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Visualisation of Asthma Research Output in India during 2010-2019

ABSTRACT

Purpose

Research in the field of Asthma has become very essential, thus the purpose of the study was to map and analyse the trends by using scientometric tools to the Asthma literature published between 2010 and 2019.

Design/Methodology/Approach

Scientometric method was used to know categories, publications, funding agencies, authors, international collaboration and web of science prolific journals in the field of Asthma. Further we used MS-Excel for the purpose of date analysis, collaboration networks have been generated by using VOSviewer software.

Findings

1,555 Scientific articles published in the field of Asthma between 2010 and 2019. There was exponential growth in publication output, further respiratory system and immunology category share highest publication output and h-index respectively. United States of America contributed largest publication share. CSIR came out by contributing highest publication and also stand as top funding agency. Scientometric analysis showed that most collaborative countries were United States of America, England, and Australia so on.

Originality/Value

This study first holistic scientometric analysis of production literature concerning Asthma disease, which may help scholars to understand India's collaboration with international top countries on Asthma research.

Keywords: Asthma, Scientometric study, visualisation, Web of Science, India.

1. Introduction

Asthma is a disease of respiratory disorder in the lung function. It is a chronic disease people experience "Wheezing" and "Whistle" sound during breathing. Coughing, chest tightness and breathlessness involves in Asthmatic patients. Airways inside the walls are sore and swollen. Two types of factors cause asthma i.e. genetic and environmental factors. Air pollution, allergens, chemicals, petroleum, Paint and animal dander are major cause for Asthma. Commonly Asthma develops in early childhood, many research have been conducted (Chen et al., 2005), conducted study on asthma in children and analyzed literature output from 1991 to 2002. It was found that gradual increase in literature output on asthma in children only 90 in 1991 to 1704 in 2002. More than 50% (1640) of literature produced from 1998-2002, highlighted that English was the dominant language.

It is also called bronchial Asthma where patients' airways become narrow and swell which leads difficult to breathe. Asthma can attach at any stage of life, Asthma causes difficulty to perform daily activities, and loss of work. Asthma can't be cured but can be controlled. Global initiative for Asthma (GINA) organizes May 5th as world Asthma day. According to global Asthma report 2018, 339 million people affected across globe, In India 10.4 million patients suffering from Asthma attack.

2. Literature Study

Many studies have been conducted on bibliometric studies, Allen Richard first to propose the “Bibliography” in 1969. The concept of bibliometric allows scholar to go in-depth in their area of research by analysing geographical, language distribution, research contribution, citations and co-citation (Yeung et al., 2017). In related to this (Sweileh et al., 2017) observes that United States of America has produced with 1926 mobile health literature comparatively less in India, only 183 documents produced literature, whereas (Jeter et al., 2015) disagrees saying more (28,080) documents published in India compared to rest of world. In context to this very few studies have been undertaken on Asthma, (Börger et al., 2008) conducted experimental study on bronchial asthma by precise bibliometric data analysis during 1900 – 2006. They investigated 3489 of strong increase in the research productivity on asthma. Switzerland ranked first in average citation per item and immunology ranked first in subject category related to animal models of asthma. Whereas USA originated majority of data, however in contradiction to this research activity in Arab countries on asthma was very low (Sweileh et al., 2014) only 1304 documents published in 2014. It has been observed that research output by Arab countries in the field of Asthma. Only a few studies have been published in the field of Asthma. Among them (Michalopoulos & Falagas, 2005), studied and evaluated global research production in respiratory medicine by Pub Med database. During the period from 1995 to 2003 48,614 articles retrieved, it has been identified that last 4 years there is significant increase in literature. United States and Western Europe was produced highest research output, but surprisingly Western Europe leads United States during mentioned period. In the later study on role and impact of animal models of Asthma, (Börger et al., 2008), through light that a strong increase in research productivity, while the majority of data originates from USA. Smallest country Switzerland takes highest citation ranking. Therefore, it has been stated that even USA and European countries produce maximum literature but smallest country Switzerland outburst as best by taking lead in citations.

(Gupta & Bala, 2011) studied only 1.27 % of publication had been contributed from India out of world output. India ranks in 15th position among the countries, quality and impact factor of Indian research is low compared to select developed and developing countries, keeping this view it was observed that (Song et al., 2015), analysed research performance was quantitatively analysed for the numbers of papers by publication year, research type, and main topic. Similarly, the performance was also examined for qualitative indices, such as impact factor and citation number. Total 1091 papers were published during 2009 – 2013 and the annual increase in publication number was 12.3%. Cumulative trends were clearly observed in several research types, containing clinical, basic, and epidemiological studies, which showed a latest growth of the research base for allergists in Korea. So it has been identified that Indian publication on Asthma are more quantitative and qualitative compared to Korea. In addition to this, bibliometric studies were also carried out in the field of asthma in India, (Gupta et al., 2018), absolute and relative bibliometric indicators were used to measure the performance of asthma research in India. India ranked 12th position in global publication. 10.85 citations per publication on asthma recorded average citation impact of India publication. USA records highest share (31.27%) compared to globe. Allergic types of asthma publication produced 317 papers whereas alcohol induced asthma only 2 articles. It has been concluded that annual growth rate of publications increased, research publication output increased from 15th to 12th rank. India’s citation impact per paper dropped from 2007-11 to 2012-16.

