

## **Inflammatory Bowel Disease Output from India: A Scientometric Assessment of Publications during 2007-18**

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### **Abstract**

The paper examines India's research output on inflammatory bowel disease research on a series of bibliometric indicators. India published a total of 1125 publications in anemia research in 12 years during 2007-18 registering an average annual growth rate of 14.71%, citation impact of 15.02 citations per paper, global publication share of 1.84% and international collaborative publication share of 19.47%. The paper presents the distribution of publications by broad subjects and by type of inflammatory bowel disease. The paper profiles global publication output and share of 15 most productive countries in inflammatory bowel disease, 15 most productive Indian organizations and 15 most productive authors on a series of indicators including publications output, number of citations, the relative citation index, citations per paper, h-index and share of international collaborative papers during 2007-18.

**Keywords:** *Inflammatory Bowel Diseases; Intestinal Disorder; Ulcerative Colitis; Crohn's Disease; Digestive Tract; Indian Publications; Scientometrics; Bibliometrics*

### **Introduction**

Inflammatory bowel disease (IBD) represents a group of intestinal disorders that lead to chronic and prolonged inflammation of the digestive tract [1]. The digestive tract comprises the mouth, esophagus, stomach, small intestine, and large intestine. It's responsible for breaking down food, extracting the nutrients, and removing any unusable material and waste products. Inflammation anywhere along the digestive tract disrupts this normal process. IBD can be very painful and disruptive, and in some cases, it may even be life-threatening [2].

Many diseases are included in this IBD umbrella term. The two most common diseases are UC (Ulcerative colitis and CD (Crohn's disease): (i) Ulcerative colitis- This condition cause long-lasting inflammation and sores (ulcers) in the innermost lining of your large intestine (Colon) and rectum. The damage is mostly superficial and (ii) Crohn's disease - This type is characterized by inflammation of the lining of your digestive tract, which often spreads deep into affected tissues [2]. Some of the differences between Crohn's disease and ulcerative colitis: (i) Crohn's Disease- It can affect any part of the GI tract (from the mouth to the anus)-Most often it affects the portion of the small intestine before the large intestine/colon. It damaged areas appear in patches that are next to areas of healthy tissue. Inflammation may reach through the multiple layers of the walls of the GI tract and (ii) Ulcerative Colitis- It can occur in the large intestine (colon) and the rectum. It damaged areas are continuous (not patchy)- usually starting at the rectum and spreading further into the colon. Inflammation is present only in the innermost layer of the lining of the colon [1,3].

The exact cause of IBD is unknown. However, genetics and problems with the immune system have been associated with IBD. You might be more likely to develop IBD if you have a sibling or parent with the disease. This is why scientists believe IBD may have a genetic component. The immune system may also play a role in IBD. Normally, the immune system defends the body from pathogens (organisms that cause diseases and infections). A bacterial or viral infection of the digestive tract can trigger an immune response. As the body tries to fight off the invaders, the digestive tract becomes inflamed. When the infection is gone, the inflammation goes away [2].

### **Literature Review**

Few scientometric studies are available on inflammatory bowel disease. Azer and Azer [4] identified the top-cited articles in IBD, assessing their characteristics and determining the quality of evidence provided by these articles. Design and outcome measures IBD and related terms were used in searching the Web of Science to identify English language articles. The 50 top-cited articles were analyzed

by year, journal impact factor (JIF), authorship, females in authorship, institute, country and grants received. The level of evidence was determined using the Oxford Centre for Evidence-Based Medicine guidelines. Connelly, Devane, Kelly, Wrafter and Messaris [5] have identified top 100 papers in ulcerative colitis (UC) using citation analysis, which provides a unique insight into the advancement of disease understanding and subsequent treatment innovations that have progressed over time. The Thomson Reuters Web of Knowledge was used to identify the 100 most cited UC manuscripts. Title, first and senior authors, institution and department of first author, journal, and country of origin, year and topic of each manuscript were analyzed. The top 100 manuscripts were published from 1955-2012. Thirty eight percent of the manuscripts originated from the US followed by the UK (26%). Genetics was the topic with the most publications (n = 27), followed by treatment (n = 22) and immunological pathways (n = 17). Truelove had the highest amount of authorships. The institutions with the highest number of publications were St. Mark’s, London and the Radcliffe Infirmary.

