

Epilepsy Research in India: A Scientometric Analysis of Publications Output during 2002-11

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ABSTRACT

This study analyses the research output of India in epilepsy research during 2002-11 on several parameters including the growth, rank and global publications share, citation impact, share of international collaborative papers, contribution of major collaborative partner countries, contribution of various subject-fields, contribution and impact of most productive institutions and authors, media of communication and characteristics of high cited papers. The Scopus Citation Database has been used to retrieve the data for 10 years (2002-11) by searching the keywords "epilepsy research" in the combined Title, Abstract and Keywords fields. Among the top 20 most productive countries in epilepsy research, India ranks at 11th position (with 1550 papers) with a global publication share of 2.88% and an annual average publication growth rate of 15.31% during 2002-11. Its global publication share has increased over the years, rising from 2.06% in 2002 to 4.65% during 2011. Its citation impact per paper was 2.77 during 2002-11, which decreased from 3.48 during 2002-06 to 2.41 during 2007-11. Its international collaborative publications share was 12.32% during 2002-11, which decreased from 12.45% during 2002-06 to 12.26% during 2007-11. Concludes that India needs to increase both the quantity and quality of research and also the need to share research data and stimulate national and international collaborative research, which will increase both the quantity and quality of research in epilepsy. There is a need to develop a national program on epilepsy as a part of national health plan, besides suggesting the funding agencies to establish a more ambitious funding program into the causes, prevention, cure and care of epilepsy. There is a need to build capacity at all levels of human resources for the management of epilepsy.

KEYWORDS: Epilepsy research, Publications, Scientometrics.

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Introduction

Epilepsy was one of the first brain disorders to be described. It was mentioned in ancient Babylon more than 3,000 years ago. The strange behavior caused by some seizures has contributed through the ages to many superstitions and prejudices. The word epilepsy is derived from the Greek word for "attack." However, in 400 B.C., the early physician Hippocrates suggested that epilepsy was a disorder of the brain – and we now know that he was right.¹

The brain consists of millions of nerve cells, or neurons, and their supporting structure. Each neuron maintains itself in an electrically charged state. It receives electrical signals from other neurons, and passes them on to others. What actually happens is that a tiny quantity of a special neurotransmitter substance is released from the terminals of one neuron. This chemical excites an electrical response in the neuron next in the chain, and so the signal moves onward. All the functions of the brain, including feeling, seeing, thinking and moving muscles depend on electrical signals being passed from one neuron to the next, the message being modified as required. The normal brain is constantly generating electrical rhythms in an orderly way. In epilepsy this order is disrupted by some neuron discharging signals inappropriately. There may be a kind of brief electri-

cal "storm" arising from neurons that are inherently unstable because of a genetic defect (as in the various types of inherited epilepsy), or from neurons made unstable by metabolic abnormalities, such as low blood glucose, or alcohol. Alternatively, the abnormal discharge may come from a localised area of the brain (this is the situation in patients with epilepsy caused by head injury or brain tumour).²

The best available classification of seizures is that proposed by the International League Against Epilepsy ("seizure" is an alternative term for "epileptic attack"). It starts by dividing seizures into partial seizures, where the abnormal electrical discharge originates from one specific area of the brain and generalised seizures, where the whole brain is involved. What makes it a little confusing is that a partial seizure may occasionally go on to become generalised, if the epileptic discharge originating in one area of the brain is strong enough to then spread to the whole brain. However, even if the situation of a partial seizure progressing to become generalised, with complete loss of consciousness, convulsions, etc., the initial symptoms will be prominent, and will distinguish it from other forms of generalised epilepsy, where the whole brain is involved from the outset.²

The incidence and prevalence of epilepsy may vary widely because of their different

causes. Parasitic, viral and bacterial infections have been suggested as important factors in the cause of epilepsy in developing countries, also infections, brain damage occurring at birth or in accidents, or other brain trauma. Some of these factors may be reduced in developing countries by improved prevention and treatment. In the affluent countries, reduction of strokes and brain tumors may lessen the incidence of epilepsy. Although it has a minor role, genetic counseling can also help to prevent certain types of epilepsy.³

Epilepsy affects about 50 million people throughout the world and is especially common in childhood and in elderly people. Epilepsy affects not only the individual, but also has consequences for the family and the rest of society. A minimum of 250 million people will experience at least one seizure in their lifetime and at least 2.4 million new cases of epilepsy occur each year. The incidence of epilepsy is generally taken to be between 40 and 70 per 100,000 people per year in industrialized countries, with estimates of 100 – 190 per 100,000 people per year in developing countries. The prevalence is between 5 and 40 per 1000 persons.³ It is estimated that there are more than 10 million persons with epilepsy (PWE) in India. Its prevalence is about 1% of our population, this being higher in the rural (1.9%) as compared with the urban population (0.6%).⁴

