

**Stomach Cancer Research: A Scientometric Study of Indian Publications during 2005-14**

Ritu Gupta\*, B.M.Gupta\* and Madhu Bansal\*\*\*

\*Sri Venkateshwara University, Tirupati 517 502  
ritu7648@gmail.com\*\*1173 Sector 15, Panchkula 134 113, Haryana,  
[bmgupta1@yahoo.com](mailto:bmgupta1@yahoo.com)\*\*\*Panjab University, Department of Mathematics Library, Chandigarh 160014  
[madhu@pu.ac.in](mailto:madhu@pu.ac.in) (Corresponding Author)**Abstract**

The paper examines 1310 Indian publications on stomach cancer research, as covered in Scopus database during 2005-14, experiencing an annual average growth rate of 15.47% and citation impact of 3.17. The world stomach cancer output (61788 publications during 2005-14) came from several countries, of which the largest global publication share (31.65%) came from China, followed by USA (18.06% share), Japan, (16.42%), U.K. (6.91% share), Germany (5.20% share), Italy (4.72%), France (4.436%), Canada, South Korea and Spain (from 2.06% to 2.56% share), Netherlands, India, Taiwan, Australia and Turkey (from 1.50% to 1.84% share) during 2005-14. India's global publication share was 1.74% and hold 12<sup>th</sup> rank in global output during 2005-14. India's international collaborative publications share in stomach cancer was 17.25% during 2005-14, which decreased from 19.49% to 17.15% from 2005-09 to 2010-14. Medicine, among subjects, contributed the largest publication share (65.34%), followed by biochemistry, genetics & molecular biology (29.69%), pharmacology, toxicology & pharmaceuticals (26.03%), agricultural & biological sciences (3.66% share) and immunology & microbiology (3.28% share) during 2005-14. Adenocarcinoma, among different types of stomach cancer, contributed the largest publication share (16.26%), followed by lymphoma (11.07%), Squamous Cell Carcinoma (4.81%), Sarcoma (3.89%), Small Cell Carcinoma (3.82%), Gastrointestinal Stromal Tumor (3.74%) and Carcinoid Tumor (1.37%) during 2005-14. Diagnosis, surgery, chemotherapy, pathology and screening among treatment methods together accounted for 56.26% share of the total publication output on stomach cancer during 2005-14. Delhi, Uttar Pradesh, Maharashtra and Karnataka together accounted for 51.9% of the country output during 2005-14. The most productive 15 Indian organizations, 10 authors and top 15 journals in stomach cancer accounted for 30.0%, 10.15% and 22.82% share in the cumulative publications output of India in stomach cancer research during 2005-14. The 15 high cited papers (receiving 100 or more citations) on stomach cancer registered an average citation per paper of 149.13. Of the 15 high cited papers (7 reviews and 8 articles), 6 involve the participation of single organization and 4 nationally collaborative and 5

international collaborative publications. These 15 high cited papers involve 85 authors and 43 organizations and they were published in 14 different journals

**Keywords:** Stomach or gastric cancer, publications, India, Scientometrics, Bibliometrics

## 0 Introduction

Stomach or gastric cancer is a disease in which malignant (cancer) cells form in the lining of the stomach. The stomach is a J-shaped organ in the upper abdomen. It is part of the digestive system, which processes nutrients (vitamins, minerals, carbohydrates, fats, proteins, and water) in foods that are eaten and helps pass waste material out of the body. Food moves from the throat to the stomach through a hollow, muscular tube called the esophagus. After leaving the stomach, partly-digested food passes into the small intestine and then into the large intestine. The wall of the stomach is made up of 3 layers of tissue: the mucosal (innermost) layer, the muscularis (middle) layer, and the serosal (outermost) layer. Gastric cancer begins in the cells lining the mucosal layer and spreads through the outer layers as it grows. Risk factors for gastric cancer include the following: (i) Having any of the following medical conditions: (a) Helicobacter pylori (H. pylori) infection of the stomach, (b) Chronic gastritis (inflammation of the stomach), (iii) Pernicious anemia, (iv) Intestinal metaplasia (a condition in which the normal stomach lining is replaced with the cells that line the intestines), (v) Familial adenomatous polyposis (FAP) or gastric polyps, (vi) Eating a diet high in salted, smoked foods and low in fruits and vegetables; (vii) Eating foods that have not been prepared or stored properly, (viii) Being older or male, (ix) Smoking cigarettes and (x) Having a mother, father, sister, or brother who has had stomach cancer[1].

