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Literature Review

Pancreatic Cancer Research in India: A Scientometric Assessment of Publications during 2007-16

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Abstract

The present study examined 1168 Indian pancreatic cancer research publications, as indexed in Scopus database during 2007-16, with a view to understand their growth rate, global share, citation impact, international collaborative papers, distribution of publications by broad subjects, productivity and citation profile of top organizations and authors, preferred media of communication and characteristics of high cited papers. The Indian publications registered an annual average growth rate of 14.19%, global share of 2.08%, international collaborative publications share of 26.71% and its citation impact averaged to 19.27 citations per paper. Among broad subjects, medicine contributed the largest publications share of 70.0% in Indian pancreatic cancer output, followed by biochemistry, genetics and molecular biology (32.19%), pharmacology, toxicology and pharmaceutics (16.72%), etc. during 2007-16. Among various organizations and authors contributing to Indian pancreatic cancer research, the top 20 organizations and authors together contributed 43.07% and 26.28% respectively as their share of Indian publication output and 66.98% and 33.13% respectively as their share of Indian citation output during 2007-16. Among 1148 journal papers in Indian pancreatic cancer research, the top 20 journals registered 27.79% share during 2007-16. There were only top 26 highly cited publications, which registered citations from 101 to 4502 during 2007-16 and they together received 10366 citations, which averaged to 370.21 citations per paper. There is a urgent need to increase the publication output, improve research quality and improve international collaboration. Indian government also needs to come up with a policy for identification, screening, diagnosis and treatment of pancreas cancer patients, besides curriculum reform in teaching, capacity building, patient education and political support are badly needed.

Keywords: *Pancreas Research; Indian Publications; Scientometrics; Bibliometrics*

Introduction

The pancreas is an organ which sits deep in the abdomen that sits in front of the spine above the level of the belly button and is in close proximity to many important structures such as the small intestine (the duodenum) and the bile ducts, as well as important blood vessels and nerves. There are two kinds of cells in the pancreas. Exocrine cells make enzymes that are released into the small intestine to help the body digest food. Neuroendocrine pancreas cells (such as islet cells) make several hormones, including insulin and glucagon that help control sugar levels in the blood. Enzymes leave the pancreas via a system of tubes called "ducts" that connect the pancreas to the intestines where the enzymes mix with ingested food [1-3].

Pancreatic cancer arises when cells in the pancreas, a glandular organ behind the stomach, begin to multiply out of control and form a mass. These cancerous cells have the ability to invade other parts of the body. There are two types of pancreatic cancer: (1) cancers of

the endocrine pancreas are called 0"islet cell" or "pancreatic neuroendocrine tumors or PNETs" and (2) cancers of the exocrine pancreas. Islet cell cancers are rare and typically grow slowly compared to exocrine pancreatic cancers. Islet cell tumors often release hormones into the bloodstream and are further characterized by the hormones they produce (insulin, glucagon, gastrin, and other hormones). Cancers of the exocrine pancreas (exocrine cancers) develop from the cells that line the system of ducts that deliver enzymes to the small intestine and are commonly referred to as pancreatic adenocarcinomas. Squamous cell pancreatic cancer is rare. Adenocarcinoma of the pancreas comprises most all pancreatic ductal cancers, accounts for about 85% of cases. Several other types of cancer, which collectively represent the majority of the non-adenocarcinomas, can also arise from these cells. One to two percent of cases of pancreatic cancer are neuroendocrine tumors, which arise from the hormone-producing cells of the pancreas. These are generally less aggressive than pancreatic adenocarcinoma [1-3].

Pancreatic cancer is considered to be one of leading causes of cancer deaths in advanced countries and it is on rise in developing countries like India. The global prevalence rate of pancreatic cancer is 1 per 100, 000 people per year. The incidence of pancreatic cancer in India is low (0.5 - 2.4 per 100,000 in men and 0.2 - 1.8 per 100,000 in women). The incidence of pancreatic cancer is higher in urban male population of Western and northern parts of India. In Aizwal, Mizoram, prevalence rate of pancreatic cancer is 2.3 per 100,000, a very high. Although there are no specific studies about causes of pancreatic cancer, doctors blame it on sedimentary lifestyle, smoking and consumption of high alcohol [4,5].

Literature Review

In the past, no specific study had been undertaken on the bibliometric assessment of pancreatic cancer research both a national and international level. However, few studies have been undertaken on bibliometric assessment of over national cancer research output at national level as well as national cancer research output of different sites. Among studies on overall national cancer output, Patra and Bhattacharya [6] made an assessment of world and Indian oncology research output during 1987-2003, using PubMed database, mainly focusing on growth trends and explored the application and application of bibliometric laws, besides identifying significant Indian organizations. Lewison and Roe [7] assessed Indian cancer output during 1990-2010, focusing on growth, research impact, international collaboration, output by geographical areas, types of research and cancer site, source of funding, etc.

