

Arthritis Research in India: A Scientometric Assessment of Publications Output during 2007-16

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Abstract

The paper examines 3064 Indian publications on arthritis research, as covered in Scopus database during 2007-16, experiencing an annual average growth rate of 7.12% and qualitative citation impact averaged to 8.92 citations per paper. India's share in global output was 3.54% during 2007-16, which increased from 2.96% to 4.09% from 2007-11 to 2012-16. Top 12 most productive countries in arthritis research accounted for 83.27% global publication share during 2007-16, which increased to 82.67% to 83.82% from 2007-11 to 2012-16. The top 12 most productive countries in arthritis research individually contributed global share from 2.69% to 26.29% with largest global publication share coming from USA (26.29), U.K. (10.02% share), Germany, Japan, Italy and France (from 5.16% to 6.72%), Netherlands, China and Canada (from 4.37% to 4.81%), Spain, India and Australia (from 2.69% to 3.77%) during 2007-16. The international collaborative share of India's publications in arthritis research was 10.77% during 2007-16, which increased from 10.38% to 11.04% from 2007-11 to 2012-16. Medicine, among subjects contributed the highest publications share (66.09%) in India's output followed by pharmacology, toxicology & pharmaceuticals (33.09%), biochemistry, genetics & molecular biology (17.43%), immunology & microbiology (10.18%) and chemistry (3.36%) during 2007-16. Rheumatoid arthritis, among different types of arthritis, contributed the largest share of 49.35%, followed by adjuvant arthritis (10.70%), tuberculosis arthritis (8.39%), osteoarthritis (7.96%), bacterial arthritis (7.83%), lupus arthritis (7.64%), juvenile arthritis (7.60%), psoriatic arthritis (3.85%), hand arthritis (2.84%), polyarthritis (2.81%), gout arthritis (2.74%) and septic arthritis (2.20%) during 2007-16. The top 15 most productive organizations and authors together contributed 27.02% and 13.71% respectively as their share of global publication output and 44.76% and 17.36% respectively as their share of global citation output during 2007-16. Among the total journal output of 3021 papers (98.06% of total output), the top 15 journals contributed 27.61% share to the global journal output during 2007-16 which decreased from 27.94% to 27.38% from 2007-11 and 2012-16. Of the total arthritis

research output, the top 25 highly cited publications registered citations from 100 to 1112 and they together received 6410 citations, with 256.4 citations per paper. These 25 highly cited papers were published in 22 journals, of which 4 papers were published in The Lancet and 1 paper each in other journals

Keywords: Arthritis research; Indian publications; Scientometrics; Bibliometrics

Introduction

"Arthritis" literally means joint inflammation. Although joint inflammation is a symptom or sign rather than a specific diagnosis, the term arthritis is often used to refer to any disorder that affects the joints. Joints are places in the body where bones come together, such as the knees, wrists, fingers, toes, and hips. These disorders fall within the broader category of rheumatic diseases. These are diseases characterized by inflammation (signs include redness or heat, swelling, and symptoms such as pain) and loss of function of one or more connecting or supporting structures of the body. They especially affect joints, tendons, ligaments, bones, and muscles. Common signs and symptoms are pain, swelling, and stiffness. Some rheumatic diseases also can involve internal organs. There are more than 100 rheumatic diseases that collectively affect more than millions of people worldwide [1-3]. Arthritis affects 15% of Indian population (about 180 million people). This prevalence is higher than other well-known diseases such as diabetes, HIV and cancer in India.

Among the most common type of arthritis, osteoarthritis, damages both the cartilage, which is the tissue that cushions the ends of bones within the joint and the underlying bone and also cause joint pain and stiffness. Disability results most often when the disease affects the spine and the weight-bearing joints (the knees and hips). Rheumatoid arthritis is an inflammatory disease of the immune system that attacks the lining of the joint, resulting in pain and swelling and loss of function in the joints. The most commonly affected joints are those in the hands and feet. Other rheumatic diseases include; (i) Bursitis; (ii) Fibromyalgia; (iii) Gout, (iv) Infectious arthritis; (v) Juvenile idiopathic; (vi) Polymyalgia rheumatic; (vii) Polymyositis; (viii); (ix) Spondyloarthropathies; (x) Psoriatic arthritis; (xi) Systemic lupus and (xii) Tendinitis [1-3].

