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# A Scientometric Study of Microbiology & Immunology: Pre & Post Covid-19 Pandemic Assessment

**Jyoti Rana ***
**R.K. Bhatt****

*Last decade has witnesses many advances in the understanding of Immunology, Human Immune system and how very cog in Immune system works to protect the body against an infection. Since 2020 COVID and prevention of pandemics in near future have also taken the centre stage in laboratories and lab-based research. This study is assessing the growth of research and also effects of pandemic on the research in the field of Immunology & Microbiology especially within India. Many of the gaps in knowledge pertaining to the comparison of pre and post covid research behaviour in the area of Immunology and Microbiology in India were attempted to be answered.*

**Keywords:** *Bibliometrics, Scientometrics analysis, Immunology and Microbiology, Scopus, Research* Output, COVID

## 1 INTRODUCTION

Last decade has witnesses many advances in the understanding of Immunology, Human Immune system and how very cog in Immune system works to protect the body against an infection. Immunology has complex nature as a subject. Immunology and varied aspects of it become essential to study in dept for medical students, primary care givers, surgeons, healthcare professionals. Immunology is a field dedicated to understand the structures of immune system and study the related disorders of the immune system, vaccination and process of transplantation[1]. Immunology is a branch in sciences

* Assistant Librarian in HNB Garhwal University, Uttarakhand, EMAIL: jyotilis14@gmail.com

** Department of Department of Library and Information Science of Delhi University. EMAIL: drbhattrk63@gmail.com

that studies the responses and effects of body's Immunity against attack by other foreign bodies. In a more scientific logic, immunology is the understanding the progress of defence in the body against disease-causing bacteria and other microorganisms and with disorders caused by that system's malfunctioning. Cancer and AIDS were always the hotspot in the research aspect of immunology but since 2020 COVID and prevention of pandemics in near future have also taken the centre stage in laboratories and lab-based research. This study is assessing the effects of pandemic on the research in the field of Immunology & Microbiology especially within India and around the world.

## 2 REVIEW OF LITERATURE

Grover, Sandeep, et al. in the study "Covid-19 and Psychology: A Scientometric Assessment of India's Publications during 2020-21." examined the publication pattern and research output of Indian authors on the topic "Covid and Psychology." The publications for bibliometric analyses were retrieved from Scopus database. The publication search was restricted by the subject "psychology" and the keyword "covid-19" with the country tag of India. The total of 372 documents were collected for the two years 2020-2021. The Indian output accounted for 4.63% of the world's output. 25.81% are result of international collaboration. 9.95% of the total publications were the result of external funding received. National Institute of Mental Health and Allied Sciences was the institute with the highest impact followed by Postgraduate Institute of Medical Education and Research and All India Institute of Medical Sciences, New Delhi. Total of 416 authors and 277 institutes participated in the research. The most impactful subject area in the terms of keywords frequency included 'mental disease', 'anxiety', 'depression', 'mental stress', and 'social isolation'. In the Covid, last two years 2020 and 2021 many publications developed in the area Covid and psychology from India. [2]

Górski, Andrzej, et al. confirm in the paper "Journal Impact Factor and Self-Citations." that with all the drawbacks and limitations of Impact factor, it remains as a measure of scholarly success while hiring and promotion in some universities. One of the major criticisms of impact factor is that IF can be spiked by increase in self-citation (SC), hence Scopus, web of science and Journal Citation Report (JCR) now publishes the values of both total average citation and the value without self-citation. It is also pointed out that there is corelation between self-citation and Impact factor, but the correlation is closer when the value of self-citations and IF is smaller. It is understood that for a journal with low IF, high self-citation will increase IF significantly but in case of journal having high IF value, smaller number of self-citation relative to high number of citations will have little influence on IF. On the contrary a journal

with medium IF value will see high influence in case the self-citations are high. Several journals in the past have been accused of IF manipulation and were temporarily withdrawn from JCR list due to unethical practices. It is easy to identify self-citations, but citation lobbies do maximum harm on the scientometrics as they are difficult to track on manipulated data.[3]