A number of studies have been undertaken which made bibliometric assessment of India's output in the areas such as breast cancer [8], cervical cancer [9], colorectal cancer [10], gall bladder [11], lung cancer [12], lymphoma cancer [13], mouth cancer [14], oral cancer [15], prostate cancer [16] and stomach cancer [17] covering different periods. These publications focus on aspects such as growth of world and Indian output, citations impact, international collaborative share, distribution of output by broad subject areas and by treatment methods, productivity and citation impact of leading organizations and authors, leading media of communication, etc.

Objectives

The present manuscript aims to study the various dimensions of Indian pancreatic cancer research output in terms of various bibliometric indicators, based on publications and citation data, derived from Scopus database during 2007-16. In particular, the study analyzed overall annual and cumulative growth of Indian publications, its global share among top 12 most productive countries, its citation impact, its international collaborative papers share, publication output distribution by broad sub-fields, productivity and citation impact of most productive organizations and authors, leading media of communications and characteristics of top highly cited papers.

Methodology

For the present study, the publication data was retrieved and downloaded from the Scopus database (http://www.scopus.com) on pancreatic cancer research during 2007-16. A main search strategy for global output was formulated, where the keyword such as ("pancreas*'') and keywords ("cancer" OR "carcinoma" or ''neoplasm'') were searched together in the "keyword tag" or "Article Title Tag" and further limited the search output to period '2007-16' within "date range tag" and India in "country tag". This search strategy generated

1168 Indian publications on pancreatic cancer from the Scopus database. Detailed analysis was carried out on 1168 Indian publications using the analytical provisions or tags existing in Scopus database such as "subject area tag", "country tag", "source title tag", "journal title name" and "affiliation tag", to get data distribution 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 29 September 2017. A number of select raw (such as number of papers and international collaborative papers, number of citations, citations per paper) and relative (activity index, relative citation index) bibliometric indicators were used to further analyze the dynamics of India's pancreatic cancer research output from different perspective (KEY (pancrea*) OR TITLE (pancrea*) AND KEY (cancer OR carcinoma OR neoplasm) OR TITLE (cancer OR carcinoma OR neoplasm)) AND PUBYEAR > 2006 AND PUBYEAR < 2017 AND (LIMIT-TO (AFFILCOUNTRY, "India")).

Analysis

The global and Indian research output in pancreatic cancer research cumulated to 56263 and 1168 publications in 10 years during 2007-16 and they increased from 3039 and 53 in the year 2007 to 6601 and 160 publications in the year 2016, registering 9.75% and 14.19% growth per annum. Their five-year cumulative output increased from 23123 and 384 to 33140 and 784 publications from 2007-11 to 2012-16, registering 43.32% and 104.17% growth respectively. The share of Indian publications in global output was 2.08% during 2007-16, which increased from 1.66% to 2.77% from 2007-11 to 2012-16. Amongst Indian publications on pancreatic cancer, 65.24% (762) was published as articles, 21.32% (249) as reviews, 6.34% (74) as letters, 2.05% (24) as notes, 1.71% (20) as conference papers and editorials, 0.68% (8) as short surveys, 0.51%(6) as book chapters and 0.43% (5) as erratum. The research impact as measured by citations per paper registered by Indian publications in pancreatic cancer averaged to 19.27 citations per publication (CPP) during 2007-16; five-yearly impact averaged to 23.86 CPP for the period 2007-11 which declined to 17.02 CPP in the succeeding five-year 2012-16 (Table 1).

Publication Period	World	India					
	TP	TP	TC	CPP	ICP	%ICP	%TP
2007	3039	53	2064	38.94	13	24.53	1.74
2008	4442	63	1399	22.21	15	23.81	1.42
2009	4913	68	1539	22.63	19	27.94	1.38
2010	5206	82	2022	24.66	21	25.61	1.58
2011	5523	118	2137	18.11	32	27.12	2.14
2012	6160	127	1978	15.57	46	36.22	2.06
2013	6649	159	2190	13.77	42	26.42	2.39
2014	6782	153	1410	9.22	54	35.29	2.26
2015	6948	185	7323	39.58	42	22.70	2.66
2016	6601	160	444	2.78	28	17.50	2.42
2007-11	23123	384	9161	23.86	100	26.04	1.66
2012-16	33140	784	13345	17.02	212	27.04	2.37
2007-16	56263	1168	22506	19.27	312	26.71	2.08

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

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

Publication Profile of Top 12 Most Productive Countries

More than 50 countries of the world participated in global research in pancreatic cancer research during 2007-16. Between 1280 and 20032 publications were contributed by top 12 most productive countries in pancreas cancer research and they together accounted for

