

ORIGINAL ARTICLE

Research on delirium: A scientometric assessment of publications from India during 2001 to 2020

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ABSTRACT

Aim: To analyze the publication growth, international collaboration, funding support, citation impact, and distribution of publications on delirium with one of the authors from India, indexed in Scopus database, published during 2001–2020. **Methodology:** The Scopus database (<http://www.scopus.com>) was searched for publications on delirium during 2001–2020 with one of the authors from India. The publications were identified and retrieved. **Results:** The initial search, which involved locating the global publication output, yielded 22,929 records. When the search was limited to research originating from India, it yielded 478 Indian records. Researchers from India contributed to 2.08% of the world's delirium research, and overall, the research output from India, ranked twelfth in the world. Of the research originating from India, only 12.97% of publications involved international collaboration. The number of publications on delirium with one of the authors from India increased from 1 in the year 2001 to 47 in the year 2020, accounting for 33.61% annual average growth rate, higher than 9.5% of publication growth rate on the topic for the worldwide publications. The 10-year cumulative publications increased from 84 during 2001–2010 to 394 during 2011–2020, registering 369% absolute growth, which was much higher than 107.52% of the world publications. **Conclusion:** To conclude, this study suggests that only 2% of the world's delirium research emerges from India and overall based on this research output, India stands at the 12th position in delirium research. However, over the last few years, the research on delirium from India has increased.

Key words: Bibliometrics, delirium, India, scientometrics

INTRODUCTION

Delirium is a medical emergency, which requires multidisciplinary care. Delirium is seen in all kinds of medical-surgical settings, including the intensive care units (ICUs). The incidence of the prevalence of delirium increases with increase in the severity and number of physical illnesses, with the highest prevalence in patients admitted to ICUs and requiring mechanical ventilation. Delirium is also associated with significant short-term and long-term negative outcomes for the patients. Considering the multidisciplinary nature of the problem,^[1] it is expected that delirium would receive significant research attention. One of the ways to understand the research output on a particular topic to look at the bibliometric studies on the topic. There are only few bibliometric studies available on delirium. In one of the studies, McCoy^[2] examined global delirium research output (consisting of

3591 articles in 874 journals) with a view to identify its overall contours and evolution of the literature over time, based on data from MEDLINE, published from 1995 to 2015. The authors found that the articles on the treatment of delirium ($n = 806$) outnumber articles on the prevention of delirium ($n = 432$). Abstract topic modeling and MeSH heading used identified similar genres in the delirium literature, including: delirium in geriatric, critically ill, palliative care, and postsurgical patients as well as diagnostic criteria or scales, and clinical risk factors. The genres identified were distributed unevenly between psychiatric journals and nonpsychiatric journals. In another study, the authors explored the progress in the "ICU" delirium research. This study was based on indexed publications in both Web of Sciences and China

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National Knowledge Infrastructure databases. This study included 1102 Chinese articles and 2422 English articles and reviews, published during 2010–2020. The published data on participating countries, institutions, and authors were identified and extracted for studying collaborative networks among them. Citespace 5.0.R1 software was used for analyzing high-frequency keywords, bursting keywords and hotspots were used to understand the evolution of research in the field of ICU delirium. The keyword mapping suggested that the research hotspots mainly focused on the prevention, or both treatment and prevention in mechanically ventilated patients, the effect of dexmedetomidine and explored the risk factors of ICU delirium.^[2] There is a dearth of research on delirium from India. A recent review assessed the research output involving patients of delirium from India, using Medline (PubMed) and other databases. The authors found 305 articles, of which 165 were included for the review. Majority of the papers were original articles ($n = 81$), and these were followed by, case reports ($n = 58$), review articles ($n = 10$), letter to the editor ($n = 13$), editorials ($n = 2$) and one clinical practice guideline. Most of the original papers either focused on epidemiology (incidence, prevalence, outcome, etc.) or symptom profile, with occasional studies focusing on the effectiveness of various pharmacological interventions. The authors overall concluded that there is a dearth of research in the field of delirium from India, with a lack of studies on biomarkers, assessment of efficacy/effectiveness of nonpharmacological interventions, and evaluation of prevention strategies.^[4] However, this review did not evaluate the bibliometric parameters of delirium research from India. As delirium is an important area in psychiatric and multidisciplinary research and there is only one systematic review focusing on publications from India, it was felt to undertake a more comprehensive bibliometric assessment of India's research output on delirium during the last 20 years and compare the same with the global research output on the topic. Accordingly, this study evaluates the research output across the globe and specifically from India, based on publications indexed in the Scopus database during 2001–2020. Using select quantitative and qualitative indicators, the study, in particular, focused on analyzing the publication growth, international collaboration, funding support, citation impact, distribution of publications by broad subjects and identification of significant keywords, profile of top 10 organizations and authors, and medium of research of papers on delirium arising from India. In addition, an attempt was made to understand the global publications growth and contribution of top 10 countries to the delirium research.

