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## **The emergence of scholarly literature on physical/social distancing related to Coronavirus:**

### **A bibliometric analysis**

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**Authors' Contribution**

Nadeem Siddique conceptualized this article, drafted and composed the introduction, discussion, conclusion, and references, sections. Shakil Ahmad equally participated in the brainstorming of this article, provided resources, drafted the methods and results sections. Asif Altaf contributed to the methodology and results section. Abid Iqbal contributed to writing and reviewing the original draft. Khalid Mahmood provided mentorship and guidance, helped writing the introduction and discussion. Muhammad Ajmal Khan managed data retrieval and conducted data analysis.

**Significance for Public Health**

Physical or social distancing is essential to control the coronavirus spread as close contact with an infected person is the leading cause of the spread of disease. The scientific literature provides empirical evidence to practice physical distancing. The present study portrays the published scientific literature on physical distancing and consequently helps create awareness among the policymakers, institutions, and individuals to safeguard public health.

**Abstract**

**Introduction:** The world is witnessing new public health crises due to the emergence of the novel coronavirus. This study aims to present a bibliometric analysis of research on coronavirus-related physical/social distancing.

**Design/methodology/approach:** In this study, a bibliometric analysis was applied to see the research productivity and its impact on coronavirus-related physical/social distancing. For this purpose, Scopus was used to retrieve the data for the analysis. A total of 2900 records was downloaded from the database for analysis.

**Results:** The findings revealed that the top four authors published their research in the year 2020. The study ranked the British Medical Journal (BMJ) at the top position on publishing the

research on the topic. Similarly, the USA took the lead in all countries in producing research on the topic. The researchers preferred the document type ‘Article’ for sharing their research, and a single authorship pattern was dominated on all other patterns.

**Conclusions:** Plenty of bibliometric studies are available on coronavirus, but not a single study is found on coronavirus-related physical/social distancing. This study will be valuable in identifying different bibliometric dimensions on the topic.

**Keywords:** public health; research productivity, coronavirus, physical distancing, social distancing, quarantine, isolation

## **Introduction**

Since December 2019, the world is witnessing new public health crises with the emergence and instant human-to-human transmission of novel coronavirus <sup>1</sup>. The World Health Organization (WHO) was reported 29 pneumonia cases with unknown aetiology on December 31, 2020, in Wuhan city situated in Hubei province of China. The virus was recognized as a novel beta-coronavirus that is now officially declared as COVID-19 and the virus SARS-CoV-2 <sup>2</sup>. The spread of COVID-19 throughout China, neighboring countries, the USA, and Europe within a month gave a clear indication to the public health experts that the new virus was highly transmissible from one person to other. The Director-General of WHO declared the outbreak of coronavirus disease (COVID-19) as Public Health Emergency of International Concern <sup>2,3</sup>.

COVID-19 is the seventh member of the coronavirus family, which infected humans. Historically, all the coronaviruses, i.e., HCoV-229E, HCoV-OC43, SARS-CoV, HCoV-NL63, HCoV-HKU1, MERS-CoV, and SARS-CoV-2 (COVID-19), were discovered in 1966, 1967, 2003, 2004, 2005, 2012, and 2019 respectively. The human coronavirus HCoV-229E, HCoV-OC43, and HCoV-HKU1 were mild and self-limiting upper respiratory tract infections, but SARS-CoV, MERS-CoV, and SARS-CoV-2 have the capability of a severe acute respiratory syndrome, which can result in life-threatening disease <sup>4</sup>. Due to this outbreak, many public health officials received an involuntary shudder about severe acute respiratory syndrome (SARS), which also originated in China in 2002. In the past two decades, there have been two similar events in which the spread of animal betacoronavirus to humans has caused severe disease. In 2002-2003, the first occurred, known as severe acute respiratory syndrome coronavirus (SARS-

