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Highly Cited Articles in "*Coronavirus*" Research: A Bibliometric Analysis

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ABSTRACT

In this paper, an analysis of 806 highly cited articles was carried out based on the data retrieved from SCOPUS multidisciplinary database on 'Coronavirus' research published during 1970-2019 and 2020. The term '*Coronavirus*' was used to retrieve data from the fields - title, abstract & keyword. Further, an analysis was carried out for the citation life cycle of the highly cited articles, performance of authors, institutions, country, and journals. During the period a total of 18,116 articles published up to 2019; and 1221 articles published in 2020 till 30 March 2020. The articles with more than 100 citations were taken as highly cited articles in coronavirus research. On this basis, there were 806 articles with more than 100 citations and considered for the data analysis. The highly cited articles were mostly published from the USA. The 'Journal of Virology' was most productive journal publishing most of the highly cited articles. These highly cited articles were published between 1973 to 2016. The University of Hong Kong, Hong Kong was the most productive institute, published most number of highly cited articles. Kwok Yung Yuen from the University of Hong Kong, Shenzhen was the most productive author, who has published most number of highly cited articles. The seven articles had shown 'sleeping beauty' characteristics in citation trends.

Keywords: Coronavirus; Bibliometric study; Citation analysis; Research impact.

1. INTRODUCTION

The Recent outbreak of 'Novel Coronavirus-19' (nCOVID-19) from Wuhan Province of China has been declared a pandemic by the World Health Organisation (WHO) in February 2020[1]. First diagnosed on 31 December 2019, The Coronavirus has now spread across the globe[2] and has become fatal for human life. Started from China, it has now affected South East Asia, Middle East, Europe, America, Africa, and Asia Pacific region covering more than two hundred countries. The research in Coronavirus is not new but was identified in the late thirties and the virus was first isolated in the sixties. The publication trends started from 1970s[3]. It came into limelight with the outbreak of Severe Acute Respiratory Syndrome (SARS) from the Chinese province of Hong-Kong in 2002-03[4] and later another form Middle East Respiratory Syndrome (MARS) from Middle-East Region[5-6].

The recent pandemic situation has put a huge pressure on the medical practitioners, virologists and researchers to devise an effective medicine, vaccines to treat the affected patients. As of now, no proper vaccine has been developed so far. The researchers are working vigorously on clinical trial research and testing methods. The research depends upon the prior highly referred research to reach at a conclusion, and very often the most referred articles help in their research with the help of literature review[7,8]. The citation analysis is one of the prime focus for every literature review while conceiving research idea[9–13]. The concept of citation frequency is the most used method for assessing the quality of research[14]. Many research work published so far highlights the most frequently cited articles[15] leading to new research directions[16–20]. Citation classics have been published for many subjects[8,21–23] and journals[13,24-25] which highlights the most cited work. Many bibliometric studies analyzing the publications related to the Coronavirus[26], SARS[27], MARS[28] have been published but the subject matter was not related to highly cited articles. There was an analysis of highly cited articles reported was related to SARS[29]. The current work is aimed to assess the highly cited articles in '*Coronavirus*' research published till 2019 and separate analysis of articles published post-pandemic situation up to March 2020.

2. METHODOLOGY

SCOPUS multidisciplinary database has been used to retrieve bibliographic data using the keywords "Coronavirus" available in title, abstract, and keywords field. The other keywords used were 'betacoronavirus', 'novel coronavirus', 'nCoV', 'coronavirus disease', 'covid', 'covid19, 'covid-19, 'SARS-CoV', 'MERS-CoV', as a subset of the 'coronavirus' keyword. The period was kept for fifty years from 1970 to 2019 to retrieve a wide range of the data. The search query used for retrieving data is as under:

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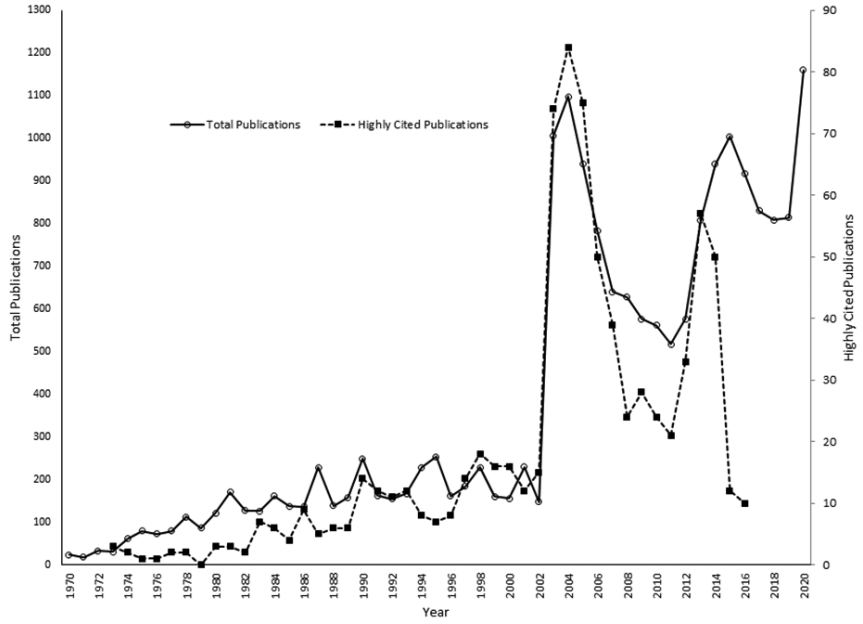

Figure 1. The Annual publication pattern of coronavirus research and highly cited publications.