96.39% of global publication share during 2007-16. Their five-year publications output increased from 95.92% to 96.72% from 2007-11 to 2016. Each of top 12 countries had global publication share between 2.28% and 35.60% during 2007-16. USA accounted for the highest publication share (35.60%), followed by Japan and China (11.67% and 10.96% share), Germany (8.20%), Italy and U.K. (6.26% and 6.21%), France (4.21%), Spain, South Korea, Canada, Netherlands and India (from 1.28% to 2.98%) during 2007-16. Their five-year global publication share have increased by 6.11% in China, followed by India (1.04%), South Korea (0.77%), Italy (0.36%) and Netherlands (0.02%), as against decline by 2.35% in USA, 2.16% in Germany, 1.37% in Japan, 1.05% in U.K., 0.45% in Spain, 0.07% in France and 0.05% in Canada from 2007-11 to 2012-16 (Table 2).

S. No	Country Name	TP			%TP		
		2007-11	2012-16	2007-16	2007-11	2012-16	2007-16
1	USA	8553	11479	20032	36.99	34.64	35.60
2	Japan	2884	3680	6564	12.47	11.10	11.67
3	China	1702	4465	6167	7.36	13.47	10.96
4	Germany	2190	2422	4612	9.47	7.31	8.20
5	Italy	1397	2123	3520	6.04	6.41	6.26
6	U.K.	1580	1915	3495	6.83	5.78	6.21
7	France	984	1386	2370	4.26	4.18	4.21
8	Spain	752	927	1679	3.25	2.80	2.98
9	South Korea	580	1086	1666	2.51	3.28	2.96
10	Canada	650	916	1566	2.81	2.76	2.78
11	Netherlands	523	757	1280	2.26	2.28	2.28
12	India	384	896	1280	1.66	2.70	2.28
	Total of 12 Countries	22179	32052	54231	95.92	96.72	96.39
	World Output	23123	33140	56263			
	Share of Top 12 in World Output	8553	11479	20032	36.99	34.64	35.60

Table 2: *Global Publication Output and Share of Top 15 Countries in Pancreatic Cancer Research during 2007-16.*

India's International Collaboration

The share of India's international collaborative publications (ICP) in its national output in pancreatic cancer research was 26.71% during 2007-16, which increased from 26.04% during 2007-11 to 27.04% during 2012-16. About 67 foreign countries collaborated with India in 312 pancreatic cancer research papers during 2007-16. These 312 papers together registered 15242 citations, with 48.85 citations per paper. USA, among foreign countries, contributed the largest share (65.06%) to India's international collaborative papers in pancreatic cancer research, followed by Japan (16.35%), U.K. (11.22%), Australia and Germany (8.97% each), Italy (7.05%), France (6.41%), Canada, Saudi Arabia and Spain (5.13% each) during 2007-16. The share of ICP increased by 9.15% in U.K., followed by 7.87% in Japan, 5.96% in Italy, 5.85% in Germany, 4.60% each in Canada and Saudi Arabia, 4.51% in USA, 3.13% in Spain, 2.08% in France, as against decrease by 1.51% in Australia 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	62	141	203	62.00	66.51	65.06
2	Japan	11	40	51	11.00	18.87	16.35
3	U.K.	5	30	35	5.00	14.15	11.22
4	Australia	10	18	28	10.00	8.49	8.97
5	Germany	5	23	28	5.00	10.85	8.97
6	Italy	3	19	22	3.00	8.96	7.05
7	France	5	15	20	5.00	7.08	6.41
8	Canada	2	14	16	2.00	6.60	5.13
9	Saudi Arabia	2	14	16	2.00	6.60	5.13
10	Spain	3	13	16	3.00	6.13	5.13
	Total	100	212	312	100.00	100.00	100.00

