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# Pneumonia Disease Research in India: A Scientometric Study during 2004-13

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## Abstract

Examines 2508 publications in Indian pneumonia research, as indexed in Scopus database during 2004-13, witnessing an annual average growth rate of 19.86%, an average citation impact per paper of 2.85 and international collaborative publication share of 14.19%. The global share of Indian pneumonia research was 2.74% during 2004-13, which increased from 1.83% to 3.39% from 2004-08 to 2009-13. Medicine contributed the largest publications share (76.28%) in Indian pneumonia research, followed by pharmacology, toxicology & pharmaceutics (16.27%), biochemistry, genetics & molecular biology (13.12%), immunology & microbiology (7.19%) and chemistry (3.99%) during 2004-13. The 15 most productive Indian organizations and authors in Indian pneumonia research contributed 34.01% and 10.88% share each to its cumulative publications output during 2004-13 and have registered an average productivity of 56.87 and 18.20, an average citation impact per paper of 3.15 and 4.06, an average h-index value of 9.27 and 7.00 and an average share of international collaborative papers of 16.65% and 14.29%..

**Keywords:** Pneumonia, Disease, Publications, India, Scientometrics

## 1. Introduction

Pneumonia is an inflammatory illness of the lung and it is also described as lung parenchyma/alveolar inflammation and abnormal alveolar filling with fluid<sup>1</sup>. Pneumonia can affect just one lobe of the left or right lung, a whole lung or both lungs. When the germs that cause pneumonia reach the lungs, the lung's air sacs (alveoli) becomes inflamed and infected. The infected lungs leak fluid and shed dead cells. As a result, fluid clogs up the air sacs and makes it less elastic and makes it hard for lungs to do their job of getting oxygen into the blood or in removing carbon dioxide from the blood as efficiently as usual. The lungs, as a result, has to work harder to satisfy the body's need for oxygen. When one has pneumonia, one gets the symptoms such as cough, fever, chill and trouble in breathing<sup>2-3</sup>. Pneumonia can result from variety of causes. Viruses are one of the two major causes of pneumonia, the other being bacteria, less common causes are other microorganisms such as fungi and parasites, certain drugs and other conditions such as autoimmune diseases. Bacteria, viruses or fungi that live in your nose, mouth, sinuses or the surrounding

environment can enter the lungs and create infection. One can also get bacteria or virus from people infected with them. Viruses are the most common cause of pneumonia in children while in adults bacteria are the most common cause<sup>4</sup>.

Pneumonia is a common illness affecting approximately 450 million people a year and occurring in all parts of the world. It is a major cause of death among all age groups resulting in 4 million deaths (7% of words yearly total). Rates are highest in children less than five and adults older than 75 years of age. It occurs about 5 times more frequently in the developing world than in the developed world. Recent estimates from UNICEF shows that pneumonia continues to be number one killer of children around the world – causing 18% of all mortality, an estimated 1.3 million child deaths in 2011 alone. Nearly all pneumonia deaths occur in developing countries and three quarter of these takes place in just 15 countries, The annual child pneumonia deaths in 2010 are highest in India (396700), followed by Nigeria (143600), Congo (87000), Pakistan (79800), Ethiopia (57800), China (54700), etc<sup>5-6</sup>.

## **1.1 Literature Review**

No scientometric study had been published on pneumonia, one of the lung disease so far. However, few scientometric studies have been published on other lung diseases. For example, Arunachalam and Gunasekaran<sup>7</sup> mapped India and China tuberculosis research during 1990-99 and identified institutions and cities active in research, journals used to publish the findings, use of high impact journals, impact of their research and extent of international collaboration reported. Gupta and Bala<sup>8</sup> examined the Indian tuberculosis research using Scopus database during 1998–2009 and focused on parameters, such as growth, rank and global publications share, citation impact, share of international collaborative papers, contribution of major collaborative partner countries, contribution of various subject fields and type of tuberculosis and patterns of research communication in most productive journals. Asthma is a major chronic lung disease characterized by recurrent attacks of breathlessness and wheezing, which vary in severity and frequency from person to person. Gupta and Bala<sup>9</sup> bibliometrically assess Indian asthma research output during 1999-1 2008 and focused on the growth, rank and global publications share, citation impact, share of international collaborative papers, contribution of major collaborative partner countries and contribution of various subject fields. It also analyzes the characteristics of most productive institutions, authors and high-cited papers

## **2. Objectives**

The main objective of this study is to analyze the research performance of India in pneumonia research during 2004-13, based on publications indexed in Scopus database. In particular, the study focuses on the

following objectives: (i) To study the world research output and its growth; (ii) To study the contribution & citation impact of 15 leading countries; (iii) To examine the distribution of citations of the Indian research output and characteristics of the high cited publications; (iv) To study the share of international collaboration publications in Indian publication output and the contribution by leading collaborating partners; (v) To study the distribution of Indian research output by broad subject areas and type of pneumonia research; (vi) To study the publication productivity and the citation impact of leading institutions and authors and (viii) To study the media of communication.

