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# Retraction Notices of COVID-19 Publications: A Comprehensive Analysis

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The study focused on retracted research publications related to COVID-19 from 2020 to 2023. Two hundred eighty records were collected from the Web of Science and Scopus databases. Among these, 182 articles, including withdrawn papers, were selected for the study. The research aimed to identify the reasons for retraction, the number of citations received by retracted articles, the parties responsible for initiating retraction requests, and the top publisher with the highest number of retracted articles. The findings revealed that the journal editors mostly retracted journal articles. The most common reasons for retraction were related to scientific misconduct and issues with authorship. Springer and Elsevier were the publishers with the highest number of articles retracted. Geographic-based results indicated that single-author publications had a higher retraction rate compared to collaborations involving multiple authors. However, there was evidence of strong international collaboration between India and the USA. The study identified the top two core journals for retracted articles: Soft Computing and Journal of Physics: Conference Series. Additionally, publishers like Elsevier, Springer, and Wiley published 36 funded articles which were retracted.

**Keywords:** *retraction, plagiarism, academic misconduct, COVID 19*

## Introduction

Covid 19, a disease caused by Corona- SARS, erupted in 2019 and became a pandemic affecting 767,972,961 people, including 6,950,655 deaths, and as of 8 July 2023, 13,474,185,140 vaccine doses have been administered globally. Governments worldwide made concerted efforts and implemented various strategies to contain the pandemic. Researchers and scientists across the globe undertook research and clinical trials to combat the pandemic. Conducting research and clinical trials is followed by disseminating and sharing findings in scholarly journals. The researchers are supposed to follow rigour, standards and honesty while undertaking research and reporting their results. The researchers cut corners and engaged in various forms of misconduct.

The full text of 876468 articles may be found in the WHO Covid-19 research database, developed in response to the Public Health Emergency of International Concern (PHEIC). Out of this, 285 have been retracted.

Retraction serves as a means to uphold the accuracy, credibility, and integrity of published literature. It takes place after research has already been published. Retraction statements warn readers and researchers, signaling that the published research is erroneous, invalid, and should not be relied upon. The methodologies, findings, and conclusions of retracted studies are deemed unreliable and should not be used as a foundation for further investigations. Retractions are necessary when researchers engage in misconduct, disregarding the gravity of their actions. This study examines retracted research on COVID-19, shedding light on the reasons behind these retractions.

The COPE guidelines mandate that editors retract a published article if its findings are deemed unreliable due to significant experimental errors, fabricated data, or manipulated images. Retraction is also warranted if plagiarism is detected if the findings are republished without proper attribution to previously published work or without seeking permission if the article reports unethical research, if the authors fail to

disclose primary competing interests, if the published article contains data that requires permission for use, if copyright infringement has occurred, or if the article has been published following a manipulated peer review.

The public's reliance on accurate and trustworthy information during a health crisis cannot be overstated, and retractions can erode confidence in scientific findings; further, the government money is wasted on fraudulent research.

In this context, the paper highlights the published articles on Covid 19, which were retracted after it came to the fore that the authors and researchers had violated the rules of scholarly communication.

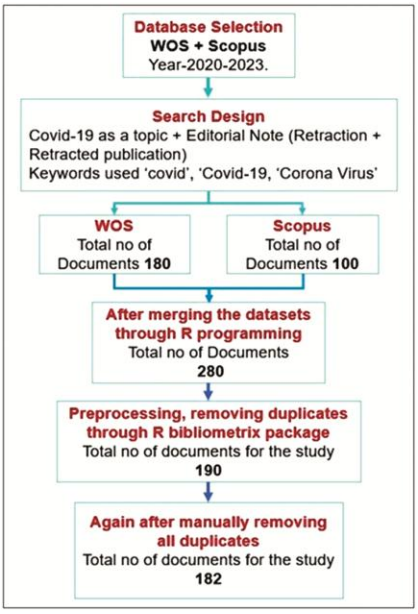
## Methodology and Objectives

The study aims to examine the number of COVID-19 research articles retracted and their reasons during 2020 – 2023. The data was retrieved from the Web of Science and Scopus; both are bibliographic and citation databases; on 5th July 2023;280 documents (WOS + Scopus) categorized as Correction/Retracted/ Withdrawn/Expression of Concern were downloaded. After pre processing and removing duplicates, 182 documents were used for the study. The data obtained for analysis consisted of '.bib' files, which were processed using the 'Biblioshiny' function within the 'Bibliometrix' package in R version 3.3.0. The authors used the Retraction Watch database (http://retractiondatabase.org/) to identify the reasons for the retracted articles. The URL of each retracted article was examined to find out the purpose for retraction. The articles categorized as "Withdrawn/ Expression of Concern" were also included in the study.