CoV), infected 8422 people and caused the death of 916 humans, mainly in China and Hongkong. The second event happened in Saudi Arabia, known as the Middle East respiratory syndrome coronavirus (MERS-CoV), affected 2494 people and took the life of 858 people. The virus COVID-19 is more infectious but has less fatality than its ancestors SARS-CoV and MERS-CoV. Inhalation or contact with infected droplets is considered the cause of transmission of the disease with required incubation periods ranging between 2 to 14 days <sup>1</sup>. The concerned authorities are thriving to prepare vaccination, treatment, and prevention but without any significant success so far <sup>5</sup>. The only globally established practice to control the transmission of the virus is to minimize human contact, and the public was advised to stay at home for this purpose <sup>2,6</sup>.

SARS was terrifying, but it was possible to control its transmission and now wholly eradicated. In the absence of the proper vaccination, it was achieved only by implementing public health measures. Now again, in the absence of therapeutics or vaccines, traditional public health measures have been adopted to restrict the epidemic. The main objectives of these classical public health measures are to thwart the transmission of this disease by separating people. In this prevailing situation, the popular strategies being used are social distancing, community containment, isolation, and quarantine. All these steps have been taken all over the world <sup>7</sup>.

In isolation, an infectious person with the illness is separated from healthy persons to protect such persons from the ill person with the contagious diseases, whereas quarantine is one of the most effective and oldest techniques to control the outbreak of transmissible disease and was used in the 14th century Italy <sup>8</sup>. The quarantine restricts the movement of the healthy person who may have been exposed to the virus due to contact with the infected people and separates them with the population to monitor symptoms and early detection of the presence of a virus <sup>9</sup>.

Social distancing has been effective in limiting the spread of COVID-19 worldwide, which involves maintaining the physical space of at least one meter from other persons around. However, it is helping in reducing the transmission of the virus. Still, it has created the misunderstanding that the term means to change the relationship with others or remain disconnected from family and friends. To avoid this misconception, WHO has started to use the term physical distancing instead of social distancing. The purpose is to emphasize maintaining only physical distance, and people can remain connected with their families and friends, which is essential for mental health and well-being. People can be connected with the help of technologies

like phone calls, video chat, and social media <sup>10</sup>. These are the same technologies that were once blamed for tearing society apart but are now most helpful to remain connected during this pandemic <sup>11</sup>.

The publishing of the genetic sequence of SARS-CoV-2 in January 2020 initiated unprecedented global R&D efforts to develop a vaccine to control the pandemic. Numerous researches have been conducted and published covering various aspects of vaccine development. To map the published research on COVID-19 vaccine development, a few bibliometric studies have also been published. Searching Embase.com and MEDLINE databases, <sup>12</sup> used the VOSviewer tool to explore the research published on the safety, efficacy, immunoinformatics, production, and delivery of the COVID-19 vaccine. Another similar bibliometric study <sup>13</sup> was carried out to analyze the research trends on the COVID-19 vaccine using the HistCite<sup>TM</sup> and VOSviewer tools.

Bibliometrics deal with the measurement regarding the productivity of scientific literature with their impact in terms of citation counts and becoming famous among almost all disciplines. It utilizes quantitative and statistical analysis to describe publication trends and patterns within a given field. Bibliometrics comprises four significant themes: productivity, subject area, collaboration, and citation impact <sup>14</sup>. Data yield by the bibliometric analysis possess a tremendous informative value and help provide a systematic comparison among researchers, scientific fields, organizations, countries, and regions <sup>15</sup>.

Evaluation and assessment play a key role in identifying the strength and weakness of any discipline by using quantitative techniques like bibliometrics that results in developing policies and making the right decisions <sup>16</sup>. Researchers are using bibliometric analysis in various fields of studies to monitor the trends and productivity of research in any area of study to frame the policies <sup>17</sup>. The bibliometric analysis produces the most prolific authors, organizations, and countries and identifies the research topics, which help in resetting the direction of funding and priorities for the policymakers <sup>18</sup>. Besides assisting the policymakers, it also guides the young researchers in identifying the focus of the research area by other researchers, research impact, and availability of funding on particular fields and reset their direction of future research <sup>19</sup>.

