COVID-19 RESEARCH PRODUCTIVITY OF INDIA AS REFLECTED IN PUBMED DATABASE: A SCIENTOMETRIC ANALYSIS USING BIBLIOSHINY

Dr.K.Ramasamy

College Librarian, M V Muthiah Government Arts College for Women, Dindigul, Tamil Nadu . Email: drkramasamy@mvmwgacdgl.ac.in

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Abstract

Covid-19 has become a deadly disease that shattered the entire world in a very short period of time. People are affected not only physically but also mentally, socially, psychologically and economically. The present study examines the scientometric dimensions of Indian research output on Covid-19 during 2020-2021. The data required for the study was downloaded from PubMed database. The data was analyzed using Biblioshiny – the shiny web interface for bibliometric analysis, which is available as a part of Bibliometrix of R Software. The study reveals that : 1841 records found in the database came from 617 sources covering two a two year period (2020-2021). There is no citation for these papers. 2432 keywords were used in these records. These records were contributed by 6589 authors who appeared 11226 times, in toto. There are 151 authors of single authored documents and 6438 authors of multi-authored documents. There are 222 single authored documents. A majority of the records were journal articles (1203). Kumar S is the most productive author with 54 records followed by Kumar A with 50 records and Gupta N with 47 records. The Indian journal of Medical Research is the topper with 57 publications followed by the journal 'Diabetes and Metabolic syndrome' with 56 publications. All India Institute of Medical Sciences is the topper with 966 (872+94) papers followed by Postgraduate Institute of Medical Education and Research with 281 (201+80) papers. India is the most productive country with 9261 records followed by USA with 361 records and China with 138 records. . The most frequently used keywords include humans (903), Sars-Cov-2 (572), India/Epidemiology (568) and Covid-19 (510).

Keywords : *Covid-19, Coronovirus, PubMed, Scientometrics, Bibloshiny, India*

1 Introduction

Coronavirus disease (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus. Most people infected with the virus will experience mild to moderate respiratory illness and recover without requiring special treatment. However, some will become seriously ill and require medical attention. Older people and those with underlying medical conditions like cardiovascular disease, diabetes, chronic respiratory disease, or cancer are more likely to develop serious illness. Anyone can get sick with COVID-19 and become seriously ill or die at any age.

The best way to prevent and slow down transmission is to be well informed about the disease and how the virus spreads. Protect yourself and others from infection by staying at least 1 metre apart from others, wearing a properly fitted mask, and washing your hands or using an alcohol-based rub frequently. Get vaccinated when it's your turn and follow local guidance.

The virus can spread from an infected person's mouth or nose in small liquid particles when they cough, sneeze, speak, sing or breathe. These particles range from larger respiratory droplets to smaller aerosols. It is important to practice respiratory etiquette, for example by coughing into a flexed elbow, and to stay home and self-isolate until you recover if you feel unwell ("Coronavirus", 2021).

Ii Review of Literature

Malik, Butt, Bashir and Gilani (2020) carried out a scientometric evaluation of coronaviruses related literature including COVID-19. Data related to Coronavirus research was extracted from the Web of Science (WoS). All types of publications (28,846) were included and retrieved. To measure the quantity and quality of the publications, "R-Bibliometrix" package was used for detailed analysis exploring a wide range of indicators. Generally, an increasing trend was observed over time led by the USA and China followed by the United Kingdom, Europe, and few other developed countries. The last two decades contributed around 39.5% of documents while only 06 months of 2020additionally contributed around 46.5% of total documents. Earlier shorter spikes of increased post epidemic publications followed by decreased productivity were detected in the last 2

decades and showed a lack of continuity-'a research epidemic following a disease epidemic'. Articles (53.4%) were the most common publication type. Journal of Virology, British Medical Journal (BMJ), and Virology were leading sources while BMJ, and Lancet showed increased contributions recently. Overall, similar trends of top authors were observed in terms of productivity, impact, collaborations, funding sources, and affiliations with few exceptions mainly from affected regions. Top 20 countries contributed >89% of documents suggesting a lack of global efforts. Networking was found to be mainly among developed nations with limited contributions from resource-limited countries perhaps requiring more cooperation.

Johnson, Sakya, Sakya, Onkendi and Hallan (2020) conducted a study to identify the 100 most cited publications focusing on COVID-19 to provide readers with useful historical information on current relevant research. A search of all databases and journals accessible in Elsevier's Scopus was performed on May 13th, 2020. The document search was performed using query "COVID-19," yielding 6,693 results. A similar search was performed using Thomson Reuter's Web of Science, yielding 2,593 documents and fewer citations. The top 100 most cited papers were identified, and data were extracted. All references contained within the top 100 articles were collected. Statistical analysis was performed using R-Studio and Bibliometrix. The top 100 most cited articles were published in 50 different journals from over 25 countries. The most cited article is "Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China" by Huang et al., published in The Lancet with 1184 citations. Included are a list of the top 100 most cited articles, the most cited authors, the top five journals these publications most frequently appeared in, the most contributing countries, the top institutional affiliations, and the top international collaborations of the top 100 most cited publications on COVID-19.