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### **3. Methodology and Data Source**

The study downloaded and retrieved the publication data of the world and of 15 leading countries in pneumonia research from the Scopus database (<http://www.scopus.com>) for 10 years from 2004 to 2013. The keyword “pneumonia” was used in “title, abstract and keyword” and restricting it period 2004-13 in “date range tag” (as shown in search strategy below) was used for searching the global publication data in the study and this become the main search string. When this search string with restricted to India in “country tag” as shown below, we get publication data on India. This string is further restricted to “subject area tag”, “country tag”, “source title tag”, “author name” and “affiliation tag”, to get information on distribution of publications by subject, collaborating countries, journal wise, author name wise and organization-wise, etc. For citation data, the three years, two years, one year citation window was used for publications during 2004-11, 2012 and 2013. and the citation time was restricted till the end of May 2014.

TITLE-ABS-KEY(pneumonia) AND PUBYEAR > 2003 AND PUBYEAR < 2014

(TITLE-ABS-KEY(pneumonia) AND AFFILCOUNTRY(India)) AND PUBYEAR > 2003 AND PUBYEAR < 2014

### **4. Analysis**

#### **4.1 Global Publication Output, Share & Rank**

The global publication share of 15 leading countries in pneumonia research varied from 1.92% to 31.94% during 2004-13, with USA contributing the largest publication share (31.94%) with first rank, followed by Japan.(7.68%, 2<sup>nd</sup> rank), U.K.(7.15%, 3<sup>rd</sup> rank), Germany (5.96%, 4<sup>th</sup> rank), France (4.66%, 5<sup>th</sup> rank), Spain (4.39%, 6<sup>th</sup> rank), Italy (4.28%, 7<sup>th</sup> rank), Canada, China, Netherlands, India, Australia, South Korea and Brazil (from 4.05% to 3.99% publication share and rank from 8<sup>th</sup> to 14<sup>th</sup>) and Turkey (1.92%, 15<sup>th</sup> rank). The global publication share has witnessed the largest increase of 2.91% in China, followed by India (1.56%), South Korea (1.20%), Japan (0.84%), Brazil (0.59%), Italy (0.56%), Australia (0.52%), Turkey (0.37%), U.K. (0.29%) and Netherlands (0.11%), as against decrease by 0.69% in Germany, followed by USA (0.55%), Spain (0.44%), Canada (0.31%) and France (0.03%) from 2004-08 to 2009-13. The countries which have increased their global publication rank among 15 most productive countries are: China (from 11<sup>th</sup> to 5<sup>th</sup>), India (from 12<sup>th</sup> to 10<sup>th</sup>), South Korea (from 15<sup>th</sup> to 13<sup>th</sup>), Japan (from 3<sup>th</sup> to 2<sup>th</sup>)

and Italy (from 8<sup>th</sup> to 7<sup>th</sup>), as against decrease in Spain (from 6<sup>th</sup> to 8<sup>th</sup>), Canada (7<sup>th</sup> to 9<sup>th</sup>), Netherlands (from 9<sup>th</sup> to 11<sup>th</sup>), Australia (from 10<sup>th</sup> to 12<sup>th</sup>), U.K. (from 2<sup>nd</sup> to 3<sup>rd</sup>), France (from 5<sup>th</sup> to 6<sup>th</sup>), Brazil (from 13<sup>th</sup> to 14<sup>th</sup>) and Turkey (from 14<sup>th</sup> to 15<sup>th</sup>) from 2004-08 to 2009-13 (Table 1).