The review of available literature reveals that myriad bibliometric studies have been conducted on various disciplines, including COVID-19. Still, not a single bibliometric study has been

conducted on physical/social distancing related to COVID-19 that highlights the different parameters of bibliometric analysis. This study is, therefore, conducted to fill this gap.

### **Research Questions**

1. What are the publishing trends on coronavirus research related to physical/social distancing?
2. What are the most productive authors and institutions?
3. What is the year-wise comparison of research growth on coronavirus and physical/social distancing?
4. What are the authorship patterns of coronavirus researchers related to physical/social distancing?
5. What are the main themes and frequently used keywords in coronavirus research related to physical/social distancing?

### **Design and Methods**

The bibliometric analysis was applied to investigate the research productivity and its impact on coronavirus-related physical/social distancing. As one of the largest data sources, Scopus was used for the data retrieval for the study at Imam Abdulrahman Bin Faisal University (IAU), Dammam, Saudi Arabia, on February 6, 2021, to extract and import the bibliometric data. In the advance search field, the following query was executed:

```
(TITLE (coronavirus OR covid* OR ncov-* OR hcov-* OR sars-cov* OR "severe acute respiratory syndrome" OR mers-cov* OR "Middle East Respiratory Syndrome" OR "corona virus") AND TITLE ("Social distanc*" OR "physical distanc*" OR quarantin* OR "lock Down*" OR lockdown* OR "self isolat*" OR selfisolat* OR self-isolat* OR curfew* OR shutdown* OR "shut down*" OR self-quarantin*)) OR (AUTHKEY (coronavirus OR covid* OR ncov-* OR hcov-* OR sars-cov* OR "severe acute respiratory syndrome" OR mers-cov* OR "Middle East Respiratory Syndrome" OR "corona virus") AND AUTHKEY ("Social distanc*" OR "physical distanc*" OR quarantin* OR "lock Down*" OR lockdown* OR "self isolat*" OR selfisolat* OR self-isolat* OR curfew* OR shutdown* OR "shut down*" OR self-quarantin*)) AND NOT EID (2-s2.0-85097323520 OR 2-s2.0-85086656970 OR 2-s2.0-85097112315 OR 2-s2.0-850998969314883 OR 2-s2.0-85086544036).
```

The search query retrieved 4277 records initially. A document type filter was applied to restrict the results to peer-reviewed items only. After using the document type filter, the query retrieved 3616 records consisting of articles, reviews, conference papers, data papers, and book chapters. These records were downloaded in RIS, CSV, BIB format to use in Bibliographic and Visualization Software, i.e., Endnote, Biblioshiny, and VOS Viewer. The both RIS files were imported in Endnote software to remove duplicate records. The records were matched on the author, title, and year. Six (6) duplicate records were removed. Finally, a total of 3611 records were selected for analysis.

For maximum recall and precision purposes, the researchers applied the query in three different abstract databases, i.e., WoS, Scopus, and PubMed. The researchers selected related keywords that were being used in research studies related to the topic and its variant forms in the three major indexing and abstracting services.

## **Data analysis**

### **Most prolific authors and institutions**

The performance of the top 10 productive authors based on their publications and citations is shown in Table 1. The analysis of the most prominent researchers on coronavirus-related physical/social distancing indicated that the number of publications by these authors ranged from 6 to 11. The top researcher was Mahase, E, with 11 publications along with a total of 38 citations. The second most prolific author in terms of publication was Gayathri, R with 9 publications but he has zero citations, followed by sixth authors (Kavitha, S.; Le, H.T.; Mazza, C.; Roma, P.; Tully, M.A.; Vishnu Priya, V) with 7 publications each but Mazza, C. and Roma, P. had the highest citations 278 among all. Ausín, B. and Bragazzi, N.L was at last in terms of publications (6), but they had a different number of citations, 129 and 82. Table 2 depicts the data about the top ten most productive institutions with the total number of publications along with the total citations. Among all institutions, the University of Rome, Italy was in the first position with 51 publications, followed by Saveetha University, India, with 44 publications. University of Padova, Italy ranked at number three with 42 publications. University of Oxford, United Kingdom was on the last with only 34 publications. University of Rome, Italy, also got the maximum (664) number of citations, followed by the University of Padova, Italy (278) and