Different types of stomach cancer include: (i) Adenocarcinoma- About 90% to 95% of cancers of the stomach are adenocarcinomas. When the term stomach cancer or gastric cancer is used, it almost always refers to an adenocarcinoma. These cancers develop from the cells that form the innermost lining of the stomach (known as the mucosa), (ii) Lymphoma- These are cancers of the immune system tissue that are sometimes found in the wall of the stomach. About 4% of stomach cancers are lymphomas. The treatment and outlook depend on the type of lymphoma. These are rare tumors that start in very early forms of cells in the wall of the stomach

called interstitial cells of Cajal. Some of these tumors are non-cancerous (benign); others are cancerous. Although GISTs can be found anywhere in the digestive tract, most are found in the stomach. Most of these tumors do not spread to other organs. About 3% of stomach cancers are carcinoid tumors. These tumors are discussed in more detail in *Gastrointestinal Carcinoid Tumors* and (v) Other cancers - Other types of cancer, such as squamous cell carcinoma, small cell carcinoma, and leiomyosarcoma, can also start in the stomach, but these cancers are very rare[2].

Almost one million new cases of stomach cancer were estimated to have occurred in 2012 (952,000 cases, 6.8% of the total), making it the fifth common malignancy in the world, after cancers in the lung, breast, colorectum and prostate. More than 70% of the cases (677,000 cases) occur in developing countries (456,000 in men and 221,000 in women) and half of the world total occurs in Eastern Asia (mainly in China). In China and India, the estimated number of cases in 2012 was (283,000 and 43,000) in men and (122,000 and 20,000) in women. Age standardized incidence rates are about twice as high in men as in women, ranging from 3.3 in Western Africa to 35.4 in Eastern Asia for men, and from 2.6 in Western Africa to 13.8 in Eastern Asia for women. Stomach cancer is the third leading cause of deaths in both sexes worldwide (723,000 deaths, 8.8% of the total). The highest estimated mortality are in Eastern Asia (24 per 10,000 in men, 9.8 per 10,000 in women), the lowest in Northern America (2.8 and 1.5 respectively). High mortality rates are also present in both sexes in Central and Eastern Europe and in Central and South America. The estimated number of mortality deaths in China and India in 2012 was: 221,000 and 41,000 in men and 104,000 and 18,000 in women [3]

## **1 Literature Review**

Few studies have been published in the past assessing the research output on gastric or stomach cancer. Among such studies, Powell, Hughes, Whear and Lewis [4] analyzed of 100 most cited manuscripts in the field of gastric cancer (GC) and these 100 most cited papers were further analysed by topic, journal, author, year and institution. Lunet, Carvalho and Barros [5] analysed major determinant for publication of stomach cancer research during 1992-2003 as covered in MEDLINE database by Portuguese authors. The authors characterize articles addressing gastric adenocarcinoma or the respective precancerous lesions published by Portuguese researchers, according to the study subjects and authors' affiliation. It was found that the high proportion of

studies on genetics/molecular biology is in contrast with the scarce number of published works addressing the etiological role of environmental exposu. Lunet, Carvalho and Barros [6] assessed the trends in the proportion of articles on gastric cancer published in major cancer journals, the research fields of interest, and the first author's affiliation. The proportion of stomach cancer articles was largely below the expected share considering the frequency of malignancies, and did not reflect the geography of biomedical publications. A trend was observed favoring the evaluation of genetic factors. Biglu, Somi, Ghojzadeh and Tabataei [7] analyzed data on gastric cancer in Iran which consisted of 1826 documents in Scopus and 468 in Medline databases. Tehran University of Medical Sciences with production of 35.17 percent of documents in Scopus database and 27.35 percent of documents in the Medline database was identified as most active centers in this field .In both of these databases, Asian Pacific Journal of Cancer Prevention includes most Iranian documents in this field. Conclusions. Ghojzadeh, Naghavi-Behzad et al [8] investigated the status of science production (121 articles) by Iranian scientists in the gastric cancer field based on the Medline database during 2000-2011. Articles of this field were published in 19 countries and 56 journals. Tehran University of Medical Sciences and Mohammadreza Zali had the most outstanding role in publishing scientific articles.

## **2 Objectives**

The main objectives of this study are to study the performance of Indian research in stomach cancer during 2005-14, based on publications covered in Scopus database. In particular, the study focuses on the following objectives: (i) To study the growth of world and Indian research output and the citation impact of the Indian research output; (ii) To study the global publication share of top 15 most productive countries and the place of India in global output; (iii) To study the international collaboration share of Indian publications and the contribution of leading foreign countries in India's collaborative output; (iv) To study the distribution of Indian research output by broad subject areas and study their growth and decline; (v) To study the Indian stomach cancer output by treatment methods and their distribution by geographical areas; (vi) To study the publication productivity and citation impact of 15 most productive organizations and authors; (vii) To study the medium of communication; and (vii) To study the characteristics of high cited papers

### 3 Methodology

The study retrieved and downloaded the publication data of the world and of 15 most productive countries in stomach cancer from the Scopus database (<http://www.scopus.com>) for 10 years during 2005-14. A number of keywords, such as “stomach or gastric” and “cancer or neoplasm or carcinoma” were used in “title, abstract and keyword” tag and restricting it to the period 2005-14 in “date range tag” was used for searching the global publication data and this become the main search string. When the main search string with restricted to 15 most productive countries in “country tag”, as shown below, the publication data on 15 productive countries were obtained. When the main search string is further restricted to “subject area tag”, “country tag”, “source title tag”, “journal title name” and “affiliation tag”, we got information on distribution of publications by subject, collaborating countries and organization-wise, etc. For citation data, the three years, two years, one year citation window was used for publications during 2005-12, 2013 and 2014. In addition, citations to publications were also collected from date of publication till the end of April 2015 for sections 4.10.