Ahmadian, Mokhtari, Ghafari and Saberi (2021) identified and visualized the scientometric indicators of top ten highly productive journals publishing documents on topics related to COVID-19. On April 4, 2021, using 36 COVID-19 keywords derived from MeSH, retrieved all relevant global publications indexed in Scopus. Then, all studies were limited to top 10 highly productive journals in this field. The top ranked journals in publication numbers belonged to the International Journal of Environmental Research and Public Health (N=1304, 16.2%), Plos One (N=1158, 14.4%) and BMJ (997, 12.4%),

respectively. The Lancet (N=69983), JAMA (N=42553) and the Journal of Medical Virology (19089) ranked first to third as to received citation numbers, respectively. Mahase, E (N=180, 2.23%), Lacobucci, G (N=126, 1.56%) and Rimmer, A (N=82, 1.01%) were ranked first to third as highly-productive authors, respectively. However, the highest-ranked authors in their citations/document indicator were Cheng, Z (3691), Gu, X (2736.25) and Xia, J (2269.66), respectively. First to third ranked countries in receiving citations were China (94776), United States (51621) and United Kingdom (32339), respectively. Out of top 10 contributing countries in producing documents, United States (1976; 24.5%), United Kingdom (1372; 17%) and China (894; 11.1%) ranked first to third, respectively. Keywords co-occurrence and clustering showed that clinical manifestation and dissemination of the disease as well as its epidemiology have been heavily considered.

Senthamilselvi, Surulinathi, Karthik and Jeyasuriya (2020) highlighted the publication status and growth of Hantavirus/Coronavirus research in India and make quantitative and qualitative assessment by way of analysing various features of research output based on Scopus online database during the period 1975-2020. A total of 3498 publications were published and overall H-Index is 50. The publications peaked in the year 2020 with 3218 publications and most frequently cited one is “Rodriguez-Morales, A.J., Cardona-Ospina, J.A., Gutiérrez-Ocampo, E., Ahmad, T., Sah, R.. (2020) Clinical, laboratory and imaging features of COVID-19: A systematic review and meta-analysis, Travel Medicine and Infectious Disease 34,101623 with 293 citations. The USA topped the list with highest share (374) of publications. United Kingdom with 212 share of publications followed by China with 154 share of publications, Thailand with 119 share of publications, Australia and Italy with 101 share of publications respectively in the context of international collaboration. All India Institute of Medical Sciences, New Delhi topped the list with 246 publications, followed by Postgraduate Institute of Medical Education & Research, Chandigarh with 178 publications, Dr. D.Y. Patil Vidyapeeth Deemed University, Pune with 108 publications. 160 Institutes are with minimum of 10 Publications 12 Institutes. The highly productive journals are: Diabetes And Metabolic Syndrome Clinical Research and Reviews(Elsevier) with 100 publications (CiteScore-2.6, SJR-0.672 and SNIP-0.982), Asian Journal Of Psychiatry(Elsevier) with 92(CiteScore-2.7, SJR-0.736 and SNIP-1.022); Indian Journal Of Ophthalmology(Wolters Kluwer

Health)(CieScore-1.6, SJR-0.482 and SNIP-0.931) and Journal Of Biomolecular Structure And Dynamics with 80 publications respectively.

Laksham, Surulinathi, Balasubramani and Jayasuriya (2020) examined the publications on Coronavirus from India as indexed in web of science online database. The search term "Coronavirus" or "COVID 19" with topic field has been used as keyword and limited to India. A total of 281 unique records over the year 1975–2020 have been downloaded and analyzed under various categories considered for this study. The highest numbers of articles are published in the year 2016, 2017, 2018 and 2019. Year 2015 has highest number of Citations with 531 for 17 (6.2 %) publications. The study found that 1369 authors concentrated the research in this field and 281 papers published in indexed journals. International Centre for Genet Engineering & Biotechnology stood in the first with the highest number of publications with 20 (7.3 %) and received 549 Citations followed by All India Institute of Medical Science with 12 (4.4 %) Publications and received 67 Citations, Guru Ghasidas Vishwavidyalaya with 10 (3.7%) Publications and received 482 Citations, Indian Institute of Technology with 10 (3.7 %) Publications and received 86 Citations, University of Delhi with 8(2.9 %) Publications and received 128 Citations, Indian Institute of Science with 6 (2.2%) and received 61Citations. India has collaborated with 38 countries. CSIR, DBT India, UGC, USDHHS, DST India and ICMR are most funded agencies in the field of Coronavirus.