Literature Review

Only one study has so far been conducted in the past on quantitative analysis of arthritis research. Few Other few

studies focused on evaluation of rheumatic diseases (including arthritis) research based on publications output. Among such studies, Lewison and Devey [4] used bibliometric methods to evaluate the magnitude and quality of publications in arthritis research in the UK and also compared this with that of other countries. Outputs from 13 countries between 1988 and 1995 were analyzed by number, research level (from clinical to basic) and potential impact on other researchers (from low to high). The UK has a strong presence in arthritis research and the highest relative commitment of all the countries studied. Papers with funding acknowledgements were of significantly higher impact and less clinical than those without. Mela and Cimmino evaluated the distribution and scope of papers (2331) published by authors from the European Union (EU) in 17 rheumatological journals during 1995 and the impact of rheumatological research in the EU in comparison with that produced elsewhere. Of them, 1316 (56.5%) came from the EU (29.4% from the UK, 17.4% from France, 11.5% from Germany, and 10.8 % from Italy) and 544 (23.3%) from the USA. The mean IF of EU papers were approximately 2 in comparison with 3.5 for the USA and 2.4 for other countries. Less than a quarter of them were cited more than twice. Go, Liu and Zhang et al evaluated the global rheumatic research output, with particular reference to China's output. China has occupied third place regarding the number of rheumatic diseases' publications. Nevertheless, most of these articles were not associated with high impact factors or frequent citations, let alone great influence [5,6].

Objectives

The main objectives of this study are to study the performance of India's arthritis research during 2007-16, based on publications output covered in Scopus database. In particular, the study focuses on the following objectives: (i) To study the growth India's research output in arthritis research and its citation impact; (ii) To study the India's international collaboration share and share of leading collaborating countries; (iii) To study the Indian research output by broad subject areas and the types of arthritis research; (iv) To study the publication

productivity and citation impact of top 15 most productive organizations and authors; (vi) To study the modes of communication and identification of most productive journals and (v) to study the characteristics of top 15 highly cited papers.

Methodology

The study retrieved and downloaded 10-year publication data of the world output in arthritis research from the Scopus database (<http://www.scopus.com>) covering the period 2007-16. Keywords, such as "arthritis" were incorporated in the search string and qualified these keywords with "keyword tag", "Article Title tag" and "Source Title tag", and in addition incorporated in this search string the period '2007-16' within "date range tag". Finally this search string was applied for searching Indian publication data on arthritis research. The search string was subsequently refined by "subject area tag", "country tag", "source title tag", "journal title name" and "affiliation tag", to get data/information on the distribution of publications output by subject, collaborating countries, author-wise, organization-wise and journal-wise, etc. For citation data, citations to publications were also collected from date of publication till March 2017.

(KEY(arthritis) OR TITLE(arthritis)) AND PUBYEAR > 2006 AND PUBYEAR < 2017

(KEY(arthritis) OR TITLE(arthritis)) AND PUBYEAR > 2006 AND PUBYEAR < 2017 AND (LIMIT-TO(AFFILCOUNTRY, "India"))

Analysis

The total research output of the world and India in field of arthritis cumulated to 86491 and 3064 publications in 10 years during 2007-16. The annual output of the world and India in arthritis research increased from 7795 and 167 in the year 2007 to 6666 and 268 publications in the year 2016, registering -1.18% and 7.12% growth per annum. The cumulative world and Indian output in arthritis research in 5 years 2007-11 increased from 41967 and 1243 to 44524 and 1821 publications during succeeding 5-year period 2012-16, registering 6.09% and 46.50% quinquennial growth. Of the total Indian publications output on arthritis, 64.95% (1990) was published as articles, 21.61% (662) as reviews, 6.46% (198) as letters, 2.15% (66) as editorials, 1.80% (55) as conference papers, 1.70% (52) as notes and the rest as short surveys (23), book chapters (13), erratum (3) and articles in press (2). The citation impact of Indian publications on arthritis research averaged to 8.92 citations per publication (CPP) during 2007-16; five-yearly impact averaged to 13.73 CPP for the period 2007-11 which declined to 5.64 CPP in the succeeding five-year 2012-16 (Table 1).