(TITLE-ABS-KEY(stomach or gastric) AND TITLE-ABS-KEY(cancer or carcinoma or neoplasm)) AND PUBYEAR > 2004 AND PUBYEAR < 2015

(TITLE-ABS-KEY(stomach or gastric) AND TITLE-ABS-KEY(cancer or carcinoma or neoplasm)) AND PUBYEAR > 2004 AND PUBYEAR < 2015 AND ( LIMIT-TO(AFFILCOUNTRY,"India" ) )

### 4 Analysis

The world and India has published 61788 and 1310 publications on stomach cancer during 2005-14, which increased from 4765 and 59 publications in 2005 to 7107 and 189 publications in 2014, registering an annual average growth rates of 4.70% and 15.47%. The cumulative growth of world and Indian publications in stomach cancer increased from 26182 and 383 during 2005-09 to 35606 and 927 publications during 2010-14, witnessing a growth rate of 71.63% and 282.65%. India’s global publications share in stomach cancer was 1.74% during 2005-14, which increased from 1.68% during 2005-09 to 1.74% during 2010-14. The average citation per publication registered by Indian publications in stomach cancer was 3.17 during 2005-14, which decreased from 3.65 during 2005-09 to 2.98 during 2010-14 (Table 1).

**Table 1. World and Indian Literature in Stomach Cancer: Growth, Citation Impact & International Collaboration, 2005-14**

Publication Year	World	India					Global Share
	TP	TP	TC	ACPP	ICP	%ICP	
2005	4765	59	232	3.93	9	15.25	1.24
2006	4922	71	213	3.00	6	8.45	1.44
2007	5149	68	275	4.04	11	16.18	1.32
2008	5366	89	328	3.69	19	21.35	1.66
2009	5980	96	351	3.66	22	22.92	1.61
2010	6433	142	636	4.48	14	9.86	2.21
2011	6743	199	666	3.35	34	17.09	2.95
2012	7522	187	793	4.24	29	15.51	2.49
2013	7801	210	454	2.16	42	20.00	2.69
2014	7107	189	210	1.11	40	21.16	2.66
2005-09	26182	383	1399	3.65	67	17.49	1.46
2010-14	35606	927	2759	2.98	159	17.15	2.60
2005-14	61788	1310	4158	3.17	226	17.25	2.12
TP=Total Papers, TC=Total Citations; ACPP=Average Citations Per Paper; ICP=International Collaborative Papers							

**4.1 Global Publication Share & Citation Impact of Top 15 Most Productive Countries**

The global research output in stomach cancer originated in more than 100 countries during 2005-14. Table 2 lists the output of top 15 most productive countries in stomach cancer during 2005-14.. The publication share of 15 most productive countries in stomach cancer varied from 1.50% to 31.65% during 2005-14, with highest publication share (31.65%) coming from China, followed by USA (18.06% share), Japan, (16.42%), U.K. (6.91% share), Germany (5.20% share), Italy (4.72%), France (4.436%), Canada, South Korea and Spain (from 2.06% to 2.56% share), Netherlands, India, Taiwan, Australia and Turkey (from 1.50% to 1.84% share) during 2005-14. The global publication share has increased by 24.42% in China, USA ( 9.18%), U.K. (2.54%), South Korea (1.14%), Turkey (0.41%) and Australia (0.26%), as against decrease by 2.67% in Japan, Germany (1.32%), France (0.88%), Italy (0.62%), Spain (0.52%), Canada

(0.48%), Taiwan (0.22%), India (0.14%) and Netherlands (0.11%) from 2005-09 to 2010-14 (Table 2).

**Table 2. Publication Output and Global Publication Share of Top 15 Most Productive Countries in Stomach Cancer, 2005-14**

S.No	Country Name	Number of Publications			Global Share of Publications		
		2005-09	2010-14	2005-14	2005-09	2010-14	2005-14
1	China	4602	14955	19557	17.58	42.00	31.65
2	USA	3344	7815	11159	12.77	21.95	18.06
3	Japan	4702	5445	10147	17.96	15.29	16.42
4	UK	1425	2842	4267	5.44	7.98	6.91
5	Germany	1561	1652	3213	5.96	4.64	5.20
6	Italy	1328	1587	2915	5.07	4.46	4.72
7	France	1299	1455	2754	4.96	4.09	4.46
8	Canada	743	838	1581	2.84	2.35	2.56
9	South Korea	383	927	1310	1.46	2.60	2.12
10	Spain	618	655	1273	2.36	1.84	2.06
11	Netherlands	498	637	1135	1.90	1.79	1.84
12	India	478	599	1077	1.83	1.68	1.74
13	Taiwan	477	569	1046	1.82	1.60	1.69
14	Australia	390	623	1013	1.49	1.75	1.64
15	Turkey	332	597	929	1.27	1.68	1.50
	World	26182	35606	61788			

