Instant response to the novel virus: A bibliometric analysis of the incipient publications on COVID-19

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ABSTRACT
The emergence of the novel coronavirus disease 2019 (COVID-19) is a serious global public health problem. The mystery around the causative agent was revealed on 7 January 2020 when the pathogen was isolated by Chinese scientists and named as novel coronavirus-2019 (2019-nCoV). With quicker reaction to the contagion, the number of scholarly research publications have increased exponentially, which calls for bibliometric analysis and review of the incipient studies. Therefore on 7 Feb 2020, the English language and Chinese publications on COVID-19 were retrieved from PubMed and CNKI (China National Knowledge Infrastructure). A retrospective bibliometric analysis was performed to gauge the output, language, document type, journal, authorship, geographical distribution, research focus, resulting in a total of 154 papers comprising 100 papers in English and another 54 in Chinese. There were 30 journals published at least 2 papers, and the Journal of Medical Virology published the most papers (11). China and USA were the most productive countries, and there were 24 international collaborative papers. Fudan University contributed the most papers. Isaac I. Bogoch, Kunling Shen, Xingguang LI, Hongzhou Lu were the most active authors as first authors, with 2 papers respectively. Among the 154 publications, 35 were opinions papers, and 30 were research articles. Papers were categorized by research areas, and five research foci were identified. Our study offers an overview of the incipient publications and quantitative information for future research on coronavirus. Besides, Chinese publications were also retrieved for an integrated data analysis and diversity comparison.

Keywords: COVID-19; 2019-nCoV; SARS-CoV2; Coronavirus; Bibliometrics.

INTRODUCTION

In December 2019, there was a pneumonia outbreak of unknown etiology in Wuhan, the capital of Hubei province in China. Mystery around the causative agent was revealed on 7 January 2020 when the pathogen was isolated by Chinese scientists and named as novel coronavirus-2019 (2019-nCoV) (Jiang, Du and Shi 2020). Also, at the very outset of the plague, genome sequences of the new virus were confirmed and published, which took several months when SARS (Severe Acute Respiratory Syndromes) broke out in 2003 (Bonilla-Aldana et al. 2020). As the contagion developed rapidly, an increasing concern has

been aroused for 2019-nCoV; and the disease was renamed as COVID-19 by the World Health Organization (WHO) on 11 Feb 2020 (Battegay et al. 2020). More than one hundred scholarly articles have been published within the first month since the virus was announced. Until 7 Feb 2020, a total of 31,524 COVID-19 cases were reported, 31,264 of which were in China. Confronted with a pandemic emergency, the Chinese and global scientists have been engaged with studies on epidemiological (Tao 2020), virological (Li and Wenquan 2020), and clinical features (Technology 2020) of COVID-19.

With the technical advancement and lessons from former contagion, scientists have been more responsive to the plague, leading to an exponential increase in the number of scholarly publications. The quantitative information and hotspots of these early papers remains unclear, and so a bibliometric analysis for the new field is requisite. Furthermore, quick scientific response to the new virus promoted global health governance, which could reduce the damage of the plague, leading to an analysis of the incipient publications on COVID-19, which aims to know human's ability to fight against the new plague and provide objective guidance for the latter studies.

Since the pandemic outbroke this year, some scholars have investigated the global research trends of coronavirus over the last twenty years based on the production, hotspots to provide the global health system using bibliometric analysis (Zhou et al. 2020). What is more, there were some bibliometric studies that just focused on the COVID-19 to summarize the characteristics of the large scale of publications (Lou et al. 2020). Most studies agreed that China owned the highest number of publications, but the categories on research areas and hotspots were not completely identified. China, the first outbreak site of the contagion, has published considerable academic papers in both English and Chinese language. However, none of the previous bibliometric studies has included Chinese-language publications, which might result in incompleteness of information. Therefore, in this study, we investigated the literature growth of early studies on COVID-19, focusing on the publication channels and types, geographical distribution and authorship; as well as the research focus.