III Objectives

The objectives of the present study are:

- To trace out the document types of Indian Covid-19 research output
- To find out the most productive authors
- To know the most relevant sources
- To explore the source dynamics
- To know the most relevant affiliating institutions
- To find out the most productive countries
- To explore the most relevant countries by corresponding authors
- To find out the most frequently used keywords

IV Research Methodology

The research output of India on covid-19 as available in PubMed database as on 17/10/2021 at 1:45 pm. The keyword ‘ Covid-19’ was used to retrieve the records, on the condition that the words ‘ Covid-19 India’ should occur in the title of the research papers to be retrieved. A total of 1841 records were downloaded as a PubMed file. The file was exported to and used in R Bibliometrix tool namely Biblioshiny for examining the scientometric dimensions of Indian research output on ‘ covid-19’.

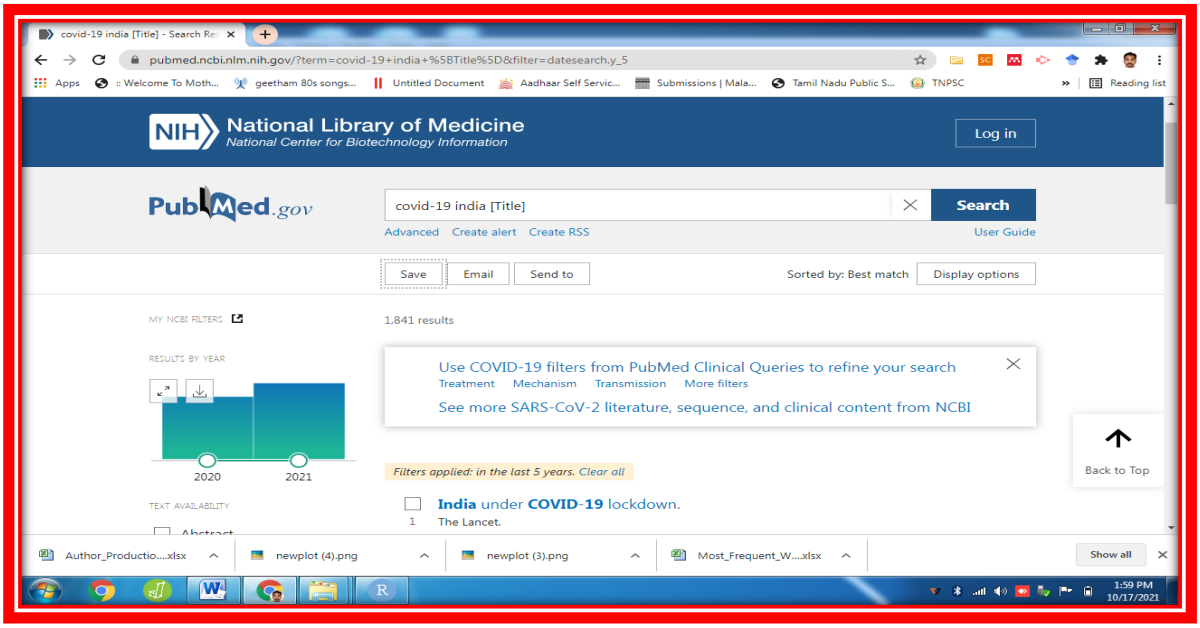

Figure 1 : Search Results

V Data Analsyis and Interpretation

Table 1 : Main Information

Description	Results
Timespan	2020:2021
Sources (Journals, Books, etc)	617
Documents	1841
Average years from publication	0.413
Average citations per documents	0
Average citations per year per doc	0

References	1
DOCUMENT CONTENTS	
Keywords Plus (ID)	2432
Author's Keywords (DE)	2432
AUTHORS	
Authors	6589
Author Appearances	11226
Authors of single-authored documents	151
Authors of multi-authored documents	6438
AUTHORS COLLABORATION	
Single-authored documents	222
Documents per Author	0.279
Authors per Document	3.58
Co-Authors per Documents	6.1
Collaboration Index	3.98

Table 1 gives main information about Indian research output on Covid-19 as available in PubMed database. 1841 records found in the database came from 617 sources covering two a two year period (2020-2021). There is no citation for these papers. 2432 keywords were used in these records. These records were contributed by 6589 authors who appeared 11226 times, in toto. There are 151 authors of single authored documents and 6438 authors of multi-authored documents. There are 222 single authored documents. There are 0.279 documents per author and there are 3.58 authors per document while there are 6.1 co-authors per document. The collaboration index is found to be at 3.98.