Kalra (Gagan) et al. conduct a comprehensive study on the impact of coronavirus disease pandemic on one of the high hit healthcare specialities i.e., ophthalmology. There is huge jump on the covid related research in ophthalmology and the paper aims to perform scientomeric analysis of all research affecting to COVID-19 and ophthalmology. The descriptive quantitative metrics in of WOS data in the paper "Covid-19 and Ophthalmology: A Scientometric Analysis." provides evidence of increased collaboration globally in the covid related research in ophthalmology to fight the pandemic together.[4]

Mayta-Tovalino, Frank, et al. in the paper "A Scientometric Analysis of Scholarly Output on Covid-19 and Dentistry" to understand the concept of scientometrics is to analyse the publications using characteristics indicators. The covid related research in the field of dentistry was studied in this paper using specialised search strategy where documents were obtained from the journals indexed in Scopus for the time period 2019-2022 and the variables were analysed in SciVal Elsevier. Total of 2071 papers were retrieved and the highest impact subject area and journal and institution, counties were reported. It was concluded that Covid pandemic caused spike in the number of papers. International collaboration bloomed during this period. UK and India were found to have highest scientific production. [5]

Liu, Yan-Li, et al. observed that since the outbreak of covid -19 at the end of the year 2019, an increase in the covid-19 related research can be observed. Many articles aim at providing better understanding of pandemic which is emerging theme. In the social sciences, there is proliferation of the research in the field problems associated with Covid-19 pandemic. Many scientometric studies have assess the medical and scientific research and put efforts in understanding the impact of covid-19 on science but it can also be observed that social science research in this aspect has been slightly ignored by scientometric researchers. This study provides the insight into social science research and the international collaborations in this landscape. The data retrieved from the database of web of science which was further analysed using VOS viewer. In the paper "The State of Social Science Research on COVID-19." the output was interpreted and then keyword and co-authorship networks were created. The most active social science subjects related to covid-19 were psychology and mental health. The USA was the leading contributors with highest global collaborations. The Harvard University was found to be

the leading University in case of institution/organisations productivity. Collaborations throughout the world were extensive. This study is highly important knowing the socio-economic impact of Covid-19. The results can be helpful for social science scientist for field gain, qualitative and quantitative insights into the building and pace of scholarly research on pandemic, finding collaborative partners and identifying the knowledge gaps for potential future social science studies.[6]

## 3 METHODOLOGY

The methodology follows longitudinal approach through which the research output of India in of Immunology and Microbiology is examined through the time period starting from the year 2013 till the years of Covid pandemic. The research metrics and indicators are used to quantify the research output and then compare the performance during the onset and peak of Covid pandemic. The study aims to analyse the change in the volume of research, the rate of growth, collaborative pattern of the researchers and quality of research. The comparison of authorship pattern and research behaviour is constantly made to the years of Covid pandemic. The data and information for the publications were collected from the Scopus. Scopus database is considered as one of the largest abstract and citation database of peer-reviewed scientific research. It has larger reach in terms of quantity as compared to PubMed or Web of science. The data collected was then evaluated and visualised using M.S. Excel.

## 4 DATA ANALYSIS AND INTERPRETATION

### 4.1. Distribution of Research Literature

| Year | No. of Papers | Percent |
|---|---|---|
| 2013 | 3150 | 8.92 |
| 2014 | 2978 | 8.43 |
| 2015 | 3364 | 9.52 |
| 2016 | 3873 | 10.96 |
| 2017 | 4002 | 11.33 |
| 2018 | 3745 | 10.60 |

| | | |
|---|---|---|
| 2019 | 3875 | 10.97 |
| 2020 | 4485 | 12.70 |
| 2021 | 5856 | 16.58 |
| Total | 35328 | 100.00 |

**Table 1. Frequency Distribution of Research Literature**

Table 1 provides the details of number of research articles that were published from 2013 to 2021 in Immunology and Microbiology by India. From the table we can infer that the number of research articles steadily grew from 2013 to 2019 with minor fluctuations in the year 2017. A sharp rise can be observed from the Covid pandemic years 2020 till 2021. The Covid pandemic year also share the largest percentage pie in the total number of papers in the tally.