The review of knowledge structure of research on asthma can be valuable to the scholars, scientists and policy makers to get an insight into trends and status of asthma research for effective judgment and formulate new research proposals.

3.Objectives

1. Examine the growth of asthma research literature covered in Web of Science Citation Database for the period 2010 to 2029
2. To analyse the research performance of India on asthma.
3. To identify the organisations conducting the research in asthma.
4. To identify and analyse the research contribution in the subject field of asthma.
5. To identify the top source titles those, carry the research productions in asthma.
6. To identify the top prolific authors in the Indian asthma Research.
7. To identify the top collaborative countries.
8. To identify the highly prolific keywords.

4.Methodologies

The study was carried out using scientometric methods. The data used in this study were based on the Web of Science (WoS) citation database. An ample online search was performed using Web of Science (WoS), which is one of the world's largest databases of peer-reviewed literature. Search string used for the data retrieval is CU=(INDIA) AND TS=(ASTHMA) Timespan: 2010-2019. Indexes: SCI-EXPANDED. With this search criteria generated 1,555 records and searches were completed on April 20, 2020 to avoid bias due to the daily updating of the database. The collected data were used to generate the following information: growth and developments of contributions in asthma research during the period; (b) research productivity by country; (c) journals in which Indian researchers published; (d) the productivity and impact of the most prolific institutions; and (e) the citations received by the publications; (f) highly prolific authors in the Indian asthma research and most used keywords. In addition MS-Excel for the purpose of data analysis, collaboration networks have been generated by using VOSviewer software.

5.Results and Discussion

1. Web of Science Categories of Asthma Research

Table 1 and figure 1 presents the asthma research output published by India during 2010 – 19 is scattered through 15 Categories (Web of Science Categories), with *respiratory system* for the highest publications share (20.19%), followed by *pharmacology pharmacy* (18.91%), *immunology* (15.76%) and in 15th place *public environmental occupational health* (3.15%). Considering the total citation and h-index, the research output under *medicine general internal* registered the highest impact of 39.57 citations per paper, followed *allergy* (23.37 citations per paper), *immunology* (18.88 citations per paper) Except *pediatrics*, *medicine research experimental* and *respiratory system* all other subjects observed an increase in their citation quality and impact in terms of average citations per paper during the study period. The research output under *immunology* scored the highest h-index value of 31, followed by *respiratory system*, *pharmacology pharmacy* and *allergy* (27 each).

Table 1: Web of Science Categories of Asthma Research during 2010 – 2019.

Sl No	Web of Science Categories	Records	% of 1555	TC	ACP	ACPY	h-index
1	RESPIRATORY SYSTEM	314	20.19	2413	7.68	219.36	27
2	PHARMACOLOGY PHARMACY	294	18.91	2677	9.82	262.55	27

3	IMMUNOLOGY	245	15.76	4626	18.88	420.55	31
4	ALLERGY	144	9.26	3365	23.37	305.91	27
5	CHEMISTRY MEDICINAL	126	8.10	1667	13.23	151.55	22
6	PEDIATRICS	109	7.01	426	3.91	38.73	10
7	BIOCHEMISTRY MOLECULAR BIOLOGY	107	6.88	1514	14.15	137.64	21
8	PLANT SCIENCES	86	5.53	941	10.94	94.10	16
9	MEDICINE GENERAL INTERNAL	67	4.31	2651	39.57	265.10	14
10	CRITICAL CARE MEDICINE	66	4.24	651	9.86	59.18	8
11	MEDICINE RESEARCH EXPERIMENTAL	64	4.12	490	7.66	49.00	13
12	INTEGRATIVE COMPLEMENTARY MEDICINE	62	3.99	694	11.19	69.40	14
13	ENVIRONMENTAL SCIENCES	59	3.79	867	14.69	86.70	13
14	CELL BIOLOGY	56	3.60	992	17.71	90.18	18
15	PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH	49	3.15	447	9.12	40.64	13

TC=Total Citations, ACP=Average Citations per Paper, ACPY=Average Citations per Year