Publication Period	World	India					
	TP	TP	TC	CPP	ICP	%ICP	%TP
2007	7795	167	3126	18.72	13	7.78	2.14
2008	7858	176	2464	14.00	22	12.50	2.24
2009	8507	240	3340	13.92	29	12.08	2.82
2010	8733	276	4494	16.28	33	11.96	3.16
2011	9074	384	3644	9.49	32	8.33	4.23
2012	9580	413	3330	8.06	35	8.47	4.31
2013	9663	419	2466	5.89	42	10.02	4.34
2014	9521	376	1604	4.27	46	12.23	3.95
2015	9094	345	2651	7.68	49	14.20	3.79
2016	6666	268	219	0.82	29	10.82	4.02
2007-11	41967	1243	17068	13.73	129	10.38	2.96
2012-16	44524	1821	10270	5.64	201	11.04	4.09
2007-16	86491	3064	27338	8.92	330	10.77	3.54

TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper; ICP=International Collaborative Papers

Table 1: World and India's Output in Arthritis Research, 2007-16.

Top 12 Most Productive Countries in Global Arthritis Research: The global research output in the field of arthritis research had originated from more than 100 countries in the world during 2007-16. Top 12 most

productive countries in arthritis research had contributed 2330 to 22728 publications each during 2007-16 (Table 2). Top 12 most productive countries in arthritis research accounted for 83.27% global publication share

during 2007-16. Their five-yearly output accounted for 82.67% global publication share during 2007-11 which increased to 83.82% during succeeding 5-year period 2012-16. Each of top 12 countries accounted for 2.69% to 26.29% global publication share during 2007-16, with USA accounting for the highest publication share (26.29%), followed by U.K. (10.02% share), Germany, Japan, Italy and France (from 5.16% to 6.72%), Netherlands, China and Canada (from 4.37% to 4.81%),

Spain, India and Australia (from 2.69% to 3.77%) during 2007-16. The global publication share in five years increased by 3.38% in China, followed by 1.13% in India, Italy and Australia (0.50% each), Japan (0.31%) and Spain (0.01%), as against decrease by 2.05% in USA, 1.43% in Germany, 0.63% in U.K., 0.37% in France, 0.11% in Canada and 0.09% in Netherlands from 2007-11 to 2012-16.

S. No.	Name of the Country	Number of Papers			Share of Papers		
		2007-11	2012-16	2007-16	2007-11	2012-16	2007-16
1	USA	11476	11262	22738	27.35	25.29	26.29
2	U.K.	4342	4328	8670	10.35	9.72	10.02
3	Germany	3129	2684	5813	7.46	6.03	6.72
4	Japan	2318	2598	4916	5.52	5.84	5.68
5	Italy	2175	2531	4706	5.18	5.68	5.44
6	France	2247	2220	4467	5.35	4.99	5.16
7	Netherlands	2038	2122	4160	4.86	4.77	4.81
8	China	1266	2846	4112	3.02	6.39	4.75
9	Canada	1858	1922	3780	4.43	4.32	4.37
10	Spain	1581	1681	3262	3.77	3.78	3.77
11	India	1243	1821	3064	2.96	4.09	3.54
12	Australia	1023	1307	2330	2.44	2.94	2.69
	Total	34696	37322	72018	82.67	83.82	83.27
	World	41967	44524	86491	100.00	100.0	100.0
	Share of 12 Countries in World Total	82.67	83.82	83.27			

Table 2: Global Publication Share of Top 12 Most Productive Countries in Arthritis Research during 2007-16.

India's International Collaboration: The international collaborative share of India's publications in arthritis research was 10.77% during 2007-16, which increased from 10.38% to 11.04% from 2007-11 to 2012-16. Among foreign countries, USA contributed the largest share of 45.15% to India's international collaborative papers in arthritis research, followed by U.K. (19.70%), France (9.70%), Canada (8.18%), Australia and Japan (8.88%

each), Japan (7.88%), Germany (7.58%), Sweden (7.27%), Netherlands and Saudi Arabia (6.67% each) during 2007-16. The share of international collaborative papers increased by 4.58% in Netherlands, followed by 4.03% in Australia, 3.53% in Germany, 2.75% in Japan, 1.76% in Sweden, 0.71% in Canada and 0.65% in France, as against decrease by 3.30% in U.K. and 0.51% in Saudi Arabia from 2007-11 to 2012-16 (Table 3).