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

Subject-Wise Distribution of Indian Research Output

As per the Scopus database classification, India's pancreatic cancer research output is distributed across six sub-fields during 2007-16. Among sub-fields, medicine registered the highest publications share (70.00%), followed by biochemistry, genetics and molecular biology (32.19%), pharmacology, toxicology and pharmaceutics (16.72%), chemistry (5.0%), agricultural and biological sciences (1.88%) and immunology and microbiology (1.64%) during 2007-16. The publication activity, as seen through activity index from 2007-11 to 2012-16, witnessed increase in biochemistry, genetics and molecular biology (from 99.51 to 100.21), pharmacology, toxicology and pharmaceutics (from 82.55 to 107.48), chemistry (from 83.33 to 107.14), as against decrease in medicine (from 115.33 to 93.43), agricultural and biological sciences (from 138.89 to 83.33) and immunology and microbiology (from 126.98 to 88.44) from 2007-11 to 2012-16. In terms of citation impact per paper, agricultural and biological sciences, among sub-fields, registered the highest CPP of 31.21, followed biochemistry, genetics and molecular biology (30.69), chemistry (20.19), medicine (19.0), pharmacology, toxicology and pharmaceutics (17.44)), and immunology and microbiology (17.19) 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	310	586	896	115.33	93.43	17021	19.00	70.00
2	Biochemistry, Genetics and Molecular Biology	123	289	412	99.51	100.21	12645	30.69	32.19
3	Pharmacology, Toxicology and Pharmaceutics	53	161	214	82.55	107.48	3732	17.44	16.72
4	Chemistry	16	48	64	83.33	107.14	1292	20.19	5.00
5	Agricultural and Biological Sciences	10	14	24	138.89	83.33	749	31.21	1.88
6	Immunology and Microbiology	8	13	21	126.98	88.44	361	17.19	1.64
	World Output	384	896	1280					

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

- *There is overlapping of literature covered under various subjects*

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

Indian Pancreatic Cancer Output by Treatment Methods

On classifying Indian pancreatic cancer output by treatment methods, it was observed that diagnosis registered the highest publication share of 24.06%, followed by surgery (19.14%), chemotherapy (15.55%), pathology (15.0%), prognosis (11.80%), etc. during 2007-16. The publication share has increased by 7.66% in pathology, 1.93% in genetics, 1.82% in screening and 1.23% in prognosis, as against decrease by 7.25% in surgery, 6.18% in diagnosis, 2.31% in radiotherapy, 1.97% in chemotherapy, 0.74% in palliative care, 0.52% in epidemiology and 0.48% n quality of life from 2007-11 to 2012-16. Prognosis, amongst treatment methods, registered the highest citation impact per paper of 42.79, followed by diagnosis (23.98), genetics (22.85), palliative care (21.0), screening (16.43), chemotherapy (15.15), epidemiology (13.73), radiotherapy (13.46), etc (Table 5).

S. No.	Name of Treatment Method	Number of Papers			Share of Papers			TC	CPP
		2007-11	2012-16	2007-16	2007-11	2012-16	2007-16		
1	Chemotherapy	65	134	199	16.93	14.96	15.55	3014	15.15
2	Diagnosis	109	199	308	28.39	22.21	24.06	7385	23.98
3	Epidemiology	8	14	22	2.08	1.56	1.72	302	13.73
4	Genetics	17	57	74	4.43	6.36	5.78	1691	22.85
5	Palliative Care	8	12	20	2.08	1.34	1.56	420	21.00
6	Pathology	37	155	192	9.64	17.30	15.00	2197	11.44
7	Prognosis	42	109	151	10.94	12.17	11.80	6462	42.79
8	Quality of Life	7	12	19	1.82	1.34	1.48	58	3.05
9	Radiotherapy	29	47	76	7.55	5.25	5.94	1023	13.46
10	Screening	20	63	83	5.21	7.03	6.48	1364	16.43
11	Surgery	93	152	245	24.22	16.96	19.14	2712	11.07
	Total of India	65	134	199	16.93	14.96			

Table 5: *Distribution of Indian Pancreatic Cancer Research Papers by Treatment Method, 2007-16.*

TC: Total Citations; CPP: Citations Per Paper

Significant Keywords

Around 60 significant keywords have been identified from the literature, which highlight possible research trends in Indian pancreatic cancer research. These keywords are listed in table 6 in the decreasing order of their frequency of occurrence in 10 years during 2007-16.

S. No.	Name of Keyword	Frequency	S. No.	Name of Keyword	Frequency
1	Pancreatic cancer	523	31	Pancreas adenocarcinoma	81
2	Pancreatic neoplasm	385	32	Cancer surgery	80
3	Computer-assisted tomography	229	33	Prognosis	79
4	Histopathology	209	34	Cancer cell	77
5	Breast cancer	201	35	Liver cancer	76
6	Human tissues	201	36	Pancreas resection	76
7	Pancreas tumour	168	37	Endoscopic echography	75
8	Antineoplastic activity	167	38	Computer X-ray tomography	73
9	Pathology	159	39	Chronic pancreatitis	72
10	Neoplasms	147	40	Gene expression	70
11	Apoptosis	146	41	Melanoma	66
12	Pancreaticoduodenectomy	146	42	NMR imaging	67
13	Prostate cancer	146	43	Genetics	64
14	Lung cancer	135	44	Oesophagus cancer	63
15	Pancreas	131	45	Lymphoma	61
16	Tumour cell line	125	46	Drug targeting	60
17	Immunohistochemistry	121	47	Leukemia	58
18	Abdominal pain	115	48	Liver cell carcinoma	58
19	Pancreatitis	113	49	Drug mechanism	57
20	Colon cancer	109	50	Laparotomy	56
21	Ovary cancer	106	51	Carcinogenesis	56
22	Colorectal cancer	104	52	Cur cumin	56
23	Signal transduction	104	53	Neuroendocrine tumor	56
24	Pancreas carcinoma	102	54	Cancer diagnosis	54
25	Drug efficacy	99	55	Acute pancreatitis	53
26	Stomach cancer	95	56	Cancer radiotherapy	51
27	Echography	93	57	Tumor markers	51
28	Adenocarcinoma	90	58	Drug structure	51
29	Metastasis	84	59	Drug synthesis	51
30	Cancer chemotherapy	81	60	Drug delivery systems	48