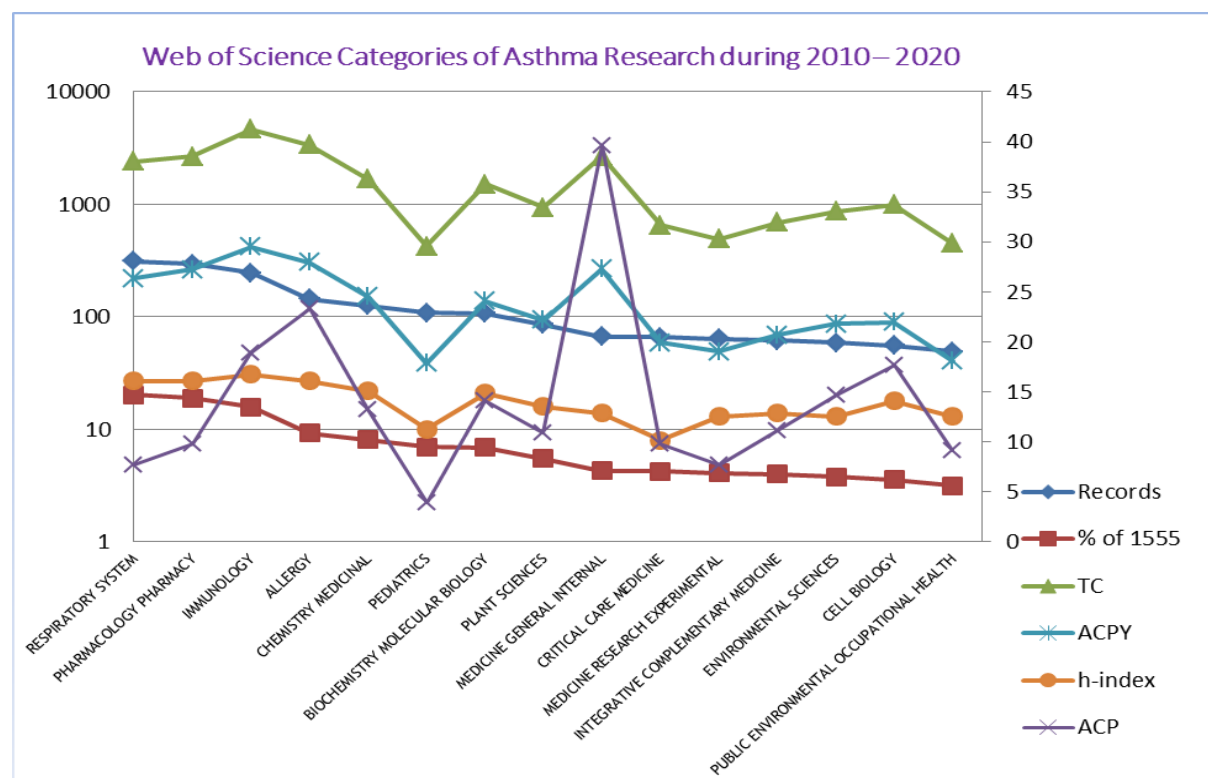


Figure 1: Web of Science Categories of Asthma Research during

2. Scientific Publications output of Asthma

The Science Citation Index (via Web of Science) retrieved literature showed that the total number of articles published on asthma during the period of 2010-2019 was 1,555. Table 2 gives the details about the year-wise distribution of articles, total citation counts, average citation counts, respectively. The number of articles had increased from 2010 (112)

to 2019 (185), except for the year 2016 (157), 2017 (149). This cumulative Indian publications output in asthma received 18759 citations, registering an average of 14.50.

Table 2: Scientific Publications of Asthma during 2010 – 2019

SI No	Publication Years	records	% of 1555	TC	C/PP
1	2010	112	7.20	651	9.86
2	2011	138	8.88	2651	39.57
3	2012	148	9.52	941	10.94
4	2013	152	9.78	1514	14.15
5	2014	159	10.23	426	3.91
6	2015	175	11.25	1667	13.23
7	2016	157	10.10	3365	23.37
8	2017	149	9.58	4626	18.88
9	2018	180	11.58	2677	9.82
10	2019	185	11.90	241	1.30

3. Ranking of Asthma Journals based on Impact Factor

Table 3 lists the top 10 most prolific journals with their total publications, citation, Pure Citations, Citations and Article Influence Score. The top 10 journals included approximately 26% of the total number of publications (n = 1555, 25.91%). *European Respiratory Journal* (82, 5.27%), *Indian Journal of Pediatrics* (48, 3.08%) and *Respirology* (42, 2.7%) are the top three journals contributing more than 40 documents each. However, of the top 10 journals and all journals have an impact factor. The Journal ‘*Allergy*’ has got highest Article Influence Score (IF= 37), followed by the *Journal of Ethnopharmacology* and *International Immunopharmacology* (IF=15). Figure 2 shows the Journals ranking and Citation network for asthma research in India.

Table 3: Ranking of Asthma Journals based on Impact Factor (2010 – 2019)

Source Titles	records	% of 1555	Citations	PC	SC	AIS	Country
EUROPEAN RESPIRATORY JOURNAL	82	5.273	84	83	1	1	UK
INDIAN JOURNAL OF PEDIATRICS	48	3.087	174	162	12	3.6	India
RESPIROLOGY	42	2.701	120	119	1	2.9	Japan
AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE	39	2.508	30	30	0	0.8	USA
JOURNAL OF ETHNOPHARMACOLOGY	39	2.508	576	573	3	15	Netherlands
INDIAN PEDIATRICS	35	2.251	91	81	10	2.6	India
ALLERGY	34	2.186	1263	1257	6	37	UK
INTERNATIONAL IMMUNOPHARMACOLOGY	31	1.994	458	446	12	15	Netherlands
INDIAN JOURNAL OF MEDICAL RESEARCH	28	1.801	228	215	13	8.1	India
JOURNAL OF ASTHMA	25	1.608	355	351	4	14	USA

