingdom</td>
<td>305</td>
</tr>
<tr>
<td>University of Central Florida</td>
<td>15</td>
<td>China</td>
<td>147</td>
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<td>Lahore University of Management Sciences</td>
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<td>France</td>
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</tr>
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<td>The University of Manchester</td>
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<td>New Zealand</td>
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<tr>
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<td>South Africa</td>
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<td>University of Johannesburg</td>
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<td>Switzerland</td>
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</tr>
<tr>
<td>City University of New York</td>
<td>10</td>
<td>Russian Federation</td>
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</tr>
<tr>
<td>Università Degli Studi di Napoli Federico II</td>
<td>10</td>
<td>Norway</td>
<td>34</td>
</tr>
<tr>
<td>Chinese Academy of Sciences</td>
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<td>Copenhagen Business School</td>
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<td>University of Canterbury</td>
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</tr>
<tr>
<td>The University of Sydney</td>
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<td>Viet Nam</td>
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</tr>
<tr>
<td>University of Economics Ho Chi Minh City</td>
<td>10</td>
<td>Ireland</td>
<td>27</td>
</tr>
</tbody>
</table>

Table 3. The most influential authors, countries, and sources based on citation analysis

<table>
<thead>
<tr>
<th>Author</th>
<th>Citation</th>
<th>Country</th>
<th>Citation</th>
<th>Source</th>
<th>Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ivanov D</td>
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<td>United States</td>
<td>1,027</td>
<td>Finance Research Letters</td>
<td>326</td>
</tr>
<tr>
<td>Gossling S</td>
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<td>United Kingdom</td>
<td>835</td>
<td>Tourism Geographies</td>
<td>235</td>
</tr>
<tr>
<td>Hall CM</td>
<td>196</td>
<td>China</td>
<td>637</td>
<td>Journal of Business Research</td>
<td>179</td>
</tr>
<tr>
<td>Scott D</td>
<td>196</td>
<td>Canada</td>
<td>460</td>
<td>Canadian Journal of Agricultural Economics</td>
<td>169</td>
</tr>
<tr>
<td>Zhang H</td>
<td>141</td>
<td>Australia</td>
<td>430</td>
<td>Journal of Sustainable Tourism</td>
<td>162</td>
</tr>
<tr>
<td>Chen K</td>
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<td>Germany</td>
<td>376</td>
<td>Transportation Research Part E: Logistics and Transportation Review</td>
<td>154</td>
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<td>Wang P</td>
<td>105</td>
<td>New Zealand</td>
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<td>Resources, Conservation, and Recycling</td>
<td>133</td>
</tr>
<tr>
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<td>France</td>
<td>243</td>
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<tr>
<td>Dolgui A</td>
<td>102</td>
<td>Sweden</td>
<td>235</td>
<td>Journal of Risk Research</td>
<td>125</td>
</tr>
<tr>
<td>Zhang D</td>
<td>94</td>
<td>Norway</td>
<td>217</td>
<td>Journal of Behavioral and Experimental Finance</td>
<td>119</td>
</tr>
<tr>
<td>Ji Q</td>
<td>91</td>
<td>Pakistan</td>
<td>150</td>
<td>Emerging Markets Finance and Trade</td>
<td>115</td>
</tr>
<tr>
<td>Rizvi SAR</td>
<td>82</td>
<td>Italy</td>
<td>149</td>
<td>Gender, Work, and Organization</td>
<td>94</td>
</tr>
<tr>
<td>Hu M</td>
<td>79</td>
<td>Viet Nam</td>
<td>140</td>
<td>Journal of Service Management</td>
<td>90</td>
</tr>
<tr>
<td>Geraghty EM</td>
<td>78</td>
<td>India</td>
<td>120</td>
<td>International Journal of Health Geographics</td>
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</tr>
<tr>
<td>Kamel Boulos MN</td>
<td>78</td>
<td>Malaysia</td>
<td>106</td>
<td>Environment, Development, and Sustainability</td>
<td>71</td>
</tr>
<tr>
<td>Chen X</td>
<td>68</td>
<td>Turkey</td>
<td>106</td>
<td>International Journal of Production Research</td>
<td>71</td>
</tr>
</tbody>
</table>
keywords of 1,979 documents. However, only 206 keywords occurred at least five times. Fig. 3 visualizes the co-occurrence of these 206 keywords. The word “COVID-19” was the most common keyword, appearing 1,132 times in the documents, followed by “pandemic” (n = 199), “coronavirus” (n = 188), “COVID-19 pandemic” (n = 70), “crisis” (n = 62), “China” (n = 43), “lockdown” (n = 43), “resilience” (n = 38), “SARS-CoV-2” (n = 36), and “social distancing” (n = 35).

Furthermore, Fig. 3 shows these keywords divided into 14 clusters (each with a different number of keywords), which are represented by colors. The first cluster (red, 26 keywords) focused on the socio-economic impact, digital technology, airline industries, and small to medium enterprises. The second cluster (green, 22 keywords) centered on air quality and pollution, public health, crisis, higher education, food security, and social security. The third cluster (blue, 21 keywords) related to business models, family business, risk management, corporate social responsibility, blockchain, entrepreneurship, and supply chains.

The fourth cluster (yellow, 18 keywords) showed links to

For articles with multiple authors, only the name of the first author is given.

Table 4. The most influential documents based on citations

<table>
<thead>
<tr>
<th>Document</th>
<th>Topic</th>
<th>Scopus citations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ivanov D [8]</td>
<td>The impact of COVID-19 on global supply chains</td>
<td>114</td>
</tr>
<tr>
<td>Ivanov D [12]</td>
<td>COVID-19 and supply chain networks</td>
<td>69</td>
</tr>
<tr>
<td>Dryhurst S [16]</td>
<td>Public risk perception of COVID-19</td>
<td>42</td>
</tr>
</tbody>
</table>

Fig. 2. Visualization of authors’ relationships based on countries.

Fig. 3. Visualization of the co-occurrence of keywords.
Fig. 3. Visualization of author’s keywords co-occurrences network.

micro- and macro-economic themes, with the gross domestic product, economic impact, labor market, employment and unemployment, and work from home. Education, university, online learning, e-commerce, hospitality, hotel, and tourism were the core topics of cluster 5 (purple, 17 keywords). The sixth cluster (light blue, 16 keywords) addressed the impact of COVID-19 on financial crises, with keywords such as financial market, bitcoin and cryptocurrency, fiscal policy, herding behavior, gold, volatility, and liquidity.

The seventh cluster (orange, 16 keywords) showed links to supply chain issues, with topics such as supply chain, disruption, supply chain risk management, supply chain resilience, food supply chain, global supply chain, global value chain, and circular economy. Public policy, informal economy, work-life balance, economic growth, globalization, and investment were the main topics of cluster 8 (brown, 16 keywords). The ninth cluster (lavender, 11 keywords) focused on social media-related issues such as sentiment analysis, well-being, mental health, anxiety, and social media. The 10th cluster (purple, 10 keywords) focused on the impact of COVID-19 on behavior, with keywords such as consumer behavior, the theory of planned behavior, willingness to pay, perceived risk, and risk perception.

The 11th cluster (lime green, nine keywords) focused on emergency management, stock returns, and the public budget. The 12th cluster (light blue, nine keywords) dealt with poverty, food insecurity, disaster, and sustainable development. The 13th cluster (light green, eight keywords) addressed the sports economy, with keywords such as football, sport, and leisure. The 14th cluster (light purple, seven keywords) focused on big data, with keywords including big data and artificial intelligence.

Discussion

Interpretation: The current study focused on articles published in two subject areas: namely economics, econometrics, and finance; and business, management, and accounting. This study aimed to provide information on the status of publications in these fields related to the impact of COVID-19. As of November 21, 2020, a total of 1979 studies published in these two subject areas were recorded in the Scopus database. The data showed the rapidity of article publications and the responsiveness of the researchers in analyzing the impact of the COVID-19 pandemic on economic sectors around the world.

Based on Tables 2 and 3, the most productive and influential country was the United States followed by the United Kingdom and China. Moreover, Table 4 showed that the top 10 articles addressed the impacts of COVID-19 on risk perception, air pollution, supply chains, the financial market, the tourism industry, and oil prices [7-16]. Furthermore, as shown in the visualization in Fig. 2, the collaboration level between countries is quite high. Of the 111 countries identified, 85.6% (n = 95) had instances of collaboration with other countries. The five countries with the highest total link strength were the United Kingdom, United States, Australia, China, and Germany. However, no instances of collaboration were found for 16 countries, including the Philippines, Brunei Darussalam, Iceland, and Afghanistan.

As shown in Fig. 3, based on the visualization of keyword
co-occurrence, research on COVID-19 was divided into 14 clusters. This result is in line with the findings of Verma and Gustafsson [4], who identified 18 sub-themes of business management. Furthermore, Fig. 3 presents a variety of studies in every economic sector, including small and medium enterprises, aviation, tourism, banking and finance, the supply chain, economic growth, and the digital economy. Likewise, the number of clusters showed that research has addressed the serious impacts of COVID-19 on the economy from both macro- and micro-economic perspectives.

**Limitation:** The current study has several limitations. First, this study was focused on two subject areas in the Scopus database, and other databases were excluded from the study. Another limitation was the inclusion of only articles. Consequently, future bibliometric analyses are still needed, including other types of documents and a more comprehensive analysis of COVID-19 studies related to the economy, business, and finance from several databases.

**Conclusion:** Based on the results of this study and the absence of signs of reductions in COVID-19 cases, it is very possible that COVID-19 research related to the economy and business will continue to grow significantly. By examining and showing the current state of the literature in these two subject areas, this research supplies important information for researchers in the area of economics, business, and finance. This research complements the existing studies on COVID-19, especially related to economics, business, and finance. The results confirm that COVID-19 has seriously affected all economic sectors.

**Conflict of Interest**

No potential conflict of interest relevant to this article was reported.

**Funding**

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**Data Availability**

Dataset file is available from: the Harvard Dataverse at: https://doi.org/10.7910/DVN/LMHPDD

**Dataset 1.** Raw data of COVID-19 articles from the Scopus database

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12. Ivanov D, Dolgui A. Viability of intertwined supply networks: extending the supply chain resilience angles to-


Bibliometric analysis of journals, authors, and topics related to COVID-19 and Islamic finance listed in the Dimensions database by Biblioshiny

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Abstract

Purpose: This bibliometric study investigated the current state of documents on coronavirus disease 2019 (COVID-19) and Islamic finance published by digital object identifier-equipped journals listed in the Dimensions database. The analysis focused on describing the characteristics and trends of the keywords, authors, and journals.

Methods: The data analyzed were from 149 research publications in Dimensions. The search terms were “COVID” and “Islamic finance.” The searches used to establish the study dataset were last updated on August 27, 2020. Descriptive statistical methods were used, and a bibliometric analysis was conducted using Biblioshiny, an R-based app, to generate a bibliometric map.

Results: The number of articles discussing the theme of COVID-19 and Islamic finance was quite large in recent months, with more than 100 articles published. The most popular keywords used were “COVID,” “food,” and “pandemic,” although there were also many keywords that related more specifically to the field of Islamic finance, namely “banks,” “markets,” “health,” “debt,” “equity,” “management,” and “stock.”

Conclusion: This study provides an overview of trends in the most popular keywords, journals, and authors of articles on the topic of COVID-19 and Islamic finance, which has been quite a popular theme in recent months, thereby providing information for researchers specializing in the field of Islamic finance. This theme has the potential to continue to be developed.

Keywords
Bibliometrics; COVID-19; Islamic finance; R

Introduction

Background/rationale: Currently, the entire world is facing a prolonged crisis due to the coronavirus disease (COVID-19) pandemic, which emerged at the end of 2019. The virus has re-
sulted in severe economic damage [1]. The attention of countries throughout the world has shifted from the problem of the spread of the disease to focus on the negative economic and financial consequences of the pandemic for nations and their people; for example, production shortages will have impacts on supply chains and result in many layoffs and a lack of employment for millions of people around the world [2]. However, Islamic social finance can serve as an instrument to maintain a country’s economic activity. This instrument merits further attention by all levels of society considering its importance in providing spiritual impacts (worship), social impacts (mutual aid/assistance), and economic impacts (income distribution). The importance of the economy during this pandemic underscores the fact that social inequality and inequalities in people’s income are the sources of a broad range of urgent problems requiring improvement [3].

**Objectives:** The analysis focused on describing the keywords, authors, journals, and characteristics of articles on COVID-19 and Islamic finance retrieved from the Dimensions database (https://www.dimensions.ai/). Papers on this topic are interesting to discuss considering the importance of scientific research for generating ideas and innovations in response to economic problems.

**Methods**

**Ethics statement:** This research did not involve human subjects. Therefore, neither institutional review board approval nor informed consent was needed.

**Study design:** This was a literature-based descriptive study involving a bibliometric analysis.

**Setting:** This study used publication data related to COVID-19 and Islamic finance sourced from the Dimensions database. The Dimensions database is an alternative indexation with the criterion that all articles have a specific DOI. The search terms were “COVID” AND “Islamic finance” in the full data. This search was conducted on August 23, 2020, and yielded 237 publications, of which 149 published articles were related to the issue of COVID-19 and Islamic finance (Dataset 1). Data on keywords, authors, journals, and the characteristics of these documents on the role of Islamic finance during the COVID-19 pandemic were analyzed using the R-based Biblioshiny app, which is freely available from: https://bibliometrix.org/.

**Statistical methods:** Descriptive data are presented as numbers, percentages, and rankings. Descriptive statistical analyses were carried out to present the timeline and distribution of the articles.

**Results**

**Publication types of sources**

The 149 publications consisted of five different types: 87 journal articles (58.3%), 12 book chapters (8.1%), two monographs (1.3%), and 48 preprint (manuscript deposited on public repository before peer review) studies or studies uploaded before peer review (32.2%).

**Three fields plot**

The three fields plot shown below is an illustration of three elements, consisting of a list of journal names, authors, and topics (Fig. 1). These three elements are plotted with gray linkages that show their relationship with each other, starting from the name of the journal, followed by the author, and each author is then linked to the topic of their publication. The size of each rectangle in each list indicates the number of papers associated with that element.

The first element, on the left, is the journal. Seven journals were indexed in the three fields plot as having published papers on the topic of COVID-19 and Islamic finance, and the top journal that published the most papers on this topic was the SSRN Electronic Journal, which is depicted with a blue rectangle and connected to several authors, namely Khan, Fahad, Faizal, Naushad, Akbar, Goodell, Taskinsoy, Ashraf, Rizwan, Yarovaya, Ahmad, Corbet, Harcon, Rizvi, Wang, and Tarazi.

The second element in the middle contains authors’ names. Authors who published articles in journals that were recognized are associated with previous elements, such as Tarazi A, who is linked to the SSRN Electronic Journal and the Global Finance Journal as journal elements. However, some others did not publish in indexed journals, and therefore do not have any connection with any of the journals listed, such as Un U and Salisu AA. Each of the authors is also associated with frequently used keyword topics on the right. The 19 top authors are listed in this plot. The size of the rectangle shows the number of papers written by each author. In this plot, Khan, Fahad, Faizal, and Naushad had the largest rectangles (of equal size). The third element contains the topic-related keywords that appeared most frequently in the papers. Each topic is associated with authors who published extensively on that topic. Sixteen keyword topics are listed, and the keyword that appeared most frequently was “COVID,” as indicated by the size of the red rectangle, which dominated the other rectangles. It also appeared that the topic of COVID was used by almost all of the registered authors, which aligns with the focus of this research on scientific papers related to COVID-19 and Islamic finance. In addition to COVID, this plot also shows several other keywords that were widely used, such as “economy” and “pandemic.”
Source impact
In addition to the quantity and relevance of publications, this study also analyzed the impact of each journal that published papers on the topic of COVID-19 and Islamic finance by calculating the journal’s h-index, which is depicted in the bar chart shown in Fig. 2. Along with a numerical representation of the h-index value of each journal, this diagram also shows the impact of each journal through the shade of blue, with a darker color indicating higher-impact journals.

SSRN Electronic Journal occupied the top position in terms of impact, with an h-index of 3 and a black bar on the chart. Nineteen other journals had h-indices of 1 and are colored light blue on the diagram, indicating their relatively low impact.

Word cloud
The word cloud in Fig. 3 presents a visualization of the words that appeared most frequently in the papers on the topic of COVID-19 and Islamic finance. The most common word was “COVID,” the second most common word was “food,” and the third most common word was “pandemic.”

The word cloud displays words in various sizes according to the number of times they appear. The placement of words is somewhat random, but the predominating words are placed in the middle so that they are more visible, given their large size.

Thematic map
A thematic map was also generated based on density and centrality, divided into four topological regions (Fig. 4). This result was obtained from a semi-automatic algorithm by reviewing the titles of all references analyzed in this study and additional relevant keywords (apart from the author’s keywords) to capture deeper variations.

The upper right quadrant shows “motor” or “driving” topics, indicated by high density and centrality; these topics, which included “development” and to some extent “food,” should be developed further given their importance for future research. The quadrant in the top left shows specific and under-represented topics that nonetheless are areas of rapid development, as indicated by high density but low centrality, including “COVID,” “crisis,” and “case.”

The lower left quadrant contains topics that have been used but have experienced a downward trend, indicated by low centrality and density; these topics; these topics are important for research as general topics, and included “COVID-,” “global,” part of the “approach” topic, and part of the “food” topic.

Conceptual structure map
A conceptual structure map was generated, containing a visualization of the contextual structure of each word that appeared often in research papers on the topic of COVID-19 and Islamic finance by mapping the relationship between one word and another through regional mapping (Fig. 5). Each word is placed according to the values of Dim 1 and Dim 2, Dim is Diminutive particle, which is a specific term in bibliometric science, thereby producing a mapping between words whose values did not differ to a considerable extent.
There are two divisions in this map: the red area and the blue area, each of which contains words that are related to each other. As shown above, the red area contained a high number and variety of words, demonstrating that many research papers presented connections between the words listed in this region, which contained the top three words that appeared most often ("COVID," "food," and "pandemic").
Discussion

Interpretation: This study presents a bibliometric analysis, conducted using the Biblioshiny app, of journal articles with a digital object identifier on the theme of COVID-19 and Islamic finance indexed by the Dimensions database. Since its global spread, COVID-19 has become a major focus of researchers' interest, including those in the field of Islamic finance. In recent months, the literature on Islamic finance has begun to widely reflect this focus on COVID-19.

Based on the results above, it appears that research on COVID-19 and Islamic finance has been widely published by various journals and numerous authors, with a broad range of specific topics. The three fields plot, which visualized three parameters (namely journals, authors, and topics) and allowed their relationships to be analyzed, showed the topics discussed by the authors and the journals in which authors published their research. This plot also presented the quantity of each element, the journals with the most publications on the relevant topics, and the most productive writers.

The SSRN Electronic Journal was shown to be the most productive journal in the three fields plot, as it published articles by many writers on the topic of COVID-19 and Islamic finance. Interestingly, this was also the only high-impact journal, with an h-index of 3, while the other journals only had h-indices of 1. Thus, SSRN Electronic Journal dominated other journals in terms of the quantity and impact of research on the theme of COVID-19 and Islamic finance, allowing it to serve as a resource for researchers who are looking for references regarding research on this theme.

The most frequently used words in articles on the theme of COVID-19 and Islamic finance included “COVID,” “pandemic,” “finance,” “Islamic,” and “COVID-19.” A conceptual structure map was generated, containing a visualization of the contextual structure of each word.

