

Parkinson's disease Research in India: A Scientometric Analysis of the SCOPUS Database during the Period 2011-2020

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Abstract

The paper analyzes Parkinson's disease research publications output by India in a scientometric analysis the publications data for the study was sourced from the Scopus database covering the ten-year period 2011 - 2020. With 3,130 research publications and 59,272 citations. From the study, it is identified that a maximum of 624 (19.94%) research publications are contributed in the year 2020. A maximum of 11,226 (18.94%), citations are received 329 publications in the year 2017. The maximum CPP is 41.63 in the year 2015. The country with a maximum of 340 (37.74%) contributions is the United States, the citations are 19845 (14.56), CPP is 58.37, H-index is 53 and RCI is 0.39. The document type of a maximum of 1807 (57.73%) research publications are contributed by Article. The relative growth rate is 0.81 in the year 2012 and 0.22 in the year 2020, is decreasing trend and Found 0.85 in the year 2012 and 3.12 in the year 2020.is an increasing trend. The authorship pattern is more than five authorship modes with 812 (25.94%) publications. The collaborative coefficient average value is 1.34, the collaboration index an average value is 7.74 and the modified collaboration co-efficient an average value is 7.78. The maximum of 166 (20.29%) contributions are from the National Institute of Mental Health and Neuro Sciences. In the study a maximum of 76 (18.77%) contributions are Pal, P.K., India, the highest citations were 1,131 (17.07%) with Manivasagam, T. Australia. The maximum of 74 (17.13%) contributions are Neurology India, The highly cited per maximum citations 4,427, Naghavi M et al (2015) Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990 - 2013: A systematic analysis for the Global Burden of Disease Study 2013, The Lancet, 385 (9963):117-

Keywords: Scientometric, Relative citation index, Relative growth rate, Degree of collaboration Collaborative index, Collaboration co-efficient, Modified collaboration co-efficient

Introduction

Parkinson's disease (PD) belongs to a group of conditions called motor system disorders, which cause unintended or uncontrollable movements of the body. The precise cause of PD is unknown, but some cases are hereditary while others are thought to occur from a combination of genetics and environmental factors that trigger the disease. In PD, brain cells become damaged or die in the part of the brain that produces dopamine--a chemical needed to produce smooth, purposeful movement. The four primary symptoms of PD are, Tremor--shaking that has a characteristic rhythmic back and forth motion, Rigidity--muscle stiffness or resistance to movement, where muscles remain constantly tense and contracted, Bradykinesia--slowing of spontaneous and automatic movement that can make it difficult to perform simple tasks or rapidly perform routine movements, Postural instability--impaired balance and changes in posture that can increase the risk of falls.

Other symptoms may include difficulty swallowing, chewing, or speaking; emotional changes; urinary problems or constipation; dementia or other cognitive problems; fatigue; and problems sleeping. PD usually affects people around the age of 70 years but can occur earlier. PD affects men more than women. Currently, there are no specific tests that diagnose sporadic PD.

At present, there is no cure for PD, but a variety of medications provide dramatic relief from the symptoms. Usually, affected individuals are given levodopa combined with carbidopa. Carbidopa delays the conversion of levodopa into dopamine until it reaches the brain. Nerve cells can use levodopa to make dopamine and replenish the brain's dwindling supply. Although levodopa helps most people with PD, not everyone responds equally to the drug. Bradykinesia and rigidity respond best, while tremors may be only marginally reduced. Problems with balance and other symptoms may not be alleviated at all. Anticholinergic drugs may help control tremors and rigidity. Other drugs, such as pramipexole, Apomorphine, and ropinirole, mimic the role of dopamine in the brain, causing the nerve cells to react as they would to dopamine.

An antiviral drug, amantadine, also appears to reduce symptoms. Safinamide tablets, istradefylline tablets, and opicapone are add-on treatments for individuals with PD who are currently taking levodopa/carbidopa and experiencing "off" episodes (when the person's medications are not working well, causing an increase in PD symptoms). Other drugs to treat PD include COMT inhibitors, which prolong the effects of levodopa by preventing the breakdown of dopamine, and MAO-B inhibitors, which block or reduce the activity of the MAO-B enzyme that breaks down dopamine in the brain. In some cases, surgery may be appropriate if the disease doesn't respond to drugs. One option is deep brain stimulation (DBS), in which electrodes are implanted into the brain and connected to a small electrical device called a pulse generator to painlessly stimulate the brain to block signals that cause many of the motor symptoms of PD. DBS is generally appropriate for people with levodopa-responsive PD who have developed dyskinesias or other disabling "off" symptoms despite drug therapy. However, DBS does not stop PD from progressing and some problems may gradually return.¹

Scientometrics Study

Scientometric is one of the truly interdisciplinary research fields to extend almost all scientific fields. In addition, many extensive bibliometric studies of important science fields appeared during the last two decades. At present, the connotation of bibliometric turns out to be the science of measurement relating to documents. The word measurement means the application of mathematical and statistical techniques to find out the growth of documents, scattering, or literature in various types of documents, publication of documents by an author, impact of document, and so on. **Cole and Eales (1917)**² in their publication on the history of comparative anatomy, applied statistical methods for analyzing the literature are called statistical analysis. The most important contribution was made by **Hulme (1923)**³ when he published the book statistical bibliography, this term continued to be used for statistical measures till the end of the 1960s. **Ranganathan (1948)**⁴ coined the term librmetry to denote measurement of various library activities and services using mathematical and statistical techniques. **Alan Prichard (1969)**⁵ coined the term bibliometric to denote the application of mathematical and statistical methods to books and other media, the process of written communication, and of the nature and course of a discipline. **Van Raan (1997)**⁶ According to scientometric research is devoted to Quantitative studies of science and technology. So this paper aims to analyze the contribution of Many Scientometrics studies that have appeared in the literature to focus on the performance of science in the field of Diabetics research in India.