METHOD

PubMed is one of the biggest English database of biomedical literature, and CNKI (China National Knowledge Infrastructure) owns the widest coverage in Chinese literature (She et al. 2016). In the present study, English-language publications and Chinese publications on COVID-19 were both taken into account. On 7 February 2020, we performed a search in PubMed and CNKI respectively. The terms "2019-nCoV" or "coronavirus" or "novel pneumonia" were searched in "title/abstract" in PubMed. The terms "2019-nCoV" or "coronavirus [in Chinese]" or "novel pneumonia [in Chinese]" were searched in "topic" in CNKI. The publication date was limited from January 7 2020 to February 7 2020. Publications type of "News" or unrelated to COVID-19 were excluded.

The search query limited in 2020 retrieved 246 articles from PubMed, of which 12 news was excluded and 128 papers beyond the date limitation or unrelated with COVID-19 were removed. Thus, there were 106 publications from PubMed, including 6 Chinese ones with English title and 100 English-language ones. The search query applied in CNKI returned 48 articles that met the criteria. In total, we had 100 English-language articles and 54 Chinese articles for information extraction.

After the articles were retrieved and selected, the following publication data wereextracted: title, language, document type, source title (journal), authorship, geographical distribution, and research focus. The Journal Impact Factor (JIF) of English journals, where applicable, were acquired in the Journal Citation Report (JCR) 2018 science edition, while the Chinese journals indexed in CNKI do not have impact factors. All the papers were reviewed by two researchers independently to avoid bias, and divergence was solved by discussion.

RESULTS

The 154 papers were arranged in chronological sequence (Figure 1), and the earliest PubMed studies were published on Jan 14 2020, written in English. The first Chinese paper was written by *CHEN JIAYUAN* (Jiayuan et al. 2020), published on 21 January. The number of papers has risen since then, and the fastest growth rate occurred from 1 to 6 February 2020.

Publication Channels and Document Types

The retrieved articles were published in 76 journals, of which 30 journals owned at least 2 articles (Table 1), 21 in English language and nine (9) in Chinese. *Journal of Medical Virology* had the most articles (11), followed by *The Lancet* (9). *The New England Journal of Medicine,* and *Radiology* published seven (7) articles each. Two Chinese journals: *Journal of Traditional Chinese Medicine and Chinese Nursing Research* published six (6) articles each.

The 154 incipient publications were distributed in 17 document types (Table 2). The main fact to be observed is that they are most published as opinions (35) and research articles (30), the latter were accounted for one fifth of the publications. Editorials (23), review (12) and comment (11) together accounted for 30 percent of documents on COVID-19 incipient publications.