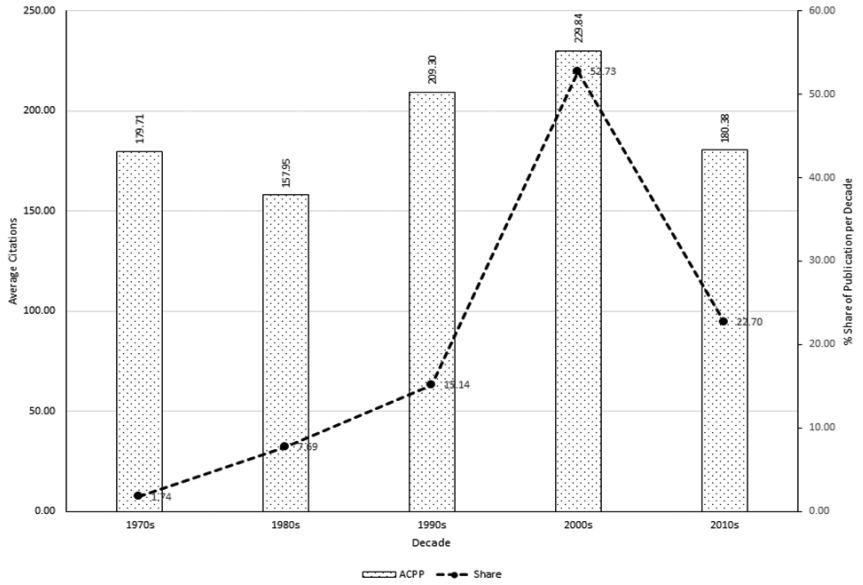

Figure 2. Share of publications and average citation by decade.

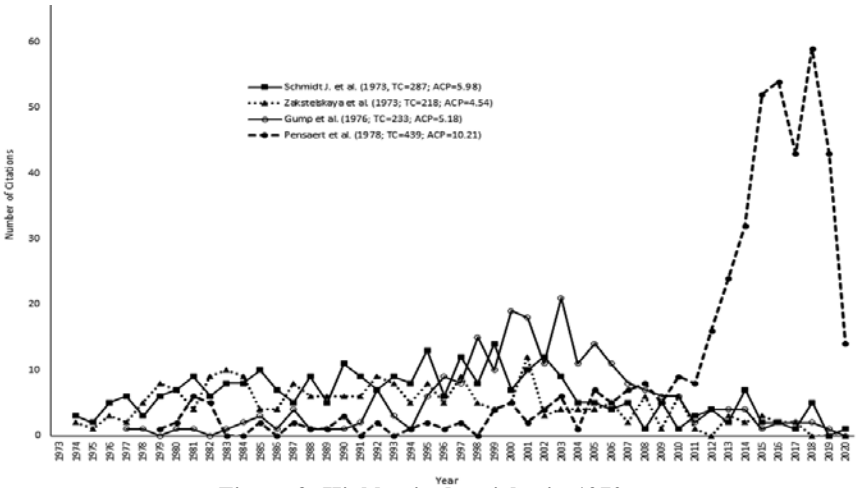

Figure 3. Highly cited articles in 1970s.

Search query : ((TITLE-ABS-KEY("*coronavirus*") OR TITLE-ABS-KEY("SARS Coronavirus") OR TITLE-ABS-KEY("*betacoronavirus"*) OR TITLE-ABS-KEY("*nCoV"*) OR TITLE-ABS-KEY("*coronavirus disease"*) OR TITLE-ABS-KEY("*covid"*) OR TITLE-ABS-KEY("*covid19"*) OR TITLE-ABS-KEY("*covid-19"*) OR TITLE-ABS-KEY("*SARS-CoV*") OR TITLE-ABS-KEY("*MERS-CoV"*)) AND (EXCLUDE (PUBYEAR,2020) OR EXCLUDE (PUBYEAR,1969))

The publications available in the year 2020 have been analysed separately until March 30, 2020. The highly cited articles were chosen as an article having 100 citations or more till March 2020 since its publication. The total citation accumulated by the article was considered for citation analysis. Basic bibliometric methods have been used to analyse data to assess the output pattern for annual growth, journals, institute, and authors. The citation received in the year of publication of articles has been denoted as TC_{2020}. The impact factor of the journals was taken from the Journal Citation Report (JCR) of the 2018 edition (compiled by *Clarivate Analytics*) and denoted as IF_{2018}. The Hirsch Index (*h*-Index)[30] was obtained from the database for most productive authors and institutes. VoS Viewer[31] was used to draw co-citation networks between productive authors for highly cited articles.

3. RESULTS AND DISCUSSION

3.1 Publication Year

The 18,116 articles that were retrieved from the SCOPUS database had been published between 1970 till 2019. Whereas, there were 1221 articles were published till 30th March 2020. Of 18,116 articles, a total of 806 articles had received 100 (TC≥100). It was 4.45 per cent of the total publication. These highly cited articles were published between 1973 and 2016. The annual publication pattern of the highly cited articles with more than 100 citations and overall publication is presented in Fig. 1.

Among the highly cited coronavirus articles, only 1.74 per cent of articles published in the decade of 1970s, 7.89 per cent articles published in the decade of 1980s, 15.73 per cent articles published in the decade 1990s, 52.73 per cent articles appeared in decade 2000s and 22.70 per cent articles appeared in decade 2010s. Chen and Ho (2015) analysed highly cited articles in 'Biomass' research through citation time window and reported that highly cited articles need a length of time to get more