S. No.	Collaborative Country	Number of International Collaborative Papers			Share of International Collaborative Papers		
		2007-11	2012-16	2007-16	2007-11	2012-16	2007-16
1	USA	79	70	149	61.24	34.83	45.15
2	U.K.	28	37	65	21.71	18.41	19.70
3	France	12	20	32	9.30	9.95	9.70
4	Canada	10	17	27	7.75	8.46	8.18
5	Australia	7	19	26	5.43	9.45	7.88
6	Japan	8	18	26	6.20	8.96	7.88
7	Germany	7	18	25	5.43	8.96	7.58
8	Sweden	8	16	24	6.20	7.96	7.27

9	Netherlands	5	17	22	3.88	8.46	6.67
10	Saudi Arabia	9	13	22	6.98	6.47	6.67
	Total	129	201	330	100.00	100.00	100.00

Table 3: The Share of Top 10 Foreign Countries in India's International Collaborative Papers during 2007-16.

Subject-Wise Distribution of Research Output: The global arthritis research output published during 2007-16 is distributed across five sub-fields (as identified in Scopus database classification), with medicine science accounting for the highest publications share (66.09%), followed by pharmacology, toxicology & pharmaceuticals (33.09%), biochemistry, genetics & molecular biology (17.43%), immunology & microbiology (10.18%) and chemistry (3.36%) during 2007-16. The activity index, which computes change in research activity in a discipline over time 2007-11 to 2012-16 (world average activity index of a given subject is taken as 100), witnessed

increase in medicine (from 99.82 to 100.12), pharmacology, toxicology & pharmaceuticals (from 96.27 to 102.55), biochemistry, genetics & molecular biology (from 87.24 to 108.71) and immunology & microbiology (from 94.81 to 103.54), as against decline of research activity in chemistry (from 102.91 to 98.02) from 2007-11 to 2012-16. In terms of citation impact per paper, chemistry tops the list with CPP of 26.66, followed by biochemistry, genetics & molecular biology (12.95), immunology & microbiology (12.80), pharmacology, toxicology & pharmaceuticals (10.06) and medicine (7.78) during 2007-16 (Table 4).

S.No	Subject*	Number of Papers (TP)			Activity Index		TC	CPP	%TP
		2007-11	2012-16	2007-16	2007-11	2012-16	2007-16	2007-16	2007-16
1	Medicine	820	1205	2025	99.82	100.12	15759	7.78	66.09
2	Pharmacology, Toxicology & Pharmaceuticals	396	618	1014	96.27	102.55	10198	10.06	33.09
3	Biochemistry, Genetics & Molecular Biology	189	345	534	87.24	108.71	6915	12.95	17.43
4	Immunology & Microbiology	120	192	312	94.81	103.54	3994	12.80	10.18
5	Chemistry	43	60	103	102.91	98.02	2746	26.66	3.36
	World Output	1243	1821	3064	100.00	100.00			
<ul style="list-style-type: none"> • There is overlapping of literature covered under various subjects 									
TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper									

Table 4: Subject-Wise Breakup of Indian Publications in Arthritis Research during 2007-16.

Type of Arthritis: Among the different types of arthritis research, the largest share of papers (49.35%) were published in rheumatoid arthritis, followed by adjuvant arthritis (10.70%), tuberculosis arthritis (8.39%), osteoarthritis (7.96%), bacterial arthritis (7.83%), lupus arthritis (7.64%), juvenile arthritis (7.60%), psoriatic arthritis (3.85%), hand arthritis (2.84%), polyarthritis (2.81%), gout arthritis (2.74%) and septic arthritis (2.20%) during 2007-16. Except for rheumatoid arthritis,

psoriatic arthritis and septic arthritis, the research activity has declined in all other types of arthritis from 2007-11 to 2012-16. Bacterial arthritis registered the highest citation impact per paper (19.81), followed by osteoarthritis (16.36), lupus arthritis (12.70), tuberculosis arthritis (10.86), adjuvant arthritis (10.48), gout arthritis (9.61), rheumatoid arthritis (9.44), juvenile arthritis (6.25), psoriatic arthritis (5.40), polyarthritis (5.16) and hand arthritis (3.39) during 2007-16 (Table 5).

