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ALZHEIMER'S DISEASE RESEARCH IN INDIA: A SCIENTOMETRIC ANALYSIS OF PUBLICATIONS OUTPUT DURING 2011-2020

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ABSTRACT

The present study of Alzheimer's disease research in India: A Scientometric analysis of publications output during 2011-2020. India's cumulative publication output in Alzheimer's disease research consisted of 4481 papers during 2011-2011, with a maximum of 895(19.97%) research publications in the year 2020. Alzheimer's disease research in 10 years. The top rank of India is 4481(71.10%) research publications. The United States is listed at the top accounting for 498(29.28%) shares among the leading countries that collaborated with India, The subjects in the maximum 1575(51.30%) research publications in Biochemistry, Genetics and Molecular Biology. The average degree of collaboration is 0.95 and the collaborative coefficient, the average is 0.65, the collaboration index has an average is 3.83. The modified collaboration coefficient average is 3.85. CAI for single, two and three authorship contributions are decreasing trend from 1st block year to 2nd block year. At the same time, CAI is increasing trend for more than three authors from 1st block year (92.62) to 2nd year block year (103.60). The institutions from India in a maximum of 120(7.61%) research publications. The productive authors from India the maximum Kamal. M.A. India. 49(1.697%) research publications, the journals a maximum of 66(9.62%) appeared as CNS and Neurological Disorders Drug Targets.

KEYWORDS

Alzheimer's disease research, Scientometrics, Degree of collaboration, Collaborative index (CC, CI, MCC), Co-authorship index and Relative citation index.

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INTRODUCTION

Alzheimer's disease is a progressive neurologic disorder that causes the brain to shrink (atrophy) and brain cells to die. Alzheimer's disease is the most common cause of dementia - a continuous decline in thinking, behavioral and social skills that affect a person's ability to function independently. Approximately 5.8 million people in the United States age 65 and older live with Alzheimer's

disease. Of those, 80% are 75 years old and older. Out of the approximately 50 million people worldwide with dementia, between 60% and 70% are estimated to have Alzheimer's disease. The early signs of the disease include forgetting recent events or conversations. As the disease progresses, a person with Alzheimer's disease will develop severe memory impairment and lose the ability to carry out everyday tasks.

Medications may temporarily improve or slow the progression of symptoms. These treatments can sometimes help people with Alzheimer's disease maximize function and maintain independence for a time. Different programs and services can help support people with Alzheimer's disease and their caregivers. There is no treatment that cures Alzheimer's disease or alters the disease process in the brain. In the advanced stages of the disease, complications from severe loss of brain function - such as dehydration, malnutrition, or infection - result in death¹.

Scientometric Study

Scientometrics is an analysis of scientific research publications. Scientometrics analysis has been used to measure the scientific literature published online or offline through the scientometrics techniques and statistical tools. The research activities contain major changes over the last few decades and emerged as an established research in the discipline of "Library and Information Science" subsequently it becomes an interdisciplinary. In the late 1960s, Alan Pritchard was coined the term bibliometric, which is used for the application of mathematical and statistical methods for books and other media of communication (Pritchard, 1969)². According to Beck (1978)³ "Scientometrics is defined as the quantitative evaluation and inter-comparison of scientific activity, productivity, and progress". Bookstein (1995)⁴ defined "scientometrics as the science of measuring science. Scientometrics is also considered as a bibliometric measurement for evaluation of scientific development, social relevance and impact of the application of science and technology". Ingwerson and Christensen (1997)⁵ defined the term "informatics designates a recent extension of the traditional bibliometric analysis,

also to cover non-scholarly communities in which information is produced, communicated and used".

REVIEW OF LITERATURE

Shilpa B. S and Padmamma S (2020)⁶ this paper examined in the growth rate of literature on oncology from 2010 to 2019 in which a total of 1275877 research papers is analyzed. A scientometric technique is one of the most prominent dimension tools to recognize and ascertain the growth of publications in the scientific disciplines. The study evaluated various scientometric dimensions i.e. the year-wise distribution of records, annual growth rate, compound annual growth rate, and authorship pattern, and found that a maximum of 143481 papers was published in 2018. The annual growth rate was registered in the year 2014 and in the same year, 4.447 CAGR was recorded. The relative growth rate is decreasing and the doubling time is increasing during the study period. The authorship pattern reveals that 93.66% of the papers collaborated paper. The study found that the growth of literature in oncology research is increasing trend.

Fu, Hang *et al*, (2015)⁷ examined his research in malaria research publications were retrieved from China National Knowledge Infrastructure, Wanfang database, Cqvip, and data has been retrieved from PubMed database between 2004 and 2014 with 5,126 publications. The study identified the first-author affiliation, journal name and high-frequency keywords were selected. The papers published 32.98% in overall articles by the top 12 Chinese journals in the field of malaria research.

Saed H. Zyoud (2016)⁸ analyzed his study of dengue research in Arab countries with 19,581 documents from the Scopus database during 1872 - 2015. Most contributed countries in dengue research publications were the USA with 4,709(24.05%) publications, India with 1,942(9.92%) publications, Brazil with 1530(7.81%) publications and Thailand with 1,260(6.43%) publications. Arab region contributions are only 226 (1.16%) research publications in dengue research. The total numbers of 3, 52,710 citations were received with an average of 18 citations per publication. Kingdom of Saudi

Arabia was the most prolific country in the Arab region with 102 (45.1%) publications.