Table 6: *List of Significant Keywords in Literature on Indian Pancreatic Cancer Research during 2007-16.*

Profile of Top 20 Most Productive Indian Organizations

The top 20 Indian organizations contribution to pancreatic cancer research varied from 11 to 78 publications and they together accounted for 43.07% (503) publication share and 66.98% (15075) citation share to its cumulative publications output during 2007-16. Table 7 presents a scientometric profile of these 20 India organizations.

S. No.	Name of the Organization	TP	TC	CPP	HI	ICP	%ICP	RCI
1	Tata Memorial Hospital (TMH), Bombay	78	5720	73.33	14	27	34.62	3.81
2	All India Institute of Medical Sciences (AIIMS), New Delhi	77	2322	30.16	16	15	19.48	1.56
3	Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh	63	2097	33.29	16	11	17.46	1.73
4	Institute of Liver and Biliary Sciences(ILBS), New Delhi	30	595	19.83	13	19	63.33	1.03
5	Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS), Lucknow	26	249	9.58	8	3	11.54	0.50
6	Christian Medical College (CMC), Vellore	20	170	8.50	5	5	25.00	0.44
7	Asian Institute of Gastroenterology, Hyderabad	20	358	17.90	11	5	25.00	0.93
8	Indian Institute of Integrated Medicine, Srinagar	20	125	6.25	8	2	10.00	0.32
9	University of Delhi	18	116	6.44	9	9	50.00	0.33
10	Banaras Hindu University	19	124	6.53	9	9	47.37	0.34
11	Maulana Azad Medical College (MAMC), Delhi	17	153	9.00	7	2	11.76	0.47
12	Sir Ganga Ram Hospital, New Delhi	17	158	9.29	6	2	11.76	0.48
13	Amrita Institute of Medical Sciences, Coimbatore	15	188	12.53	7	1	6.67	0.65
14	Bhabha Atomic Research Center (BARC), Bombay	14	1618	115.57	6	4	28.57	6.00
15	G.B. Pant Hospital, Delhi	13	81	6.23	7	0	0.00	0.32
16	Jamia Hamdard, Delhi	12	259	21.58	7	2	16.67	1.12
17	SASTRA University	11	223	20.27	9	6	54.55	1.05
18	Sher-I-Kashmir Institute of Medical Sciences, Srinagar	11	45	4.09	4	1	9.09	0.21
19	Manipal University	11	260	23.64	5	7	63.64	1.23
20	Indian Institute of Chemical Technology (IICT), Hyderabad	11	214	19.45	6	5	45.45	1.01
	Total of 20 organizations	503	15075	29.97	8.65	135	26.84	1.56
	Total of India	1168	22506	19.27				
	Share of top 20 organizations in Indian total output	43.07	66.98					

Table 7: *Scientometric Profile of Top 20 Most Productive Indian Organizations in Pancreatic Cancer Research during 2007-16.*

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

- Five organizations registered higher productivity than the group average of 25.15: TMH-Bombay (78 papers), AIIMS-New Delhi (78 papers), PGIMER-Chandigarh (63 papers), ILBS -New Delhi (30 papers) and SGPGIMS–Lucknow (26 papers) during 2007-16.
- Four organizations registered higher citation impact than group average of 29.97 citations per publication: BARC-Bombay (115.57), TMH-Bombay (73.33), PGIMER-Chandigarh (33.29) and AIIMS-New Delhi (30.16) during 2007-16.

- Eight organizations registered higher h-index than group average of 8.65: PGIMER – Chandigarh and AIIMS-New Delhi (16 each), TMH-Bombay (14), ILBS-New Delhi (13), AIG-Hyderabad (11),
- SASTRA University, Banaras Hindu University and University of Delhi (9 each) during 2007-16.
- Eight organizations achieved higher international collaborative publications share than group average of 26.84%: Manipal University (63.6%), ILBS - New Delhi (63.33%), SASTRA University (54.55%), University of Delhi (50.0%), Banaras Hindu University(47.37%), IICT-Hyderabad (45.45%), TMH-Bombay (34.62%) and BARC-Bombay (28.57%) during 2007-16.
- Three organizations registered higher relative citation index than group average (1.56): BARC-Bombay (6.0), TMH-Bombay (3.81) and PGIMER-Chandigarh (1.73) during 2007-16.