### Objectives of the Study

The present study is aimed at making a scientometric assessment of India’s publications on inflammatory bowel disease (IBD) research, indexed in Scopus database during 2007-18. The specific objectives are to study:

- The growth and distribution of world and top 10 countries publications and Indian literature on inflammatory bowel disease, its publication output, its global share and citation impact;
- International collaboration and identification of major collaborators with India;
- The distribution of India’s publication output by broad subject areas and by type of inflammatory bowel disease research;
- The scientometric profile of 10 most productive countries, 15 most productive Indian organizations and 15 most productive Indian authors;
- The leading medium of communication in India and the bibliographic characteristics of its 24 highly cited publications on inflammatory bowel disease research.

### Methodology

The global publications and of the world and of top 10 countries in inflammatory bowel disease research were sourced from Scopus international database (<http://www.scopus.com>) using a keyword “inflammatory bowel disease” or “ulcerative colitis” or “crohn’s disease” for the years 2007 to 2018. The “Keyword” (as shown in the search string below) tags were searched for the keyword restricting the hit to the period 2007-18 in “date range tag”. This statement became the main search string. The main search string was further restricted to 10 countries one by one in “country tag” for obtaining publication information of these countries (as shown below for India). On further restricting India’s main search string (as provided in analytical functions of Scopus database) by “subject area tag”, “country tag”, “source title tag”, “journal title name” and “affiliation tag”, statistics on distribution of publications by subject, collaborating countries, author-wise, organization-wise and journal-wise were obtained. Citations data was obtained from the date of publication till 3 January 2019.

(( KEY ( inflammatory AND bowel AND disease ) AND PUBYEAR > 2006 AND PUBYEAR < 2019 ) OR ( KEY ( ulcerative AND colitis ) AND PUBYEAR > 2006 AND PUBYEAR < 2019 ) OR ( KEY ( crohn’s AND disease ) AND PUBYEAR > 2006 AND PUBYEAR < 2019 ) )  
 ( ( KEY ( inflammatory AND bowel AND disease ) AND PUBYEAR > 2006 AND PUBYEAR < 2019 ) OR ( KEY ( ulcerative AND colitis ) AND PUBYEAR > 2006 AND PUBYEAR < 2019 ) OR ( KEY ( crohn’s AND disease ) AND PUBYEAR > 2006 AND PUBYEAR < 2019 ) ) AND ( LIMIT-TO ( AFFILCOUNTRY, “India” ) )

### Analysis

Inflammatory Bowel Disease research (IBD) consisting of 61188 global and 1125 Indian publications were derived from Scopus database and studied during 12 years (2007-18). The annual and cumulative publication output of world-over and India increased from 3666 and 35 in the year 2007 to 5525 and 124 publications in the year 2018, averaging 4.01% and 14.71% annual growth rate, respectively. The global and Indian cumulative output (computed in 6 years) in inflammatory bowel disease increased from 25616 and 382 (during 2007-12) to 35572 and 743 (during 2013-18), registering 38.87% and 94.50% growth rates, respectively. India’s global share in inflammatory bowel disease research averaged to 1.84% during 2007-18, which increased from 1.49% during 2007-12 to 2.09% during 2013-18. On measuring impact of publications in terms of citations per paper, it was observed Indian publications on inflammatory bowel disease averaged to 15.02 citations per publication (CPP) during 2007-18, which decreased from 25.47 CPP during 2007-12 to 9.64 CPP during 2013-18 (Table 1). Of the total Indian publications output, 65.23% (735) was published as articles, 23.29% (262) as reviews, 5.51% (62) as letters, 1.96% (22) as notes, 1.69% (19) as editorials, 0.71% (8) as book chapters and conference papers, 0.44% (5) as short surveys and 0.36% (4) as articles in press.