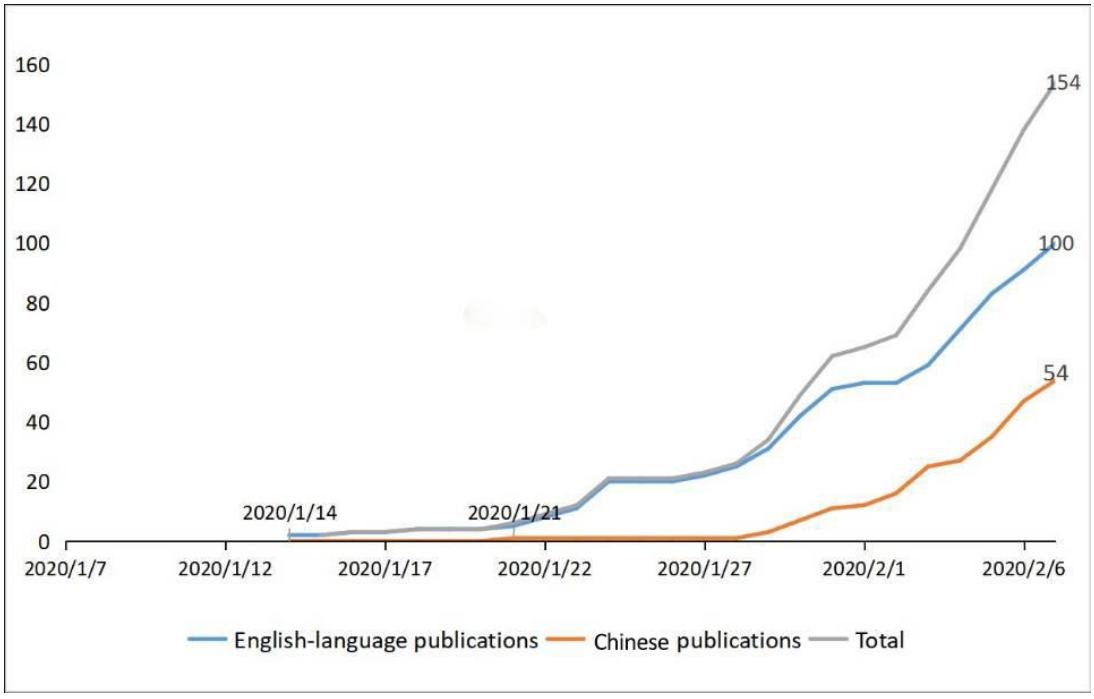

Figure 1: Publications on COVID-19 from January 7 2020 to February 7 2020 in Chronological Order

Table 1: Journals with at least Two (2) Incipient Publications on COVID-19

Journal Title	Number of Papers	Language	JCR IF (2018)
Journal of Medical Virology	11	English	2.049
The Lancet	9	English	59.102
The New England Journal of Medicine	7	English	70.670
Radiology	7	English	7.608
Journal of Traditional Chinese Medicine	6	Chinese	Not available
Chinese Nursing Research	6	Chinese	Not available
Nature	5	English	30.641
JAMA	4	English	51.273
Chinese Journal of Tuberlosis and Respiratory Disease	4	Chinese	Not available
Journal of Travel Medicine	3	English	4.155
Euro Surveill	3	English	7.421
Emerging Microbes & Infections	3	English	6.212
Travel Medicine and Infectious Disease	3	English	4.868
European Communicable Disease Bulletin	3	English	7.421
Herald of Medicine	3	Chinese	Not available
Chinese General Practice Nursing	3	Chinese	Not available
International Journal of Infectious Diseases	2	English	3.538
Journal of Hospital Infection	2	English	3.704
Viruses	2	English	3.811
Infection, Genetics and Evolution	2	English	2.611
Clinical Chemistry	2	English	6.891
Microbes and Infection	2	English	2.669
Communicable Diseases Intelligence	2	English	1.000
The Lancet. Psychiatry	2	English	18.329
World Journal of Pediatrics	2	English	1.169
Virologica Sinica	2	English	2.467
Chinese Journal of Evidence-Based Medicine	2	Chinese	Not available
Journal of Clinical Radiology	2	Chinese	Not available
Journal of Chinese Pediatrics	2	Chinese	Not available
Chinese Journal of Disinfection	2	Chinese	Not available

Table 2: Distribution of Different Document Types

Document Type	Number of Papers	Percent	Document Type	Number of Papers	Percent
Opinion	35	23%	Brief Report	4	3%
Research Article	30	19%	Short Communication	3	2%
Editorial	23	15%	Case Report	3	2%
Review	12	8%	Case Series	3	2%
Comment	11	7%	Mini-review	1	1%
Letter	8	5%	Communication	1	1%
Guideline	8	5%	Retrospective Cohort Study	1	1%
Rapid Communication	5	3%	Information Series	1	1%
Correspondence	5	3%			

Geographical Distribution and Authorship

Within the first month of the pandemic, at least 18 countries have contributed to the research on COVID-19 (Figure 2). China, where the pandemic broke out and spread widely, outnumbered other countries with 90 publications. This is expected considering that Chinese publications were included as the focus of the study, and the CNKI was also used as the data source. The USA took the second place, with a total of 13 publications. Other

countries produced relatively fewer publications. Out of the 154 publications, there were 24 international collaborative papers.