The incidence and prevalence of epilepsy may vary widely because of their different causes. Parasitic, viral and bacterial infections have been suggested as important factors in the cause of epilepsy in developing countries, also infections, brain damage occurring at birth or in accidents, or other brain trauma. Some of these factors may be reduced in developing countries by improved prevention and treatment. In the affluent countries, reduction of strokes and brain tumors may lessen the incidence of epilepsy. Although it has a minor role, genetic counseling can also help to prevent certain types of epilepsy.³

Till today, no quantitative study at the global or country level on epilepsy research literature has been carried out in the past. However, few Indian scholars and the present author in collaboration with other scholars has carried out similar studies in Indian context on other diseases such as diabetes,⁵⁻⁷ tuberculosis,^{8,9} malaria,^{10,11} AIDS/HIV,¹² cancer,¹³ asthma,¹⁴ typhoid¹⁵ and heredity blood disorder¹⁶.

Objectives

The main objective of this study is to analyze the research output of India in epilepsy research in national and global contexts, as reflected in its publications output during 2002-11. The study has the following objectives: (i) To study the Indian research output, its growth, rank and global publications share and citation impact, (ii) To study the patterns of international collaboration and identification of major collaborators, (iii) To study the contribution by sub-fields, (iv) To study the publications productivity and impact of leading institutions and authors of India and (v) To study the characteristics of highly cited papers.

Methodologies and Source of Data

This study used Scopus International Database [<http://www.scopus.com/search/>] to extract relevant data on Epilepsy research in India and other most productive countries for the 10 years (2002-11).

For search world data on epilepsy research, the following string was used in advanced search

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TITLE-ABS-KEY(epilepsy) AND PUBYEAR > 2001 AND PUBYEAR < 2012
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For search data on India, an advanced search strategy involving "Epilepsy" as the keyword in "Title, Abstract and Keywords field" together with "India" in the

"affiliation field" and limiting the data range to 2002 to 2011 was used, resulting in downloading of 1550 records on India related to epilepsy. The actual search strategy used in advanced search for downloading data on India is given below:

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(TITLE-ABS-KEY(Epilepsy) AND AFFIL(india)) AND PUBYEAR > 2001 AND PUBYEAR < 2012
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For downloading Indian data on various subjects, the above strategy was limited to individual subjects, such as the following string in advanced search for search data on medicine.

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(TITLE-ABS-KEY(epilepsy) AND AFFIL(india)) AND PUBYEAR > 2001 AND PUBYEAR < 2012 AND (LIMIT-TO(SUBJAREA,"medi" )).
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For searching data on top most productive countries, string similar to Indian string was used such as the following"

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(TITLE-ABS-KEY(epilepsy) AND AFFIL(germany)) AND PUBYEAR > 2001 AND PUBYEAR < 2012
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For citations data, three years, two years, one year and zero year citation windows have been used for computing average citations per paper in epilepsy research during 2002-08, 2009, 2010 and 2011. For example, for papers published in 2002, citation window is three years from 2002-05. For papers published in 2009, citation window is two years from 2009-2011, and for papers published in 2010 citation window is one year 2010-11. For identifying India's international collaborative papers, a separate search strategy was prepared. For analyzing significant institutions, authors and journals, separate search strategies were developed, which later combined with the main string lead to the generation of the desired output. For generating high-cited papers, the main string was first run. Then, the tag "citation to" was ticked, to rearrange the entire output in the decreasing order of citations received by each paper with most high-cited papers at the top. Then the high-cited papers are marked and downloaded for analyses.

Analysis

Global Publication Share & Rank

The global publication share of the top 20 most productive countries in epilepsy research varies from 1.06% to 25.58% during 2002-11. The United States tops the list, with a publication share of 25.58%

during 2002-11. The United Kingdom ranks second (with 8.67% share), followed by Germany (7.81% share), Italy (7.52% share), France, Japan, Canada, China, Spain and Netherlands (with publications share ranging from 3.01% to 5.68%). India, Brazil, Australia and Turkey ranks at 11th to 14th positions (their global publications share ranging from 2.25% to 2.88%). The countries that fall between 15th and 20th positions are Switzerland, Belgium, Sweden, South Korea, Poland and Austria with their global publications share ranging from 1.05% to 1.99% (Table 1).

The developed countries showing increase in their publications share are United States by 2.11%, followed by Turkey (1.04%), Italy (0.70%), Australia (0.69%), Poland (0.66%), Sweden (0.19%), Netherlands (0.017%), Belgium (0.17%), Switzerland (0.03%) and Austria (0.01%) from the year 2002 to the year 2011. In contrast, the developed countries showing decrease in their publications share during the same period are France by 1.29%, Germany (1.17%), Spain (1.02%), U.K. (0.99%), Japan (0.88%) and Canada (0.01%). All developing countries among the top 20 countries, on the other hand, have shown rise in their publications share in epilepsy research: China by 3.48%, followed by India (2.58%), South Korea (0.87%) and Brazil (0.55%) from the year 2002 to the year 2011 (Table 1).

