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Pharmacology Research in India: A Bibliometric Study

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Abstract

This article analysis the research output performance on Pharmacology in India. A total of 363 research articles published in Web of Science were analyzed to find the performance of Indian scientists in terms of growth during the period 1999-2011(upto May). Patterns related to authorship, bibliographic forms, citations, contributing institutions and subjects were analyzed. Based on these details ranking of journals in the field of pharmacology has also been done.

Keywords: *Bibliometrics, Citations, Pharmacology*

1. INTRODUCTION

Pharmacology has been defined as an experimental science which studies the effects of drugs and how they exert their effects. There is a distinction between what a drug does and how it acts [1]. Pharmacology is one of the corner stone of the drug discovery process. The medicinal chemist may create the candidate compound, but the pharmacologist is the one who tests it for physiologic activity. After 1950, there was spurt in medical education in the country, and pharmacological researches were initiated in most of the medical institution in the country. Col. Sir Ram Nath Chopra, Father of Pharmacology in the year 1965 itself says, "I, now, only wish that the pharmacologists in India shall continue their research activities more zealously. They have better laboratories and more trained persons and should, therefore, contribute to the store house of world knowledge". Hence, it is better to evaluate the pharmacology research contributions by Indians during the period of January 1999 to May 2011 (13 years) that are included in the Web of Science [2].

Web of Science is an online academic citation index, designed for providing access to multiple databases, cross-disciplinary research, and in-depth exploration of specialized subfields within an academic or scientific discipline. Moreover, as a citation index, any cited paper will lead to any other literature (book, academic journal, proceedings etc.) which currently, or in the past, cites this work. Web of Science has indexing coverage from the year 1900 to the present.

2. OBJECTIVES OF THE STUDY

The main objectives of the study is to identify/analyze the following:

1. To examine the growth of pharmacology literature during the period 1999-2011;
2. To identify and analyse the research contribution in the subject field of pharmacology;
3. To identify the first 50 journals in which including contribution on pharmacology included and impact factor of these journals;
4. To compare and measure the growth rate of literature published;
5. To identify the listed highly cited articles;
6. To identify the year-wise citations of Indian contribution.

3. METHODOLOGY

A total 363 records were identified in the field of pharmacology during the period 1999-2011 (Up to May). The collected data has been classified by using excel and the same has been loaded in to SPSS (Statistical Package for Social Sciences) for the purpose of analysis.

4. GROWTH OF PHARMACOLOGY LITERATURE IN INDIA

The year-wise distribution and growth pattern of articles is given in Table 1. During the year 2010 the publication output is 66 (18.18%).

Table 1Citation for Indian Contributions

Sl. No.	Publication Year	No. of Articles	%	No. of Citations	%
1	1999	14	3.86	0	0
2	2000	9	2.48	6	0.19
3	2001	11	3.03	23	0.73
4	2002	22	6.06	42	1.34
5	2003	25	6.89	76	2.43
6	2004	22	6.06	123	3.92
7	2005	17	4.68	193	6.16
8	2006	26	7.16	243	7.75
9	2007	26	7.16	305	9.73
10	2008	47	12.95	458	14.61
11	2009	52	14.33	528	16.85
12	2010	66	18.18	664	21.19
13	2011	26	7.16	473	15.09
	Total	363	100	3134	100

Total 363 research publications during 1999-2011 were published with an average of 26 articles per year. Further the citations were evaluated and the same is shown in Table 1. These are 3134 citations during the period 1999-2011 with average citations of 214.08.

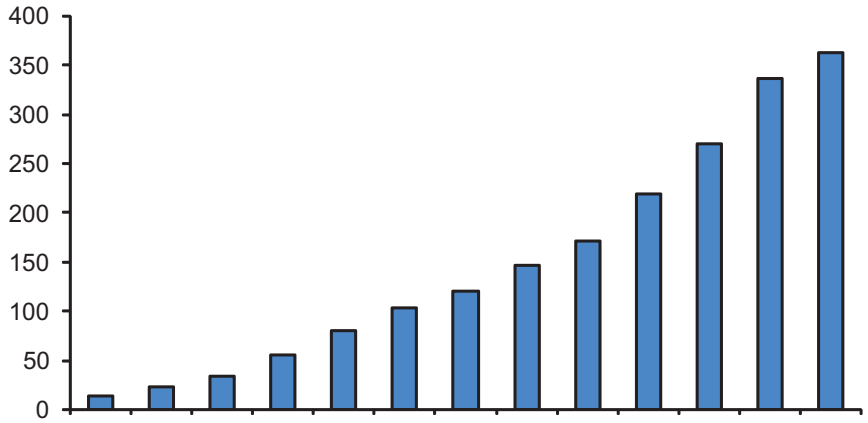

Fig.1 Growth of literature

The Figure 1 indicates the cumulative of literature on pharmacology. It can be seen that the growth is parabolic in nature.

