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Bibliometric analysis of Severe Acute Respiratory Syndrome-related research in the beginning stage

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Severe Acute Respiratory Syndrome (SARS) has become the major of health issues since its outbreak early 2003. No analyses by bibliometric technique that have examined this topic exist in the literature. The objective of this study is to conduct a bibliometric analysis of all SARS-related publications in *Science Citation Index* (SCI) in the early stage. A systematic search was performed using the SCI for publications since SARS outbreak early 2003. Selected documents included 'severe acute respiratory syndrome' or 'SARS' as a part of its title, abstract, or keyword from the beginning stage of SARS outbreak, March till July 8, 2003. Analysis parameters included authorship, patterns of international collaboration, journals, language, document type, research institutional address, times cited, and reprint address. Citation analysis was mainly based on impact factor as defined by *Journal Citation Reports* (JCR) issued in 2002 and on the actual citation impact (ACI), which has been used to assess the impact relative to the whole field and has been defined as the ratio between individual citation per publication value and the total citation per publication value. Thirty-two percent of total share was published as news features, 25% as editorial materials, 22% as articles, 13% as letters, and the remaining being biographic items, corrections, meeting abstracts, and reprints. The US dominated the production by 30% of the total share followed closely by Hong Kong with 24%. Sixty-three percent of publication was published by the mainstream countries. The SARS publication pattern in the past few months suggests immediate citation, low collaboration rate, and English and mainstream country domination in production. We observed no associations of research indexes with the number of cases.

Introduction

Infectious diseases have always been a threat to humans, especially when social conditions were continuously changing. Well-known epidemics such as the bubonic plague, AIDS, the Ebola virus in the 1980s, the influenza pandemic of 1918, and presently, the Severe Acute Respiratory Syndrome (SARS) has seriously affected us.[1] SARS was first identified in February 2003 by an Italian expert, Carlo Urbani and his early work to detect SARS has heightened the global surveillance level and made many

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new cases identified.[2] SARS broke out rapidly and seriously affected life in Hong Kong, Singapore, Toronto, Taiwan, and various regions of China since early March 2003. From November 1st 2002 to June 6th 2003, there were 8,404 SARS cases with 779 deaths and with 5,937 being recovered.[3] The technique to sequence SARS virus was completed in mid April 2003 to make future development of drugs and vaccines possible.

The defensive move the human will take against this disease can only be established among scientists with sufficient communications. The most common mean is through publication.[4] Garfield in 1970 also observed that a recent research focus can be reflected on its publication output.[5] Hence, a dramatic increase of SARS-related publications would be expected shortly after the outbreak. This study was intended to analyze significant SARS publication patterns, especially in international collaboration and authors' country of origin in the beginning stage of SARS outbreak.

Materials and methods

Publications used in this analysis were extracted from the *Science Citation Index* (SCI) established by the Institute of Scientific Information (ISI), in Philadelphia, the United States. Selected documents included 'severe acute respiratory syndrome' or 'SARS' as a part of its title, abstract, or keyword from March till the update of July 8, 2003. Then, we checked the search result to make sure that all entries were related to the SARS topic. Analysis parameters include authorship, patterns of international collaboration, journals, language, document type, research institutional address, times cited, and reprint address. Citation analysis was partly based on Journal Impact Factors, as defined by *Journal Citation Report* (JCR) for the journals actually published the SARS articles (Table 1) partly on the number of citations received per publication during the period studied in 2003, and relative to the average citation impact of the SARS publications covering the same period (Table 2). The average citation impact, corresponding to a kind of Immediacy Index for SARS, 2003, was 0.735 citations per published article with research institutional address (97 cit./132 publ.), January-July, 2003.

Results and discussion

Six papers were published in March, 45 in April, 132 in May, 68 in June and 2 in July as of July 8th. Total production was 256 papers by 38 countries with 48% being absent in recorded address. Thirty-two percent of total share was published as news features, 25% as editorial materials, 22% as articles, 13% as letters, and the remaining being biographic items, corrections, meeting abstracts, and reprints.