Review Literature

Chengxian Yang-et al (2020)⁷ examined publication trends in stem-cell research in the context of Parkinson's disease. The publications data for the study was sourced from the Scopus database covering the 30-year period 1990-2019. The study reveals that the global research in the domain of Parkinson's disease is highly skewed. The top 15 most productive countries in the subject account for a 99.59% global publications share. The USA is the world leader in the subject with a 31.71% global share. India ranks as the 13th most productive country in the world with a global publications share of 2.35% (3149 publications). India registered a 22% annual growth rate in the subject, averaged citation impact of 19.08 citations per paper, and published 21.88% of its country output as a share of international collaborative papers. The paper identifies the most productive organizations, most cited organizations most productive authors, and most cited authors. The paper also identifies the most productive journals and the most cited journals.

Ahmad Batcha & Jahina (2019)⁸ quantitatively measured the research productivity in the area of artificial intelligence at the global level over the study period of ten years (2008-2017). The study acknowledged the trends and features of growth and collaboration pattern of artificial intelligence research output. The average growth rate of artificial intelligence per year increases at the rate of 0.862. The multi-authorship pattern in the study is found high and the average number of authors per paper is 3.31. Collaborative Index is noted to be the highest range in the year 2014 with 3.50. The mean CI during the period of study is 3.24. This is also supported by the mean degree of collaboration at the percentage of 0.83. The mean CC observed is 0.4635.

Regarding the application of Lotka's Law of authorship productivity in the artificial intelligence literature it proved to be fit for the study.

Ahmad & Batcha (2020)⁹ explores and analyzes the trend of world literature on "Coronavirus Disease" in terms of the output of research publications as indexed in the Science Citation Index Expanded (SCI-E) of Web of Science during the period from 2011 to 2020. The growth rate is 0.64 in 2012, which is increased up to 2.76 in 2020. The mean relative growth rate is 1.44 during doubling time is 0.47 during the period 2011-2020. Each of the top 20 countries had a global publication share between 1.40% and 33.30% during 2011-2020. The USA accounted for the highest publication share (33.30%) Document type Article 4648 (76.56%) and the author of Drosten C published 114 (1.90%) articles with 6104 TGCS articles. Journal of Virology acquired 1st rank among the top twenty Journals under consideration with its total global citation score of 9897. The institution "University of Hong Kong" holds the first rank and the institution published 236 (3.90%) research papers with 3635 local and 7436 global citation scores, the average citation per paper is 31.51.

Ravichandran S & Vivekanandhan S (2021)¹⁰ have examined the Wireless Network Research Output in India from Scopus Database during 2010 -2019: A Scientometric Analysis. The study, maximum of 1561(18.24%) publications in the year 2019, CAGR is 35.98. and the total number of citations is 25558. The relative growth rate is 0.91 in the year 2011 and 0.20 in the year 2019. At the same time, doubling time is found that 0.76 in the year 2011 and 3.44 in the year 2019. The average degree of collaboration is 0.96. The Maximum of 43(11.53%) papers are published by the author of Tamma, B.R. And the International Journal of Applied Engineering Research published a maximum of 256(16.91%) publications. Time series analysis study will be expected in the wireless network research publications in India in the year 2025 is around are equal to 1986 and the year 2030 is around are equal to 2551.

Gupta B M & Dhawan S M (2021)¹¹ examined Parkinson's disease Research by India: A Scientometric Assessment of Publications Output for the Period 1990-2019. The publications data for the study was sourced from the Scopus database covering the 30-year period 1990-2019. The study reveals that the global research in the domain of Parkinson's disease is highly skewed. The top15 most productive countries in the subject account for a 99.59% global publications share. The USA is the world leader in the subject with a 31.71% global share. India ranks productive country in the world with a global publications share of 2.35% (3149 publications). India registered a 22% annual growth rate in the subject, averaged citation impact of 19.08 citations per paper, and published 21.88% of its country output as a share of international collaborative papers.

Objectives

In this paper, an attempt has been made to project the Indian research output on the subject of Parkinson's covering the period 2011 to 2020 and analyzed by using scientometric indicators. The study has been designed with the following objectives:

- To examine the growth of Parkinson's research output of India from 2011 to 2020

- To analyze the country, subject, document type research
- To determine the Relative Growth Rate (RGR), Doubling Time (Dt) research
- To examine and analyze the authorship pattern in Parkinson’s research
- To the degree of Collaboration (DC), and collaboration coefficient (CC),
- To collaborative index(CI), modified collaborative coefficient (MCC) research
- To co-Authorship Index (CAI); and keyword research
- To find out institutes, authors, journals, in the field of Parkinson’s.
- To examine the highly cited papers research in Parkinson’s

Methodology

The study is based on publication and citation data downloaded from the SCOPUS database. A Sum of 3130 records in Parkinson’s from a Covered period of sixty years spanning between 2011 and 2020, were obtained from the SCOPUS database were analyzed. The data was collected on 26.07.2021 and the data downloading from a Microsoft Excel sheet.