Period	World	India					
	TP	TP	TC	CPP	%TP	ICP	%ICP
2007	3666	35	1389	39.69	0.95	6	17.14
2008	3929	36	701	19.47	0.92	3	8.33
2009	4078	57	1468	25.75	1.40	7	12.28
2010	4467	60	2684	44.73	1.34	12	20.00
2011	4612	102	2197	21.54	2.21	14	13.73
2012	4864	92	1292	14.04	1.89	13	14.13
2013	5549	107	1401	13.09	1.93	18	16.82
2014	5963	120	1885	15.71	2.01	18	15.00
2015	6023	117	1734	14.82	1.94	25	21.37
2016	6182	126	718	5.70	2.04	33	26.19
2017	6330	149	1295	8.69	2.35	38	25.50
2018	5525	124	128	1.03	2.24	32	25.81
2007-12	25616	382	9731	25.47	1.49	55	14.40
2013-18	35572	743	7161	9.64	2.09	164	22.07
2007-18	61188	1125	16892	15.02	1.84	219	19.47

**Table 1:** India and World on Inflammatory Bowel Disease Research: Annual and Cumulative Publications Output during 2007-18.

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

**International collaboration**

19.47% of the total research output by India in Inflammatory Bowel Disease was published as international collaborative papers during 2007-18. India’s collaborative output increased from 14.40% during 2007-12 to 22.07% during 2013-18. The leading foreign countries that collaborated with India in Inflammatory Bowel Disease research were: USA (45.66% publication share), followed by U.K. (21.46%), Canada and Japan (10.96% each), Australia (10.05%), China (9.13%), Germany (8.68%), France and Saudi Arabia (7.76% each) 2007-18. India’s international collaborative publications share showed increase in USA, Japan, China, France and Saudi Arabia (from 5.51% to 9.91%), as against decrease in U.K, Canada, Australia and Germany (from 0.55% to 7.76%) during 2007-12 to 2013-18 (Table 2).

S. No	Collaborative Country	Number of ICP			Share of ICP		
		2007-12	2013-18	2007-18	2007-12	2013-18	2007-18
1	USA	21	79	100	38.18	48.17	45.66
2	U.K.	15	32	47	27.27	19.51	21.46
3	Canada	9	15	24	16.36	9.15	10.96
4	Japan	3	21	24	5.45	12.80	10.96
5	Australia	6	16	22	10.91	9.76	10.05
6	China	2	18	20	3.64	10.98	9.13
7	Germany	5	14	19	9.09	8.54	8.68
8	France	2	15	17	3.64	9.15	7.76
9	Saudi Arabia	2	15	17	3.64	9.15	7.76
	Indian Total	55	164	219			

**Table 2:** Publication Share of Leading Foreign Countries in India’s Collaborative Papers (ICP)

Output in Inflammatory Bowel Disease Research during 2007-18.

ICP: International Collaborative Papers.

**Most productive countries in global inflammatory bowel disease**

The global inflammatory bowel disease research witnessed the participation of 155 countries during 2007-18, of which 71 countries contributed 1 - 10 papers each, 27 countries 11 - 40 papers each, 11 countries 41 - 100 papers each, 18 countries 101 - 500 papers each, 10 countries 501 - 1000 papers each, 17 countries 1001 - 5000 papers each, 1 country each 5001 - 10,000 papers and 17511 papers. However, the top 15 countries together alone accounted for 94.96% global publication share during 2007-18, which showed increase from 89.97% during 2007-12 to 98.55% during 2013-18. Individually, the top 10 countries publications ranged from 497 to 17511 and accounted for 1.86% to 28.62% of global publication share during 2008-17. USA, among top countries, accounted for the largest publication share (28.62%), followed by U.K (9.52%), Italy and Germany (7.26% and 7.05%), China (6.81%), Canada, Japan and France (from 5.10% to 5.80%), Spain (4.25%), Netherlands and Australia (3.63% and 3.05%), Belgium (2.48%) and Switzerland, South Korea and Poland (from 1.86% to 1.99%) during 2007-18. Nine countries which showed increase in their global publication share in six years (from 0.18% to 4.78%) were: USA, Italy, China, Canada, France, Netherlands, Australia, Belgium, Switzerland and South Korea, as against only five countries, namely U.K., Germany, Japan, Spain and Poland showing decrease in their global publication share (from 0.17% to 1.43%) from 2007-12 to 2013-18.