**Table 1. Global Publication Output, Share and Rank of Top 15 Countries in Pneumonia, 2004-13**

Country	Number of Publications			Global Share of Publications			Global Publication Rank		
	04-08	09-13	04-13	04-08	09-13	04-13	04-08	09-13	04-13
USA	12253	16943	29196	32.26	31.71	31.94	1	1	1
Japan	2599	4104	6703	6.84	7.68	7.33	3	2	2
U.K.	2653	3885	6538	6.99	7.27	7.15	2	3	3
Germany	2415	3030	5445	6.36	5.67	5.96	4	4	4
France	1778	2485	4263	4.68	4.65	4.66	5	6	5
Spain	1764	2246	4010	4.64	4.20	4.39	6	8	6
Italy	1503	2411	3914	3.96	4.51	4.28	8	7	7
Canada	1584	2063	3647	4.17	3.86	3.99	7	9	8
China	784	2657	3441	2.06	4.97	3.76	11	5	9
Netherlands	1086	1585	2671	2.86	2.97	2.92	9	11	10
India	695	1813	2508	1.83	3.39	2.74	12	10	11
Australia	860	1490	2350	2.26	2.79	2.57	10	12	12
South Korea	600	1483	2083	1.58	2.78	2.28	15	13	13
Brazil	662	1244	1906	1.74	2.33	2.09	13	14	14
Turkey	647	1107	1754	1.70	2.07	1.92	14	15	15
World	37981	53430	91411	100.00	100.00	100.00			

## 4.2 Indian Publications Output and Citation Impact

India has published 2508 publications in pneumonia during 2004-13 as covered in Scopus database, which increased from 106 in 2004 to 468 publications in 2013, witnessing an annual average growth rate of 19.86%. India's cumulative publications in pneumonia research increased from 695 during 2004-08 to 1813 publications during 2009-2013, witnessing a growth rate of 160.86%. Compared to this, the world has published 91411 publications in pneumonia research during 2004-13, which increased from 6618 in 2004 to 11871 publications in 2013, witnessing an annual average growth rate of 6.75%. The average citation impact (on a three year citation window) registered by all Indian publications in pneumonia research during 2004-13 was 2.85, which decreased from 3.24 during 2004-08 to 2.71 during 2009-2013 (Table 2). The total Indian output (2508 publications) in pneumonia consisted of 1819 articles (72.53%), 299 reviews (11.92%), 224 letters (8.93%), 58 conference papers (2.31%), 45 editorials (1.79%), 36 notes (1.44%), 10 short surveys (0.40%), 9 article in press (0.36%) and 6 book chapters (0.24%) during 2004-13.

**Table 2. World and Indian Publications and Citation Impact in Pneumonia Research in India, 2004-13**

Period	World	India				
	TP	TP	TC	ACPP	ICP	%ICP
2004	6618	106	335	3.16	19	17.92
2005	7325	141	547	3.88	14	9.93

2006	7678	121	387	3.20	14	11.57
2007	8011	166	506	3.05	26	15.66
2008	8349	161	476	2.96	21	13.04
2009	9189	207	599	2.89	30	14.49
2010	10093	279	1358	4.87	37	13.26
2011	10819	426	1681	3.95	65	15.26
2012	11758	433	976	2.25	62	14.32
2013	11871	468	294	0.63	68	14.53
1998-2005	37981	695	2251	3.24	94	13.53
2006-2013	53430	1813	4908	2.71	262	14.45
1998-2013	91411	2508	7159	2.85	356	14.19
TP=Total Publications; TC=Total Citations; ACP=Average Citation Per Paper						

### 4.3 Citation Pattern of Indian Research Output

Citations of publications since their publication were examined from 2004 till May 2014. During this period, 16012 citations were received by 2508 publications and the average rate of citations per publication is 6.38. Around 41.43% of the total publications did not get any citations (zero citation) and rest of the 58.57% publications were cited one or more times. Of the total cited publications, 0.84% publications (receiving more than 100 citations) contributed 28.91% citations share, 1.04% publications (receiving citations from 51 to 100) contributed 11.54% citations share, 1.79% publications (receiving citations from 31 to 50) contributed 11.10% citations share, 8.65% publications (receiving citations from 11 to 30) contributed 23.83% citations and the rest 46.29% publications (receiving citations from 1 to 10) contributed 24.62% citations share (Table 3).