DATA ANALYSIS AND DISCUSSION

Citations per Publication (CPP)

CPP has been broadly used in the scientometric assessment to stabilize the variation in volumes of literature published by the different institutions/countries and etc., Bharvi and Khaizer (2016)¹² and Sandhya (2016)¹³. From this study, CPP has been used to assess the impact of Parkinson’s research publications for the years, countries, institutes, and authors for the below-mentioned formula,

$$CPP = \frac{\text{Total Citations of a Country or Institution}}{\text{Total of Publications}}$$

H-Index

Hirsch (2005)¹⁴ proposed the h-index is one of the alternatives into the standard bibliometric indicators for the single scientists, it is defined as in table 4.1,

A scientist has index h if h of his or her Np papers have at least h citations each and other papers (Np – h) have ≤ citations each.

Ye (2009)¹⁵ found that the Glanzel-Schubert (2007)¹⁶ model was better than the Hirsch and Egghe-Rousseau (2006)¹⁷ model to estimate the h-index of countries and other units. Gupta and Bala (2013)¹⁸ discussed the h-index in the various acts of Epilepsy research in India. Differences among the various models of h-index are

Various methods of h-index

Model	Equation	Description
Hirsch	$h = \sqrt{(C / a)}$	C = Total Citations; a = Constant
Egghe-Rousseau	$h = P^{1/\infty}$	P = Total Publications; a > 1 is Lotka’s Exponential
Glanzel-Schubert	$h = c P^{1/3} (CPP)^{2/3}$	c is a Constant; P = Total Publications CPP

		= Citations Per Publications
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Relative Citation Index (RCI)

Relative citation index (RCI) was developed by the Institute of Scientific Information (now Thomson Reuters, USA) and examine the impact of different countries and institutions in the field of Parkinson’s 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. It has been broadly used in biometric studies as it normalizes a large difference in the volumes of publications among most productive countries, institutions, and authors.

To measure both influence and visibility of a country’s research global wise, the following formula has been used by Bharvi Dutt and Khaiser Nikam (2016)¹⁹

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

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 indicate that a country’s citation rate is lower than the world citation rate

Publication Output and Citations Count in Parkinson’s disease Research Publications

Table 1: Publication Output and Citations Count in Parkinson’s disease Research Publications

S.No	year	Total Publications	%	Total Citations	%	Cited	%	CPP	RCI
1	2011	136	4.35	3,578	6.04	122	4.72	26.31	1.39
2	2012	170	5.43	4,044	6.82	157	9.95	23.79	1.26
3	2013	184	5.88	5,353	9.03	165	6.39	29.09	1.54
4	2014	242	7.73	7,655	12.92	218	8.44	31.63	1.67
5	2015	250	7.99	10,408	17.56	215	8.32	41.63	2.20
6	2016	326	10.42	5,168	8.72	227	8.79	15.85	0.84
7	2017	329	10.51	11,226	18.94	284	10.99	34.12	1.80
8	2018	434	13.87	5,291	8.93	366	14.17	12.19	0.64
9	2019	435	13.90	4,344	7.33	349	13.51	9.99	0.53
10	2020	624	19.94	2,205	3.72	380	14.71	3.53	0.19
	Total	3,130	100.00	59,272	100.00	2,583	100.00		

Note; CPP-Citations per paper, RCI- Relative Citation Index

Table 1 shows the Publication Output and Citations Count in Parkinson’s disease research publications during the ten-year study period between 2011 and 2020 with 3,130 research publications and 59,272 citations. From the study, it is identified that the maximum of 624 (19.94%) research publications are contributed in the year 2020, followed by 435 (13.90%) publications in the year 2019, and 434 (13.87) publications in the year 2018. The average research publication per year is 313.

During the ten-year study, it is identified that a total number of 3,130 publications are received 59,272 citations. Out of that maximum of 11,226 (18.94%), citations are received 329 publications in the year 2017. Followed by 10,408 (17.56%) citations are received 250 publications in the year 2015. From the study, out of 3,130 publications, 2583 research publications are cited publications and 59,272 citations research publications. The maximum citation per paper is 41.63 in the year 2015, followed by CPP is 34.12 in the year 2017, and by CPP is 31.63 in the year 2014 and the average citation per paper is 22.81. The maximum of RCI is 2.20 in the year 2015, followed by 1.80 in the year 2017, by 1.67 in the year 2014 and the average RCI is 1.21.