Bibliographic form of the literatures in pharmacology research contributed by Indian authors is given in the Table 2.

Table 2 Distribution of Articles by Bibliographic Form

Sl. No.	Bibliographic Form	Record Count	%
1	Article	250	68.87
2	Review	81	22.31
3	Letter	15	4.13
4	Editorial Material	8	2.20
5	Meeting Abstract	5	1.38
6	Proceedings Paper	4	1.10
	Total	363	100

Table 2 shows that maximum number of articles (68.87%) is published in the journal. This is followed by reviews (22.31%) and letters (4.13%). It could be noted that out of 363 research output, 2.20% are editorial material, 1.38% are meeting abstract and 1.10% are proceeding papers. Hence journal articles holds first place as that of the other fields.

Table 3 shows the language-wise distribution of pharmacology literature contributed by Indian authors.

Table 3 Language-wise Distribution of Articles

Sl. No.	Language	Record Count	%
1	English	362	99.72
2	Portuguese	1	0.28
	Total	363	100

It can be seen from Table 3 that maximum number of articles is published in English language (99.72%). The only other language in which papers have been indexed was Portuguese (0.28%). It is interesting to note that the scientific communication in the field of pharmacology is mainly in English language.

Table 4 shows the Relative Growth Rate (RGR) and Doubling Time of the Indian pharmacology publications.

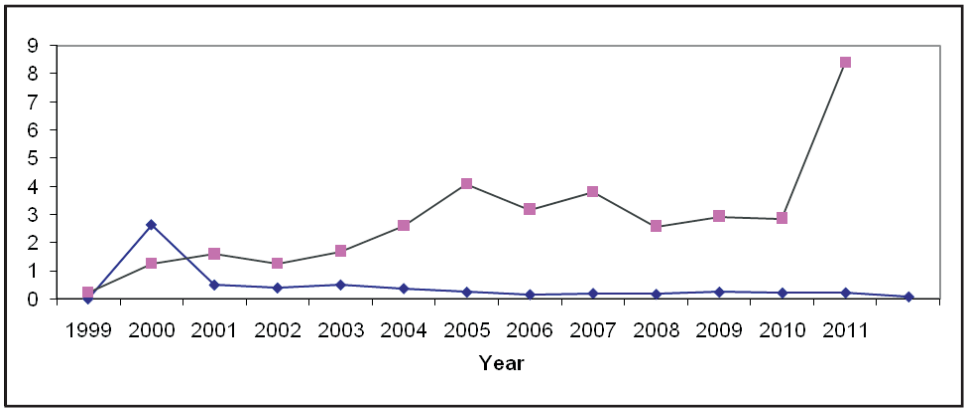

Fig. 2 RGR and doubling time of publications

Table 4 RGR and Doubling Time of Publications

Sl. No.	Publication Year	No. of Articles	Cumulative	W1	W2	RGR	dt
1	1999	14	14	0.00	2.64	2.64	0.24
2	2000	9	23	2.64	3.14	0.50	1.25
3	2001	11	34	3.14	3.53	0.39	1.59
4	2002	22	56	3.53	4.03	0.50	1.25
5	2003	25	81	4.03	4.39	0.37	1.69
6	2004	22	103	4.39	4.63	0.24	2.59
7	2005	17	120	4.63	4.79	0.15	4.08
8	2006	26	146	4.79	4.98	0.20	3.18
9	2007	26	172	4.98	5.15	0.16	3.80
10	2008	47	219	5.15	5.39	0.24	2.58
11	2009	52	271	5.39	5.60	0.21	2.92
12	2010	66	337	5.60	5.82	0.22	2.86
13	2011	26	363	5.82	5.89	0.07	8.38
	Total	363					

Table 5 Rank List of Subjects

Sl. No.	Subjects	Record Count	%
1	Pharmacology & Pharmacy	146	40.22
2	Chemistry, Medicinal	64	17.63
3	Biochemistry & Molecular Biology	38	10.47
4	Chemistry, Organic	36	9.92
5	Chemistry, Multidisciplinary	24	6.61
6	Biochemical Research Methods	21	5.79
7	Chemistry, Analytical	21	5.79
8	Neurosciences	20	5.51
9	Medicine, Research & Experimental	17	4.68
10	Plant Sciences	16	4.41
11	Behavioral Sciences	10	2.75
12	Integrative & Complementary Medicine	10	2.75
13	Medicine, General & Internal	10	2.75
14	Toxicology	9	2.48
15	Agriculture, Dairy & Animal Science	8	2.20
16	Anesthesiology	8	2.20
17	Biology	8	2.20
18	Multidisciplinary Sciences	8	2.20
19	Veterinary Sciences	6	1.65
20	Biophysics	5	1.38
21	Biotechnology & Applied Microbiology	5	1.38