Jeyshankar R and Chithiravel S (2019)⁹ analyzed the Eosinophilia research output in India during the year 1998-2017 with 267 publications from the web of science online database. The study examined the different type of parameters like authorship pattern, growth of publications, time series analysis, degree of collaboration and most productivity journals. The overall growth rate was increasing trend, and multi-authored papers were the majority of contributions in Eosinophilia research in India.

Sivasamy K and Vivekanandhan S (2020)¹⁰ the present study examines the leprosy research publications that are contributed from the Scopus database during the study period of 2009-2018 with a total number of 6266 publications. This study aims to analyze scientometric tools such as frequency distribution, percentage analysis, relative growth rate and doubling time, the degree of collaboration. During the study period maximum of 675(10.77%) research publications are contributed in the year 2015. The relative growth rate is identified decreasing trend and doubling time is increasing trend from 2009 to 2018. Maximum of 99(1.58%) research publications are contributed by Sarno, E.N. with top-ranking authors, the average degree of collaboration is 0.83 and 4218(67.32%) of research publications are articles. India is the most contributing top-ranking countries with 1522(24.29%) leprosy research publications. Even though India is top most productive country in the leprosy research, hardly any Indian institution is not listed among the most productive institutions.

Ravichandran S and Vivekanandhan S. (2020)¹¹ analysis of solid waste management research publications (2010-2019) using the Scopus database with a total number of 5198 research publications. The study identified that a maximum of 694 (13.35%) research publications are contributed in the year 2019, the compound annual growth rate was 3.67. A maximum of 3907(75.16%) research publications are contributed by articles, maximum of 43(0.83%) research publications are contributed by Huang G.H, India. Out of 5198 research publications, 579(11.14%) research publications are

contributed by single authors, and the remaining 4619(88.86%) research publications are contributed by multi-authors and the average degree of collaboration was 0.88. From this study, the relative growth rate is 0.63 in the year 2011 and 0.14 in the year 2019 at the same time doubling time was 1.10 in the year 2011 and 4.84 in the year 2019.

Ravichandran S and Vivekanandhan S (2021)¹² examines the Scientometric analysis of waste water management research publications from 2010 to 2019 from the Scopus online database. This study identified that a maximum of 2842(14.31%) research publications with 19857 citations are contributed in the year 2019. Ngo, H.H, contributed a maximum of 101 (0.51%) research publications, maximum of 19355 articles were contributed by joint authors and the average degree of collaboration was 0.97. The range of the Collaborative Co-efficient was (0.76-0.69) and the range of the Collaborative index was (4.85-4.09). A maximum of 2102(10.58%) research publications are contributed in Bioresource technology, the ministry of education, china with 863(22.32%) research publication, and China has contributed a maximum of 5919(29.80%) research publications. A maximum of 18037(90.82%) research publications are contributed by article.

Objectives

To study the global output in the top 10 most productive countries

To study the growth of global share and its impact on citation

To study the international collaboration of Indian publications and partner countries.

To study the Relative growth rate, Authorship pattern

Degree of collaboration, CI, CC, MCC, and Co-author Index

To study the output of Indian research by broad subject areas and its growth and decline

To study the most productive Indian organizations and authors

To study the top 15journal's contributions.

RESEARCH METHODOLOGY

The Scopus database (<http://www.scopus.com>) was used to retrieve and download the 10-year publications data for Alzheimer's disease research at the global level for the period 2011-2020. Your query: (TITLE-ABS-KEY ("Alzheimer's disease") AND PUBYEAR > 2010 AND PUBYEAR < 2021 AND (LIMIT-TO (AFFILCOUNTRY, "India"))) Data was collected on 16.07.2021 the file download MS excel sheet.

Data Analysis

Relative Citation Index (RCI)

The relative citation index (RCI) was developed by the institute of scientific information and examined the impact of different countries, institutions, authors, and journals research publications. The scientific impact of leading countries was examined by using two relative indicators, namely citations per paper (CPP) and relative citations index (RCI). Citations per paper (CPP) is a relative indicator computed as the average number of citations per paper. To measure both influence and visibility of country research, the following formula has been used by Bharvi Dutt and Khaizer Nikam (2016)¹³.

$$RCI = \frac{\text{A Country share of the World Citations}}{\text{A Country share of the World Publications}}$$

RCI = 1 indicates that a country's citation rate is equal to the world citation rate

RCI > 1 indicates that a country's citation rate is greater than the world citation rate

RCI < 1 indicates that a country's citation rate is lower than the world citation rate

Global and India's Output in Alzheimer's disease Research publications

India's cumulative publication output in Alzheimer's disease research consisted of 4481 papers during 2011-2011, with an average number of 44.81 papers per year. The cumulative publications output of India in Alzheimer's disease research increased from 1469 papers during 2011-2015 to 3012 papers during 2016-2020, with a maximum of 895(19.97%) research publications in the year 2020, followed by 660(14.73%) research publications in the year 2019, and 556(12.63%) research publications in the year 2018. The highest citation is 16511(16.52%) CCP is 76.80 and RCI is 1.95. The second is 15262

(15.27%) citations, CPP is 70.99, and RCI is 2.87. 14258(14.29%) citations, CPP is 66.44, and RCI is 1.37. The lowest number of citations is 3735(3.74%), CPP is 17.37 and RCI is 0.19.