Collaborator countries contributions in Parkinson’s disease Research Publications

Table 2 Collaborator Countries contributions in Parkinson’s disease Research Publications

S.No	Country	Publications	%	Citations	%	CPP	H-Index	RCI
1	United States	340	37.74	19845	14.56	58.37	53	0.39
2	Saudi Arabia	92	10.21	13392	9.82	145.57	30	0.96
3	Australia	83	9.21	13490	9.90	162.53	26	1.07
4	United Kingdom	80	8.88	13093	9.61	163.66	21	1.08
5	Italy	62	6.88	14252	10.46	229.87	29	1.52
6	South Korea	54	5.99	12700	9.32	235.19	22	1.55
7	Canada	50	5.55	12921	9.48	258.42	22	1.71
8	Germany	49	5.44	12920	9.48	263.67	19	1.74
9	Malaysia	46	5.11	12892	9.46	280.26	22	1.85
10	Oman	45	4.99	10806	7.93	240.13	22	1.59
	Total	901	100.00	136311	100.00			

During the 10 year study period, the collaborator Countries’ contributions are identified from Table 2, from the study the maximum of 340 (37.74%) contributions are the United States, the citations are 19845 (14.56), CPP is 58.37, H- index is 53 and RCI is 0.39. Followed by Saudi Arabia contributing 92 (10.21%) research publications, the citations are 13392 (9.82%), CPP is 145.57, H-index is 30 and RCI is 0.96. Australia with 83 (9.21%) research publications. The citations are 13490 (9.90%), CPP is 162.53, H-index is 26 and RCI is 1.07. the lowest citations of 10806 (7.93%) Oman the CPP is 240.13, h-index 22, RCI is 1.59.

Subject-wise distribution of Research Output Parkinson's Disease

Table 3 Subject-wise distribution of Research Output Parkinson's Disease

S.No	Subject	Publications	%
1	Agricultural and Biological Sciences	119	6.78
2	Arts and Humanities	11	0.63
3	Biochemistry, Genetics and Molecular Biology	932	53.14
4	Business, Management, and Accounting	11	0.63
5	Chemical Engineering	105	5.99
6	Chemistry	218	12.43
7	Computer Science	328	18.70
8	Decision Sciences	21	1.20
9	Dentistry	6	0.34
10	Earth and Planetary Sciences	3	0.17
	Total	1,754	100.00

During the 10 year study period, the top 10 subjects contributions are identified from table 3, from the study maximum of 932(53.14%) contributions are Biochemistry, Genetics, and Molecular Biology followed by Computer Science with 328(18.70%) research publications, the Chemistry with 218 (12.43%) research publications. During ten year study period the lowest 3(0.17%) research publications.

Document Type of Parkinson's Disease Research Publications

Table 4 Document Type of Parkinson's Disease Research Publications

S.No	Document Type	Publications	%	Citations	%
1	Article	1,807	57.73	36,223	61.11
2	Review	758	24.22	20,973	35.38
3	Conference Paper	227	7.25	641	1.08
4	Book Chapter	163	5.21	560	0.94
5	Letter	69	2.20	277	0.47
6	Editorial	49	1.57	351	0.59
7	Note	37	1.18	31	0.05
8	Short Survey	7	0.22	177	0.30
9	Erratum	6	0.19	4	0.01
10	Book	4	0.13	5	0.01
11	Data Paper	1	0.03	4	0.01
12	Retracted	1	0.03	26	0.04
13	Undefined	1	0.03	0	0.00
	Total	3,130	100.00	59,272	100.00

Document types are identified during the ten-year study period on Parkinson’s research publications are shown in table 04. From the study, it is identified that a maximum of 1,807 (57.73%) research publications are contributed by Article, followed by 758 (24.22%) research publications are Review and third-placed in Conference paper with 227 (7.25%) research publications. Book chapter 163 (5.21%), Letter 69 (2.205), Editorial 49 (1.57%), Note 37 (1.18%), Short survey 7 (0.22%), Erratum 6 (0.19%), Book 4 (0.13%), Data paper 1 (0.03%), Retracted 1 (0.03%), Undefined 1 (0.03%). This study confirmed that more than 90% of research publications are contributed by articles, conference papers, and reviews. The remaining nearby 11% of research publications are identified in the other form documents. The highest citations of 36,233 (61.11%) articles, and lowest citations of 0 (0.00%) Undefined.

Relative Growth Rate

The most important feature of science and technology in recent years has been calculated by the rate of growth. Scientific growth has been involved not only increase in manpower and financial investment. The RGR is identified by the increase in the number of publications per unit of time. The mean RGR over the particular period of the interval can be calculated in the following formula developed by Mahapatra (1985)²⁰

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

Where,

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

W₁ = the logarithm of the beginning number of publications/pages

W₂= the logarithm of ending number of publications/pages after a specific period of interval

T₂ – T₁ = the unit difference between the beginning time and the ending time.

