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 (2002-2011) 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 electric – 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.² 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%).³
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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, tuberculosis, malaria, AIDS/HIV, cancer, asthma, and heredity blood disorder.

**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 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

**TITLE-ABS-KEY(epilepsy) AND PUBYEAR > 2001 AND PUBYEAR < 2012**

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:

**(TITLE-ABS-KEY(Epilepsy) AND AFFIL(india)) AND PUBYEAR > 2001 AND PUBYEAR < 2012**

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.

**(TITLE-ABS-KEY(epilepsy) AND AFFIL(india)) AND PUBYEAR > 2001 AND PUBYEAR < 2012 AND (LIMIT-TO(SUBJAREA,"medi") ).**

For searching data on top most productive countries, string similar to Indian search 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 (0.17%), 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.
India’s Publication Output in Epilepsy Research

India’s cumulative publication output 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 have 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 (0.92%) 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 & pharmaceutics (301 papers and 19.42% publications share), biochemistry, genetics & molecular biology (179 papers and 11.55% publications share), psychiatry and psychology (48 papers and 2.65% publications share), immunology and microbiology (40 papers and 2.58% publications share).
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, followed 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, toxicology & pharmaceutics (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, Trivandrum (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, 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. These are Sree Chitra Tirunal Institute for Medical Science and Technology, Trivandrum 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 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 |5    |5.49  |
| 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 2002-06 | %ICP 2002-06 | ICP 2007-11 | %ICP 2007-11 |
|--------|--------------------------------------------|-------------|-----------|------------|------------|
| 1.     | USA                                       | 3.4         | 46        | 0.80       | 52.31      |
| 2.     | UK                                        | 13          | 34        | 47         | 20.00      |
| 3.     | Japan                                     | 5           | 10        | 15         | 7.69       |
| 4.     | Australia                                 | 4           | 10        | 14         | 6.15       |
| 5.     | Canada                                    | 4           | 10        | 14         | 6.15       |
| 6.     | Germany                                   | 2           | 9         | 11         | 3.08       |
| 7.     | Switzerland                               | 5           | 5         | 10         | 7.69       |
| 8.     | Italy                                     | 2           | 7         | 9          | 3.08       |
| 9.     | Belgium                                   | 1           | 7         | 8          | 1.54       |
| 10.    | Malaysia                                  | 1           | 6         | 7          | 1.54       |
| 11.    | Brazil                                    | 1           | 5         | 6          | 1.54       |
| 12.    | Spain                                     | 1           | 5         | 6          | 1.54       |
| 13.    | Singapore                                 | 1           | 4         | 5          | 1.54       |
| 14.    | France                                    | 0           | 5         | 5          | 0.00       |
| 15.    | Austria                                   | 0           | 4         | 4          | 0.00       |
| Total* |                                           | 65          | 126       | 191        | 12.32      |

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.
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 Shahujai 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

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.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.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, Thiruvanathapuram | 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, Thiruvanathapuram | 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, Thiruvanathapuram | 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, Thiruvanathapuram | 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    |
|      | 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
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.

land (5.24%), Italy (4.71%) and Belgium
Japan (7.85%), Australia and Canada
(7.33% each), Germany (5.76%), Switz-er-
land (5.24%), Italy (4.71%) and Belgium
(4.19%), etc during 2002-2011.

The distribution of Indian epilepsy re-
search under different subjects shows that
the highest research output (1150 papers)
coming from medicine with 74.19% publi-
cations share, followed by neurosciences
(32.06%), pharmacology, toxicology &
pharmaceutics (19.42%), biochemistry,
genetics & molecular biology (11.55%),
psychiatry and psychology (3.10%), chem-
istry (2.65%), immunology and microbiol-
ogy (2.58%) and agricultural & biological
sciences (2.06%). Agricultural & biological
sciences had scored the highest cita-
tion 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 mi-
crobiology (2.85), pharmacology, toxicol-
ogy & pharmaceutics (2.84) and medicine
(2.53) papers.

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

| Author / et al | 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 et al | 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., Debiskdar V. et al | 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., Kunirji 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. et al | 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., Kanzode S., Saoji A. et al | 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. et al | 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 |
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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