India ranks at 11th position among the top 20 most productive countries in epilepsy research with its global publications share of 2.88% during 2002-11. China, Brazil and South Korea ranked at 8th, 12th and 18th positions, with global publications share of 3.56%, 2.86% and 1.19%, respectively during 2002-11. India's global publications share increased from 2.06% to 4.65% from the year 2002 to the year 2011. China, Brazil and South Korea's global publications share increased from 1.75% to 5.23%, 2.29% to 2.84% and 0.79% to 1.19% from the year 2002 to the year 2011 (Table 1).

Considering the quality of papers published by these productive countries in terms of average citation per paper which varies from 3.53 to 12.56 during 2002-11. The highest citation impact is registered by Sweden with 12.07 citations per paper, followed by Netherlands (9.88), U.K (9.52), Australia (9.23), Belgium (9.18), Switzerland (8.82), Canada (8.76), Germany (8.19), Austria (7.75), USA (7.48), Italy (6.88), France (6.88), South Korea (5.47), Spain (5.09), Japan (4.38), Poland

Table 1: Publications Output, Share and Rank of Top 20 Countries in Epilepsy Research, 2002-11

S. No.	Country	Number of Papers			Share of Papers			Total Citations	ACPP
		2002	2011	2002-11	2002	2011	2002-11	2002-11	2002-11
1.	USA	1086	1749	13755	24.62	26.73	25.58	102845	7.48
2.	UK	422	561	4662	9.57	8.57	8.67	44386	9.52
3.	Germany	376	481	4198	8.52	7.35	7.81	34398	8.19
4.	Italy	302	494	4043	6.85	7.55	7.52	27826	6.88
5.	France	243	276	3055	5.51	4.22	5.68	21024	6.88
6.	Japan	249	312	2459	5.64	4.77	4.57	10770	4.38
7.	Canada	183	271	2408	4.15	4.14	4.48	21106	8.76
8.	China	77	342	1917	1.75	5.23	3.56	5188	2.71
9.	Spain	171	187	1663	3.88	2.86	3.09	8466	5.09
10.	Netherlands	117	185	1617	2.65	2.83	3.01	15980	9.88
11.	India	91	304	1550	2.06	4.65	2.88	4295	2.77
12.	Brazil	101	186	1538	2.29	2.84	2.86	6265	4.07
13.	Australia	84	170	1296	1.90	2.60	2.41	11960	9.23
14.	Turkey	62	160	1209	1.41	2.45	2.25	4061	3.36
15.	Switzerland	79	119	1068	1.79	1.82	1.99	9416	8.82
16.	Belgium	54	91	860	1.22	1.39	1.60	7895	9.18
17.	Sweden	49	85	670	1.11	1.30	1.25	8084	12.07
18.	South Korea	35	109	639	0.79	1.67	1.19	3495	5.47
19.	Poland	35	95	598	0.79	1.45	1.11	2582	4.32
20.	Austria	46	69	570	1.04	1.05	1.06	4416	7.75
	World	4411	6543	53778					

ACPP=Average Citation Per Paper

(4.32), Brazil (4.07), Turkey (3.36), India (2.77) and China (2.71) (Table 1)

India's Publication Output in Epilepsy Research

India's cumulative publication output in epilepsy research consisted of 1550 papers during 2002-11, with an average number of 155 papers per year and an annual average growth rate of 15.31%. The cumulative publications output of India in epilepsy research increased from 522 papers during 2002-06 to 1028 papers during 2007-11, witnessing a growth of 96.93% (Table 2). In terms of impact and citation quality, the average citation per paper registered by India's publication output was 2.77 during 2002-11. The average citation per paper of cumulative publications in epilepsy research of India has decreased from 3.48 during 2002-06 to 2.41 during 2007-11 (Table 2).

International Collaboration in India's Publication Output

The total number of Indian papers involving international collaboration during 2002-11 is 191, accounting for 12.32%

share in the cumulative publications output of India in epilepsy research. India witnessed a decrease in the share of its international collaborative papers from 12.45% during 2002-06 to 12.26% during 2007-11 in epilepsy research (Table 2)

Among the major international collaborators (59 countries), 15 countries have published 4 or more collaborative papers with India during 2002-11 (Table 3). United States was the major collaborating partner of India during 2002-11 accounting for 41.88% of collaborative publications, followed by United Kingdom (with 24.61% share), Japan, Australia, Canada, Germany, Switzerland, Italy and Belgium (varying its publication share from 4.19% to 7.85%), Malaysia, Brazil, Spain, Singapore, France and Austria (varying its publication share from 2.09% to 3.66%) during 2002-2011.