The doubling time is the time taken for the doubling of the number of records actually published within a stipulated period. The doubling time is calculated from the RGR and the natural logarithm number is used, the difference has a value of 0.693. The corresponding doubling time can be calculated by the following formula,

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

Relative Growth Rate Parkinson's disease Research Publications

Table 5 Relative Growth Rate Parkinson's disease Research Publications

S.No	Year	Publications	Cum	W1	W2	RGR=(W2-W1)	Dt=(0.693/RGR)
1	2011	136	136		4.91		
2	2012	170	306	4.91	5.72	0.81	0.85
3	2013	184	490	5.72	6.19	0.47	1.47

4	2014	242	732	6.19	6.60	0.40	1.73
5	2015	250	982	6.60	6.89	0.29	2.36
6	2016	326	1308	6.89	7.18	0.29	2.42
7	2017	329	1637	7.18	7.40	0.22	3.09
8	2018	434	2071	7.40	7.64	0.24	2.95
9	2019	435	2506	7.64	7.83	0.19	3.63
10	2020	624	3130	7.83	8.05	0.22	3.12
	Total	3130					

The RGR and the doubling time (Dt) in Parkinson’s research output in India are calculated and the results are presented in Table 5. From the study, it is identified that the RGR is 0.81 in the year 2012 and 0.22 in the year 2020. This study confirmed that the RGR is decreasing trend from 2011 to 2020. At the same time, doubling time is found that 0.85 in the year 2012 and 3.12 in the year 2020. It is confirmed that doubling time is an increasing trend during the study period.

Authorship Pattern in Parkinson's disease Research Publications

Table 6 Authorship Pattern in Parkinson's disease Research Publications

Authorship Pattern							
year	1	2	3	4	5	>5	Total
2011	9	21	23	25	26	32	136
2012	16	30	24	28	34	38	170
2013	10	39	39	36	19	41	184
2014	13	50	45	37	35	64	244
2015	21	56	50	39	25	59	250
2016	22	68	59	53	42	82	326
2017	21	69	63	61	40	75	329
2018	11	96	78	84	52	112	433
2019	16	94	78	88	48	111	435
2020	20	121	128	74	82	198	623
Total	159	644	587	525	403	812	3,130
%	5.08	20.58	18.75	16.77	12.88	25.94	100.00

Table 6 indicates the authorship pattern in the field of Parkinson’s research output in India for the selected ten-year study period. From the study it is identified from Table-6, the majority of the authors in the field are preferred to publish their research works in more than five authorship modes with 812 (25.94%) publications. This was followed by two authorship modes with 644 (20.58%) publications, three authorship modes with 587 (18.75%) publications, four authorship modes with 525 (16.77%), and five authorship modes with 403 (12.88%). During the study period, single authors have contributed only 159 (5.08%) publications. This study confirmed that more than 94.92 % of publications are contributed by multiple authors.

Degree of Collaboration

The degree of collaboration is the relationship between the single author and multi-author contributions. The degree of collaboration is calculated by the Subramanian formula (1983)²¹, used by Vivekanandhan (2016)²² Sivasamy (2020)²³ Ravichandran (2021)²⁴

$$DC = \frac{N_m}{(N_m + N_s)}$$

Where DC = Degree of Collaboration

N_m = Number of multi-authored publications

N_s = Number of single-authored publications

In the present study, $N_m = 2971$, $N_s = 159$

So that, the degree of collaboration is $=2971 / (159+2971) = 0.95$

Degree of Collaboration in Parkinson's disease Research Publications

Table 7 Degree of Collaboration in Parkinson's disease Research Publications

Year	Single author Publications	Multi-author Publications	Total author Publications	DC = Degree of Collaboration DC= $N_m / (N_s + N_m)$
2011	9	127	136	0.93
2012	16	154	170	0.91
2013	10	174	184	0.95
2014	13	231	244	0.95
2015	21	229	250	0.92
2016	22	304	326	0.93
2017	21	308	329	0.94
2018	11	422	433	0.97
2019	16	419	435	0.96
2020	20	603	623	0.97
Total	159	2971	3130	

Table 7 shows that, degree of collaboration in Parkinson's disease research publications in India for the selected ten-year studies period. From this study, it is identified that the degree of collaboration is between 0.93 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 Parkinson's disease research publications are contributed by collaborative authors.

Collaborative Coefficient (CC)

The pattern of co-authorship collaboration among the authors can be measured with the following formula suggested by Ajiferuke, et al. (1988)²⁵

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

Whereas,

F_j = Number of publications with j author papers

N = Total number of the 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, which is to be understood nearly as the mean number of authors per paper are suggested by Ajiferuke, et al (988)²⁵

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

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 the same time field.

Modified Collaboration Coefficient

The modified collaboration coefficient (MCC) counted by the formula which is suggested by (Savanur and Srikanth, 2010)²⁶

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 Coefficient Collaboration Index, Modified Collaboration Coefficient
 Parkinson's disease Research Publications**

**Table 8 Collaborative Coefficient Collaboration Index, Modified Collaboration Coefficient
 Parkinson's disease Research Publications**

Authorship Pattern									
year	1	2	3	4	5	>5	CC	CI	MCC
2011	9	21	23	25	26	32	0.68	3.99	4.01
2012	16	30	24	28	34	38	0.65	3.87	3.89
2013	10	39	39	36	19	41	0.66	3.75	3.77
2014	13	50	45	37	35	64	0.67	3.91	3.93
2015	21	56	50	39	25	59	0.64	3.67	3.69
2016	22	68	59	53	42	82	0.66	3.83	3.84
2017	21	69	63	61	40	75	0.66	3.78	3.79
2018	11	96	78	84	52	112	0.69	3.94	3.95
2019	16	94	78	88	48	111	0.68	3.90	3.91
2020	20	121	128	74	82	198	0.69	4.08	4.08
Total	159	644	587	525	403	812			