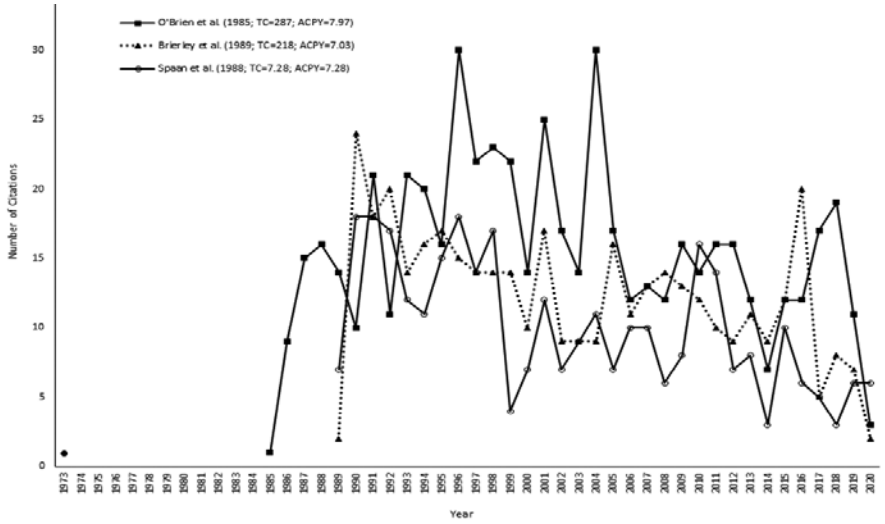

Figure 4. Highly cited articles in 1980s.

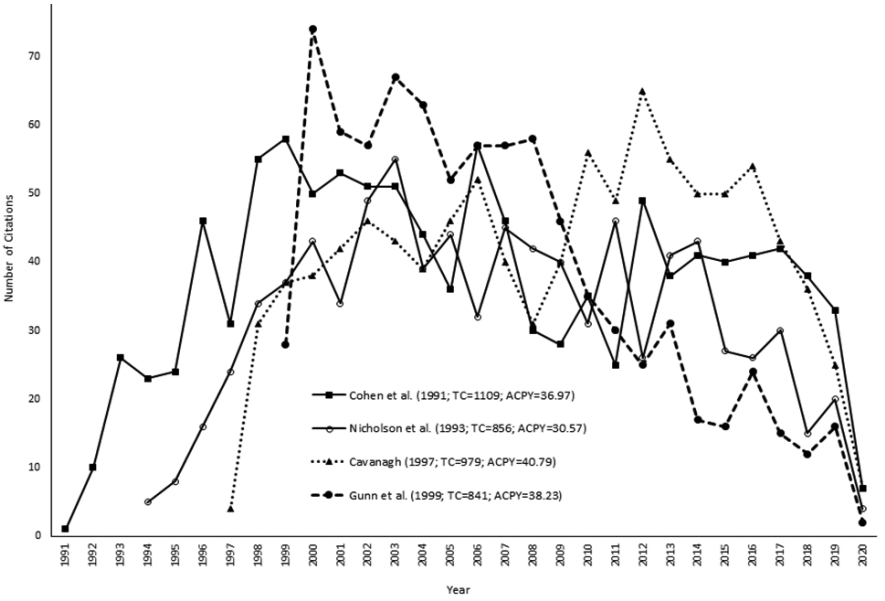

Figure 5. Highly cited articles in 1990s.

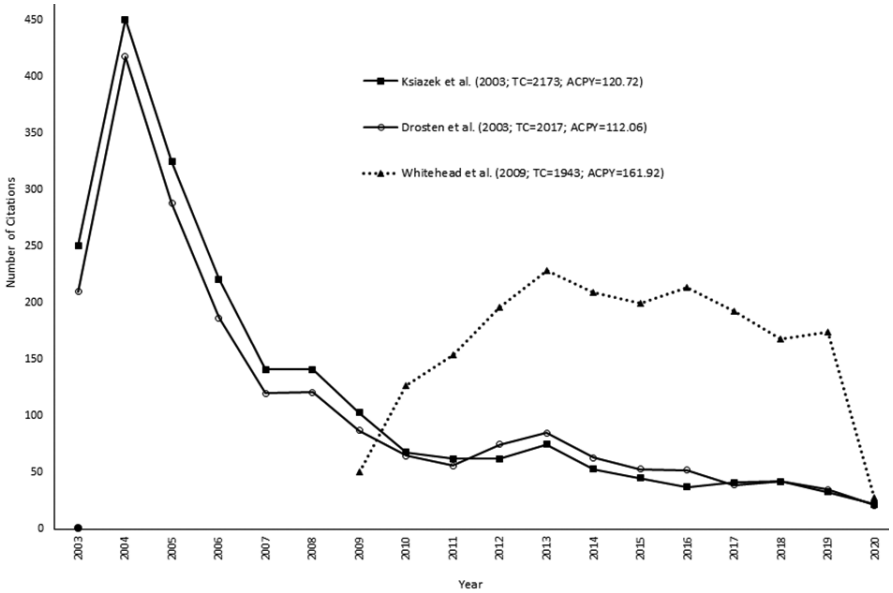

Figure 6. Highly cited articles in 2000s.

citations. In general, the article age is directly proportional to the count of citation in case of the highly cited article as the article has had more time to gather popularity[32-33]. Here 'time' is not a significant factor for highly cited articles published in 1970s. Though time is higher not all articles were highly cited with 14 publications and Average citations per paper (ACPP) of 179.11 (Fig. 2). The citations per year calculated as Average Citation Per Year (ACPY) may be a crucial indicator to judge the popularity of an article[9,34]. The highly cited articles with maximum citations in the decade 1970s were Schmidt J. *et al.* (1973) (TC=287; ACPY=5.98); Zakstelskaya *et al.* (1973) (TC=218; ACPY=4.54); Gump et al. (1976) (TC=233; ACPY=5.18); and Pensaert *et al.* (1978) (TC=439; ACPY=10.21) (Fig. 3). The decade 1980s had 62 publications (7.69 % share), with a total citation of 9,793 (ACPP=157.95) citations. In this decade, the three highly cited articles were O'Brien *et al.* (1985) (TC=560; ACPY=15.56), Brierley *et al.* (1989) (TC=394; ACPY=12.31) and Spaan *et al.* (1988) (TC=12.31; ACPY=9.76) (Fig. 4). The 1990s had 122 (15.14 % share) articles, with 25,535 (ACPP=209.30) citations. The highly cited articles were Cohen *et al.* (1991) (TC=1109; ACPY=36.97), Nicholson *et al.* (1993), (TC=856; ACPY=30.57), Cavanagh (1997) (TC=979; ACPY=40.79) and Gunn *et al.* (1999), (TC=841; ACPY=38.23) (Fig. 5). The decade 2000s had 425 (52.73 % share) articles with 97,681 (ACPP=229.84) citations. The highly cited articles were Ksiazek *et al.* (2003) (TC=2173; ACPY=120.72), Drosten *et al.* (2003) (TC=2017; ACPY=112.06), Whitehead *et al.* (2009) (TC=1943; ACPY=161.92) (Fig. 6). The decade 2010s had 183 (22.70 % share) articles, with 33,010 (ACPP=180.38) citations. The most cited articles were Loo *et al.* (2011) (TC=830; ACPY=83.00) and Zaki *et al.* (2012) (TC=1373; ACPY=152.56) (Fig. 7). A summary of highly cited articles on coronavirus with more than 800 citations is given in (Annexure I).