Of these top 15 international collaborative countries, India's collaborative linkages has decreased with two countries with largest decrease in USA by 15.80%, followed by Switzerland (3.72%) from 2002-06 to 2007-11. India's collaborative linkages have increased with 13 countries

with maximum increase of 6.98% with UK, followed by Germany (4.07%), Belgium (4.02%), France (3.97%), Malaysia (3.22%), Austria (3.17%), Italy (2.48%), Brazil (2.43%), Spain (2.43%), Australia (1.78%), Canada (1.78%), Singapore (1.64%) and Japan 90.24% from 2002-06 to 2007-11 (Table 3).

Indian Epilepsy Research Output in Context of Different Subjects

India's publication output in Epilepsy research during 2002-11 has been published in context of 8 subjects (as reflected in database classification based on journal subject content), with highest publications output coming from medicine (1150 papers and 74.19% publications share), followed by neurosciences (497 papers and 32.06% publications share), pharmacology, toxicology & pharmaceuticals (301 papers and 19.42% publications share), biochemistry, genetics & molecular biology (179 papers and 11.55% publications share), psychiatry and psychology (48 papers and 3.10% publications share), chemistry (42 papers and 2.65% publications share), immunology and microbiology (40 papers and 2.58% publications share)

Table 2: Growth & International Collaboration Share of Indian Epilepsy Publications, 2002-11

Period	TP	TC	ACPP	ICP	%ICP
2002	91	185	2.03	5	5.49
2003	104	313	3.01	13	12.50
2004	90	357	3.97	13	14.44
2005	111	441	3.97	23	20.72
2006	126	522	4.14	11	8.73
2007	146	833	5.71	22	15.07
2008	175	665	3.80	27	15.43
2009	171	590	3.45	23	13.45
2010	232	309	1.33	21	9.05
2011	304	80	0.26	33	10.86
2001-06	522	1818	3.48	65	12.45
2007-11	1028	2477	2.41	126	12.26
2002-11	1550	4295	2.77	191	12.32

TP=Total Papers; TC=Total Citations; CPP=Average Citations per Paper; ICP=International Collaborative Papers

Table 3: Contribution of Major Collaborative Partners of India in Epilepsy Research during 2002-11

S. No.	Names of Collaborating Countries with India	ICP			% ICP		
		2002-06	2007-11	2002-11	2002-06	2007-11	2002-11
1.	USA	34	46	80	52.31	36.51	41.88
2.	UK	13	34	47	20.00	26.98	24.61
3.	Japan	5	10	15	7.69	7.94	7.85
4.	Australia	4	10	14	6.15	7.94	7.33
5.	Canada	4	10	14	6.15	7.94	7.33
6.	Germany	2	9	11	3.08	7.14	5.76
7.	Switzerland	5	5	10	7.69	3.97	5.24
8.	Italy	2	7	9	3.08	5.56	4.71
9.	Belgium	1	7	8	1.54	5.56	4.19
10.	Malaysia	1	6	7	1.54	4.76	3.66
11.	Brazil	1	5	6	1.54	3.97	3.14
12.	Spain	1	5	6	1.54	3.97	3.14
13.	Singapore	1	4	5	1.54	3.17	2.62
14.	France	0	5	5	0.00	3.97	2.62
15.	Austria	0	4	4	0.00	3.17	2.09
	Total*	65	126	191			

ICP =International Collaborative Papers

*Total collaborating papers of India. In all collaborating papers of India, there are one or more foreign collaborating countries. As a result, the combined output of 15 foreign collaborating countries listed above in Indian international collaborative output will be more than its total international collaborative papers

and agricultural & biological sciences (32 papers and 2.06% publications share). On analyzing the quality and citation impact of epilepsy research under different subjects, it was found that agricultural & biological sciences had scored the highest impact of 5.13 citations per paper), fol-

lowed by psychiatry and psychology (4.98 citations per paper), neurosciences (4.02 citations per paper), chemistry (3.95 citations per paper), biochemistry, genetics & microbiology (3.78 citations per paper), immunology and microbiology (2.85 citations per paper), pharmacology, toxicol-

ogy & pharmaceuticals (2.84 citations per paper), and medicine (2.53 citations per paper) (Table 4)