**4.2 International Collaboration**

The share of international collaborative publications in India’s in stomach cancer research output was 17.25% during 2005-14, which decreased from 17.49% during 2005-09 to 17.15% during 2010-14. India has collaborated with several countries in stomach cancer research during 2005-14. Among the collaborating countries, the largest share (39.82%) was contributed by United States, followed by UK (11.06%), France (10.62%), Germany (9.73%), Italy (8.41%), Australia and Japan (7.08% each), China (6.64%), Canada (6.19%) and South Korea (5.75%) during 2005-14. The international collaborative publications share of foreign countries in India’s publications output increased by 5.12% in U.K., followed by Canada (4.56%), France (4.49%), Australia

(3.70%), USA (3.57%), Italy (1.34%), Germany (1.11%), as against decrease by 9.66% in China and South Korea (6.67%), from 2005-09 to 2010-14 (Table 3).

**Table 3. Share of Leading Countries in India’s International Collaborative Output in Indian Stomach Cancer during 2005-14**

Country Name	Number of Papers			Share of Papers		
	2005-09	2010-14	2005-14	2005-09	2010-14	2005-14
USA	25	65	90	37.31	40.88	39.82
UK	5	20	25	7.46	12.58	11.06
France	5	19	24	7.46	11.95	10.62
Germany	6	16	22	8.96	10.06	9.73
Italy	5	14	19	7.46	8.81	8.41
Australia	3	13	16	4.48	8.18	7.08
Japan	4	12	16	5.97	7.55	7.08
China	9	6	15	13.43	3.77	6.64
Canada	2	12	14	2.99	7.55	6.19
South Korea	7	6	13	10.45	3.77	5.75
Total of the Country	67	159	226			

**4.3 Subject-Wise Distribution of Research Output**

India’s stomach cancer research output during 2005-14 has been published in the context of five sub-fields (as reflected in Scopus database classification), with highest publications share (65.34%) coming from medicine, followed by biochemistry, genetics & molecular biology (29.69%), pharmacology, toxicology & pharmaceuticals (26.03%), agricultural & biological sciences (3.66% share) and immunology & microbiology (3.28% share) during 2005-14. The research activity, as reflected in activity index, has witnessed increase in biochemistry, genetics & molecular biology (from 37.96 to 106.80), pharmacology, toxicology and pharmaceuticals (from 30.37 to 109.82), agricultural & biological sciences (from 7.19% to 88.32) and immunology & microbiology (from 4.40 to 105.17), in contrast to decrease in medicine (from 111.48 to 95.26) from 2005-09 to 2010-14. Among these five subjects, the largest citation impact per publication (3.93 and 3.85) were registered by pharmacology, toxicology and pharmaceuticals and



biochemistry, genetics & molecular biology, followed agricultural & biological; sciences (3.10), immunology & microbiology (3.02) and medicine (2.68) during 2005-14 (Table 4).

**Table 4. Subject-Wise Break-up of Indian Publications in Stomach Cancer, 2005-14**

Subject	Number of Papers			Activity Index		TC	ACP P	%TP
	2005-09	2010-14	2005-14	2005-09	2010-14			
Medicine	279	577	856	111.48	95.26	2291	2.68	65.34
Biochemistry, Genetics & Molecular Biology	95	294	389	37.96	106.80	1496	3.85	29.69
Pharmacology, Toxicology & Pharmaceutics	76	265	341	30.37	109.82	1340	3.93	26.03
Agricultural & Biological Sciences	18	30	48	7.19	88.32	149	3.10	3.66
Immunology & Microbiology	11	32	43	4.40	105.17	130	3.02	3.28
Total of the country	383	927	1310					

**4.4 Type of Stomach Cancer**

The largest publication share (16.26%) in Indian stomach cancer output was contributed by adenocarcinoma, followed by lymphoma (11.07%), Squamous Cell Carcinoma (4.81%), Sarcoma (3.89%), Small Cell Carcinoma (3.82%), Gastrointestinal Stromal Tumor (3.74%) and Carcinoid Tumor (1.37%) during 2005-14. The publication share increased by 2.07% in Small Cell Carcinoma, followed by Sarcoma (0.70%), Squamous Cell Carcinoma (0.52%) and Gastrointestinal Stromal Tumor (0.12%), as against decrease by 2.11% in adenocarcinoma, followed by Lymphoma (0.96%) and Carcinoid Tumor (0.27%) from 2005-09 to 2010-14 (Table 5).