Table 2 : Document Types

Document Type	Count
Journal Article	1203
Letter	162
Journal Article;Review	93
Journal Article;Research Support, Non-Us Gov't	68

Editorial	62
Comment;Letter	55
Journal Article;Observational Study	34
Journal Article;Multicenter Study	18
News	16
Comment;Journal Article	14
Published Erratum	9
Case Reports	8
Case Reports;Journal Article	7
Case Reports;Letter	7
Letter;Research Support, Non-Us Gov't	7
Comparative Study;Journal Article	6
Journal Article;Practice Guideline	6
Preprint	6
Journal Article;Multicenter Study;Observational Study	4
Journal Article;Video-Audio Media	4
Journal Article;Published Erratum	3
Journal Article;Randomized Controlled Trial	3
Journal Article;Research Support, Nih, Extramural	3
Journal Article;Systematic Review	3
Case Reports;Journal Article;Review	2
Clinical Trial;Journal Article	2
Journal Article;Multicenter Study;Research Support, Non-Us Gov't	2
Journal Article;Randomized Controlled Trial;Research Support, Non-Us Gov't	2
Journal Article;Research Support, Nih, Extramural;Research Support, Non-Us Gov't	2
Journal Article;Research Support, Non-Us Gov't;Review	2
Letter;Observational Study	2
Letter;Review	2
Biography;Historical Article;News;Portrait	1
Clinical Trial Protocol;Journal Article	1

Clinical Trial, Phase Ii;Journal Article;Multicenter Study;Randomized Controlled Trial	1
Clinical Trial, Phase Iii;Journal Article;Randomized Controlled Trial;Research Support, Non-Us Gov't	1
Comment;Editorial	1
Comment;News	1
Comparative Study;Evaluation Study;Journal Article	1
Comparative Study;Journal Article;Multicenter Study	1
Comparative Study;Journal Article;Multicenter Study;Observational Study	1
Comparative Study;Journal Article;Observational Study	1
Comparative Study;Journal Article;Research Support, Non-Us Gov't	1
Comparative Study;Journal Article;Validation Study	1
Comparative Study;Letter;Multicenter Study	1
Editorial;Interview	1
Editorial;Research Support, Non-Us Gov't	1
Evaluation Study;Journal Article	1
Journal Article;Meta-Analysis	1
Journal Article;Meta-Analysis;Research Support, Non-Us Gov't	1
Journal Article;Observational Study;Research Support, Nih, Extramural;Research Support, Non-Us Gov't	1
Journal Article;Observational Study;Research Support, Non-Us Gov't	1
Journal Article;Research Support, Nih, Extramural;Research Support, Non-Us Gov't;Research Support, Us Gov't, Non-Phs	1
Journal Article;Research Support, Nih, Extramural;Research Support, Us Gov't, Phs;Review	1
Journal Article;Research Support, Nih, Intramural	1
Journal Article;Research Support, Non-Us Gov't;Research Support, Us Gov't, Non-Phs	1

Table 2 shows the document types of Indian research output on Covid-19 during 2020-2021. The pubmed database has its own classification of documents published

therein. A majority of the records were journal articles (1203) followed by letters (162), journal article reviews (93), journal article research support, non-UG Govts (68) and editorials (62). Journal articles are classified into many divisions – journal article observational study (34), journal article multicenter study (18), and journal article practice guideline (6) and so on. A good number of comparative studies were also published (7) during the study period.

Table 3: Most Relevant Authors

Authors	Articles	Articles Fractionalized
Kumar S	54	10.94
Kumar A	50	7.51
Gupta N	47	6.54
Sharma S	40	7.92
Singh S	36	5.14
Gupta S	34	5.99
Kumar R	33	8.42
Singh A	33	5.35
Gupta A	32	3.28
Sharma P	27	4.81
Sharma N	26	3.94
Sharma A	24	3.63
Ghosh A	23	4.65
Panda S	23	3.10
Gupta R	22	3.04
Das A	20	3.26
Misra S	19	2.49
Singh Ak	19	3.06
Singh R	19	2.10
Kumar M	17	2.82
Kumar P	17	3.22
Sarkar S	17	3.37

Bhatnagar S	16	1.39
Ghosh S	16	3.04
Kumar N	16	3.65
Sharma R	16	2.74
Singh K	16	1.68

Table 3 shows the most productive authors. Kumar S is the most productive author with 54 records followed by Kumar A with 50 records and Gupta N with 47 records. While Sharma S has published 40 records, Singh S and Gupta S have published 36 and 34 records respectively. Both Kumar R and Singh A have published 33 records each. These 27 authors, who have contributed more than 15 papers each, had published a total of 712 papers out of 1841.

Table 4 : Most Relevant Sources

Sources	Articles
The Indian Journal of Medical Research	57
Diabetes & Metabolic Syndrome	56
Journal of Family Medicine and Primary Care	54
Indian Journal of Ophthalmology	49
Asian Journal of Psychiatry	42
Bmj (Clinical Research Ed.)	32
The Journal of the Association of Physicians of India	22
Indian Journal of Psychological Medicine	20
Plos One	19
The Science of the Total Environment	18
Clinical Epidemiology and Global Health	17
Medical Journal Armed Forces India	17
Asia-Pacific Journal of Public Health	16
Disaster Medicine and Public Health Preparedness	15
Nature	15
Bmj Open	14