S. No	Name of the Country	Number of Papers			Share of Papers		
		2007-12	2013-18	2007-18	2007-12	2013-18	2007-18
1	USA	7059	10452	17511	27.56	29.38	28.62
2	U.K.	2554	3270	5824	9.97	9.19	9.52
3	Italy	1763	2682	4445	6.88	7.54	7.26
4	Germany	2017	2294	4311	7.87	6.45	7.05
5	China	1034	3135	4169	4.04	8.81	6.81
6	Canada	1399	2147	3546	5.46	6.04	5.80
7	Japan	1496	1954	3450	5.84	5.49	5.64
8	France	1235	1888	3123	4.82	5.31	5.10
9	Spain	1114	1488	2602	4.35	4.18	4.25
10	Netherlands	846	1377	2223	3.30	3.87	3.63
11	Australia	653	1216	1869	2.55	3.42	3.05
12	Belgium	607	913	1520	2.37	2.57	2.48
13	Switzerland	483	733	1216	1.89	2.06	1.99
14	South Korea	290	864	1154	1.13	2.43	1.89
15	Poland	497	643	1140	1.94	1.81	1.86
	Total	23047	35056	58103	89.97	98.55	94.96
	World Total	25616	35572	61188			
	Share of 20 Countries in World Total	89.97	98.55	94.96			

**Table 3:** Publication Output and Global Publication Share (%) of Top 15 Most Productive Countries in Inflammatory Bowel Disease during 2007-18.

**Subject-wise distribution of Indian research papers**

Global inflammatory bowel disease output from India published during 2007-18 was classified under four broad subjects (as defined by Scopus database). Medicine accounted for the largest publication share (65.16%) and immunology and microbiology (8.09%) for the least. The activity index showed increase in publication activity in medicine, biochemistry, genetics and molecular biology and immunology and microbiology, as against decline in pharmacology, toxicology and pharmaceuticals from 2008-12 to 2013-17. The average value of activity index is 100. Biochemistry, genetics and molecular biology registered the highest citation of 24.59 per paper and pharmacology, toxicology and pharmaceuticals registered the least citation impact (12.86 per paper) during 2007-18 (Table 4).

S. No	Subject*	Number of Papers (TP)			Activity Index		TC	CPP	%TP
		2007-12	2013-18	2007-18	2007-12	2013-18			
1	Medicine	240	493	733	96.43	101.84	9603	13.10	65.16
2	Pharmacology, Toxicology and Pharmaceutics	120	213	333	106.13	44.00	4283	12.86	29.60
3	Biochemistry, Genetics and Molecular Biology	80	175	255	92.39	36.15	6271	24.59	22.67
4	Immunology and Microbiology	24	67	91	77.67	13.84	1316	14.46	8.09
	Total	382	743	1125					

**Table 4:** Subject-Wise Breakup of India’s Publications on Global Inflammatory Bowel Disease Research during 2007-18.

\*: There is overlapping of literature covered under various subjects

TP: Total Papers; TC: Total Citations; CPP: Citations Per Paper.