**Table 3. Citations Received by Indian Publications in Pneumonia, 2004-13**

No. of Citations	No. of Publications	Total Citations	% Publications	% Citations
0	1039	0	41.43	0.00%
1-10	1161	3942	46.29	24.62%
11-30	217	3816	8.65	23.83%
31-50	45	1778	1.79	11.10%
51-100	26	1847	1.04	11.54%
>100	20	4629	0.80	28.91%
Total	2508	16012	100.00	100.00%

### 4.4 International Collaboration

The share of international collaborative publications in total Indian publication output in pneumonia during was 14.19% (356 publications) during 2004-13, which increased from 13.53% (94 publications) during 2004-08 to 14.45% (262 publications) during 2009-13. In all 98 foreign countries collaborated with India, as reflected in India's collaborative publications during 1998-2013. During this period, United States contributed the largest share (50.56%) of international collaborative publications with India, followed by U.K.(16.85%), Switzerland (10.11%), Australia (9.27%), Canada (8.71%), Argentina (7.30%), Germany

(7.02%), Mexico (6.46%), Brazil (6.18%), France (5.90%), etc India's international collaborative publication share has increased by 7.08% in Argentina, followed by France (6.57%), Thailand (6.19%), Philippines (3.60%), Canada (3.16%), Taiwan (1.47%), Germany (0.87%) and Singapore (0.02%), as against decrease in Switzerland by 5.05%, USA (3.57%), Brazil (1.72%), Mexico (1.34%), Pakistan (0.74%), Australia (0.41%) and U.K. (0.23%) from 2004-08 to 2009-2013 (Table 4).

**Table 4. Share of Various Foreign Countries in India's International Collaborative Publications in Pneumonia during 2004-13**

Collaborating Country	Number of International Collaborative Publications			Share of International Collaborative Publications		
	04-08	09-13	04-13	04-08	09-13	04-13
USA	50	130	180	53.19	49.62	50.56
U.K.	16	44	60	17.02	16.79	16.85
Switzerland	13	23	36	13.83	8.78	10.11
Australia	9	24	33	9.57	9.16	9.27
Canada	6	25	31	6.38	9.54	8.71
Argentina	2	24	26	2.13	9.16	7.30
Germany	6	19	25	6.38	7.25	7.02
Mexico	7	16	23	7.45	6.11	6.46
Brazil	7	15	22	7.45	5.73	6.18
France	1	20	21	1.06	7.63	5.90
Thailand	1	19	20	1.06	7.25	5.62
Taiwan	4	15	19	4.26	5.73	5.34
Singapore	5	14	19	5.32	5.34	5.34
Pakistan	5	12	17	5.32	4.58	4.78
Philippines	2	15	17	2.13	5.73	4.78
Total of the country	94	262	356			

#### 4.5 Subject-Wise Distribution

The India's publication output in pneumonia research during 2004-13 has been considered in the context of five sub-fields (as reflected in Scopus database classification), with highest publication output coming from medicine (1913 publications, 76.28% share), followed by pharmacology, toxicology & pharmaceuticals (408 publications, 16.27%), biochemistry, genetics & molecular biology (329 publications, 13.12%), immunology & microbiology (178 publications, 7.19%) and chemistry (100 publications, 3.99%) during 2004-13. On analyzing the trends in pneumonia research in India using activity index, it was found that research activity has increased in pharmacology, toxicology & pharmaceuticals (activity index from 46.88 to 120.36), biochemistry, genetics & molecular activity (activity index from 64.71 to 113.53) and chemistry (activity index from 36.09 to 124.50), as against decrease in medicine (activity index from 106.58 to 97.48) and immunology & microbiology (activity index from 137.86 to 85.49) from 2003-07 to 2008-13. In terms of citation impact per paper, it was found that chemistry had scored the highest citation impact (5.30), followed by immunology & microbiology (4.56), biochemistry, genetics & molecular biology (3.14), medicine (2.87) and pharmacology, toxicology & pharmaceuticals (2.82) during 1998-2013 (Table 5).

**Table 5. Subject-Wise break-up of Indian publications in Pneumonia, 2004-13**

Subject	Number of Publications (TP)			Activity Index		TC 1998-2013	ACPP 1998-2013	%TP 1998-2013
	2003-07	2008-12	2003-12	2003-07	2008-12			
Medicine	565	1348	1913	106.58	97.48	5481	2.87	76.28
Pharmacology, toxicology & pharmaceuticals	53	355	408	46.88	120.36	1150	2.82	16.27
Biochemistry, genetics & molecular biology	59	270	329	64.71	113.53	1034	3.14	13.12
Immunology & Microbiology	68	110	178	137.86	85.49	812	4.56	7.10
Chemistry	10	90	100	36.09	124.50	530	5.30	3.99
Total of India	695	1813	2508	100.00	100.00		0.00	100.00

#### 4.6 Type of Pneumonia

Among the type of pneumonia, the largest number of Indian publications were on bacteria pneumonia (936 publications, 37.32% share), followed by tuberculosis pneumonia (165 publications, 6.58%), ventilator associated pneumonia (139 publications, 5.54%), fungal pneumonia (131 publications, 5.22%), aspiration pneumonia (126 publications, 5.02%), viral pneumonia (113 publications, 4.51%), community-acquired pneumonia (111 publications, 4.43%), pneumocystis carinii pneumonia (61 publications, 2.43%), atypical pneumonia (52 publications, 2.07%) and parasite pneumonia (45 publications, 1.79%) during 2004-13.