**Table 5. Distribution of Publications by Type of Stomach Cancer during 2005-14**

Type of Cancer	Number of Papers			Share of Papers		
	2005-09	2010-14	2005-14	2005-09	2010-14	2005-14
Adenocarcinoma	68	145	213	17.75	15.64	16.26
Lymphoma	45	100	145	11.75	10.79	11.07
Squamous Cell Carcinoma	17	46	63	4.44	4.96	4.81
Sarcoma	13	38	51	3.39	4.10	3.89
Small Cell Carcinoma	9	41	50	2.35	4.42	3.82
Gastrointestinal Stromal Tumor	14	35	49	3.66	3.78	3.74
Carcinoid Tumor	6	12	18	1.57	1.29	1.37
Total of India	383	927	1310			

**4.5 Distribution of Publications by Treatment Methods**

In terms of treatment methods used in stomach cancer research in India during 2005-14, the largest publication share (16.11%) was registered by diagnosis, followed by surgery (13.05%), chemotherapy (12.29%), pathology (7.63%), screening (7.18%), prognosis (6.26%), radiotherapy (3.82%), genetics (3.28%), epidemiology (2.98%), quality of life (2.29%) and palliative care (1.07%) during 2005-14. The top 5 treatment methods together account for 56.26% share of the total publication output on stomach cancer during 2005-14. The publication share has increased by 3.35% in chemotherapy, screening (2.76%), prognosis (2.57%), quality of life (2.13%), genetics (0.95%), epidemiology (0.52%), , as against decrease by 3.60% in pathology, 1.96% in diagnosis, 1.85% in surgery, 1.07% in palliative care and 0.14% in radiotherapy from 2005-09 to 2010-14 (Table 6).

**Table 6. Distribution of India’s Stomach Cancer Publications by Treatment Methods, 2005-14**

Treatment Methods	Number of Publications			Share of Publications		
	2005-09	2010-14	2005-09	2010-14	2005-09	2010-14
Diagnosis	67	144	211	17.49	15.53	16.11
Surgery	55	116	171	14.36	12.51	13.05
Chemotherapy	38	123	161	9.92	13.27	12.29
Pathology	39	61	100	10.18	6.58	7.63
Screening	20	74	94	5.22	7.98	7.18
Prognosis	17	65	82	4.44	7.01	6.26
Radiotherapy	15	35	50	3.92	3.78	3.82
Genetics	10	33	43	2.61	3.56	3.28
Epidemiology	10	29	39	2.61	3.13	2.98
Quality of Life	3	27	30	0.78	2.91	2.29
Palliative Care	7	7	14	1.83	0.76	1.07
Total of India	383	927	1310			

**4.6 Distribution of Research Output by Geographical Areas**

Among Indian states and union territories contributing to stomach cancer research during 2005-14, the largest publication share (16.79%) came from Delhi, followed by Uttar Pradesh (13.28%), Maharashtra (11.91%), Karnataka (9.92%), Tamil Nadu (6.79%), Telegana (6.72%), Andhra Pradesh (5.11%), Kerala (4.81%) during 2005-14. The top 4 states together account for 51.9% of the country output during 2005-14, which decreased from 54.31% to 50.92% from 2005-09 to 2010-14. The national publication share of stomach cancer research increased by 4.8% in Karnataka, followed by Haryana (1.93%), Andhra Pradesh (1.69%), West Bengal (1.19%), Punjab (1.01%), Maharashtra (0.59%), Tamil Nadu (0.38%), Rajasthan (0.28%) and Orissa (0.25%), as against decrease by 5.95% in Uttar Pradesh, followed by Chandigarh (3.62%), Telegana (3.42%), Delhi (2.83%), Madhya Pradesh (1.36%) and Kerala (1.32%) from 2005-09 to 2010-14 (Table 7).

**Table 7. Geographical Distribution of Lung Cancer Research Publications in India, 2005-14**

Name of Geographical Area	Number of Publications			Share of Publications		
	2005-09	2010-14	2005-09	2010-14	2005-09	2010-14
Delhi	72	148	220	18.80	15.97	16.79
Uttar Pradesh	67	107	174	17.49	11.54	13.28
Maharashtra	44	112	156	11.49	12.08	11.91
Karnataka	25	105	130	6.53	11.33	9.92
Tamil Nadu	25	64	89	6.53	6.90	6.79
Telegana	35	53	88	9.14	5.72	6.72
Andhra Pradesh	15	52	67	3.92	5.61	5.11
Kerala	22	41	63	5.74	4.42	4.81
Chandigarh	25	27	52	6.53	2.91	3.97
Madhya Pradesh	18	31	49	4.70	3.34	3.74
West Bengal	7	28	35	1.83	3.02	2.67
Haryana	5	30	35	1.31	3.24	2.67
Rajasthan	8	22	30	2.09	2.37	2.29
Punjab	4	19	23	1.04	2.05	1.76
Orissa	4	12	16	1.04	1.29	1.22
Total of India	383	927	1310			

**4.7 Profile of Top 15 Most Productive Organizations**

The productivity of 15 most productive Indian organizations in stomach cancer varied from 13 to 60 publications and together contributed 30.0% (393 publications) share in the cumulative publications output of India in stomach cancer research during 2005-14. The scientometric profile of these 15 Indian organizations is presented in Table 8. Five organizations have registered higher publications output than the group average of 26.20: Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow (60 publications), Tata Memorial Hospital, Bombay (53 publications), All India Institute of Medical Sciences, New Delhi (44 publications), Sher-I-Kashmir Institute of Medical Sciences, Srinagar (33 publications) and Christian Medical College, Vellore (28 publications) during 2005-14.