METHODOLOGY

The global publications on delirium during 2001–2020 were searched, identified, retrieved, and downloaded from the Scopus database (<http://www.scopus.com>) for the present study. The keywords used to locate these studies included “delirium*” OR “delirious*,” which were searched in the “TITLE” or “KEY” tags and the search

output was confined to the period “2001–2020” using “date range tag.” The initial search, involved locating the global publication output, yielded 22, 929 records. Then the search strategy was subsequently refined by country (including India) to identify the most productive countries in delirium research.

When the search was limited to research originating from India, it yielded 478 Indian records, which were further analyzed by broad subjects, collaborating countries, author, organization, and journal, etc., using analytical provisions of Scopus database. Citations to publications were counted from the date of their publication till May 16, 2021.

RESULTS

During 2001–2020, total numbers of publications emerging from all the countries were 22,929. These articles emerged from 139 countries, with an uneven distribution. Authors from only 6 countries contributed to more than 1000 articles each. Further, it was seen that researchers from only 31 countries published more than 100 publications on delirium. The authors from the top 12 countries accounted for 88.63% of global research output and majority of the citations. In terms of specific countries, researchers from the United States accounted for the maximum share of publications and citations, followed by the United Kingdom, Canada, Germany, and Japan. Researchers from India accounted for 2.08% of the total global publications and based on this, and India was at the 12th position in the global research output on delirium. Five out of top 12 countries registered relative citation index above the average with relative citation index being highest for research from Canada (1.64), followed by that from the Netherlands (1.51), United States (1.47), United Kingdom (1.42), and Italy (1.42) [Table 1].

Collaborative linkages among authors from top 10 countries in terms of delirium research output

All the top 12 countries had one-to-one collaborative linkages [Table 2]. The largest numbers of collaborative linkages were depicted by authors from United States, United Kingdom, and Canada. Among individual country-country collaborative linkages, the highest number of collaborative linkages were seen between the authors from the United States and Canada ($n = 335$), followed by researchers from the United States and United Kingdom ($n = 232$), United States and Italy (177 linkages), United States and Australia (140 linkages) [Table 2 and Figure 1].

Delirium research from India

During 2001–2020, 478 publications as indexed in the Scopus database had one of the authors from India. The number of publications on delirium with one of the authors from India increased from 1 in the year 2001 to 47 in the year 2020, accounting for 33.61% annual average growth rate, higher than 9.5% of publication growth rate on the topic for the worldwide publications. Similarly, 10-year cumulative publications increased from 84 during 2001 to 2010 to 394 during 2011 to 2020,

Table 1: Contribution of researchers from top 12 countries to global delirium research

Name of the country	Number of papers			Share of papers			TC	CPP	RCI
	2001-10	2011-20	2001-20	2001-10	2011-20	2001-20			
USA	2894	5517	8411	38.81	35.66	36.68	253,336	30.12	1.47
U.K.	616	1364	1980	8.26	8.82	8.64	57,842	29.21	1.42
Canada	399	1069	1468	5.35	6.91	6.40	49,493	33.71	1.64
Germany	459	881	1340	6.16	5.69	5.84	31,029	23.16	1.13
Japan	339	839	1178	4.55	5.42	5.14	16,728	14.20	0.69
Australia	291	802	1093	3.90	5.18	4.77	26,769	24.49	1.19
Netherlands	235	759	994	3.15	4.91	4.34	30,911	31.10	1.51
Italy	302	662	964	4.05	4.28	4.20	28,086	29.13	1.42
China	44	833	877	0.59	5.38	3.82	10,750	12.26	0.60
France	305	512	817	4.09	3.31	3.56	18,577	22.74	1.11
Spain	301	421	722	4.04	2.72	3.15	14,237	19.72	0.96
India	84	394	478	1.13	2.55	2.08	4662	9.75	0.48
Total of 10 countries	6269	14,053	20,322	84.08	90.82	88.63	542,420	26.69	1.30
World	7456	15,473	22,929	100.00	100.00	100.00	470,728	20.53	1.00