Top 10 Most Productive Countries in Artificial Intelligence Research

As from the publications data from 2011 to 2020 Alzheimer's disease research is spread across more than 132 countries. Table No.2, shows the top 20 most productive countries that accounted for 1977 of global publication share in Alzheimer's disease research in 10 years. The top rank of India is 4481(71.10%), the top citations are 99969(22.05%), CPP is 22.31, and RCI is 0.31. The second rank is the United States 498(8.24%), the are citations is 37348(8.24%), CPP is 75.00, and RCI is 1.04. The third rank is Saudi Arabia 216(2.53%), the citations 28207(6.22%), CPP 130, and the RCI is 1.82 during the period 2011-2020. The tenth rank is Japan 62(0.98%), 25592(5.64%) citations, CPP is 412.77, RCI is 5.74, and the twenty ranks is Brazil 39(0.62%) 15960(3.52%), CPP is 409.23, and RCI is 5.69.

International Collaboration in India's Publication Output

Table No.3 shows that the United States is listed at the top accounting for 498(29.28%) shares among the leading countries that collaborated with India, followed by Saudi Arabia. 216(12.70%), Australia 133(7.82%), the United Kingdom and South Korea 99(5.82% and 96(5.64%) during 2011-2020. The top countries whose share in India's international collaborative publications increased were the USA, Saudi Arabia, Australia, the U.K and South Korea, whereas decreases in the collaborative output by Malaysia, Italy, Germany, Japan, China, Canada, Singapore, France, Spain, Sweden, Bangladesh from 2011 - 2015 to 2016-2020 were shown in Table No.3.

Subject-wise break-up of Indian Alzheimer's disease publications

Table No.4 identified the year-wise subjects in the field of Alzheimer's disease research Publications, during the ten-year study period. From the study, it is identified that the maximum 1575(51.30%) research

publications in Biochemistry, Genetics, and Molecular Biology, followed by 617(20.10%) research publications in chemistry, and 394(12.83%) research publications in computer science. The highest citations are 30070(59.82%) research publications, the CPP is 19.09, the h-index is 74, and the RCI is 1.17. The lowest citations are 06(0.01%) research publications, the CPP is 1.50, H-index is 1 and the RCI is 0.09.

Relative Growth Rate (RGR)

The rate of growth has been calculated as the most important feature of science and technology in recent years. Scientific progress has necessitated an increase in both manpower and financial investment. The increase in the number of publications per unit of time indicates the relative growth rate. Mahapatra (1985)¹⁴ developed the following formula to calculate the mean relative growth rate over the specific period of the interval.

$$R(a) = \frac{(W_2 - W_1)}{(T_2 - T_1)}$$

Where,

R (a) = RGR = the mean relative growth rate over the specific period of interval

W_1 = the logarithm of the beginning number of publications/pages

W_2 = the logarithm of the ending number of publications/pages after a specific period of interval

$T_2 - T_1$ = the unit difference between the beginning time and the ending time.

The doubling time is the time required to double the number of records actually published in a given period. The doubling time is calculated from the relative growth rate and the natural logarithm number is used, the difference has a value of 0.693. The following formula can be used to calculate the corresponding doubling time:

$$Dt = \frac{0.693}{R(a)}$$

Relative Growth Rate (RGR) in Alzheimer's disease Research Publications

Table No.5 shows the results of calculating the relative growth rate and the doubling time (Dt) in Alzheimer's disease research output in India. According to the research, the relative growth rate in 2012 is 0.75, and in 2020 the relative growth rate is

0.22. According to this study, the relative growth rate is decreasing from 2011 to 2020. At the same time, the doubling time is found to be 0.93 in 2012 and 3.12 in 2020. During the study period, it was confirmed that the doubling time was increasing.

Authorship pattern in Alzheimer's disease research publications

Table No.6 identified the year-wise authorship pattern in the field of Alzheimer's disease research Publications, during the ten-year study period. From the study, it is identified that, out of 4481 research publications, 982 research publications two authors, 813 research publications three authors, 779 research publications four authors, 488 research publications five authors, 216 research publications single authors, and 4265 multi-authors research publications. During the ten-year study period, more than five authors are contributed 1203 publications

Degree of Collaboration

The degree of collaboration is the relationship between single author and multi-author contributions. The degree of collaboration is calculated by the Subramanian (1983)¹⁵ formula and used by Vivekanandhan (2016)¹⁶, Sivasamy (2020)¹⁷.

$$DC = \frac{Nm}{(Nm + Ns)}$$

Where DC = Degree of Collaboration

N_m = Number of Multi authored publications

N_s = Number of single-authored publications

In the present study, $N_m = 4265$, $N_s = 216$

So that the degree of collaboration is $= \frac{4265}{(216+4265)} = 0.95$

Degree of collaboration in Alzheimer's disease Research Publications

Table No.7 shows the degree of collaboration in Alzheimer's disease research publications for the ten-year study period. From this study, it is identified that the degree of collaboration is between 0.88 in the year 2011 and 0.97 in the year 2020. The average degree of collaboration is 0.95. From this study, it is identified that the majority of Alzheimer's disease research publications are contributed by collaborative authors.