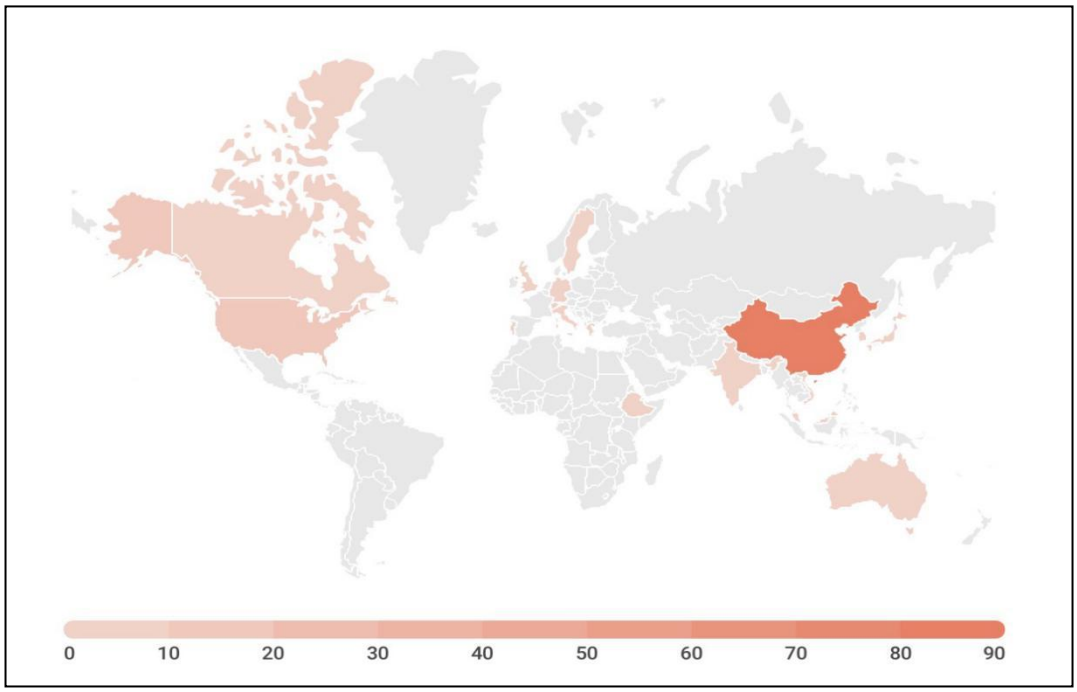

Figure 2: Geographical Distribution of Countries Where Papers Are Published

Table 3: Institutions Published at least 2 Publications

No	**Institution**	**Number of Papers**	**Country**
1	Fudan University	7	China
2	The University of Hong Kong	6	China
3	Wuhan University	6	China
4	West China Hospital, Sichuan University	6	China
5	Tongji Hospital, Huazhong University of Science and Technology	6	China
6	Union Hospital, Huazhong University of Science and Technology	5	China
7	Chinese University of Hong Kong	3	China
8	Zhongnan Hospital of Wuhan University	3	China
9	Chinese Center for Disease Control and Prevention	3	China
10	Toronto General Hospital	2	Canada
11	Renmin Hospital of Wuhan University	2	China
12	European Centre for Disease Prevention and Control	2	Sweden
13	the Shandong First Medical University	2	China
14	China-Japan Friendship Hospital	2	China
15	Universidad Tecnológica de Pereira	2	Colombia
16	Chinese Academy of Sciences, Wuhan	2	China
17	Beijing Institute of Pharmacology and Toxicology	2	China
18	Beijing Children's Hospital	2	China
19	Beijing Hospital of Traditional Chinese Medicine, Capital Medical University	2	China

The institutions that published at least two (2) papers, comprising universities, hospitals and Centre for Disease Prevention and Control, is presented in Table 3, listing a total of 19; one (1) from Colombia, Canada, Sweden respectively and the rest (16) from China. Fudan University accounted for the most papers (7), followed by the University of Hong Kong, Wuhan University, West China Hospital, Sichuan University, Tongji Hospital, and Huazhong University of Science and Technology, with six (6) publications respectively.

The authors who contributed more than one (1) articles as first author that denotes the person who contributed most to the work, were especially remarked (Table 4). *ISAAC I. BOGOCH* from Canada*, KUNLING SHEN, XINGGUANG LI,* and *HONGZHOU LU,* all three from China, were the most productive first authors in the initial stage, with two (2) articles published respectively.

Table 4: Authors contributed at least 2 studies as 1st author

1st Authors	Number of papers	Affiliation	Country
Isaac I. Bogoch	2	University of Toronto, University Health Network	Canada
Kunling Shen	2	China National Clinical Research Center for Respiratory Diseases, Beijing Children's Hospital, National Center for Children's Health	China
Xingguang LI	2	Wuhan University of Bioengineering	China
Hongzhou Lu	2	Fudan Univeristy Shanghai School of Medicine	China