Cureus	14
Journal of Medical Virology	14
Lancet (London England)	14
Chaos Solitons and Fractals	13
Environmental Science and Pollution Research International	13
Indian Journal of Public Health	13
Scientific Reports	13
The Primary Care Companion for CNS Disorders	13
Environment Development and Sustainability	12
Frontiers in Public Health	12
Indian Journal of Critical Care Medicine : Peer-Reviewed Official Publication of Indian Society of Critical Care Medicine	12
Journal of Public Affairs	12
Postgraduate Medical Journal	12
The Lancet. Global Health	12
Epidemiology and Infection	11
Indian Journal of Otolaryngology and Head and Neck Surgery : Official Publication of the Association of Otolaryngologists of India	11
Indian Journal of Psychiatry	11

Table 4 and Fig.2 show the most productive journals of Indian research output on Covi-19 during 2020-2021. The Indian journal of Medical Research is the topper with 57 publications followed by the journal ‘ Diabetes and Metabolic syndrome’ with 56 publications and the ‘Journal of family medicine and primary care’ with 54 publications. These three journals have published more than 50 publications each with a total share of 167 publications. Indian journal of ophthalmology and Asian Journal of Psychiatry have published 49 and 42 papers respectively. All other enlisted sources have published more than 10 papers. These 33 journals have published 675 papers, all together.

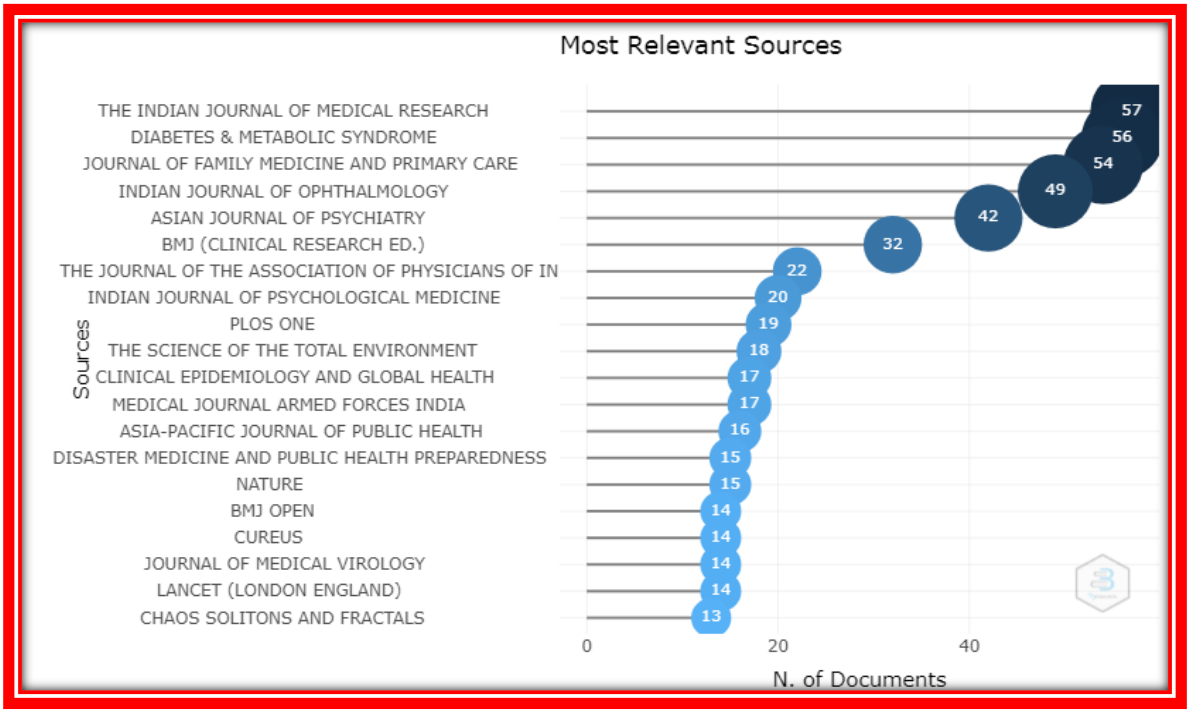

Figure 2 : Most productive Sources : Indian Covid-19 research output

Table 5: Source Dynamics

Year	2020	2021
The Indian Journal of Medical Research	36	21
Diabetes & Metabolic Syndrome	32	24
Journal of Family Medicine and Primary Care	24	30
Indian Journal of Ophthalmology	26	23
Asian Journal of Psychiatry	26	16
Bmj (Clinical Research Ed.)	11	21
The Journal of the Association of Physicians of India	10	12
Indian Journal of Psychological Medicine	16	4
Plos One	9	10
The Science of the Total Environment	15	3

Table 5 gives the year-wise publications of top 10 most productive sources in Indian Covid-19 research output during 2020-2021. The Indian Journal of Medical Research has published 36 papers in 2020 and 21 papers in 2021 followed by the journal

'Diabetes & Metabolic Syndrome' with 32 papers in 2020 and 24 papers in 2021. Journal of Family medicine and primary care published 24 papers in 2020 and 30 papers in 2021, the highest by a journal in 2021. Indian Journal of Ophthalmology had 26 and 23 papers while Asian Journal of Psychiatry had 26 and 16 papers respectively in 2020 and 2021. PLOS one, the popular open access journal has published 9 paper sin 2020 and 10 papers in 2021.