The various objectives framed for the study are: 1) To examine the reasons for retractions. 2) To investigate whoinitiated the retraction of articles. 3) To analyze the number of articles retracted from the top ten journals and their impact factor. 4) To analyze the citation count received by the retracted article. 5) To examine the major funding organizations.

## Literature Review

Elango (2021) identified retracted articles in the field of biomedical research co-authored by Indian researchers and also examined the characteristics of these retracted articles. The findings revealed that a significant portion of the biomedical articles were rescinded after 2010. The primary reasons for retractions were found to be plagiarism and data




falsification. Interestingly, there were no repeat offenders among the authors, and over 50% of the retracted publications resulted from collaborations with other academics at various universities. The study also highlighted that approximately 33% of the retracted publications were published in journals with no impact factor, while 25% were from the top 15 journals. Retractions resulting from fabricated data took the longest to address, with an average of 2.86 years from the initial publication to the retraction. Moreover, the research revealed that most retracted publications involving funded studies were attributed to fake data, whereas non-funded research retractions were mainly due to plagiarism. This study highlights the prevalence of retracted articles in the biomedical literature co-authored by Indian researchers and provides valuable insights into the reasons behind these retractions.

Hsiao & Schneider (2021) conducted a temporal analysis of 7,813 retracted papers indexed in PubMed. They collected 169,434 citations from iCite and 48,134 from the PubMed Central Open Access Subset. The study revealed that these publications continued to be mentioned in subsequent research despite being retracted, although citations to older retracted papers declined over time. Interestingly, the analysis of citation texts before and after retraction showed that the act of retraction had no discernible impact on how the researchers cited the retracted works. Only 722 (5.4%) of 13,252 post-retraction citation contexts referenced the retraction. The retracted articles in these instances were frequently

cited as related work or instances of subpar scientific inquiry.

On the other hand, Toma & Padureanu (2021) investigated data from 4,844 publications that were retracted between 2009 and 2020 and were found through a PubMed search. They observed that errors and inconsistent data accounted for 32% of all retractions, followed by imagery (22.5%), plagiarism (13.7%), and overlap (11.5%). The study attributed 94.79% of the 4,844 retractions to thirty countries, with China (32.78%) having the highest number of retractions, followed by the United States (18.84%) and India (7.25%). The impact of retracted research varied across countries, with higher impacts observed in Spain, Sweden, the United Kingdom, and the United States, and lower impacts in Pakistan, Turkey, Malaysia, and China. The reasons for retraction differed, with mistakes and data inconsistencies being the most common. However, while plagiarism and overlap continue to be major obstacles, the frequency of retractions owing to imagery and ethical concerns increased noticeably.

Ajiferuke & Adekannbi (2020) undertook a study evaluating the correction and retraction procedures in LIS journals from 1996 to 2016. During this time, they examined 517 revisions and 5 retractions published in LIS publications. The majority of article revisions were deemed to be minor.On the other hand, the grounds cited for retraction included plagiarism, replication, irreproducible findings, and procedural errors. The average time taken to retract an article was approximately 587 days, and interestingly, a few articles continued to be cited even after their retraction.

In another study, Coudert (2019), investigated retraction practices in Chemistry and Material Sciences during 2017-2018. The distribution of retractions worldwide was relatively similar, except for two countries, India and Iran, which had significantly higher retraction percentages. The primary reasons for retractions were related to misconduct, with plagiarism accounting for 42% of the retractions, followed by erroneous data with 27%. Frequent authorship issues were also addressed, particularly cases where papers were submitted without all authors' prior knowledge or permission, usually by aspiring co-authors.

Moylan & Kowalczuk (2016) also assessed the reasons behind article retractions from BioMed Central Journals. Their study covered the period from 2000 to 2015 and identified 134 retraction notices, accounting for 0.07% of all the articles published in BioMed Central. The percentage of retractions showed an increase over time. While the Committee on Publication Ethics (COPE) guidelines were strictly applied to all retractions, some notices failed to report the responsible authority (6%) and the precise cause, such as unintentional errors or negligence (11%). However, a significant portion of the notices (35%) provided appropriate information. The study found that most retractions (76%) occurred due to misconduct, followed by issues related to peer review (33%), plagiarism (16%), and false creation and representation of data (7%).

These studies shed light on the correction and retraction practices in different academic fields, highlighting the reasons behind retractions and the prevalence of specific types of misconduct leading to retraction.