Seven organizations have registered more than the average citation per publication (4.19) among the 15 organizations during 2004-15: Dr. Harisingh Gour University, Sagar (7.0), Postgraduate Institute of Medical Education and Research, Chandigarh (5.86), Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow (5.35), Jawaharlal Nehru University (4.50), Tata Memorial Hospital, Bombay (4.45), Banaras Hindu University Institute of Medical Sciences (4.41) and Cancer Institute India (4.31) during 2005-14.

Eight organizations have registered more than the average h-index (7.67) of all 15 organizations: Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow (15), All India Institute of Medical Sciences, New Delhi (11), Dr. Harisingh Gour University, Sagar, Tata Memorial Hospital, Bombay, Annamalai University and Sher-I-Kashmir Institute of Medical Sciences, Srinagar (9 each), Jawaharlal Nehru University and University of Madras (8 each) during 2005-14.

Seven organizations have achieved more than the average share of international collaborative publications (16.79%) of all organizations: Jawaharlal Nehru University (35.0%), Kidwai Memorial Institute of Oncology India (31.25%), Cancer Institute India (30.77%), Jamia Hamdard Faculty of Pharmacy (28.57%), Tata Memorial Hospital, Bombay (24.53%), Amrita Institute of Medical Sciences India (23.08%), University of Madras (21.74%) and Dr. Harisingh Gour University, Sagar (18.75%) during 2005-14

**Table 8. Scientometric Profile of Top 15 Most Productive Indian Organizations in Stomach Cancer, 2005-14**

S.No	Name of the Organization	TP	TC	ACPP	HI	ICP	%ICP
1	Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow	60	321	5.35	15	8	13.33
2	Tata Memorial Hospital, Bombay	53	236	4.45	9	13	24.53

3	All India Institute of Medical Sciences, New Delhi	44	150	3.41	11	7	15.91
4	Sher-I-Kashmir Institute of Medical Sciences, Srinagar	33	118	3.58	9	0	0.00
5	Christian Medical College, Vellore	28	47	1.68	6	2	7.14
6	University of Madras	23	74	3.22	8	5	21.74
7	Postgraduate Institute of Medical Education and Research, Chandigarh	22	129	5.86	4	3	13.64
8	Annamalai University	21	83	3.95	9	1	4.76
9	Jawaharlal Nehru University	20	90	4.50	8	7	35.00
10	Banaras Hindu University Institute of Medical Sciences	17	75	4.41	5	1	5.88
11	Dr. Harisingh Gour University, Sagar	16	112	7.00	9	3	18.75
12	Kidwai Memorial Institute of Oncology India	16	52	3.25	5	5	31.25
13	Jamia Hamdard	14	56	4.00	6	4	28.57

	Faculty of Pharmacy						
14	Amrita Institute of Medical Sciences India	13	49	3.77	5	3	23.08
15	Cancer Institute India	13	56	4.31	6	4	30.77
	Total of 15 organizations	393	1648	4.19	7.67	66	16.79
	Total of India	1310	4158				
	Share of 15 organizations in India's total	30.00	39.63				
TP=Total Papers, TC=Total Citations; ACP=Average Citations Per Paper; ICP=International Collaborative Papers; HI=h-index							

#### 4.8 Profile of Top 10 Most Productive Authors

The productivity of 10 most productive Indian authors in stomach cancer varied from 8 to 26 publications and together contributed 10.15% (133 publications) share in the cumulative publications output of India in stomach cancer research during 2005-14. The scientometric profile of these 15 Indian authors is presented in Table 9. Four authors have registered higher publications output than the group average of 13.3: U.C. Ghosal (26 publications), B. Mittal (20 publications), S.V. Shrikhande (18 publications) and N. Ahmed (15 publications) during 2005-14. Five authors have registered more than the average citation per publication (5.04) among all 10 authors: M.A.Malik (8.0), B. Mittal (7.65), S.Nagini (6.42), U.C. Ghosal (6.27) and N.Krishnani (4.50) during 2005-14. Four authors have registered more than the average h-index (5.4) of all 10 authors during 2004-13: B. Mittal (11), S.Nagini (9), N. Ahmed (7) and M.A.Malik (6) during 2005-14. Three authors have achieved more than the average share of national collaborative publications (17.29%) of all authors: B.Sirohi (50.00%), S.P.Misra (37.50%) and S.V. Shrikhande (22.22%) during 2005-14.