The share of publications has increased in bacterial pneumonia (from 31.80% to 39.44%), viral pneumonia (from 3.60% to 4.85%), ventilator associated pneumonia (from 3.02% to 6.51%) and as against decrease in fungal pneumonia (from 5.47% to 5.13%), parasite pneumonia (from 1.87% to 1.77%), tuberculosis pneumoni (from 7.34% to 6.29%), pneumocystis carinii pneumonia (from 4.89% to 1.49%), aspiration pneumonia (from 5.61% to 4.80%) and community-acquired pneumonia (from 4.46% to 4.41%) from 2004-08 to 2009-13 (Table 6).

**Table 6. Distribution of Indian Publications by Type of Pneumonia, 2004-13**

Type of Pneumonia	Number of Papers			Share of Papers		
	2004-08	2009-13	2004-13	2004-08	2009-13	2004-13
<b>Bacterial Pneumonia</b>	221	715	936	<b>31.80</b>	<b>39.44</b>	<b>37.32</b>
Klebsiella	32	255	287	4.60	14.07	11.44
Escherichia coli	32	226	258	4.60	12.47	10.29
Staphylococcus aureus	36	215	215	5.18	11.86	8.57
Pseudomonas aeruginosa	25	166	191	3.60	9.16	7.62
Streptococcus	22	66	88	3.17	3.64	3.51
Bacillus subtilis	5	79	84	0.72	4.36	3.35
Gram negative bacterium	12	35	47	1.73	1.93	1.87
Haemophilus influenza	14	26	40	2.01	1.43	1.59
<b>Fungal Pneumonia</b>	38	93	131	<b>5.47</b>	<b>5.13</b>	<b>5.22</b>
<b>Viral Pneumonia</b>	25	88	113	<b>3.60</b>	<b>4.85</b>	<b>4.51</b>
<b>Parasite pneumonia</b>	13	32	45	<b>1.87</b>	<b>1.77</b>	<b>1.79</b>



Others						
<b>Tuberculosis pneumonia</b>	51	114	165	<b>7.34</b>	<b>6.29</b>	<b>6.58</b>
<b>Pneumocystis carinii pneumonia</b>	34	27	61	<b>4.89</b>	<b>1.49</b>	<b>2.43</b>
<b>Atypical pneumonia</b>	16	36	52	<b>2.30</b>	<b>1.99</b>	<b>2.07</b>
<b>Aspiration pneumonia</b>	39	87	126	<b>5.61</b>	<b>4.80</b>	<b>5.02</b>
<b>Ventilator associated pneumonia</b>	21	118	139	<b>3.02</b>	<b>6.51</b>	<b>5.54</b>
<b>Community-acquired pneumonia</b>	31	80	111	<b>4.46</b>	<b>4.41</b>	<b>4.43</b>
Total of the country	695	1813	2508	100.00	100.00	100.00

#### 4.7 Scientometric Profile of Top 20 Most Productive Indian Organizations

The total Indian research output in pneumonia was published from several organizations, of which the top 15 most productive Indian organizations have published 20 to 206 publications each during 2004-13 and together contributed 34.01% (853 publications) share in the cumulative Indian publications. The scientometric profile of these 15 Indian organizations is presented in Table 7. The average publication productivity per organization reported by the top 15 Indian organizations was 56.87 and only three organizations have registered higher output than the group average. These are All India Institute of Medical Sciences (AIIMS), Delhi with 206 publications, followed by Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh (177 publications) and Christian Medical College, Vellore (77 publications).

The average citation per paper registered by the total publications of these 15 Indian organizations was 3.15 (varying from 0.81 to 11.43) during 1998-2013 and seven Indian organizations have registered higher citation impact than the group average. They are Tata Memorial Hospital, Mumbai with citation impact per paper of 11.43, followed by Christian Medical College, Vellore (4.49), PD Hinduja National Hospital & Medical Research Center, Mumbai (4.41), Annamalai University (3.96), Nizam Institute of Medical Sciences (NIMS), Hyderabad (3.35), Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS), Lucknow (3.28) and All India Institute of Medical Sciences (AIIMS), Delhi (3.23).