3.2 Journals Publishing Highly Cited Articles

These highly cited articles were published in 209 journals. The rate of highly cited articles was varying from journal to journal. However, the most productive journals with more than 500 articles during the study period were *Journal of Virology* (IF_{2018}=4.324), *Advances in Experimental Medicine and Biology* (Book Series), and

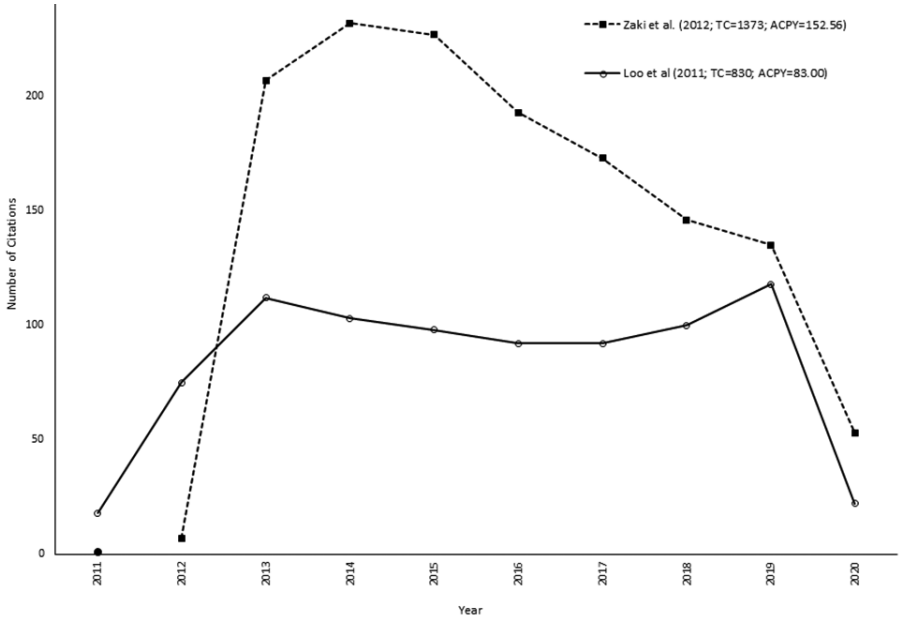

Figure 7. Highly cited articles in 2010s.

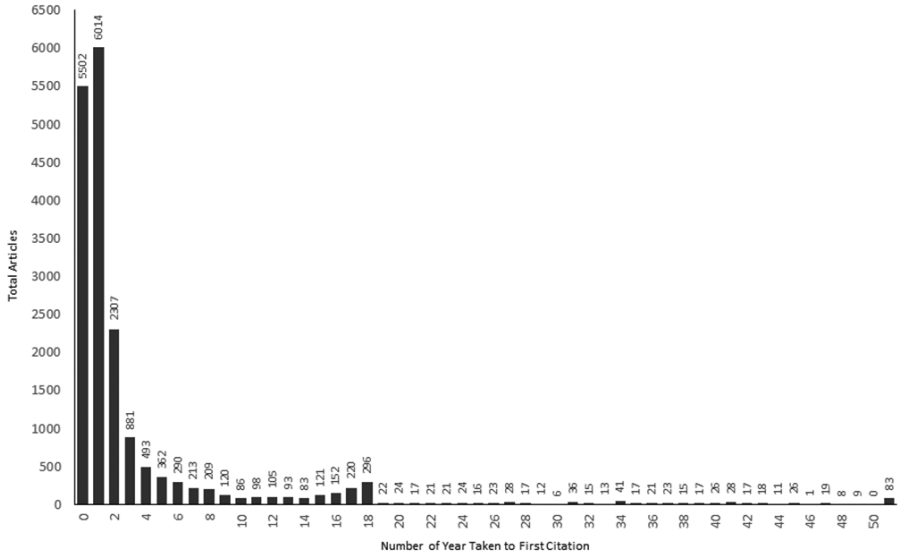

Figure 8. Citation time coronavirus articles.

Virology (IF_{2018}=2.657). The number of highly cited articles with 20 or more appeared in *Journal of Virology* (119 articles; IF_{2018}=4.434), *Proceedings of the National Academy of Sciences of the United States of America* (50 articles; IF_{2018}=9.580), *Emerging Infectious Diseases* (32 Articles; IF_{2018}=7.185), *Virology* (27 articles; IF_{2018}=2.657)), *Clinical Infectious Diseases* (21 articles; IF_{2018}=9.055). The highly cited articles published in some of the high impact factor journals. The high Impact factor journals published highly cited articles were the *New England Journal of Medicine* (IF_{2018}=70.670), *Lancet* (IF_{2018}=59.102), *Nature* (IF_{2018}=43.07), *Science* (IF_{2018}=41.063), and *Nature Reviews Microbiology* (IF_{2018}=34.648) (Annexure II).