## Results and Discussion

#### Initiation forretraction

A study by Vuong (2020)13 discussed that editors and publishers do not solely initiate the retraction of articles; sometimes, contributors, including authors, take the initiative. However, most retraction notices do not disclose the initiators, and approximately 15% of retractions were found to be initiated by the authors themselves. Vuong referred to these authors as "heroic souls" who, despite facing potential damage to their reputation, chose to retract their articles and provided reasons for removing their findings from the literature. This act was a commitment to correcting the scholarly record and maintaining its integrity.

According to the guidelines provided by COPE (Committee on Publication Ethics), the primary purpose of retractions is to rectify the literature and uphold its integrity rather than to punish authors (COPE Retraction guidelines)14.

Table 1 presents the distribution of retractions in scholarly articles. Among the 182 retracted articles, the majority of retractions (46) were initiated by the Editor-in-Chief, followed by joint retractions by the Editor-in-Chief and the publisher (23). Other retractions were initiated by authors, publishers, journals, or a combination of authors, editors, and publishers. Additionally, there were cases where the information about the initiator of the retraction was unavailable (56).

#### Reasons for retraction of the articles

Nair et al. (2019) conducted a study to investigate the reasons for article retractions and the retraction

rate in the field of anesthesia over the past 30 years. The research revealed that the most common reason for retraction was data fabrication or manipulation, accounting for 49.4% of cases. The second most prevalent cause was the lack of appropriate ethical approval, constituting 28% of retractions.

Mansourzadeh et al. (2021) investigated retracted publications in Iran, finding that authorship issues, plagiarism, and redundant publication were the primary reasons for retractions. Data falsification or manipulation accounted for 39.2% of the retractions, followed by ethical misconduct, including plagiarism (30.4%), and concerns about errors in data or methods (26.2%) (Brown, Bakker, and Theis-Mahon, 2022).

Wadgave and Khairnar (2022) reported that repetitive publishing (35%) was the most frequent cause of retraction, followed by plagiarism (30.1%) and data manipulation (32.2%), in their examination of dental literature published between April 1, 1993, and March 31, 2020.

Table 2 illustrates the factors that led to the retraction of articles. The retractions related to misconduct and authorship (N=95) encompassed 95 articles. These retractions were attributed to various issues, including inaccessibility of raw data for all authors, inability to verify data, honest errors, disputes over authorship contribution, coding errors, citation manipulation, and compromised peer review processes.

Errors in data analysis and conclusion (N=19) led to the retraction of 19 articles. The errors involved invalid

Table 1 — Initiation for retraction

| Sl. No | Retracted By | No. of Articles |
|---|---|---|
| 1 | Editor-in-Chief | 46 |
| 2 | Editor-in-Chief and the publisher | 23 |
| 3 | Withdrawn by Author | 21 |
| 4 | Publisher | 17 |
| 5 | Journal/publisher | 10 |
| 6 | Author, Editor and Publisher | 3 |
| 7 | Journal | 3 |
| 8 | Author, Editor and Journal | 1 |
| 9 | Editors-in-Chief and Author | 1 |
| 10 | Founding Editor | 1 |
| 11 | No Information | 56 |
| | Total | 182 |

Table 2 — Reasons for retraction of the articles

| **Sl. No** | **Reasons for Retraction** | **No. of articles** |
|---|---|---|
| 1 | **Issues relating to misconduct and authorship** | 95 |
| | Inaccessibility of the raw data to all the authors and unable to verify the data | |
| | Failed to disclose potential conflicts of interest/ Consent letter | |
| | Honest errors that invalidate the results | |
| | Authorship contribution has not been verified. | |
| | hypothesis is misleading. | |
| | Data analysis violated a data use agreement | |
| | Peer review process was compromised | |
| | Coding Error | |
| | Citation manipulation | |
| 2 | **Errors in data analysis and conclusion** | 19 |
| | Publisher error | |
| | Findings and conclusion of the study are doubtful | |
| | Invalid results reported | |
| 3 | **Duplicate publications** | 31 |
| | Duplicate publication | |
| | Plagiarismof text and Images | |
| 4 | **Other issues** | 10 |
| | Violation of journal policy | |
| | Inconsistency in the Supplementary Information files | |
| | Method used in this study is not appropriate for randomised clinical trials. | |
| | Concerns were raised on the terminology used in the results, | |
| | Overlap with a previously written, but not yet defended, PhD thesis | |
| | Testing accuracy for the method; Problem with classifier to predict the graph label | |
| | Study protocol violated | |
| | Inaccurate statements and personal opinions from social media | |
| 5 | **No information** | 27 |
| | Total | 182 |

reporting of results, doubts regarding findings and conclusions, and mistakes during the publishing process.

Duplicate Publication (N=31) resulted in the retraction of 31 articles due to the use of significant portions of text from previously published works without proper attribution and reuse of figures and tables without appropriate citation.