Table 6 : Most Relevant Affiliations

Affiliations	Articles
All India Institute of Medical Sciences	872
Postgraduate Institute of Medical Education and Research	201
ICMR-National Institute of Virology	127
Government Medical College	115
Indian Council of Medical Research	103
All India Institute of Medical Sciences (Aiims)	94
Post Graduate Institute of Medical Education and Research	80
National Institute of Mental Health and Neurosciences	76
King George's Medical University	71
Banaras Hindu University	67
Kasturba Medical College	66
Homi Bhabha National Institute	63
Chandigarh	59
L V Prasad Eye Institute	55
National Centre for Disease Control	54
Christian Medical College	52
Vardhman Mahavir Medical College and Safdarjung Hospital	52
Topiwala National Medical College and Byl Nair Charitable Hospital	51
Postgraduate Institute of Medical Education and Research (PGIMER)	50
Jodhpur	44
Government Medical College Srinagar	42
Armed Forces Medical College	41

CSIR -Institute of Genomics and Integrative Biology	41
Tata Medical Center	40

Table 6 and Fig. 3 show the institutional that have contributed at least 40 papers on covid-19 research output in India. All India Institute of Medical Sciences is the topper with 966 (872+94) papers followed by Postgraduate Institute of Medical Education and Research with 281 (201+80) papers and ICMR-National Institute of Virology with 127 papers. The other two institutions with more than 100 papers are : Government medical college (115) and Indian Council of Medical Research (103). National Institute of Mental Health and Neurosciences and King George's Medical university have published 76 and 71 papers respectively. Three institutions have 63-67 papers while 7 institutions have 50-59 papers and 5 institutions have 40-44 papers on covid-19 during 2020-2021.

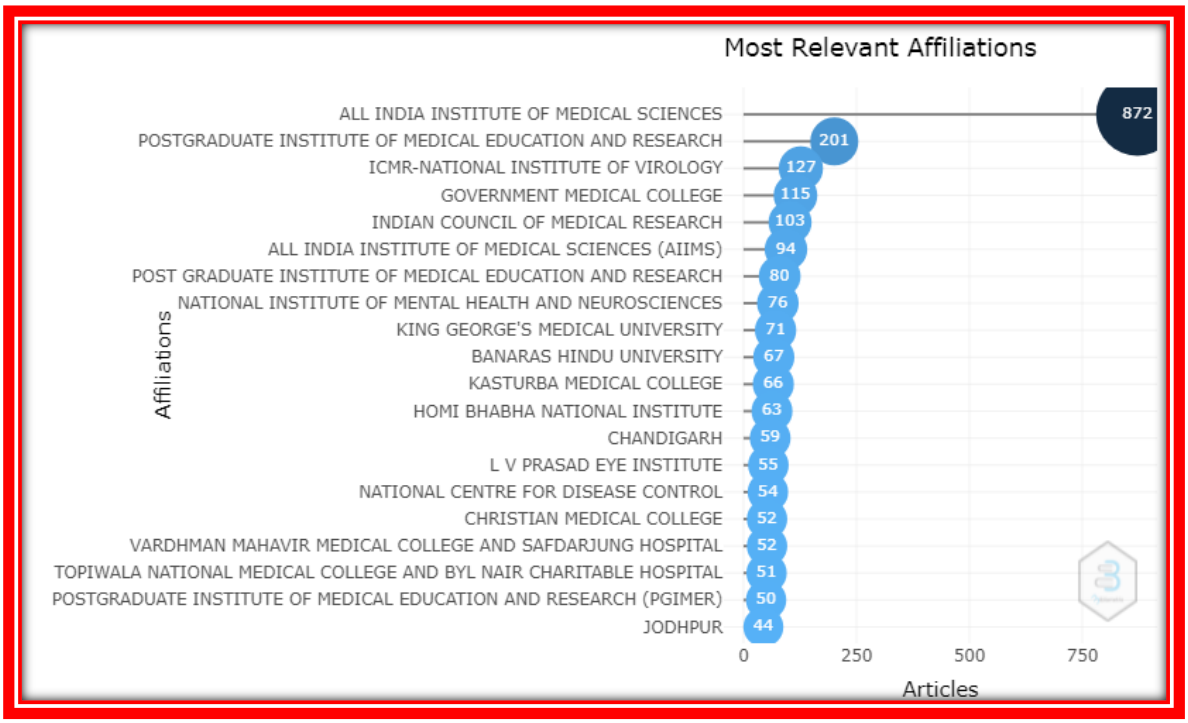

Figure 3: Most Relevant Affiliations

Table 7: Most Relevant Countries

Country	Frequency
India	9261

USA	361
China	138
Canada	51
Bangladesh	49
Australia	44
Saudi Arabia	44
UK	38
Pakistan	33
Singapore	30
Brazil	28
Japan	21
France	17
Italy	17
Germany	14
Norway	14
South Korea	13
Portugal	11
South Africa	11
Switzerland	11
Netherlands	10