TC: Total citation, CPP: Citation per paper, RCI: Relative citation index

Table 2: Collaboration Linkages among authors from top 12 countries in delirium research

Country name	Collaborative linkages with other 11 countries	Total collaborative linkages
1. United States	2 (232), 3 (335), 4 (151), 5 (64), 6 (140), 7 (108), 8 (177), 9 (80), 10 (95), 11 (27), 12 (27)	1436
2. United Kingdom	1 (232), 3 (96), 4 (94), 5 (12), 6 (120), 7 (99), 8 (117), 9 (31), 10 (57), 11 (62), 12 (20)	940
3. Canada	1 (335), 2 (96), 4 (48), 5 (9), 6 (87), 7 (53), 8 (51), 9 (14), 10 (51), 11 (27), 12 (9)	780
4. Germany	1 (151), 2 (94), 3 (48), 5 (7), 6 (26), 7 (60), 8 (70), 9 (8), 10 (45), 11 (47), 12 (5)	561
5. Japan	1 (64), 2 (12), 3 (9), 4 (7), 6 (8), 7 (2), 8 (8), 9 (9), 10 (6), 11 (8), 12 (6)	139
6. Australia	1 (140), 2 (120), 3 (87), 4 (26), 5 (8), 7 (42), 8 (24), 9 (25), 10 (21), 11 (20), 12 (10)	523
7. Netherlands	1 (108), 2 (99), 3 (53), 4 (60), 5 (2), 6 (42), 8 (50), 9 (5), 10 (30), 11 (26), 12 (3)	478
8. Italy	1 (177), 2 (117), 3 (51), 4 (70), 5 (8), 6 (24), 7 (50), 9 (9), 10 (57), 11 (67), 12 (8)	565
9. China	1 (89), 2 (31), 3 (14), 4 (8), 5 (9), 6 (25), 7 (5), 8 (9), 10 (5), 11 (9), 12 (4)	208
10. France	1 (95), 2 (57), 3 (51), 4 (45), 5 (6), 6 (21), 7 (30), 8 (57), 9 (5), 11 (42), 12 (4)	413
11. Spain	1 (27), 2 (62), 3 (27), 4 (47), 5 (8), 6 (20), 7 (26), 8 (67), 9 (9), 10 (42), 12 (5)	340
12. India	1 (27), 2 (20), 3 (9), 4 (5), 5 (6), 7 (10), 8 (8), 9 (4), 10 (4), 11 (5)	98



Figure 1: Collaboration network between top 12 countries

registering 369% absolute growth, which was again much higher than 107.52% of the world publications. The global share of India’s publications was 2.08% during 2001–2020, which increased from 1.13% during the years 2001 to 2010 to 2.55% during 2011 to 2020. The 478 publications on delirium with one of the authors from India averaged 9.65 citations per paper (CPP) during 2001-2020, that is much less than the CPP of 20.53 for

global publications during 2001–2020. The citation impact per paper for papers from India decreased from 13.0 CPP and 8.93 CPP from 2001 to 2010 to 2011 to 2020 [Table 3]. Only a small proportion (4.39%) of the publications on delirium with one of the authors from India were an outcome of funded research [Table 3]. Of the total publications, research articles, reviews and letters contributed the largest publications share (59.41%, 17.78%, and 16.32%), followed by notes, editorials, conference papers (1.88%, 1.67%, and 1.46%), and book chapters and short surveys (0.84% and 0.63%).

Collaborative linkages of publications with one of the authors being of Indian origin

Out of the 478 publications, 62 papers (12.97%) involved international collaboration. These 62 international collaborative papers received 1655 citations, averaging 26.69 CPP. The largest number of collaborations were seen with researchers from United States ($n = 27$), followed by United Kingdom ($n = 17$), Australia ($n = 9$), Canada ($n = 8$), and Italy ($n = 8$).