Other issues (N=10) led to the retraction of 10 articles, which were related to inappropriate reporting of conclusions and methodology, violation of journal policies, inconsistencies in Supplementary Information files, concerns about terminology used in results, discussions, and analysis, violations of study protocols, and overestimation of model classification accuracy.

In 27 cases, articles were retracted (N=27), but no specific information was provided regarding the reasons for the retractions.

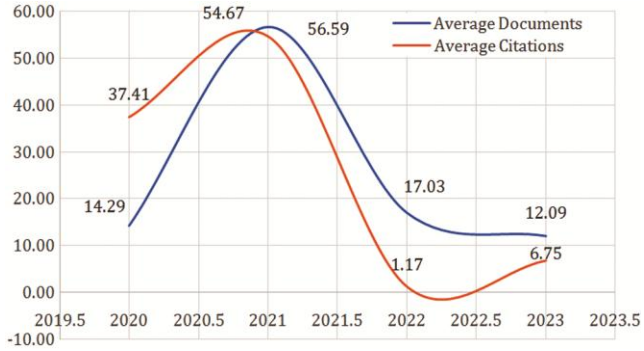



Fig. 1 — No. of DocumentsRetracted and Average Number of Citations over the year

**Source Information**

Figure 1 showcases the average document and Total Citations (TC) values for 2020-2023. Notably, there was a significant increase in 2021, followed by a substantial decrease in 2022 and a further reduction in 2023.

Figure 2 presents a multi-field plot displaying the top 15 affiliations (AU_UN) and countries (AU_CO) of authors involved in retracted articles. The analysis identified China, USA, Egypt, and UK as the countries with the highest number of leading authors. Notably, the top affiliation was the Chinese Academy of Medical Science and Peking Union Medical College, followed by Tanta University, Zhejiang University, and Zhejiang Gongshang University.

The Sankey diagram highlights that among the authors of retracted articles, 6 were affiliated with institutions in Egypt, 4 were from China, and 3 were from the USA.

**Countries of corresponding authors**

The Figure 3 given below depicts the countries of corresponding authors in retracted articles. It reveals that articles authored by individuals from China had the highest number of retractions, followed by the USA, India, and Egypt. On the other hand, authors from Australia, Brazil, and Canada conducted their research independently, resulting in single-country publications. These single-country publications are represented as individual bars on the graph. Additionally, the graph shows instances of collaborative research by authors from different