### 4.2. Year Wise Document Type Publications

| **Document type** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|
| ARTICLE | 2668 | 2561 | 2841 | 3044 | 2849 | 2768 | 2768 | 3304 | 4012 | **26815** |
| REVIEW | 247 | 228 | 239 | 334 | 324 | 386 | 388 | 666 | 1046 | **3858** |
| BOOK CHAPTER | 105 | 49 | 140 | 216 | 582 | 441 | 535 | 207 | 346 | **2621** |
| LETTER | 38 | 32 | 36 | 57 | 46 | 43 | 45 | 64 | 118 | **479** |
| CONFERENCE PAPER | 8 | 5 | 4 | 123 | 51 | 2 | 4 | 85 | 145 | **427** |
| NOTE | 21 | 23 | 31 | 29 | 52 | 28 | 24 | 46 | 60 | **314** |
| ERRATUM | 17 | 25 | 17 | 13 | 22 | 21 | 40 | 51 | 47 | **253** |
| EDITORIAL | 23 | 23 | 24 | 19 | 18 | 15 | 25 | 28 | 53 | **228** |
| BOOK | 10 | 13 | 17 | 23 | 40 | 29 | 38 | 18 | 23 | **211** |
| SHORT SURVEY | 9 | 15 | 11 | 10 | 14 | 9 | 7 | 10 | 6 | **91** |
| RETRACTED | 4 | 4 | 4 | 5 | 4 | 2 | 1 | 6 | | **30** |
| DATA PAPER | | | | | | 1 | | | | **1** |
| **Total** | **3150** | **2978** | **3364** | **3873** | **4002** | **3745** | **3875** | **4485** | **5856** | **35328** |

**Table 2. Year wise Document type Publications**

This table analyses types of documents for the study year wise. The maximum number of articles were produced in the year 2021, peak covid year, with 4012 articles followed by 2020 with 3304 articles. Majority of Book chapter were published in 2017. In case of conference papers majority were published in 2021 followed by 2016 with 123 papers. It is observed that there is a major dip in the conference papers in 2020 with peak of COVID.

### 4.3. Research Literature Growth Rate

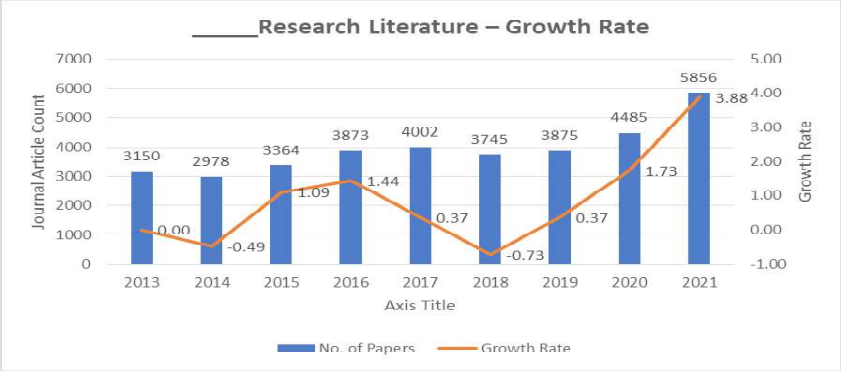


**Fig 1. Research Literature**

From corresponding graph, an inconsistent growth rate is observed in the research articles published in the area immunology and microbiology in Indian context. The Covid Pandemic time frame i.e., 2020 and 2021 observed the highest growth rate signalling to the fact that there was an increase in the volume of papers in pandemic. The overall average annual growth rate for the whole period under study is found to be 0.96 percent, which is slightly less than 1.0 percent