22	Chemistry, Applied	5	1.38
23	Immunology	5	1.38
24	Oncology	5	1.38
25	Cell Biology	4	1.10
26	Chemistry, Physical	4	1.10
27	Clinical Neurology	4	1.10
28	Public, Environmental & Occupational Health	4	1.10
29	Tropical Medicine	4	1.10
30	Chemistry, Inorganic & Nuclear	3	0.83
31	Crystallography	3	0.83
32	Education, Scientific Disciplines	3	0.83
33	Endocrinology & Metabolism	3	0.83
34	Engineering, Multidisciplinary	3	0.83
35	Food Science & Technology	3	0.83
36	Medical Laboratory Technology	3	0.83
37	Nutrition & Dietetics	3	0.83
38	Surgery	3	0.83
39	Dentistry, Oral Surgery & Medicine	2	0.55
40	Dermatology	2	0.55
41	Environmental Sciences	2	0.55
42	Mathematical & Computational Biology	2	0.55
43	Obstetrics & Gynecology	2	0.55
44	Pediatrics	2	0.55
45	Spectroscopy	2	0.55
46	Agronomy	1	0.28
47	Anatomy & Morphology	1	0.28
48	Anthropology	1	0.28
49	Cardiac & Cardiovascular Systems	1	0.28
50	Critical Care Medicine	1	0.28
51	Ecology	1	0.28
52	Engineering, Biomedical	1	0.28
53	Engineering, Chemical	1	0.28
54	Genetics & Heredity	1	0.28
55	Geriatrics & Gerontology	1	0.28
56	Health Care Sciences & Services	1	0.28
57	Infectious Diseases	1	0.28
58	Information Science & Library Science	1	0.28
59	Materials Science, Biomaterials	1	0.28
60	Medicine, Legal	1	0.28
61	Microbiology	1	0.28
62	Microscopy	1	0.28
63	Ophthalmology	1	0.28
64	Parasitology	1	0.28

65	Peripheral Vascular Disease	1	0.28
66	Physiology	1	0.28
67	Polymer Science	1	0.28
68	Psychiatry	1	0.28
69	Psychology, Clinical	1	0.28
70	Psychology, Multidisciplinary	1	0.28
71	Radiology, Nuclear Medicine & Medical Imaging	1	0.28
72	Reproductive Biology	1	0.28
73	Respiratory System	1	0.28
74	Rheumatology	1	0.28
75	Soil Science	1	0.28
76	Substance Abuse	1	0.28
77	Urology & Nephrology	1	0.28
78	Zoology	1	0.28
	Total	599	100

All articles published in pharmacology journals were distributed into 78 subfields. Table 5 gives the subfield-wise distribution of papers, which shows that the subject Pharmacology & Pharmacy constituted the highest number of articles i.e. 146 (40.22%). It is followed by Medicinal Chemistry (17.63%), Biochemistry & Molecular Biology (10.47%). All the remaining subjects constituted less than 10%. The least number of articles were occupied by other subjects (0.28%). The main thrust on research seems to be in the field of Pharmacology and Pharmacy.

Table 6 Pharmacology Journals that Contributed by Indian Authors

Sl. No.	Source Title	No. of Records	Indian %	Cumulative %	Overall %	Impact Factor
1	Indian Journal of Pharmacology	21	5.79	5.79	0.15	-
2	Bioorganic & Medicinal Chemistry	9	2.48	8.26	0.06	2.662
3	Bioorganic & Medicinal Chemistry Letters	8	2.20	10.47	0.06	2.604
4	Journal Of Ethno pharmacology	8	2.20	12.67	0.06	2.049
5	Asian Journal Of Chemistry	7	1.93	14.60	0.05	0.292
6	Behavioural Pharmacology	7	1.93	16.53	0.05	2.389
7	Current Science	7	1.93	18.46	0.05	0.80
8	Indian Journal Of Animal Sciences	6	1.65	20.11	0.04	0.116
9	Biomedical Chromatography	5	1.38	21.49	0.03	1.663
10	Chromatographia	5	1.38	22.87	0.03	1.145
11	Journal Of Clinical Pharmacology	5	1.38	24.24	0.03	2.993
12	Arzneimittel-Forschung-Drug Research	4	1.10	25.34	0.03	0.692
13	Current Drug Metabolism	4	1.10	26.45	0.03	4.49
14	European Journal Of Medicinal Chemistry	4	1.10	27.55	0.03	2.301
15	Fundamental & Clinical Pharmacology	4	1.10	28.65	0.03	2.129
16	Indian Journal Of Chemistry Section B-Organic Chemistry Including Medicinal Chemistry	4	1.10	29.75	0.03	0.368