S.No	Type of Arthritis	No. of Papers			Share of Papers			TC	CPP
		2007-11	2012-16	2007-16	2007-11	2012-16	2007-16		
1	Rheumatoid Arthritis	600	912	1512	48.27	50.08	49.35	14272	9.44
2	Adjuvant Arthritis	147	181	328	11.83	9.94	10.70	3438	10.48
3	Tuberculosis Arthritis	122	135	257	9.81	7.41	8.39	2790	10.86
4	Osteoarthritis	118	126	244	9.49	6.92	7.96	3991	16.36
	Knee	22	26	48	1.77	1.43	1.57		
	Hip	6	6	12	0.48	0.33	0.39		

	Ankle	4	5	9	0.32	0.27	0.29		
5	Bacterial Arthritis	119	121	240	9.57	6.64	7.83	4754	19.81
6	Lupus Arthritis	105	129	234	8.45	7.08	7.64	2972	12.70
7	Juvenile Arthritis	110	123	233	8.85	6.75	7.60	1456	6.25
8	Psoriatic Arthritis	43	75	118	3.46	4.12	3.85	637	5.40
9	Hand Arthritis	36	51	87	2.90	2.80	2.84	295	3.39
10	Polyarthritis	49	37	86	3.94	2.03	2.81	444	5.16
11	Gout Arthritis	43	41	84	3.46	2.25	2.74	807	9.61
12	Septic Arthritis	20	40	60	1.61	2.20	1.96	448	7.47
	Total of India	1243	1821	3064	100.00	100.00	100.00		

Table 5: Types of Arthritis Research as reflected in Indian Output during 2007-16.

Profile of Top 15 Most Productive Indian Organizations:

In Indian arthritis research, the productivity of 15 most productive Indian organizations varied from 27 to 136 publications and together they contributed 27.02% (828) publication share and 44.76% (12237) citation share to its cumulative publications output during 2007-16. The scientometric profile of these 15 organizations is presented in Table 6. Four of these organizations registered publications output greater than the group average of 55.20: All India Institute of Medical Sciences, New Delhi (136 papers), Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow (122 papers), Postgraduate Institute of Medical Education & Research, Chandigarh (112 papers) and Christian Medical College, Vellore (65 papers) during 2007-15. Five organizations registered impact above the group average of 14.78 citations per publication during 2007-16: Chhatrapati Shahuji Maharaj Medical University, Lucknow (38.93), National Institute of Pharmaceutical Education & Research, Mohali (24.85), Postgraduate Institute of Medical Education & Research, Chandigarh (22.73), All India Institute of Medical Sciences, New Delhi (21.33) and Jamia Hamdard University, Delhi (17.6) during 2007-16. Six organizations registered h-index above the group average of 10.93: Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow (22),

All India Institute of Medical Sciences, New Delhi (20), Postgraduate Institute of Medical Education & Research, Chandigarh (18), Jamia Hamdard University, Delhi (13), National Institute of Pharmaceutical Education & Research, Mohali and Punjabi University, Patiala (11 each) during 2007-16. Seven organizations contributed international collaborative publications share above the group average of 11.59%: Christian Medical College, Vellore (23.08%), Jamia Hamdard University, Delhi (21.15%), Nizam's Institute of Medical Sciences, Hyderabad (19.51%), Chhatrapati Shahuji Maharaj Medical University, Lucknow (16.67%), Vellore Institute of Technology, Vellore (12.5%), Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow (12.3%) and Jawaharlal Institute of Postgraduate Medical Education & Research, Pondicherry (11.90%) during 2007-16. Five organizations registered the relative citation index above the group average (1.66) of all organizations: Chhatrapati Shahu Ji Maharaj University, Lucknow (4.36), National Institute of Pharmaceutical Education & Research, Mohali (2.79), Postgraduate Institute of Medical Education & Research, Chandigarh (2.55), All India Institute of Medical Sciences, New Delhi (2.39) and Jamia Hamdard University, Delhi (1.97) during 2007-16

S.No	Name of the Organization	TP	TC	CPP	HI	ICP	%ICP	RCI
1	All India Institute of Medical Sciences (AIIMS), New Delhi	136	2901	21.33	20	13	9.56	2.39
2	Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS), Lucknow	122	1579	12.94	22	15	12.30	1.45
3	Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh	112	2546	22.73	18	12	10.71	2.55
4	Christian Medical College (CMC), Vellore	65	442	6.80	9	15	23.08	0.76
5	Jawaharlal Institute of Postgraduate Medical Education & Research (JIPMER), Pondicherry	42	168	4.00	5	5	11.90	0.45