Table 8 shows that, collaborative measures of Parkinson’s research publications in India for the selected ten-year study period from 2011 to 2020. From the study, it is identified that it is identified from table 8, the maximum collaboration value is 0.69 in the year 2018, 2020, and the minimum collaborative coefficient value is 0.65 in the year 2012. The average collaborative coefficient value is 1.34. The collaboration index values are identified from table 8, maximum the collaboration index value is 4.08 in the year 2020, and the minimum collaboration index value is 3.67 in the year 2015. During the study period, the average collaboration index value is 7.74. The modified collaboration co-efficient maximum value is 4.08 in the year 2020 and the minimum value is 3.69 in the year 2015. During the study period, the average value is 7.78.

Co-authorship Index Parkinson's disease

To study how the pattern of co-authorship and the use of co-authorship index suggested by Garg and Padhi (2001)²⁷ has been explained the under mentioned formula. To evaluate the co-authorship index (CAI) is the whole set of data is divided into 2 block years.

$$CAI = \left[\frac{(N_{ij}/N_{io})}{(N_{oj}/N_{oo})} \right] \times 100$$

Whereas,

N_{ij} - Number of publications having j authors in I block

N_{io} - Total publications of I block

N_{oj} - Number of publications having j authors for all blocks

N_{oo} - Total number of publications for all authors and all blocks

Here CAI=100 implies that a country’s co-authorship effort for particular authorship correspond to the world average

CAI > 100 reflects higher than average co-authorship effort

CAI < 100 reflects lower than average co-authorship effort by the given type of authorship pattern.

For calculating the co-authorship index for authors, years have been replaced into 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 3 authors.

Co-authorship Index Parkinson's disease Research Publications

Table 9 Co-authorship Index Parkinson's disease Research Publications

5 year Block	Single author	CAI	Two author	CAI	Three author	CAI	More than three author	CAI	Total
2011-2015	69	138.04	196	96.81	181	98.08	538	98.35	984
2016-2020	90	82.56	448	101.46	406	100.88	1202	100.76	2146
Total	159	220.60	644	198.27	587	198.96	1740	199.11	3130

Table 9 shows that Co-Authorship Index values are calculated by the block year period for Parkinson’s research publications in India for the selected ten-year study period. From the study, it is identified that CAI for two and three, more than three authorship contributions are increasing trend from 1st block year to 2nd block year. At the same time, CAI is decreasing trend for single authors from 1st block year to (138.04) 2nd block years (82.56).

Top 10 Significant keywords Parkinson's disease Research Publications

Table 10 top 10 significant keywords Parkinson's disease Research Publications

S.No	Keyword	Publications	%
1	Parkinson Disease	2,044	16.79
2	Human	1822	14.97
3	Article	1429	11.74
4	Parkinson's Disease	1177	9.67
5	Humans	1163	9.55
6	Nonhuman	1158	9.51
7	Priority Journal	933	7.67
8	Controlled Study	895	7.35
9	Male	795	6.53
10	Animals	756	6.21
	Total	12,172	100.00

As seen from the Scopus database, the top 10 significant keywords seem to define and identify India’s literature on Parkinson’s disease as well as give some idea about the broad research trends in the treatment and investigation of the disease (Table-10). These keywords have been classified under broad subject headings along with the frequency of keyword occurrence. The maximum keyword is Parkinson’s Disease with 2,044 (16.79%) research publications, followed by the Human of the keyword with 1,822 (14.97%) research publications, an Article of the keyword with 1, 429,(11.74%).

Top 10 Institutions in Parkinson’s disease Research Publications

Table 11 Top 10 Institutions in Parkinson’s disease Research Publications

S.No	Institutions	Total Publications	%	Total Citations	%	CPP	H-Index	RCI
1	National Institute of Mental Health and Neuro Sciences	166	20.29	2,345	4.84	14.13	26	0.24
2	All India Institute of Medical Sciences, New Delhi	129	15.77	11,205	23.14	86.86	20	1.47
3	Academy of Scientific and Innovative Research AcSIR	75	9.17	1,681	3.47	22.41	19	0.38
4	Banaras Hindu University	72	8.80	3,026	6.25	42.03	23	0.71
5	Indian Institute of Toxicology Research	72	8.80	7,650	15.80	106.25	24	1.80
6	Jamia Hamdard	65	7.95	1,816	3.75	27.94	24	0.47
7	Aligarh Muslim University	63	7.70	1,151	2.38	18.27	21	0.31
8	Postgraduate Institute of Medical Education & Research, Chandigarh	62	7.58	11,494	23.74	185.39	20	3.13
9	Annamalai University	59	7.21	1,430	2.95	24.24	24	0.41
10	University of Delhi	55	6.72	6,620	13.67	120.36	19	2.03
	Total	818	100.00	48,418	100.00			

Note: CPP-Citations per paper; RCI-Relative citation index

During the 10 year study period, the top 10 institutions’ contributions in India are identified from Table 11, from the study the maximum of 166 (20.29%) contributions are National Institute of Mental Health and Neuro Sciences, followed by the All India Institute of Medical Sciences, New Delhi contributed with 129 (15.77%) research publications, the Academy of Scientific and Innovative Research AcSIR with 75 (9.17%) research publications. During ten year study period the highest citations were 11,494 (23.74%) with Postgraduate Institute of Medical Education & Research, Chandigarh the CPP being 185.39, h-index is 20, RCI is 3.13, and the lowest citations of 1,430 (2.95%) the Annamalai University with the CPP is 24.24, h-index 24, RCI is 0.41.