Fig. 5. A conceptual structure map was generated, containing a visualization of the contextual structure of each word.
demic,” “food,” “financial,” “international,” and “crisis.” Thus, most of the articles focused on prioritizing the topic of COVID-19, with a secondary focus on Islamic finance. As shown by the most widely used words, which included “banks,” “markets,” “health,” “debt,” “equity,” “management,” and “stock,” the discussions of Islamic finance dealt with a broad range of themes. Therefore, it can be concluded that the research on this theme was quite comprehensive and covered various sectors in Islamic finance.

Interestingly, several names of countries and regions of the world appeared in the word cloud, including Indonesia, China, Pakistan, Europe, Asia, and Bulgaria. This fact shows that several countries were frequent objects of study in research on COVID-19 and Islamic finance. This may reflect a specific focus on COVID-19, as in studies dealing with China, or a primary focus on Islamic finance in countries where this system is quite developed, such as Indonesia. Research on Islamic finance in the COVID-19 era requires a country that has implemented the Islamic financial system as an object of study, and these countries seem to be quite popular as the object of research based on the articles on COVID-19 and Islamic finance studied in this study.

The topic development shown by the thematic map provides an overview of the position of each topic in a quadrant comparing the density and centrality of the topic. The upper left quadrant and the lower right quadrant were most extensively populated. The upper left quadrant, which shows topics that are rarely investigated, but whose development is quite rapid, was occupied by the words “COVID,” “crisis,” and “case.” These three words seem to have developed rapidly, with high density but low centrality. Therefore, these three topics are experiencing developments in research on COVID-19 and Islamic finance.

The lower right quadrant, which contains basic topics with low centrality but high density, was occupied by words such as “approach,” “global,” “COVID,” and “food.” These words were widely used, although the level of development was not as high as for concepts in the upper left quadrant; nonetheless, the high quantity of these terms indicates that these themes can continue to be developed through further studies to address existing research gaps and to provide more comprehensive insights.

An interesting finding of the thematic map was that the topic “food” occupied part of the lower right quadrant and part of the upper right. Since the upper right quadrant corresponds to high density and centrality, it can be concluded that the “food” topic was widely used and that it developed quite rapidly, it can be seen that the topic of “food” is widely used and is growing quite rapidly, this shows that many papers are examining the relationship between food and COVID-19, especially when considering the importance of health with nutritious and hygienic foods.

Apart from being able to see these keywords in the word cloud and thematic map, the conceptual structure map placed each word based on its Dim 1 and Dim 2 values. Two large clusters emerged, showing connections between the words used in the research on the theme of COVID-19 and Islamic finance. In this map, several popular keywords are included in the red cluster, including the three most popular keywords based on the word cloud (namely “COVID,” “food,” and “pandemic”).

**Limitation:** This study has several limitations. First, it only focused on articles published on the theme of COVID-19 and Islamic finance, as analyzed through a three fields plot that describes the relationship between journals, authors, and the topics used, an analysis of source impact that identified the most influential journals, and the most popular keywords, as shown in the word cloud, thematic map and conceptual structure map.

Other topics that could be explored include the names of the most popular authors on this topic, the most productive or commonly analyzed countries in this research area, the most productive institutions, and so on. The collection of articles was obtained from the Dimensions database and was limited to August 27, 2020, meaning that changes and developments may continue in the future. Suggestions for further research are to conduct a more complete bibliometric analysis with more elements in order to produce more comprehensive results.

**Conclusion:** The number of articles on the theme of COVID-19 and Islamic finance published by digital object identifier-equipped journals is quite large, and has the potential to continue growing, given the ongoing spread of the pandemic and the increasing importance of Islamic finance. Several topics and keywords were popularly used in this theme and have the potential for further development, especially in specific domains in Islamic finance in the face of this pandemic. In addition, some of the most productive journals and authors can also be used as references for researchers working on this topic. Thus, it is necessary to encourage Islamic scholars to contribute to research on COVID-19 and to integrate that knowledge into Islamic finance practice.

**Conflict of Interest**

No potential conflict of interest relevant to this article was reported.
Funding
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Data Availability
Data are available from the author upon reasonable request.

Dataset 1. Raw data collected from Dimensions with search terms were “COVID” AND “Islamic finance.”

References


Bibliometric analysis of publications on inclusive education from the Web of Science Core Collection published from 1992 to 2020

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Abstract

Purpose: This study analyzed the bibliometric characteristics of publications on inclusive education in the Social Science Citation Index and Science Citation Index Expanded in the Web of Science Core Collection from 1992 to 2020.

Methods: Terms related to “inclusive education” and “inclusion of education” were used as keywords to search for journal articles on July 3, 2020.

Results: There were 1,786 articles, representing 3,376 authors, in the 345 journals scanned. The United States, United Kingdom, and Australia were the three leading countries/regions in this field. In the top 12 countries, the top 15 institutions and the top 10 most-cited journals were identified by either the number of publications or the number of total citations. Core themes from the 30 most highly-cited articles were teachers’ attitudes, teachers’ self-efficacy, and the effects of inclusive education. Teachers included both pre-service and in-service teachers; students represented those with and without special educational needs.

Conclusion: The results indicate that the United States, United Kingdom, and Australia dominated inclusive education research, originating most of the highly-cited articles, having more prolific authors, and presenting the most-cited institutions. Furthermore, three emerging core themes from the 30 most highly-cited articles were teachers’ attitudes, teachers’ self-efficacy, and the effects of inclusive education. Frontline teachers are recommended to submit manuscripts about their teaching experiences to the most-cited journals, which have a large readership. To measure the effects of inclusive education, it is essential to formulate reliable, valid, and culture-free research instruments for future studies.

Keywords: Bibliometric analysis; Histcite Pro 2.0; Historiograph; Inclusive education; Total Local Citation
Introduction

Background/rationale: Inclusive education was ratified in the UNESCO (United Nations Educational, Scientific and Cultural Organization) Salamanca Statement and Framework for Action in Special Needs Education in 1994. Since inclusive education emphasizes placing students with special needs in age-appropriate general education classes or mainstream schools and enables them to succeed [1,2], it is seen as “an issue of social justice as well as an issue of equity” [3] and as one of the most effective means of combatting educational inequity.

With the advent of inclusive education practices, advocates for inclusive education believe that all students, with and without learning disabilities, may potentially receive high-quality instruction and interventions; however, the long-term effects of inclusive education remain controversial, despite the increasing number of publications on this topic.

Purpose: We sought to map inclusive education knowledge through a holistic bibliometric evaluation, including annual publications, most-cited countries, most-cited journals, most-cited institutions, core themes, and potential trends.

Methods

Ethics statement: Neither institutional review board approval nor informed consent was required because this study was based on a literature database.

Study design: This study conducted a bibliometric analysis of a specific topic from a literature database.

Data/measurement: Data related to the present study were retrieved from the core collection of Web of Science on July 3, 2020. Two terms (“inclusive education” and “inclusion of education”) were used as the keywords for searching journal articles. Only publications published from 1992 to 2020 were considered. The timespan was set as “ALL YEAR” to thoroughly retrieve related data from the past. There are 1,786 articles (including early-access articles), representing 3,376 authors, in the 345 journals that were scanned. A total of 54,747 references with 2,981 keywords were included in the titles and abstracts (Dataset 1).

Visualization: Data obtained from Web of Science were exported to Histcite Pro 2.0, which was used to visualize bibliometric maps related to scientific affairs [4] and to profile the citation relationships among articles in the historiograph.

Total Local Citation Score: The Total Local Citation Score (TLCS) referred to the total number of citations from scholars in the field of inclusive education within the collected datasets.

Results

Annual number of articles: As shown in Fig. 1, the first article appeared in 1992 and then the growth rate showed a zigzag pattern of instability from 1995 to 2005. Since 2006, the number of publications has gradually increased. Since 2012, the annual publication volume has exceeded 100, and the highest number of publications was found in 2019.

Countries of publications: A total of 99 countries were counted, and only the top 12 countries were listed. The top 12 countries are presented in Fig. 2. The United Kingdom, which ranked first based on the TLCS, contributed the most original articles (292, 16.3% of the 1,786), followed by the United States (379, 21.2%), Australia (235, 13.2%), South Africa (134, 7.5%), Canada (89, 5%), and the People’s Republic of China (89, 5%), respectively. The United States had the most publi-
citations, followed by the United Kingdom and then Australia; these three leading countries accounted for 50.7% of the 1,786 articles. Canada and China had the same amount of publications, but Canada had more citations. Six of the top countries are in Europe. China and Cyprus are in Asia, the United States of America and Canada are in America, Australia is in Oceania, and South Africa is in Africa.

**Institutions of authors:** As shown in Fig. 3, Monash University produced the most articles (46 articles), followed by North West University (38), Queensland University of Technology (37), the University of Jyvaskyla (35), and the University of Kansas (31). Monash University ranked first in citations (TLCS, 174), followed by North West University (TLCS, 158) and the University of Manchester (TLCS, 158), Hong Kong Institute of Education (TLCS, 156), and the University of Eastern Finland (TLCS, 129).

**Most-cited journals:** The 10 most-cited journals with at least 300 total citations are listed in Fig. 4. The top five were the International Journal of Inclusive Education (465 articles), European Journal of Special Needs Education (97 articles), International Journal of Disability Development and Education (75 articles), Disability & Society (61 articles), and Teaching and Teacher Education (56 articles). According to TLCS, the International Journal of Inclusive Education had the most citations (1,010), followed by European Journal of Special Needs Education (270), Teaching and Teacher Education (226), Disability & Society (154), and Research and Practice for Persons with Severe Disabilities (117). The European Journal of Psychology of Education, with only nine articles, ranked eighth and Exceptional Children, with only eight articles, ranked 10th.

**Most-cited authors:** Fig. 5 shows the top 12 most-cited authors by articles and citations. Sharma, U. published the most articles, but ranked seventh in citations. Engelbrecht, P. ranked first in citations, but ranked fourth in the number of articles. Despite only publishing only six articles, Singal, N. ranked 10th in citations.

**Citation relationship of articles:** The historiograph shown in Fig. 6 presents the citation relationship of the top 30 most-cited articles extracted by their numerical citations in 345 journals and in the direct citations made between those 1786 articles. Of the 30 most-cited articles, the most significant articles were written by Savolainen et al. (466) [5], Forlin et al. (252) [6], Ruijs et al. (245) [7], and Parasuram (156) [8].

**Core themes:** The following core themes emerged teachers’ attitudes towards inclusive education, pre-service and in-service teachers’ self-efficacy, the effects of inclusive education, and educational policies.

**Discussion**

**Interpretation:** A total of 1,786 articles on inclusive education were published during the past 29 years, from 1992 to 2020. The amount of publications gradually increased after 2006.
and then dramatically increased from 2012 onwards. The publications between 2012 and 2020 accounted for 74.8% of the total of 1786 articles (Fig. 1). The most productive publication interval was from 2018 to 2019. The United States was found to be the country with the most publications, while the United Kingdom was the leading country in terms of citations (Fig. 2).

Out of the top 15 institutions, four institutions are located in the United Kingdom, three in Australia, two in South Africa, two in the United States, two in Finland, one in the Netherlands, and one in China (Fig. 3). Most institutions are located in the leading countries. Seven of the top 15 institutions...
were found to be in Europe, three in Oceania, two in the America, two in Africa, and one in Asia. These top 10 most-cited journals in Fig. 4 are attributed to two clusters: cluster 1 includes special education-related journals, such as the International Journal of Inclusive Education, European Journal of Special Needs Education, and Disability & Society; cluster 2 includes education-related journals, such as Teaching and Teacher Education, Cambridge Journal of Education, and European Journal of Psychology of Education.

One leading article, “Variables that affect teachers’ attitudes towards disability and inclusive education in Mumbai, India” [8], explored the variables that influenced teachers’ attitudes towards children’s disability and inclusive education. To a certain extent, teachers’ attitudes are vital for the effectiveness of implementing inclusive education. The most-cited articles in 2009 focused on demographic variables in terms of changing pre-service teachers’ attitudes and sentiments [6]. In addition, scholars were interested in the real effects of inclusive education on students with and without special educational needs [7]. Both teachers’ attitudes and self-efficacy in inclusive education are important and should be included in pre-service and in-service teacher education [5].

Limitations: First, only bibliographic data from the Web of Science were selected; thus, some relevant publications might have been overlooked in this study. Second, the TLCS values were inherently affected by the time elapsed since article publication. Third, the historiograph generated by Histcite Pro 2.0 cannot display international collaboration, and few internationally collaborative publications were found in this study. Last, since the literature search was conducted in July 2020, the data for 2020 lacked completeness and were not representative. Based on the above limitations, further research might expand the scope of databases to include others, such as Scopus or ERIC, and average citations per year is recommended as an indicator for future research. Visualization software such as VOSviewer and CiteSpace can be applied to map collaborative networks among countries, institutions, and authors; furthermore, data for the full year of 2020 can be retrieved in the future to update the completeness of this study.

Core themes from the most highly-cited articles included teachers’ attitudes, teachers’ self-efficacy, and the effects of inclusive education. Teachers included both pre-service and in-service teachers; students represented those with and without special educational needs. Teachers’ attitudes and self-efficacy towards inclusion of education will have significant impacts on the success of practicing inclusive education. Therefore, pre-service teachers need to take special education courses to enhance their pedagogical knowledge, whereas in-service teachers need continuing training to empower their pedagogical ability. The International Journal of Inclusive Education was the most-cited journal in this field and published the most professional articles regarding inclusive education. The most-cited journals also included education-related journals, which accept manuscripts regarding teaching and teacher education. Frontline teachers in general classrooms should consider submitting manuscripts about their teaching experiences to these most-cited journals, which have a large readership. To measure the effects of inclusive education and teachers’ self-efficacy, it is necessary to formulate instruments for quantitative or qualitative research, such as questionnaires, scales, and interview protocols. Moreover, the reliability and validity of those research instruments should be carefully calculated. Few collaborative studies of inclusive education were found, but it is possible to conduct cross-cultural studies in the near future. Thus, developing a culture-free research instrument will also be essential.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Funding

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Data Availability

Data are available from the author upon reasonable request.

Dataset 1. Inclusive education: 1992 to 2020

References

Five clusters of flood management articles in Scopus from 2000 to 2019 using social network analysis

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Abstract

Purpose: This study aimed to analyze the bibliographic characteristics and content of articles on flood management published in journals indexed by Scopus written by researchers from throughout the world from 2000 to 2019.

Methods: We obtained data from the Scopus database on October 2, 2020. “Flood management” was used to search across several categories, including article title, abstract, and keywords, filtered by subject area (social science; environmental science; and business, management, and accounting). We only retrieved articles written in English. We conducted content analysis using the VOSviewer software and visualized the co-occurrence of keywords and bibliographic coupling of sources and countries.

Results: Following the study protocol, we found 984 articles on flood management over the past 20 years. Among the three subject areas, environmental science was the most productive field for publishing flood management articles. Flood control, flood management, and risk assessment were the top three most popular topics. Flood management publications were published in 266 journals. In total, 86 countries collaborated to produce research related to flood management. Natural Hazard Journal and Journal of Flood Risk Management were the most prominent journals. Institutions from Europe dominated the top 10 institutions with the most publications by affiliated researchers.

Conclusion: From a global perspective, flood management research in the past two decades has increased significantly. There were five major topic clusters, and European-published journals dominated publications. Thus, Asian institutions need to conduct more active research on this topic.

Keywords

Bibliometric; Flood management; Publications; Scopus; VOSviewer
Introduction

Background/rationale: Researchers have found that the frequency of flood occurrences worldwide is closely related to climate change [1-3]. Developing countries are considered to be the most vulnerable areas to flooding due to the multiple economic, social, and environmental impacts of floods [4]. Asia is the continent that recorded the most frequent disasters [5], and in Africa, 64% of disasters that occurred over the last two decades (2000–2019) were catastrophic floods. Similar events have also occurred in Europe [6]. The economic loss caused by floods in India and the United States (2018–2019), for example, amounted to 10 billion US dollars each. Similarly, flooding in Jakarta, Indonesia, in 2007 caused financial losses of 5.2 trillion Indonesian rupiah [7]. Meanwhile, in Venezuela, floods in 1999 were estimated to have claimed 30,000 people’s lives and damaged settlements and other infrastructure [8]. Although some researchers have produced bibliometric articles on flooding occurrence and flood management [9-11], we have not found any bibliometric articles that utilized social network analysis.

Objectives: This aim of this article was to provide useful data for understanding global publication trends regarding flood management. This study aimed to analyze the bibliographic characteristics and trends of articles on flood management published in journals indexed in Scopus written by researchers from throughout the world from 2000 to 2019 and to conduct an analysis of keyword co-occurrence using VOSviewer.

Methods

Ethics statement: This study did not deal with human subjects; therefore, neither approval by the institutional review board nor informed consent was required.

Study design: This was a literature database-based descriptive study.

Data sources: We used the Scopus database as the primary source for information, since Scopus is considered to be a reliable source by academics. We used the term “flood management” as a specific parameter in the search. The selection of keywords in Scopus involved not only flood management, but also other keywords that appeared frequently along with flood management. For example, flood management often co-occurred with the concept words “resilience,” “hazard,” and “uncertainty” [12].

Analysis methods: Next, we followed the methods presented in an earlier paper on social network analysis for the scientific literature on low-carbon supply chain management because we were not able to find a bibliometric study using social network analysis with topics related to flood management [13].

In the first phase, we browsed the Scopus database on October 2, 2020. We searched for all articles published in the Scopus database using “flood management” as a keyword, and then sorted the data based on title, abstract, and keyword in the search tab. We also limited the searching criteria by only including articles published in the last 20 years (2000–2019). We additionally limited our search to articles, and chose “all” for the access type. In this step, we found 1,364 publications. Next, we refined the results by applying an inclusion strategy to limit the number of articles by using three subject areas (including social science; environmental science; and business, management, and accounting). We also narrowed the search by applying certain filters to other parameters, such as “final” articles for publication stage, “journal” for the source type, and only articles in the English language. In this inclusion stage, we retrieved 984 publications.

In the next step, we downloaded the articles from the Scopus database and analyzed the 984 publications that had been sorted by relevance.

Visualization: Our third stage was analyzing the collected articles using VOSviewer ver. 1.6.15 (https://www.vosviewer.com/) for data interpretation. The first VOSviewer analysis used was co-occurrence to identify themes in flood management. We selected the “all keyword” option to ensure that all of the keywords in the publications would be retrieved. In the next step, we presented trends in flood management publications, and then we conducted a co-occurrence analysis using VOSviewer and bibliographic coupling for sources and countries. Based on this step, we presented the top 10 significant journals and the top 10 countries with the most affiliations.

Results

Amount of flood management research from 2000 to 2019
The amount of flood management publications in three subject areas (social science; environmental science; and business, management, and accounting) over the past 20 years globally showed a positive trend (Fig. 1). However, there were some fluctuations over the years in the annual number of publications related to flood management in the Scopus database. Environmental science was the subject area with the most publications related to flood management, with 867 publications, followed by social science with 288, and business, management, and accounting with 25 articles. However, the number of publications related to flood management in the business, management and accounting subject area was relatively limited, with only a single article published before 2007 and only five documents related to flood management published in 2019.
Content analysis of flood management publications

A content analysis was performed of the 984 publications sorted by relevance. Next, we performed a co-occurrence analysis with VOSviewer, using the “all keyword” analysis unit and the “full counting” method. We limited the frequency of keyword occurrence to 10 times; out of 6,086 keywords, VOSviewer found 269 keywords that met the threshold. The results of this analysis are presented in Fig. 2.