6	Nizam's Institute of Medical Sciences (NIMS), Hyderabad	41	260	6.34	8	8	19.51	0.71
7	Vellore Institute of Technology (VIT), Vellore	40	361	9.03	10	5	12.50	1.01
8	Punjabi University, Patiala	36	500	13.89	11	0	0.00	1.56
9	Institute of Post Graduate Medical Education & Research (IPGMER), Kolkata	36	273	7.58	8	2	5.56	0.85
10	Jamia Hamdard University, Delhi	52	915	17.60	13	11	21.15	1.97
11	King Edward Memorial Hospital (KEMH), Mumbai	31	291	9.39	10	0	0.00	1.05
12	Medical College & Hospital (MCH), Kolkata	30	117	3.90	7	1	3.33	0.44
13	Chhatrapati Shahu Ji Maharaj University (CSMMU), Lucknow	30	1168	38.93	8	5	16.67	4.36
14	Dr Ram Manhar Lohia Hospital, New Delhi	28	45	1.61	4	1	3.57	0.18
15	National Institute of Pharmaceutical Education & Research (NIPER), Mohali	27	671	24.85	11	3	11.11	2.79
	Total of 15 organizations	828	12237	14.78	10.93	96	11.59	1.66
	Total of India	3064	27338	8.92				
	Share of top 15 organizations in Indian total output	27.02	44.76					
TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper; HI=h-index; ICP=International Collaborative Papers; RCI=Relative Citation Index								

Table 6: Scientometric Profile of Top 15 Most Productive Indian Organization in Arthritis Research during 2007-16.

Profile of Top 15 Most Productive Authors

In the field of Indian arthritis research, the research productivity of top 15 most productive authors varied from 15 to 80 publications. Together they contributed 13.71% (420) global publication share and 17.36% (4747) citation share during 2007-16. The scientometric profile of these 15 authors is presented in Table 7. Four authors registered publications output above the group average of 28.0: A.A. Aggarwal (80 papers), R. Misra (46 papers), V. Agarwal and A. Chopra (34 papers each) during 2007-16. Six authors registered impact above the group average of 11.30 citations per publication: O. Silakari (19.35), A.A. Aggarwal (17.31), A. Chopra (15.24), M. Rasool (15.20), R. Misra (15.13) and R. Gupta (11.31)

during 2007-16. Seven authors registered h-index above the group average of 9.53 of all authors: A.A. Aggarwal (20), O. Silakari (17), R. Misra (15), A. Chopra (12), M. Rasool, A. Kumar and V. Agarwal (10 each) during 2007-16. Nine authors contributed international collaborative publications share above the group average of 8.10% of all authors: A. Kumar (16), A.N. Malaviya (15.79), A. Chopra (14.71), S. Agrawal (13.33), R. Gupta and A. Sharma (12.50% each), M. Rasool (10.0%), A.A. Aggarwal (8.75%) and S. Singh (8.33%) during 2007-16. Five authors registered the relative citation index above the group average (1.27) of all authors: S. Singh (2.17), O. Silakari (1.94), M. Rasool (1.71), A.A. Aggarwal and V. Dhir (1.70) during 2007-16

S.No	Name of the Author	Affiliation of the Author	TP	TC	CPP	HI	ICP	%ICP	RCI
1	A.A. Aggarwal	SGPGIMS, Lucknow	80	1385	17.31	20	7	8.75	1.94
2	R. Misra	SGPGIMS, Lucknow	46	696	15.13	15	3	6.52	1.70
3	V. Agarwal	Govt. Medical College & Hospital, Chandigarh	34	297	8.74	10	1	2.94	0.98
4	A. Chopra	Centre for Rheumatic Diseases, Pune	34	518	15.24	12	5	14.71	1.71
5	D. Danda	CMV, Vellore	28	82	2.93	6	0	0.00	0.33
6	A. Kumar	AIIMS, New Delhi	25	227	9.08	10	4	16.00	1.02
7	A. Sharma	PGIMER, Chandigarh	24	105	4.38	7	3	12.50	0.49
8	S. Singh	PGIMER, Chandigarh	24	130	5.42	8	2	8.33	0.61