### 4.4. Authorship Pattern – Trend Analysis

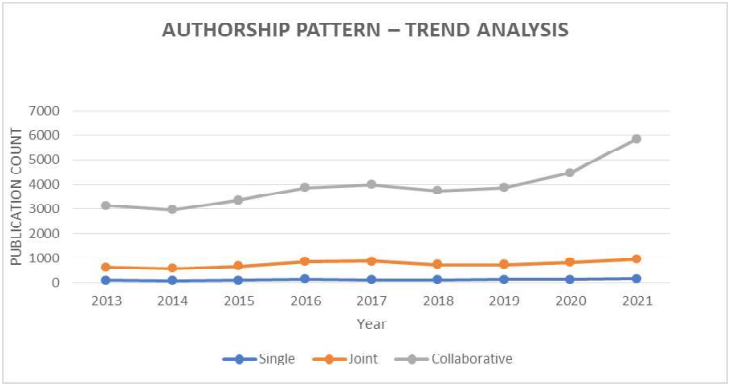


**Fig 2. Authorship Pattern – Trend Analysis**

It is observed in the corresponding figure that single and joint authorship remained almost consistent from 2013 to 2021, whereas collaborative authorship underwent an increasing trend. The number of single authored articles remained below 100 from 2013 to 2018; afterwards there is an increase of all time high in 2021 when pandemic was at peak. From the graph, it can be inferred that the collaborative authorship occupies the major portion of total authorship count and with high peak observed in Covid.

### 4.5. Year Wise Publication Output on Immunology Research

| Year | No. of Papers | Cumulative no. of papers | Percent | Cumulative Percentage | Total Citations |
|---|---|---|---|---|---|
| 2013 | 3150 | 3150 | 8.92 | 8.92 | 72885 |
| 2014 | 2978 | 6128 | 8.43 | 17.35 | 65713 |
| 2015 | 3364 | 9492 | 9.52 | 26.87 | 63419 |
| 2016 | 3873 | 13365 | 10.96 | 37.83 | 65411 |
| 2017 | 4002 | 17367 | 11.33 | 49.16 | 58053 |
| 2018 | 3745 | 21112 | 10.60 | 59.76 | 54459 |
| 2019 | 3875 | 24987 | 10.97 | 70.73 | 41074 |
| 2020 | 4485 | 29472 | 12.70 | 83.42 | 41711 |
| 2021 | 5856 | 35328 | 16.58 | 100.00 | 25139 |
| | 35328 | | 100.00 | | |

**Table 3. Year Wise Publication Output on Immunology Research**

In above table a year wise distribution was performed for Indian output during 2013-2021. The total articles published amounted to 35328. Out of this total of 35328 articles, majority of articles were published in the year 2021.The year 2020 and 2022, the years marked the onset of COVID Pandemic, observed a peak in the output of India and the world. The year 2014 with 8.43% of total records was the least productive year in terms of quantity. The cumulative percentages show that almost 50% of total record was published in the block 2013-2017.

### 4.6. Relative Quality Index (RQI) of the Immunology Research

The Relative Quality Index is measured for the qualitative assessment of papers published by India on Immunology and Microbiology research for the time period 2013-2021 and the formula used to depict that.

$$\text{Relative Quality Index} = \frac{\text{Number of cited publication/ total citations of the year}}{\text{Total cited publications of that year / Total citations}}$$

$$= \frac{3150/\ 33103}{72885/487864}$$

$$= .060$$

| Year | No. of Papers | Total Citation | RQI |
|---|---|---|---|
| 2013 | 3150 | 72885 | 0.60 |
| 2014 | 2978 | 65713 | 0.63 |
| 2015 | 3364 | 63419 | 0.73 |
| 2016 | 3873 | 65411 | 0.82 |
| 2017 | 4002 | 58053 | 0.95 |
| 2018 | 3745 | 54459 | 0.95 |
| 2019 | 3875 | 41074 | 1.30 |
| 2020 | 4485 | 41711 | 1.48 |
| 2021 | 5856 | 25139 | 3.22 |
| | 35328 | 487864 | |

**Table 4. Relative Quality Index (RQI)**

The Relative Quality Index is calculated for the measure of the excellence of papers published with reference to the cited publication in the particular year to the number of citations in that year. The RQI values are ranging from 0.60 to 1.48 and the values are high in the quality journals. The study table has total 35328 papers with 487864 citations in total.