**Distribution of Indian papers by types of inflammatory bowel disease**

Crohn’s disease, among the type of bowel diseases, registered the largest publication share (56.52%) in Indian output compared to Ulcerative colitis (24.19%) during 2008-17. Ulcerative colitis Indian publications registered higher global publication share (3.92%) than Crohn’s disease (1.41%). Similarly, Ulcerative colitis Indian publications registered the highest citation impact (19.09 citations per paper), compared to Crohn’s disease (18.60 citations per paper) during 2007-18 (Table 5).

S. No	Type of Anemia	Global	India				
		GTP	TP	TC	CPP	%GTP	%TP
1	Ulcerative Colitis	14803	581	11094	19.09	3.92	24.19
2	Crohn’s Disease	34583	489	9097	18.60	1.41	56.52
	Total of India	61188	1125	16892	15.02	1.84	

**Table 5:** Distribution of India’s Publications by Type of Inflammatory Bowel Disease during 2007-18.

GTP: Global Total Papers, TP: Total Papers; TC: Total Citations; CPP: Citations Per Paper; ICP: International Collaborative Papers.

**Top 15 most productive Indian organizations contribution and impact**

Four Hundred Thirty Three organizations (433) participated in Indian Inflammatory Bowel Disease research, of which 359 organizations contributed 1 - 5 papers each, 55 organizations 6 - 10 papers each, 16 organizations 11 - 30 papers each, 1 organization each 44, 61 and 118 papers each.

The 15 most productive organizations together contributed 470 publications (41.78% share) and 11833 citations (70.05% share) in India’s output and citations during 2007-18. Individually the top 15 organizations contribution varied from 12 to 118 in 12 years. Only three organizations registered productivity rate above the group average of 31.33 per organization: All India Institute of Medical Sciences, New Delhi (118 papers), Postgraduate Institute of Medical Education and Research, Chandigarh (61 papers) and Christian Medical College, Vellore (44 papers). Only five organizations registered citation impact and relative citation index above the group average of 25.18 citations per publication and 1.68: University of Delhi (75.79 and 5.05), Dayanand Medical and Hospital, Ludhiana (57.36 and 3.82), Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow (38.87 and 2.59), Christian Medical College, Vellore (33.91 and 2.26) and Dr Harisingh Gour University, Sagar (25.33 and 1.69). Six organizations registered international collaborative publications above the group average of 21.70%: University of Delhi (57.89%), Dayanand Medical and Hospital, Ludhiana (50.0%), Asian Institute of Gastroenterology, Hyderabad (42.11%), Christian Medical College (CMC), Vellore (40.91%) and Kasturba Medical College, Manipal (29.17%) and Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow (26.67%) (Table 6).

S. No	Name of the Organization	TP	TC	CPP	HI	ICP	%ICP	RCI
1	All India Institute of Medical Sciences (AIIMS), New Delhi	118	2609	22.11	24	22	18.64	1.47
2	Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh	61	1360	22.30	14	9	14.75	1.48
3	Christian Medical College (CMC), Vellore	44	1492	33.91	17	18	40.91	2.26
4	Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPIMS), Lucknow	30	1166	38.87	13	8	26.67	2.59
5	Bharati Vidyapeeth University, Pune	26	395	15.19	12	0	0.00	1.01
6	Poona College of Pharmacy	25	340	13.60	12	0	0.00	0.91
7	Kasturba Medical College (KMC), Manipal	24	278	11.58	8	7	29.17	0.77
8	Dayanand Medical and Hospital, Ludhiana	22	1262	57.36	22	11	50.00	3.82
9	Manipal Academy of Higher Education (MAHE), Manipal	20	158	7.90	6	3	15.00	0.53
10	Asian Institute of Gastroenterology, Hyderabad	19	401	21.11	8	8	42.11	1.41
11	P.D. Hinduja National Hospital and Medical Centre, Mumbai	19	213	11.21	7	2	10.53	0.75
12	University of Delhi	19	1440	75.79	10	11	57.89	5.05
13	Jawaharlal Nehru University, New Delhi	19	287	15.11	9	2	10.53	1.01
14	Panjab University, Chandigarh	12	128	10.67	6	1	8.33	0.71
15	Dr Harisingh Gour University, Sagar	12	304	25.33	6	0	0.00	1.69
	Total of 15 organizations	470	11833	25.18	11.6	102	21.70	1.68
	Total of India	1125	16892	15.02				
	Share of top 15 organizations in India total output	41.78	70.05					

**Table 6:** Scientometric profile of top 15 most Indian productive organizations on inflammatory bowel disease research during 2007-18.

