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Scientometric Study on Immunology at National Level Through Web Of Science Database

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Abstract

This study reveals that research productivity of Immunology in India during the year 1993-2017 (25 years). The Web of Science (WoS) database was used in the data reclamation. The explore term used was “Immunology” and considered as a vital keyword of the topic discussed. Source and highly cited articles based on data obtained on Immunology beginning Web of Knowledge. It is found that the Country is India together contributed 397 articles during 1993-2017. The study mainly focused that year wise, Language wise publications, Document type publications, Authorship pattern, Subramaniam’s degree of collaboration and H- index score for highly productive authors, Source wise distributions, Keywords wise distributions, Applicability of Zipf’s law method, Page wise and Subject wise Publications was tested. This downloaded, transferred to Bibexcel, VoS viewer, and MS-Excel files for further scrutiny.

Keywords: Scientometric, Immunology, VoS viewer, Zipf law, Bibexcel tool, Co-Authorship Index, H-Index

1. Introduction

Immunity, or resistance, is a state in which a person, either naturally or by some acquired mechanism, is protected from contracting certain disease or infections. In the 15th century, cured attempts were made by the Chinese and the Turks to induce immunity. The report suggests that dried crusts derived from smallpox pustules were inhaled or inserted into the cuts in the skin. The ability to resist disease may be innate (nonspecific), or it may be acquired (specific) when the disease state is emulated in the host. Immunological processes underlying the reaction of the body to infectious agents, to tumors, to transplanted tissues and organs have been well understood and great advances have been made in the immunological techniques.

The antibodies power has a decisive role in immunity and this actuality was reinforced by Jules Border who discovered flatterling remark in 1899. The stimulation of a antibodies to a particular

pathogen is known as adoptive or acquired immune response, because it is required during the life time of an individual as an adoptive response to a specific pathogen.

2. Review of Literature

Gupta, Kaur & Bala (2011) analyze the research output in diabetes during 1999-2008 on numerous parameters, as well as its growth, rank and global publications share, citation impact, the overall share of international collaborative papers, and share of major collaborative partners. They also analyze the individuality of most productive institutions, authors, and highly-cited papers. The publications output, impact and collaborative publication share of India are also compared with that of China, South Korea, and Brazil.

Vanitha A et.al (2017) this research concentrated on earthworm analysis. The records are collected from the web of science database for the period of 2007-2016. The total number of publications collected for this study was 3939. In the authorship productivity, the highest number of articles was developed by a three authors 771. The highest number of publications that is 491 was produced in the year 2016. The application Zipf law in the earthworm search, the “Soil” is a keyword used frequency of 526 times. The vermin composting used soil has a lot of nutrition than in a normal soil. And compare to the harmful pesticides, the earthworm vermin composting gives the natural breath to the soil and crops.

3. Objectives of the study

- ✓ To study the Indian research output and Relative Growth Rate of Immunology research
- ✓ To analyze the Language wise publications
- ✓ To find out the Document type publications
- ✓ To determine the Authorship pattern, Degree of Collaborations
- ✓ To investigate H- Index score for highly productive authors
- ✓ To identify the most productive Journals and Keywords wise publications
- ✓ To study the broad Subject areas and Page wise publications
- ✓ To examine the Collaborative Country wise publications
- ✓ To find out the Abstract wise distributions of immunology publications

4. Methodology

The data for this study was downloaded from the Web of Science database for the keyword “immunology”. This may be considered as central keywords of the topic discussed. Therefore, the maximum retrieves may be expected by using this term. A total 397 of unique records spanning over the year 1993-2017 has been downloaded and saved. The downloaded data have been analyzed with Bibexcel, VoS viewer and MS-Excel files for further analysis.

5. Data analysis and interpretation

Table 5.1 - Year of publications

Research output on Immunology in India during the period 1993-2017 (25 years), inclusive of both years extracted from Web of Science database. The World level output of the immunology research was 34259, out of world output only Indian publications (397) were selected. Out of 397 articles, it is seen that the largest number of an article published in the year 2016 with 49 research articles (ACPP 1.69), however 35 (23.71ACPP) and 35 (21ACPP). The lowest number of article published in the year 1993 and 1994 records were 2 and the total citation was 38 (19ACPP) in the year of, total citation was 51 (25.5ACPP) in the year of 1994 respectively.