Collaborative of Co-efficient (CC)

The pattern of co-authorship collaboration among the authors can be measured with the following formula suggested by Ajiferuke, et al, (1988)¹⁸

$$CC = 1 - \left[\sum_{j=0}^k \left(\frac{1}{j} \right) \times F_j / N \right]$$

Whereas,

F_j = Number of publications with j author papers

N = Total number of research publications and

k = the greatest number of authors/papers in the given field

Collaboration Index (CI)

The simple indicator is presently employed in the publications to the collaboration index among the co-authors, which is to be understood nearly as the mean number of authors per paper are suggested by Ajiferuke, et al, (1988)¹⁸

$$CI = \frac{\sum_{j=1}^k jf_j}{N}$$

Here

J - The number of co-authored papers appearing in a discipline

N - The total number of publications in the field over the same time period of interval and

k - The highest number of authors per paper in a same time field.

Modified Collaboration Coefficient

The modified collaboration coefficient (MCC) counted by the formula which is suggested by (Savanur and Srikanth, 2010)¹⁹.

Which is given below:

Where,

$$MCC = \frac{N}{N - 1} \left[1 - \frac{\sum_{j=1}^k jf_j}{N} \right]$$

j = the number authors in an article i.e. 1, 2, 3.....

F_j = the number of j - authored articles

N = the total number of articles published in a year, and

A = the total number of authors per article

Collaborative Index Alzheimer's disease Research Publications

It is observed in Table No.8, the collaborative coefficient is calculated and presented during the

ten-year study period for Alzheimer's disease research publications. It is observed from the table highest collaboration coefficient is 0.69 in the year 2020, the lowest CC is 0.62 in the year 2011, and the average CC is 0.65. The collaboration index observed in Table No.7 maximum collaboration Index is 4.06 in the year 2020, a minimum of 3.58 in the year 2011, and an average CI is 3.83. The Modified collaboration coefficient observed in Table No.7 maximum is 4.07 in the year 2020, a minimum of 3.60 in the year 2011, and the average CI is 3.847.

Co-Authorship Index

Co-authorship Index (CAI) is obtained by calculating proportionately the publications by single, two and multi-authored papers (Garg and Padhi, 1999)²⁰.

$$CAI = \frac{N_{ij}/N_{io}}{N_{oj}/N_{oo}} \times 100$$

Where,

N_{ij} = Number of papers having authors in block i

N_{io} = Total output of block i

N_{oj} = Number of papers having j authors for all blocks.

N_{oo} = Total number of papers for all authors and all blocks

CAI=100 indicates that a country's co-authorship effort for a particular type of Authorship corresponds to the world average.

CAI>100 reflects a higher than average co-authorship effort and

CAI<100 shows lower than average Co-authorship effort for a given type of authorship pattern.

For calculating the co-authorship index for authors, years have been replaced with block years. For this study, the authors have been classified into two blocks (ie.2011-2015 and 2016-2020) Vs. Single, Two, Three authors, and More than three authors.

Co-Authorship Index in Alzheimer's disease Research Publications

Table No.9 shows that Co-Authorship Index values are calculated by block year period for Alzheimer's disease research publications for the selected ten-year study period. From the study, it is identified that CAI for single, two, and three authorship contributions are decreasing trend from 1st block year to 2nd block year. At the same time, CAI is

increasing trend for more than three authors from 1st block year (92.62) to 2nd year block year (103.60).

Top twenty Indian Institutions in Alzheimer's disease Research Publications

A scientometric analysis of the top 10 most productive institutions from India in Alzheimer's disease research publications revealed that their productivity varied from 51 to 120 publications shown in Table No.10. Their scientometric profile is presented in Table No.10. Four organizations registered productivity rates above the group average of 28.54. Panjab University, Panjab, 120(7.61%) research publications, 7605(7.27%) citations, CPP is 63.28, h- index is 30, and RCI is 0.98, King Abdulaziz University, Jeddah, Saudi Arabia.116(7.36%) research publications, 2056(1.96%) citations, CPP is 17.72, h-index is 26, RCI is 0.27. Academy of Scientific and Innovative Research AcSIR Tharamani Chennai. 110(6.98%) research publications, 2226(2.13%) citations, CPP is 20.24, h-index is 22 and RCI is 0.30. And All India Institute of Medical Sciences, New Delhi, 104(6.09%) research publications, 23999(22.93%) citations, CPP is 230.76, h-index is 23 and RCI is 3.48.