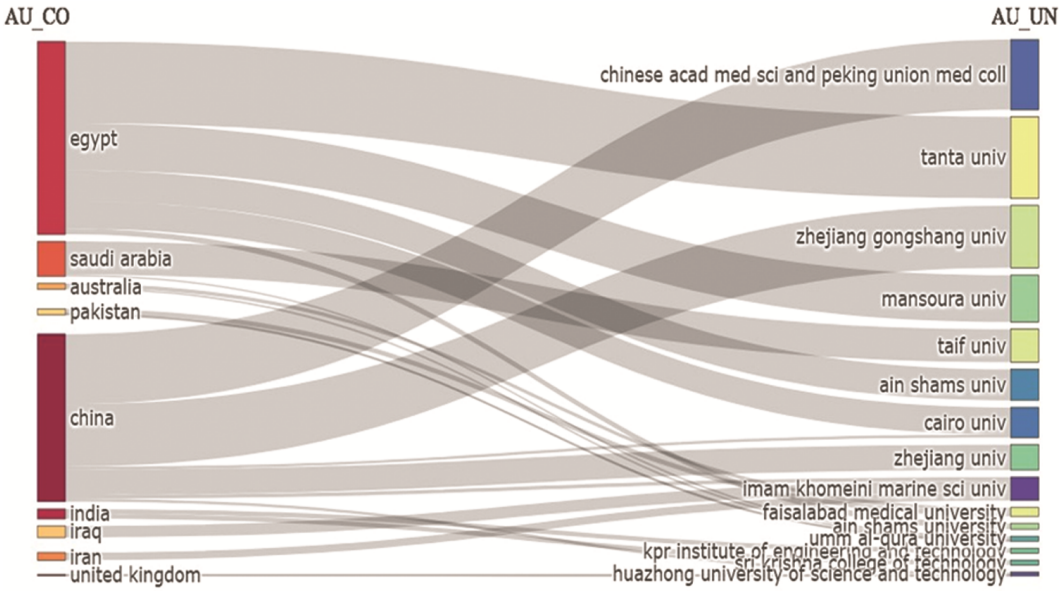



Fig. 2 — Snaky Diagram

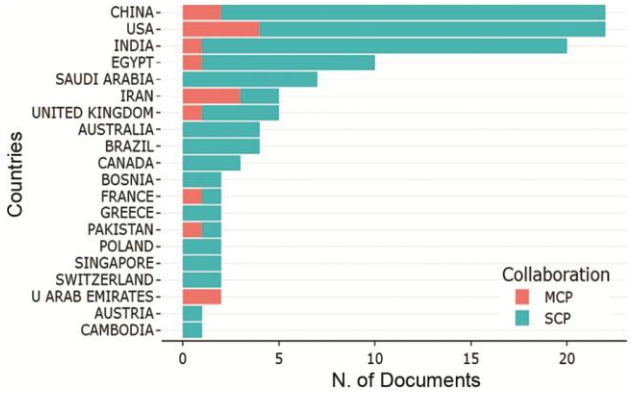



Fig. 3 — Top 20 countries of corresponding authors countries (MCP-Multi-Country Publications, SCP- Single Country Publications)

countries, termed as "MCP" (Multi-Country Publications). Notably, authors from China, USA, and India collaborated in several cases to contribute to MCP articles, which are shown as a distinct bar on the graph. The graph effectively highlights both single-country and multi-country publications, providing insights into the geographical distribution of retracted articles and collaboration patterns among authors.

Different colors represent different clusters of international connections. The strength of cooperation between two countries is illustrated by the size of the connecting lines. The names of countries have been set to lowercase by default and the Louvain cluster algorithm has been used.

Figure 4 reveals the existence of four distinct clusters of collaborating countries based on the corresponding authors. China, India and USA had a strong connection, as China and India had funded the highest number of studies (articles) which are retracted (Table 7).

**Impact factor of the journals which published retracted articles**

The impact factor is a valuable tool used to assess the standing of a journal and the quality of research it publishes. It measures the average number of citations received by papers in the journal during a given year. Clarivate Analytics assigns Impact Factors annually for various journals worldwide. (source: https://scientific-publishing.webshop. elsevier.com/ research-process/what-journal-impact-factor/). The retracted articles were published in 124 unique journals.

Table 3 presents the top 20 journals based on the number of articles published and their impact factors. The impact factor is an indicator of a journal's influence and significance within its field. Journals

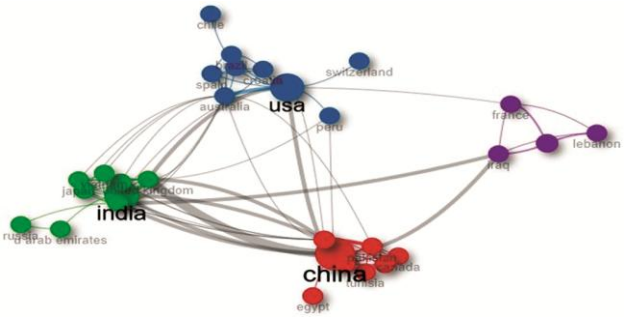



Fig. 4 — Collaboration among countries.

with higher impact factors are generally regarded as more prestigious. For instance, the journal "Soft Computing" holds the top spot with 15 articles and an impact factor of 4.1. Other noteworthy journals include "Scientific Reports" with an impact factor of 4.997 and "The Lancet" with an impressive impact factor of 168.9.

The "New England Journal of Medicine," with an impact factor of 176.082, is a highly esteemed medical journal published weekly by the Massachusetts Medical Society. Being one of the oldest and most prestigious medical journals, it had retracted two articles related to COVID-19. Interestingly, these retracted papers were also from high-impact factor journals.

A study by Cokol et al. (2007)19 found that low-quartile journals had retracted more articles compared to higher-quartile journals. Articles published in high-impact factor journals generally undergo a standard and rigorous peer-review process, making them more susceptible to retractions than those in low-impact factor journals or non-indexed journals.

It is worth noting that the higher retraction rate observed in high impact factor journals is not indicative of poor quality; instead, it reflects the precision of their peer-review processes (Gholampour et al., 2022). The impact factor serves as a crucial metric for evaluating journals, but it is essential to interpret retractions in the context of the journal's rigorous review process rather than assuming lower quality due to retraction rates in high-impact factor journals.