| S. No | Publication period | TP | % | TC | ACPP |
|-------|--------------------|----|-------|-----|-------|
| 1 | 1993 | 2 | 0.50 | 38 | 19 |
| 2 | 1994 | 2 | 0.50 | 51 | 25.5 |
| 3 | 1995 | 4 | 1.00 | 29 | 7.25 |
| 4 | 1996 | 4 | 1.00 | 47 | 11.75 |
| 5 | 1997 | 7 | 1.76 | 125 | 17.85 |
| 6 | 1998 | 5 | 1.25 | 11 | 2.2 |
| 7 | 1999 | 6 | 1.51 | 228 | 38 |
| 8 | 2000 | 5 | 1.25 | 103 | 20.6 |
| 9 | 2001 | 3 | 0.75 | 14 | 4.67 |
| 10 | 2002 | 12 | 3.02 | 120 | 10 |
| 11 | 2003 | 6 | 1.51 | 176 | 29.33 |
| 12 | 2004 | 6 | 1.51 | 222 | 37 |
| 13 | 2005 | 5 | 1.25 | 146 | 29.2 |
| 14 | 2006 | 6 | 1.51 | 118 | 19.67 |
| 15 | 2007 | 18 | 4.53 | 297 | 16.5 |
| 16 | 2008 | 13 | 3.27 | 239 | 18.38 |
| 17 | 2009 | 24 | 6.04 | 707 | 29.45 |
| 18 | 2010 | 32 | 8.06 | 823 | 25.71 |
| 19 | 2011 | 35 | 8.81 | 810 | 23.14 |
| 20 | 2012 | 35 | 8.81 | 735 | 21 |
| 21 | 2013 | 33 | 8.31 | 520 | 15.76 |
| 22 | 2014 | 28 | 7.05 | 701 | 25.03 |
| 23 | 2015 | 29 | 7.30 | 110 | 3.79 |
| 24 | 2016 | 49 | 12.34 | 83 | 1.69 |

| | | | | | |
|----|--------------|------------|------------|-------------|---------------|
| 25 | 2017 | 28 | 7.05 | 9 | 0.32 |
| | Total | 397 | 100 | 6462 | 452.79 |

Table 5.2 - Relative Growth Rate and Doubling Time

This table shows that Relative Growth Rate of total output and also the Doubling Time for publications. It is observed that the Relative Growth Rate for all sources of output has decreased from the first Five years of 1993-1997 (0.45) last Five years 2012-2017 (0.11) respectively. The mean doubling time for the period first five years 1993-1997 (1.04), and last five years 2012-2017 (6.73) respectively. The whole study period has witnessed a a doubling time for total contribution at 22.6. In general in the Relative Growth Rate of publication output has shown a decline trend, Where as a Mean Doubling time for publication has shown increasing trend.

| S. No | No. of Articles | Cumulative Articles | Log (W1) | Log (W2) | R (a) (W2-W1) | Mean (a) | Doubling Time Dt (a) | Mean Doubling Time |
|-------|-----------------|---------------------|----------|----------|---------------|----------|----------------------|--------------------|
| 1993 | 2 | 2 | - | 0.69 | - | 0.45 | - | 1.04 |
| 1994 | 2 | 4 | 0.69 | 1.38 | 0.69 | | 1.00 | |
| 1995 | 4 | 8 | 1.38 | 2.07 | 0.69 | | 1.00 | |
| 1996 | 4 | 12 | 2.07 | 2.48 | 0.41 | | 1.69 | |
| 1997 | 7 | 19 | 2.48 | 2.94 | 0.46 | | 1.50 | |
| 1998 | 5 | 24 | 2.94 | 3.17 | 0.23 | 0.194 | 3.01 | 4.36 |
| 1999 | 6 | 30 | 3.17 | 3.40 | 0.23 | | 3.01 | |
| 2000 | 5 | 35 | 3.40 | 3.55 | 0.15 | | 4.62 | |
| 2001 | 3 | 38 | 3.55 | 3.63 | 0.08 | | 8.67 | |
| 2002 | 12 | 50 | 3.63 | 3.91 | 0.28 | | 2.48 | |
| 2003 | 6 | 56 | 3.91 | 4.02 | 0.11 | 0.12 | 6.3 | 6.55 |
| 2004 | 6 | 62 | 4.02 | 4.12 | 0.1 | | 6.93 | |
| 2005 | 5 | 67 | 4.12 | 4.20 | 0.08 | | 8.67 | |