Research Profile of Most Productive Indian Institutions in Epilepsy Research

The top 15 most productive Indian institutions involved in epilepsy research have published 16 or more papers each during 2002-11. The publication profiles of these 15 Indian institutions along with their research output, citations received and h-index values are presented in Table 5. These 15 Indian institutions account for 42.64% share (661 papers) of the publications output of India with an average output per institution of 44.06. Five Indian institutions have registered higher publications share than the group average. These are All India Institute of Medical Sciences, New Delhi with 133 papers during 2002-11, followed by Sree Chitra Tirunal Institute for Medical Science and Technology, Thiruvananthapuram (122 papers), National Institute of Mental Health & Neurosciences, Bangalore (71 papers), Postgraduate Institute of Medical Education & Research, Chandigarh (60 papers) and Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow (51 papers). The average citation per paper registered by the total papers of these 15 Indian institutions is 3.72 on a three year citation window. Six Indian institutions have registered comparative higher impact than the group average. The highest impact of 7.57 citations per paper was scored by the Panjab University, University Institute of Pharmaceutical Sciences, Chandigarh, followed by King Edward Memorial Hospital, Mumbai (5.89 citations per paper), National Institute of Mental Health & Neurosciences, Bangalore (4.90 citations per paper), Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow (4.22 citations per paper), Dayanand Medical College and Hospital, Ludhiana (4.13) and Chhatrapati Shahuji Maharaj Medical University, Lucknow (4.05). Measuring the performance of these institutions on the basis of h-index, seven institutions have achieved a higher h-index value than the group average of 9.0. These are Sree Chitra Tirunal Institute for Medical Science and Technology, Thiruvananthapuram and All India Institute of Medical Sciences, New Delhi with h-index of 16 each, followed by Panjab University, University Institute of Pharmaceutical Sciences, Chandigarh, National Institute of Mental Health & Neurosciences, Bangalore and Sanjay Gandhi Postgraduate

Table 4: Subject-Wise Break-up of Indian Epilepsy Publications during 2002-11

Subject	2002-11		
	TP	TC	ACPP
Medicine	1150	2905	2.53
Neurosciences	497	1997	4.02
Pharmacology, Toxicology & Pharmaceutics	301	855	2.84
Biochemistry, Genetics & Molecular Biology	179	676	3.78
Psychiatry & Psychology	48	239	4.98
Chemistry	41	162	3.95
Immunology & Microbiology	40	114	2.85
Agricultural & Biological Sciences	32	164	5.13
Total*	1550		

TP=Total Papers; TC=Total Citations; ACPP=Average Citations per Paper;

*Total of India in Epilepsy research. There is some overlapping of literature under different subject fields. As a result, the combined output of India under 7 subject fields will be more than its total research output

Table 5: Productivity & Impact of Top Fifteen Indian Institutions in Epilepsy Research, 2002-11

S.No	Name	TP	TC	ACPP	H-Index
1	All India Institute of Medical Sciences, New Delhi	133	459	3.45	16
2	Sree Chitra Tirunal Institute for Medical Science and Technology, Thiruvananthapuram	122	425	3.48	16
3	National Institute of Mental Health & Neurosciences, Bangalore	71	348	4.90	12
4	Postgraduate Institute of Medical Education & Research, Chandigarh	60	178	2.97	11
5	Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow	51	215	4.22	12
6	Christian Medical College & Hospital, Vellore	40	144	3.60	10
7	Gajra Raja Medical College, Gwalior	30	63	2.10	5
8	Jamia Hamdard, Delhi	28	104	3.71	8
9	Panjab University, University Institute of Pharmaceutical Sciences, Chandigarh	21	159	7.57	12
10	Chhatrapati Shahuji Maharaj Medical University, Lucknow	20	81	4.05	8
11	King Edward Memorial Hospital, Mumbai	19	112	5.89	6
12	Nizam's Institute of Medical Sciences, Hyderabad	17	49	2.88	5
13	University College of Medical Sciences, Dehi	17	28	1.65	4
14	G.B.Pant Hospital, Delhi	16	27	1.69	5
15	Dayanand Medical College and Hospital, Ludhiana	16	66	4.13	5
	Total	661	2458	3.72	9
	Total of the Country's Output	1550			
	Share of top 15 institutions in country's total output	42.64			

TP =Total Papers; TC = Total Citations; ACPP = Average Citations Per Paper

Institute of Medical Sciences, Lucknow (12 each), Postgraduate Institute of Medical Education & Research, Chandigarh (11), Christian Medical College & Hospital, Vellore (10)(Table 5).

Contributions and Impact of Most Productive Authors in Indian Epilepsy Research

Fifteen authors have been identified as productive authors who have published 18 or more papers in epilepsy research. These 15 authors together contributed 399 papers with an average of 26.60 papers per author and account for 25.74% of publications share in output of India during 2002-11. Six authors have published higher number of papers than the group average (28.60). These are: Kurupath Radhakrishnan with 59 papers, followed by S.V. Thomas (35 papers), Harinder Jaseja (30 papers), P. Satishchandra (29 papers), C. Kesavadas (28 papers) and M. Tripathi (28 papers). Considering the quality/impact of papers, these productive authors have received a total of 1579 citations for 399 papers with an average of 3.71 citations per paper. Eight authors have registered higher impact than the average. These are: S.K. Kulkurni with ACPP of 8.0, followed by K. Kalita (5.0), P. Satishchandra (4.83), P.S.Sarma (4.58), U.K.Misra (4.55), S. Sinha (4.09), Kurupath Radhakrishnan (4.02) and S.V. Thomas (3.80). Measuring the performance of these authors on the basis of h-index, seven authors have achieved a higher h-index value than the group average of 7.33. These are Kurupath Radhakrishnan with h-index of 12, S.K. Kulkurni (11), S.V. Thomas, P. Satishchandra and M. Tripathi (9 each), P.S.Sarma and S. Jain (8 each) (Table 6)

Patterns of Research Communication

The 15 most productive Indian and foreign journals publishing Indian research papers together contributed 217 papers in epilepsy research, which accounts for 35.74% of the total output of India during 2002-11. The cumulative publications share of these 15 most productive journals showed a decrease in India's publications output from 41.57% during 2002-06 to 32.78% during 2007-11 (Table 7).