Top 10 Indian Authors in Parkinson’s disease Research Publications

Table 12 Top 10 Indian Authors in Parkinson’s disease Research Publications

S.No	Author	Country	Total publications	%	Total citations	%	CPP	H-Index	RCI
1	Pal, P.K.	India	76	18.77	928	14.01	12.21	19	0.75
2	Yadav, R.	United States	54	13.33	436	6.58	8.07	13	0.49
3	Behari, M.	Saudi Arabia	44	10.86	593	8.95	13.48	15	0.82
4	Manivasagam, T.	Australia	41	10.12	1,131	17.07	27.59	22	1.69
5	Goyal, V.	United Kingdom	40	9.88	272	4.11	6.80	10	0.42
6	Essa, M.M.	Italy	32	7.90	1,048	15.82	32.75	18	2.00
7	Borah, A.	South Korea	31	7.65	705	10.64	22.74	14	1.39
8	Lenka, A.	Canada	30	7.41	392	5.92	13.07	12	0.80
9	Siddique, Y.H.	Germany	29	7.16	399	6.02	13.76	11	0.84
10	Singh, M.P.	Malaysia	28	6.91	720	10.87	25.71	14	1.57
	Total		405	100.00	6,624	100.00			

Note: CPP-Citations per paper; RCI-Relative citation index

During the 10 year study period, the top 10 authors’ contributions in India are identified from Table 12, from the study the maximum of 76 (18.77%) contributions are Pal, P.K., India, followed by Yadav, R. the United States contributed with 54 (13.33%) research publications, the Behari, M., Saudi Arabia with 44 (10.86%) research publications. During ten year study period the highest citations were 1,131 (17.07%) with Manivasagam, T. Australia, the CPP being 27.59, h-index is 22, RCI is 1.69, and the lowest citations of 272 (4.11%) the Goyal, V. the United Kingdom with the CPP is 6.80, h-index 10, RCI is 0.42.

Top 10 Journals in Parkinson’s disease Research Publications

Table 13 Top 10 Journals in Parkinson’s disease Research Publications

S.No	Journals	Publications	%	Citations	%	CPP	H-Index	RCI
1	Neurology India	74	17.13	397	6.36	5.36	11	0.37
2	Annals Of Indian Academy Of Neurology	67	15.51	409	6.55	6.10	9	0.42
3	CNS And Neurological Disorders Drug Targets	48	11.11	735	11.78	15.31	17	1.06
4	Molecular Neurobiology	45	10.42	922	14.78	20.49	19	1.42

5	Parkinsonism And Related Disorders	45	10.42	865	13.86	19.2 2	16	1.3 3
6	ACS Chemical Neuroscience	35	8.10	533	8.54	15.2 3	13	1.0 5
7	Neurochemistry International	31	7.18	715	11.46	23.0 6	15	1.6 0
8	Research Journal Of Pharmacy And Technology	30	6.94	35	0.56	1.17	3	0.0 8
9	Neurochemical Research	29	6.71	941	15.08	32.4 5	17	2.2 5
10	Current Pharmaceutical Design	28	6.48	688	11.03	24.5 7	12	1.7 0
	Total	432	100.0 0	6,240	100.0 0			

During the 10 year study period, the top 10 Journals contributions are identified from Table 13, from the study maximum of 74 (17.13%) contributions are Neurology India, followed by Annals Of Indian Academy Of Neurology contributed with 67 (15.51%) research publications, the CNS And Neurological Disorders Drug Targets with 48 (11.11%) research publications. During ten year study period the highest citations were 941 (15.08%) with Neurochemical Research, the CPP being 32.45, h-index is 17, RCI is 2.25, and the lowest citations of 35 (0.56%) the Research Journal of Pharmacy and Technology with the CPP is 1.17, h-index 03, RCI is 0.08.

Highly-cited papers in Parkinson’s disease Research Publications

Table 14 Highly-cited papers in Parkinson’s disease Research Publications

S.No	Titles	Citations	Document Type
1	Naghavi, M., et.al (2015) Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: A systematic analysis for the Global Burden of Disease Study 2013, The Lancet, 385(9963):117-171.	4,427	Article
2	Mizushima, N., and Komatsu, M. (2011) Autophagy: Renovation of cells and tissues, Cell, 147(4):728-741.	3,089	Review
3	Esteller, M. (2011) Non-coding RNAs in human disease, Nature Reviews Genetics, 12(12):861-874.	2,899	Review
4	Vos, T. et.al (2017) Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016, The Lancet, 390(10100):1211-1259.	2,552	Article
5	Wittchen, H.U., et.al (2011) The size and burden of mental disorders and other disorders of the brain in Europe 2010, European Neuropsychopharmacology, 21(9):655-679.	2,129	Article