| | | | | | | | | |
|--------------|------------|-----|------|------|------|--------------|------|-------------|
| 2006 | 6 | 73 | 4.20 | 4.29 | 0.09 | | 7.7 | |
| 2007 | 18 | 91 | 4.29 | 4.51 | 0.22 | | 3.15 | |
| 2008 | 13 | 104 | 4.51 | 4.64 | 0.13 | 0.18 | 5.33 | 3.92 |
| 2009 | 24 | 128 | 4.64 | 4.85 | 0.21 | | 3.3 | |
| 2010 | 32 | 160 | 4.85 | 5.07 | 0.22 | | 3.15 | |
| 2011 | 35 | 195 | 5.07 | 5.27 | 0.2 | | 3.47 | |
| 2012 | 35 | 230 | 5.27 | 5.43 | 0.16 | | 4.33 | |
| 2013 | 33 | 263 | 5.43 | 5.57 | 0.14 | 0.11 | 4.95 | 6.73 |
| 2014 | 28 | 291 | 5.57 | 5.67 | 0.1 | | 6.93 | |
| 2015 | 29 | 320 | 5.67 | 5.77 | 0.1 | | 6.93 | |
| 2016 | 49 | 369 | 5.77 | 5.91 | 0.14 | | 4.95 | |
| 2017 | 28 | 397 | 5.91 | 5.98 | 0.07 | | 9.9 | |
| Total | 397 | | | | | 1.054 | | 22.6 |

Relative Growth Rate (RGR) is the measure to analyze the increase in terms of number of literature output of a particular period of time whereas Doubling Time (DT) is the period of the required for a quantity to double in size of value.

Table 5.3 - Language wise publications

It is forever helpful for the canvasser and the in sequence, scientists to know the language(s) in which objects of their area of specialty is available. The majority of the articles were published in English 396 (99.75%). The succeeding grade taken by Polish was 1 (0.25%) only.

| Name of the Language | TP | TC |
|---|------------|------------|
| English | 396 | 6462 |
| Polish | 1 | 0 |
| Total | 397 | 100 |
| TP = Total Papers; TC = Total Citation | | |

Table 5.4- Document type wise distributions

The analysis of the “Immunology” is published in 10 types of document. Out of 397 references, 285 (71.78%) are from Articles, followed by Review with 71 (17.88%), Editorial Material 22 (5.54%) and so on. The remaining was produced below 10 publications.

| S. No | Name of the document | TP | % | TC | ACPP | H – Index |
|---|----------------------------------|------------|------------|------|-------|-----------|
| 1 | Article | 285 | 71.78 | 4489 | 15.75 | 34 |
| 2 | Review | 71 | 17.88 | 1714 | 24.14 | 20 |
| 3 | Editorial Material | 22 | 5.54 | 198 | 9 | 5 |
| 4 | Article; Proceedings Paper | 9 | 2.26 | 58 | 6.44 | 3 |
| 5 | Meeting Abstract | 4 | 1.00 | 3 | 0.75 | 1 |
| 6 | Letter | 2 | 0.50 | 0 | 0 | 0 |
| 7 | Reprint | 1 | 0.25 | 0 | 0 | 0 |
| 8 | News Item | 1 | 0.25 | 0 | 0 | 0 |
| 9 | Biographical-Item | 1 | 0.25 | 0 | 0 | 0 |
| 10 | Editorial Material; Book Chapter | 1 | 0.25 | 0 | 0 | 0 |
| Total | | 397 | 100 | | | |
| TP = Total Paper; TC = Total Citation; ACPP = Average Citation Per paper | | | | | | |

Table 5.6 - Authorship pattern

Table 4 depicts that the authorship pattern of assistance by a more than seven authors 69 (17.38%). The contributions of three authors is 64 (16.12%), Five authors 56 (14.12%) and Two authors contributions is 52 (13.09%). The authorship pattern reveals a remarkable different between the number of single and multi authors. The study opined that team research is favored in Immunology research in Web of Science database.

| S. No | No. of. Authors | Records | Cumulative Records | % | Cumulative % |
|-------|-----------------|---------|--------------------|-------|--------------|
| 1 | Single Author | 31 | - | 7.80 | - |
| 2 | Two Authors | 52 | 83 | 13.09 | 20.89 |
| 3 | Three Authors | 64 | 147 | 16.12 | 37.01 |
| 4 | Four Authors | 49 | 196 | 12.34 | 49.35 |
| 5 | Five Authors | 56 | 252 | 14.12 | 63.47 |
| 6 | Six Authors | 40 | 292 | 10.07 | 73.54 |
| 7 | Seven Authors | 36 | 328 | 9.06 | 82.6 |
| 8 | > Seven Authors | 69 | 397 | 17.38 | 100 |

| | | | | |
|--------------|------------|--|------------|--|
| Total | 397 | | 100 | |
|--------------|------------|--|------------|--|

Table 5.7 - Degree of Collaboration

The year –wise degree of collaboration of authors is shown in Table 5. The extent of the degree of collaboration in Immunology research has been measured with the help of the formula devised by K. Subramaniam. Thos formula has been adopted to examine the extent of research collaboration in the study.

| S. No | Authorship Pattern | Records | % |
|--------------|--------------------|------------|------------|
| 1 | Single Author | 31 | 7.80 |
| 2 | Multi Authors | 366 | 92.19 |
| Total | | 397 | 100 |