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

**Top 15 most productive Indian authors contribution and impact**

Five Hundred Nineteen (519) authors participated in Indian Inflammatory Bowel Disease research, of which 429 authors contributed 1 - 5 papers each, 46 authors 6 - 10 papers each, 27 authors 11 - 20 papers each and 7 authors 21 - 38 papers each. The top 15 most productive authors contributed 13 to 74 papers each, and together they contributed 364 papers (32.36%) and received 6110 citations (36.17%) during 2004-17.

- Five authors registered publication productivity above the group average of 24.27: V. Ahuja (74 papers), G.K. Makharia (38 papers), S. Kedia (36 papers), G. Makharia (28 papers) and A. Sood (25 papers).
- Four authors registered impact and relative citation index above the group average of 16.79 citations per publication and 1.12: V. Midha (51.47 and 3.43), A. Sood (51.12 and 3.40), G.K. Makharia (24.97 and 1.66) and B.S. Ramakrishna (17.88 and 1.19).
- Seven authors registered international collaborative publications (ICP) share more than the average ICP share (25.0%): R. Banerjee (53.85%), A. Sood (48.0%), V. Midha (41.18%), B.S. Ramakrishna (33.33%), S. Bopanna (30.43%), S. Kedia (27.78%) and G.K. Makharia (26.32%).

**Distribution of publications by source and channel of communication**

Of the 1125 publications by India in Inflammatory Bowel Disease research, 99.02% (1114) appeared in journals and the rest as books (0.44%), book series (0.27%), conference proceedings (0.18%) and trade publications (0.09%) during 2007-18. The 1114 journal papers were published in 211 journals, of which 172 journals published 1 - 5 papers each, 23 journals 6 - 10 papers each, 14 journals 11 - 20 papers each, and 2 journals 21 - 60 papers each.

The top 15 most productive journals (with contributions from 11 to 60 papers) together contributed 264 publications (27.70% share of total journal output) during 2007-18. The cumulative six year journal publication output reported in 15 journals increased from 21.58% during 2007-12 to 24.80% during 2013-18. The leading journals contributing to Indian research in Inflammatory Bowel Disease research are listed in table 8. *Indian Journal of Gastroenterology* published the largest number of papers (60 publications), followed by *Digestive Diseases and Sciences* (25 publications), *Journal of Gastroenterology and Hepatology Australia and Intestinal Research* (20 publications each), *BMJ Case Reports* and *PLOS One* (14 publications each), etc. during 2007-18 (Table 8).