Distribution of papers by population age groups

The maximum number of papers on delirium from India focused on “adults” age group (with 67% publication share), followed by elderly (21.07%), and adolescents (17%), with some of the papers focusing on more than one age group.

Table 3: Publications output and citations count for papers on delirium published during 2001-20

Publication period	Global			Indian					
	TP	TC	CPP	TP	TC	CPP	TP (%)	ICP (%)	FP
2001	411	20,941	50.95	1	8	8.00	0.24		
2002	466	16,649	35.73	4	0	0.00	0.86		
2003	580	22,561	38.90	4	93	23.25	0.69		
2004	685	22,438	32.76	6	31	5.17	0.88		
2005	785	25,993	33.11	4	43	10.75	0.51		
2006	758	24,559	32.40	8	153	19.13	1.06	3 (37.50)	1
2007	866	28,949	33.43	10	119	11.90	1.15	1 (10.00)	
2008	906	29,914	33.02	11	141	12.82	1.21	2 (18.18)	
2009	952	33,313	34.99	18	252	14.00	1.89	1 (5.56)	1
2010	1047	34,479	32.93	18	252	14.00	1.72	5 (27.78)	
2011	1070	26,050	24.35	28	490	17.50	2.62	3 (10.71)	
2012	1320	31,437	23.82	39	384	9.85	2.95	4 (10.26)	1
2013	1326	29,337	22.12	36	358	9.94	2.71	5 (13.89)	2
2014	1405	28,214	20.08	34	456	13.41	2.42	7 (20.59)	5
2015	1445	26,864	18.59	36	781	21.69	2.49	7 (19.44)	2
2016	1521	18,951	12.46	32	131	4.09	2.10	1 (3.13)	1
2017	1653	19,397	11.73	47	327	6.96	2.84	5 (10.64)	2
2018	1745	15,395	8.82	47	187	3.98	2.69	5 (10.64)	3
2019	1794	8942	4.98	48	68	1.42	2.68	6 (12.50)	1
2020	2194	6345	2.89	47	388	8.26	2.14	7 (14.89)	2
2001-10	7456	259,796	34.84	84	1092	13.00	1.13	12 (14.29)	2
2011-20	15473	210,932	13.63	394	3520	8.93	2.55	50 (12.69)	19
2001-20	22929	470,728	20.53	478	4612	9.65	2.08	62 (12.97)	21

TP: Total paper, TC: Total citation, CPP: Citations per paper, ICP: International collaborative paper, FP: Funded projects papers

Significant keywords

Sixty seven keywords (assumed to be significant) were identified which were represented in papers on delirium from India [Table 4].

Organizational distribution of publications

Research on delirium from India emerged from 238 organizations with authors from 223 organizations contributing to 1–5 papers each, authors from 11 organizations contributing to 6–10 papers each and authors from only 4 organizations contributed to more than 10 publications [Table 5]. The productivity of authors from the top 25 most productive organizations varied from 4 to 98 publications per organization, together these 25 organizations contributed to 62.76% ($n = 300$) share in publications from India and 68.08% (3140) share of the citations of the papers with one of the authors from India. Four organizations registered their publication output above the group average (12.0) of all organizations, with the highest number of publications emerging from Postgraduate Institute of Medical Education and Research, Chandigarh [Table 5]. Five organizations registered their CPP and relative citation index above the group average (10.47 and 1.08) of all organizations, with Tata Memorial Hospital, Mumbai was the most impactful organization [Table 5].

Most productive authors

Three hundred and forty one authors contributed to research on delirium from India, with 327 authors contributing to 1–5 papers each, 8 authors contributed to 6–10 papers each, and 6 authors contributed to more than 10 papers each. The research productivity of the top 25 most productive authors varied from 4 to 58 publications

per author. Together they contributed 54.2% ($n = 259$) share of publications from India and 75.71% (3492) share of citations of papers from Indian authors.