3.3 Citation Time of Coronavirus Articles

The citation life cycle of Coronavirus research cited articles were analysed year by year. It is found that 85.83 per cent of articles were cited at least once whereas 14.87 per cent did not have any citations till March 2020. It was found that about 30.37 per cent (5502 articles) were cited within the first year of its publication. 33.20 per cent (6014 articles) took one year to get cited until the year next to publication, 12.73 per cent (2307 articles) and there were 0.45 per cent (83 articles) which were cited after more than 50 years of its publication. There were 14.86 (2693 articles) that were not cited until the time of the study (Fig. 8).

3.4 Authors of Highly Cited Articles in Coronavirus Research

The 806 highly cited articles were authored by 6158 authors either single or in collaboration. The author's contribution pattern was found as: 3190 (51.80 %) authors contributed only one article, 450 (7.31 %) authors contributed two articles, 145 (2.35 %) contributed three, 71 (1.45 %) contributed four, and 144 (2.34 %) contributed five or more articles. Table 3 gives the list of the most productive author with fifteen or more highly cited articles. The most productive author was Yuen, K.Y. who published 36 highly cited articles in Coronavirus. The articles published by Osterhaus, A.D.M.E. from Artemis One Health, Utrecht, Netherlands were most frequently cited and the sixteen articles have an average citation of 490.56 per paper. It is found that these highly cited authors have higher contributed research in coronavirus as shown in the co-citation network (Fig. 9).

3.5 Institutes of Highly Cited Articles

Thirty-eight institutions had published at least ten highly cited articles on Coronavirus. Table 4 presents the top twelve institutions with more than 20 highly cited articles. The University of Hong Kong, Hong Kong was the most productive institution with 65 highly cited articles on Coronavirus total citations of 17299 (ACPP=266.14). Queen Mary Hospital Hong Kong, Hong Kong had the highest average citation per paper of 383.74 citations per paper.

3.6 Sleeping Beauty in Coronavirus Research

The scientific research becomes frightening when the work remained un-noticed because the article does not receive any citations (the prime factor of impact assessment)[14,51]. The publications which remain un-noticed for a long period and suddenly got attention and started accumulating high citations

Table 3. Productive authors of highly cited articles on coronavirus

Author	Affiliation	Total publication	Total citations	Average citations per paper	h-Index
Yuen, K.Y.	The University of Hong Kong, Shenzhen Hospital, Shenzhen, China	36	10574	293.72	36
Drosten, C.	German Centre for Infection Research, Berlin, Germany	31	9234	297.87	31
Guan, Y.	State Key Laboratory of Emerging Infectious Diseases, China	24	8558	356.58	24
Chan, K.H.	The University of Hong Kong, Pokfulam, Hong Kong	23	6402	278.35	23
Baric, R.S.	The University of North Carolina at Chapel Hill, Chapel Hill, United States	22	3232	146.91	22
Peiris, J.S.M.	The University of Hong Kong, Pokfulam, Hong Kong	22	8519	387.23	22
Woo, P.C.Y.	The University of Hong Kong Li Ka Shing Faculty of Medicine, Hong Kong	19	4332	228.00	19
Gorbalenya, A.E.	Lomonosov Moscow State University, Moscow, Russian Federation	18	4609	256.06	18
Müller, M.A.	Charité – Universitätsmedizin Berlin, Berlin, Germany	18	3260	181.11	18
Rottier, P.J.M.	Departement Infectieziekten en Immunologie, Universiteit Utrecht, Utrecht, Netherlands	18	3523	195.72	18
Snijder, E.J.	Leiden University Medical Center - LUMC, Leiden, Netherlands	18	4893	271.83	18
Corman, V.M.	German Centre for Infection Research (DZIF), Berlin, Germany	17	2886	169.76	17
Lau, S.K.P.	The University of Hong Kong Li Ka Shing Faculty of Medicine, Hong Kong	17	3857	226.88	17
Memish, Z.A.	Ministry of Health Saudi Arabia, Riyadh, Saudi Arabia	17	3416	200.94	17
Haagmans, B.L.	Erasmus MC, Rotterdam, Netherlands	16	3418	213.63	16
Horzinek, M.C.	Departement Infectieziekten en Immunologie, Universiteit Utrecht, Utrecht, Netherlands	16	2712	169.50	16
Osterhaus, A.D.M.E.	Artemis One Health, Utrecht, Netherlands	16	7849	490.56	16
Poon, L.L.M.	The University of Hong Kong Li Ka Shing Faculty of Medicine, Hong Kong	16	7346	459.13	16
Bosch, B.J.	Departement Infectieziekten en Immunologie, Universiteit Utrecht, Utrecht, Netherlands	15	2918	194.53	15
Holmes, K.V.	University of Colorado School of Medicine, Denver, United States	15	721	48.07	15
Stohlman, S.A.	Cleveland Clinic Foundation, Cleveland, United States	15	2030	135.33	15
Ziebuhr, J.	Justus Liebig University Giessen, Giessen, Germany	15	4302	286.80	15

are termed as 'Sleeping Beauty'[52,53] . The determination of sleeping beauty depends upon the length of the un-noticed period, very fewer citations as one or two, and the intensity of the citations after awakening.

In coronavirus research, seven articles have shown this characteristic. Table 6 lists seven articles with characteristics of sleeping beauties but become high impact research in coronavirus. It is quite perceptible from (Fig. 10) through the citation curve, The life of the article by Pensaert *et al.* (1978) is an example of high impact Sleeping Beauty. The particular article remained unnoticed for 33 years. Most of the other articles had been un-noticed or less cited for over more than 20 years. The article by Kocherhans et al. (2001) was un-noticed or less cited for about 10 years (Table 5).