S. No	Name of the author	Affiliation of the author	TP	TC	CPP	HI	ICP	%ICP	RCI
1	V. Ahuja	All India Institute of Medical Sciences, New Delhi	74	1093	14.77	18	15	20.27	0.98
2	G.K. Makharia	All India Institute of Medical Sciences, New Delhi	38	949	24.97	17	10	26.32	1.66
3	S. Kedia	All India Institute of Medical Sciences, New Delhi	36	153	4.25	7	10	27.78	0.28
4	G. Makharia	All India Institute of Medical Sciences, New Delhi	28	170	6.07	6	6	21.43	0.40
5	A. Sood	Dayanand Medical and Hospital, Ludhiana	25	1278	51.12	12	12	48.00	3.40
6	B.S. Ramakrishna	Christian Medical College, Vellore	24	429	17.88	12	8	33.33	1.19
7	S. Bopanna	All India Institute of Medical Sciences, New Delhi	23	68	2.96	5	7	30.43	0.20
8	V. Midha	Dayanand Medical and Hospital, Ludhiana	17	875	51.47	9	7	41.18	3.43
9	P. Das	All India Institute of Medical Sciences, New Delhi	16	193	12.06	5	0	0.00	0.80
10	U.C. Ghosh	Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow	15	219	14.60	9	3	20.00	0.97
11	J. Paul	Jawaharlal Nehru University, New Delhi	15	210	14.00	8	0	0.00	0.93
12	R. Dhingra	All India Institute of Medical Sciences, New Delhi	14	113	8.07	6	3	21.43	0.54
13	P. Abraham	P.D. Hinduja National Hospital and Medical Centre, Mumbai	13	104	8.00	6	1	7.69	0.53
14	R. Banerjee	Asian Institute of Gastroenterology, Hyderabad	13	90	6.92	5	7	53.85	0.46
15	D. Desai	P.D. Hinduja National Hospital and Medical Centre, Mumbai	13	166	12.77	6	2	15.38	0.85
		Total of 15 authors	364	6110	16.79	8.73	91	25.00	1.12
		Total of India	1125	16892	15.02				
		Share of 15 authors in India's total	32.36	36.17					

**Table 7:** Scientometric profile of top 15 most productive Indian authors in inflammatory bower disease research during 2007-18.

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

S. No	Name of the Journal	Number of Papers		
		2007-12	2013-18	2007-18
1	Indian Journal of Gastroenterology	24	36	60
2	Digestive Diseases and Sciences	10	15	25
3	Journal of Gastroenterology and Hepatology Australia	9	11	20
4	World Journal of Gastroenterology	6	14	20
5	Intestinal Research	0	15	15
6	BMJ Case Reports	2	12	14
7	PLOS One	0	14	14
8	Alimentary Pharmacology and Therapeutics	4	9	13
9	Asian Journal of Pharmacology and Clinical Research	4	9	13
10	Indian Journal of Dermatology, Venenology and Leprology	4	9	13
11	Indian Journal of Dermatology	6	6	12
12	Indian Journal of Medical Research	7	5	12
13	Indian Journal of Pharmacology	5	6	11
14	International Immuno-pharmacology	1	10	11
15	Journal of Clinical and Diagnostic Research	0	11	11
	Total of 15 journals	82	182	264
	Indian total output	380	734	1114
	Share of top 15 journals in Indian journal output	21.58	24.80	23.70

**Table 8:** Top 15 most productive journals reporting output from Indian scholars in inflammatory bowel disease research during 2007-18.

### Highly cited papers

Out of 1125 papers from Indian scholars published, there were 24 highly cited papers having received citations from 100 to 1643 citations per paper (13 in 100-199 citations range each, 7 in 200 - 399 citations range, 3 in 400 - 500 citations range and 1 paper with 1643 citations. during 2008-17. Of the 24 high cited papers (10 articles and 14 reviews), 10 were published without any institutional collaboration and 16 involved national and international institutional collaboration (6 national collaborative and 10 international collaborative). Together these 54 papers accounted for 6448 citations, averaging 268.67 citations per paper. 47 Indian organizations participating in these 24 highly cited papers include All India Institute of Medical Sciences, New Delhi (4 papers), University of Delhi and Dayanand Medical College and Hospital (3 papers each), etc. The 24 highly cited papers had the participations of 1380 authors and 1111 organizations and were published in 20 journals, of which 3 were published in the Lancet and 1 paper each in other journals.

## Findings and Conclusion

### Findings

The global inflammatory bowel disease worldwide originated in 155 countries during 2007-18. The 94.969% of total global publication share, however, has come from 15 most productive countries during 2007-18, which showed increase from 89.97% during 2007-12 to 98.55% during 2013-18. USA, among top 15 countries, accounted for the highest publication share (28.62%), followed by U.K (9.52%), Italy and Germany (7.26% and 7.05%), China (6.81%), Canada, Japan and France (from 5.10% to 5.80%), Spain (4.25%), Netherlands and Australia (3.63% and 3.05%), Belgium (2.48%) and Switzerland, South Korea and Poland (from 1.86% to 1.99%) during 2007-18.