The formula where; $DC = \frac{Nm}{Nm+Ns}$

DC = Degree of Collaboration Nm = Number of Multi Authors Ns = Number of Single Author

$$= \frac{366}{366+31} = \frac{366}{397} = 0.92$$

Table 5.8 H – Index score for Highly Productive authors (Top 10)

| S. No | h-index | Author | Citation sum within h-core | All citations | All articles |
|-------|---------|-------------|----------------------------|---------------|--------------|
| 1 | 7 | Saha B | 368 | 372 | 8 |
| 2 | 6 | Singh S | 118 | 143 | 16 |
| 3 | 6 | Gupta S | 121 | 126 | 9 |
| 4 | 5 | Raghava GPS | 308 | 308 | 5 |
| 5 | 4 | Mishra GC | 85 | 85 | 4 |
| 6 | 4 | Bal V | 37 | 37 | 4 |
| 7 | 4 | Aggarwal A | 94 | 95 | 6 |
| 8 | 4 | Misra R | 94 | 94 | 5 |
| 9 | 4 | Bayry J | 169 | 169 | 4 |
| 10 | 4 | George A | 37 | 37 | 4 |

Bibexcel tool used to identify h-index of authors. 1000 authors Research Productivity on Immunology in India during the year 1993-2017. The research output is 397. With the author field, the .doc file is created. The total number of times the articles are cited is identified with the command ‘tc’ and jn1 file

is created. Select .jn1 file, type 2/3 'The Box' and run Edit out files / Select columns. The result is .col file. The command, 'Run Analyze / h-index' produced the outcome i.e. hdx file. This can be opened in excel format. Below table 10 shows that Saha, B published 8 articles, with the h-index of 7. The researcher received 368 citations of 7 articles. But his total citation for his 8 publication is 372. The highly prolific 10 scientist's h-index, citation counts, citation total sum of h-index are shown in table 10.

Table 5.9 - Source wise distribution (Top 20)

The source wise publications in the Immunology research during the year of 1993-2017. The most of the papers were published in the Journal of Immunology 57 (14.35%), and followed by the Journal of Immunology and Cell Biology 7 (1.76%).

| S. NO | Name of the Source | Records | % |
|-------|---|---------|-------|
| 1 | JOURNAL OF IMMUNOLOGY | 57 | 14.35 |
| 2 | IMMUNOLOGY AND CELL BIOLOGY | 7 | 1.76 |
| 3 | INDIAN JOURNAL OF MEDICAL RESEARCH | 7 | 1.76 |
| 4 | INDIAN JOURNAL OF ANIMAL SCIENCES | 6 | 1.51 |
| 5 | ANNALS OF ALLERGY ASTHMA & IMMUNOLOGY | 6 | 1.51 |
| 6 | RHEUMATOLOGY INTERNATIONAL | 5 | 1.25 |
| 7 | INDIAN JOURNAL OF BIOCHEMISTRY & BIOPHYSICS | 5 | 1.25 |
| 8 | FRONTIERS IN IMMUNOLOGY | 5 | 1.25 |
| 9 | HUMAN IMMUNOLOGY | 5 | 1.25 |
| 10 | VACCINE | 5 | 1.25 |
| 11 | CURRENT SCIENCE | 4 | 1.00 |
| 12 | CLINICAL AND EXPERIMENTAL RHEUMATOLOGY | 3 | 0.76 |
| 13 | JOURNAL OF LEUKOCYTE BIOLOGY | 3 | 0.76 |
| 14 | CELLULAR & MOLECULAR IMMUNOLOGY | 3 | 0.76 |
| 15 | BULLETIN OF THE WORLD HEALTH ORGANIZATION | 3 | 0.76 |
| 16 | INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH | 3 | 0.76 |
| 17 | INTERNATIONAL JOURNAL OF RHEUMATIC DISEASES | 3 | 0.76 |
| 18 | INDIAN JOURNAL OF EXPERIMENTAL BIOLOGY | 3 | 0.76 |
| 19 | JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH | 3 | 0.76 |
| 20 | MEDICAL HYPOTHESES | 3 | 0.76 |

Table 5.10 - Keywords wise distributions (top 10)

Application of the Zipf law

Zipf law explains that which keyword was used number of times total keywords used to explore in the Immunology 397. The “Immunology” is a keyword used frequently of 46 (2.87%) times to the Immunology and followed that “Infection” was used to explore 33 (2.06%) times. The keyword “Disease” used in 28 (1.75%) times. It takes the ninth place only. Application of Zipf law is shown in the below table.