The average h-index value of these 15 Indian organizations was 9.27 (varying from 3 to 21) and five organizations have achieved higher h-index value than the group's average. These are All India Institute of Medical Sciences (AIIMS), Delhi with h-index value of 21, followed by Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh (17), Christian Medical College, Vellore (15), Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS), Lucknow (10) and CS Maharaj Medical University, Lucknow (10).

The average share of international collaborative publications of top 15 Indian organizations was 16.65 (varying from 2.56% to 40.0%) and five Indian organizations have achieved higher international collaborative publications (ICP) share than the group's average. These are Nizam Institute of Medical

Sciences (NIMS), Hyderabad with ICP share of 40.00%, followed by Christian Medical College, Vellore (37.66%), Tata Memorial Hospital, Mumbai (34.29%), PD Hinduja National Hospital & Medical Research Center, Mumbai (31.82%) and Annamalai University (25.00%).

**Table 7. Scientometric Profile of Top Fifteen Indian Organizations in Pneumonia, 2004-13**

S.No	Name of Institute	TP	TC	ACPP	h-index	ICP	%ICP
1	All India Institute of Medical Sciences (AIIMS), Delhi	206	666	3.23	21	34	16.50
2	Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh	177	356	2.01	17	20	11.30
3	Christian Medical College, Vellore	77	346	4.49	15	29	37.66
4	Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS), Lucknow	50	164	3.28	10	5	10.00
5	CS Maharaj Medical University, Lucknow	43	102	2.37	10	7	16.28
6	Kasturba Medical College, Manipal	42	34	0.81	6	3	7.14
7	Jawaharlal Institute of Postgraduate Medical Education & Research (JIPMER), Pondicherry	39	88	2.26	8	1	2.56
8	Government Medical College & Hospital (GMCH), Chandigarh	35	46	1.31	3	3	8.57
9	Tata Memorial Hospital, Mumbai	35	400	11.43	8	12	34.29
10	Maulana Azad Medical College (MAMC), New Delhi	30	79	2.63	7	1	3.33
11	KEH Hospital, Mumbai	29	88	3.03	7	4	13.79
12	Punjab University, Chandigarh	24	59	2.46	6	2	8.33
13	Annamalai University	24	95	3.96	8	6	25.00
14	PD Hinduja National Hospital & Medical Research Center, Mumbai	22	97	4.41	6	7	31.82
15	Nizam Institute of Medical Sciences (NIMS), Hyderabad	20	67	3.35	7	8	40.00
		853	2687	3.15	9.27	142	16.65
		2508					
		34,01					
TP=Total Publications; TC=Total Citations; ACPP=Average Citation Per Paper; ICP=International Collaborative Publications							

#### 4.8 Profile of Top 15 Most Productive Authors

The top 15 most productive authors involved in Indian pneumonia research have published 11 or more papers each and together contributed 10.88% (273 papers) share in the cumulative publications output of India during 2004-13.. The publication profile of these 15 authors along with their research output, citations received and h-index values are presented in Table 8.. Seven authors have registered higher publications share than the group average of 18.20. They are S.K. Kabra with research output of 37 papers, followed by R. Lodha (28 papers), R. Agarwal (27 papers), S. Singh (24 papers), S. Chibber (20 papers), S. Awasthi (16 papers) and R. Guleria (16 papers). Six authors have registered more than the average citation per paper (4.06) of all 15 authors. They are H. Nair with average citation per paper of 19.58, followed by M. Gopalakrishnan (5.27), S.K. Kabra (4.78), D. Gupta (4.57), N.M. Joseph (4.36) and A. Awasthi (4.13) during 2004-13. Seven authors have registered more than the average h-index (7.00) of all

15 authors during 2004-13. They are S.K.Kabra with h-index of 10, followed by A.Awasthi (9), R.Agarwal (9), R.Lodha (9), D.Gupta (8), S.Singh (8) and N.Kumarasamy (8). Seven authors have achieved more than the average share (14.29%) of international collaborative papers of all 15 authors. They are N.Kumarasamy with international collaborative papers (ICP) share of 56.25%, followed by S. Awasthi (31.25%), R.Lodha (21.43%), S.Singh (16.67%), A.Kapil (16.67%) and H.Nair (16.22%) (Table 8).