Table 1. Publication, impact factor, and country distribution of journals

Journal	IF	Journal Country	P	%P
Lancet Infectious Diseases	–	–	5	1.95
Lancet Oncology	–	–	1	0.391
New England Journal of Medicine	31.736	USA	15	5.86
Nature	30.432	UK	13	5.08
Nature Medicine	28.74	USA	2	0.781
Science	26.682	USA	18	7.03
JAMA-Journal of the American Medical Association	16.586	USA	21	8.20
Lancet	15.397	UK	43	16.8
Journal of Clinical Investigation	14.051	USA	1	0.391
Gastroenterology	13.44	USA	1	0.391
British Medical Journal	7.585	UK	30	11.7
Current Biology	7.007	USA	1	0.391
Faseb Journal	7.252	USA	1	0.391
Molecular Therapy	6.275	USA	1	0.391
Clinical Chemistry	4.788	USA	2	0.781
Emerging Infectious Diseases	4.757	USA	2	0.781
Journal of Nuclear Medicine	4.587	USA	1	0.391
Journal of Medicinal Chemistry	4.566	USA	1	0.391
Clinical Infectious Diseases	4.75	USA	4	1.56
Journal of Urology	3.03	USA	1	0.391
European Respiratory Journal	2.931	Denmark	1	0.391
Canadian Medical Association Journal	3.22	Canada	17	6.64
Radiation Research	2.768	USA	2	0.781
Journal of Applied Physiology	2.72	USA	1	0.391
Bulletin of the World Health Organization	2.694	Switzerland	3	1.17
Scientific American	2.456	USA	1	0.391
British Journal of Anaesthesia	2.098	UK	1	0.391
Bioorganic & Medicinal Chemistry Letters	2.051	UK	2	0.781
Bioorganic & Medicinal Chemistry	2.043	USA	1	0.391
American Journal of Roentgenology	2.424	USA	2	0.781
Journal of Biogeography	1.788	UK	1	0.391
International Journal of Tuberculosis and Lung Disease	1.888	France	1	0.391
Medical Journal of Australia	1.673	Australia	4	1.56
Marine Biology	1.672	Germany	1	0.391

Table 1. continued

Journal	IF	Journal Country	P	%P
Journal of the American Statistical Association	1.669	USA	1	0.391
British Journal of General Practice	1.593	UK	3	1.17
Journal of the American Veterinary Medical Association	1.25	USA	1	0.391
Clinical Radiology	1.048	UK	1	0.391
Medicina Clinica	0.854	Spain	2	0.781
Cleveland Clinic Journal of Medicine	0.722	USA	1	0.391
Journal of Crustacean Biology	0.724	USA	1	0.391
Journal of Small Animal Practice	0.704	UK	1	0.391
International Journal of Surgical Pathology	0.663	USA	1	0.391
Deutsche Medizinische Wochenschrift	0.651	Germany	3	1.17
Journal of Biosciences	0.606	India	1	0.391
Chinese Science Bulletin	0.57	Peoples R China	1	0.391
Chemical & Engineering News	0.465	USA	6	2.34
Chemistry & Industry	0.461	UK	3	1.17
New Scientist	0.277	USA	6	2.34
Organisms Diversity & Evolution	0.45	Germany	1	0.391
Infections in Medicine	0.298	USA	1	0.391
Physician and Sportsmedicine	0.492	USA	1	0.391
Presse Medicale	0.395	France	1	0.391
Scientist	0.365	USA	1	0.391
Saudi Medical Journal	0.301	Saudi Arabia	1	0.391
Laboratory Medicine	0.259	USA	1	0.391
American Journal of Nursing	0.242	USA	3	1.17
Geriatric Nursing	0.168	USA	1	0.391
Natural History	0.157	USA	1	0.391
Genetic Engineering News	0.114	USA	3	1.17
Aviation Week & Space Technology	0.023	USA	4	1.56
Professional Engineering	0.04	UK	1	0.391
Veterinary Economics	0.025	USA	1	0.391
E&MJ-Engineering and Mining Journal	0.011	USA	1	0.391

IF: Impact factor, P: Publication, %P: Percentage of publication

Table 2. Publication, citation, and case number distribution among origin of countries