Figure 5 provides a count of articles divided into different sources to identify the most relevant journals in a specific knowledge domain. Bradford's Law divides citations into three zones and determines the core zone, where the highest number of citations is concentrated infewer journals. As we move from the core zone to zone 3, the number of journals required to obtain the same number of citations increases,

Table 3 — Top 20 journals and Impact factor of the journals

| Sl. No | Sources | Articles | Impact factor (IF) | Rank Quartile (JCR) |
|---|---|---|---|---|
| 1 | Soft Computing | 15 | 4.1 | Q2 |
| 2 | Journal Of Physics: Conference Series | 12 | 1.6 | Q4 |
| 3 | International Journal of Clinical Practice | 8 | 2.6 | Q3 |
| 4 | Scientific Reports | 8 | 4.6 | Q1 |
| 5 | Journal Of Investigative Medicine | 6 | 2.6 | Q2 |
| 6 | PLoS One | 7 | 3.7 | Q1 |
| 7 | Viruses- Basel | 4 | 4.7 | Q2 |
| 8 | American Journal of Health-System Pharmacy | 3 | 2.7 | Q3 |
| 9 | BMC Infectious Diseases | 3 | 3.7 | Q2 |
| 10 | Coatings | 3 | 3.4 | Q2 |
| 11 | Early Human Development | 3 | 2.5 | Q2 |
| 12 | Frontiers In Public Health | 3 | 5.2 | Q1 |
| 13 | The Lancet | 4 | 168.9 | Q1 |
| 14 | Vaccines | 3 | 7.8 | Q1 |
| 15 | American Journal of Tropical Medicine and Hygiene | 2 | 3.3 | Q1 |
| 16 | Archives of Virology | 2 | 2.7 | Q3 |
| 17 | Biological Psychiatry | 2 | 10.6 | Q1 |
| 18 | Education And Information Technologies | 2 | 5.5 | Q1 |
| 19 | Expert Review of Anti-Infective Therapy | 2 | 5.7 | Q2 |
| 20 | New England Journal of Medicine | 1 | 176.082 | Q1 |
| 21 | The Lancet Global health | 1 | 34.3 | Q1 |

**IF 2022*

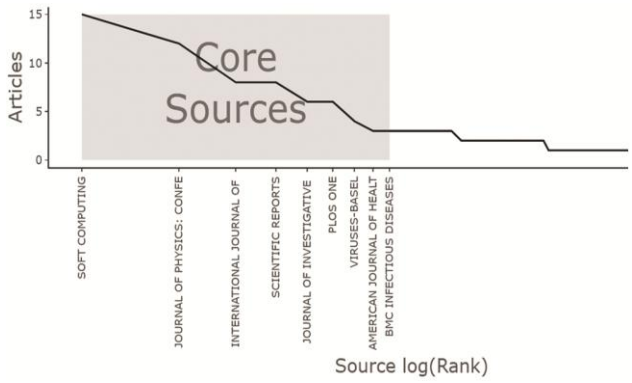



Fig. 5 — Bradford's Law plot.

indicating decreased productivity. By applying Bradford's Law, researchers can identify highly cited journals and categorize core journals based on citation patterns, as illustrated in Figure 4. The core zone, Zone 1, is composed of 9 articles which comprise two sources' articles and conference proceedings. Zone two comprises 39 articles and in zone three, there are 140 articles.

The most influential journals in terms of the three indexes—H-index, G-index, and M-index—are Soft Computing and Scientific Reports, as was already demonstrated in core zone 1 of the Bradford's Law plot. They are followed by the International Journal of Clinical Practice, Plos One, The Lancet, and New England Journal of Medicine as shown in Table 4.

**Citations for retracted publications**

Mansourzadeh et al. (2021)16 conducted a study on retracted Iranian papers indexed in the PubMed database. The findings revealed that these retracted publications had received a total of 789 citations, with an average of 11.6 citations per publication.

In another study by Brown, Bakker, and Theis-Mahon (2022)17, retracted papers in the field of pharmacy were investigated. Out of 1,396 retracted publications, 283 were cited 1,096 times in systematic reviews. This situation raises concerns as the inclusion of citations from retracted articles in published works can lead to unreliable and distorted inferences for readers, researchers, patients, and clinicians, as shown in Table 5.

Boll and, Grey, and Avenell (2022)21 highlighted the impact of continuously citing retracted papers over time. Although old retracted papers may no longer be cited, their previous inclusion in the literature can still influence subsequent works. The analysis of pre- and post-retraction citations indicated that the retracted papers continued to be cited without significant changes in how they were referenced. These retracted articles were often cited in relation to related work or as examples of hard science.