**Table 9. Scientometric Profile of Top 15 Most Productive Indian Authors in Stomach Cancer, 2005-14**

S.No	Name of Author	Affiliation of the Author	TP	TC	ACPP	HI	ICP	%ICP
1	U.C. Ghosal	Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow	26	163	6.27	5	1	5.00
2	B. Mittal	Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow	20	153	7.65	11	1	22.22
3	S.V. Shrikhande	Tata Memorial Hospital, Mumba	18	64	3.56	5	4	53.33
4	N. Ahmed	Centre for DNA Fingerprinting and Diagnostics, Hyderabad,	15	60	4.00	7	8	8.33
5	S.Nagini	Annamalai University, Annamalinagar	12	77	6.42	9	1	10.00
6	N.Krishnani	Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow	10	45	4.50	5	1	50.00
7	B.Sirohi	Tata Memorial Centre, Mumbai,	8	26	3.25	2	4	0.00
8	M. Tewari	Institute of Medical Sciences, Banaras Hindu University, Varanasi	8	8	1.00	1	0	37.50
9	S.P.Misra	MLN Medical College Allahabad,	8	10	1.25	3	3	0.00
10	M.A.Malik	Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow	8	64	8.00	6	0	17.29
	Total of 10 authors		133	670	5.04	54	23	0.00
	Total of India		1310	4158				
	Share of 10 authors in India's output		10.15	16.11				

TP=Total Papers, TC=Total Citations; ACPP=Average Citations Per Paper; ICP=International Collaborative Papers; HI=h-index

**4.9 Medium of Communication**



The 15 most productive journals contributed from 12 to 42 papers and together contributed 22.82% share (299 papers) to the total India’s publication output in stomach cancer during 2005-14. The publication share of these top 15 most productive journals increased from 14.10% to 26.43% from 2005-09 to 2010-14. The most productive journal (with 42 papers) was *Indian Journal of Gastroenterology*, followed by *Asia Pacific Journal of Cancer* (29 papers), *Indian Journal of Pathology & Microbiology* (28 papers), *International Journal of Pharmacy & Biosciences* (22 papers), etc during 2005-14 (Table 10).

**Table 10. List of Most Productive Journals in Indian in Stomach Cancer during 2005-14**

S.No	Name of the Journal	Number of Papers		
		2005-09	2010-14	2005-14
1	Indian Journal of Gastroenterology	20	22	42
2	Asia Pacific Journal of Cancer	5	24	29
3	Indian Journal of Pathology & Microbiology	10	18	28
4	International Journal of Pharmacy & Biosciences	0	22	22
5	Indian Journal of Cancer	2	19	21
6	International Journal of Pharmaceutical Sciences Review & Research	0	19	19
7	Indian Journal of Surgery	6	11	17
8	Journal of Gastrointestinal Cancer	2	15	17
9	Research Journal of Pharmaceutical Biology & Chemical Sciences	0	17	17
10	Journal of Clinical & Diagnostic Research	0	17	17
11	Journal of Cancer Research & Therapy	3	13	16
12	Journal of the Indian Medical Association	5	11	16
13	BMJ Case Reports	1	12	13
14	Indian Journal of Medical & Pediatric Oncology	0	13	13
15	International Journal of Pharmacy & Pharmaceutical Sciences	0	12	12
	Total of 15 journals	54	245	299
	Total of India	383	927	1310
	Share of 15 journals in India’s output	14.1	26.43	22.82

#### 4.10. High Cited papers

There were 15 high cited papers, which have received citations from 105 to 252 and they together registered 2237 citations, leading to average citation per paper of 149.13. Of the 15 high cited papers (7 reviews and 8 articles), 6 involve the participation of single organization and 9 involved participation of more than 1 organization (4 nationally collaborative and 5 international collaborative). These 15 high cited papers involve 85 authors and 43 organizations and they were published in 14 different journals. The major Indian organizations involved in high cited papers were: Tata Memorial Hospital, Mumbai (2 papers) and 1 paper each from Institute of Post Graduate Medical Education and Research, Kolkata, Indian Toxicological Research Center, Lucknow, Centre for Cellular & Molecular Biology, Hyderabad, Institute of Genomics and Integrative Biology, Delhi, National Institute of Cholera and Enteric Diseases, Kolkata, Indian Institute of Chemical Biology, Kolkata, Amala Cancer Research Center, Trissur Regional Cancer Centre, Kerala, All India Institute of Medical Sciences, New Delhi, Postgraduate Institute of Medical Education and Research, Chandigarh, Annamalai University, Dr Hari Singh Gour University, Sagar, Jadavpur University, Kolkata, Indian Institute of Technology, Guwahati, B P Poddar Hospital and Medical Research, Kolkata, West Bengal, Epidemiological Research Centre, Chennai, Healis-Seskaria Institute of Public Health, Navi Mumbai, Post Graduate Institute of Medical Education and Research, Chandigarh, Bisen Biotech. and Biopharma Pvt. Ltd., Gwalior, Jiwaji University, Gwalior, etc. The leading journals of publications of high cited papers were: The Lancet (2 papers) and 1 paper each in *Acta Biomaterialia*, *American Journal of Surgery*, *Antimicrobial Agents and Chemotherapy*, *Anti-Cancer Agents in Medicinal Chemistry*, *Chinese Medicine*, *Current Medicinal Chemistry - Anti-Cancer Agents*, *Current Pharmaceutical Biotechnology*, *Food and Chemical Toxicology*, *Journal of Gastroenterology and Hepatology (Australia)*, *Journal of Heterocyclic Chemistry*, *Journal of Pharmacy and Pharmaceutical Sciences*, *Molecular Cancer and Pharmacological Report.*,