Table 7 and Fig. 4 show the most productive countries of Indian Covid-19 research output 2020-2021. India is the most productive country with 9261 records followed by USA with 361 records and China with 138 records. Canada has published 51 records while Bangladesh has published 49 records. Both Australia and Saudi Arabia have 44 publications each. UK, Pakistan and Singapore have 30-38 publications while Brazil and Japan have 28 and 21 publications respectively. Other nine countries have contributed 10-17 papers on Covid-19 research.

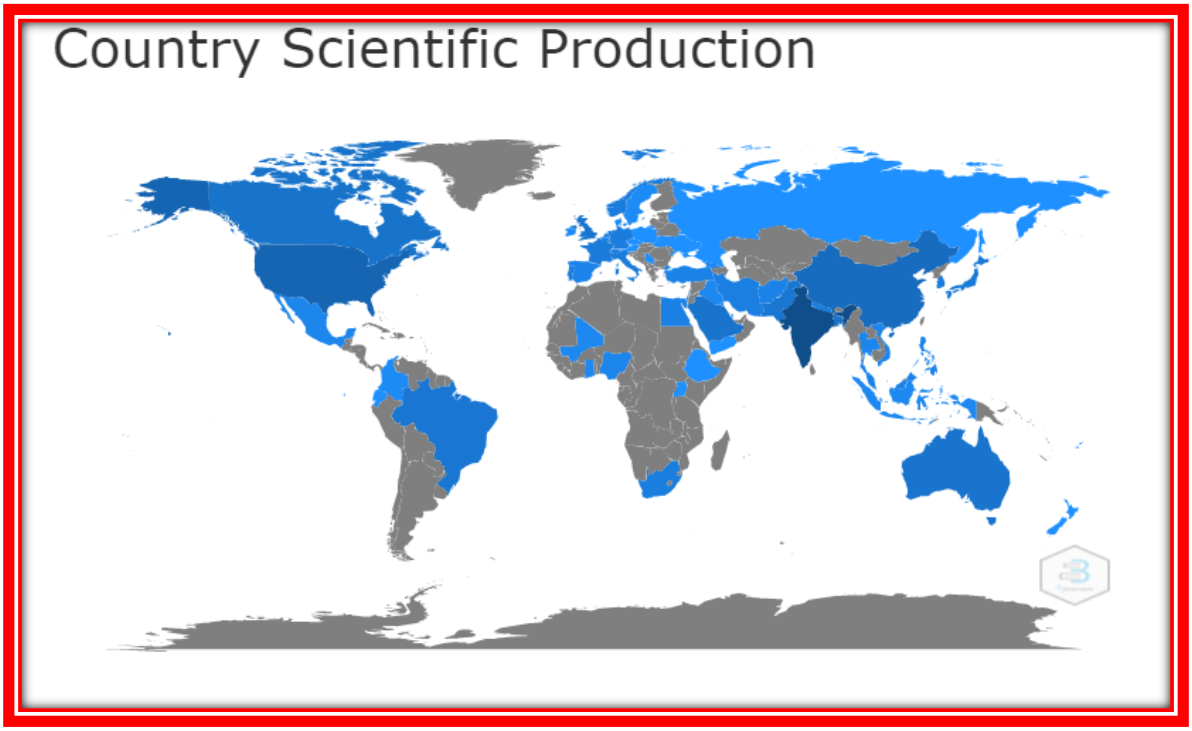

Figure 4 : Country Scientific Production

Table 8 : Most relevant countries by corresponding authors

Country	Articles	Freq	SCP	MCP	MCP_Ratio
India	1330	0.897436	1161	169	0.127
USA	60	0.040486	24	36	0.6
China	21	0.01417	13	8	0.381
Australia	7	0.004723	2	5	0.714
Canada	6	0.004049	2	4	0.667
Saudi Arabia	6	0.004049	2	4	0.667
Bangladesh	5	0.003374	5	0	0
United Kingdom	5	0.003374	4	1	0.2
France	4	0.002699	3	1	0.25
Pakistan	4	0.002699	1	3	0.75
Netherlands	3	0.002024	1	2	0.667
Singapore	3	0.002024	1	2	0.667
Italy	2	0.00135	2	0	0
Japan	2	0.00135	0	2	1

Malaysia	2	0.00135	0	2	1
Philippines	2	0.00135	0	2	1
Qatar	2	0.00135	0	2	1
Switzerland	2	0.00135	2	0	0

Table 8 shows the most productive countries in terms of corresponding authors of research papers. Indian authors served as the corresponding authors in 1330 articles of which 1161 papers are single county collaborative papers and 169 are multi country collaborative papers. Authors of USA were the corresponding authors in 60 papers of which 24 are single country and 36 are multi country collaborative papers. Countries like Bangladesh, Italy and Switzerland had only single country collaborative papers while such countries as Japan, Malaysia, Philippines and Qatar have only multi country collaborative papers. Only 1.2% of Indian contributions were out of multi-country origin while 60% of USA contributions were out of multi-country origin.