| S. No | Keywords | Records | % |
|-------|------------------|---------|------|
| 1 | IMMUNOLOGY | 46 | 2.87 |
| 2 | INFECTION | 33 | 2.06 |
| 3 | DISEASE | 28 | 1.75 |
| 4 | EXPRESSION | 22 | 1.37 |
| 5 | DENDRITIC CELLS | 22 | 1.37 |
| 6 | IN-VIVO | 21 | 1.30 |
| 7 | T-CELLS | 20 | 1.25 |
| 8 | ACTIVATION | 19 | 1.18 |
| 19 | IMMUNE-RESPONSE | 19 | 1.18 |
| 10 | IMMUNE-RESPONSES | 18 | 1.12 |

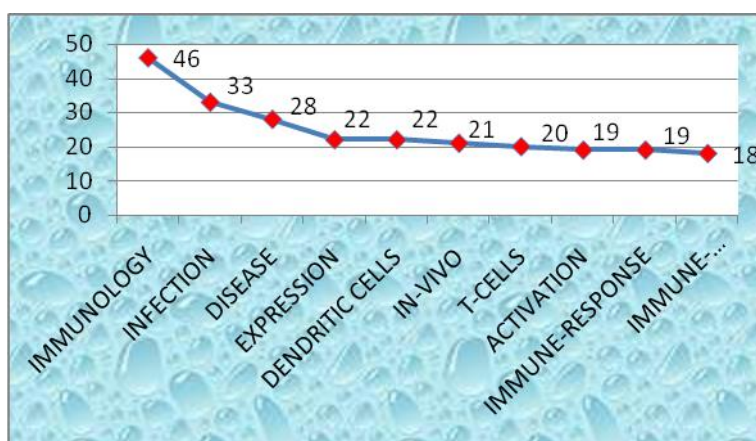


Fig 5.10.1

Table 5.11 - Cited References Top 12

Explains top 12 cited reference from India in Immunology research have received cited reference mostly used reference was Flynn JL, 2001, V19, P93, Annu Rev Immunol records were (12),

the second place of reference in Lowry OH, 1951, V193, P265, J Biol Chem (10) times and followed by the Mathur RK, 2004, V10, P540, Nat Med records were (8) respectively.

| S. No | Cited References | Records | % |
|-------|---|---------|------|
| 1 | Flynn JL, 2001, V19, P93, Annu Rev Immunol | 12 | 0.15 |
| 2 | Lowry OH, 1951, V193, P265, J Biol Chem | 10 | 0.12 |
| 3 | Mathur RK, 2004, V10, P540, Nat Med | 8 | 0.10 |
| 4 | Cole ST, 1998, V393, P537, Nature | 8 | 0.10 |
| 5 | Van Crevel R, 2002, V15, P294, Clin Microbiol Rev | 7 | 0.08 |
| 6 | Kaufmann SHE, 2001, V1, P20, Nat Rev Immunol | 7 | 0.08 |
| 7 | Flynn JL, 1995, V2, P561, Immunity | 6 | 0.07 |
| 8 | Awasthi A, 2003, V197, P1037, J Exp Med | 6 | 0.07 |
| 9 | Laemmli UK, 1970, V227, P680, Nature | 6 | 0.07 |
| 10 | Haldar JP, 1983, V42, P702, Infect Immun | 6 | 0.07 |
| 11 | Sakaguchi S, 1995, V155, P1151, J Immunol | 6 | 0.07 |
| 12 | Walport MJ, 2001, V344, P1058, New Engl J Med | 6 | 0.07 |

Table 5.12 - Page wise Publications

This table shows page ranges and mean page of length of papers published during the year of 1993-2017 (25 Yrs) in the central Keyword of “**Immunology**” out of 397 papers, 49 papers (11.61%) had between 396 pages in the year of 2016, 35 papers (10.79%) had between 368 pages in the year of 2012. Followed by 2011 papers are 35 (9.83%) 335 pages. The minimum number of papers published in the year of 1993, 1994 papers are 2 (0.35%) 12 pages respectively.

| S. No | Publication Period | Records | Number of Pages | % |
|-------|--------------------|---------|-----------------|-------|
| 1 | 1993 | 2 | 12 | 0.35 |
| 2 | 1994 | 2 | 12 | 0.35 |
| 3 | 1995 | 4 | 33 | 0.97 |
| 4 | 1996 | 4 | 26 | 0.76 |
| 5 | 1997 | 7 | 45 | 1.35 |
| 6 | 1998 | 5 | 13 | 20.93 |
| 7 | 1999 | 6 | 40 | 10.17 |
| 8 | 2000 | 5 | 30 | 0.88 |
| 9 | 2001 | 3 | 24 | 0.70 |
| 10 | 2002 | 12 | 79 | 2.32 |