S.No	Name of the Author	Affiliation of the Author	TP	TC	CPP	HI	ICP	%ICP	RCI
9	V. Dhir	AIIMS, New Delhi	22	138	6.27	4	0	0.00	0.70
10	M. Rasool	VIT, Vellore	20	304	15.20	10	2	10.00	1.70
11	A.N. Malaviya	Indian Spinal Injury Centre, Delhi	19	104	5.47	6	3	15.79	0.61
12	O. Silakari	Punjabi University, Patiala	17	329	19.35	17	0	0.00	2.17
13	V. Arya	JIPMER, Pondicherry	16	85	5.31	3	0	0.00	0.60
14	R. Gupta	AIIMS, New Delhi	16	181	11.31	9	2	12.50	1.27
15	S. Agrawal	SGPGIMS, Lucknow	15	166	11.07	6	2	13.33	1.24
		Total of 15 authors	420	4747	11.30	9.53	34	8.10	1.27
		Total of India	3064	27338	8.92				
		Share of top 15 authors in Indian total output	13.71	17.36					

TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper; HI=h-index; ICP=International Collaborative Papers; RCI=Relative Citation Index

Table 7: Scientometric Profile of Top 15 Most Productive Authors in Arthritis Research during 2007-16.

Medium of Communication: Of the total Indian output in arthritis research, 98.60% (3021) appeared in journals. The top 15 most productive journals accounted for 24 to 219 papers each in arthritis research and together accounted for 27.61% share (834 papers) of total journal publication output during 2007-16. The publication share of these top 15 most productive journals decreased from 27.94% to 27.38% from 2007-11 and 2012-16. The

top most productive journal (with 219 papers) was *Indian Journal of Rheumatology*, followed by *International Journal of Rheumatic Diseases* (219 papers), *International Journal of Pharmacy & Pharmaceutical Sciences* (67 papers), *International Journal of Pharmaceutical Sciences Review & Research* (57 papers), etc. during 2007-16 (Table 8).

S.No	Name of the Journal	Number of Papers		
		2007-11	2012-16	2007-16
1	Indian Journal of Rheumatology	111	108	219
2	International Journal of Rheumatic Diseases	21	51	72
3	International Journal of Pharmacy & Pharmaceutical Sciences	11	56	67
4	International Journal of Pharmaceutical Sciences Review & Research	17	40	57
5	International Journal of Pharma & Bio Sciences	16	37	53
6	Indian Journal of Pediatrics	21	27	48
7	Rheumatology International	12	33	45
8	Clinical Rheumatology	23	22	45
9	Research Journal of Pharmaceutical, Biological & Chemical Sciences	14	29	43
10	Journal of Dermatology, Venereology & Leprology	18	19	37
11	Journal Clinical & Diagnostic Research	5	32	37
12	Journal of Association of Physicians	18	15	33
13	Asian Journal of Pharmaceutical & Clinical Research	25	4	29
14	BMJ Case Reports	25	0	25
15	Journal of Ethnopharmacology	8	16	24
	Total of 150 journals	345	489	834
	Total global journal output	1235	1786	3021
	Share of top 15 journals in Indian journal output	27.94	27.38	27.61

Table 8: Top 15 Most Productive Journals in Indian Arthritis Research during 2007-16.

Highly Cited Papers: A total of 25 highly cited papers were identified which received citations from 100 to 1112 during 2007-16. These 25 papers together received 6410 citations, which averaged to 256.4 citations per paper. Among these high cited papers, the largest foreign participation was from USA (8 papers), followed by U.K. (6 papers), Netherlands (5 papers), Canada and Germany (4 papers each), Japan, France, Sweden and Saudi Arabia (3 papers each), etc. Among the various Indian organizations involved, Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS), Lucknow accounted for 4 papers, followed by All India Institute of Medical Sciences, New Delhi, Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh and Jamia Hamdard, Delhi (2 papers each), etc. These 25 highly cited papers were published in 22 journals, of which 4 papers were published in *The Lancet* and 1 paper each in *Advanced Drug Delivery Review*, *Asia and Pacific Journal of Tropical Medicine*, *Arthritis Research & Therapy*, *Bioorganic & Medicinal Chemistry*, *Biomaterials*, *Colloids & Surfaces B*, *Current Problems in Cancer*, *Cytokine*, *Current Opinion in Pharmaceuticals*, *Drug Discovery Today*, *European Journal of Medicinal Chemistry*, *European Journal of Pharmaceutical Science*, *International Journal of Nanomedicine*, *Journal of American Medical Association*, *Journal of Rheumatology*, *Journal of Clinical Pharmacology*, *Medicinal Research Review*, *Pharmacological Reports*, *Seminars in Nuclear Medicine*, *Systematic Reviews in Pharmacy* and *Yale Journal of Biology & Medicine*.