High Cited Papers

India has published 12 high cited papers in Epilepsy research in last 10 years (2002-11) and these have received from 50 to 217 citations per paper. Of these

Table 6: Productivity & Impact of Fifteen Most Productive Indian Authors in Epilepsy Research, 2002-11

S.No	Name	Address	TP	TC	ACPP	H-Index
1	Kurupath Radhakrishnan	Sree Chitra Tirunal Institute for Medical Science and Technology, Thiruvananthapuram	59	237	4.02	12
2	Harinder Jaseja	Gajra Raja Medical College, Gwalior	30	62	2.07	5
3	S.V. Thomas	Sree Chitra Tirunal Institute for Medical Science and Technology, Thiruvananthapuram	35	133	3.80	9
4	P. Satishchandra	National Institute of Mental Health & Neurosciences, Bangalore	29	140	4.83	9
5	C. Kesavadas	Sree Chitra Tirunal Institute for Medical Science and Technology, Thiruvananthapuram	28	87	3.11	7
6	M. Tripathi	All India Institute of Medical Sciences, New Delhi	28	104	3.71	9
7	P.S.Sarma	Sree Chitra Tirunal Institute for Medical Science and Technology, Thiruvananthapuram	24	110	4.58	8
8	S. Jain	All India Institute of Medical Sciences, New Delhi	23	82	3.57	8
9	S. Sinha	National Institute of Mental Health & Neurosciences, Bangalore	22	90	4.09	7
10	K. Kalita	Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow	22	110	5.00	7
11	S. Gulati	All India Institute of Medical Sciences, New Delhi	22	36	1.64	5
12	U.K..Misra	Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow	22	100	4.55	7
13	S.K. Kulkurni	Panjab University, University Institute of Pharmaceutical Sciences, Chandigarh	18	144	8.00	11
14	V.Kalra	All India Institute of Medical Sciences, New Delhi	19	40	2.11	5
15	R. Harikumar	Bannar Amman Institute of Technology, Sathyamangalam	18	4	0.22	1
	Total		399	1479	3.71	7.33
	Total of the Country's output		1550			
	Share of top 15 authors in country total		25.74			

TP =Total Papers; TC = Total Citations; ACPP = Average Citations Per Paper

Table 7: List of Most Productive Journals Publishing Indian Papers in Epilepsy, 2002-11

S.No	Name of the Journal	Number of Papers		
		2002-06	2007-11	2002-11
1	Neurology India	70	42	112
2	Epilepsia	28	36	64
3	Annals of the Indian Academy of Neurology	4	47	51
4	Epilepsy and Behavior	10	37	47
5	Indian Journal of Pediatrics	22	20	42
6	Indian Pediatrics	21	18	39
7	Seizure	13	24	37
8	Journal of Indian Medical Association	12	16	28
9	Journal of Pediatric Neurosciences	0	28	28
10	Epilepsy Research	2	20	22
11	Medical Hypothesis	10	8	18
12	Journal of Child Neurology	6	12	18
13	Journal of Association of Physicians of India	9	8	17
14	Indian Journal of Pharmacology	10	7	17
15	Pharmacologyonline	0	14	14
	Total	217	337	554
	Total of the country	522	1028	1550
	Share of top 15 journals in country output	41.57	32.78	35.74

12 high cited papers, 8 appeared as articles and 4 as review paper. Of these 12 papers, 5 were international collaborative (2 bilateral and 3 multilateral), 1 was national collaborative and remaining 6 have no collaboration. Of the international collaborative papers, Indian institutions were first author in 10 papers and foreign authors in 2 papers. In overall, Indian participation in these 12 papers was from 9 institutions including 3 papers from National Chemical Laboratory, Pune, 2 papers from National Institute of Mental Health and Neurosciences, Bangalore and one paper each from 7 other institutions. These 12 papers appeared in 10 journals including 2 papers each in *Progress in Neuro-Psychopharmacology* and *Biological Psychiatry* and one paper each in eight other journals. (Table 8)

Summary and Discussion

Indian scientists together have published 1550 papers in epilepsy research during

Table 8: High Cited Papers in Epilepsy Research during 2002-11.