Top fifteen Most Productive Indian Authors in Alzheimer's disease Research publications

A scientometric analysis of the top 10 most productive authors from India in Alzheimer's disease Research publications revealed that their productivity varied from 20 to 49 publications. Their scientometric profile is presented in Table No.11. Their scientometric profile is presented in Table No.11. Four authors registered productivity rates above the group average of 38.66. Kamal M.A. India. 49(1.697%) research publications, 1016(10.89%) citations, CPP is 20.73, h- index is 19, and RCI is 0.93, Ashraf, G.M. United States. 46(10.96%) research publications, 1045(11.20%) citations, CPP is 22.72, h-index is 21, RCI is.02. Mathew, B.Saudi Arabia .34 (8.11%) research publications, 846(9.07%) citations, CPP is 24.88, h-index is 19, and RCI is1.12. And Uddin, M.S. Australia, 33(7.88%) research publications, 791(8.48%) citations, CPP is 23.97, h-index is 18, and RCI is 1.08.

Top fifteen Most Productive Journals in Indian Papers in Alzheimer's disease publications

Of the total publications output by India in artificial intelligence research, 66(9.62%) appeared as CNS and Neurological Disorders Drug Targets, 58(8.45%) in ACS Chemical Neuroscience, 58(8.45%) in Journal of Biomolecular Structure and Dynamics, 54(7.87%) and Journal of Alzheimer S Disease 53(7.73%). The top 10 journals accounted for a 32.93 % share (217 papers) of total country output appearing in journal medium during 2011- 2020. The publication output in these 15 journals varied between 06 and 66 papers per journal; the five-year output by India in these 15 journals increased marginally from18.92 % in 2011-2015 to 78.30% in 2016-2020. During the study period 2011-2020 as shown in Table No.12.

SUMMARY AND DISCUSSION

The present study of Alzheimer's disease research in India: A Scientometric analysis of publications output during 2011-2020. India's cumulative publication output in Alzheimer's disease research consisted of 4481 papers during 2011-2011, with an average number of 44.81 papers per year. The cumulative publications output of India in Alzheimer's disease research increased from 1469 papers during 2011-2015 to 3012 papers during 2016-2020, with a maximum of 895(19.97%) research publications in the year 2020.

As from the publications data from 2011 to 2020 Alzheimer's disease research is spread across more than 132 countries. The top 20 most productive countries accounted for 1977 of the global publication share in Alzheimer's disease research in 10 years. The top rank of India is 4481(71.10%) research publications.

During the United States is listed at the top accounting for 498(29.28%) shares among the leading countries that collaborated with India, followed by Saudi Arabia. 216(12.70%), Australia 133(7.82 %), the United Kingdom and South Korea 99(5.82% and 96(5.64%) during 2011- 2020.

The year-wise subjects in the maximum 1575(51.30%) research publications in Biochemistry, Genetics, and Molecular Biology,

followed by 617(20.10%) research publications in chemistry, and 394(12.83%) research publications in computer science, and during the authorship pattern out of 4481 research publications, 982 research publications two authors,

During the degree of collaboration, the average degree of collaboration is 0.95. From this study, it is identified that the majority of Alzheimer’s disease research publications are contributed by collaborative authors. During the collaborative coefficient, the average is 0.65. The collaboration index has an average is 3.83. The Modified collaboration coefficient average is 3.85.

The Co-Authorship Index values are calculated by block year period from the study, it is identified that CAI for single, two, and three authorship contributions are decreasing trend from 1st block year to 2nd block year. At the same time, CAI is increasing trend for more than three authors from 1st block year (92.62) to 2nd year block year (103.60).

The institutions from India in a maximum 28.54. Panjab University, Panjab, 120(7.61%) research publications, 7605(7.27%) citations, CPP is 63.28, h-index is 30 and RCI is 0.98, King Abdulaziz University, Jeddah, Saudi Arabia. 116(7.36%) research publications, 2056(1.96%) citations, CPP is 17.72, h-index is 26, RCI is 0.27

The productive authors from India the maximum Kamal. M.A. India. 49(1.697%) research publications, 1016(10.89%) citations, CPP is 20.73, h-index is 19 and RCI is 0.93, Ashraf, G.M. United States. 46(10.96%) research publications, 1045(11.20%) citations, CPP is 22.72, h-index is 21, RCI is .02

During the journals a maximum of 66(9.62%) appeared as CNS and Neurological Disorders Drug Targets, 58(8.45%) in ACS Chemical Neuroscience, 58(8.45%) in Journal of Biomolecular Structure and Dynamics.