Summary & Conclusion

Arthritis research had originated from more than 100 countries, of which the 12 most productive countries in arthritis research accounted for 83.27% global publication share during 2007-16, which increased from 82.67% to 83.82% from 2007-11 to 2012-16. Each of top 12 countries accounted for 2.69% to 26.29% global publication share during 2007-16, with USA accounting for the highest publication share (26.29%, rank 1), followed by U.K. (10.02% share, rank 2), Germany, Japan, Italy and France (from 5.16% to 6.72%, ranks from 3-6), Netherlands, China and Canada (from 4.37% to 4.81%, rank 7-9), Spain, India and Australia (from 2.69% to 3.77%, rank 10-12) during 2007-16. The global publication share in five years increased in China, India, Italy and Australia, Japan and Spain, as against decrease in USA, Germany, U.K., France, Canada and Netherlands from 2007-11 to 2012-16.

India has published 3064 publications in arthritis research during 2007-16, increasing from 167 in the year 2007 to 268 publications in the year 2016, registering a 7.12% growth per annum. The cumulative Indian output in arthritis research increased from 1243 to 1821 publications from 2007-11 to 2012-16, registering 46.50% growth. India's share in global output was 3.54% during 2007-16, which increased from 2.96% to 4.09% from 2007-11 to 2012-16. The average citation impact of Indian publications per paper on arthritis research was 8.92 citations, which decreased from 13.73 to 5.64 from 2007-11 to 2012-16. The international collaborative share of India's publications in arthritis research was 10.77% during 2007-16, which increased from 10.38% to 11.04% from 2007-11 to 2012-16. USA contributed the largest share of 45.15% to India's international collaborative papers in arthritis research, followed by U.K. (19.70%), France (9.70%), Canada (8.18%), Australia and Japan (8.88% each), Japan (7.88%), Germany (7.58%), Sweden (7.27%), Netherlands and Saudi Arabia (6.67% each) during 2007-16. Medicine, among subjects contributed the highest publications share (66.09%) in India's output followed by pharmacology, toxicology & pharmaceuticals (33.09%), biochemistry, genetics & molecular biology (17.43%), immunology & microbiology (10.18%) and chemistry (3.36%) during 2007-16. On classifying arthritis research, it was observed that rheumatoid arthritis contributed the largest share of 49.35%, followed by adjuvant arthritis (10.70%), tuberculosis arthritis (8.39%), osteoarthritis (7.96%), bacterial arthritis (7.83%), lupus arthritis (7.64%), juvenile arthritis (7.60%), psoriatic arthritis (3.85%), hand arthritis (2.84%), polyarthritis (2.81%), gout arthritis (2.74%) and septic arthritis (2.20%) during 2007-16.

The top 15 most productive organizations and authors together contributed 27.02% and 13.71% respectively as their share of global publication output and 44.76% and 17.36% respectively as their share of global citation output during 2007-16. Among the total journal output of 3021 papers (98.06% of total output), the top 15 journals contributed 27.61% share to the global journal output during 2007-16 which decreased from 27.94% to 27.38% from 2007-11 and 2012-16. Only 25 highly cited publications registered citations from 100 to 1112 in arthritis research and they together received 6410 citations, with 256.4 citations per paper. These 25 highly cited papers were published in 22 journals, of which 4 papers were published in *The Lancet* and 1 paper each in 18 other journals.

Conclude that India's share in global output is only 3.54%, which needs to be substantially increased over the year. Its citation impact per paper is 8.92 during 2007-16. The increase in research output and citation impact can be achieved in India by identifying arthritis research as a national priority research area by government funding agencies, increasing the investment in R&D, designing suitable training programs for manpower development and boosting the international collaborative efforts with foreign countries active in research in this area.

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