Flood control (588), flood management (284), and risk assessment (247) were the top three keywords that appeared most frequently. Moreover, we found five clusters in this analysis. The first cluster, represented in red, consisted of 90 keyword items with the keyword “flood control” being the most common, as marked by a larger size than the other nodes. The keywords “hydrological modeling” (90), “rainfall-runoff modeling” (39), “flood forecasting” (9), and “watershed” (51) were the most widely featured discussion topics in international articles discussing flood management in the subject areas of social science; environmental science; and business, management, and accounting. The geographic regions that appeared in this first cluster included China, Iran, and Malaysia. Thus, based on the 90 keywords in cluster 1, this cluster appears to be a series of articles discussing flood control and flood modeling in Asian countries.

The second cluster (green) consisted of 83 keywords, among which “flood management” (284), “risk assessment” (247), “hazard management” (110), “disaster management” (97), and “climate change” (148) were the most commonly used. The keyword “flood risk management” (90) was connected to “adaptive management” (62) and “governance approach” (36). However, the distance from flood management was further than for other keywords in the same cluster, indicating that the relationship was not yet strong. Furthermore, the keywords “environmental policy” (19), “Asia” (16), “policy implementation” (11), and “local government” (10) had smaller nodes and were located in the outermost position relative to other keywords, indicating that publications on this topic are still limited in number. This cluster’s geographical regions were European and Asian countries. It can be inferred that the articles in this cluster mostly discussed flood risk management in Europe and Asia, and started to build connections with the governance approach and adaptive management.

The third cluster, represented in blue, consisted of 48 keywords, of which “water management” (100), “urban area” (86), “sustainable development” (82), “urbanization” (52), and “urban planning” (49) appeared most widely. India, Indonesia, and Australia appeared in cluster 3 The third cluster mostly dealt with water management and its connection with urban development. In comparison, the fourth cluster (yellow) consisted of 21 keywords, among which “GIS” (70) (which had a connection with the first cluster [flood modeling and forecasting] and the third cluster [urban floods]), “hazard assessment” (58), and “integrated approach” (40) were widely encountered. Interestingly, there were “flood risk” keywords connected closely to the “risk assessment” keyword in the second cluster. Furthermore, “early warning system” and “multi-criteria analysis” were located at the outermost point of cluster 4. Japan and Thailand were the countries that tended to appear in this cluster. Nevertheless, the fourth cluster raised discussions about the analyses and approaches used for hazard assessment.

Finally, the fifth cluster, which is represented in purple, consisted of 18 keywords. This cluster connected the keywords “floodplain” (71) with “flood control” in the first cluster and “flood management” in the second cluster. This cluster also connected the keywords “environmental risk” (14) with “risk assessment.” The United States, Canada, and California ap-
peared most frequently in this cluster, as some of the articles in the fifth cluster dealt with the risk of flooding in the United States and Canada.

Fig. 3 shows an overlay visualization of the flood management literature with the average number of publications from 2011 to 2016. There was a shift in topics; around 2013, the literature on flood management contained extensive discussions of the terms “disaster management,” “mitigation,” and “Europe,” which then developed into “flood management” and “flood control,” and then the last 3 years discussed “risk assessment” and “risk management.” The latest articles on flood management also discussed the governance approach, since in the last 3 years, the keywords “adaptive governance,” “government approach,” and “environmental risk” have appeared. However, the distance between nodes was longer than for other themes, indicating that these thematic relationships were weaker than those for different themes. This analysis also showed that flood control has been connected to the literature on governance, albeit to a limited extent.

The density visualization analysis showed that research with keywords related to public administration such as “governance approach,” “local government,” “policy approach,” and “policy implementation” had relatively limited impact. Although it appeared in clusters, these studies were not widely associated with other studies, as seen in Fig. 4. Thus, research on flood management in the future can raise further issues related to governance, policy implementation, and local government.

Bibliographic coupling of sources on flood management in social science; environmental science; and business, management, and accounting

We restricted the article search by selecting only the areas of social science; environmental science; and business, management, and accounting and retrieved 984 publications. We sorted the articles based on their relevance. Over the past two decades, *Natural Hazard Journal* (Netherlands) published the most articles containing “flood management” in their titles/keywords and abstracts, with 60 articles. The second-ranked journal was the *Journal of Flood Risk Management* (Denmark). The top 10 journals that published articles related to flood management are presented in Table 1. There were four journals each from the United Kingdom and the Netherlands, and one journal each from Denmark and Switzerland.

Bibliographic coupling of sources with at least five documents and one minimum citation resulted in 266 sources, of which 48 met the threshold. Based on network visualization

<table>
<thead>
<tr>
<th>Rank</th>
<th>Journal</th>
<th>No. of publications</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Natural Hazards</em></td>
<td>60</td>
<td>Netherlands</td>
</tr>
<tr>
<td>2</td>
<td><em>Journal of Flood Risk Management</em></td>
<td>46</td>
<td>Denmark</td>
</tr>
<tr>
<td>3</td>
<td><em>Water Switzerland</em></td>
<td>37</td>
<td>Switzerland</td>
</tr>
<tr>
<td>4</td>
<td><em>Journal of Hydrology</em></td>
<td>36</td>
<td>Netherlands</td>
</tr>
<tr>
<td>5</td>
<td><em>Water Resources Management</em></td>
<td>35</td>
<td>Netherlands</td>
</tr>
<tr>
<td>6</td>
<td><em>International Journal of River Basin</em></td>
<td>25</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>7</td>
<td><em>Environmental Science and Policy</em></td>
<td>22</td>
<td>Netherlands</td>
</tr>
<tr>
<td>8</td>
<td><em>Wit Transactions on Ecology and the</em></td>
<td>22</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>9</td>
<td><em>International Journal of Water Resources Development</em></td>
<td>21</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>10</td>
<td><em>Water International</em></td>
<td>18</td>
<td>United Kingdom</td>
</tr>
</tbody>
</table>

Table 1. Top 10 journals on flood management in the subject areas of social science, environmental science, and business, management, and accounting
as seen in Fig. 5, there were five journal clusters. The top three journals were in a single cluster of three (blue). Cluster 1 consisted of journals with a hydrology scope, and cluster 2 was dominated by environmental journals. The third cluster contained journals dealing with natural hazard and flood management.

Interestingly, cluster 4 had quite a dispersed network compared to other clusters, indicating that this cluster did not have many citations in common with other clusters. The fourth cluster consisted of the Journal of Canadian Water Resources, Disaster Prevention and Management, and Environmental Hazards. Furthermore, the fifth cluster consisted of only one journal, Environmental Engineering, which was connected to the third cluster.

From the overlay visualization, it was seen that the most recent discussions on flood management in the last 2 years were published in Water (Switzerland), Sustainability (Switzerland), and Modeling Earth Systems and Env (Fig. 6).

Table 2 presents the top five journals with flood management publications from the three subject areas. The Journal of Flood

<table>
<thead>
<tr>
<th>Rank</th>
<th>Social science</th>
<th>Environmental science</th>
<th>Business, management, and accounting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Journal of Flood Risk Management</td>
<td>1st</td>
<td>1st Applied Geography</td>
</tr>
<tr>
<td>2</td>
<td>Water (Switzerland)</td>
<td>2nd</td>
<td>2nd Cities</td>
</tr>
<tr>
<td>3</td>
<td>Environmental Science and Policy</td>
<td>3rd</td>
<td>3rd Journal of Cleaner Production</td>
</tr>
<tr>
<td>5</td>
<td>Environmental Hazards</td>
<td>5th</td>
<td>5th Forsight</td>
</tr>
</tbody>
</table>

Table 2. Top five journals for flood management in the subject areas of social science, environmental science, and business, management, and accounting.

Fig. 5. Network visualization of bibliographic coupling of sources on flood management.

Fig. 6. Overlay visualization of bibliographic coupling of sources on flood management.
An analysis of bibliographic coupling of countries with at least five documents and one citation resulted in 86 countries, of which 45 met the threshold. Based on the network visualization as seen in Fig. 8, there were seven clusters. A larger circle for a given node indicates that a country is more productive. The United Kingdom, United States, Netherlands, and China were in different clusters. Some of the countries that collaborated with researchers in the United Kingdom were New Zealand, South Africa, Nigeria, and Ireland, while the United States showed connections to Canada, Japan, and Indonesia. Interestingly Thailand was the only country in cluster 7, but had proximity to the Netherlands in cluster 3 and Australia in cluster 5. Meanwhile, the overlay visualization showed that researchers from developing countries primarily began publishing flood management articles in the last 5 years, as shown in Fig. 9.

**Affiliations with global institutions**

In the last 20 years, the IHE Delft Institute for Water Education was the institution with the most flood management-themed publications, with 30 articles, followed by the Delft University of Technology (with 27 articles) and Wageningen University & Research (with 21 articles). Four each of the top 10 institutions were in the Netherlands and the United Kingdom, as seen in Table 3. The Chinese Academy of Sciences was the only Asian institution among the top 10 institutions that published flood management publication in the subject areas of social science; environmental science; and business, management, and accounting.

**Risk Management** and **Water** (Switzerland) are both renowned journals in social science and environmental science.

**Bibliographic coupling of countries for research on flood management in the areas of social science; environmental science; and business, management, and accounting**

In the period 2000 to 2019, the United Kingdom was the country with the most publications on flood management, with 205 articles, followed by the United States with 151 articles. China, Japan, India, and Iran were the Asian countries ranked in the top 10 countries in terms of the most flood management publications in the areas of social science; environmental science; and business, management, and accounting. These four Asian countries ranked fourth, eighth, ninth, and tenth, respectively. The top 10 countries can be seen in Fig. 7 below.

**Fig. 7.** Top 10 countries with publications on flood management.

**Fig. 8.** Network visualization of bibliographic coupling of countries for flood management research.

**Fig. 9.** Overlay visualization of bibliographic coupling of countries for flood management research.
Discussion

Interpretation: Based on data from Scopus, the publication trends, journal performance, content analysis, and bibliographic coupling of countries and sources were analyzed for research on flood management issues throughout the world. The results showed that worldwide scientific publications on flood management grew significantly. Of the three subject areas that were analyzed, environmental science was the most productive field for flood management publications. The global content analysis yielded five clusters with five critical topics: flood modeling, flood risk management, watershed and river management, approaches/analyses of flood hazards, and environmental risk. However, limited research from a global perspective on flood management in the past 3 years has discussed flood management and its relationship with governance within the scope of social science and environmental science.

Journals from Europe published the most flood management-related articles. The Journal of Flood Risk Management and Water are renowned in the areas of social science and environmental science, and published numerous publications on flood management. The United States, United Kingdom, and Netherlands were the most productive countries in terms of flood management articles. However, in the last 5 years, researchers in developing countries began doing research and publishing flood management articles in these three subject areas. Although institutions from Europe dominated the top 10 institutions with the most publications by affiliated researchers, the Chinese Academy of Sciences is the only institution from Asia in the top five.

Limitation: We recognize that this study is not free of limitations for several reasons. First, we only retrieved studies from Scopus and did not use other sources such as Web of Science, Crossref, or PubMed Central. Secondly, we only analyzed three subject areas. Finally, we did not use other analyses in VOSviewer, such as co-citation or co-authorship. Thus, we hope that bibliometric research on this topic will expand in terms of the databases used, the subject areas, and the analyses conducted in order to provide a broader overview of the issue.

Conclusion: In the past two decades, global research on flood management has increased significantly. Previous studies on flood management have focused on technical and disaster management issues, but have paid little attention to public administration. The theme of research on flood management related to environmental policy, policy implementation, and local government could be interesting for future discussions. There are also opportunities to foster discussions about flood management in social science journals related to public administration. Finally, Europe dominated this field in terms of publications and affiliations, while research from Asia on this topic remains limited, and further research is therefore necessary.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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Data Availability

Dataset file is available from: the Harvard Dataverse at: https://doi.org/10.7910/DVN/NUHJF7.

Dataset 1. Scopus database on flood management retrieved on October 2, 2020

References

3. Al-Amin AQ, Nagy GJ, Masud MM, Filho WL, Doberstein B. Evaluating the impacts of climate disasters and the integration
Case Study

Manuscript Exchange Common Approach and Journal Article Tag Suite (JATS) compatibility: a case study utilizing the JATS Compatibility Meta Model

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1National Center for Biotechnology Information, National Library of Medicine, National Institutes of Health, Bethesda, MD; 2Aries Systems Corporation, North Andover, MA, USA

Abstract

The National Information Standards Organization (NISO) Manuscript Exchange Common Approach (MECA) project is a cross-organization industry initiative to develop a common approach to manuscript transfer that can be adopted across the scholarly publishing industry. MECA establishes a vocabulary set that includes transfer, review, and manifest models. These models are designed to work with different article XML schemas, including the latest NISO Journal Article Tag Suite (JATS) standard (v1.2). In order to avoid conflicts between these project vocabularies and the JATS, we reviewed the MECA vocabularies against the NISO JATS Compatibility Meta Model (v0.7). This paper describes the review and analysis of the MECA schemas against the JATS Meta Model, how we documented the analysis, and the recommendations we made to resolve issues revealed by the analysis. It includes the documentation we produced to communicate the results of the analysis and what actions we took to move forward with the project, including both changes to the schemas and requests for changes in the JATS. We hope sharing our experiences with this process will help others who are trying to do the same.

Keywords

Documentation; Industry; Scholarly communication; Vocabulary

Introduction

Background/rationale: Academic career progression often depends on a researcher’s number and quality of publications and the prestige of the journal in which the research is published [1]. It can be difficult for authors to find an initial match between the paper’s content and the scope of the journal. Approximately 85% of researchers resubmit rejected manuscripts to an-
other journal, which can be a tedious and error-prone process [2]. Reviewers can become frustrated by the time wasted repeating reviews for papers that are submitted to a different publication after rejection. One study found that 20% of biomedical researchers performed between 69% and 94% of reviews [3]. In peer review, papers are often rejected but reviews are not typically shared between publications. Researchers spend 15 million person-hours a year reviewing unpublished submissions to scientific journals [4]. If 85% of researchers resubmit rejected papers to a different journal, and 20% of biomedical reviewers perform 80% of reviews, the odds are high that the same researchers will be invited to review a paper that they have previously reviewed.

The publishing ecosystem is evolving. New publication workflows require submission transfers to and from preprint servers, other submission systems, and vendors. At the same time, interest in online and collaborative authoring tools is growing. Each system must implement a separate exchange mechanism with each other system.

**Objectives:** It aims to describe the analysis of the Manuscript Exchange Common Approach (MECA) schemas against the Journal Article Tag Suite (JATS) Compatibility Meta Model. Specifically, the follows were included: original MECA Working Group’s work, JATS Compatibility Meta Model (JCMM) analysis, and recommendation to resolves issues after analysis.

**Original MECA Group and Their Work**

Early in 2017, a team of producers and users of manuscript systems identified a strong need to be able to seamlessly transfer manuscripts and reviews between and among manuscript systems, such as those in use at publishers and preprint servers. An industry-wide initiative was formed to create a common mechanism for transferring submissions, based on industry standards and best practices. The original MECA group submitted a proposal to National Information Standards Organization (NISO) to form a Working Group to develop a NISO Recommended Practice. This proposal was approved by the NISO Information Creation & Curation Topic Committee and NISO voting members. The Working Group was announced in May 2018 and the group met regularly to review the use cases, transmission method, packaging, and document type definitions (DTDs). The draft MECA Recommended Practice was made available for public comment in January 2020.

The following principles guide the MECA project: (1) journals and authors set the rules on what metadata and files are transferred to another system. (2) The goal is to facilitate transfer between publications and platforms. The package may not represent a complete submission, but it should contain enough data and files to create a record in the receiving system. MECA defines the minimal set of data required to initiate a submission. (3) Various systems can independently define a Minimal Viable Product to get started with submission transfers. (4) The MECA practice uses current common technology and industry standards. (5) MECA presents a set of recommendations but does not prescribe a specific code to be written. There is no hub, software, or service. Unlike CrossRef or ORCID, there is no attempt to trace the path of a manuscript as it traverses the publishing ecosystem.

The original MECA group consisted of Aries Systems, Clarivate, ejournalPress, HighWire Press, and PLOS. The expanded working group includes the original MECA members, plus representatives of the American Chemical Society, the American Physical Society, Cold Spring Harbor, eLife, IEEE, Green Fifty, IJisc, the Journal of Clinical Investigation, the US National Library of Medicine, Springer Nature, and Taylor and Francis.

**JATS Compatibility Meta Model Analysis**

For a project like MECA—whose primary goals include the interchange of JATS documents—it is very important that the methods and models respect the existing systems that are intended to utilize the MECA data. The JCMM was created to ensure that data creators can “extend the reach of the JATS vocabularies without conflicting with current JATS vocabularies” [5]. In order to ensure that the MECA models did not conflict with the current JATS vocabularies, we evaluated those models against v0.7 of the JCMM [5].

**Compatibility Analysis of MECA to JATS**

Performing the compatibility analysis began by listing the structures in the MECA schemas that shared names with structures in JATS. The shared structures needed to match JATS on all the points of compatibility: semantic match; element or attribute; the structure is a section-like model; structure contains alternatives; the ID/IDREF definition in attributes; and whitespace handling.

To check for a semantic match, we utilized the non-normative JATS Tag Libraries for version 1.2 [6] and compared the definitions of the JATS elements against the intended use of the MECA structures. For example, an early draft of the MECA manifest DTD included a `name` element in a structure to capture metadata.

```xml
<!ELEMENT metadata (name, value)>
<!ELEMENT name (#PCDATA)>
<!ELEMENT value (#PCDATA)>
```

In this structure, the semantic definition of the name can be
stated as the name component of a name-value pair describing a piece of metadata not otherwise enumerated in the model.

JATS also includes a *name* element, which is defined as, “Container element for the component elements of personal names, such as a `<surname>`” [7].

The use in MECA, to define metadata, is not a semantic match to the element in JATS which is used to capture the name of a person. This semantic mismatch was recorded as a point of incompatibility between MECA and JATS in the analysis.

In order to make the MECA models JATS-compliant, they need to be compliant on each of the aspects defined in the JCMM. So even once we identified one point of incompatibility, we continued to evaluate the models. All points of incompatibility need to be resolved for MECA to be compatible with the JATS. Continuing with the analysis of the name element, evaluating the remaining points of compatibility involved comparing definitions in the different DTDs. The element model in NISO JATS v1.2 is an element-only model:

```xml
<!ELEMENT name (((surname, given-names?) | given-names), prefix?, suffix?)>
```

Both the MECA manifest and JATS models define the name as an element, so on the element vs. attribute compatibility requirement, MECA is compatible. Neither the MECA manifest DTD nor the JATS definitions of the name have a section-like model or contain alternatives, so on those two points of compatibility, MECA is compliant. Since the name is an element in both models, the ID/IDREF definition isn’t a consideration.

The last point of compatibility is how an element handles whitespace—whether it handles it as data (significant whitespace) or element-only (insignificant whitespace). For the `#PCDATA` model of the name in MECA’s manifest DTD, the whitespace is significant. For the element-only name defined in JATS, the whitespace is insignificant. On this compatibility requirement, the name defined in the early MECA manifest DTD is incompatible with JATS. Once the analysis of all the shared structures was complete, the results of the analysis need to be recorded in a way that could be communicated with the entire MECA Working Group.

**Communication of the Compatibility Requirements**

In addition to the description of the compatibility requirements, the JCMM includes a Suppl. 1 that communicates the compatibility requirements in a table format (Table 1). Table 1 provides a clear and concise look at the compatibility requirements, so we utilized this format to communicate the results of the compatibility analysis, expanding it to include columns for recording semantic match and which model’s properties were being recorded (Table 2).