PC-Pure Citations, SC-Self Citations, AIS-Article Influence Score

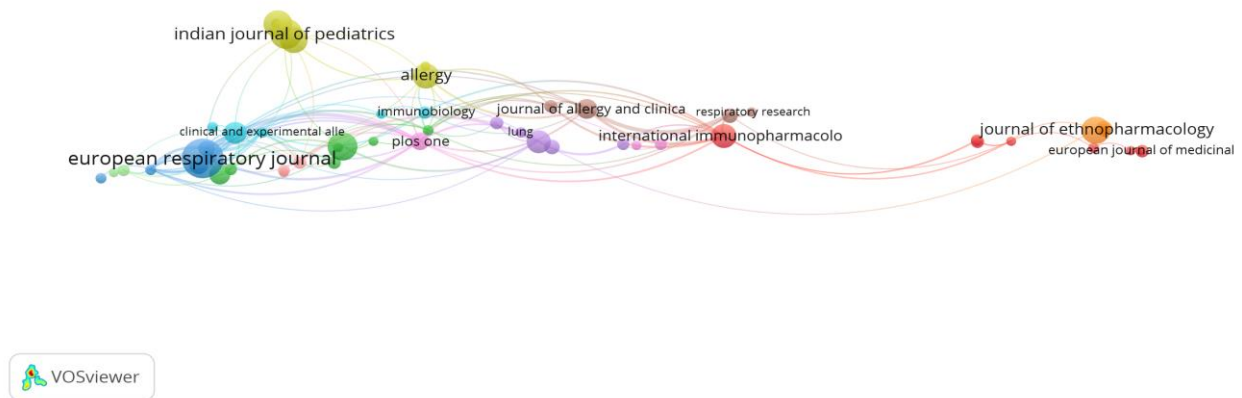


Figure 2: Journals ranking and Citation network with VOSviewer

4. Contribution and Output of Top Cited Indian Authors in Asthma Research

Citations are the indicators of credentials of a research and the author. Table 4 shows the highly prolific authors and their citations in asthma research during 2010 – 2019. The citations showed that 4 authors received citations more than 1000 (Agrawal A, Agarwal R, Ghosh B and Mabalirajan U), 2 authors received citations between 500 and 1000 (Chakrabarti A and Aggarwal A N) and six authors received citations less than 500. Among these authors Agrawal A registered higher h-index (23) followed by Ghosh B (22) and Agarwal R (20). The combined contribution of these authors counts 24.69% share (384 research output) in asthma, with average output of 38.4 papers per author. 4 authors have contributed more publications than the group's average. Agrawal A with 50 papers, Agarwal R with 49 papers, Ghosh B with 44 papers and Salvi S with 42 papers. Figure 3&4 shows Highly Prolific Authors and Co-authorship network & Authorship Citation Network with VOSviewer.

Table 4: Ranking of Asthma Researcher based on Number of publications (2010 – 2019)

Authors	records	% of 1555	h-index	Citations	PC	SC
AGRAWAL A	50	3.215	23	1762	1640	122
AGARWAL R	49	3.151	20	1366	1133	233
GHOSH B	44	2.83	22	1286	1204	82
SALVI S	42	2.701	7	238	234	4
MABALIRAJAN U	36	2.315	18	1034	956	78
CHAKRABARTI A	34	2.186	17	880	754	126
KUMAR S	34	2.186	12	497	458	39
SINGH S	33	2.122	11	452	446	6
AGGARWAL AN	31	1.994	16	645	550	95
SINGH M	31	1.994	8	198	194	4