3.7 Highly Cited Coronavirus Articles in 2020

In 2020 (until 31st March 2020), 1221 articles were published. Of these: 823 (67.40 %) were not cited yet, 144 (11.79 %) had one citation, 63(5.16 %) had two citations, 44(3.60 %) had three citations; 23(1.88 %) had four citations, 21(1.72 %) had five citations and 103(8.44 %) had more six or more citations. The top eight most cited articles in 2020 are given in Table 6. Of these four articles were published in The Lancet (IF_{2018}=59.102), Two articles in The New England Journal of Medicine (IF_{2018}= 70.67), one each in JAMA (IF_{2018}=51.273) and Nature (IF_{2018}=40.07). The most cited article was Huang C. *et al.* (2020) with TC2020 of 308.

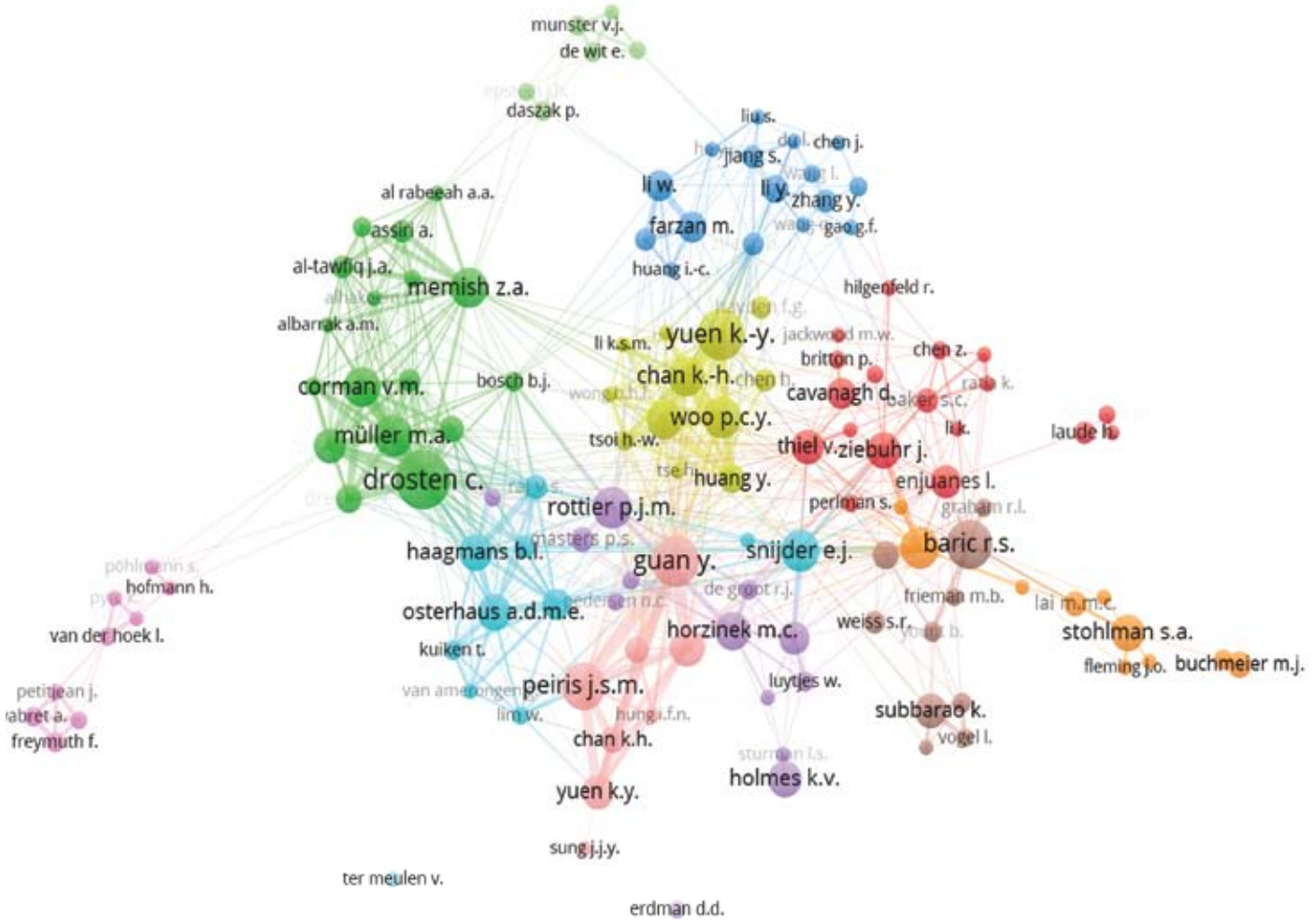

Figure 9. Co-citation network of highly cited articles in coronavirus research.

Table 4. Productive institutions of highly cited articles on Coronavirus

Institutes	TP	TC	ACPP	*h*-Index
The University of Hong Kong, Hong Kong	65	17299	266.14	65
National Institutes of Health, USA	41	7671	187.10	41
Utrecht University, Netherlands	40	7016	175.40	40
Queen Mary Hospital Hong Kong, Hong Kong	35	13431	383.74	35
Erasmus MC, Netherlands	28	8325	297.32	28
Centers for Disease Control and Prevention, USA	27	6726	249.11	27
The University of North Carolina at Chapel Hill, USA	26	3922	150.85	26
Departement Infectieziekten en Immunologie, Universiteit Utrecht, Netherlands	25	4760	190.40	25
Leiden University Medical Center - LUMC, Netherlands	24	5587	232.79	24
Universität Bonn, Germany	23	4298	186.87	23
The University of Hong Kong, State Key Laboratory of Emerging Infectious Diseases, Hong Kong	21	4254	202.57	21
National Institute of Allergy and Infectious Diseases, USA	20	3553	177.65	20