In addition to the table recording compatibility model properties, the analysis document contained details of all the recorded conflicts and suggested solutions to those conflicts. An example of conflicts noted in the summary table is as follows:

```xml
<aff>
    JATS name: Affiliation
    JATS definition: Name of an institution or organization (for
```

### Table 1. JATS compatibility properties catalog

<table>
<thead>
<tr>
<th>JATS structure name</th>
<th>Element or Attribute property</th>
<th>Alternatives property</th>
<th>Section-like property</th>
<th>Whitespace handling property</th>
<th>Attribute ID or IDREF property</th>
</tr>
</thead>
<tbody>
<tr>
<td>abbr</td>
<td>Attribute</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>abbrev</td>
<td>Element</td>
<td></td>
<td></td>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>

JATS, Journal Article Tag Suite.

In these columns, “X” means “yes”, and no value means “no”; In this column, “E” means “element-like whitespace”, “D” means “data-like whitespace”, and “P” means “preserve whitespace.” Table 1 do not contain X, E, and P since this is a snippet copied from the supplementary data rather than a complete table.

### Table 2. Summary table of JATS compatibility

<table>
<thead>
<tr>
<th>Structure name</th>
<th>Semantic match</th>
<th>Model</th>
<th>Element or attribute</th>
<th>Alternative</th>
<th>Section-like</th>
<th>Whitespace handling (D or E)</th>
<th>ID/IDREF</th>
</tr>
</thead>
<tbody>
<tr>
<td>addr-line</td>
<td>Yes</td>
<td>JATS</td>
<td>Element</td>
<td></td>
<td></td>
<td>D</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MECA</td>
<td>Element</td>
<td></td>
<td></td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>aff</td>
<td>Yes</td>
<td>JATS</td>
<td>Element</td>
<td></td>
<td></td>
<td>D</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MECA</td>
<td>Element</td>
<td></td>
<td></td>
<td>E</td>
<td></td>
</tr>
</tbody>
</table>


example, university, corporation) with which a contributor is affiliated.

MECA usage: Element-only content

Conflict: JATS defines `<aff>` a mixed-content model, MECA defines it as element only. This affects whitespace handling.

Possible solution: Allow mixed-content

After detailing the analysis of the specific element and attribute model compatibilities, conflicts, and possible solutions, the analysis document also made note of several items defined in the MECA schemas that, while not direct conflicts with the JATS models, are close enough to existing JATS structures that they were worth review. This category included, for example, the use of an `href` attribute on external links in the MECA models that is identical to the `xlink:href` attribute usage in JATS.

### Methods to Resolve Compatibility Conflicts

The Working Group used three different methods to resolve compatibility conflicts: (1) changing the MECA model to match the model in JATS. This was used to resolve incompatibilities in whitespace handling or to bring the models into alignment. (2) Changing the name of the element or attribute. This implementation typically resulted in element and attribute name that were more specific. (3) Submit a change request to the NISO JATS Standing Committee. The Working Group submitted two requests to the JATS Standing Committee requesting that definitions be revised.

In the previously discussed example regarding `name`, the Working Group opted to restructure the way the metadata was captured, using a single element (`metadata`) and putting the name of the metadata into an attribute:

```xml
<!ELEMENT metadata (#PCDATA)>
<!ATTLIST metadata metadata-name CDATA #REQUIRED>
```

By creating an attribute named `metadata-name` instead of `name`, this updated model avoids compatibility conflicts with the JATS.

In two cases of the semantic mismatch, `date-type` and `version` attributes, the recommended action for resolving the conflicts was to suggest to the NISO JATS Standing Committee that they redefine the JATS structure.

The JATS v1.2 definition of the `date-type` attribute includes the word “article”

“Event in the lifecycle of an article that this date is marking...” [8]

In performing the review for MECA, however, we noted that the JATS uses the attribute on the `date` element which is used to capture dates of non-article content. JATS includes the `date` element in the citation models (`element-citation` and `mixed-citation`) and on `related-object`, all of which describe both article and non-article content. Because JATS was already using the attribute in ways beyond its own semantic definition, we requested that the semantic definition in JATS be broadened [9].

This requested was granted by the NISO JATS SC and was implemented in v1.3d1 of the Tag Suite (emphasis added):

“Event in the lifecycle of an object that this date is marking...”

https://jats.nlm.nih.gov/archiving/tag-library/1.3d1/attribute/date-type.html

The second request made to the NISO JATS Standing Committee was to revise the definition of the version attribute. The NISO JATS currently has a `version` attribute used exclusively on the `tex-math` element. Its semantic definition limits the use to just that element:

“Version of TeX or LaTeX used to produce the mathematics.”[10]

Early drafts of MECA used a more generic `version` attribute on several different elements to capture the appropriate version information of the element, without creating more specific attributes for those elements. Because of the wide-ranging applicability of an attribute to capture an element’s version information, we requested the NISO JATS SC consider broadening the definition of `version` so it could be applied more widely [11]. This request acknowledged that this is a non-trivial change, but one that would offer a broad solution to capture version information. Unlike the request for `date-type`, however, this request was denied by the JATS Standing Committee.

Since this request was denied, the MECA use of the `version` attribute was still incompatible with the JATS per the JCMM guidelines. To resolve this, the MECA Working Group chose to change the attributes in the models to make them more specific. Ultimately the Working Group implemented several element specific `*version` attributes (`item-version`, `manifest-version`, `review-version`, `transfer-version`) to be used on the respective elements. The NISO MECA Working Group made revisions to the models to make them compliant with the JATS as described by the JCMM.

### Conclusion

It can be challenging to work in a group comprised of competitive systems. The original MECA group was formed with a common goal of defining a method of manuscript exchange that could be adopted industry-wide. This meant that each organization had to compromise on some aspects of the solution. Having a common goal and an outlook of compromise in favor of the common good enabled the group to work collaboratively to define the MECA practice. Members of the original MECA group developed reference implementations based on the initial MECA definition. Each organization understood that the initial method would be modified by the NISO Working Group and committed to updating its implementation to conform with the NISO Recommended Prac-
tice. The NISO MECA Working Group benefited from having the initial MECA recommendation as a starting point. Yet it still took about a year to complete the project. Commitment to the project from each member of the group was essential to developing the NISO Recommended Practice.

Conflict of Interest

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Supplementary Material

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Suppl. 1. MECA model review for JATS compatibility

References

Korean court cases regarding research and publication ethics from 2009 to 2020

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Abstract
Research and publication misconduct may occur in various forms, including author misrepresentation, plagiarism, and data fabrication. Research and publication ethics are essentially not legal duties, but ethical obligations. In reality, however, legal disputes arise over whether research and publication ethics have been violated. Thus, in many cases, misconduct in research and publication is determined in the courts. This article presents noteworthy legal cases in Korea regarding research and publication ethics to help editors and authors prevent ethical misconduct. Legal cases from 2009 to 2020 were collected from the database of the Supreme Court of Korea in December 2020. These court cases represent three case types: 1) civil cases, such as affirmation of nullity of dismissal and damages; 2) criminal cases, such as fraud, interference with business, and violations of copyright law; and 3) administrative cases related to disciplinary measures against professors affiliated with a university. These cases show that although research and publication ethics are ethical norms that are autonomously established by the relevant academic societies, they become a criterion for case resolution in legal disputes where research and publication misconduct is at issue.

Keywords
Author misrepresentation; Data fabrication; Korean court cases; Plagiarism; Research and publication ethics

Introduction

Background/rationale: Research and publication misconduct may arise in various forms, including author misrepresentation, plagiarism, and data fabrication. As the term suggests, research and publication ethics are essentially ethical, not legal, obligations. Therefore, when misconduct in research and publication is at issue, the most appropriate and desirable solution is for the relevant academic community to resolve the issue itself.

The Supreme Court of Korea stated in its 2015Da5170 decision [1], which will be discussed below, “in cases where the issue of plagiarism arises regarding a specific thesis or dissertation,
the matter is initially determined by the relevant academic field.” The court declared that the academic community is fundamentally responsible for resolving issues of research and publication misconduct. In a recent case involving the sale of paintings by a famous singer, the Supreme Court also stated that the issue of who become(s) the author(s) in cases involving multiple people in the creation of works of art “should be resolved in a self-regulatory fashion within the realm of art by way of criticism and discourse. That said, judicial determination thereof must be limited to cases in which such controversy develops into a legal dispute and copyright has become the categorical subject matter of the lawsuit” [2]. In reality, however, legal disputes arise over whether research and publication ethics have been violated. Consequently, in many cases, misconduct in research and publication is determined in the courts.

Objectives: This article presents nine recent Korean court cases in which research and publication ethics were at issue. It will help researchers and academic journal editors in Korea prevent and manage research and publication misconduct appropriately.

Methods

Ethics statement: As this is not human-subject research, but an analysis of judicial precedents, neither approval by the institutional review board nor obtaining of informed consent was required.

Study design: This is a summary presentation of Korean judicial precedents related to research and publication misconduct.

Data sources: Judicial precedents were searched from the database of the Supreme Court of Korea. Nine court cases were summarized.

Court Cases regarding Plagiarism

First case: dismissal for plagiarizing a doctoral dissertation

Supreme Court decision 2015Da5170 (decided October 27, 2016) [1], a landmark judgment on plagiarism, regards a case in which plagiarism in a doctoral dissertation was judged in court [3]. A government-funded research institute had hired a PhD holder as a researcher. The research institute later fired the researcher, alleging that she had committed plagiarism in her doctoral dissertation. The researcher filed a lawsuit against the research institute seeking affirmation of nullity of dismissal. Thus, at issue in the lawsuit was plagiarism in her doctoral dissertation.

Before this case went to court, the university that had awarded the doctoral degree to the researcher examined the doctoral dissertation and determined that the researcher had not committed plagiarism according to the university’s regulations. However, the Korean Progressive Academy Council, upon a request made by the research institute to investigate this case, and the research institute’s special investigation committee both determined that the researcher had committed plagiarism. The researcher argued that the final responsibility for verification of her doctoral dissertation in this case lay with the university that had awarded the degree, and the research institute and academic association had no authority to determine whether plagiarism had been committed in her doctoral dissertation. This led to the following questions: what were the criteria for determining whether she had committed plagiarism in her doctoral dissertation, and who had the final authority to determine whether plagiarism was committed or not?

In response to these questions, the Supreme Court answered that “plagiarism should be determined depending on the research ethics prevailing at the time a work of authorship was written. [...] Research ethics refer to a set of standards generally and universally accepted within the academic community that researchers need to comply with, and are not necessarily confined to the statutory definition under the regulation on research ethics.” The court stated further, “in cases where the issue of plagiarism arises regarding a specific thesis or dissertation, the matter is initially determined by the relevant academic field. However, where plagiarism in a thesis or dissertation creates legal relations that cause friction and thus becomes the subject of judicial review, courts have the ultimate authority to decide whether plagiarism has occurred.” Moreover, the court underlined, “The competent court is required to determine whether plagiarism occurred through rational methods, rather than being bound by the judgment of affiliated organizations of authors, thesis or dissertation examination bodies, academic societies, etc.; Provided, feedback from experts of the relevant academic field is sought during the determination process.”

In this case, the researcher was suspected of plagiarizing 1) her own master’s thesis as well as 2) the works of her dissertation supervisor and Japanese authors in writing her doctoral dissertation. Therefore, the Supreme Court distinguished conventional plagiarism (corresponding to the second example above) from self-plagiarism as an unconventional type of plagiarism (corresponding to the first example above) in its ruling.

First, the Supreme Court defined (conventional) plagiarism as “an act of using another person’s work of authorship or original idea that does not pertain to general knowledge in the relevant field without properly indicating the source” (emphasis added) and ruled that plagiarism occurs “where an au-
Author cited another person's work in his/her work without indicating the source and thereby made it difficult to distinguish the works, notwithstanding that the author collectively and comprehensively indicated the source of the cited work in the introduction or reference (other than the body) of his/her work.

Furthermore, the court clarified that an author cannot avoid liability for plagiarism solely on the grounds of having followed previous practices, and the occurrence of plagiarism cannot be negated on the basis that the author being plagiarized gave his/her consent to the use of his/her work.

In particular, because the researcher was suspected of plagiarizing works written by Japanese authors and she defended herself by asserting that she and her supervisor had co-authored her supervisor's books, the Supreme Court enumerated the methods of citing sources to avoid plagiarism as follows: 1) where an author cites foreign literature he/she has translated in his/her work, the relevant foreign literature should be indicated as the source; 2) where an author cites translations of foreign literature in his/her work, the said foreign literature should be reasonably indicated as the primary source and the translation as the secondary source; and 3) in principle, an author bears a duty to indicate the source when citing parts of a previous work that was co-written in his/her work as well as when citing another co-author's work among compiled or combined works that were co-written.

Next, the Supreme Court clarified that self-plagiarism occurs when authors use parts of their previous works in subsequent work and 1) "fail to reference his/her previous works" or 2) "the parts newly added in the subsequent work did not contribute whatsoever to the development of the relevant academic field due to lacking originality, despite the author having indicated the sources of his/her previous works cited."

On the basis of the principles above, the Supreme Court found that the researcher had committed plagiarism by including parts of her supervisor's work in her doctoral dissertation without citing the source, adding that even if the supervisor had allowed her to use those parts without citing the source, this does not negate plagiarism. The court also found that the researcher's use of her master's thesis without referencing it constituted self-plagiarism. Finally, the court held that these facts were sufficient to uphold the researcher's dismissal.

Second and third cases: fraud cases relating to plagiarism
Gwangju District Court decision 2019Gowan1104 (decided February 13, 2020) concerns a criminal case regarding a plagiarized article. A professor was compensated for publication fees and received a research grant from his university after publishing a plagiarized article, which was a translation of an article written in a foreign language and published overseas.

The professor subsequently submitted the article to his university for the evaluation of his achievements for reappointment. The court convicted him of fraud according to Article 347 (1) of the Korean Criminal Act for receiving a publication fee and grant from his university. The court also convicted him of interference with business according to Article 314 (1) of the Korean Criminal Act on the grounds that he had interfered with the business of the university through fraudulent means.

Gwangju District Court decision 2018No244 (decided September 20, 2018) reflects a similar criminal case, but with a different result. After hearing the case, the court acquitted the defendant professor, finding that she had not plagiarized someone's work or, at least, had not intended to do so.

Court Cases Dealing with Authorship

Fourth case: a professor who published a part-time lecturer's book indicating himself as a co-author
Supreme Court decision 2007Do7181 (decided December 10, 2009) pertains to a leading case on how to determine authorship when two or more persons are involved in the creation of a work. In this criminal case, the prosecutor accused a professor of infringing the copyright of a part-time lecturer by adding his name as the co-author of a book that had been written solely by the lecturer and subsequently publishing the book. The professor claimed that he had provided materials and files to the lecturer in his role as supervisor, and thus, the book was a joint work. However, the lower courts both rejected the professor's claims and convicted him.

The Supreme Court affirmed the intermediate appellate court's decision, stating, "when two or more persons engage in the creation of a work, only a person who made a contribution to the creative form of expression itself becomes an author of the said work, and a person who did not contribute to the creative form of expression is not considered an author even though he or she participated in the process of creating the work by providing an idea, subject matter, or necessary materials. This conclusion does not change even if the person who is recognized as the author agrees that the person who did not contribute to the work is indicated as a co-author."

Fifth case: ghostwriting master's theses and doctoral dissertations
In 2017, two professors at a graduate school of oriental medicine were convicted of having received bribes by breach of trust, according to Article 357 (1) of the Korean Criminal Act, as they had accepted money in exchange for conducting the experiments necessary for writing master's theses and doctoral dissertations and delivering the results to graduate students...
Sixth case: a professor who allowed his student to fraudulently use his article

Daejeon High Court (Cheongju) Decision 2014Nu5522 (decided August 26, 2015; affirmed by Supreme Court decision 2015Du51545) concerns an administrative case in which a disciplinary measure against a university professor was at issue. The professor had provided a draft of an article to one of his students. The student subsequently presented the article at an academic conference and it was published in the conference proceedings under the student’s name. The professor later published the same article in a journal under his name as the sole author. The professor’s university suspended him for three months, reasoning that the act of publishing an article that was identical to a paper published under the name of his student constituted plagiarism, and the act of indicating himself as the sole author of the article constituted a misrepresentation of authorship.

In the lawsuit filed by the professor for revocation of the disciplinary measure, the court ruled in favor of the university. However, the court’s reasoning differed from that of the university. First, the court held that the professor had not committed plagiarism, as he had not stolen the student’s idea or the results of the student’s research. The court also held that it was not a misrepresentation of authorship to publish the article under the professor’s name as the sole author without listing the student’s name as co-author because the student did not contribute to the article. Instead, the court concluded that the university’s disciplinary measure was justifiable because a series of the professor’s actions had furthered his student’s research misconduct and simultaneously caused serious confusion as to the true author of the article.

Seventh and eighth cases: publishing another author’s book as one’s own with a different cover and title

In 2015, 179 professors were indicted for changing the covers and titles of books that other professors had authored and republishing the books as their own. The original authors, who had impliedly agreed to this, also were indicted [6]. The court convicted the defendant professors for violating the Korean Copyright Act under Article 137 (1) (i) because they had made works public under the name of a person other than the author. The convictions were affirmed by the Supreme Court in 2017 [7]. Concerning the addition of a professor’s name as co-author to another author’s book when publishing a new edition of the book, the court in the first instance held that such a practice does not fall in the category of “making works public” under the name of a person other than the author prescribed by the Copyright Act. In 2020, however, the Supreme Court held otherwise, ruling that such a practice also constitutes “making a work public” under the name of a person other than the author, which is punishable by the Act [8,9].

Court Case regarding Data Fabrication

Ninth case: retraction of a journal article due to data fabrication

Seoul High Court decision 2017Na2065914 (decided January 11, 2019; affirmed by Supreme Court decision 2019Da207493) pertains to a civil case regarding violation of research ethics due to data fabrication. The plaintiff in this case had published an article in an academic journal in the field of microbiology and life sciences, but was later suspected of violation of research ethics. The academic society that published the journal had an internal regulation that an author suspected of research misconduct had the burden to prove that there was none. Therefore, the academic society requested the plaintiff author to submit the research notes and all relevant data to prove that he had worked on the methods and data of all the experiments published in the journal article. However, the plaintiff claimed that the research notes had been lost while submitting some data for explanation. After reviewing these data submitted by the plaintiff, the academic society concluded that it could not find sufficient evidence to determine that the plaintiff had not violated research ethics. The academic society decided to retract the article and announced via its journal, “The article was retracted due to research misconduct (data fabrication).” The plaintiff, asserting that the retraction of his article constituted a tort on the grounds that it infringed his personality rights and damaged his reputation, then filed a lawsuit seeking cancellation of the retraction and
damages of 100 million Korean won in accordance with Articles 764 and 751 of the Korean Civil Act.

The court stated that an academic society enjoys academic freedom guaranteed at a higher level than freedoms of speech and the press, and thus, the academic society’s standards for publishing an article in its journal and retracting an article from its journal should be honored. The court also stated that the plaintiff had implicitly agreed to these standards at the time of submitting his article to the journal. The court explained that if there are no research notes (the most important evidence that can prove the researcher actually performed the research), or if important data are missing from the research notes, the researcher cannot prove his/her innocence when accused of data fabrication. The Manual for research and publication ethics in science and engineering states, “The reasons behind the retraction should be as detailed as possible. [...] It is recommended that exact phrases are quoted from the report of the investigative committee of the research institution [10].” In light of this, the court rejected the plaintiff’s claim that the retraction of his article and its announcement constituted a tort and ruled in favor of the academic society.