PC-Pure Citations, SC-Self Citations

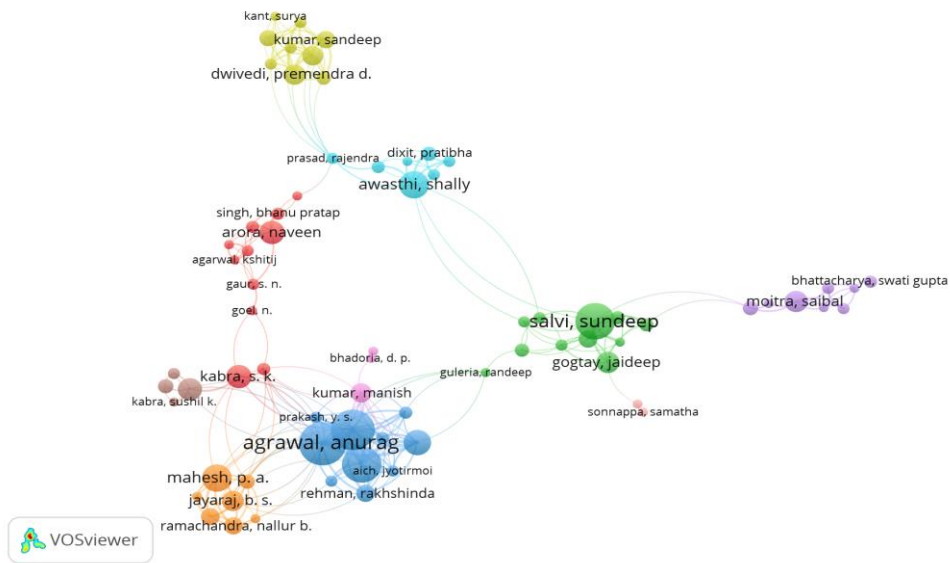


Figure 3: High Prolific Authors and Co-authorship analysis with VOSviewer

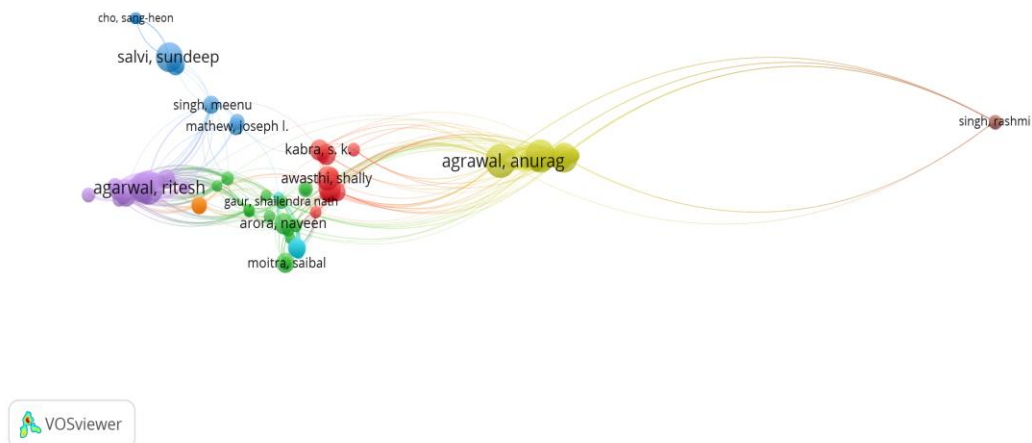


Figure 4: Authorship Citation Network with VOSviewer

5. India's Collaboration with International Top Countries in Asthma Research

The Indian research output and the percentage share of international collaborative papers on asthma during the study period of 2010 to 2019 are presented in table 5. Among the collaborative partners of India, USA contributed the largest publications share of 11.64% share (181 papers), followed by England with 5.59% publications share (87 papers), Australia with 3.66% publications share (57 papers), Malaysia with 2.7% publications share (42

papers) and Switzerland with 2.63% publications share (41 papers), etc. Figure 5 shows the India's International linkages of Asthma research network with VOSviewer.

Table 5: India's Collaboration with International Top Countries in Asthma Research (2010 – 2019)

SI No	Countries/Regions	records	% of 1555
1	INDIA	1555	100
2	USA	181	11.64
3	ENGLAND	87	5.595
4	AUSTRALIA	57	3.666
5	MALAYSIA	42	2.701
6	SWITZERLAND	41	2.637
7	PEOPLES R CHINA	38	2.444
8	CANADA	33	2.122
9	GERMANY	33	2.122
10	NETHERLANDS	31	1.994
11	SPAIN	30	1.929
12	SOUTH KOREA	29	1.865
13	FRANCE	28	1.801
14	SINGAPORE	28	1.801
15	SWEDEN	28	1.801
16	JAPAN	26	1.672
17	SAUDI ARABIA	25	1.608
18	ITALY	24	1.543
19	BRAZIL	21	1.35
20	SOUTH AFRICA	21	1.35