Profile of Top 20 Most Productive Authors

The top 20 Indian author's contribution to pancreatic cancer research varied from 9 to 40 publications and they together accounted for 26.28% (307) publication share and 33.13% (7456) citation share to its cumulative publications output during 2007-16. Table 8 presents a scientometric profile of these 20 India authors.

S. No.	Name	Affiliation	TP	TC	CPP	HI	ICP	%ICP	RCI
1	S. V. Shrikhande	TMH-Bombay	40	989	24.73	13	18	45.00	1.28
2	V. Bhatia	ILBS-New Delhi	23	739	32.13	13	21	91.30	1.67
3	S. Phadhye	Dr DY Patil University, Pune	26	1514	58.23	18	26	100.00	3.02
4	R. Gupta	Asian Institute of Gastroenterology, Hyderabad	19	331	17.42	8	0	0.00	0.90
5	P. J. Shukla	TMH-Bombay	19	221	11.63	8	7	36.84	0.60
6	S. G. Barreto	TMH-Bombay	19	221	11.63	8	7	36.84	0.60
7	C. Bal	AIIMS-New Delhi	14	181	12.93	7	0	0.00	0.67
8	D. K. Bhasin	PGIMER-Chandigarh	16	174	10.88	6	2	12.50	0.56
9	S. Lakhtakia	Asian Institute of Gastroenterology, Hyderabad	12	290	24.17	8	3	25.00	1.25
10	B. R. Mittal	PGIMER-Chandigarh	12	71	5.92	5	0	0.00	0.31
11	S. S. Rana	PGIMER-Chandigarh	12	95	7.92	6	1	8.33	0.41
12	P. Sharma	AIIMS-New Delhi	12	222	18.50	8	0	0.00	0.96
13	M. Goel	TMH-Bombay	11	115	10.45	4	2	18.18	0.54
14	R. Kumar	AIIMS-New Delhi	11	125	11.36	5	2	18.18	0.59
15	A. Maitra	University of Delhi	11	1084	98.55	10	11	100.00	5.11
16	A. Malhotra	AIIMS-New Delhi	11	171	15.55	7	0	0.00	0.81
17	D. N. Reddy	Asian Institute of Gastroenterology, Hyderabad	11	268	24.36	7	1	9.09	1.26
18	S. Srinivasan	PGIMER-Chandigarh	10	181	18.10	8	4	40.00	0.94
19	A. Chaudhary	Sir Ganga Ram Hospital, New Delhi	9	66	7.33	5	0	0.00	0.38
20	A. Pandey	Institute of Bioinformatics, Bangalore	9	398	44.22	8	9	100.00	2.29
	Total of 20 authors		307	7456	24.29	8.1	114	37.13	1.26
	Total of India		1168	22506	19.27				
	Share of 20 authors in India's output		26.28	33.13					

Table 8: *Scientometric Profile of Top 20 Most Productive Authors in Pancreatic Cancer Research during 2007-16*

- Eight authors registered higher publications productivity than group average of 15.35: SV Shrikhande (40 papers), S Phadhye (26 papers), V Bhatia (23 papers), R Gupta, PJ Shukla and SG Barreto (19 papers each) during 2007-16.
- Six authors registered higher citation impact than the group average of 24.29 citations per publication: A Maitra (98.55), S Phadhye (58.23), A Pandey (44.22), V Bhatia (32.13), SV Shrikhande (24.73) and DN Reddy (24.36) during 2007-16.
- Four authors registered higher h-index than group average of 8.1: S Phadhye (18), V Bhatia and SV Shrikhande (13 each) and A Maitra (10) during 2007-16.

- Six authors achieved higher international collaborative publications share than the group average of 37.13% of all authors: S Phadhye, A Maitra and A Pandey (100.0%), V Bhatia (91.30%), SV Shrikhande (45.0%), and S Srinivasan (40.0%) during 2007-16.

- Five authors registered higher relative citation index than the group average of 1.26: A Maitra (5.11), S Phadhye (3.02), A Pandey (2.29), V Bhatia (1.67) and SV Shrikhande (1.28) during 2007-16.