17	Indian Journal Of Medical Research	4	1.10	30.85	0.03	1.67
18	Neuroscience Letters	4	1.10	31.96	0.03	-
19	Pharmacology	4	1.10	33.06	0.03	1.195
20	Current Therapeutic Research-Clinical And Experimental	3	0.83	33.88	0.02	0.475
21	European Journal Of Pharmacology	3	0.83	34.71	0.02	2.376
22	Indian Journal Of Experimental Biology	3	0.83	35.54	0.02	0.551
23	Indian Journal Of Pharmaceutical Education And Research	3	0.83	36.36	0.02	-
24	Indian Journal Of Pharmaceutical Sciences	3	0.83	37.19	0.02	-
25	Journal Of Chromatography B-Analytical Technologies In The Biomedical And Life Sciences	3	0.8	38.02	0.02	2.935
26	Journal Of Medicinal Chemistry	3	0.83	38.84	0.02	4.895
27	Journal Of Scientific & Industrial Research	3	0.83	39.67	0.02	0.387
28	Pharmacological Research	3	0.83	40.50	0.02	1.895
29	Pharmacology Biochemistry And Behavior	3	0.83	41.32	0.02	2.355
30	Pharmazie	3	0.83	42.15	0.02	0.775
31	Phytotherapy Research	3	0.83	42.97	0.02	1.430
32	Biological & Pharmaceutical Bulletin	2	0.55	43.53	0.01	1.614
33	Biomedicine & Pharmacotherapy	2	0.55	44.08	0.01	1.418
34	British Journal Of Anaesthesia	2	0.55	44.63	0.01	2.948
35	British Journal Of Clinical Pharmacology	2	0.55	45.18	0.01	2.681
36	British Journal Of Pharmacology	2	0.55	45.73	0.01	3.767
37	Cancer Letters	2	0.55	46.28	0.01	3.398
38	Chemico-Biological Interactions	2	0.55	46.83	0.01	3.09
39	Current Medicinal Chemistry	2	0.55	47.38	0.01	4.944
40	European Journal Of Anesthesiology	2	0.55	47.93	0.01	1.435
41	Expert Opinion On Drug Discovery	2	0.55	48.48	0.01	3.667
42	International Journal Of Pharmacology	2	0.55	49.04	0.01	2.408
43	Journal Of Pharmaceutical And Biomedical Analysis	2	0.55	49.59	0.01	2.761
44	Journal Of Pharmacy And Pharmacology	2	0.55	50.14	0.01	1.718
45	Journal Of Sulfur Chemistry	2	0.55	50.69	0.01	-
46	Journal Of Veterinary Medicine Series A - Physiology Pathology Clinical Medicine	2	0.55	51.24	0.01	0.702
47	Medicinal Research Reviews	2	0.55	51.79	0.01	7.264
48	Methods And Findings In Experimental And Clinical Pharmacology	2	0.55	52.34	0.01	0.808
49	National Medical Journal Of India	2	0.55	52.89	0.01	-
50	Pharmaceutical Biology	2	0.55	53.44	0.01	0.364
51	Pharmacological Reports	2	0.55	53.99	0.01	2.290
52	Phosphorus Sulfur And Silicon And The Related Elements	2	0.55	54.5	0.01	0.669
53	Others	165	45.45	100	-	-
	Total	363	100.00	-	-	-

The journals were the preferred means of communications by Indian contributors. The Table 6 shows the list of journals contributed by the Indian authors. The impact factors of journals were ranked accordingly. In all, from 1999-2011, 363 records were ranked. Out of first 52 journals, Indian Journal of Pharmacology ranked first. This observation reveals that Indian researchers prefer Indian journals for research and reference work. In order to avoid a long list of journals, only those journals having over two records were taken into account for preparing the rank list.