Tabulation of the Nine Court Cases

The above-discussed Korean court cases regarding violation of research and publication ethics are summarized in Table 1.

<table>
<thead>
<tr>
<th>Related issue</th>
<th>Year</th>
<th>Case No.</th>
<th>Case name</th>
<th>Case type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plagiarism</td>
<td>2016</td>
<td>Supreme Court 2015Da5170</td>
<td>Affirmation of nullity of dismissal etc.</td>
<td>Civil</td>
</tr>
<tr>
<td></td>
<td>2020</td>
<td>Gwangju District Court 2019Godan1104</td>
<td>Fraud, interference with business etc.</td>
<td>Criminal</td>
</tr>
<tr>
<td></td>
<td>2018</td>
<td>Gwangju District Court 2018No244</td>
<td>Fraud</td>
<td>Criminal</td>
</tr>
<tr>
<td>Authorship</td>
<td>2009</td>
<td>Supreme Court 2007Do7181</td>
<td>False accusation, violation of copyright act</td>
<td>Criminal</td>
</tr>
<tr>
<td></td>
<td>2018</td>
<td>Suwon District Court 2017Gojung2593 etc.</td>
<td>Giving bribe by breach of trust, interference with business</td>
<td>Criminal</td>
</tr>
<tr>
<td></td>
<td>2015</td>
<td>Daejeon High Court (Cheongju) 2014Nu5522</td>
<td>Revocation of the disciplinary measure</td>
<td>Administrative</td>
</tr>
<tr>
<td></td>
<td>2017</td>
<td>Supreme Court 2016Do16031</td>
<td>Violation of copyright act, interference with business, obstruction of performance of official duties by fraudulent means</td>
<td>Criminal</td>
</tr>
<tr>
<td></td>
<td>2020</td>
<td>Supreme Court 2017Do9459</td>
<td>Violation of copyright act, interference with business</td>
<td>Criminal</td>
</tr>
<tr>
<td>Data Fabrication</td>
<td>2019</td>
<td>Seoul High Court 2017Na2065814</td>
<td>Affirmation of nullity of retraction of a journal article</td>
<td>Civil</td>
</tr>
</tbody>
</table>

Conclusion

As discussed in this article, research and publication misconduct can lead to various legal disputes, including 1) civil cases, such as affirmation of nullity of dismissal or damages; 2) criminal cases, such as fraud, interference with business, and violations of copyright law; and 3) administrative cases related to disciplinary measures against professors affiliated with a university. Therefore, researchers should keep in mind that if they violate research publication ethics, not only will they be censured, but they may also be held legally responsible for their misconduct.

Research and publication ethics themselves do not constitute laws, but ethical norms that are autonomously established by the relevant academic society. Nevertheless, they become a criterion for case resolution in legal disputes where research and publication misconduct is at issue. This is supported by the Korean Supreme Court’s ruling that research ethics refer to “a set of standards generally and universally accepted in the academic community” and the Seoul High Court case (the ninth case above) where the court employed the internal regulations of the academic society as the applicable standard for determination of research and publication misconduct [1]. In other words, to be free from both moral condemnation and legal responsibility, it is best for researchers to adhere to research and publishing ethics.

Conflict of Interest

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Development of an open peer review system using blockchain and reviewer recommendation technologies

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Abstract
In order to create a transparent and sound academic communication ecosystem centered on researchers, we developed a system that applied blockchain technology to an open peer review system. In this study, an open peer review system was developed based on Hyperledger Fabric, which is a private blockchain. The system can be operated in connection with the reviewer recommendation module of the existing submission management system. In the reviewer recommendation module, reviewers are recommended by excluding co-authors and colleagues after an expertise test. The blockchain system performs an open peer review process based on smart contracts, while the submission management system selects reviewers for peer review. A service broker intervenes between these two systems for data interchange. The system developed herein is expected to be used as a researcher-centered scholarly communication model in the open science era, in which the intervention of publishers is minimized, and authors and reviewers (as researchers) are centered.

Keywords
Blockchain; Smart contract; Open peer review; Reviewer recommendation; Scholarly communication

Introduction

Background/rationale: Peer review is a key part of the journal publishing process. In other words, it is difficult for a journal to be recognized as legitimate unless it publishes peer reviewed research, because peer review is a process wherein manuscripts or scientific findings are evaluated by peer experts and their quality is formally confirmed. Reviewers help authors to improve the quality of the manuscript and editors to make reasonable decisions by providing opinions on the scholarly validity and novelty of manuscripts [1,2].

Peer review began in Europe in the 17th century, but the current form of peer review only began in the 19th century, and the full-scale introduction began in the mid-20th century, after World War II [1]. Initially, single-blind peer review was introduced. In the single-blind system,
the identity of the reviewer is not disclosed, so there are few restrictions on critical reviews, but there are concerns about biased reviews. Since then, double-blind peer review has become more common; the double-blind system has few restrictions on critical reviews, as the reviewer’s identity is not disclosed, and concerns about biased reviews are reduced because the author’s identity is not disclosed to the reviewer; however, it is difficult to use the authors’ research information available from previously published articles by authors. Triple-blind review has also been introduced, but the fundamental problems of peer review have not been solved [3].

In recent years, some studies have been conducted with the goal of solving the problems of traditional peer review. Tennant et al. [4] described how blockchain technology can be used to inspire and motivate reviewers by preventing forgery and alterations and by providing rewards. The development of a peer review system that rewards reviewers with tokens through blockchain has been explored in several studies [5-8]. Furthermore, proposals have been made for a governance framework [9] and a peer review ecosystem to decentralize academic publications and to put in place a token economy using blockchain technology [8].

Assigning reviewers to review submitted manuscripts is a very difficult task for editors. Methods for solving the reviewer assignment problem include topic-based methods, bidding-based methods, and knowledge-based methods [10]. Kou et al. [11] developed a reviewer assignment system that applied a reviewer profile automatically extracted from published papers using the reviewer’s research topic. Goldsmith and Sloan [12] considered bidding for the selection of reviewers based on the editor’s preference. Sun et al. [13] applied knowledge rules and mathematical decision models. In addition, Karimzadehgan and Zhai [14] used an integer linear programming method that reflected multiple subtopics.

Furthermore, Schmidt et al. [15] argued that open peer review (OPR) can improve review quality, enhance transparency and accountability, and highlight the role of reviewers. In fact, the number of journals in the Directory of Open Access Journals that have adopted OPR has increased from 20 in 2016 to 147 in 2020. Some journal publishers are also attempting various forms of OPR [3].

Objectives: The aim of this study was to systematically analyze and categorize the problems of peer review, and then to present the design and development of an OPR system using a blockchain and reviewer recommendation technologies.

Problem-solving Model for Peer Review

Ross-Hellauer [2] summarized the problems of traditional peer review into six types: 1) unreliability and inconsistency, 2) delay and expense, 3) unaccountability and risks of subversion, 4) social and publication biases, 5) lack of incentives, and 6) wastefulness. We analyzed these six types of problems and developed a model to solve them.

Fig. 1 is a schematic diagram of the model that explains the causes and paths towards solving the problems of the traditional peer review system. The upper left part of the diagram shows the submitter’s point of view. It is necessary to prevent unfair/biased reviews and fraudulent activities by enhancing transparency in the peer review process. The lower left part of the diagram shows the editor’s point of view. It is necessary to ensure the selection of optimal reviewers and to prevent delayed/poor reviews to enhance the reliability of peer review.

More specifically, it can be said that delayed/poor reviews, which are related to problems 1) and 2) listed above, are due to a lack of reviewers and low motivation of reviewers, while unfair/biased reviews, which are related to problems 3) and 4), are due to the confidentiality of the review process and inter-
ests of the reviewers. Although 5) and 6) have not been addressed by traditional peer review, they seem to be related to the above problems as well. Specifically, 5) is related to problems 1) and 2), while 6) is related to problems 3) and 4).

The right part of Fig. 1 shows measures and solutions, we suggest, to solve the problems. Measures to resolve the problem of unfair/biased reviews include a) permanent recording of the review history, b) disclosure of the review process, and c) consideration of interests in the selection of reviewers. As measures to resolve the problem of delayed/poor reviews, d) contract-based review and rewards, e) open recruitment of reviewers, and f) reflection of expertise information in reviewer selection will be helpful.

First of all, blockchain technology can be used to implement some of those measures. In particular, blockchain can be used to solve problems a) and d). Blockchain can permanently record the review history, and it enables smart contracts and token rewards.

Next, problems b) and e) can be resolved by introducing OPR. Problems b) and e) are deeply related to open identity, open participation, open interaction, open pre-review manuscript, and open final-version commenting among the seven areas of OPR presented in Ross-Hellauer’s article [2].

Finally, problems c) and f) can be addressed by introducing knowledge-based reviewer recommendations. By managing expertise information in the candidate reviewer pool and comparing it with the subjects of submitted manuscripts, the best reviewers can be recommended. Information on interests such as co-author and colleague relationships can also be gathered and reflected in the selection of reviewers.

In summary, an OPR system using blockchain and reviewer recommendation technologies would help to solve the problems of traditional peer review.

**Development of an OPR System**

**Conceptual design**

In this study, an OPR system was developed that can help solve the traditional peer review problems presented above. The system is divided into on-chain and off-chain parts, as shown in Fig. 2. The on-chain part developed using blockchain includes a smart contract-based review management module (hereafter, “review management module”), a review disclosure management module, and a token bank module. The off-chain part consists of a submission management module and a reviewer recommendation module. A service broker is placed between the on-chain part and the off-chain part for mutual data interchange.

The functions of each module in the on-chain part are as follows. First, the review disclosure management module determines whether and when to disclose each of the six disclosure items. According to Table 1, the editor-in-chief of the journal can decide whether and when each item will be disclosed. The review management system performs rounds of peer review under the conditions chosen in the review disclosure management module. Each review round includes functions such as review contract, writing and revising review reports, and reviewer assessment. The review management module manages the execution status of the review contracts, records the scores of the reviewer's contributions, and transfers them to the token bank. The token bank takes over the reviewer’s contribution scores and rewards the reviewer with tokens.

In the off-chain part, the submission module accepts a manuscript from the submitter and transfers it to the review management module through the service broker. The submission module also transfers the selected reviewers, who are
recommended by the reviewer recommendation module, to the review management system.

**Process design**

The review procedure for the OPR system developed in this study is designed as shown in Fig. 3. When a submitter submits a manuscript to the submission management module in the off-chain part, the editor-in-chief assigns an editor. When the editor is determined, the submitted manuscript is automatically transferred to the review management system in the on-chain part. In the review management system, when the editor sets the review period for the manuscript to be re-

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**Table 1. Options for open items permissible in the OPR system**

<table>
<thead>
<tr>
<th>OPR open items</th>
<th>Description</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Identity</td>
<td>Whether the author and reviewer's personal information is disclosed</td>
<td>Not disclosed</td>
</tr>
<tr>
<td></td>
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OPR, open peer review.
viewed and starts recruiting reviewers. Candidate reviewers who are interested apply for review. When the editor finishes recruiting reviewers, the list of candidate reviewers is transferred to the submission management module. When the editor selects a candidate reviewer from the reviewer pool and requests a reviewer recommendation, the reviewer recommendation module displays a list of reviewers recommended. In the list of reviewers, not only is the reviewer’s expertise sorted in the order most similar to that of the submitted manuscript, but it also displays when there is a co-author relationship or colleague relationship with the authors. The editor selects the most suitable candidate reviewers from the list of candidate reviewers and sends a request for a review contract to the review management module. If all candidate reviewers accept the contract, the review begins. When the review is over, the reviewers write and submit the review report. When the review is over, the editor clicks the “finish review” button, reviews the review report, corrects any revisions, and submits. The submitter submits the revised manuscript reflecting the review report and assesses the reviewers. Editors can adjust the reviewer’s assessment scores. The scores are transferred to the token bank and saved as tokens.

Development result
Fig. 4 presents the configuration of the developed system. The blockchain used in the development is a private blockchain called Hyperledger Fabric, which utilizes open-source code developed in a project led by the Linux Foundation. The on-chain part was developed in the Go language on Ubuntu 16.04, which is a Linux operating system, and the off-chain part uses Java language on CentOS 7.7. The service broker is implemented based on Apache Kafka 2. The off-chain part was developed by embedding it in ACOMS, the submission management system of Journal of Information Science Theory and Practice, an international journal published by KISTI (Korea Institute of Science and Technology Information), available at https://www.jistap.org/journal/intro.do?journalSeq=J000043. Fig. 5 shows the overall workflow of the full peer review process of the Journal of Information Science Theory and Practice. Fig. 6 shows an example of the user interface of the on-chain modules and the off-chain modules on the journal homepage.

Discussion
Private blockchain versus public blockchain
Blockchains are divided into public and private. In this study, the review management system was developed using Hyperledger Fabric, a private blockchain. Several review management systems have been developed based on public blockchains such as Bitcoin [16] and Ethereum [8,9,17], but systems using private blockchains have not yet been reported. Unlike a public blockchain, a private blockchain requires approval from a central organization to participate, so processing speed is fast, security is excellent, and it can be optimized for specific communities. It is believed that in an environment in which academic societies publish journals, such as in Korea, private blockchains are more suitable than public ones.

Gradual OPR acceptance model
The system developed in this study allows publishers to select among the six OPR items (Table 1) suggested by Ross-Hellauer [2] according to the policies of the publisher, so that OPR can be adopted step by step. Namely, when publishers begin to adopt OPR, at first, they can adopt a low level of OPR and gradually develop to a higher level.

Knowledge-based reviewer recommendation
In this study, a module for recommending reviewers was developed that can help editors assign reviewers. In this module, reviewers can be recommended after examining their expertise and completing the process of excluding interests. The procedure for selecting a reviewer is as follows. First, candidate reviewers are arranged in order of expertise similarity, after calculating the degree of expertise similarity between the attribute set extracted from the papers of the candidate reviewers using TextRank and the attribute set of the submitted manuscript. Second, conflict of interest checks are performed by matrix multiplication by expressing co-author and colleague relationships as a 2-mode network matrix. Third, the editor selects the best reviewer by referring to the list of final candidate reviewers. This module is expected to help editors solve the problems of traditional peer review, both by shortening the time to find reviewers and by helping them select the best reviewers.

Fig. 4. Configuration of the developed open peer review system.
Service broker
In the system described in this study, manuscript submission and reviewer selection are performed in the off-chain part, while smart contracts, peer review, assessment, and rewards...
are in the on-chain part. Between the two parts, a service broker intervenes. The presence of a service broker makes the process slightly more complicated, but provides an opportunity to link the on-chain part to various services such as conferences and research proposal review, as shown in Fig. 7.

**Conclusion**

In this study, an OPR system using blockchain and knowledge-based reviewer recommendation technologies was developed. Blockchain technology will be able to increase the transparency and reliability of peer review by permanently recording the review history, enabling the selection of OPR items, performing smart contracts, and rewarding tokens. The knowledge-based reviewer recommendation technology will enable the selection of reviewers according to expertise while avoiding conflicts of interest, thereby lightening the editor’s workload. The OPR system developed in this study is equipped with devices to resolve the problems of traditional peer review. If this system is applied to actual journals in the future, it will be a model of the peer review ecosystem in the future open science era.

In addition, establishing an assessment model for reviewers and using it widely to assess researchers will contribute to converting the current publisher-led scholarly publishing paradigm to a researcher-centered autonomous scholarly publishing paradigm.

**Conflict of Interest**

No potential conflict of interest relevant to this article was reported.

**Funding**

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Open peer review system using blockchain


Consultation questions on publication ethics from 2016 to 2020 addressed by the Committee on Publication Ethics of the Korean Council of Science Editors

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Abstract
With the goal of improving the publishing ecosystem and promoting transparency in journal publishing, we describe some recent cases in scientific publishing in Korea. The current article summarizes ethical inquiries from domestic journals and publishers, most of whom are members of the Korean Council of Science Editors. We selected 15 representative questions asked during the last 4 years. Those inquiries were classified into hot topics such as plagiarism, duplicate publications, multiple submission, and others (informed consent, copyright, compliance with journal regulations, authors’ responsibilities, and voluntary retraction requests). When plagiarism is suspected, editors and reviewers should assess the situation following the relevant rules and procedures, and if necessary, the manuscript should be rejected. Cases of duplicate publication should be clearly stated in both papers based on the explicit agreement of the editor-in-chief of both journals. As a general rule, the entire content of an article should be published in one issue, but if the article is too long, it may need to be published in two issues. Permission from both journals is required. The abstract and references should be separated accordingly. In cases of copyright conflict, voluntary withdrawal of a paper, or non-compliance with publishing regulations, the manuscript must be withdrawn according to specific procedures (referring to the COPE flow chart). All correspondence regarding a manuscript should be with the corresponding author, who communicates directly with the journal. We hope that these recommendations will help readers in the field of scientific publishing to address issues related to publication ethics.

Keywords
Duplicate publication; Multiple submission; Plagiarism; Publication ethics
Introduction

Publication ethics is a virtue that researchers and specialists should cultivate in the process of writing and publishing articles. It encompasses the ethical standards necessary to ensure high-quality scientific publications, to enrich public trust in the findings reported by the scientific community, and to provide scientists with appropriate credit for their ideas. The overall principle of publication ethics in practice is to avoid data fabrication and falsification, plagiarism, multiple submissions, duplicate publications, and improper author contributions or attributions. Nonetheless, publishers and journals often face ethical issues, which appear impossible to avoid completely. Therefore, the importance of publication ethics is being increasingly recognized in order to disseminate research results in an ethically principled manner.

In many cases, the identification of wrongdoing may be clear, but it may not be clear whether the wrongdoing was accidental or intentional. As the proverb says, “people learn from mistakes,” and therefore, it would be helpful to collect questions based on actual, practical cases from the field. For this reason, this article presents a compilation and analysis of questions about publication ethics that the Korean Council of Science Editors (KCSE) received through various sources, including e-mail and questionnaires at in-person seminars and symposia. The KCSE has the goal of promoting the quality of science journals published in Korea through information exchange and discussions on editing activities, with the vision of improving the style and format of science journals in Korea to reach the international level, and the ultimate mission of promoting cultural development and human well-being through scientific journal publishing. The questions and the corresponding responses are summarized below, with the goal of helping readers, authors, and editors at journals and publishers to cope with publication ethics problems more smoothly, since these difficulties often present complicated issues during the publication process of a manuscript.

Definitions of Terms Used in the Present Article on Publication Ethics

Plagiarism: Plagiarism refers to taking the ideas, thoughts, or expressions of others without giving them credit (proper citation); this practice is unfair and dishonest, and is an act of fraud.

COPE: The Committee on Publication Ethics (COPE), is a non-profit organization dedicated to encouraging integrity in research and its publication. COPE provides official guidelines on publication ethics, practical resources including flowcharts and cases, e-learning, seminars, forum and more to educate and support editors and publishers. COPE has defined a set of recommended core practices that are applicable in publishing scholarly literature for reviewers, editors, journal team members, publishers and institutions [1].

Similarity Check: This platform was developed by Crossref in collaboration with the STM (science, technology, and medicine) publishing community in 2008, mainly in order to help editors verify the originality of papers. Similarity Check is powered by the iThenticate software from iParadigms, known as the provider of Turnitin.

Salami publication or segmented publication: A form of self-plagiarism, salami or segmented publication can be defined as the publication of two or more articles derived from a single study.

Duplicate publication: A duplicate population is also called a multiple publication or redundant publication, and this concept refers to publishing the same intellectual material more than once, by the author or publisher. It should be noted that this category does not include unauthorized republication by someone else, which constitutes plagiarism and/or copyright violation.