### 4.7. Keyword Output

The Keyword analysis for a block of 5 years was conducted for the purpose of understanding the correlation between the hike in COVID related publications and the overall peak in the publications in the field of Immunology and Microbiology during Pandemic. An advanced search of the top keywords on Scopus database related for COVID was deployed. The search was limited to keywords "**COVID-19", "Coronavirus Disease 2019", "SARS-CoV-2**" and **"Pandemic".** Total of 1062 documents were extracted limited by these keywords for subject Immunology and Microbiology for five-year time block 2017-2021 for India publication.

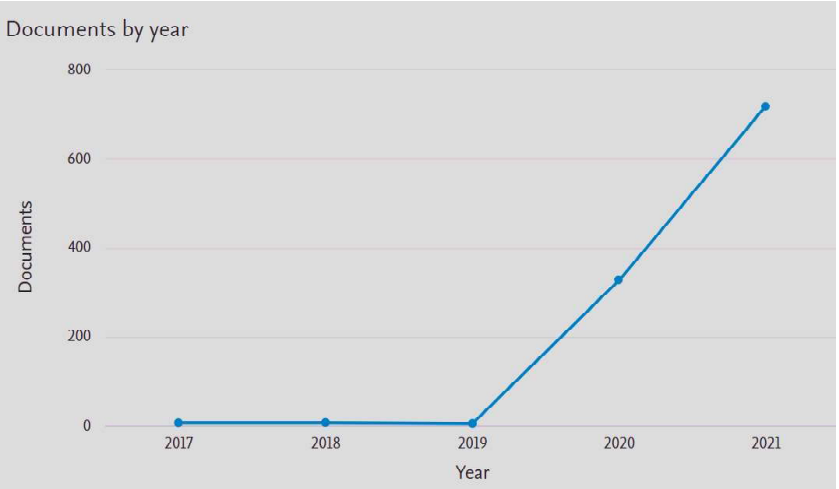


**Fig3. Keyword Analysis for COVID related keywords**

The papers which received maximum citations from 2017-2021 were separately analysed. To create a keyword cluster top 400 of these highly cited Indian papers were picked and evaluated. In the year 2021 when the Covid wave reached a peak, the 400 highly cited papers were dominant with COVID related keywords such as "coronavirus", "COVID 19", "Sarscov2" indicating the shift in the publication pattern as opposed to the previous years


**Fig 4. Keyword analysis for top 400 papers with highest citations in 2021**

## 5 CONCLUSION

The total tally of research articles published amounted to 35328. Out of this total of 35328 articles, majority of articles were published in the year 2021 with 4012 articles followed by 2020 with 3304 articles. The year 2020 and 2022, the years marked the onset of COVID Pandemic, observed a peak in the output of India and the world. The number of research articles steadily grew from 2013 to 2019 with minor fluctuations in the year 2017. A sharp rise can be observed from the Covid pandemic years 2020 till 2021. The Covid pandemic year also share the largest percentage pie in the total number of papers in the tally. Majority of Book chapter were published in 2017. In case of conference papers majority were published in 2021 followed by 2016 with 123 papers. It is observed that there is a major dip in the conference papers in 2020 with peak of COVID. The Covid Pandemic Years i.e., 2020 and 2021 observed the highest growth rate signalling to the fact that there was an increase in the volume of papers in pandemic. The overall average annual growth rate for the whole period under study is found to be 0.96 percent, which is slightly less than 1.0 percent. Single and joint authorship remained almost consistent from 2013 to 2021, whereas collaborative authorship underwent an increasing trend. The number of single authored articles remained below 100 from 2013 to 2018; afterwards there is an increase of all time high in 2021 when pandemic was at peak.

Many of the gaps in knowledge pertaining to the comparison of pre and post covid research behaviour in the area of Immunology and Microbiology topic were attempted to be answered. The scholarly yield in Immunology and

Microbiology in India and the world in general increased in Covid pandemic. There is a clear rise in the rate of the growth during this time. There is visible rush to produce scholarly literature during covid and the quality of these papers and the correlation to journal's performance during this time should be further explored.

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