Author	Affiliation	Title	Journal Title	Citation
Vaswani M., Linda F.K., Ramesh S.	All India Inst. of Medical Sciences, New Delhi	Role of selective serotonin reuptake inhibitors in psychiatric disorders: A comprehensive review	Progress in Neuro-Psychopharmacology and Biological Psychiatry	217
Ranjekar P.K., Hinge A., Hegde M.V. <i>et al</i>	National Chemical Laboratory, Pune	Decreased antioxidant enzymes and membrane essential polyunsaturated fatty acids in schizophrenic and bipolar mood disorder patients	Psychiatry Research	143
Kumari A., Yadav S.K., Yadav S.C.	Institute of Himalayan Bioresource Technology, CSIR, Palampur	Biodegradable polymeric nanoparticles based drug delivery systems	Colloids and Surfaces B: Biointerfaces	129
Arvindakshan M., Sitasawad S., Debsikdar V. <i>et al</i>	National Chemical Laboratory, Pune	Essential polyunsaturated fatty acid and lipid peroxide levels in never-medicated and medicated Epilepsy patients	Biological Psychiatry	112
Arvindakshan M., Ghate M., Ranjekar P.K., Evans D.R., Mahadik S.P.	National Chemical Laboratory, Pune	Supplementation with a combination of ω -3 fatty acids and antioxidants (vitamins E and C) improves the outcome of Epilepsy	Epilepsy Research	103
Andrade C., Kurinji S.	Natl. Inst. Mental Hlth./ Neurosci., Bangalore	Continuation and maintenance ECT: A review of recent research	Journal of ECT	62
Jayakumar P.N., Venkatasubramanian G., Gangadhar B.N. <i>et al</i>	Natl. Inst. Mental Hlth./ Neurosci., Bangalore	Optimized voxel-based morphometry of gray matter volume in first-episode, antipsychotic-naïve Epilepsy	Progress in Neuro-Psychopharmacology and Biological Psychiatry	58
Das U.N.	Bharati Vidyapeeth University Medical College, Pune	Essential fatty acids and their metabolites could function as endogenous HMG-CoA reductase and ACE enzyme inhibitors, anti-arrhythmic, anti-hypertensive, anti-atherosclerotic, anti-inflammatory, cytoprotective, and cardioprotective molecules	Lipids in Health and Disease	56
Dakhale G., Khanzode S., Khanzode S., Saoji A. <i>et al</i>	Government Medical College, Nagpur	Oxidative damage and Epilepsy: The potential benefit by atypical antipsychotics	Neuropsychobiology	52
Cohen A., Patel V., Thara R., Gureje O.	Epilepsy Research Foundation, Chennai	Questioning an axiom: Better prognosis for Epilepsy in the developing world?	Epilepsy Bulletin	51
Rajender S., Singh L., Thangaraj K., Lee W.M.	Centre for Cellular and Molecular Biology, Hyderabad	Phenotypic heterogeneity of mutations in androgen receptor gene	Asian Journal of Andrology	51
Talkowski M.E., Seltman H., Bassett A.S., Brzustowicz L.M., Deshpande, S.N. <i>et al</i>	Dr. Ram Manohar Lohia Hospital, New Delhi,	Evaluation of a Susceptibility Gene for Epilepsy: Genotype Based Meta-Analysis of RGS4 Polymorphisms from Thirteen Independent Samples	Biological Psychiatry	50

2002-11. India ranks 11th among the top 20 countries in Epilepsy research with a global publications share of 2.88% during 2002-11. India has witnessed increase in its global publications share from 2.06% in 2002 to 4.65% in 2011. It witnessed an annual average publication growth rate of 15.31% and registered an average of 2.77 citations per paper during 2002-11, which has decreased from 3.48 during 2002-06 to 2.41 during 2007-11. International collaboration of India in epilepsy research accounts for 12.32% share during 2002-11, which has decreased from 12.45% during 2002-06

to 12.26% during 2007-11. USA is India's major collaborative partner during 2002-11 with a share of 41.88%, followed by United Kingdom (with 24.61% share), Japan (7.85%), Australia and Canada (7.33% each), Germany (5.76%), Switzerland (5.24%), Italy (4.71%) and Belgium (4.19%), etc during 2002-2011.

The distribution of Indian epilepsy research under different subjects shows that the highest research output (1150 papers) coming from medicine with 74.19% publications share, followed by neurosciences (32.06%), pharmacology, toxicology &

pharmaceuticals (19.42%), biochemistry, genetics & molecular biology (11.55%), psychiatry and psychology (3.10%), chemistry (2.65%), immunology and microbiology (2.58%) and agricultural & biological sciences (2.06%). Agricultural & biological sciences had scored the highest citation impact of 5.13 citations per paper, followed by psychiatry and psychology (4.98), neurosciences (4.02), chemistry (3.95 citations), biochemistry, genetics & microbiology (3.78), immunology and microbiology (2.85), pharmacology, toxicology & pharmaceuticals (2.84) and medicine (2.53) papers.