Table 9 : Most Relevant Keywords (Keyword Plus)

Words	**Occurrences**
Humans	903
Sars-Cov-2	572
India/Epidemiology	568
Covid-19	510
Pandemics	399
India	310
Female	293
Male	272
Adult	231
Middle Aged	207
Betacoronavirus	189
Young Adult	110
Aged	100
Cross-Sectional Studies	99

Adolescent	93
Child	85
Pandemics/Prevention & Control	84
Communicable Disease Control	76
Retrospective Studies	65
Surveys And Questionnaires	65
Covid-19/Epidemiology	60
Pneumonia Viral	60

Table 9 and Fig.5 show the most frequently used keywords of Indian Covid-19 research output during 2020-2021. The most frequently used keywords include humans (903), Sars-Cov-2 (572), India/Epidemiology (568) and Covid-19 (510). The second order of frequently used words includes pandemics (399), India (310), Female (293), male (272), adult (231) and middle aged (207). The third order includes three words namely betacoronovirus (189), young adult (110) and aged (100). Other 9 keywords appeared in 60-99 times.

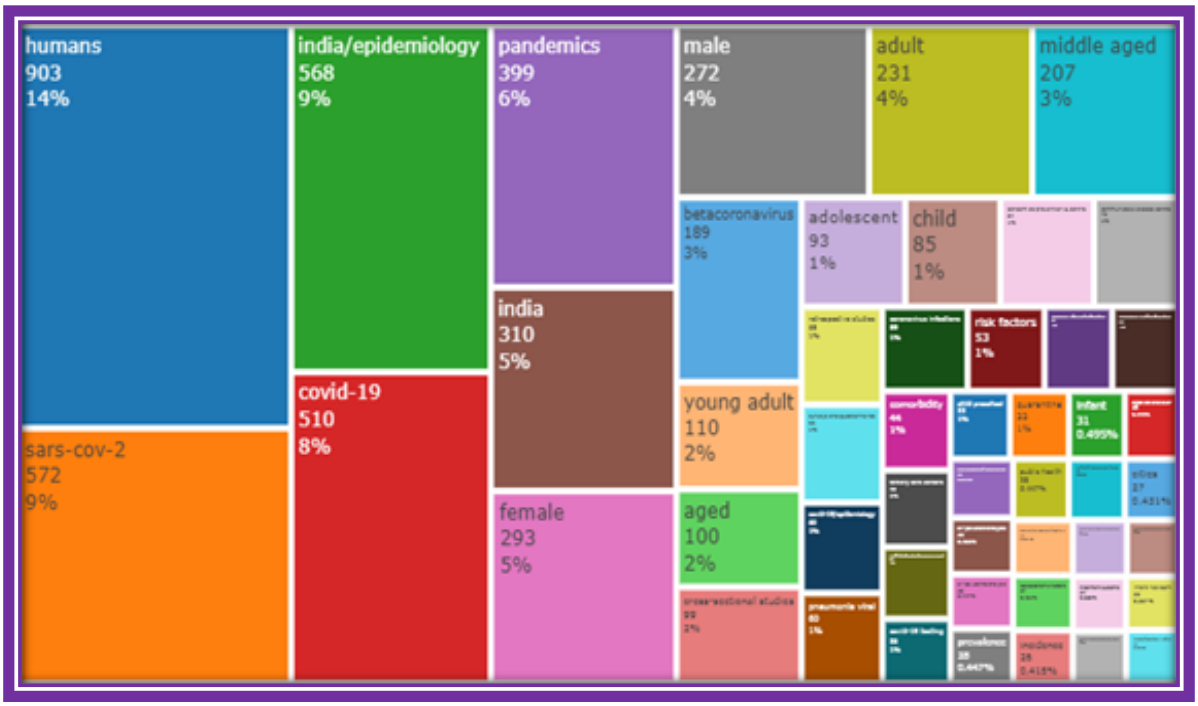

Figure 5 : Word Tree : Covid-10 Research Output of India

VI Conclusion

The Indian research on covid-19 is significant and impactful. More covid-19 related research publications should be made available in the open access platforms. Both the government and non-governmental organizations and research institutions should earmark a good amount of funds for sponsoring research projects on covid-19 and related issues. A holistic approach is required in the research activities. It is the time when the scientists of various disciplines come together and undertake collaborative research works to bring out better findings to ameliorate the present post-covid 19 era.

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