CNRS - French National Centre for Scientific Research, France (275), while the Saveetha University, India had the zero citations.

### **Year wise comparison of research growth on coronavirus and physical/social distancing**

Table 3 elaborates the year-wise overall publication trends on coronavirus, which started from 1968 until 2021. Results show that overall research on coronavirus grew years by year as it began from 1968 with only four publications, but since 2003 it was more than five hundred annually. However, the year 2020 got the maximum number (87164) of publications among all years, and it depicts that the pandemic increases the researchers' interest in coronavirus. Further analysis elaborates the data about year-wise publication trends on physical/social distancing related to coronavirus. The results show that before 2003, there was no concept of physical/social distancing related to coronavirus as there was no publication found before 2003 on coronavirus with physical/distancing.

Results show no significant growth in publications in all years except the year 2020, having 2904 publications when the pandemic burst and the phenomena of social distancing spread in overall society.

### **Authorship pattern**

Three authorship emerged as the top publishing trend with 543 publications (Table 2), followed by two authorship with 530, four authorship patterns had 488 publications, and single authorship pattern had 437 publications on their name and 414 publications contributed by more than ten authors in a single paper. Publications that got maximum citations (2390) were the contribution of two authorship patterns followed by three authorship, which had 2320 citations. Results also revealed that six publications had no author information available.

### **Most frequently used keywords**

The Word Cloud is generated through the 'Biblioshiny App' of 'Bibliometrix' software. In graphical parameters, author keywords were selected. The main advantage of selecting author keywords is that it provides insight into main topics and research trends. The size of the

keywords indicated the frequency of accuracies of that keyword. Figure 1 shows the visualization of the most frequently occurred author keywords.

### **Co-occurrence of author keywords**

The co-occurrence of author keywords depicted in Figure 2 was used to define groups for the full method of counting, which included co-occurrence from analysis types and author keywords from the analysis unit. A total of 20 author keywords occurrences were chosen as a minimum. There were 6828 author keywords in all, and 59 sources fulfilled the criteria. For each of the 59 sources, the total strength of the co-occurrence links with other keywords was measured. The authors' keywords with the highest total link strength were chosen.

### **Three factor analyses of major aspects of the data**

Figure 5 represents the three-factor analysis of the relationship among source (left), keywords (middle), and countries (right). It shows that ten countries (Italy, India, United States, China, United Kingdom, Spain, France, Germany, Brazil, and Canada) published Coronavirus and Physical/Social Distancing literature mostly using seven main keywords (COVID-19, lockdown, quarantine, pandemic, social distancing, coronavirus, SARS-CoV-2). These countries and keywords have a strong relationship with eight sources (Science of the Total Environment, Chaos, Solitons & Fractals, Sustainability (Switzerland), Frontiers in Public Health, Indian Journal of Forensic Medicine & Toxicology, Frontiers in Psychology, International Journal of Environmental Research and Public Health, and Frontiers in Psychiatry).

### **Discussion**

Bibliometrics provides a very useful analysis to reveal trends and progress in any research area. The current study aims to present different dimensions of coronavirus research concerning physical/social distancing, which include the most prolific authors, journals, and countries. The author Li Y, who was at the top among all the authors in contributing a number of publications on coronavirus related to physical/social distancing with the publications starting the year 2005. After Li, Y, WANG Y is another author who also produced 20 publications, but it is interesting to note that all the publications were published in the year 2020. Similarly, the other authors CHEN Y, ZHANG L, ZHANG X, and WANG L who also contributed all of their 15

publications each in the year 2020. It is evident from the findings that the topic received attention from the researchers in the year 2020 as compared to the previous years. Similarly, ZHANG L also obtained more citations than other contemporary researchers who even started writing on the topic earlier than ZHANG L.