Country	Cases	% Cases	P	%P	C	%C	ACI
USA	68	0.809	39	29.5	12	12.4	0.419
Hong Kong	1750	20.8	32	24.2	64	66.0	2.72
Canada	219	2.61	22	16.7	18	18.6	1.11
UK	4	0.0476	15	11.4	5	5.15	0.454
Singapore	206	2.45	12	9.09	11	11.3	1.25
Germany	10	0.119	11	8.33	9	9.28	1.11
Taiwan	676	8.04	6	4.55	8	8.25	1.81
Switzerland	1	0.0119	5	3.79	0	0	0
Spain	1	0.0119	4	3.03	0	0	0
Netherlands	0	0	3	2.27	10	10.3	4.54
Thailand	8	0.0952	3	2.27	7	7.22	3.18
Vietnam	63	0.750	3	2.27	7	7.22	3.18
France	7	0.0833	2	1.52	5	5.15	3.40
India	3	0.0357	2	1.52	0	0	0
Australia	5	0.0595	2	1.52	0	0	0
Belgium	0	0	1	0.758	0	0	0
Mexico	0	0	1	0.758	0	0	0
Norway	0	0	1	0.758	0	0	0
Saudi Arabia	0	0	1	0.758	0	0	0
Senegal	0	0	1	0.758	0	0	0
South Africa	1	0.0119	1	0.758	0	0	0
Malaysia	5	0.0595	1	0.758	0	0	0
Peoples Rep. China	5329	63.4	1	0.758	0	0	0
Colombia	1	0.0119	0	0	0	0	-
Finland	1	0.0119	0	0	0	0	-
Kuwait	1	0.0119	0	0	0	0	-
Macao	1	0.0119	0	0	0	0	-
New Zealand	1	0.0119	0	0	0	0	-
Republic of Ireland	1	0.0119	0	0	0	0	-
Romania	1	0.0119	0	0	0	0	-
Russian Federation	1	0.0119	0	0	0	0	-
Brazil	2	0.0238	0	0	0	0	-
Indonesia	2	0.0238	0	0	0	0	-
Republic of Korea	3	0.0357	0	0	0	0	-
Sweden	3	0.0357	0	0	0	0	-
Italy	9	0.107	0	0	0	0	-
Mongolia	9	0.107	0	0	0	0	-
Philippines	12	0.143	0	0	0	0	-

Cases: Cumulative number of cases from 1 Nov 2002 to 6 June 2003 WHO Report (http://www.who.int/csr/sars/country/2003_06_06/en/)

%Cases: percentage of cumulative number of cases, P: publications, %P: percentage of publications, C: citations, %C: percentage of citations, ACI: actual citation impact

Similar to the finding of a study on drug and alcohol journals,[6] the quantity of SARS-related articles were found to be low. That a high percentage share of news item was found might be a faster way of communication. As shown in Table 1, 256 documents were published in 64 SCI journals, with 61% Northern American journals, 20% in European journals, 5% in Asian journals and 3% with no records in JCR of 2002. Four journals had impact factors higher than 20, 4 journals impact factors between 10 and 20, 4 between 5 and 10, 24 between 1 and 5, and 26 below 1. Fifty-seven percent of the documents was published in journals with impact factors higher than 5. The US dominated the journal countries followed distantly by the UK. Four languages were used for all SCI publications. Ninety-eight percent of total journals was published in English. Only 3 journals published in German, 2 in Spanish, and 1 in French.

In analyzing 132 documents with recorded addresses. We found that the US dominated the production by 30% of total share followed closely by Hong Kong with 24%. Out of 38 document-producing countries, Belgium, Mexico, the Netherlands, Norway, Saudi Arabia, and Senegal did not report any SARS cases (Table 2). Out of 32 countries with SARS cases, 47% of them had no SCI publications. Surprisingly, China with most cases had only one SCI publication. Moreover, 24% of documents was published by Hong Kong where 1,750 cases have been reported. Sixty-three percent of publication was published by the mainstream countries such as the US, the UK, Canada, Germany, and Switzerland where only 302 cases have been reported totally.

Domination in publication was not surprising from mainstream countries since this pattern has occurred in most scientific fields.[7,8] High production in countries with many cases would be due to active research of the disease, mainly on identification, diagnosis, and treatment. Contra wise mainstream countries would focus on controlling the disease and developing possible drugs and vaccines. The number of SARS cases did not affect the SCI publication output. However, countries with SARS cases, especially China, may have published in non-SCI journals that were not included in this study. All documents in this study were published in English. Thus, scientists in non-English speaking countries may have disadvantages in publishing in SCI journals since English is *lingua franca* of science.[9,10] In a short period of time, English may not be the choice of communication language for those scientists who are not native speakers. Publishing was from Europe and Asia besides two Northern American countries. In our study, we found that only 17% of SARS-related papers were internationally collaborated. This finding is unusual since international collaboration is essential in modern science.[11]