**Table 8. Productivity and Citation Impact of Top Fifteen Authors on Pneumonia Research during 2003-12**

S.No	Name	Affiliation	TP	TC	ACPP	h-index	ICP	%ICP
1	S.K. Kabra	All India Institute of Medical Sciences, Delhi	37	177	4.78	10	6	16.22
2	R. Lodha	All India Institute of Medical Sciences, Delhi	28	67	2.39	9	6	21.43
3	R. Agarwal	Postgraduate Institute of Medical Education & Research, Chandigarh	27	95	3.52	9	0	0.00
4	S. Singh	Postgraduate Institute of Medical Education & Research, Chandigarh	24	63	2.63	8	4	16.67
5	S. Chibber	Punjab University, Chandigarh	20	50	2.50	6	2	10.00
6	S. Awasthi	King George Medical University	16	66	4.13	9	5	31.25
7	R. Guleria	All India Institute of Medical Sciences, Delhi	16	58	3.63	6	1	6.25
8	N. Kumarasamy	Y R G Center for AIDS Education, Mumbai	16	6	0.38	8	9	56.25
9	J L Mathew	Maulana Azad Medical College, Delhi	14	32	2.29	5	1	7.14
10	N M Joseph	Jawaharlal Institute of Postgraduate Medical Education & Research, Pondicherry	14	61	4.36	5	0	0.00
11	D. Gupta	Postgraduate Institute of Medical Education & Research, Chandigarh	14	64	4.57	8	0	0.00
12	H Nair	Public Health Foundation of India, Delhi	12	235	19.58	4	2	16.67
13	R. Chaudhry	All India Institute of Medical Sciences, Delhi	12	34	2.83	6	0	0.00
14	A. Kapil	All India Institute of Medical Sciences, Delhi	12	43	3.58	6	2	16.67
15	M. Gopalakrishnan	Annamalai University	11	58	5.27	6	1	9.09
	Total of 15 Authors Contribution		273	1109	4.06	7.0-	39	14.29
	India's Total Contribution		2508					
	Share of Top 15 Authors in India's Total Contribution		10.88					

#### 4.9 Media of Communications

The top 15 most productive Indian journals contributed 640 publications in Indian pneumonia research, accounting for 25.52% share of the total Indian publications output during 2004-13. The share of Indian publications from 15 journals has increased from 22.73% to 26.59% from 2004-08 to 2009-13. The top 15 journals contributing to pneumonia research reported an average citation impact per paper of 2.59 during 2004-13. The journal receiving the highest citation impact per paper (5.17) was Indian Journal of Medical Research, followed by Indian Journal of Pediatrics (3.98), Indian Journal of Medical Microbiology (3.83),

Indian Pediatrics (3.78), Indian Journal of Critical Care Medicine (2.37), Journal of Association of Physicians of India (1.84), Indian Journal of Pathology & Microbiology (1.78), Lung India (1.76), International Journal of Pharmacy & Pharmaceutical Science (1.43), etc (Table 9).

**Table 9. Top 15 leading journals contributing to Indian pneumonia research during 2004-13**

S.No	Name of the Journal	TP			TC	ACPP
		2004-08	2009-13	2004-13	2004-13	2004-13
1	Indian Journal of Pediatrics	34	76	110	438	3.98
2	Indian Pediatrics	39	57	96	363	3.78
3	Indian Journal of Medical Research	19	40	59	305	5.17
4	International Journal of Pharmacy & Pharmaceutical Science	0	49	49	70	1.43
5	Indian Journal of Critical Care Medicine	12	34	46	109	2.37
6	Journal of Association of Physicians of India	16	28	44	81	1.84
7	Lung India	0	38	38	67	1.76
8	Indian Journal of Medical Microbiology	11	19	30	115	3.83
9	International Journal of Pharma & Biosciences	0	28	28	13	0.46
10	Journal of Clinical & Diagnostic Research	0	27	27	14	0.52
11	Indian Journal of Practical Pediatrics	13	10	23	0	0.00
12	Indian Journal of Pathology & Microbiology	9	14	23	41	1.78
13	Journal of Indian Medical Association	5	18	23	19	0.83
14	BMJ Case Reports	0	22	22	5	0.23
15	International Journal of Pharmaceutical Sciences Review & Research	0	22	22	18	0.82
	Total of 15 journals	158	482	640		
	Total of the country	695	1813	2508		
	Share of top 15 journals in country output	22.73	26.59	25.52		