| | | | | |
|--------------|------|------------|-------------|------------|
| 11 | 2003 | 6 | 23 | 0.67 |
| 12 | 2004 | 6 | 50 | 1.46 |
| 13 | 2005 | 5 | 46 | 1.35 |
| 14 | 2006 | 6 | 34 | 0.99 |
| 15 | 2007 | 18 | 137 | 4.02 |
| 16 | 2008 | 13 | 126 | 3.69 |
| 17 | 2009 | 24 | 209 | 6.13 |
| 18 | 2010 | 32 | 339 | 9.94 |
| 19 | 2011 | 35 | 335 | 9.83 |
| 20 | 2012 | 35 | 368 | 10.79 |
| 21 | 2013 | 33 | 256 | 7.51 |
| 22 | 2014 | 28 | 273 | 8.01 |
| 23 | 2015 | 29 | 248 | 7.27 |
| 24 | 2016 | 49 | 396 | 11.61 |
| 25 | 2017 | 28 | 254 | 7.45 |
| Total | | 397 | 3408 | 100 |

Table 5.13- Subject wise Publications Top 20

Among the Subject wise distribution in India publications from “Immunology” publications take in top 20 subjects only. The largest share in the subject was Immunology 91 (22.92%), followed by the Science & Technology – Other Topics 14 (3.52%) and Allergy Immunology 13 (3.27%), Rheumatology 13 (3.27%) and Agriculture 10 (2.51%).

| S. No | Subject wise top 20 | Records | % |
|--------------|---|----------------|----------|
| 1 | Immunology | 91 | 22.92 |
| 2 | Science & Technology - Other Topics | 14 | 3.52 |
| 3 | Allergy; Immunology | 13 | 3.27 |
| 4 | Rheumatology | 13 | 3.27 |
| 5 | Agriculture | 10 | 2.51 |
| 6 | Pharmacology & Pharmacy | 9 | 2.26 |
| 7 | General & Internal Medicine | 8 | 2.01 |
| 8 | Cell Biology; Immunology | 8 | 2.01 |
| 9 | Ophthalmology | 8 | 2.01 |
| 10 | Immunology; General & Internal Medicine; Research & Experimental Medicine | 7 | 1.76 |

| | | | |
|----|--|---|------|
| 11 | Oncology | 7 | 1.76 |
| 12 | Biochemistry & Molecular Biology; Biophysics | 7 | 1.76 |
| 13 | Life Sciences & Biomedicine - Other Topics | 6 | 1.51 |
| 14 | Microbiology | 6 | 1.51 |
| 15 | Dermatology | 5 | 1.25 |
| 16 | Veterinary Sciences | 5 | 1.25 |
| 17 | Immunology; Research & Experimental Medicine | 5 | 1.25 |
| 18 | Pediatrics | 5 | 1.25 |
| 19 | Public, Environmental & Occupational Health | 5 | 1.25 |
| 20 | Research & Experimental Medicine | 5 | 1.25 |

Table 5.14 - Country collaboration top 30

This study of joint country research increasing. Here this Immunology investigates in the year of 1993-2017 (25 Yrs). And 104 countries involved in collaborative research, India has highly collaborated with USA in the number of (66) times and UK (19) times. India has done a collaborated research in Germany (17), France (13), and Spain (10) Switzerland (8). This study was paper taken in collaboration with other country. The top 30 collaborative Countries are given below;

| S. No | Name of the Country | | Records |
|-------|---------------------|-------------|---------|
| 1 | India | USA | 66 |
| 2 | India | UK | 19 |
| 3 | Germany | India | 17 |
| 4 | India | Japan | 13 |
| 5 | France | India | 13 |
| 6 | UK | USA | 11 |
| 7 | India | Spain | 10 |
| 8 | Germany | USA | 9 |
| 9 | France | UK | 8 |
| 10 | India | Switzerland | 8 |
| 11 | France | USA | 8 |
| 12 | Australia | India | 7 |
| 13 | Brazil | India | 7 |
| 14 | Germany | UK | 7 |
| 15 | Spain | USA | 7 |
| 16 | India | Italy | 7 |

| | | | |
|----|-----------------|-----------------|---|
| 17 | Japan | USA | 7 |
| 18 | Italy | USA | 6 |
| 19 | Australia | USA | 6 |
| 20 | Brazil | USA | 6 |
| 21 | Canada | India | 6 |
| 22 | France | Spain | 6 |
| 23 | Spain | UK | 6 |
| 24 | India | Peoples R China | 6 |
| 25 | Peoples R China | UK | 5 |
| 26 | Denmark | USA | 5 |
| 27 | Denmark | UK | 5 |
| 28 | France | Germany | 5 |
| 29 | France | Italy | 5 |
| 30 | Switzerland | UK | 5 |