Informed consent: This term refers to the process of getting permission before conducting a healthcare intervention on a person, or disclosing personal information [2]. The patient must be competent to make a voluntary decision about whether to undergo the procedure or intervention. The required elements for documentation of the informed consent discussion are the nature of the procedure, the risks and benefits and the procedure, reasonable alternatives, risks and benefits of alternatives, and assessment of the patient’s understanding of elements 1 through 4 [3].

Methods

Ethics statement: Since this study did not involve human subjects, no institutional review board approval or informed consent was required.

Study design: This study presents a descriptive analysis of the categories of questions on publication ethics.

Setting and data source: We analyzed inquiries submitted to the KCSE between January 2016 and April 2020. The inquiries and questions were received through the website of the KCSE or via e-mail from the editorial boards of journals or individuals in Korea. Dozens of inquiries were classified into various categories that reflected important and noteworthy issues in the field of publication ethics, including plagiarism, duplicate or multiple publications, salami publication, informed consent, copyright, journal regulation, and the author’s responsibilities. The inquiries were transferred to the Committee on Publication Ethics at the KCSE and reviewed.
carefully. Formal deliberations were conducted through discussions among members of the Committee on Publication Ethics. Soon after the meeting, replies were sent for most—if not all—questions and inquiries to the corresponding person or organization. During the period when an inquiry was being discussed among the committee members and a response was being composed to the person who made the query, the KCSE maintained a neutral position on the issue. Cases were classified according to common categories of misconduct in publication ethics; furthermore, specific cases were described. **Statistical methods**: A descriptive analysis of the data was done.

**Results**

As shown in Table 1, the inquiries were classified into the categories of plagiarism, duplicate publications, and others (informed consent, copyright, non-compliance with journal regulations, the author's responsibilities, and voluntary retraction requests). The 15 cases we described here were selected among the numerous inquiries submitted to the KCSE, excluding similar questions.

**Plagiarism**

**Case 1-1.** A review paper was published in 2017, and seven out of eight figures in the paper received reports of research misconduct from journals alleging plagiarism, as the figures were first published in other journals. Some of the journals were paid journals, making the problem especially serious. **Recommendation**: In this case, it was determined that the journal editors had a significant responsibility. The editorial committee of the journal that published the plagiarized paper and its ethics committee should have identified the problem and notified the author, who was responsible for the plagiarized paper, that this was a fraudulent act. After withdrawing the paper, the plagiarized academic journals should have been informed of the paper's withdrawal. According to COPE regulations, it is possible to inform the organization where the responsible author is affiliated; however, it is also possible that this issue may reflect mistakes in the editing process, such as manuscript editing. Therefore, in the process of journal editing, it is necessary to check whether the original manuscript is acknowledged in the figure or table of a review article and to ensure that material from the original article is not published without permission (or citation) if that article was not published under an appropriate CC license.

**Case 1-2.** After internal deliberation by the editorial committee of a journal due to the suspicion of plagiarism in a submitted manuscript, it was found that the results, discussion, and abstract were completely identical to previously published articles. **Recommendation**: The authors should be notified of the deliberation results and should be requested to send the raw data for review; alternatively, if plagiarism is evident, the submission should be rejected.

**Case 1-3.** After Similarity Check for a submitted paper, it was found that significant parts of previously published papers were copied in the submitted paper. **Recommendation**: First, it is necessary to figure out exactly what parts of other papers were duplicated. If the author of the submission does not provide accurate information, it must be identified by the relevant journal. This is because in the field of medical and scientific research, overlapping materials and methods are not considered to be plagiarism. Duplication of results is much more serious than that in the introduction; therefore, the journal editor should contact the responsible author to verify that the submitted manuscript is the original manuscript. If this cannot be proven, it can be considered a case of evident plagiarism.

**Duplicate publications**

**Case 2-1.** A question arose regarding whether if it is possible to publish guidelines or review articles in multiple journals. **Recommendation**: Duplicate publications are not considered a problem if the relevant journals decide to publish the article based on mutual consultation. However, it is mandatory that the relevant information be published on the first page of the article. For multiple submissions, it is recommended not to change the order of the authors or the corresponding author. To do so, permission must be granted by the editor and all co-authors.

**Case 2-2.** A paper being submitted to an SCI-indexed journal is planned to be published as a brief communication in another journal.
**Recommendation**: If the editors (or editor-in-chief) of both journals agree, duplicate publication is possible; however, on the first page of the brief communication paper, it must be revealed that the content overlaps with a previously published paper. Importantly, the editorial format is recommended rather than the brief communication format. If the manuscript has not been published yet, and is currently under the submission and review process, as distinct from the previous recommendation, it is suggested to move forward with the agreement of the editorial committees of both journals after confirming that the manuscript will be published, since otherwise it may not be published in the relevant journal and the submission rules of each journal may be different.

**Case 2-3.** A question arose regarding whether it is possible to submit a paper presented at a conference to the journal associated with that conference or another conference.

**Recommendation**: Papers presented at academic conferences are generally considered less important than publications in academic journals, but presentations at conferences in specific fields may be considered more important, so it is difficult to present a uniform standard. In particular, conference proceedings (e.g., the Institute of Electrical and Electronics Engineers) in fields with rapidly changing trends, such as electric engineering and computer science, have a journal-like character.

**Case 2-4.** A paper was submitted to an academic journal by a supervisor who was not the corresponding author.

**Recommendation**: It is not malfeasance for a thesis for a degree to be published in an academic journal. However, it is recommended to use the following phrasing in the paper to avoid confusion: “A paper submitted in a partial fulfillment of the requirements for the degree of Doctor of Philosophy.” In cases similar to those introduced, authorship disputes can arise. Even if the corresponding author and the first author’s supervisor of a thesis for a degree have mutually agreed to publication, the parties must be notified if there is a problem, such as the source of research funding.

**Case 2-5.** A submitted paper being reviewed by other journals was caught.

**Recommendation**: The editors should contact the author to have one of the duplicate submissions withdrawn.

**Case 2-6.** Salami publication: At a meeting of the journal editorial committee, the length of a submitted review article was judged to be too long; instead, it was thought to be more suitable for the two parts to be published separately.

**Recommendation**: Even if a manuscript is long, it should be published in one issue. However, if the journal permits it, each abstract of the paper to be divided should be prepared separately, and each part of the paper should have a clearly separate list of references.

**Others**

**Case 3-1.** A question arose of whether informed consent must be provided in animal research papers.

**Recommendation**: In almost all animal experiments, informed consent is not applicable. However, if a companion animal is used for experimental purpose, its owner's signature is required, and the owner should be informed about the meaning of the study and its effect on the companion animal.

**Case 3-2.** A question arose regarding the relationship between copyright and the article processing charge when a manuscript that received research funding from a European public institution was submitted (related to changes in European open access [OA] publishing policy).

**Recommendation**: If an OA journal is published under a CC-BY license, the publication cost must be paid by the author or the relevant academy. If it is a subscription-based journal that is operated through fees paid by libraries without requiring authors to pay for publication costs, under current European OA publishing policies, the publication cost must be received from the author and the article must be processed as an OA article under the CC-BY license.

**Case 3-3.** A case was reported in which a patient’s photo was published without informed consent.

**Recommendation**: This problem was caused by failing to include a statement of patient consent during the paper submission process. It is recommended that the journal should promptly take measures to prevent the patient’s photo from being seen publicly and immediately proceed with the paper withdrawal procedure.

**Case 3-4.** A voluntary retraction request was made by the responsible author due to a data error that occurred by mistake.

**Recommendation**: It is necessary to clearly confirm the content affected by the author’s mistake, and the incorrect part should then be corrected by writing and publishing an erratum, assuming that the manuscript has not been published in other journals. If the journal considers withdrawing the paper, it is necessary to receive consent from the co-author(s) and corresponding author of the manuscript.

**Case 3-5.** Responsibility and role of corresponding author: a first author, who was not the corresponding author, regularly sent and received correspondence with the journal.

**Recommendation**: If an editor realizes this during the editing process, the author should be notified that this practice is inappropriate, and correspondence should be discontinued immediately. Communication during the publication process must be conducted with the corresponding author.

**Case 3-6.** Non-compliance with journal regulations: non-compliance with the journal’s regulations was found in a published article.

**Recommendation**: This amounts to a confession that the editing level of the journal is poor. Furthermore, since there is a
possibility of dispute with the author(s), the issue should be handled carefully. After determining exactly which regulations were not followed, the editor should make a judgment of whether it is reasonable to withdraw the paper. In this particular case, the fault of the editor is as large as that of the authors, so it is necessary to determine whether the problem is serious enough to cause readers to doubt the scientific integrity and prestige of the journal. If the decision is made to withdraw the paper for aforementioned reasons, consent from all authors must be received before the withdrawal procedure. A retraction notice must be issued for the manuscript, containing the reason for retraction and the bibliographic information in unambiguous language that is distinct from other types of corrections or comments. The retraction must also be freely available to all readers without barriers to access.

Conclusion

Issues related to publication ethics are as important as any other aspect of research activities, such as conceptualizing and designing experiments, obtaining research results, and writing the manuscript. It is our hope that the readers of this article will be able to prevent and handle inadvertent misconduct when they face various issues related to publication ethics in light of the recommendations made herein. We also strongly recommend readers to refer to the guidance from the COPE that deals with publication ethics in detail, including flowcharts [4], guidelines [5], and cases [6]. Recently, the Korean Association of Medical Journal Editors reported consulting cases on publication ethics issues including duplicate publication, author qualifications, copyright disputes, and plagiarism [7]. The current article presents questions and consultations from 2016 to 2020 handled by the Committee on Publication Ethics of the KCSE after in-depth consideration of issues related to publication ethics that arose with regard to actual cases. Therefore, the content of the present article might be of practical help to authors, reviewers, and editors involved in the publication process who face publishing-related ethical issues. Although we all know the importance of publication ethics, once ethical principles are violated unexpectedly or even unknowingly, serious consequences can ensue; thus, one needs to know exactly how to deal with these issues in advance. It is our hope that various issues in publication ethics that have been problems in the past might gradually disappear in the near future as we establish a healthier publishing culture.

Conflict of Interest

Cheol-Heui Yun serves as an editor of Science Editing, but has no role in the decision to publish this article. Except for that, no potential conflict of interest relevant to this article was reported.

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References

Was the number of submissions to scholarly journals in Korea affected by the COVID-19 pandemic?

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Abstract
This study investigated whether there was an increase in submissions to scholarly journals in Korea according to journals’ field and indexation status in Scopus or Science Citation Index Expanded (SCIE) in 2020, the year when the coronavirus disease 2019 (COVID-19) pandemic first spread throughout the world. The analysis included 60 journals with e-submission systems operated by M2PI. Early and monthly submissions were counted from 2016 to 2020. The yearly proportional change was also calculated. In 2020, submissions soared for medical journals indexed in Scopus/SCIE (49.5%), corresponding to an increase of 36.9% relative to the expected number of submissions. There was also a surge of submissions to these journals from March to July 2020. However, non-medical journals and medical journals not indexed in Scopus/SCIE did not show an increase in submissions. The number of submissions to scholarly journals in Korea was affected by the COVID-19 pandemic in a specific subset of journals. The background of the spike in submissions is required to be re-investigated. Editors’ burden also should be mitigated through editorial board members’ help and publishers’ support.

Keywords
Bibliometrics; COVID-19; Republic of Korea; Scholarly journal; Submission

Introduction

Background/rationale: As the editor-in-chief of the Journal of Educational Evaluation for Health Professions, I found that the number of submissions soared from 147 in 2019 to 286 in 2020, reflecting a 94.6% increase [1,2]. Therefore, the burden of the editorial office also increased. I have also heard from some colleague editors that submissions soared in 2020. Altogether, this has been an unexpected change in the environment for editors’ voluntary work.

There have also been reports that the number of submissions increased in 2020 for other journals, which some editors interpreted as possibly resulting from the coronavirus disease...
2019 (COVID-19) pandemic. In eight neurosurgical, stroke neurology, and neurointerventional journals, submissions of original articles soared by 42.3% in 2020 compared to the previous year [3]. In six journals of the British Ecological Society, the number of submissions between March 15, 2019 and October 1, 2019 was compared to the number of submissions during the same period in 2020, and an increase of 15.6% was found [4]. Compared to the period from February to June 2019, during the corresponding period in 2020 (i.e., from February to June), a 55% increase in submissions was found for the *Journal of Neurosurgery*, an increase of 77% for the *Journal of Neurosurgery: Spine*, and an increase of 78% for the *Journal of Neurosurgery: Pediatrics* [5]. In *Annals of Emergency Medicine*, the median number of unique articles submitted each month soared by 29.8% in March 2020, 113.3% in April 2020, and 133.0% in May 2020 compared to a baseline period extending from January 2017 to February 2020 [6]. According to a survey of editors, between March 25 and May 1, 2020, submissions increased to 11 journals, whereas no change or a decrease in submissions was reported for four journals [7]. In a survey of Asian editors, 28.9% of 152 editors reported an increased number of submissions to their journals since the COVID-19 pandemic [8].

What does the soaring number of submissions to scholarly journals in Korea mean? Non-profit societies or organizations publish all but a few scholarly journals in Korea, so the editor's job is a voluntary one without payment. If the number of submissions grows rapidly, editors are required to spend more time reviewing and editing manuscripts. Since editors are usually top-ranking researchers in their fields, and most of them work in universities or hospitals, the soaring number of submissions may induce burnout. Appropriate steps should be taken to help editors. Thus, in light of previous findings and anecdotal reports, it is necessary to confirm whether this phenomenon has also taken place in Korea.

**Objectives**: This study aimed to determine whether the number of submissions to scholarly journals in Korea was affected by the COVID-19 pandemic. Specifically, the following parameters were analyzed for the journals included in this study: the number of yearly submissions from 2016 to 2020, the number of monthly submissions from 2016 to 2020, and differences in the number of submissions according to journals' scope and database indexation status.

The following hypotheses were set: first, there was an increase in submissions in 2020 from previous years; and second, the increased number of submissions was confined to medical journals indexed in international databases.

**Methods**

**Ethics statement**: Data were analyzed from the e-submission systems used by journals, the editors of which agreed to provide information for this study. No research data from each individual journal was used. Institutional review board approval and obtainment of informed consent were not required because this study did not have human subjects.

**Study design**: This was an observational study of the submission count in the e-submission systems operated by a single publishing company. Data were analyzed according to the year, category of journals, and whether journals were indexed in Scopus or Science Citation Index Expanded (SCIE).

**Participating journals**: Among the 105 journals included in the M2PI's e-submission system, a list was provided of 77 journals that received at least one submission in 2016. Three of these 77 journals were excluded due to a lack of editor information on the journal website. Since the author is an editor of one of those journals, an email was sent to the editors of the 73 other journals to request permission to use the information on their e-submission system. One editor refused to grant permission, and there was no response from 13 editors. Therefore, 60 journals were included in the analysis (81.1%). Data from these 60 journals were provided by the M2PI.

**Data sources/measurement**: The number of manuscripts submitted by month and year in the 60 journals was counted. The journals were divided into medical and non-medical fields and then classified according to whether they were listed in Scopus or SCIE. First, the average number of submissions per journal was analyzed in the resulting four groups by year, and the proportional change in the number of submissions by year was calculated. Changes in the number of monthly submissions by group were quantified. Finally, monthly changes in the number of submissions were determined by year in the Scopus/SCIE-indexed journals.

**Variables**: The variables analyzed in this study were the number of submissions and the journal's category, database indexation status, and year.

**Bias**: There was no selection bias because this was an observational study of all target journals in a single company's e-submission system.

**Study size**: Because this was not an experimental study, the number of target journals could not be estimated.

**Statistical methods**: Comparisons were made by observing the trends of changes. No statistical analysis was done for the comparisons. To estimate the number of submissions in 2020, regression analysis of data from 2016 to 2019 was done with DBSAT ver. 5.0 (DBSTAT Co., Chuncheon, Korea).
Results

The number of journals according to field and indexation status in Scopus or SCIE: The list of journals included in this study is available in Suppl. 1. Out of 60 journals, the number of medical journals indexed in Scopus or SCIE was 33 (55.0%), while the number of medical journals indexed in neither Scopus nor SCIE was 18 (30.0%). The number of non-medical journals indexed in either Scopus or SCIE was six (10.0%), while the number of non-medical journals indexed in neither Scopus nor SCIE was three (5.0%).

Yearly changes in submissions: The yearly changes in submissions are presented in Fig. 1 (Suppl. 2). The rates of change from the previous year are shown in Fig. 2 (Suppl. 2). There was an increase of 49.5% in the medical journals indexed in Scopus/SCIE. The average expected number of submissions in medical journals indexed in Scopus/SCIE for 2020 estimated from the trends in the previous 4 years was 192. Instead, the real number was 262.8, reflecting a 36.9% increase. In contrast, a decrease was observed for the non-medical journals indexed in Scopus/SCIE when the same estimation process was applied (Table 1).

The regression functions of the four groups from 2016 to 2019 were as follows: Medical journals indexed in Scopus/SCIE: \( \text{SUBMISSIONS}(Y) = 19.700 \times \text{YEAR}(X) + 93.500 \) \( (R^2 = 0.958, P = 0.0210) \)

Non-medical journals indexed in Scopus/SCIE: \( \text{SUBMISSIONS}(Y) = -0.230 \times \text{YEAR}(X) + 37.700 \) \( (R^2 = 0.030, P = 0.8273) \)

Non-medical journals not indexed in Scopus/SCIE: \( \text{SUBMISSIONS}(Y) = 14.350 \times \text{YEAR}(X) + 203.550 \) \( (R^2 = 0.944, P = 0.0287) \)

Non-medical journals not indexed in Scopus/SCIE: \( \text{SUBMISSIONS}(Y) = 4.930 \times \text{YEAR}(X) + 75.500 \) \( (R^2 = 0.256, P = 0.4940) \)

The regression functions of the non-indexed groups were not significantly different \( (P > 0.05) \). Therefore, it was not possible to estimate the tendency of submissions by year for these groups.

![Fig. 1. Average number of submissions to journals in Korea according to research field and database indexation status by year. MED1, medical journals indexed in Scopus or Science Citation Index Expanded (SCIE) (33 journals); MED2, medical journals indexed in neither Scopus nor SCIE (18 journals); NON-MED1, non-medical journals indexed in Scopus or SCIE (six journals); NON-MED2, non-medical journals indexed in neither Scopus nor SCIE (three journals).](image1.png)

![Fig. 2. Annual proportional change in the number of submissions according to research field and database indexation status by year. MED1, medical journals indexed in Scopus or Science Citation Index Expanded (SCIE) (33 journals); MED2, medical journals indexed in neither Scopus nor SCIE (18 journals); NON-MED1, non-medical journals indexed in Scopus or SCIE (six journals); NON-MED2, non-medical journals indexed in neither Scopus nor SCIE (three journals).](image2.png)

Table 1. Changes in the average number of submissions from the expected number extrapolated according to the number of submissions from 2016 to 2019

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<th>Expected in 2020</th>
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<td>115.4</td>
<td>127.6</td>
<td>159.1</td>
<td>175.8</td>
<td>262.8</td>
<td>192.0</td>
<td>36.9</td>
</tr>
<tr>
<td>MED2</td>
<td>38.2</td>
<td>35.2</td>
<td>38.9</td>
<td>33.8</td>
<td>36.2</td>
<td>36.8</td>
<td>NA</td>
</tr>
<tr>
<td>NON-MED1</td>
<td>221.8</td>
<td>225.7</td>
<td>248.0</td>
<td>262.2</td>
<td>261.5</td>
<td>275.3</td>
<td>-5.1</td>
</tr>
<tr>
<td>NON-MED2</td>
<td>72.0</td>
<td>101.0</td>
<td>84.3</td>
<td>94.0</td>
<td>74.0</td>
<td>95.0</td>
<td>NA</td>
</tr>
</tbody>
</table>

MED1, medical journals indexed in Scopus or SCIE (33 journals); MED2, medical journals indexed in neither Scopus nor SCIE (18 journals); NON-MED1, non-medical journals indexed in Scopus or SCIE (six journals); NON-MED2, non-medical journals indexed in neither Scopus nor SCIE (three journals).
The pattern of monthly changes in submissions: The average number of submissions to journals in Korea according to research field and database indexation status by month is shown in Fig. 3 (Suppl. 3). Analyzing the medical journals indexed in Scopus or Science Citation Index Expanded (SCIE) (33 journals); MED2, medical journals indexed in neither Scopus nor SCIE (18 journals); NON-MED1, non-medical journals indexed in Scopus or SCIE (6 journals); NON-MED2, non-medical journals indexed in neither Scopus nor SCIE (3 journals).