Table 4 — H, G, and M-index sources comparison

| Source | h_index | g_index | m_index | Total Citations | Number of Document | Year of Publication |
|---|---|---|---|---|---|---|
| Soft Computing | 7 | 13 | 2.333 | 171 | 15 | 2021 |
| Scientific Reports | 5 | 8 | 1.667 | 164 | 8 | 2021 |
| International Journal of Clinical Practice | 3 | 7 | 1 | 53 | 8 | 2021 |
| PloS One | 3 | 6 | 0.75 | 154 | 6 | 2020 |
| American Journal of Health-System Pharmacy | 2 | 3 | 0.667 | 9 | 3 | 2021 |
| BMC Infectious Diseases | 2 | 3 | 0.667 | 18 | 3 | 2021 |
| Coatings | 2 | 3 | 0.667 | 79 | 3 | 2021 |
| Early Human Development | 2 | 3 | 0.5 | 62 | 3 | 2020 |
| Frontiers In Public Health | 2 | 3 | 0.5 | 100 | 3 | 2020 |
| Journal Of Physics: Conference Series | 2 | 4 | 0.667 | 23 | 12 | 2021 |
| The Lancet | 2 | 3 | 0.5 | 2944 | 3 | 2020 |
| New England Journal of Medicine | 2 | 2 | 0.5 | 877 | 2 | 2020 |
| Thinking Skills and Creativity | 2 | 2 | 0.667 | 9 | 2 | 2021 |
| Viruses | 2 | 4 | 0.667 | 46 | 4 | 2021 |
| Aids Research and Human Retroviruses | 1 | 1 | 0.333 | 4 | 1 | 2021 |

Table 5 — Citations for retracted publications

| Title | Total Citations |
|---|---|
| 6-month Consequences of Covid19 in Patients Discharged from Hospital A Cohort Study Publication with Expression of Concern | 2135 |
| Cardiovascular Disease Drug Therapy and Mortality in Covid19 | 851 |
| Hydroxychloroquine or Chloroquine with or Without a Macrolide for Treatment of Covid19 a Multinational Registry | 809 |
| Deep Learning System to Screen Coronavirus Disease 2019 Pneumonia Retracted Article | 448 |
| Obesity And Mortality of Covid19 Meta-analysis | 246 |
| Mental Health Burden for The Public Affected by The Covid19 Outbreak in China Who Will Be theHighrisk Group | 168 |
| The Antivaccination Infodemic on social media A Behavioural Analysis | 141 |
| Chinese Mental Health Burden During the Covid19 Pandemic | 130 |
| Clinical Characteristics and Outcomes of Covid19 infected Cancer Patients A Systematic Review And Meta-analysis | 113 |
| Efficacy Of Favipiravir in Covid19 Treatment a Multicenter Randomized Study | 97 |
| Ai Techniques for Covid19 | 91 |
| Hydroxychloroquine In the Treatment of Covid19 a Multicenter Randomized Controlled Study | 89 |
| Utilizing Of Zinc Oxide Nanospray for Disinfection Against Sarscov-2 and Testing Its Biological | 66 |
| Effectiveness on Some Biochemical Parameters During Covid-19 Pandemiczno Nanoparticles Have Antiviral Activity Against Sarscov-2 | |
| Covid19 As an Infodemic in Public Health Critical Role of the social media | 65 |

Additionally, a study on retracted articles published on COVID-19 investigated the highest number of citations received. The title that received the highest number of citations (2135) was published by "The Lancet." Similarly, other titles published on COVID-19 also received a substantial number of citations.

Overall, the inclusion of citations from retracted articles poses challenges to the reliability and accuracy of research findings, making it crucial for researchers, publishers, and readers to be cautious about referencing retracted works in their studies.

**Publishers of the retracted articles**

Table 6 shows the top thirteen publishers with the highest retraction rate. Springer has published many retracted articles (33), whereas Elsevier has 26 publications. Shimray (2022)[22], in a study, revealed that Elsevier publishers have the highest retraction rate with 80 (50.96%), whereas Springer with 12 (7.64%). There was a total of 36 articles funded by various organizations; whereas 31 funded articles were retracted from top tier journals. Elsevier retracted 7 funded articles, similarly, Nature and MDPI retracted 6 and 4 articles, respectively. Low impact factor journal has retracted less funded articles.

**Retraction of funded research**

Retraction of published work might undermine the public's confidence in research and their determination to continue supporting it. Any

Table 6 — Top Publisher of the retracted articles

| Sl.No | Publisher | No. of Articles | No of Funded Articles |
|---|---|---|---|
| 1 | Springer | 33 | 3 |
| 2 | Elsevier | 26 | 7 |
| 3 | Wiley | 12 | 1 |
| 4 | Sage | 11 | 2 |
| 5 | MDPI | 11 | 4 |
| 6 | IOP Publishing Ltd | 11 | |
| 7 | Nature | 10 | 6 |
| 8 | Oxford University Press Inc | 7 | 1 |
| 9 | Public Library of Science | 7 | 2 |
| 10 | Frontiers Media S.A. | 7 | 2 |
| 11 | Taylor & Francis Inc | 6 | 1 |
| 12 | BMJ Publishing Group | 6 | |
| 13 | Biomed Central Ltd | 4 | 2 |