Research Focus

After reviewing the keywords, abstracts and texts of the 154 articles, 5 research foci were summarized based on their research areas and categorized by document type. Papers on “public health governance” composed the largest proportion (56), followed by those on “clinical features and diagnosis and treatment” (55). “Epidemiology and transmission” papers were ranked third (18), while papers on “basic research for virus and medicine”(15) and “origin and evolution of 2019-nCoV”(10) were numerically small in number (Table 5). Opinion document type accounted the most for papers on “public health governance” and “clinical features and diagnosis and treatment”. On the topic of “public health governance”, comments (9) were ranked after opinions (16) and editorials (16). Reviews (7), research articles (7) and guidelines (6) followed opinions (17) in the “clinical features and diagnosis and treatment” papers. As for the other three research foci (epidemiology and transmission, basic research for virus and medicine, and origin and evolution of 2019-nCoV), research articles took the first place, followed by communications, opinions and reviews.

DISCUSSIONS

The findings of this study leads to the following important discussions. As the newly announced disease spread beyond national borders, the WHO declared the public health emergency of international concern (PHEIC) on 30 Jan 2020 (Lewis 2020). Faced with the pandemic threat to global health, the global scientific community has given a rapid response to the emerging virus infected disease at the very outset. Timely scientific information sharing facilitates the containment of transmission and the prevention against diseases caused by similar pathogen (Heymann 2020). Since one week after the

identification of the novel organism, there has been an expanding scale of publications, which keep updating the scholarly view in this infectious disease field. Quantitative information of the scientific papers at the primary stage of the field needs to be gathered by the means of bibliometric analysis.

Among the articles published from 7 January 2020 to 7 February 2020, those written in the English language were issued at least one week earlier than the Chinese. A total of 154 articles came from at least 18 countries, most were written in English for international communication and published in prestigious journals. Some of the top journals with relatively high JIF - *The New England Journal of Medicine, Nature, The Lancet,* and *JAMA* - have issued at least 25 incipient papers concerning COVID-19 in total. However, it is learnt that although Chinese scientists are encouraged to publish their articles in foreign journals, 54 incipient papers on COVID-19 written by the Chinese found their home in home-grown journals. This indicates that the growth in Chinese authored publications is also driven by publication in non-impact factored journals. A plausible explanation may be that, faced with imminent requirement of health care for patients, there seems to be a divide between clinical research and clinical practice. However, the lesson learnt from the outbreak of COVID-19 is that clinical, epidemiological, virological studies could save lives by improving diagnosis, and treatment measures and guiding governments' responses, and the publication of these studies is essential regardless of the journal impact.

Table 5: Research Focus of the Incipient Publications on COVID-19

Research focus (Total Number of Papers)	Document type	Number of Papers
public health governance (56)	Opinion	16
	Editorial	16
	Comment	9
	Letter	5
	Research Article	4
	Others	6
clinical features and diagnosis and treatment (55)	Opinion	17
	Review	7
	Research Article	7
	Guideline	6
	Brief Report	3
	Case Report	3
	Editorial	3
	Others	9
epidemiology and transmission (18)	Research Article	6
	Rapid Communication	5
	Editorial	3
	Others	4
basic research for virus and medicine (15)	Research Article	7
	Opinion	2
	Review	2
	Others	4
origin and evolution of 2019-nCoV (10)	Research Article	6
	Short Communication	2
	Others	2

As for country, China has contributed 58.4 percent of all papers, predominantly because it was the earliest outbreak site burdened by the contagion and we included the Chinese language publications for analysis. USA, ranked second, also had reason for high productivity: it is the country of the first rank in coronavirus research (Horton 2020). Furthermore, international authorship accounted for 15.6 percent, demonstrating collaboration among countries did work, which should not be overlooked in the face of global emergency. Among the 19 institutions which owned at least two (2) papers, six (6) were located in Wuhan, China. Three of four most productive authors came from China. Except for *KUNLING SHEN*, who is working for the China National Clinical Research Center for Respiratory Diseases, as well as the hospital, the other authors were affiliated to universities.

There were a wide variety of document types, mainly composed of opinions, research articles and editorials. Among the 35 opinions, 29 were published in Chinese language, providing suggestions for the management of hospital departments and primary communities during the epidemic situation, and some unique Chinese medicine opinions and treatments on COVID-19 (Chen et al. 2020; Zheng, Zhang and Guang 2020; Zhifang and Ling 2020). Traditional Chinese medicine has been widely used in combination treatment for the disease, such as“*Lianghuaqingwen*”, which was also effective against SARS (Yao et al. 2020).