Table No.1: Growth and International Collaboration Share of Indian Alzheimer’s disease Publications, 2002-11

S.No	Period	TP	%	T C	%	CPP	RCI
1	2011	215	4.80	6298	6.30	29.29	1.31
2	2012	238	5.31	15262	15.27	70.99	2.87
3	2013	286	6.38	7952	7.95	36.99	1.25
4	2014	351	7.83	11778	11.78	54.78	1.50
5	2015	379	8.46	16511	16.52	76.80	1.95
6	2016	425	9.48	10387	10.39	48.31	1.10
7	2017	466	10.40	14285	14.29	66.44	1.37
8	2018	566	12.63	6673	6.68	31.04	0.53
9	2019	660	14.73	7088	7.09	32.97	0.48
10	2020	895	19.97	3735	3.74	17.37	0.19
	2011-2015	1469	32.78	57801	57.82	268.84	1.76
	2016-2020	3012	67.22	42168	42.18	196.13	0.63
	2011-2020	4481	100.00	99969	100.00	464.97	

Table No.2: Publications Output, Share and Rank of Top 20 Countries in Alzheimer’s disease Research, 2002-11

S.No	Country	No. of Paper			Share of Paper			Total Citations	%	CPP	RCI
		2011-2015	2016-2020	2011-2020	2011-2015	2016-2020	2011-2020	2011-2020	2011-2020	2011-2020	
1	India	1469	3012	4481	74.30	69.64	71.10	99969	22.05	22.31	0.31
2	United States	163	335	498	8.24	7.75	7.90	37348	8.24	75.00	1.04
3	Saudi Arabia	50	166	216	2.53	3.84	3.43	28207	6.22	130.59	1.82
4	Australia	26	107	133	1.32	2.47	2.11	27970	6.17	210.30	2.92
5	United Kingdom	37	62	99	1.87	1.43	1.57	27738	6.12	280.18	3.89
6	South Korea	19	77	96	0.96	1.78	1.52	18208	4.02	189.67	2.64
7	Malaysia	33	48	81	1.67	1.11	1.29	16870	3.72	208.27	2.89
8	Italy	23	54	77	1.16	1.25	1.22	26603	5.87	345.49	4.80
9	Germany	21	41	62	1.06	0.95	0.98	18119	4.00	292.24	4.06
10	Japan	23	39	62	1.16	0.90	0.98	25592	5.64	412.77	5.74
11	China	10	49	59	0.51	1.13	0.94	24715	5.45	418.90	5.82
12	Canada	19	38	57	0.96	0.88	0.90	26368	5.82	462.60	6.43
13	Singapore	26	29	55	1.32	0.67	0.87	25663	5.66	466.60	6.49
14	France	16	37	53	0.81	0.86	0.84	25551	5.64	482.09	6.70
15	Spain	12	41	53	0.61	0.95	0.84	25443	5.61	480.06	6.67
16	Sweden	14	37	51	0.71	0.86	0.81	26044	5.74	510.67	7.10
17	Bangladesh	2	47	49	0.10	1.09	0.78	16514	3.64	337.02	4.68
18	Russian Federation	6	35	41	0.30	0.81	0.65	24575	5.42	599.39	8.33
19	Egypt	3	37	40	0.15	0.86	0.63	15919	3.51	397.98	5.53
20	Brazil	5	34	39	0.25	0.79	0.62	15960	3.52	409.23	5.69
	Total	1977	4325	6302	100.00	100.00	100.00	453407	100.00		

Table No.3: Contribution of major collaborative partners of India in Alzheimer’s disease Research during 2002-11

S.No	Names of Collaborating Countries with India	International Collaborative Papers			International Collaborative Papers %		
		2011-2015	2016-2020	2011-2020	2011-2015	2016-2020	2011-2020
1	United States	163	335	498	33.00	27.75	29.28
2	Saudi Arabia	50	166	216	10.12	13.75	12.70
3	Australia	26	107	133	5.26	8.86	7.82
4	United Kingdom	37	62	99	7.49	5.14	5.82
5	South Korea	19	77	96	3.85	6.38	5.64
6	Malaysia	33	48	81	6.68	3.98	4.76
7	Italy	23	54	77	4.66	4.47	4.53
8	Germany	21	41	62	4.25	3.40	3.64
9	Japan	23	39	62	4.66	3.23	3.64

10	China	10	49	59	2.02	4.06	3.47
11	Canada	19	38	57	3.85	3.15	3.35
12	Singapore	26	29	55	5.26	2.40	3.23
13	France	16	37	53	3.24	3.07	3.12
14	Spain	12	41	53	2.43	3.40	3.12
15	Sweden	14	37	51	2.83	3.07	3.00
16	Bangladesh	2	47	49	0.40	3.89	2.88
	Total	494	1207	1701	100.00	100.00	100.00
*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 16 foreign collaborating countries listed above in Indian international collaborative output will be more than its total international collaborative papers							

Table No.4: Subject-wise break-up of Indian Alzheimer’s disease Publications

S.No	Subject	TP	%	TC	%	CPP	H-Index	RCI
1	Agricultural and Biological Sciences	203	6.61	3413	6.79	16.81	31	1.03
2	Arts and Humanities	8	0.26	231	0.46	28.88	4	1.76
3	Biochemistry, Genetics, and Molecular Biology	1575	51.30	30070	59.82	19.09	74	1.17
4	Business, Management and Accounting	26	0.85	29	0.06	1.12	3	0.07
5	Chemical Engineering	204	6.64	2880	5.73	14.12	28	0.86
6	Chemistry	617	20.10	11228	22.34	18.20	47	1.11
7	Computer Science	394	12.83	2304	4.58	5.85	24	0.36
8	Decision Sciences	34	1.11	30	0.06	0.88	3	0.05
9	Dentistry	5	0.16	75	0.15	15.00	4	0.92
10	Earth and Planetary Sciences	4	0.13	6	0.01	1.50	1	0.09
	Total	3070	100.00	50266	100.00			