TP: Total Publication, TC: Total Citations and ACPP: Average Citations Per Paper

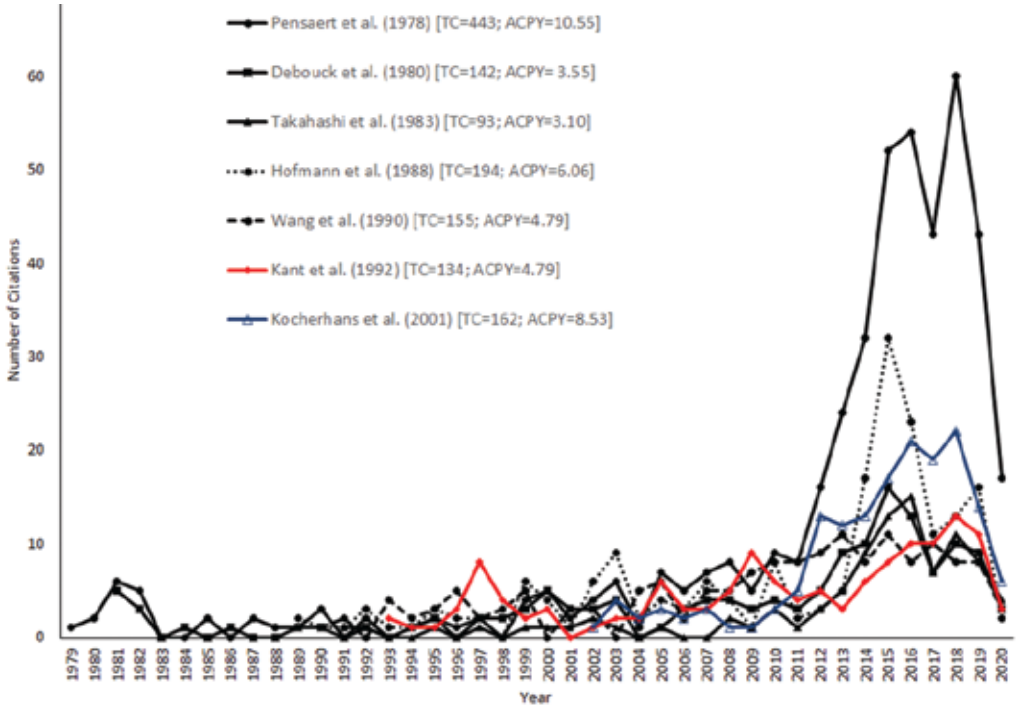

Figure 10. The citation life cycle of 'sleeping beauties' of coronavirus research.

4. CONCLUSIONS

The Coronavirus has been declared pandemic by Word Health Organisation because the disease has spread over 206 countries, claimed 46,000+ lives, crippled economies, industries affected, jobs laid off. The medical scientist are working day and night to discover vaccine for the treatments, as of now there is no effective medication available. This work has tremendous relevance for those scientists who are looking for prior research work with high impact value. The analysis was carried out with the help of literature retrieved from the SCOPUS database. The study has highlighted how the research trends evolved during the five decades period, 1970-2019. It has analysed 806 articles which attracted more than 100 citations. These highly cited articles were published between 1973-2016. Most of the highly cited articles were published in the decade 2000s. Journal of Virology was the most productive journals. Over 85.83 per cent articles were cited at least once and 30.37 per cent were cited within first year of its publication. However, there were 14.87 per cent articled did not get any citation until March 2020. K.Y. Yuen from the University of Hong Kong, Shenzhen Hospital, Shenzhen, China was most productive author among the highly cited articles. The University of Hong Kong, Hong Kong was the most productive institute from where the most productive authors contributed highly cited articles. There were eight articles which have shown 'sleeping beauty' citation characteristics and remains un-noticed on an average of over twenty years but become highly cited articles. There were eight articles published in the year 2020 which were highly cited. The work is aimed to present and overview of the highly cited articles in Coronavirus research. The research work can be used by the researchers for making decision for the various bibliographic research and literature review based on highly cited articles. Future research can be carried from here involving other bibliometric parameters.

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Table 5. Sleeping beauties in coronavirus research

TC_{2020}	C_0	C_{2019}	L_{D10}	Title	Author
443	1	43	33	A new coronavirus-like particle associated with diarrhea in swine	Pensaert et al. (1978)
142	5	9	33	Experimental infection of pigs with a new porcine enteric coronavirus, CV 777.	Debouck et al. (1980)
93	1	8	24	An outbreak of swine diarrhea of a new-type associated with coronavirus-like particles in Japan.	Takahashi et al. (1983)
194	2	16	25	Propagation of the virus of porcine epidemic diarrhea in cell culture	Hofmann et al. (1988)
155	1	8	23	Design, synthesis, testing, and quantitative structure-activity relationship analysis of substituted salicylaldehyde Schiff bases of 1-amino-3-hydroxyguanidine tosylate as new antiviral agents against coronavirus	Wang et al. (1990)
134	2	11	23	Location of antigenic sites defined by neutralizing monoclonal antibodies on the S1 avian infectious bronchitis virus glycopolypeptide	Kant et al. (1992)
162	1	14	10	Completion of the porcine epidemic diarrhoea coronavirus (PEDV) genome sequence	Kocherhans et al. (2001)

TC_{2020}= Total Citation till 2020; C_0=Citation in Year of Publication; C_{2019}=Citations in 2019, L_{D10}=Length of Deep Sleep in year with less than 10 citations

Table 6. Top cited articles of coronavirus research published in 2020 (upto 31st March 2020)

TC_{2020}	Reference
308	Huang C. et al (2020), Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China, *Lancet*, 395(10223)
215	Zhu N. et al. (2020), A novel coronavirus from patients with pneumonia in China, 2019, *New England Journal of Medicine*, 382(8)
183	Li Q. et al. (2020), Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia, *The New England journal of medicine*, 382(13),
169	Chen N. et al. (2020), Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study, *The Lancet*, 395(10223)
150	Wang D. et al. (2020), Clinical Characteristics of 138 Hospitalized Patients with 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China, *JAMA - Journal of the American Medical Association*, 323 (11)
150	Chan J.F.-W. et al. (2020), A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster, *The Lancet*, 395(10223)
123	Zhou P. et al. (2020), A pneumonia outbreak associated with a new coronavirus of probable bat origin, *Nature*, 579(7798)
120	Lu R. et al. (2020), Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding, *The Lancet*, 395(10224)