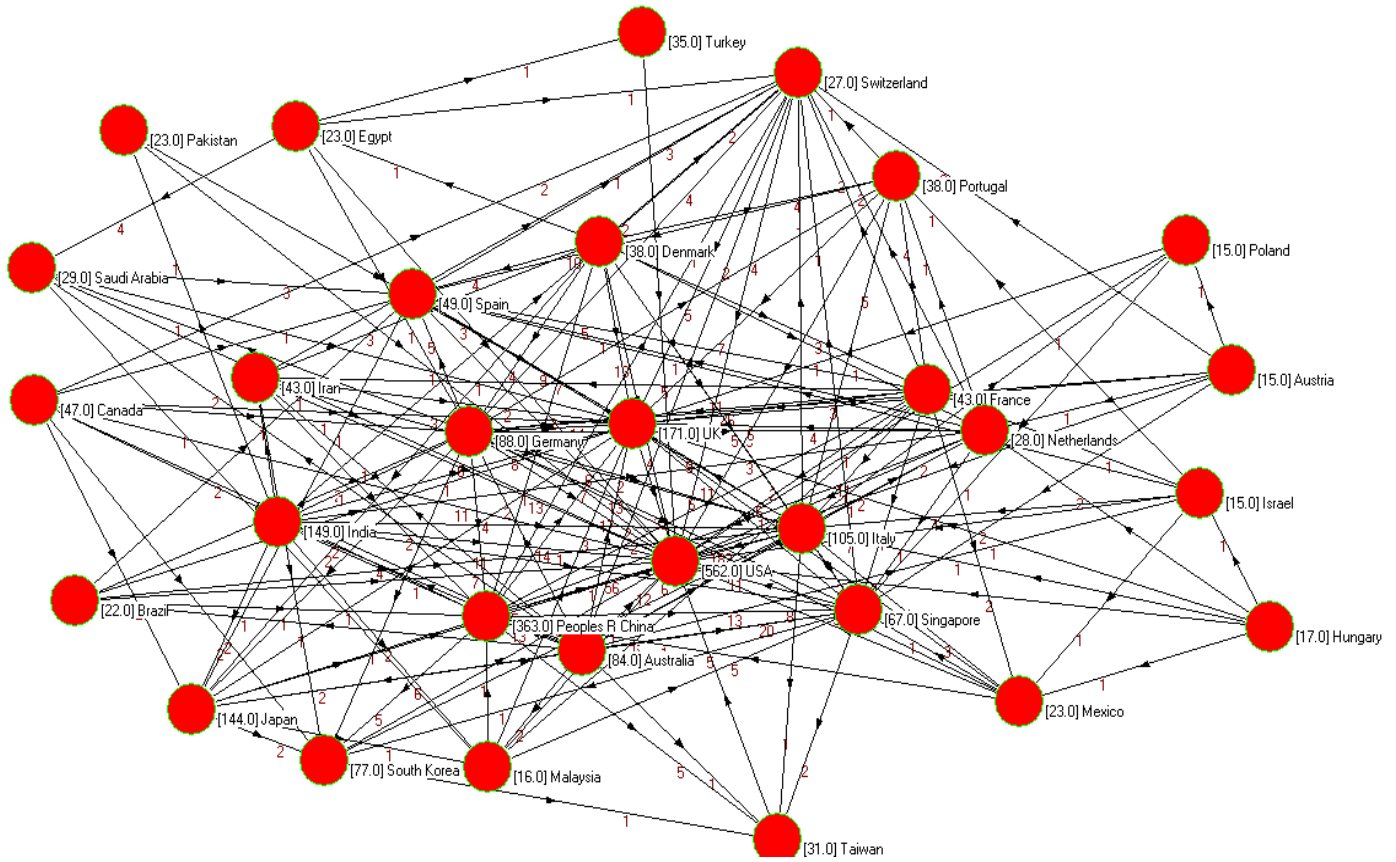


Fig 5.14.2

In the above the picture (or) chart, the decidedly contributed countries in the refer to the Immunology research on USA, UK, Germany, Japan, France, Spain are shows in large number of cited and lowest charity of countries are Brazil, Denmark, Canada, Australia, Portugal are shows in tiny circles

Table 5.15 - Abstract wise

This picture shows that the abstract analysis of this study from Immunology research. This study divided into four clustering in VOS Viewer visualizations. On the basis cluster color of Red, 2 cluster color of Green, 3 cluster color of Yellow and last cluster of Blue. The maximum number of abstract words occupying the word of “response” and the bare minimum number of times using the word of abstract in this study was “hiv”.