Discussion

Key results: The number of yearly submissions from 2016 to 2020 showed that the spike in submissions was confined to medical journals indexed in Scopus/SCIE (Figs. 1, 2). No meaningful change in the number of submissions was found for non-medical journals or medical journals not indexed in Scopus/SCIE. The pattern of monthly submissions to medical journals indexed in Scopus/SCIE showed an increase from March to July 2020 (Fig. 4).

Interpretation: Why was the increase in submissions limited to medical journals indexed in Scopus/SCIE? This observation is challenging to interpret because no precise information was available on the country of submitters or the content of manuscripts. However, one can speculate about some possible explanations, as follows.

First, since March 2020, due to lockdowns and cancellations of offline scientific meetings, medical researchers may have had more time to write papers. Second, the number of manuscripts on COVID-19 surged in medical journals [9]. Third, submissions increased not only from Korea, but also from outside Korea. The 33 medical journals listed in Scopus/SCIE are all open-access and either do not require article processing charges from authors or have very low article processing charges. Thirty-one of these journals are also indexed in PubMed Central; therefore, they might be suitable journals for many medical researchers throughout the world to consider as possible venues for their research. The same point may hold for Korean researchers. Fourth, researchers in Korea tend to submit their work to Scopus/SCIE journals; therefore, medical journals not indexed in Scopus/SCIE would have...
Increased submission in COVID-19 pandemic

been unlikely to receive more submissions during the COVID-19 pandemic period. Fifth, in some fields, including the natural sciences, engineering, and agriculture, lockdown measures may have made it difficult to continue experiments or to collaborate with researchers in other countries. The above five speculations can be verified by a more intensive survey of editors or researchers, but for the moment, they must remain hypothetical suggestions.

Some other findings of this study are worth noting. The steady number of submissions to medical journals not indexed in Scopus/SCIE indicates that those journals have been able to continue publishing a consistent number of articles because society members or researchers were loyal to their society journals. The non-medical journals not indexed in Scopus/SCIE received fewer submissions. Therefore, those journals should develop a strategy to recruit more submissions. The monthly submission pattern with peaks in January, April, July, and October in non-medical journals indexed in Scopus/SCIE is difficult to explain. It may reflect random chance. An alternative possibility is that this trend may be due to submission deadlines 2 months before the publication of the issue.

**Comparison with previous studies:** The increased number of submissions to the 33 medical journals indexed in Scopus/SCIE (49.5%) is comparable to the findings of other studies, including a 42.3% increase in 2020 from the previous year in eight clinical journals [3], and 55% to 78% increases in three neurosurgery journals [5]. The monthly patterns of these 33 journals are also comparable to those reported for *Annals of Emergency Medicine*, which experienced an increase of 29.8% in March 2020, 113.3% in April 2020, and 133.0% in May 2020 from the baseline period [6].

**Limitation:** Although this study included 60 journals with submission systems operated by one publishing company, it could not represent all scholarly journals in Korea. There were 5,824 Korean scholarly journals as of February 7, 2021, according to the Korea Citation Index database [10]. A random selection of journals would have provided more accurate data. A confounding factor of increased submissions is the inclusion of certain journals in SCIE in 2019, since being indexed in SCIE is usually followed by a surge in the number of submissions to the journal. This phenomenon has frequently been observed for Korean journals [11]. Two journals began to be indexed in SCIE in 2019, but this corresponds to a relatively small proportion (2/33), so it is unlikely that this issue would excessively affect the overall trends. The number of non-medical journals was 15. Therefore, it would be difficult to conclude that these findings represent the overall status of non-medical journals, although the results are suggestive of some general trends. An editor told me that some manuscripts were sent directly to the editors (approximately 30 per year) besides those received from the e-submission system. Likewise, this is not a large enough number to affect the overall submission count. Finally, journals were classified only by the author; therefore, differences in opinion regarding the journal classification could be possible.

**Generalizability:** About 130 medical journals in Korea are indexed in Scopus/SCIE, although the precise number depends on the definition of a medical journal. Thirty-three corresponds to roughly one-fourth of 130. Therefore, this study may be considered representative of the status of Korean medical journals indexed in Scopus/SCIE.

**Conclusion**

This analysis was done to answer the question, “Was the number of submissions to scholarly journals in Korea affected by the COVID-19 pandemic?” The answer is that only medical journals indexed in Scopus/SCIE received more manuscript submissions than expected, with an increase of 36.9% relative to the expected number of submissions during 2016 to 2019. There was also a surge in submissions from March to July 2020. These changes might affect editors’ daily life by increasing their workload. The number of submissions may also increase in 2021 according to the present trends. Publishers should provide support for editors to overcome this new challenge. Medical academic societies’ finances may also be affected by the COVID-19 pandemic, which has made it impossible to hold offline meetings. Editorial board members should share these burdens, and societies should provide financial support for journal editing. To make the review and editorial process more efficient, artificial intelligence tools should also be considered [12].

This study’s hypotheses were accepted: there was an increase in submissions in 2020 compared to previous years, and this phenomenon was confined to medical journals indexed in international databases.

**Conflict of Interest**

Sun Huh has been the president of the Korean Council of Science Editors since January 2020, but had no role in the decision to publish this case study. M2PI (https://www.m2-pi.com/) is a special publishing company member of the Korean Council of Science Editors. It is not for the propagation of the company but for providing submission information in the company’s e-submission system. No other potential conflicts of interest relevant to this article were reported.
**Funding**

The author received no financial support for this case study.

**Data Availability**

To access each journal’s data, please contact the editor of each journal mentioned in Suppl. 1.

**Supplementary Material**

Supplementary file is available from the Harvard Dataverse at: https://doi.org/10.7910/DVN/G1W39K

**Suppl. 1.** List of journals included in this analysis with permission from the corresponding journal editors.

**Suppl. 2.** Total number, average number, and proportional change of submissions to journals in Korea according to research field and database indexation status by year. MED1, medical journals indexed in Scopus or SCIE (33 journals); MED2, medical journals indexed in neither Scopus nor SCIE (18 journals); NON-MED1, non-medical journals indexed in Scopus or SCIE (six journals); NON-MED2, non-medical journals indexed in neither Scopus nor SCIE (three journals).

**Suppl. 3.** Average number of submissions to journals in Korea according to research field and database indexation status by month. MED1, medical journals indexed in Scopus or SCIE (33 journals); MED2, medical journals indexed in neither Scopus nor SCIE (18 journals); NON-MED1, non-medical journals indexed in Scopus or SCIE (six journals); NON-MED2, non-medical journals indexed in neither Scopus nor SCIE (three journals).

**Suppl. 4.** Average number of submissions to 33 medical journals indexed in Scopus or SCIE in Korea according to month and year from 2016 to 2020.

**Suppl. 5.** Average number of submissions to six non-medical journals indexed in Scopus or SCIE in Korea according to month and year from 2016 to 2020.

**References**


Within and beyond my control

Beom Sun Chung, Min Suk Chung
Department of Anatomy, Ajou University School of Medicine, Suwon, Korea

I overheard film directors’ talking to each other.
Producing a good movie is within my control, but the box office success is beyond my control.

Even if the movie is well-made, people may not watch it. The box office is a mystery.
Whatever is beyond my control is in God’s hands.

Scientists say similar things.
Writing a good proposal/article is within my control, but their acceptance is beyond my control.

If accepted, I focus on my hard work.
Effort 7
Luck 3

If rejected, I focus on my bad luck.

Sometimes, my research grant proposal is accepted even though I did not put a lot of effort into writing it. In such a case, I say it is “70% effort and 30% luck.” Other times, my proposal is rejected even though I put a lot of effort into it. Then, I say it is “70% luck and 30% effort.” Framing it this way is good for my mental health.
Research is the process of verifying a hypothesis. The process includes the hypothesis, materials and methods, results, and conclusion. The hypothesis and conclusion are two different things. If a scientist is confused and writes the hypothesis as if it is the conclusion, the article turns into a novel (fiction). This is the moment when a scientist changes into a swindler.

When I was a graduate student, it took me a lot of time to improve my article writing skills. It even took me half a year to finish writing my first article, during which time I was scolded by my academic advisor. However, after that harsh time, I have been able to write as many articles as I need. In the long term, ability is more important than achievement.
Researchers at academic institutions and research centers can form a team to carry out an investigation based on a research grant and write an article. However, they cannot give authorship to each other only because of the research grant. Like in the comic strip, they need to ask for a fair exchange of work.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Funding

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The impact of the COVID-19 pandemic on science editing

Ilke Coskun Benlidayi
Department of Physical Medicine and Rehabilitation, Cukurova University Faculty of Medicine, Adana, Turkey

The coronavirus disease 2019 (COVID-19) pandemic has had a major impact on populations throughout the world. Although the most detrimental consequences have been seen for public health, several aspects of human life have been affected by the pandemic, including science editing.

Science editing requires collaboration among editors, reviewers, authors, journal staff, and print and delivery services. Medical editors, reviewers, and authors are also actively practicing healthcare workers. During the pandemic, some had to realign their priorities due to additional daytime duties and/or night shifts. Prolonged lockdowns led to serious delays in print and delivery services. Cancellations of scientific and educational events, as well as disruptions of ongoing research activities, added to the complexity of the issue [1].
Starting from the beginning of this viral pandemic, researchers have focused their attention on studying COVID-19–related topics. The pathophysiology, diagnostic elements, treatment strategies, and overall impact of COVID-19 have been extensively studied. Researchers’ efforts have resulted in a tremendous volume of articles and related publications, placing an additional burden on science editors’ shoulders. Given the growing number of publications, another potential threat to quality publishing is plagiarism. Editors should apply a comprehensive strategy, instead of relying solely on anti-plagiarism tools [2].

In response to the pandemic, journals have adopted some measures to ensure safety for journal staff. For instance, roundtable meetings have been changed to online video meetings. Some journals have announced a number of changes to their reviewing processes and publishing decisions. Revision periods were extended, and in some cases, unreasonable revisions that would not change the conclusions of a manuscript were avoided [3,4].

The European Association of Science Editors issued a statement on quality standards for editors to ensure excellence in science editing during the pandemic [5]. Specifically, the European Association of Science Editors encouraged editors to ensure adherence to ethical principles and standard reporting guidelines, and to implement open data sharing. Simultaneously, editors were advised to avoid strict language requirements in order to accelerate the rapid transfer of knowledge [5].

Science editing is a hard task. It is much harder during the days of the pandemic. We should be aware of our responsibilities to preserve our journals for future generations.

Conflict of Interest
No potential conflict of interest relevant to this article was reported.

Funding
The author received no financial support for this case study.

References
Events in 2021

The Korean Council of Science Editors announces the schedule of the events in 2021. Precise schedule and registration of above workshops were or will be available from: https://www.kcse.org.

Table 1. Schedule of the events by the Korean Council of Science Editors in 2021

<table>
<thead>
<tr>
<th></th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science Editing (twice a year)</td>
<td>Vol.8 No.1 (20)</td>
<td></td>
<td></td>
<td></td>
<td>No. 38 (30)</td>
<td></td>
</tr>
<tr>
<td>Newsletter (4 times a year)</td>
<td>No. 37 (31)</td>
<td>No. 38 (30)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Editor's Workshop</td>
<td>Basic Manuscript Editing (10, 17, 24, 31)</td>
<td>Basic Manuscript Editing (7, 14, 21, 28)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manuscript Editor's Training &amp; Workshop</td>
<td>Scopus Workshop (2)</td>
<td>10th Anniversary Workshop (8)</td>
<td>Scopus Workshop (28-29)</td>
<td>Editor’s Workshop (24)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Publication Ethics Workshop</td>
<td>Scopus Workshop (28-29)</td>
<td>Editor’s Workshop (24)</td>
<td></td>
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</tr>
<tr>
<td>Manuscript Editor's Training &amp; Workshop</td>
<td>Examination for Korea Manuscript Editors Certification (17)</td>
<td>Manuscript Editor’s Workshop (4)</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Publication Ethics Workshop</td>
<td>Publication Ethics Workshop</td>
<td>Publication Ethics Workshop</td>
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</tbody>
</table>
Restriction of some datasets from open access repositories

Editorial Office, Korean Council of Science Editors

It has been informed that Clarivate Analytics does not allow the data downloaded from the Web of Science Core Collection or their derivatives to be posted on open access data repositories. Therefore, the approach to the dataset files of the following articles in the Harvard Dataverse has been restricted:


1. General information

*Science Editing* (Sci Ed) is the official journal of the Korean Council of Science Editors (KCSE) and Council of Asian Science Editors (CASE). Anyone who would like to submit a manuscript is advised to carefully read the aims and scope section of this journal. Manuscripts should be prepared for submission to *Science Editing* according to the following instructions. For issues not addressed in these instructions, the author is referred to the International Committee of Medical Journal Editors (ICMJE) “Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals” (http://www.icmje.org). It also adheres completely to the Principles of Transparency and Best Practice in Scholarly Publishing (joint statement by COPE, DOAJ, WAME, and OASPA; http://doaj.org/bestpractice) if otherwise not described below.

2. Copyright and Creative Commons Attribution license

A submitted manuscript, when published, will become the property of the journal. Copyrights of all published materials are owned by KCSE. The Creative Commons Attribution License available from: http://creativecommons.org/licenses/by/4.0/ is also in effect.

3. Research and publication ethics

The journal adheres to the ethical guidelines for research and publication described in Guidelines on Good Publication (http://publicationethics.org/resources/guidelines) and the ICMJE Guidelines (http://www.icmje.org).

1. Authorship

Authorship credit should be based on 1) substantial contributions to conception and design, acquisition of data, and/or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; 3) final approval of the version to be published; and 4) agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Every author should meet all of these four conditions. After the initial submission of a manuscript, any changes whatsoever in authorship (adding author(s), deleting author(s), or re-arranging the order of authors) must be explained by a letter to the editor from the authors concerned. This letter must be signed by all authors of the paper. Copyright assignment must also be completed by every author.

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- Correction of authorship after publication: *Science Editing* does not correct authorship after publication unless a mistake has been made by the editorial staff. Authorship may be changed before publication but after submission when an authorship correction is requested by all of the authors involved with the manuscript.

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Submitted manuscripts must not have been previously published or be under consideration for publication elsewhere. No part of the accepted manuscript should be duplicated in any other scientific journal without the permission of the Editorial Board. Submitted manuscripts are screened for possible plagiarism or duplicate publication by Similarity Check upon arrival. If plagiarism or duplicate publication is detected, the manuscripts may be rejected, the authors will be announced in the journal, and their institutions will be informed. There will also be penalties for the authors.

A letter of permission is required for any and all material that has been published previously. It is the responsibility of the author to request permission from the publisher for any material that is being reproduced. This requirement applies to text, figures, and tables.
3. Secondary publication
It is possible to republish manuscripts if the manuscripts satisfy the conditions of secondary publication of the ICMJE Recommendations (http://www.icmje.org/urm_main.html).

4. Conflict of interest statement
The corresponding author must inform the editor of any potential conflicts of interest that could influence the authors' interpretation of the data. Examples of potential conflicts of interest are financial support from or connections to companies, political pressure from interest groups, and academically related issues. In particular, all sources of funding applicable to the study should be explicitly stated.

5. Statement of human and animal right
Clinical research should be done in accordance of the Ethical Principles for Medical Research Involving Human Subjects, outlined in the Helsinki Declaration of 1975 (revised 2013), available from: https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/. Clinical studies that do not meet the Helsinki Declaration will not be considered for publication. Human subjects should not be identifiable, such that patients’ names, initials, hospital numbers, dates of birth, or other protected healthcare information should not be disclosed. For animal subjects, research should be performed based on the National or Institutional Guide for the Care and Use of Laboratory Animals, and the ethical treatment of all experimental animals should be maintained.

6. Statement of informed consent and institutional review board approval
Copies of written informed consent documents should be kept for studies on human subjects, which includes identifiable information or sensitive information. For clinical studies of human subjects, a certificate, agreement, or approval by the Institutional Review Board (IRB) of the author’s institution is required. If necessary, the editor or reviewers may request copies of these documents to resolve questions about IRB approval and study conduct.

7. Process for managing research and publication misconduct
When the journal faces suspected cases of research and publication misconduct such as redundant (duplicate) publication, plagiarism, fraudulent or fabricated data, changes in authorship, an undisclosed conflict of interest, ethical problems with a submitted manuscript, a reviewer who has appropriated an author’s idea or data, complaints against editors, and so on, the resolution process will follow the flowchart provided by the Committee on Publication Ethics (http://publicationethics.org/resources/flowcharts). The discussion and decision on the suspected cases are carried out by the Editorial Board.

8. Process for handling cases requiring corrections, rejections, and editorial expressions of concern
Cases that require editorial expressions of concern or retraction shall follow the COPE flowcharts available from: http://publicationethics.org/resources/flowcharts. If correction needs, it will follow the ICMJE Recommendation for Corrections, Retractions, Reproductions and Version Control available from: http://www.icmje.org/recommendations/browse/publishing-and-editorial-issues/corrections-and-version-control.html as follows:
- Honest errors are a part of science and publishing and require publication of a correction when they are detected. Corrections are needed for errors of fact. Minimum standards are as follows: First, it shall publish a correction notice as soon as possible detailing changes from and citing the original publication on both an electronic and numbered print page that is included in an electronic or a print Table of Contents to ensure proper indexing; Second, it shall post a new article version with details of the changes from the original version and the date(s) on which the changes were made through Crossmark; Third, it shall archive all prior versions of the article. This archive can be either directly accessible to readers; and Fourth, previous electronic versions shall prominently note that there are more recent versions of the article via Crossmark.

9. Editorial responsibilities
The Editorial Board will continuously work to monitor and safeguard publication ethics: guidelines for retracting articles; maintenance of the integrity of the academic record; preclusion of business needs from compromising intellectual and ethical standards; publishing corrections, clarifications, retractions, and apologies when needed; and excluding plagiarism and fraudulent data. The editors maintain the following responsibilities: responsibility and authority to reject and accept articles; avoiding any conflict of interest with respect to articles they reject or accept; promoting publication of corrections or retractions when errors are found; and preservation of the anonymity of reviewers.

4. Author qualifications, language requirement, and reporting guideline
1. Author qualifications
Any researcher throughout the world can submit a manuscript if the scope of the manuscript is appropriate.
2. Language
Manuscripts should be submitted in good scientific English.

3. Reporting guidelines for specific study designs
Research reports frequently omit important information. As such, reporting guidelines have been developed for a number of study designs that some journals may ask authors to follow. Authors are encouraged to also consult the reporting guidelines relevant to their specific research design. A good source of reporting guidelines is the EQUATOR Network (http://www.equator-network.org/home/) and the United States National Institutes of Health/National Library of Medicine (http://www.nlm.nih.gov/services/research_report_guide.html).