The findings show that the British Medical Journal (BMJ) published all the research on the topic in the year 2020 and also stood at the first position among other journals. It may be due to that the journal received fewer citations as compare to other journals. Whereas, The Lancet started publishing on coronavirus with physical/social distancing in 2011 and stood second in the list but received more than 1000 citations. Hossain <sup>20</sup> conducted a bibliometric study on “Current Status of Global Research on Novel Coronavirus Disease (COVID-19)” without focusing on physical/social distancing, reported BMJ at the number sixth and Lancet at the 14th position in publishing research on COVID-19. Whereas, Dehghanbanadaki, Seif <sup>21</sup> reported BMJ Clinical Research Ed and The Lancet as equally top journals publishing research on coronavirus (COVID-19) only. Out of the top 20 journals, seven journals published the first research on the topic only in the year 2020. It can be inferred that the topic took the attention of researchers in the year 2020 due to the outbreak of the disease all over the world; otherwise, least attention was given to the topic.

Country-wise analysis of data shows that most of the research on the topic was originated from the USA, which was almost double that of China, the UK, and Italy. Although the recent outbreak was originated in China, most of the research was conducted in the USA. Laksham, Surulinathi <sup>22</sup> conducted a Scientometric study only on coronavirus and reported the USA as the most prolific country in producing research on coronavirus followed by Peoples R China, Netherland, and the UK. The bibliometric study by Dehghanbanadaki, Seif <sup>19</sup> on Coronavirus (COVID-19) ranked China as a top country producing literature on coronavirus, followed by the USA.

The analysis also provided the preferred format of communication by the researchers on the topic. The research was mostly published in the form of articles, followed by letters and reviews. In medical-related research, letters are considered very valuable and acknowledged. Articles, letters, and reviews with other similar document types are a swift way of sharing research with other colleagues. It may be the reason that only two books and 13 book chapters have been contributed so far on the topic with few citation counts. In their Scientometric study, Laksham,

Surulinathi<sup>22</sup> shared 17 forms of publication on coronavirus. Among these forms 'Article' was at the top position, followed by 'Review', 'Editorial Material', and 'Letter'.

The findings reveal the year-wise research growth of the topic, and the first publication on coronavirus with physical/social distancing appeared in 1979 with only one publication. After a gap of years, the researchers contributed over 1100 publications in the year 1991, and then again, a decline in the research was observed. Only one publication was found in the year 2002 with one citation, but suddenly an upward trend in the publications was observed in the year 2003, which contributed 75 publications with over 4000 citations. Again, the topic started losing the attention of the researchers until 2020, when publications were jumped over 2400 with a huge citation count. It is evident that the researchers had less focus on coronavirus in regard to physical/social distancing, but due to the world over the outburst of the disease, it became the focus of many researchers.

Further analysis of the research on coronavirus and physical/social distancing provides very interesting results. According to the analysis of retrieved data from Scopus, the first research came out on coronavirus in 1951 with a very slow rise in the quantity but gained an upward trend in the year 2003, and up to 2019, it remained around 1000 publications per year. But only in the year 2020, up to the data retrieval date, over 22000 research has been published. Here it is essential to mention that the literature review revealed the first appearance of coronavirus in the year 1966, but the search results with the query used in this study to retrieve data from the Scopus showed the first document on coronavirus in the year 1951. Therefore, to verify, the researchers checked all the search results before the year 1966. The researchers were surprised to find the term coronavirus only under the keywords. This could be a possible reason for the inclusion of all the articles before the year 1966. For further verification, the same query was tried on the Web of Science (WoS) database and retrieved zero results before the year 1966. Again, the same query was tried on the PubMed database, and 17 results were retrieved before 1966. On investigating all records before 1966, coronavirus was found under the MeSH terms only.