Medium of research communication

Of the total “delirium” research, 99.16% (474) appeared in 159 journals and 0.84% (4) as book chapters. The maximum number of papers were published in the Indian Journal of Psychiatry (34 papers), followed by Asian Journal of Psychiatry, Journal of Anesthesiology Clinical Pharmacology (19 papers each), Journal of Clinical and Diagnostic Research (15 papers), Annals of the Indian Academy of Neurology (13 papers), Indian Journal of Critical Care Medicine (12 papers), Neurology India (11 papers), and General Hospital Psychiatry (10 papers).

DISCUSSION

The present study shows that during the 20 years of 2001–2020, 478 publications on delirium with one of the authors from India were listed in the Scopus database. This number forms 2.08% of the total publications of 22,929 arising from all the countries during the same time frame. This finding can be seen from multiple viewpoints. First, this finding suggests that the contribution of authors from India to delirium is meager. Second, this finding should not be looked in isolation and need to be seen in the context of the contribution of researchers from India on other mental disorders. When one compares this finding with research on other mental disorders, like schizophrenia and bipolar disorder, the contribution of Indian researchers to delirium is comparable.^[4-6] This suggests that delirium possibly receives as much attention as schizophrenia and bipolar disorder. Third, it is important to note that delirium research involves multiple specialties. Hence,

Table 4: The commonly encountered key words in publications on delirium from India

Name of the keyword	n
Delirium	478
Clinical articles	184
Case reports	133
Haloperidol	65
Depression	63
Clinical trials	59
Lorazepam	58
Risk factors	57
Anxiety	56
Seizure	53
Agitation	52
Confusion	52
Mental disease	52
Psychosis	51
Sedation	51
Drug withdrawal	45
Treatment outcome	44
Olanzapine	44
Alcoholism	44
Cognitive defect	41
Insomnia	41
NMR imaging	41
Risperidone	40
Tremors	40
Hallucination	39
Tachycardia	39
Disorientation	38
Hypertension	37
Sleep disorders	37
Restlessness	33
Schizophrenia	35
Computer assisted tomography	34
Incidence	34
Outcome assessment	34
Postoperative complications	34
Midazolam	33
Prevalence	32
Mortality	31
Benzodiazepine	31
Diarrhea	31
Electroconvulsive therapy	30
Hypotension	29
Postoperative complications	29
Postoperative delirium	28
Dexmedetomidine	28
Fentanyl	28
Postoperative delirium	28
Delirium tremens	27
Dementia	27
Ketamine	27
Alcohol consumptions	26
Behavior disorders	26
Bipolar disorder	26
Antidepressants	26
Hypernatremia	25
Mania	25
Neurological disease	23
Clozapine	22
Antibiotics	22
Brain disease	20
Diabetes mellitus	20
Diazepam	20

Contd...

Table 4: Contd...

Name of the keyword	n
Treatment response	19
Cholinergic receptor blocking agents	14
Serotonin uptake inhibitors	12
Beta adrenergic receptor blocking agents	9
Monomine oxidase inhibitors	7
Enzyme inhibitors	4
Biomarkers	2

research on this topic is expected to be more than other psychiatric disorders. Accordingly, it can be said that delirium research has not received as much attention as other psychiatric disorders.

Besides the number of publications, other parameters which can help in understanding the research output include is the publication growth rate and the citation index of the published papers. When the research output from India during the 2001–2010 and 2011–2020 was compared, there was 33.61% and 369.05% annual and 10-year cumulative growth in the number of publications respectively, which was much higher than 9.5% and 107.52% of global output during the last same period. Based on this finding it can be said that, in the last decade or so, the research output on delirium by the authors from India has increased considerably and when this is compared with the research output from other countries, it is more. This can be considered a healthy sign. This increased attention is important because the causes of delirium in the context of developed countries may be different than that of India, where rates of infections are relatively higher. When one looks at the literature from India, it is apparent that delirium is mostly talked in the context of the adult population, which is in contrast to the developed countries where delirium is mostly reported among the elderly. Hence, it can be said that the increased attention on delirium in recent times is a healthy sign and this need to be continued in future too.