Table 7 List of Indian Institutions that Contributed to Pharmacology

Sl. No.	Institution Name	Record Count	%	Cumulative Total	Cumulative %
1	All India Inst Med Sciences	14	2.30	14	2.30
2	Punjab University	14	2.30	28	4.60
3	Central Drug Research Institute	13	2.13	41	6.73
4	CSIR	10	1.64	51	8.37
5	Christian Medical College & Hospital	8	1.31	59	9.69
6	Hamdard Univ	7	1.15	66	10.84
7	Indian Vet Res Inst	7	1.15	73	11.99
8	Natl Inst Pharmaceut Educ & Res	7	1.15	80	13.14
9	Seth Gordhandas Sunderdas Med Coll	7	1.15	87	14.29
10	Univ Madras	7	1.15	94	15.44
11	Indian Inst Technol	6	0.99	100	16.42
12	Kakatiya Univ	6	0.99	106	17.41
13	Univ Delhi	6	0.99	112	18.39
14	Jadavpur Univ	5	0.82	117	19.21
15	Postgrad Inst Med Educ & Res	5	0.82	122	20.03
16	Ranbaxy Labs Ltd	5	0.82	127	20.85
17	Suramus Biopharm	5	0.82	132	21.67
18	Annamalai Univ	4	0.66	136	22.33
19	Bhabha Atom Res Ctr	4	0.66	140	22.99
20	Birla Inst Technol & Sci	4	0.66	144	23.65
21	Dr Babasaheb Ambedkar Marathwada Univ.	4	0.66	148	24.30
22	Dr Reddys Labs Ltd	4	0.66	152	24.96
23	Jawaharlal Nehru Technol Univ	4	0.66	156	25.62
24	King Edward Vii Mem Hosp	4	0.66	160	26.27
25	Maharaja Sayajirao Univ Baroda	4	0.66	164	26.93
26	Natl Inst Mental Hlth & Neurosci	4	0.66	168	27.59
27	NIPER	4	0.66	172	28.24
28	Aligarh Muslim Univ	3	0.49	175	28.74
29	Banaras Hindu Univ	3	0.49	178	29.23
30	Bharathiar Univ	3	0.49	181	29.72
31	Def Res & Dev Estab	3	0.49	184	30.21
32	Govt Med Coll & Hosp	3	0.49	187	30.71
33	Indian Inst Chem Technol	3	0.49	190	31.20
34	Jamia Hamdard	3	0.49	193	31.69
35	Jawaharlal Inst Postgrad Med Educ & Res	3	0.49	196	32.18

36	Jubilant Innovat	3	0.49	199	32.68
37	Mahatma Gandhi Inst Med Sci	3	0.49	202	33.17
38	Mp Shah Med Coll	3	0.49	205	33.66
39	Natl Bot Res Inst	3	0.49	208	34.15
40	Padmashree Dr Dy Patil Univ	3	0.49	211	34.65
41	Punjab Univ	3	0.49	214	35.14
42	Rashtrasant Tukadoji Maharaj Nagpur Univ.	3	0.49	217	35.63
43	Univ Coll Med Sci	3	0.49	220	36.12
44	Univ Pune	3	0.49	223	36.62
45	Others	386	63.38	609	100
	Total	609	100		

It is implicit from Table 7 that 363 articles published from January 1999 to May 2011 by Indian authors belong to 609 institutions. Out of 609 institutions contributing 363 articles, All India Institute of Medical Sciences, and Punjab University ranked first with 14 publications (2.30%). Central Research Drug Research Institute ranked second with 13 publications (2.13%), CSIR followed next with 10 (1.64%) contributions from these followed by the "others" category comprising of other institutions, scientists and research workers contributing 386 articles (63.38%).

5. MAJOR FINDINGS

a. There are 363 articles were published during the period 1999-2011(Up to May) that are covered in International journals.

b. Average citations of Indian articles works out to 241.08.

c. The growth of Indian contributions are seems to be parabolic in nature.

d. Among 363 articles, 250 (68.85%) are belong to nature and 81(22.31%) are belong to review nature.

e. It is surprise to see that there is one article published in Portuguese.

f. The doubling time of Indian Pharmacological research works out to 2-3 years.

g. The relative growth rate is linear in nature.

h. Indian contributions are appeared in 78 different fields among this Pharmacology and Pharmacy field has a maximum number of (40.22%) fields.

i. Indian contributions are appeared in almost highly impact factor journals.

j. All India Institute of Medical Sciences and Punjab University contributes maximum number of publications during the period. It is followed by Central Drug Research Institute.

k. Indian Journal of Pharmacology ranking first.

l. The age of the Indian articles seems to be minimum 13 years.

6. CONCLUSION

The studies on bibliometric are mostly concentrated on data drawn from databases, individual journals, individual institutions, research output in a particular field of knowledge, individual subjects research output, individual author's publication and so on. The present study also appears to be a landmark in the above said fact. Though there is a variation in number of articles published each year, the increasing number of citation per year shows that pharmacology research workers are seeking a greater platform for their work at international level.

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