TC_{2020}: Total citations in 2020

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Annexure I

Highly cited articles in coronavirus research with more than TC_{2020}≥800 citations

Overall Rank	TC	ACPY	Article Details
1	2173	114.37	Ksiazek et al. (2003), A novel coronavirus associated with severe acute respiratory syndrome, New England Journal of Medicine, 348(20), *New England Journal of Medicine*, 348 (20)
2	2017	106.16	Drosten et al. (2003), Identification of a novel coronavirus in patients with severe acute respiratory syndrome, *New England Journal of Medicine*, 348(20)
3	1943	161.92	Whitehead K.A., et al (2009), Knocking down barriers: Advances in siRNA delivery, *Nature Reviews Drug Discovery*, 8(2)
4	1670	87.89	Peiris J.S.M. et al. (2003), Coronavirus as a possible cause of severe acute respiratory syndrome, *Lancet* (361(9366)
5	1573	87.39	Rota P.A., et al. (2003), Characterization of a novel coronavirus associated with severe acute respiratory syndrome, *Science* 300(5624)
6	1373	152.56	Zaki A.M., et al. (2012), Isolation of a novel coronavirus from a man with pneumonia in Saudi Arabia, *New England Journal of Medicine,* 367(19)
7	1362	75.67	Marra M.A. et al. (2003), The genome sequence of the SARS-associated coronavirus, *Science,* 300(5624)
8	1134	75.60	Kramer A., et al. (2006), How long do nosocomial pathogens persist on inanimate surfaces? A systematic review, *BMC Infectious Diseases,* 6,
9	1125	75.00	Allander T., et al. (2005), Cloning of a human parvovirus by molecular screening of respiratory tract samples, *Proceedings of the National Academy of Sciences of the United States of America*, 102(36)
10	1109	36.97	Cohen S., et al. (1991), Psychological stress and susceptibility to the common cold, *New England Journal of Medicine,* 325(9)
11	1068	59.33	Li W., et al. (2003), Angiotensin-converting enzyme 2 is a functional receptor for the SARS coronavirus, *Nature*, 426(6965)
12	1034	57.44	Guan Y., et al. (2003), Isolation and characterization of viruses related to the SARS coronavirus from animals in Southern China, *Science*, 302(5643)
13	979	40.79	Cavanagh D. (1997), Nidovirales: a new order comprising Coronaviridae and Arteriviridae, *Archives of Virology,* 142(3)
14	971	53.94	Peiris J.S.M., et al. (2003), Clinical progression and viral load in a community outbreak of coronavirus-associated SARS pneumonia: A prospective study, *Lancet,* 361(9371)
15	936	58.50	Li W., et al. (2005), Bats are natural reservoirs of SARS-like coronaviruses, *Science,* 310(5748)
16	863	45.42	Poutanen S.M., et al. (2003), Identification of severe acute respiratory syndrome in Canada, *New England Journal of Medicine*, 348(20)
17	856	31.70	Nicholson K.G., et al. (1993), Respiratory viruses and exacerbations of asthma in adults, *British Medical Journal,* 307(6910)
18	841	38.23	Gunn M.D., et al. (1999), Mice lacking expression of secondary lymphoid organ chemokine have defects in lymphocyte homing and dendritic cell localization, *Journal of Experimental Medicine*, 189(3)
19	830	83.00	Loo Y.-M., et al. (2011), Immune Signaling by RIG-I-like Receptors, *Immunity*, 34(5)
20	824	48.47	Van Der Hoek L., et al. Identification of a new human Coronavirus, *Nature Medicine*, 10(4)
21	803	50.19	Espy M.J., et al. (2006), Real-time PCR in clinical microbiology: Applications for routine laboratory testing, *Clinical Microbiology Reviews,* (19), 1

Annexure II

Journals publishing highly cited articles in coronavirus

Journal Title	Total Article Published	Highly Cited Articles	Per cent	IF_{2018}
Journal of Virology	1128	119	10.55	4.324
Adv. Experimental Med. and Biology	642	3	0.47	-
Virology	501	27	5.39	2.657
Journal of General Virology	325	16	4.92	2.809
Archives of virology	309	5	1.62	2.261
Emerging Infectious Diseases	283	32	11.31	7.185
PLoS ONE	254	6	2.36	2.776
Virus Research	249	6	2.41	2.736
Avian diseases	232	4	1.72	1.306
Veterinary Microbiology	231	2	0.87	2.791
Journal of Virological Methods	187	3	1.60	1.746
American Journal of Veterinary Research	169	3	1.78	1.07
Viruses	169	2	1.18	3.811
Journal of Clinical Microbiology	159	17	10.69	4.959
Journal of Medical Virology	141	9	6.38	2.049
Vaccine	140	3	2.14	3.269
Journal of Infectious Diseases	131	3	2.29	5.045
PNAS	126	50	39.68	9.58
Antiviral Research	118	3	2.54	4.13
Science	108	18	16.67	41.063
Virology Journal	107	2	1.87	2.464
Journal of Veterinary Medical Science	106	1	0.94	0.91
Clinical Infectious Diseases	104	21	20.19	9.055
Journal of Clinical Virology	104	5	4.81	3.02
Virus Genes	104	3	2.88	1.616
Journal of Immunology	102	12	11.76	4.718
Journal of Biological Chemistry	87	10	11.49	4.106
Nature	82	18	21.95	43.07
New England Journal of Medicine	59	17	28.81	70.67
Lancet	54	17	31.48	59.102
Nature Reviews Microbiology	34	16	47.06	34.648
Japanese Journal of Infectious Diseases	25	14	56.00	1.004