India had published 1125 publications in inflammatory bowel disease during 2007-18, which showed increase from 35 in the year 2007 to 124 in the year 2018, averaging 14.71% annual growth rate. India's share in the global publication output on inflammatory bowel disease was 1.84% during 2007-18, which showed increase from 1.49% during 2007-12 to 2.09% during 2013-18. India's publications impact on inflammatory bowel disease averaged to 15.02 citations per publication (CPP) during 2007-18, which dropped from 25.47 CPP during 2007-12 to 9.64 CPP during 2013-18. The share of India's international collaborative papers was 19.47% during 2008-17, which showed increase from 14.40% during 2007-12 to 22.07% during 2013-18. Medicine registered the highest publications share (65.16 and immunology and microbiology (8.09%) for the least) during 2007-18.

433 organizations and 519 authors participated in inflammatory bowel disease. The 15 most leading organizations and authors together contributed 41.78% and 32.36% as their share of Indian publication output and 70.05% and 36.17% as their share of Indian citation output respectively during 2007-18. Indian organizations showing comparatively higher productivity in inflammatory bowel disease were: All India Institute of Medical Sciences, New Delhi (118 papers), Postgraduate Institute of Medical Education and Research, Chandigarh (61 papers) and Christian Medical College, Vellore (44 papers) during 2007-18. Indian organizations showing comparatively higher citation impact per paper and relative citation index were: University of Delhi (75.79 and 5.05), Dayanand Medical and Hospital, Ludhiana (57.36 and 3.82), Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow (38.87 and 2.59), Christian Medical College, Vellore (33.91 and 2.26) and Dr Harisingh Gour University, Sagar (25.33 and 1.69) during 2007-18.

Indian authors showing comparatively higher productivity in inflammatory bowel disease research were: V. Ahuja (74 papers), G.K. Makharia (38 papers), S. Kedia (36 papers), G. Makharia (28 papers) and A. Sood (25 papers) during 2007-18. Similarly, Indian authors showing with comparatively higher citation impact per paper and relative citation index were: K.V. Midha (51.47 and 3.43), A. Sood (51.12 and 3.40), G.K. Makharia (24.97 and 1.66) and B.S. Ramakrishna (17.88 and 1.19) during 2007-18.

Of the 1125 Indian publications on inflammatory bowel disease, 1114 appeared in 211 journals. The 15 most productive journals contributed 27.70% share to the Indian journal publication output during 2007-18. The publication share in five years from top 15 journals increased from 21.58% during 2007-12 to 24.80% during 2013-18. The leading journals contributing to India's inflammatory bowel disease were: *Indian Journal of Gastroenterology* (60 papers), followed by *Digestive Diseases and Sciences* (25 publications), *Journal of Gastroenterology and Hepatology Australia* and *Intestinal Research* (20 publications each), *BMJ Case Reports* and *PLOS One* (14 publications each), etc. during 2007-18

Only 24 highly cited papers, out of output of 1125 publications on inflammatory bowel disease research from India received from 100 to 1643 citations per paper during 2007-18. These 24 highly cited papers together received 6488 citations, averaging to 268.67 citations per paper.



## Conclusion

The inflammatory bowel diseases (IBDs) are contemporary conditions of industrialized societies. The prevalence of IBD continues to increase steadily in Western countries, and newly industrialized countries have a rapidly increasing incidence. The global spread of IBD appears to associate with Westernization of diets and environments, which affects the intestinal micro biome and increases the risk of IBD in genetically susceptible individuals. It is important to increase our understanding of these events to slow progression of IBD. There is the need for research into prevention of inflammatory bowel disease and innovations in health-care systems to manage this complex and costly disease.

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