Table No.5: Relative Growth Rate (RGR) in Alzheimer’s disease research publications

S.No	Year	Publications	Cumulative	W1	W2	RGR	Dt
1	2011	215	215		5.37		
2	2012	238	453	5.37	6.12	0.75	0.93
3	2013	286	739	6.12	6.61	0.49	1.42
4	2014	351	1090	6.61	6.99	0.39	1.79
5	2015	379	1469	6.99	7.29	0.30	2.33
6	2016	425	1894	7.29	7.55	0.25	2.74
7	2017	466	2360	7.55	7.77	0.22	3.16
8	2018	566	2926	7.77	7.98	0.21	3.24
9	2019	660	3586	7.98	8.18	0.20	3.42
10	2020	895	4481	8.18	8.41	0.22	3.12
	Total	4481					

Table No.6: Authorship pattern in Alzheimer’s disease research publications

S.No	Authorship pattern							Total
	year	1	2	3	4	5	>5	
1	2011	26	40	40	41	28	40	215
2	2012	15	50	49	43	33	48	238
3	2013	16	76	52	43	37	62	286
4	2014	14	91	68	51	32	95	351
5	2015	21	80	81	78	34	85	379
6	2016	26	97	65	75	45	117	425
7	2017	24	99	68	77	56	142	466
8	2018	17	125	115	115	53	141	566
9	2019	26	143	120	111	70	190	660
10	2020	31	181	155	145	100	283	895
	Total	216	982	813	779	488	1203	4481

Table No.7: Degree of collaboration in Alzheimer’s disease research publications

S.No	Year	Single author publications	Multi-author publications	Total author publications	DC =Nm/(Nm+Ns) Degree of collaboration
1	2011	26	189	215	0.88
2	2012	15	223	238	0.94
3	2013	16	270	286	0.94
4	2014	14	337	351	0.96
5	2015	21	358	379	0.94
6	2016	26	399	425	0.94
7	2017	24	442	466	0.95
8	2018	17	549	566	0.97
9	2019	26	634	660	0.96
10	2020	31	864	895	0.97
	Total	216	4265	4481	

Table No.8: Collaborative of co-efficient, collaboration index, modified collaboration coefficient in Alzheimer’s disease research publications

S.No	Authorship pattern										
	year	1	2	3	4	5	>5	CC	CI	MCC	Total
1	2011	26	40	40	41	28	40	0.62	3.58	3.60	215
2	2012	15	50	49	43	33	48	0.66	3.73	3.74	238
3	2013	16	76	52	43	37	62	0.65	3.68	3.69	286
4	2014	14	91	68	51	32	95	0.67	3.80	3.81	351
5	2015	21	80	81	78	34	85	0.66	3.74	3.75	379
6	2016	26	97	65	75	45	117	0.66	3.86	3.87	425
7	2017	24	99	68	77	56	142	0.68	4.00	4.01	466
8	2018	17	125	115	115	53	141	0.68	3.86	3.86	566
9	2019	26	143	120	111	70	190	0.68	3.95	3.95	660
11	2020	31	181	155	145	100	283	0.69	4.06	4.07	895
	Total	216	982	813	779	488	1203				4481

Table No.9: Co-Authorship Index in Alzheimer’s disease research publications

S.No	Block year	Single	CAI	Two	CAI	Three	CAI	More than three	CAI	Total
1	2011-2015	92	129.92	337	104.68	290	108.81	750	92.62	1469
2	2016-2020	124	85.41	645	97.72	523	95.70	1720	103.60	3012
	Total	216		982		813		2470		4481

Table No.10: Top twenty Indian Institutions in Alzheimer’s disease research publications

S.No	Institutions	TP	%	TC	%	CCP	H-Index	RCI
1	Panjab University	120	7.61	7605	7.27	63.38	30	0.96
2	King Abdulaziz University	116	7.36	2056	1.96	17.72	26	0.27
3	Academy of Scientific and Innovative Research AcSIR	110	6.98	2226	2.13	20.24	22	0.30
4	All India Institute of Medical Sciences, New Delhi	104	6.59	23999	22.93	230.76	23	3.48
5	National Institute of Mental Health and Neuro Sciences	103	6.53	1505	1.44	14.61	19	0.22
6	Postgraduate Institute of Medical Education and amp; Research, Chandigarh	101	6.40	17652	16.87	174.77	29	2.63
7	Jamia Hamdard	91	5.77	2606	2.49	28.64	27	0.43
8	Banaras Hindu University	89	5.64	6362	6.08	71.48	23	1.08
9	University of Delhi	80	5.07	10134	9.68	126.68	23	1.91
10	Aligarh Muslim University	71	4.50	1356	1.30	19.10	19	0.29
11	Council of Scientific and Industrial Research India	70	4.44	10765	10.29	153.79	25	2.32
12	University Institute of Pharmaceutical Sciences India	66	4.19	2178	2.08	33.00	23	0.50
13	Jawaharlal Nehru University	62	3.93	1063	1.02	17.15	17	0.26
14	Manipal Academy of Higher Education	61	3.87	814	0.78	13.34	16	0.20
15	Indian Institute of Technology Banaras Hindu University	57	3.61	935	0.89	16.40	18	0.25
16	Central Drug Research Institute India	57	3.61	1233	1.18	21.63	21	0.33
17	Amity University	57	3.61	557	0.53	9.77	13	0.15
18	King Saud University	56	3.55	10087	9.64	180.13	19	2.71
19	University of Calcutta	55	3.49	756	0.72	13.75	14	0.21
20	Indian Institute of Chemical Biology	51	3.23	756	0.72	14.82	15	0.22
	Total	1577	100.00	104645	100.00			