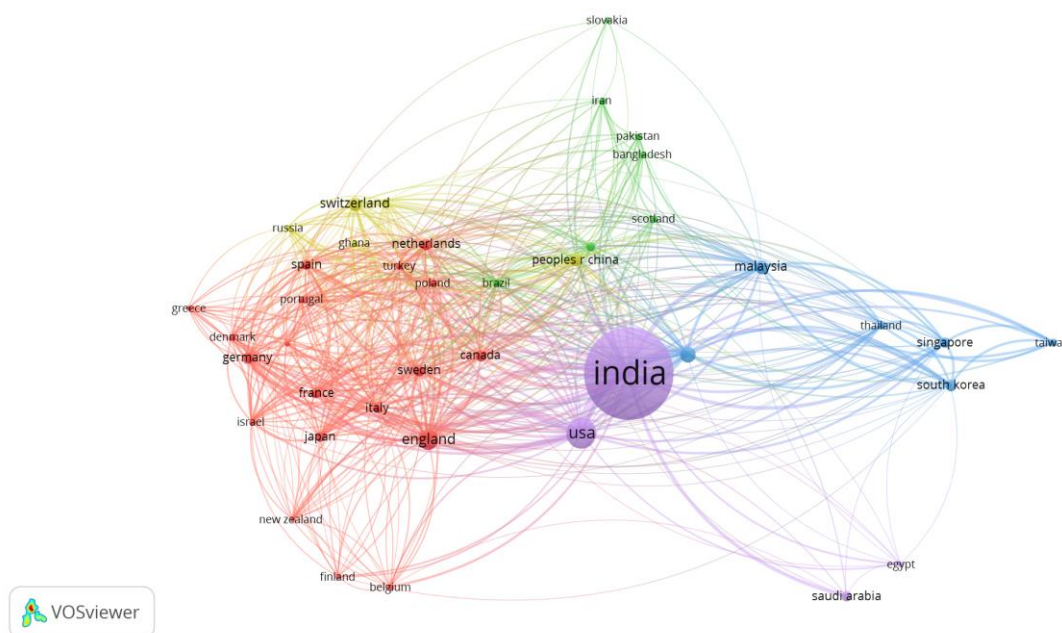


Figure 5: India's International linkages of Asthma research network with VOSviewer

6. Contribution and Output of Major Indian Organisational Collaboration in Asthma Research

Table 6 shows the 20 most productive Indian institutions engaged in asthma. The total publications output of these 20 productive institutions together contributed 64.37% share (1001 papers) in the total publications output in asthma research during the study period, with an average of 50.05 papers per institute. *CSIR India* contributed highest publications to the field i.e. 165 publications (10.61%), followed by *Post Graduate Institute of Medical Education Research, Chandigarh* with 130 publications (8.36%), *CSIR Institute OF Genomics Integrative Biology IGIB* with 89 publications (5.72%), *All India Institute of Medical Sciences, New Delhi* with 88 publications (5.66%), *University Of Delhi* with 78 publications (5.02%), *Indian Institute Of Technology, System* with 59 publications (3.79%) etc. Figure 6&7 shows the Major Indian Organisational Collaboration of Asthma Research network and Citation network with Vosviewer.

Table 6: Organisational Collaboration

SI No	Organizations-Enhanced	records	% of 1555
1	COUNCIL OF SCIENTIFIC INDUSTRIAL RESEARCH CSIR INDIA	165	10.61
2	POST GRADUATE INSTITUTE OF MEDICAL EDUCATION RESEARCH PGIMER CHANDIGARH	130	8.36
3	CSIR INSTITUTE OF GENOMICS INTEGRATIVE BIOLOGY IGIB	89	5.72
4	ALL INDIA INSTITUTE OF MEDICAL SCIENCES AIIMS NEW DELHI	88	5.66
5	UNIVERSITY OF DELHI	78	5.02
6	INDIAN INSTITUTE OF TECHNOLOGY SYSTEM IIT SYSTEM	59	3.79
7	CHEST RES FDN	50	3.22

8	KING GEORGE S MEDICAL UNIVERSITY	37	2.38
9	JSS ACADEMY OF HIGHER EDUCATION RESEARCH	35	2.25
10	MANIPAL ACADEMY OF HIGHER EDUCATION MAHE	31	1.99
11	PANJAB UNIVERSITY	29	1.87
12	NOVARTIS	27	1.74
13	DEPARTMENT OF SCIENCE TECHNOLOGY INDIA	25	1.61
14	JADAVPUR UNIVERSITY	24	1.54
15	JAMIA HAMDARD UNIVERSITY	24	1.54
16	UNIVERSITY OF LONDON	23	1.48
17	IMPERIAL COLLEGE LONDON	22	1.42
18	JOHNS HOPKINS UNIVERSITY	22	1.42
19	UNIVERSITY OF MYSORE	22	1.42
20	BANARAS HINDU UNIVERSITY	21	1.35