The further comparison between the coronavirus and physical/social distancing research shows that the first publication on coronavirus with physical/social distancing appeared in 1979 with only one publication. The topic did not receive any significant attention from the researchers, but again in the year 2020, more than 2400 research was published. Although the sole research on

the coronavirus conducted earlier but researchers felt significance of coronavirus research with physical/social distancing after many years, even though, due to the absence of any proper treatment and vaccination, physical/social distancing in the form of isolation and quarantine was considered the only remedy for the disease <sup>6</sup>.

The analysis regarding authorship patterns disclosed single authorship as most favourite for the researchers, which was followed by two and three authorship patterns. It was also observed that the research involving three authors received the highest citations, followed by research conducted by two authors. Laksham, Surulinathi <sup>22</sup> reported only 4.86 % of publications as single author whereas, remaining 95.17% as multiple authors. The data also indicate the absence of authorship in 44 publications for unknown reasons.

## **Conclusion**

The current study analysed the research on coronavirus-related physical/social distancing. The study unfolds the publishing trends, the most prolific authors, journals, authorship, and collaborative patterns. It also presents a year-wise comparison between research related to coronavirus and physical/social distancing. The findings ranked the author Li Y, at the first position among all other authors on coronavirus with physical/distancing along with WANG Y, who also produced the same number of publications but with fewer citations. The analysis also revealed that among the top 20 authors, four authors conducted all their research on the topic in the year 2020. The British Medical Journal (BMJ) secured the first position even though it published all the research on the topic in the current year 2020. The topic related to the current study got the attention of the researchers mostly in the year 2020 when the disease outburst all over the world because out of the top 20 journals, seven journals published the research only in the current year 2020. The USA was a leading country in publishing research on the topic. Among the document types, 'Article' was the most preferred way of sharing research with other colleagues. The single authorship pattern was dominated on the other collaborative patterns. The findings also revealed the year-wise comparison of research on coronavirus and physical distancing. There was no concept of research on coronavirus with a focus on physical/social distancing before 1979. The year 2020 was the most productive in producing research on coronavirus and physical/social distancing.

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**Table 1. Top 10 most productive authors and institutions with impact.**

Most Active Authors						Most Active Institutions				
Author	Affiliation	TP	TC	CP	NP	Institutions	TP	TC	CP	NP
Mahase, E	British Medical Journal (BMJ), UK	11	38	6	5	University of Rome, Rome, Italy	51	664	26	25
Gayathri, R.	Saveetha University, Chennai, India	9	0	0	9	Saveetha university, Chennai, India	44	0	0	44
Kavitha, S.	Saveetha University, Chennai, India	7	0	0	7	University of Padova, Italy	42	278	25	17
Le, H.T.	Institute for Preventive Medicine and Public Health, Vietnam	7	11	4	3	CNRS - French National Centre for Scientific Research, France	41	275	21	20
Mazza, C.	University "G. d'Annunzio", Chieti, Pescara, Italy	7	278	5	2	University College London, United Kingdom	34	232	19	15
Roma, P.	Sapienza University of Rome, Italy	7	278	5	2	University of Milan, Italy	37	208	19	18
Tully, M.A.	Ulster University, Belfast, United Kingdom	7	77	6	1	Inserm, France	34	102	16	18
Vishnu Priya, V	Saveetha University, Chennai, India	7	0	0	7	All India Institute of Medical Sciences, New Delhi, India	27	108	13	14
Ausín, B.	Complutense University of Madrid, Spain	6	129	4	2	University of Oxford, United Kingdom	24	215	21	7
Bragazzi, N.L.	York University, Toronto, ON, Canada,	6	82	4	2	London School of Hygiene and Tropical Medicine	19	4	23	869