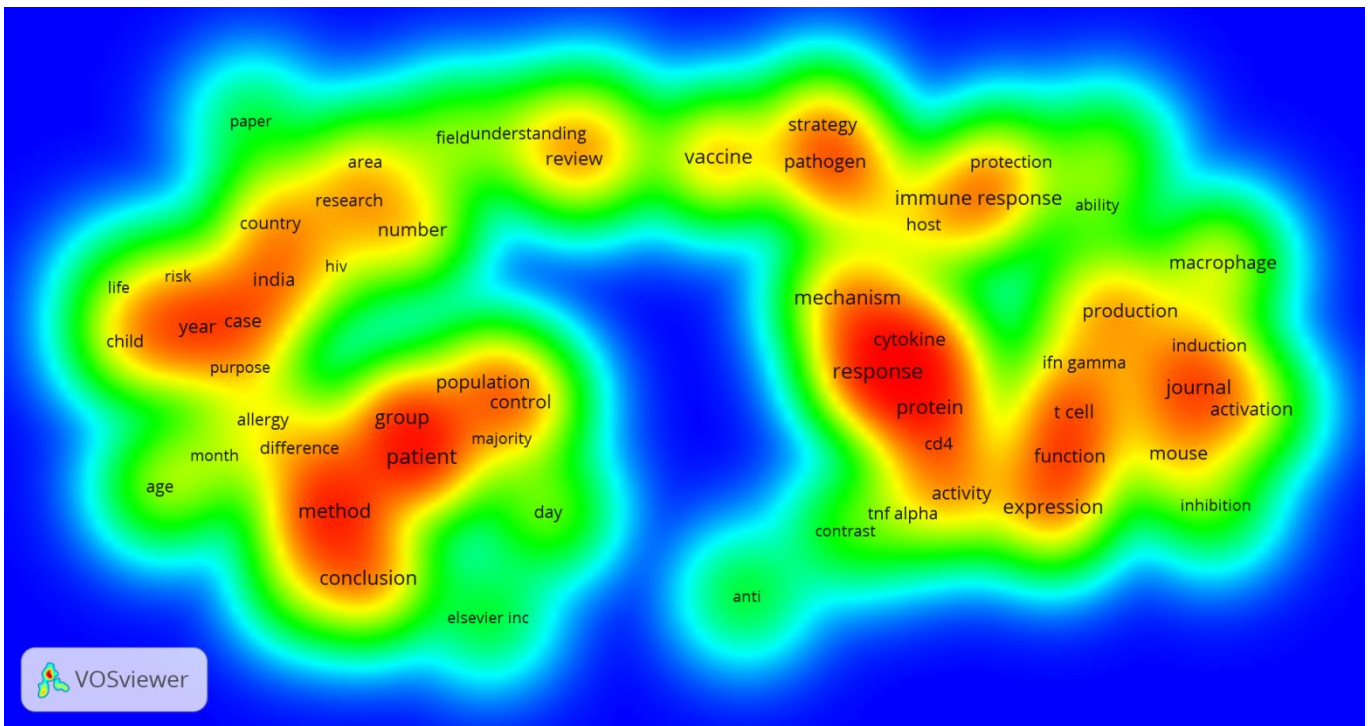


Fig 5.15.3

Findings

- ✓ The maximum number of papers published in 2016 (49) and minimum in 1993, 1994 (2)
- ✓ The Average Publication Per Black of 79
- ✓ The most of the papers published English language 396 and the total Citation core was in this language 6462 respectively
- ✓ The Maximum number of papers published in Article were 285, the total Citation was 4489 and the Index score was 34 respectively
- ✓ The highest number of research papers contributed by multiple authors during the study period

- ✓ The H – Index Score for highly productive authors in top 10. The maximum H – Index score for highly productive author in **Saha, B (H-Index 7)**, Citation h- core 368, and followed by the author was **Singh S (H- Index 6)** Citation h- core 118
- ✓ The degree of collaboration was 0.92
- ✓ This study was used keywords are “**Immunology**” 46 times
- ✓ The maximum subject, covering in this study was Immunology

Conclusion

One of the possible confines of this study was its spotlight on the keywords was “Immunology” research in India within the moment in time span of (25Yrs) 1993-2017. This study was conducted using data from the Web of Knowledge database. During this time a total of 49 papers were published 2013 being the years, which result in the maximum number of publications. The whole study period records the mean relative growth rate of 0.954 and means doubling time for publications at the aggregate level has been designed as 22.6 in the total years. Single authored work is less than that of the multiple authored contributions. The Degree of Collaboration (using Subramanian’s formula) indicates that there exists a high degree of collaboration. The articles were most of the published in the English language records were 396 (99.75%) respectively. The immunology emerged as being the most common keyword with a recurrence rate of 46 (2.87%). In the 104 countries involved in collaborative research, India has highly collaborated with USA in the number of (66) times and UK (19) times. India has done a collaborated research in Germany (17), France (13), and Spain (10) Switzerland (8).

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