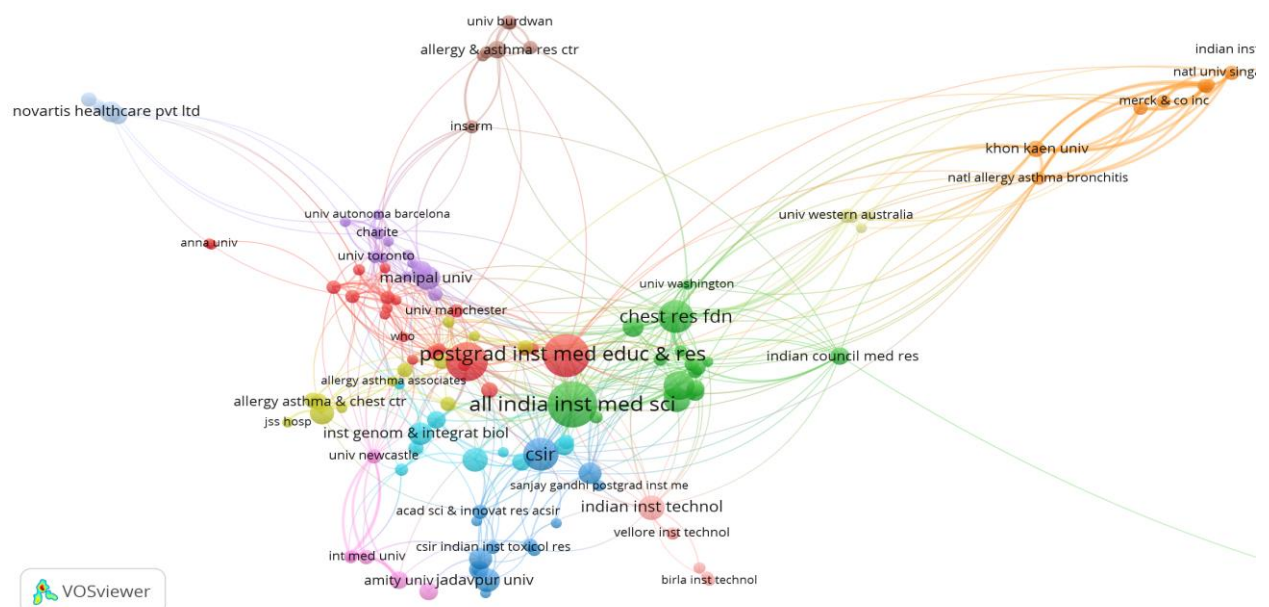


Figure 6: Major Indian Organisational Collaboration of asthma network with Vosviewer

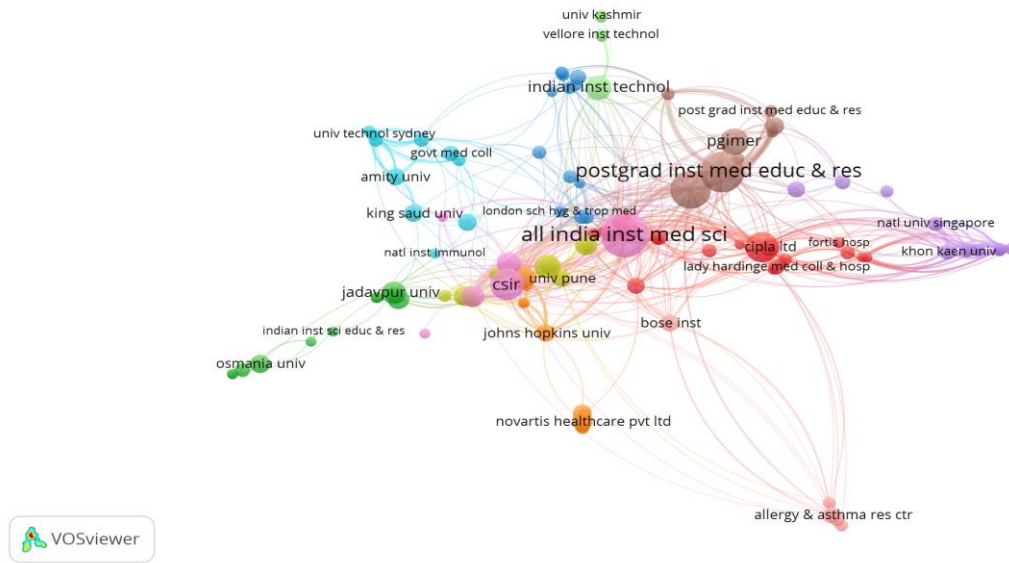


Figure 7: Indian Organisational Collaboration Citation network of Asthma Research with Vosviewer

7. Top Funding Agencies for Asthma Research in India

Funding agencies are institutions or organizations who offer grant in aid to the ones in need to promote their research work in the discipline of asthma. This study identified few agencies are funded for asthma publications. Table 7 shows the maximum 1036 asthma research paper's funding agency are Undefined, remaining 519 papers got funded by various agencies among CSIR funded 127 research publications, followed UGC India (76), DST India (70) and ICMR (69) etc.

Table 7: Top 11 Indian Funding Agencies for Asthma Research (2010 – 2019)

Sl No	Funding Agencies	records	% of 1555
1	COUNCIL OF SCIENTIFIC INDUSTRIAL RESEARCH CSIR INDIA	127	8.167
2	UNIVERSITY GRANTS COMMISSION INDIA	76	4.887
3	DEPARTMENT OF SCIENCE TECHNOLOGY INDIA	70	4.502
4	INDIAN COUNCIL OF MEDICAL RESEARCH	69	4.437
5	DEPARTMENT OF BIOTECHNOLOGY DBT INDIA	52	3.344
6	NATIONAL INSTITUTES OF HEALTH NIH USA	34	2.186
7	UNITED STATES DEPARTMENT OF HEALTH HUMAN SERVICES	34	2.186
8	WELLCOME TRUST	16	1.029
9	GLAXOSMITHKLINE	15	0.965
10	MERCK COMPANY	15	0.965
11	NATIONAL INSTITUTE FOR HEALTH RESEARCH NIHR	11	0.707

8.Highly Prolific Keywords Cluster Analysis of India’s Asthma Research

The clusters of asthma research were created using VOSviewer software. The keyword that appeared more than fifty times in the title of articles only was considered for cluster analysis. The keywords were grouped under 4 major clusters as shown in the table 8. The keywords are grouped under 4 clusters such as airway inflammation, children, association, and copd as indicated by the Figure 8. The cluster asthma had appeared in 526 articles followed by children in 130, inflammation in 107, prevalence in 88 and expression in 79 articles.