TP= total publications; TC=total citations; CP= cited publications; NP= non-cited publications



**Table 2. Year-wise comparison of research growth on coronavirus and physical/social distancing.**

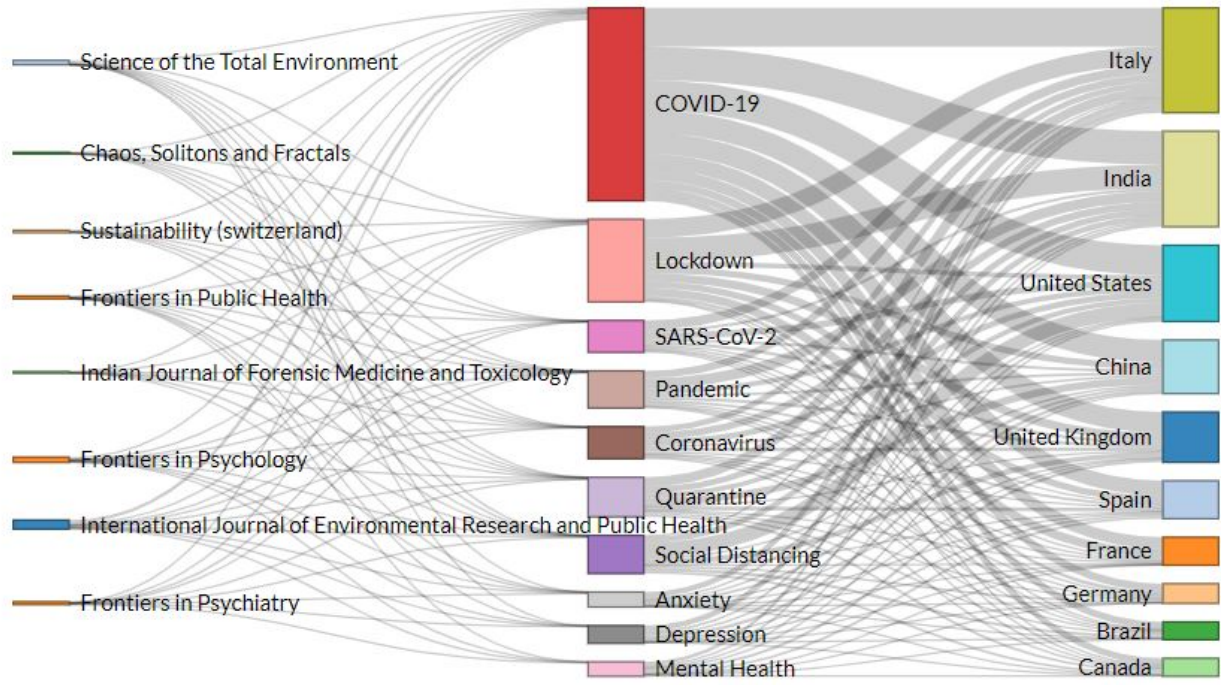
<b>Year</b>	<b>Total publications on coronavirus</b>	<b>Total publications on coronavirus related physical/social distancing</b>
2021	16473	675
2020	87164	2904
2019	480	2
2018	407	2
2017	439	1
2016	548	3
2015	530	2
2014	523	0
2013	444	0
2012	261	1
2011	238	0
2010	310	0
2009	330	0
2008	397	2
2007	447	1
2006	605	0
2005	786	4
2004	904	5
2003	833	9
1968-2002	2060	0

**Table 3. Authorship pattern.**

Authors	TP	TC	Impact:TC/TP
0	6	136	22.67
1	437	1247	2.85
2	530	2390	4.51
3	543	2320	4.27
4	488	2036	4.17
5	381	1960	5.14
6	291	1284	4.41
7	241	1492	6.19
8	147	875	5.95
9	133	526	3.95
$\geq 10$	414	3473	8.39







**Fig. 3:** Three-factor analysis of the relationship among source (left), keywords (middle), and countries (right)