6	Naghavi, M. et.al (2017) Global, regional, and national age-sex specific mortality for 264 causes of death, 1980-2016: A systematic analysis for the Global Burden of Disease Study 2016, <i>The Lancet</i> , 390(10100):1151-1210.	2,029	Article
7	Kalia, L.V., and Lang, A.E. (2015) Parkinson’s disease, <i>The Lancet</i> , 386(9996):481-487.	2,001	Review
8	Liddelow, S.A., et. al(2017)Neurotoxic reactive astrocytes are induced by activated microglia, <i>Nature</i>	1,985	Article
9	Hartl, F.U., et.al (2011) Molecular chaperones in protein folding and proteostasis, <i>Nature</i> , 475(7356):324-332.	1,858	Review
10	Youle, R.J., and Narendra, D.P. (2011) Mechanisms of mitophagy, <i>Nature Review Molecular Cell Biology</i> , 12(1):9-14.	1,843	Article

The highly cited paper in table 14 has the highest citations 4,427, and document type of articles. Naghavi, M., et.al (2015) Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990 - 2013: A systematic analysis for the Global Burden of Disease Study 2013, *The Lancet*, 385 (9963):117-171 and document type Article. The second one of the high citations of 3,089 and document type of review. Mizushima, N., and Komatsu, M. (2011) Autophagy: Renovation of cells and tissues, *Cell*, 147 (4):728-741 and document type Review. The third one of the high citations in 2,899 and document type of review. Esteller, M. (2011) Non-coding RNAs in human disease, *Nature Reviews Genetics*, 12 (12):861-874 and document type Review. During the study period, the high citations were in the top 10 of 06 articles and 04 reviews.

Discussion and Conclusion

- ❖ The paper analyzes Parkinson’s disease research publications output by India in a scientometric analysis the publications data for the study was sourced from the Scopus database covering the ten-year period 2011 - 2020. With 3,130 research publications and 59,272 citations. From the study, it is identified that a maximum of 624 (19.94%) research publications are contributed in the year 2020. A maximum of 11,226 (18.94%), citations are received 329 publications in the year 2017. The maximum citation per paper is 41.63 in the year 2015,
- ❖ The study has a maximum of 340 (37.74%) contributions are the United States, the citations are 19845 (14.56), CPP is 58.37, H- index is 53 and RCI is 0.39. Followed by Saudi Arabia contributing 92 (10.21%) research publications, the citations are 13392 (9.82%), CPP is 145.57, H-index is 30 and RCI is 0.96. Australia with 83 (9.21%) research publications. The citations are 13490 (9.90%), CPP is 162.53, H-index is 26 and RCI is 1.07. the lowest citations of 10806 (7.93%) Oman the CPP is 240.13, h-index 22, RCI is 1.59.
- ❖ The document type of a maximum of 1,807 (57.73%) research publications are contributed by Article, followed by 758 (24.22%) research publications are Review and third-placed in Conference paper with 227 (7.25%) research publications.
- ❖ The relative growth rate is 0.81 in the year 2012 and 0.22 in the year 2020. This study confirmed that the relative growth rate is decreasing trend from 2011 to 2020. Found that 0.85 in the year 2012 and 3.12 in the year 2020. The doubling time is an increasing trend

- ❖ The authorship pattern is more than five authorship modes with 812 (25.94%) publications. followed by two authorship modes with 644 (20.58%) publications, three authorship modes with 587 (18.75%) publications, four authorship modes with 525 (16.77%), and five authorship modes with 403 (12.88%).
- ❖ The maximum collaboration value is 0.69 in the year 2018, 2020, the average value is 1.34. The maximum collaboration index value is 4.08 in the year 2020, the average value is 7.74. The modified collaboration co-efficient maximum value is 4.08 in the year 2020 and the average value is 7.78.
- ❖ The CAI for two and three, more than three authorship contributions are increasing trend from 1st block year to 2nd block year. At the same time, CAI is decreasing trend for single authors from 1st block year (138.04) to 2nd block years (82.56).
- ❖ The maximum keyword is Parkinson's Disease with 2,044 (16.79%) research publications, followed by the Human of the keyword with 1,822 (14.97%) research publications, an Article of the keyword with 1,429 (11.74%).
- ❖ During the maximum of 166 (20.29%) contributions are National Institute of Mental Health and Neuro Sciences, followed by All India Institute of Medical Sciences, New Delhi contributed with 129 (15.77%) research publications, the Academy of Scientific and Innovative Research AcSIR with 75 (9.17%) research publications.
- ❖ The study a maximum of 76 (18.77%) contributions are Pal, P.K., India, followed by Yadav, R. the United States contributed with 54 (13.33%) research publications, the Behari, M., Saudi Arabia with 44 (10.86%) research publications
- ❖ The maximum of 74 (17.13%) contributions are Neurology India, followed by Annals of Indian Academy Of Neurology contributed with 67 (15.51%) research publications, the CNS and Neurological Disorders Drug Targets with 48 (11.11%) research publications.
- ❖ During the highly cited paper in highest citations 4427, and document type of articles. Naghavi, M., et.al (2015) Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990 - 2013: A systematic analysis for the Global Burden of Disease Study 2013, *The Lancet*, 385 (9,963):117-171.

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