Medium of Communication

Among India's pancreatic cancer output, 98.29% (1148) appeared in journals, 0.77% (8) in book series, 0.60% (7) in conference proceedings and 0.34% (4) as books. The top 20 most productive journals accounted for 9 to 48 papers. The top 20 journals publishing Indian papers in pancreatic cancer together accounted for 27.79% share (319 papers) of total Indian journal publication output during 2007-16, decreasing from 28.61% during 2007-111 to 27.38% during 2012-16. *Journal of Pancreas was* the most productive journals each with 48 papers each, followed by *Indian Journal of Cancer* (24 papers), *Indian Journal of Gastroenterology and Journal of Clinical and Diagnostic Research* (22 papers each), *Indian Journal of Surgical Oncology* and *Journal of Cancer Research and Therapeutics* (18 papers each), etc. during 2007-16 (Table 9).

S. No.	Name of the Journal	Number of Papers		
		2007-11	2012-16	2007-16
1	Journal of Pancreas	32	16	48
2	Indian Journal of Cancer	12	12	24
3	Indian Journal of Gastroenterology	7	15	22
4	Journal of Clinical and Diagnostic Research	3	19	22
5	Indian Journal of Surgical Oncology	2	16	18
6	Journal of Cancer Research and Therapeutics	4	14	18
7	Indian Journal of Pathology and Microbiology	9	8	17
8	Indian Journal of Surgery	6	11	17
9	PLOS One	5	10	15
10	Endoscopy	5	9	14
11	Hepatobiliary and Pancreatic Disease International	9	4	13
12	Pancreatology	3	9	12
13	Indian Journal of Nuclear Medicine	1	10	11
14	Tumor Biology	0	11	11
15	BMJ Case Reports	0	10	10
16	Cancer Letters	1	9	10
17	Journal of Gastroenterology and Hepatology Australia	6	4	10
18	Anticancer Agents in Medicinal Chemistry	0	9	9
19	Clinical and Nuclear Medicine	0	9	9
20	Gastrointestinal Endoscopy	4	5	9
	Total of 20 journals	109	210	319
	Total Indian journal output	381	767	1148
	Share of 20 journals in Indian journal output	28.61	27.38	27.79

Table 9: *Productivity of Top 20 Most Productive Journals in Indian Pancreatic Cancer Research during 2007-16.*

Characteristics of Highly Cited Papers

Twenty eight even papers receiving 100 or more citations in Indian pancreatic cancer research output were identified and are assumed as high cited papers:

- These 28 papers received citations from 101 to 4502 (with 20 papers in citation range from 101-175, 5 papers in citation range from 203-296, 3 papers in citation range from 571 to 4502) during 2007-16 and together registered 10366 citations, which averaged to 370.21 citations per paper.
- Amongst 28 high cited papers, 23 were articles, 4 reviews and 1 short survey;
- Among 28 high cited papers, 5 do not involve any collaboration and 23 involve collaboration (all 23 international collaborative);
- Among 47 foreign countries participating in these 28 high cited papers, USA contributed the largest (16 papers), followed by Japan (5 papers), France and Germany (4 papers each), U.K., Spain and China (3 papers each), Turkey and Italy (2 papers each) and all other countries 1 paper each;
- The 28 high cited papers involve the participation of 977 authors and 613 organizations.
- Thirty six Indian organizations are participating in these 26 high cited papers, with 4 papers by Tata Memorial Hospital, Mumbai, 3 papers by Dr D.Y. Patil University, Pune, 2 paper each by All India Institute of Medical Sciences, New Delhi, Institute of Bioinformatics, Bangalore and Abeda Inamdar Senior College, Pune, 1 paper each by Center for Disease Control, New Delhi, Center for DNA Fingerprinting and Diagnostics, Hyderabad, IICT-Hyderabad, IITR-Lucknow, Indian Institute of Public Health, New Delhi and Gurgaon, Institute of Life Sciences, Bhubaneshwar, International Institute of Population Sciences, Bombay, ISI-Kolkata, Institute of Liver and Billary Sciences, New Delhi, PGIMER-Chandigarh, Sekhsaria Institute of Public Health, Bombay, University of Delhi, University of Hyderabad, Jadavpur University, Kolkata, King George Medical University, Lucknow, Manipal University, MS University of Baroda, Vadodara, Shri Ramachandra University, Chennai, SNDT Women's University, Bombay, Visvabharti University, Shantiniketan, Amala Cancer Research Centre, Trissur, Kerala, Fortis Christian Medical College, Ludhiana, Escorts Hospital, Jaipur, Janakpuri Superspeciality Hospital, New Delhi, Suraj Eye Hospital, New Delhi, Public Health Foundation of India, New Delhi and Voluntary Health Services, Sneha, Chennai.
- The 26 highly cited papers were published in 24 journals, with 2 papers each in *Cancer Research* and *Proceeding of the National Academy of Sciences of United States*, and 1 paper each in *American Journal of Surgery, Annals of the New York Academy, Annals of Surgical Oncology, Biomaterials, Cancer Cell, Cell, Chinese Medicine, Current Problems in Cancer, Current Pharmacological Design, Endoscopy, European Journal of Pharmacology, International Journal of Cancer, Journal of American College of Surgeons, Journal of Gastroenterology, Journal of Nano-biotechnology, The Lancet, The Lancet Oncology, Medicinal Research Review, Microbial Technology, Molecular Cancer Therapeutics, PLOS One, PLOS Medicine, Silence* and *Surgery (United States).*