Table No.11: Top fifteen Most Productive Indian Authors in Alzheimer’s disease Research publications

S.No	Author	Country	TP	%	TC	%	CCP	H-Index	RCI
1	Kamal, M.A	India	49	11.69	1016	10.89	20.73	19	0.93
2	Ashraf, G.M	United States	46	10.98	1045	11.20	22.72	21	1.02
3	Mathew, B	Saudi Arabia	34	8.11	846	9.07	24.88	19	1.12
4	Uddin, M.S	Australia	33	7.88	791	8.48	23.97	18	1.08
5	Tripathi, M	United Kingdom	32	7.64	671	7.19	20.97	14	0.94
6	Chinnathambi, S	South Korea	30	7.16	405	4.34	13.50	12	0.61
7	Chakrabarti, S	Malaysia	24	5.73	731	7.83	30.46	15	1.37
8	Bharate, S.B	Italy	23	5.49	291	3.12	12.65	11	0.57
9	Devi, K.P	Germany	22	5.25	420	4.50	19.09	13	0.86
10	Essa, M.M.	Japan	22	5.25	650	6.97	29.55	13	1.33
11	Manivasagam, T	China	22	5.25	634	6.79	28.82	15	1.29
12	Ramakrishnan, S	Canada	21	5.01	76	0.81	3.62	5	0.16
13	Singh, N	Singapore	21	5.01	952	10.20	45.33	15	2.04
14	Anand, A	France	20	4.77	352	3.77	17.60	9	0.79
15	Dey, S.G	Spain	20	4.77	451	4.83	22.55	11	1.01
	Total		419	100.00	9331	100.00			

Table No.12: Top fifteen most productive journals in Indian papers in Alzheimer’s disease publications

S.No	Name of the Journal	Number of Papers			Share of Papers		
		2011-2015	2016-2020	2011-2020	2011-2015	2016-2020	2011-2020
1	CNS and Neurological Disorders Drug Targets	30	36	66	13.82	7.68	9.62
2	ACS Chemical Neuroscience	4	54	58	1.84	11.51	8.45
3	Journal of Biomolecular Structure and Dynamics	5	40	58	2.30	8.53	8.45
4	Research Journal of Pharmacy and Technology	18	36	54	8.29	7.68	7.87
5	Journal of Alzheimer S Disease	26	27	53	11.98	5.76	7.73
6	Molecular Neurobiology	10	39	49	4.61	8.32	7.14
7	European Journal of Medicinal Chemistry	11	37	48	5.07	7.89	7.00
8	International Journal of Research In Pharmaceutical Sciences	4	40	41	1.84	8.53	5.98
9	Asian Journal of Pharmaceutical and Clinical Research	16	23	39	7.37	4.90	5.69
10	Current Topics in Medicinal Chemistry	4	35	39	1.84	7.46	5.69
11	International Journal of Biological Macromolecules	5	34	37	2.30	7.25	5.39
12	Plos One	26	11	37	11.98	2.35	5.39
13	Annals of Indian Academy of Neurology	20	16	36	9.22	3.41	5.25
14	International Journal of Pharmacy and Pharmaceutical Sciences	32	12	36	14.75	2.56	5.25
15	Current Pharmaceutical Design	6	29	35	2.76	6.18	5.10
	Total of Indian journals	217	469	686	100.00	100.00	100.00
	Total of Indian journals	1147	599	1657			
	Share of the 15 journals in India’s total output	18.92	78.30	41.40			

CONCLUSION

The present study of Alzheimer's disease research in India: A Scientometric analysis of publications output during 2011-2020. India's cumulative publication output in Alzheimer's disease research consisted of 4481 papers during 2011-2020. The United States is listed at the top accounting for 498(29.28%) shares among the leading countries that collaborated with India, The institutions from India in a maximum 28.54. Panjab University, Panjab, 120(7.61%) research publications. the journals a maximum of 66(9.62%) appeared as CNS and Neurological Disorders Drug Targets. In view of its low publication productivity and citation impact, India needs to increase both the quantity and quality of research output through increased national funding and by enlarging national and international collaborative research efforts. The government must develop a strategy to respond to the growing need for care from early diagnosis to end-of-life care for the disease patients. The government should declare Alzheimer's disease as a national priority and a sufficient budget should be provided for its care and research in the Five Year Plans of the Ministry of Health and Family Welfare. There is a need to increase the quantum of research efforts through extra-mural funding of all major Indian science agencies/departments.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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