Table 8: Highly Prolific Keywords Cluster Analysis

Clusters	Key words in the title of articles	No. of appearances
Cluster I	airway inflammation	53
	Allergy	55
	asthma	526
	expression	79
	in-vitro	58
	inflammation	107
Cluster II	children	130
	india	52
	prevalence	88
	symptoms	50
Cluster III	association	54
	disease	76
Cluster IV	copd	55

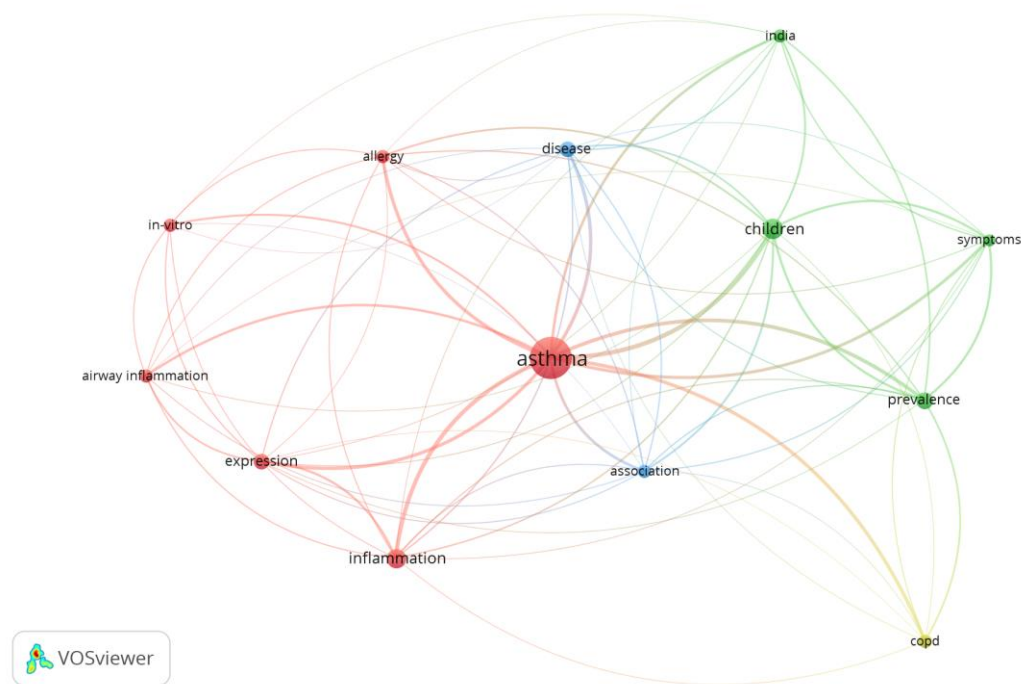


Figure: 8 Highly Prolific Keywords Cluster Analysis of India’s Asthma Research with VOSviewer

6. Discussions and Findings

Indian researchers produced 1555 papers in asthma research during 2010 – 2019 as indexed in Scopus database with average citation 14.53 per paper. India's global rank was 19th with 1.90% global publications share and international collaborative publications, USA contributed the largest publications share (181). India had published highest (185) publications in the year 2019 with 11.90% and got 4626 highest total citation in the year 2017. The top 10 organisations and authors produced the 49% and 25% of total publications output among *CSIR India* (165) and *Agrawal A* (50 with h-index 23) contributed highest publications to the field.

Top 10 most productive journals accounted for (403) 25.92% share of total Indian journal publication output among *European Respiratory Journal* is leading journal to publish the papers of Indian researchers. 82 papers are published in the journal with top possession and followed by *Indian Journal of Pediatrics* 48 & *Respirology* 42 publications. *CSIR India* is the leading funding agency for researcher and it is funded for 127 publications and followed by *UGC India* funded 76 publications during the study period. Highly prolific keywords are *asthma*, *children* and *inflammation*.

7. Conclusion

The Indian research productivity in asthma research is very poor and also registered poorer citation impact compared to world research output. In view of very large popularity and deaths from asthma cases in India, the research efforts in the country are considerably less and the quality of Indian research is low. Therefore, there is urgent need to increase the current Research and Development, both in terms of funding and participation of more skilled and trained personnel. Similarly, the government must make investments more and encourage our scientists to get involved in international collaborative projects and growth mutual collaborative projects with leading nations in this area. Efforts ought to be made to recognize asthma as a disease of foremost public health importance. The country wide efforts must be made to raise public focus of the disease to make sure patients and health professionals, identify the disease and privy to the sternness of related problems; organise and co-ordinate international epidemiological surveillance to reveal international and regional trends in bronchial asthma; increase and implement an most fulfilling method for its control and prevention and stimulate research into the reasons of bronchial asthma to broaden new control strategies and treatment.

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