5. Submission and peer review process

1. Submission
All manuscripts should be submitted via e-submission system available from: https://submit.escienceediting.org/. If any authors have difficulty in submitting via e-submission system, please send a manuscript to kcse@kcse.org by the corresponding author.

2. Peer review process
Science Editing reviews all manuscripts received. A manuscript is first reviewed for its format and adherence to the aims and scope of the journal. If the manuscript meets these two criteria, it is checked for plagiarism or duplicate publication with Similarity Check. After confirming its result, it is dispatched to three investigators in the field with relevant knowledge. Assuming the manuscript is sent to reviewers, Science Editing waits to receive opinions from at least two reviewers. In addition, if deemed necessary, a review of statistics may be requested. The authors' names and affiliations are removed during peer review (double-blind peer review). The acceptance criteria for all papers are based on the quality and originality of the research and its scientific significance. Acceptance of the manuscript is decided based on the critiques and recommended decision of the reviewers. An initial decision will normally be made within 4 weeks of receipt of a manuscript, and the reviewers' comments are sent to the corresponding author by e-mail. The corresponding author must indicate the alterations that have been made in response to the reviewers' comments item by item. Failure to resubmit the revised manuscript within 4 weeks of the editorial decision is regarded as a withdrawal. If further revision period is required, author should contact editorial office through form mail available from: https://www.escienceediting.org/about/contact.php. A final decision on acceptance/rejection for publication is forwarded to the corresponding author from the editor.

3. Peer review process for handling submissions from editors, employees, or members of the editorial board
All manuscripts from editors, employees, or members of the editorial board are processed same to other unsolicited manuscripts. During the review process, submitters will not engage in the selection of reviewers and decision process. Editors will not handle their own manuscripts although they are commissioned ones.

6. Manuscript preparation

1. General requirements
• The main document with manuscript text and tables should be prepared in an MS Word (docx) or RTF file format.
• The manuscript should be double spaced on 21.6×27.9 cm (letter size) or 21.0×29.7 cm (A4) paper with 3.0 cm margins at the top, bottom, right, and left margin.
• All manuscript pages are to be numbered at the bottom consecutively, beginning with the abstract as page 1. Neither the author's names nor their affiliations should appear on the manuscript pages.
• The authors should express all measurements according to International System (SI) units with some exceptions such as seconds, mmHg, or °C.
• Only standard abbreviations should be used. Abbreviations should be avoided in the title of the manuscript. Abbreviations should be spelled out when first used in the text—for example, extensible markup language (XML)—and the use of abbreviations should be kept to a minimum.
• The names and locations (city, state, and country only) of manufacturers should be given.
• When quoting from other sources, a reference number should be cited after the author's name or at the end of the quotation.

Manuscript preparation is different according to the publication type, including original articles, reviews, case studies, essays, training materials, editorials, book reviews, correspondence, and video clips. Other types are also negotiable with the Editorial Board.

2. Original articles
Original articles are reports of basic investigations. The manuscript for an original article should be organized in the following sequence: title page, abstract and keywords, main text (introduction, methods, results, and discussion), conflict of interest, acknowledgments, references, tables, figure legends, and figures. The figures should be received as separate files. Maximum length: 2,500 words of text (not including the ab-
abstract, tables, figures, and references) with no more than a total of 10 tables and/or figures.

- **Title page:** The following items should be included on the title page: 1) the title of the manuscript, 2) author list, 3) each author’s affiliation, 4) the name and e-mail address of the corresponding author, 5) when applicable, the source of any research funding and a list of where and when the study has been presented in part elsewhere, and 6) a running title of fewer than 50 characters.

- **Abstract and keywords:** The abstract should be concise content of equal to or less than 250 words in an structured format including purpose, methods, results, and conclusion. Abbreviations or references are not allowed in the abstract. Up to 5 keywords should be listed at the bottom of the abstract to be used as index terms.

- **Introduction:** The purpose of the investigation, including relevant background information, should be described briefly. Conclusion should not be included in the Introduction.

- **Methods:** The research plan, materials (or subjects), and methods used should be described in that order. The names and locations (city, state, and country only) of manufacturers of equipment and software should be given. Methods of statistical analysis and criteria for statistical significance should be described.

- **Results:** The results should be presented in logical sequence in the text, tables, and figures. If resulting parameters have statistical significance, P-values should be provided, and repetitive presentation of the same data in different forms should be avoided. The results should not include material appropriate for the discussion.

- **Discussion:** Observations pertaining to the results of the research and other related work should be interpreted for readers. New and important observations should be emphasized rather than merely repeating the contents of the results. The implications of the proposed opinion should be explained along with its limits, and within the limits of the research results, and the conclusion should be connected to the purpose of the research. In a concluding paragraph, the results and their meaning should be summarized.

- **ORCID (Open Researcher and Contributor ID):** ORCID of all authors should be described.

- **Conflict of interest:** Any potential conflict of interest that could influence the authors’ interpretation of the data, such as financial support from or connections to companies, political pressure from interest groups, or academically related issues, must be stated.

- **Acknowledgments:** All persons who have made substantial contributions, but who have not met the criteria for authorship, are to be acknowledged here. All sources of funding applicable to the study should be stated here explicitly.

- **Appendix:** If any materials are not enough to be included in the main text such as questionnaires, they can be listed in the Appendix.

- **Supplementary materials:** If there are any supplementary materials to help the understanding of readers or too great amount data to be included in the main text, it may be placed as supplementary data. Not only text, audio or video files, but also data files should be added here.

- **References:** In the text, references should be cited with Arabic numerals in brackets, numbered in the order cited. In the references section, the references should be numbered and listed in order of appearance in the text. The number of references is limited to 20 for original articles. All authors of a cited work should be listed if there are six or fewer authors. The first three authors should be listed followed by “et al.” if there are more than six authors. If a reference has a digital object identifier (DOI), it should be supplied. Other types of references not described below should follow The NLM Style Guide for Authors, Editors, and Publishers (http://www.nlm.nih.gov/citingmedicine).

**Journal articles:**


**Books and book chapters:**


**Online sources:**


7. Testa J. The Thomson Reuters journal selection process [Internet]. Philadelphia, PA: Thomson Reuters; 2012 [cit-
Instructions to Authors


• Tables: Tables are to be numbered in the order in which they are cited in the text. A table title should concisely describe the content of the table so that a reader can understand the table without referring to the text. Each table must be simple and typed on a separate page with its heading above it. Explanatory matter is placed in footnotes below the tabular matter and not included in the heading. All non-standard abbreviations are explained in the footnotes. Footnotes should be indicated by \textsuperscript{a)}, \textsuperscript{b)}, \textsuperscript{c)}, \ldots. Statistical measures such as standard deviation (SD) or standard error (SE) should be identified. Vertical rules and horizontal rules between entries should be omitted.

• Figures and legends for illustrations: Figures should be numbered, using Arabic numerals, in the order in which they are cited. Each figure should be uploaded as a single image file in either uncompressed EPS, TIFF, PSD, JPEG, and PPT format over 600 dots per inch (dpi) or 3 million pixels (less than 6 megabytes). Written permission should be obtained for the use of all previously published illustrations (and copies of permission letters should be includ-
ed). In the case of multiple prints bearing the same number, English letters should be used after the numerals to indicate the correct order (e.g., Fig. 1A; Fig. 2B, C).

3. Reviews
Reviews are invited by the editor and should be comprehensive analyses of specific topics. They are to be organized as follows: title page, abstract and keywords, main text (introduction, text, and conclusion), conflict interest, acknowledgments, references, tables, figure legends, and figures. There should be an unstructured abstract of no more than 200 words. The length of the text excluding references, tables, and figures should not exceed 5,000 words. The number of references is limited to 100.

4. Case studies
Case studies are intended to report practical cases that can be encountered during editing and publishing. Examples include interesting cases of research misconduct and publication ethics violations; experience of new and creative initiatives in publishing; and the history of a specific journal development. They are to be organized as follows: title page, abstract and keywords, main text (introduction, text, and conclusion), conflict interest, acknowledgments, references, tables, figure legends, and figures. There should be an unstructured abstract of 200 words maximum. The length of the text excluding references, tables, and figures should not exceed 2,500 words. The number of references is limited to 20.

5. Essays
Essays are for the dissemination of the experience and ideas of editors for colleague editors. There is no limitation on the topics if they are related to editing or publishing. They are to be organized as follows: title page, main text (introduction, text, and conclusion), conflict interest, acknowledgments, references, tables, figure legends, and figures. The length of the text excluding references, tables, and figures should not exceed 2,500 words. The number of references is limited to 20.

6. Training materials
Training materials are for training editors or publishers. If there are new standards, policies, technologies, guidelines or trends, they can be submitted for training editors or publishers. It may be unsolicited or commissioned. This publication type will be able to provide the practical information for the journal advancement. They are to be organized as follows: title page, abstract and keywords, main text (introduction, text, and conclusion), conflict interest, acknowledgments, references, tables, figure legends, and figures. There should be an unstructured abstract of 200 words maximum. The length of the text excluding references, tables, and figures should not exceed 2,500 words. The number of references is limited to 20.

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7. Editorials
Editorials are invited by the editor and should be commentaries on articles published recently in the journal. Editorial topics could include active areas of research, fresh insights, and debates in all fields of journal publication. Editorials should not exceed 1,000 words, excluding references, tables, and figures. References should not exceed 10. A maximum of 3 figures including tables is allowed.

8. Book reviews
Book reviews are solicited by the editor. These will cover recently published books in the field of journal publication. The format is same as that of Editorials.

9. Correspondence
Correspondence (letters to the editor) may be in response to a published article, or a short, free-standing piece expressing an opinion. Correspondence should be no longer than 1,000 words of text and 10 references.

In reply: If the Correspondence is in response to a published article, the Editor-in-Chief may choose to invite the article’s authors to write a Correspondence Reply. Replies by authors should not exceed 500 words of text and 5 references.

10. Video clips
Video clips can be submitted for placement on the journal website. All videos are subject to peer review and must be sent directly to the editor by e-mail. A video file submitted for consideration for publication should be in complete and final format and at as high a resolution as possible. Any editing of the video will be the responsibility of the author. Science Editing accepts all kinds of video files not exceeding 30 MB and of less than 5 minutes duration, but Quicktime, AVI, MPEG, MP4, and RealMedia file formats are recommended. A legend to accompany the video should be double-spaced in a separate file. All copyrights for video files after acceptance of the main article are automatically transferred to Science Editing.

11. Commissioned or unsolicited manuscripts
Unsolicited manuscript with publication types of original articles, case studies, essays, training materials, video clips, and correspondence can be submitted. Other publication types are all commissioned or invited by the Editorial Board.

Table 1 shows the recommended maximums of manuscripts according to publication type; however, these requirements are negotiable with the editor.

### Table 1. Recommended maximums for articles submitted to *Science Editing*

<table>
<thead>
<tr>
<th>Type of article</th>
<th>Abstract (word)</th>
<th>Text (word)</th>
<th>References</th>
<th>Tables &amp; figures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original article</td>
<td>250</td>
<td>2,500</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Review</td>
<td>200</td>
<td>5,000</td>
<td>100</td>
<td>No limits</td>
</tr>
<tr>
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<td>200</td>
<td>2,500</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Training material</td>
<td>200</td>
<td>2,500</td>
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<td>2,500</td>
<td>20</td>
<td>10</td>
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<td>1,000</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
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<td>10</td>
<td>3</td>
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<tr>
<td>Correspondence</td>
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<td>-</td>
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<td>10</td>
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<tr>
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*Maximum number of words is exclusive of the abstract, references, tables, and figure legends.*

7. Final preparation for publication

1. Final version
After the paper has been accepted for publication, the author(s) should submit the final version of the manuscript. The names and affiliations of the authors should be double-checked, and if the originally submitted image files were of poor resolution, higher resolution image files should be submitted at this time. Color images must be created as CMYK files. The electronic original should be sent with appropriate labeling and arrows. The EPS, TIF, Adobe Photoshop (PSD), JPEG, and PPT formats are preferred for submission of digital files of photographic images. Symbols (e.g., circles, triangles, squares), letters (e.g., words, abbreviations), and numbers should be large enough to be legible on reduction to the journal’s column widths. All of the symbols must be defined in the figure caption. If the symbols are too complex to appear in the caption, they should appear on the illustration itself, within the area of the graph or diagram, not to the side. If references, tables, or figures are moved, added, or deleted during the revision process, they should be renumbered to reflect such changes so that all tables, references, and figures are cited in numeric order.

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Before publication, the manuscript editor may correct the manuscript such that it meets the standard publication format. The author(s) must respond within 2 days when the editor
contacts the author for revisions. If the response is delayed, the manuscript's publication may be postponed to the next issue.

3. Galley proof
The author(s) will receive the final version of the manuscript as a PDF file. Upon receipt, within 2 days, the editorial office (or printing office) must be notified of any errors found in the file. Any errors found after this time are the responsibility of the author(s) and will have to be corrected as an erratum.

8. Page charges or article processing charges
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NOTICE: These instructions to authors will be applied beginning with the February 2019 issue.
Compliance of *Science Editing* to the Principles of transparency and best practice in scholarly publishing

(joint statement by COPE, DOAJ, WAME, and OASPA; http://doaj.org/bestpractice)

Posted in July 7, 2018 and printed in February 20, 2019

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   i. The URL address of official journal web site: https://www.escienceediting.org/
   ii. ‘Aims & Scope’ statement: It is described at the masthead page.
   iii. Readership: It is primarily for scientific journal editors and personnel who works for scientific journals. Its readership can be expanded to other positions: Researchers on journal publishing and bibliometrics can get the recent topics of journal publishing and editing; Professors on communication can access and adopt a variety of data for education; Students can understand the recent trends of the journal publishing and editing; Policy makers are able to reflect the results of the articles to the nation-wide science promotion policies; The scientists are able to read the advancement in the journal to be submitted so that they have a better knowledge on the journal selection.
   iv. Authorship criteria: It is described at the Instructions to authors.
   v. Duplicate submission and redundant publication: It is described at the Instructions to authors.
   vi. pISSN: 2288-7474 eISSN: 2588-8063

2. Name of journal
   The official journal title is *Science Editing*. Abbreviated title is Sc Ed.

3. Peer review process
   It is described at the Instructions to authors. We adopts double-blind peer review.

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   ii. Management team of a journal
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   - Ethics Editor: Cheol-Heui Yun, Seoul National University, Korea
   - Statistics Editor: Yong Gyu Park, The Catholic University of Korea, Korea
   - Manuscript Editor: Jae Hwa Chang, Infolumi, Korea;
   - Layout Editor: Da Hye Lee, Academya, Korea
   - Website and JATS XML File Producers: Minyoung Choi M2community, Korea; Jeonghee Im, M2community, Korea
   - Administrative Manager: Jisoo Yoon, Korean Council of Science Editors, Korea

5. Governing body
   The governing body is the journal’s editorial board.

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   i. Editorial team is available from Editorial Board page at the front part of the journal.
   ii. Contact information
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       Administrative Manager
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i. Journal policies on authorship and contributorship: It is described at the Instructions to authors.

ii. How the journal will handle complaints and appeals: The policy of the journal is primarily aimed at protecting the authors, reviewers, editors, and the publisher of the journal. If not described below, the process of handling complaints and appeals follows the guidelines of the Committee on Publication Ethics available from: https://publicationethics.org/appeals

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- Who is responsible to resolve and handle complaints and appeals?: The Editor, Editorial Board, or Editorial Office is responsible for them.

- What may be the consequence of remedy?: It depends on the type or degree of misconduct. The consequence of resolution will follow the guidelines of the Committee of Publication Ethics (COPE).

iii. Journal policies on conflicts of interest / competing interests: It is described at the Instructions to authors.

iv. Journal policies on data sharing and reproducibility: Open data policy: For clarification on result accuracy and reproducibility of the results, raw data or analysis data will be deposited to a public repository after acceptance of the manuscript. Therefore, submission of the raw data or analysis data is mandatory. If the data is already a public one, its URL site or sources should be disclosed. If data cannot be publicized, it can be negotiated with the editor. If there are any inquiries on depositing data or waiver of data sharing, authors should contact the editorial office. Clinical data sharing policy: This journal follows the data sharing policy described in "Data Sharing Statements for Clinical Trials: A Requirement of the International Committee of Medical Journal Editors" (https://doi.org/10.3346/jkms.2017.32.7.1051). As of July 1, 2018 manuscripts submitted to ICMJE journals that report the results of interventional clinical trials must contain a data sharing statement as described below. Clinical trials that begin enrolling participants on or after January 1, 2019 must include a data sharing plan in the trial’s registration. The ICMJE’s policy regarding trial registration is explained at https://www.icmje.org/recommendations/browse/publishing-and-editorial-issues/clinical-trial-registration.html. If the data sharing plan changes after registration this should be reflected in the statement submitted and published with the manuscript, and updated in the registry record. All of the authors of research articles that deal with interventional clinical trials must submit data sharing plan. Based on the degree of sharing plan, authors should deposit their data after deidentification and report the DOI of the data and the registered site.

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When invited by the editorial office to review a manuscript, reviewers recommended by the authors will usually be invited to review corresponding manuscripts. Authors may recommend reviewers from the same institute. We recommend them not to decline the invitation to review solely for the reason that the authors are in acquaintance or from the same institution; we welcome reviewers in acquaintance with the authors who are eager to comment with affection. If review comments cannot be submitted within the 14 days of review period, please decline to review or ask for extension of the review period. If there is no review comment within the 7 days from acceptance to review, the reviewer will be given a notice.

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After entering the e-submission system with ID and password, please download PDF files and supplementary files. It is not necessary to comment on the style and format, but just concentrate on the scientific soundness and logical interpretation of the results.

- **Comment to authors:** Summarize the whole content of manuscript in one sentence. Please make a specific comment according to the order of each section of the manuscript. Page mark is good to trace the review comment. The reviewer’s recommendation on acceptance should not be stated at the comment to authors. Consider if the peer review opinion may increase the quality of manuscript or further research by author.

- **Comment to editor:** Both the strength and shortness of the manuscript are recommended to be added. The reviewer’s recommendation on acceptance may be added here including special opinion to editor.

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   - Reviewer may have an antipathy with the author(s).
   - Reviewer may profit financially from the work.
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☐ Double-spaced typing with 11-point font.

☐ Sequence of title page, abstract and keywords, main text, acknowledgments, references, tables, figure legends, and figures. All pages numbered consecutively, starting with the abstract.

☐ Title page with article title, authors' full name(s) and affiliation(s), corresponding author's e-mail, running title (less than 50 characters), and acknowledgments, if any.

☐ Abstract up to 250 words for original articles and up to 200 words for reviews, essays, and features. Up to 5 keywords.

☐ All table and figure numbers are found in the text.

☐ Figures as separate files, in EPS, TIFF, Adobe Photoshop (PSD), JPEG, or PPT format.

☐ References listed in proper format. All references listed in the reference section are cited in the text and vice versa.

☐ The number of references is limited to 20 (for original articles, case studies, and essays), 100 (for reviews), or 10 (for editorials, book reviews, and letters to the editor).
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Signed Date

Print name

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Conflict of interest form

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Examples of conflicts of interest include the following: source of funding, paid consultant to sponsor, study investigator funded by sponsor, employee of sponsor, board membership with sponsor, stockholder for mentioned product, any financial relationship to competitors of mentioned product, and others (please specify).

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I accept the responsibility for the completion of this document and attest to its validity on behalf of all co-authors.

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Date