Summary and Conclusion

1168 Indian publications in pancreatic cancer research as indexed in Scopus database, was published during 2007-16 and they increased from 53 to 160 in the year to the year 2016, registering 14.19% growth per annum. Their cumulative Indian output increased from 384 to 784, witnessing 104.17% growth from 2007-11 to 2012-16. India's global publications share in pancreatic cancer research was only 2.08% during 2007-16, witnessing increase from 1.66% to 2.77% from 2007-11 to 2012-16. The citation impact per paper of Indian publications on pancreatic research was averaged to 19.27 citations, however, decreasing from 23.86 during 2006-11 to 17.02 during 2012-16.

The share of India's international collaborative publications in pancreatic cancer research was 26.71% during 2007-16, showing increase from 26.04% during 2007-11 to 27.04% during 2012-16. USA in India's international collaborative papers, contributed the largest

publications share of 65.06%, followed by Japan (16.35%), U.K. (11.22%), Australia and Germany (8.97% each), Italy (7.05%), France (6.41%), Canada, Saudi Arabia and Spain (5.13% each) during 2007-16.

Medicine, among sub-fields contributed the highest publications share (70.0%), followed by biochemistry, genetics and molecular biology (32.19%), pharmacology, toxicology and pharmaceutics (16.72%) chemistry (5.0%), agricultural and biological sciences (1.88%) and immunology and microbiology (1.64%) during 2007-16. The research activities, as reflected in activity index, showed increase in biochemistry, genetics and molecular biology, pharmacology, toxicology and pharmaceutics and chemistry, as against decrease in medicine, agricultural and biological sciences and immunology and microbiology from 2007-11 to 2012-16.

Among leading organizations and authors participating in India's pancreatic cancer research, the top 20 organizations and authors together contributed 43.07% and 26.28% respectively as their share of Indian publication output and 66.98% and 33.13% respectively as their share of Indian citation output during 2007-16. The leading organizations in research productivity were: TMH-Bombay (78 papers), AIIMS-New Delhi (77 papers), PGIMER-Chandigarh (63 papers), ILBS-New Delhi (30 papers), SGPGIMS- Lucknow (26 papers), etc. The leading organizations in terms of citation impact per paper were: BARC-Bombay (115.57), TMH-Bombay (73.33), PGIMER-Chandigarh (33.29) and AIIMS-New Delhi (30.16) during 2007-16. The leading authors in publication productivity were SV Shrikhande (40 papers), S Phadhye (26 papers), V Bhatia (23 papers), R Gupta, PJ Shukla and SG Barreto (19 papers each) during 2007-16. The leading authors in terms of research impact were A Maitra (98.55), S Phadhye (58.23), A Pandey (44.22), V Bhatia (32.13), SV Shrikhande (24.73) and DN Reddy (24.36) during 2007-16.

Among the total journal output of 1148 papers, the top 20 journals publishing Indian papers in pancreatic cancer together accounted for 27.79% share of total Indian journal publication output during 2007-16. Among journals contributing to Indian pancreatic cancer research, *Journal of Pancreas* was the most productive journals each with 48 papers each, followed by *Indian Journal of Cancer* (24 papers), *Indian Journal of Gastroenterology* and *Journal of Clinical and Diagnostic Research* (22 papers each), *Indian Journal of Surgical Oncology* and *Journal of Cancer Research and Therapeutics* (18 papers each), etc. during 2007-16.

The 26 highly cited publications individually received citations varying from 101 to 4502 in Indian pancreatic cancer research and together these papers received 10366 citations, with 370.21 citations per paper. The 28 high cited papers involve the participation of 977 authors and 613 organizations and were published in published in 24 journals, with 2 papers each in *Cancer Research* and *Proceeding of the National Academy of Sciences of United States* and 1 paper each in other journals.

Concludes that pancreatic cancer research have been a neglected subspecialty in India, both in teaching and research. There is an urgent need to increase the publication output, improve research quality and improve international collaboration. With higher patient coming for treatment and shortage of trained pancreas specialists are some of the challenges that confront pancreas research at the national level. To address the problems with pancreas research in India, Indian government needs to come up with a policy for identification, screening, diagnosis and treatment of pancreas cancer patients, besides curriculum reform in teaching, capacity building, patient education and political support are badly needed.

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