Table 7 — Retraction of funded research

| No of Funded Articles | Funding Countries | Major Funding Organizations |
|---|---|---|
| **14** | China | National Natural Science Foundation of China (funded by 6 articles); Boxin (Beijing) Biotechnology Development LTD; Clinical Pharmacy Innovation Research Institute of Shanghai |
| **5** | India | Bharathidasan University; Anna University; Ministry of Human Resources Development; Department of Science and Technology; Pulse Pharmaceuticals; Takeda Pharmaceutical Company |
| **5** | USA | University of California; National Institute of Neurological Disorders and Stroke, NINDS, Rainwater Charitable Foundation |
| **3** | Saudi Arabia | King Saud University; Taif University |
| **1** | Brazil | FIPE (Research and Events Incentive Fund) of Hospital de Clinicas de Porto Alegre |
| **1** | Iran | Clarkson University; Iran National Science Foundation |
| **1** | Sweden | Umea University; Lion's Cancer Research Foundation |
| **1** | Switzerland | NCCR Molecular Systems Engineering |
| **1** | Thailand | Thammasat University |
| **1** | UAE | Research Office of Zayed University; Al Ain University, |
| **1** | UK | American Spinal Injury Association, ASIA; European Commission, EC |
| **1** | Italy | Italian Ministry of Health |
| **1** | Japan | Innovative Science and Technology Initiative for Security |

retraction represents a significant waste of scientific resources frequently supported by funding (Fang & Casadevall (2011)[23]. Stern, et al. (2014)[24] revealed that the NIH spent less than 1% of its budget on retracted studies because of misconduct, or around $58 million, between 1992 and 2012.

Various organizations fund 36 retracted articles. Out of which, 14 were from China, followed by India (5), USA (5), Saudi Arabia (3). National Natural Science of China funded six articles, Department of Science and Technology and the Ministry of Human Resources Development, India also funded the articles. Mostly the funded retracted articles are published by a reputed publisher. Table 7 enumerates different funding organizations along with their respective countries.

**Findings**

The present study revealed that some publishers had not mentioned the reason for the retraction of the articles. It was found that the URL of the original article and the retracted notice differs, and some articles are watermarked to inform the readers about the retraction. Original articles and their links are not removed and the retracted notices are interlinked with the original articles to inform the readers. It was also observed that the Retraction Watch database does not index the retracted titles in case of missing reasons. Articles are withdrawn by the authors and in case of expression of concern, an investigation is carried out and if nothing is found amiss, the EOC is lifted. The retracted articles received high citations as the information is not widespread among the academic community.

**Recommendations**

Based on the study's findings, it is strongly recommended that the article be watermarked to draw the readers' attention. It was found that most of the

retracted articles were not marked and were easily accessible through the search engine. Christopher (2022)[25] shared in a study that Thirty-one percent of HTML articles and 14% of PDFs were available online but not marked as retracted. The URLs of the original article and the retraction notice are different, so sometimes readers miss the information about the retraction. Some retracted articles do not contain information regarding the initiation of the retraction request. Publishers need to ensure to mention the details in the retraction notice. The RISRS recommended creating a rigorous strategy to ensure prompt disclosure of an article's retraction. All parties involved must establish a nomenclature of retraction categories/classifications in relation to the retraction metadata. Best practices must be devised to conduct the retraction process quickly, fairly, and impartially (Schneider et al., 2022)[26]. The present study suggests the implementation of proactive measures to minimize the occurrence of retractions. Strengthening the peer review process is crucial, ensuring rigorous evaluation and scrutiny of research articles. Emphasis should be placed on promoting transparency in methodology and data-sharing practices. Additionally, fostering a culture of integrity and ethical conduct among researchers is essential. These measures collectively contribute to maintaining the credibility and reliability of published scientific literature.

## Conclusion

Society will be the ultimate target of misconduct in education and research as the flawed research findings generated by the scientific community serve as the basis for future research. Misconduct comprises erroneous practices like plagiarizing, fabricating, or falsifying data and manipulating images or pictures to substantiate their findings. Researchers often involve in misconduct while pursuing their research work worldwide. The academic community is also encountering the threat of gift and ghost authorship.

The retracted articles are still cited without indicating their present status. The quality of the citing article gets affected when a study refers to the retracted article and could distort the inferences (Szilagyi, 2022)[27].The study is confined to COVID-19 retracted articles and the findings suggest that there should be more clarity and consistency in the retraction process. It is observed that only a few retracted articles were watermarked, and in some files, even the reason for retraction is not mentioned.The reasons for retraction are significant for the readers so that they can avoid them in their publications. The study has contributed to the ongoing discourse on scientific integrity and the challenges the researchers face during times of crisis. It is imperative to learn from their instances and adhere to honest scientific practices to ensure that reliable and trustworthy information guides our understanding and response to global health emergencies of pandemics.

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