#### 4.10 High Cited Publications

There are 20 high cited publications which have received more than 100 citations since the publication of the paper till May 2014. These 20 high cited publications together received 4643 citations registering an average citation per paper of 232.15. These 20 publications have received citations in range of: 1300-1400 (1 publications), 301-400 (1 publications), 201-300 (4 publications), 101-200 (14 publications). Of the 20 high cited publications, 7 are reviews and 13 articles. These 20 high cited publications are published in 15 professional journals: *The Lancet* and *Journal of Ethnopharmacology* (3 publications each), *American Journal of Infection Control* (2 publications), *American Journal of Transplantation*, *Journal of Pharmacy & Pharmacology*, *Current Drug Delivery*, *Annals of Internal Medicine*, *Molecular Immunology*, *BMC Complementary & Alternative Medicine*, *World Psychiatry*, *European Journal of Clinical Nutrition*, *Journal of the American College of Surgeons*, *Blood*, *The Lancet Neurology* and *New England Journal of Medicine* (1 publication each). The 20 high cited publications involve 22 Indian organizations, including All India Institute of Medical Sciences, Delhi, Bombay College of Pharmacy, Medical College, Jaipur, J.N. Medical College, Belgaum, St John Medical College, Bangalore, BHU-Institute of Medical sciences, Tata Memorial Institute, Mumbai, Sterling Hospital, Ahmedabad, Escorts Heart Institute Research Center, Delhi; AMRI Hospital, Kolkata, GEM Hospital, Coimbatore, Bombay Hospital. Mumbai, PD Hinduja National Hospital, Mumbai, Public Health Foundation of India, Delhi, University Institute of Chemical Technology, Mumbai. IGIB, Delhi, Lyola College, Chennai, Panjab University, University Institute of Pharmaceutical Sciences, Chandigarh, National Botanical Research Institute, Lucknow and Diabetes

Harmone Research Institute, Indore. The 20 high cited publications involve 14 international collaborative publications and 3 national collaborated publications.

## 5. Results & Conclusion

In pneumonia research, India has published 2508 publications during 2004-13. It increased its publications output from 106 to 468 from 2004-08 to 2009-13, registering an annual average growth rate of 19.86%. India's global publication rank was 11<sup>th</sup> among the 15 leading countries with global publication share of 2.74% during 2004-13. India's global publication share and rank increased from 1.83% to 3.39% and from 12<sup>th</sup> to 10<sup>th</sup> from 2004-08 to 2009-13. The average citation impact per publications registered by Indian publications in pneumonia research was 2.85, which decreased from 3.24 to 2.71 from 2004-08 to 2009-13. Of the total publications in Indian pneumonia research, 41.43% did not get any citations (zero citation) and 58.57% publications were cited one or more times. Of the cited publications, only 0.84% of the publications contributed 28.91% citations share, 1.04% publications contributing 11.54% citation share, 1.79% publications contributed 11.10% citations share, 8.65% publications contributed 23.83% citation share and 46.29% publications contributed 24.62% citations share during 2004-13. Only 14.19% of the total Indian publications in pneumonia research were internationally collaborative during 1998-2013, which increased from 13.53% to 14.45% from 2004-08 to 2009-13. Among the leading foreign collaborative partners of India, USA contributed the largest share of 50.56% during 2004-13, followed by U.K.(16.85%), Switzerland (10.11%), Australia (9.27%), Canada (8.71%), Argentina (7.30%), Germany (7.02%), Mexico (6.46%), Brazil (6.18%), France (5.90%), etc. Among the subjects, medicine contributed the largest share of 76.28% during 2004-13, followed by pharmacology, toxicology & pharmaceuticals (16.27%), biochemistry, genetics & molecular biology (13.12%), immunology & microbiology (7.19%) and chemistry (3.99%). Bacteria pneumonia contributed the largest share (37.32%) of publication by type of pneumonia, followed by tuberculosis pneumonia (6.58%), ventilator associated pneumonia (5.54%), fungal pneumonia (5.22%), aspiration pneumonia (5.02%), viral pneumonia (4.51%), etc during 2004-13. The 15 Indian leading organizations and authors contributed 34.01% and 10.88% share to Indian pneumonia research during 2004-13 and have recorded an average productivity of 56.87 and 18.20, average citation impact per paper of 3.15 and 4.06, average h-index of 9.27 and 7.00 and average share of international collaborative papers of 16.65% and 14.29% respectively. The top 10 most productive journals contributed 25.52% share of the total Indian publications in pneumonia research during 2004-13, which has increased from 22.73% to 26.59% from 2004-08 to 2009-13.

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