We identified the papers based on five research topics to know how the attention was put on the research areas. Papers concerning public health management and clinical research have been published the most in COVID-19 early papers, suggesting the urgent practical need in these two aspects. Opinions, editorials and comments occupied the majority of publications on “public health governance”, arousing scientists and the masses to take action against the disease. The necessity of public education campaigns, health policy guidance and international cooperation were mentioned in public health articles (Phelan, Katz and Gostin 2020). Given the apparent human-to-human transmission characteristics, prevention and isolation need to be headed (Perlman 2020). Facing the huge pandemic threat, the Chinese government has implemented strict public health policy and redistributed the medical resources (Wang et al. 2020): Masks and other medical materials were supplied to Hubei province first, and elite medical teams from the other provinces of China served in Wuhan and surrounding cities. When it comes to clinical research, early diagnosis and timely treatment can reduce the possibility of severe illness and death (Wang et al. 2020; Chen et al. 2020). However, research articles in this area were only ranked third, after opinions and reviews, probably because research requires more time to conduct. Papers on “epidemiology and transmission”, “basic research for virus and medicine” and “origin and evolution of 2019-nCoV” were mainly in the type of research article, and progress on these research areas was more dependent on basic research and rigorous verification. Scientists nowadays were in favor of serological assays research for more rapid diagnosis and less stringent specimen restrictions (Xiao, Wu and Liu 2020). As for drugs, there were no specific medical choices yet, and patients were performed symptomatic treatment learnt from SARS and other viruses infections (Wang et al. 2020; Lu 2020). However, remdesivir and chloroquine were regarded as promising drugs for the new virus due to their effectiveness in vitro and former safety track record in human (Wang et al. 2020). Origin and transmission of the novel pathogen needed further identification, which were conducive to containment of the disease. *P ZHOU* (Zhou et al. 2020) reported bats could be the potential reservoir host, but the zoonotic transmission patterns have not yet been defined. SARS CoV and MERS CoV (Middle East respiratory syndrome CoV), originated from bats, infected human from palm civet and dromedary camel respectively, giving the

world an alert that keeps the wild animals at a distance (Chan et al. 2015; Cheng et al. 2007).

With 75-80 percent consistency in gene, respiratory symptoms and other similarity with SARS CoV, the virus was officially named as SARS-CoV2 by the CSG (Coronavirus Study Group of the International Committee on Taxonomy of Viruses) (Gorbalenya et al. 2020). Coronaviruses were announced in the annual review of the Blueprint list of priority diseases in 2018, since they have caused massive spread for several times and put global health at risk. From SARS to COVID-19, the human race is still vulnerable to global pandemics, but the response and reaction of the scientific community towards infectious diseases has improved. In 2003, it took several months to issue the first academic paper on SARS, which had postponed the crucial knowledge sharing. As science, technology and medicine advanced, pandemics could be constrained earlier and mortality rates better controlled (Chahrour et al.2020). However, there is still no valid vaccine for prevention and finite antivirus treatment available, indicating an urgent need to convert previous scientific fruits into effective measures (Bonilla-Aldana et al.2020).

CONCLUSION

In this study, a range of bibliometric parameters were extracted from the early publications on COVID-19. Chinese and English language publications were included for a complete analysis and diversity comparison. There has been an exponential increase in number of publications within the first month, publications in English accounted the majority with some high impact-factored journals paying attention to the pandemic. China, first hit by the plague, with much practical experience, played a leading role in incipient publications on COVID-19, having 16 Chinese institutions producting at least two (2) papers each. Three out of four most active authors, producing at least two (2) papers each were from China. Due to the domestic and global attention, instant response was given to the novel virus in the early stage, and our study offers an overview of the incipient publications and quantitative information for future research. However, there are some limitations: Chinese journals lacked some information such as JIFs and only PubMed and CNKI were used for this study, thus we might have missed some important papers or crucial information.

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AUTHOR CONTRIBUTION

RL and PJ contributed equally to this work. RL and MY conceived and design the study. RO and YW developed and conducted the initial literature search and data extraction. RL, PJ worked collaboratively to several draft and revise the manuscript. All the authors made substantive intellectual contributions to the research and approved the final version.

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