#### 5. Summary & Conclusion

In stomach cancer research, the world and India have published 61788 and 1310 publications during 2005-14, which increased from 4765 and 59 publications in 2005 to 7107 and 189 publications in 2014, registering annual average growth rates of 4.70% and 15.47%. India's

global publications share in stomach cancer was 1.74% during 2005-14, which increased from 1.68% during 2005-09 to 1.74% during 2010-14. The average citation per publication registered by Indian publications in stomach cancer was 3.17 during 2005-14, which decreased from 3.65 during 2005-09 to 2.98 during 2010-14. The global research output in stomach cancer came from more than 100 countries during 2005-14, with highest publication share (31.65%) coming from China, followed by USA (18.06% share), Japan, (16.42%), U.K. (6.91% share), Germany (5.20% share), Italy (4.72%), France (4.436%), Canada, South Korea and Spain (from 2.06% to 2.56% share), Netherlands, India, Taiwan, Australia and Turkey (from 1.50% to 1.84% share) during 2005-14. The global publication share has increased in China, USA, U.K., South Korea, Turkey and Australia, as against decrease in Japan, Germany, France, Italy, Spain, Canada, Taiwan, India and Netherlands (0.11%) from 2005-09 to 2010-14. India's share of international collaborative papers in its total output on stomach cancer was 17.25% during 2005-14, which decreased from 19.49% during 2005-09 to 17.15% during 2010-14. Among India's leading collaborating countries, the largest share (39.82%) was contributed by United States, followed by UK (11.06%), France (10.62%), Germany (9.73%), Italy (8.41%), Australia and Japan (7.08% each), China (6.64%), Canada (6.19%) and South Korea (5.75%) during 2005-14. Medicine, among subjects, contributed the largest publication share (65.34%), followed by biochemistry, genetics & molecular biology (29.69%), pharmacology, toxicology & pharmaceuticals (26.03%), agricultural & biological sciences (3.66% share) and immunology & microbiology (3.28% share) during 2005-14. The research activity, as reflected in activity index, has witnessed increase in biochemistry, genetics & molecular biology, pharmacology, toxicology and pharmaceuticals, agricultural & biological sciences and immunology & microbiology, in contrast to decrease in medicine from 2005-09 to 2010-14. Pharmacology, toxicology and pharmaceuticals and biochemistry, genetics & molecular biology registered the largest citation impact per publication (3.93 and 3.85), followed agricultural & biological; sciences (3.10), immunology & microbiology (3.02) and medicine (2.68) during 2005-14. Among different types of stomach cancer, the largest publication share (16.26%) was contributed by adenocarcinoma, followed by lymphoma (11.07%), Squamous Cell Carcinoma (4.81%), Sarcoma (3.89%), Small Cell Carcinoma (3.82%), Gastrointestinal Stromal Tumor (3.74%) and Carcinoid Tumor (1.37%) during 2005-14. The top 5 treatment methods, namely diagnosis, surgery, chemotherapy,

pathology and screening together accounted for 56.26% share of the total publication output on stomach cancer during 2005-14. Delhi, Uttar Pradesh, Maharashtra and Karnataka together accounted for 51.9% of the country output during 2005-14, which decreased from 54.31% to 50.92% from 2005-09 to 2010-14. The combined productivity of most productive 15 Indian organizations, 10 authors and 15 journals in stomach cancer accounted for 30.0%, 10.15% and 22.82% share in the cumulative publications output of India in stomach cancer research during 2005-14. Of the total Indian output on stomach cancer during 2005-14, there were only 15 high cited papers (receiving 100 or more citations) which together registered average citation per paper of 149.13. Of the 15 high cited papers (7 reviews and 8 articles), 6 involve the participation of single organization and 9 involved participation of more than 1 organization (4 nationally collaborative and 5 international collaborative). These 15 high cited papers involve 85 authors and 43 organizations and they were published in 14 different journals.

Concludes that stomach cancer is a disease of complex etiology involving multiple risk factors and multiple genetic and epigenetic alterations. Control of *H. pylori* infection by means of eradication or immunization is likely to have immense potential in stomach cancer prevention. In addition, changes in dietary habits and lifestyle could reduce the incidence of stomach cancer especially in high prevalence areas. Despite the availability of new drugs and association regimens, the therapeutic outcome for gastric cancer is still dismal. Knowledge of the diverse risk factors together with current genomic and proteomic technologies would help in identification of high-risk individuals, targeting precursor lesions, improving preventive strategies, and providing appropriate personalized therapy. More rigorous, larger scale and controlled studies are however required to validate the genetic markers. Pharmacogenetics may be an attractive approach to optimize therapeutic regimens and minimize adverse side effects. Multitargeted preventive and therapeutic strategies for gastric cancer are a major challenge for the future.

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