The publications on delirium with one of the authors of Indian origin had 9.65 CPP during 2001–2020, that was much lower than the figure of 20.53 CPP of global publications. This finding suggests that the papers of Indian authors are not cited as much as those emerging from developed countries. This finding can again be interpreted in different ways. First, the quality of research emerging from India may not of high quality that could be cited. This could be due to poor research infrastructure in India, compared to the western world. This is further reflected by the fact that most of the research which emerged from India was not funded. Second, it could also be possible that, as most of the research emerged from developed countries; the publications from India are not cited deliberately. An indirect evidence for this is also apparent when one looks at the citations of publications with international collaborations, which are cited more often than the papers without international collaboration.

In terms of involvement of different organizations, this study suggests that although the research on delirium emerged from 238 Indian organizations, most of the research was limited to few institutes with the top 8 institutes

Table 5: The most productive and most impactful organizations from India in delirium research

Name of the organization	TP	TC	CPP	HI	ICP (%)	RCI
Most productive organizations						
PGIMER, Chandigarh	98	1360	13.88	23	12 (12.24)	1.44
NIMHANS, Bangalore	35	328	9.37	11	4 (11.43)	0.97
AIIMS, New Delhi	34	301	8.85	8	3 (8.82)	0.92
CMC, Vellore	13	143	11.00	5	4 (30.77)	1.14
KGMU, Lucknow	10	82	8.20	6	4 (40.00)	0.85
JIPMER, Pondicherry	8	64	8.00	4	0 (0.00)	0.83
Dayanand Medical College and Hospital	8	99	12.38	3	1 (12.50)	1.28
IMS-BHU, Varanasi	8	31	3.88	4	0 (0.00)	0.40
Most impactful organizations						
TMH, Mumbai	7	362	51.71	3	1 (14.29)	5.36
Dr Ram Manohar Lohia Hospital, New Delhi	6	93	15.50	3	0 (0.00)	1.61
PGIMER, Chandigarh	98	1360	13.88	23	12 (12.24)	1.44
Dayanand Medical College and Hospital	8	99	12.38	3	1 (12.50)	1.28
CMC, Vellore	13	143	11.00	5	4 (30.77)	1.14
NIMHANS, Bangalore	35	328	9.37	11	4 (11.43)	0.97
AIIMS, New Delhi	34	301	8.85	8	3 (8.82)	0.92
JSS Academy of Higher Education and Research	5	44	8.80	2	0 (0.00)	0.91

TP: Total paper, TC: Total citation, CPP: Citations per paper, ICP: International collaborative paper, RCI: Relative citation index, PGIMER: Postgraduate Institute of Medical Education and Research, NIMHANS: National Institute of Mental Health and Allied Sciences, AIIMS: All India Institute of Medical Sciences, CMC: Christian Medical College, KGMU: King George's Medical University, JIPMER: Jawaharlal Postgraduate Institute of Medical Education and Research, IMS-BHU: Institute of Medical Sciences-BHU, TMH: Tata Memorial Hospital, HI: H-Index

accounting for nearly half (44.76%) of publications. Similar trends in mental health research from India on other topics have been noted. This significant disparity in research is not specific to mental health but possibly applies to all the specialties of medicine. This suggests that there is a need to improve the research infrastructure and capacity in this country to improve the research output. This may involve providing adequate training for research and possibly providing more funding support.

The present study has certain limitations which include limiting the search to Scopus search engine. It is quite possible that some of the research could have been missed, because, many of the journals published from India are not listed in the Scopus. The citation index obtained can also be considered as more conservative, as the numbers of citations as reflected in Scopus are lower than that reported in Google Scholar. Third, the study was limited to the research publications of the last 20 years only.

CONCLUSION

This study suggests that only 2% of the world's delirium research emerges from India and overall based on this research output, India stands at the 12th position in delirium research. Compared to 2001–2010, there is a significant increase in the research on the topic of delirium from India, which was more than compared the average of research output growth on delirium from the whole world. Most of the research on delirium from India focuses on the adult age group; is not funded and researchers working on delirium from India have few collaborative

networks with researchers from other countries. Although the research on delirium emerges from researchers from 238 institutes, about half of the research comes from 8 institutes. The present study also suggests that research from India is less often cited that the mean number of citations received by worldwide publications on delirium. These findings suggest that there is a need to improve research on delirium from India, both in terms of quantity and quality.

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Conflicts of interest

There are no conflicts of interest.

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