Although citation by other authors was affected significantly by visibility,[12] the citation frequency of SARS-related articles was considered to be high. Papers published from 11 countries had been cited in the short period after its appearance in print published. The country with the highest ACI value of 4.54 was the Netherlands. Except the US and the UK, all other countries have ACI higher than 1. The finding that low ACI values of these two countries was surprising because that both they had not had

many reported SARS cases. In the ACI ranking, number of SARS cases has affected citation pattern. Hong Kong, where had the serious SARS outbreak and the sequencing of corona virus been completed, has the most impact to this field. Further analysis show that there is no evidence of association between number of national SARS cases and article production (Pearson r = 0.130, p value = 0.437), national citations received (Pearson r = 0.248, p value = 0.134), and national citation impact (Pearson r = -0.046, p value = 0.835)**.**

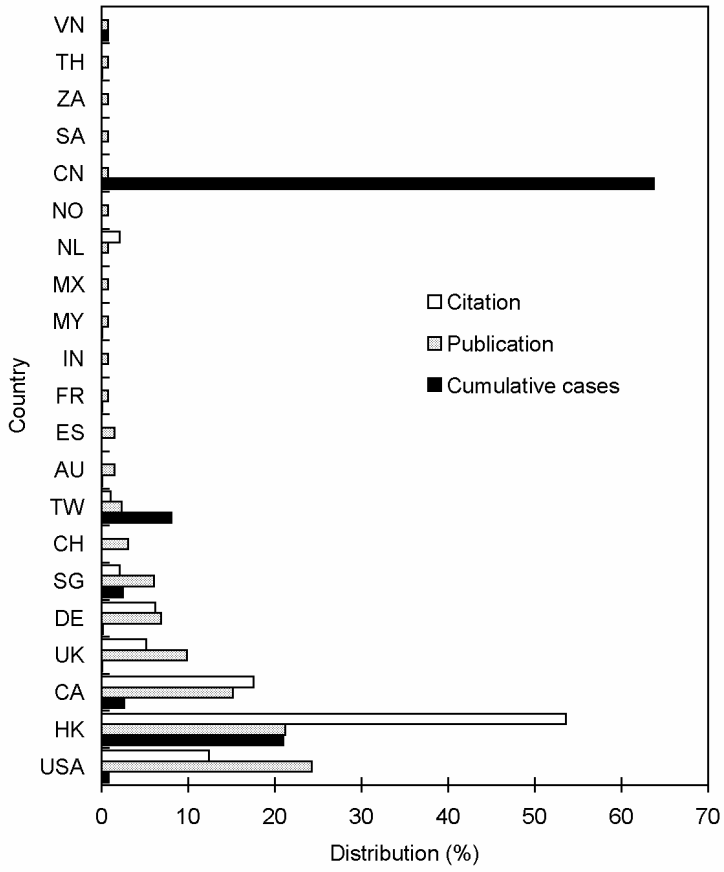

Figure 1. SARS cases, citation and publication distribution of reprint address
VN: Vietnam, TH: Thailand, ZA: South Africa, SA: Saudi Arabia, CN: Peoples Republic of China, NO: Norway, NL: Netherlands, MX: Mexico, MY: Malaysia, IN: India, FR: France, ES: Spain, AU: Australia, TW: Taiwan, CH: Switzerland, SG: Singapore, DE: Germany, UK: United Kingdom, CA: Canada, HK: Hong Kong, USA: United States

In our study, we found that 48% of publications have no recorded reprint addresses. The sum of 21 countries was counted for the remaining ones distributed 9 in Asia, 7 in Europe, 2 in Northern America, and 1 in Africa, Central America, and Australia. Countries with reprint addresses showed similar publication and citation patterns as the origin of countries. The high percentage of documents that appeared without reprint addresses may be due to the low production of articles because other document types may not include them. The US dominated the number of publications and Hong Kong that of citation (Figure 1). Mainstream countries, the US, Canada, the UK, and Germany, published 81 (61%) papers. The reprint address often represents the location when the research was done. Therefore, the results of this study indicate that most SARS research was done in the US, but that 10 papers had reprint address at the Chinese University at Hong Kong, 9 at University of Hong Kong, 7 at Center of Disease Control at Atlanta, 4 at WHO at Switzerland and Prince Wales Hospital in Hong Kong. Therefore, Hong Kong ranked the top for reprint address production.

Conclusion

SARS is not only a recent emerged disease, but also a new research topic. The SARS publication pattern in the first few months of its outbreak suggests immediate citation, low collaboration rate, and English and mainstream country domination in production, may be the features of this new topic which sets foot for future patterns. The results from this study showed no associations of research indexes with the number of cases. Although the major SARS outbreaks occurred in Asia, the high percentage of involvement from mainstream countries, suggests that SARS epidemic is no longer just a national affair of any single country but a disease that everyone should be aware.

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