The 661 cumulative publications from 15 most productive Indian institutions in epilepsy research accounts for 42.64% share in India's total publications output, registered an average citation impact of 3.72 citations per paper and an average h-index value of 9.0 during 2002-11. The 15 most productive Indian authors in Epilepsy research together contributed 399 papers and 25.74% publications share, registered an average impact of 3.71 citations per paper and an average h-index of 7.33 per author during 2002-11. The 15 most productive journals publishing Indian research papers in epilepsy research together accounts for 35.74% (554 papers) share of the total output of India during 2002-11, which decreased from 41.57% during 2002-06 to 32.78% during 2007-11.

India has published 12 high cited papers in Epilepsy research in last 10 years (2002-11) and these have received from 50 to 217 citations per paper. Of these, 5 papers were of international collaborative (2 bilateral and 3 multilateral) and Indian participation in these 12 papers was from 9 institutions.

In spite of 10 million people suffering from dementia by 2010 in India, it had produced only 1500 papers during the last ten years from 2002-11. There is therefore an urgent need to increase both the quantity and quality of research. This can be achieved by government by taking number of steps. To begin with there is a need to develop a national program on epilepsy as a part of national health plan of the Ministry of Health and Family Planning, which should subsequently be monitored and evaluated regularly. Indian medical and social research funding agencies must establish a more ambitious funding program into the causes, prevention, cure and care of epilepsy.

There is a need to build capacity at all levels of human resources for the management of epilepsy. There is a need to develop training programs at all levels to educate and train staff involved in diagnosis, treatment, services, prevention and research. For this purpose, the guidelines prepared by Indian Epilepsy Association in collaboration with Indian Epilepsy Society for the management of epilepsy should be strictly followed. There is also need to share research data and stimulate national and international collaborative research, which will increase both the quantity and quality of research in epilepsy. There is also need to bring scientists from diverse fields together to advance research on the mechanisms underlying epilepsy and translate into new human therapies.

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References

1. Epilepsy (Seizure Disorder). 1996-2012. <http://www.medicinenet.com/seizure/article.htm> (Accessed on July 21, 2012)
2. The EpiCentre. What Causes Epilepsy? <http://137.172.248.46/epilepsy.htm> (Accessed on July 21, 2012)
3. Epilepsy out of shadows. Global Campaign Against Epilepsy. http://www.who.int/mental_health/management/en/Gcae-BroEn.pdf (Accessed on Jul 27, 2012)
4. Tripathi M, Jain DC, Gourie DM et al. Need for a national epilepsy control program. *Annals of the Indian Academy of Neurology* 2012; 25(2): 89-93.
5. Arunachalam S, Gunasekaran S. Diabetes research in India and China today: From literature-based mapping to health-care policy. *Current Science* 2002; 82(9): 1086-1097
6. Gupta BM, Kaur H, Bala A. Mapping of Indian diabetes research during 1999-2008. *DESIDOC Journal of Library & Information Technology* 2011; 31(2): 71-80
7. Adarsh B and Gupta BM. Diabetes research in India, China and Brazil: A comparative quantitative study, 2000-09. *Journal of Advances in Library and Information Science* 2012; 1(2): 69-78.
8. Subbiah A, Gunasekaran S. Tuberculosis research in India and China: From bibliometrics to research policy. *Current Science* 2002; 82(8): 933-947.
9. Gupta BM and Bala A. Mapping of tuberculosis research in India: A scientometric analysis of publications output during 1998-2009. *COLLNET Journal of Scientometrics & Information Management* 2011; 5(1): 33-51.
10. Gupta BM and Bala A. A bibliometric analysis of malaria research in India during 1999-2008. *Journal of Vector Borne Diseases* 2011; 48: 163-170.
11. Raja S and Balasubramani R. Plasmodium falciparum research publication in India: A scientometric analysis. *European Journal of Scientific Research* 2011; 56(3): 294-300.
12. Gupta BM, Bala A, Kaur H. Mapping of AIDS/HIV research in India: A scientometric analysis publications output during 1999-2008. *COLLNET Journal of Scientometrics & Information Management* 2011; 5(2): 185-203.
13. Patra, Swapan K, Bhattacharya P. Bibliometric study of cancer research in India. *DESIDOC Bulletin of Information Technology* 2005; 25(2): 11-18.
14. Gupta BM and Bala A. Mapping of asthma research in India: A scientometric analysis of publications output during 1999-2008. *Lung India* 2011; 28(4): 239-46.
15. Gupta BM, Bala A, Baidwan K, et al. Mapping of typhoid research in India: A scientometric analysis of publications output in 2000-2009. *Chinese Librarianship: an International Electronic Journal* 2011; 31: 1-22.
16. Gupta BM. Heredity Blood Disorders (HBD): A Scientometric Analysis of Publications Output from India during 2002-2011. *J Blood Disorder and Transfusion* 2012; 3: 126.