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Literature Review

Hepatocellular Carcinoma Research in India: A Scientometric Assessment of Publications during 2004 - 2017

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Abstract

The present paper provides a quantitative and qualitative description of Hepatocellular Carcinoma research in India (1731) vis-à-vis the world (90110 publications) based on measures like growth rate, global publications share, share of international collaborative papers, citations per paper, and highly cited papers. The publications data for the study was sourced from Scopus database covering 14-year period during 2004-17. The study identifies top 15 most productive countries in the subject, and also top 15 most productive organizations and authors. The study describes the scattering of research output of India across source journals, and distribution of research by subject areas that intersect with Hepatocellular Carcinoma. The study finds that the China is the world leader in the subject followed by USA, Japan, Italy, Germany, South Korea, Taiwan, etc. India registered 19.43% average annual growth in the subject. India's citations impact was 15.52 citations per paper and its share of highly cited papers was 1.85% (32 papers) of the total national output. The leading research organizations in Hepatocellular Carcinoma research in India include: Postgraduate Institute of Medical Education and Research, Chandigarh (104 papers), All India Institute of Medical Research, New Delhi (97 papers), University of Madras (65 papers), Institute of Liver and Biliary Sciences, New Delhi (56 papers) and Tata Memorial Hospital (TMH), Mumbai (48 papers). The top 15 journals that contributed 20.75% publication share include: *Journal of Clinical and Experimental Hepatology* (70 papers), followed by *Indian Journal of Gastroenterology* (36 papers), etc.

Keywords: *Hepatocellular Carcinoma; Liver Cancer; Indian Publications; Scientometrics; Bibliometrics*

Introduction

The liver is the largest glandular organ in the body and performs various critical functions to keep the body free of toxins and harmful substances. It's located in the right upper quadrant of the abdomen, right below the ribs. The liver is responsible for producing bile, which is a substance that helps you digest fats, vitamins, and other nutrients. This vital organ also stores nutrients such as glucose, so that you remain nourished at times when you're not eating. It also breaks down medications and toxins.

When cancer develops in the liver, it destroys liver cells and interferes with the ability of the liver to function normally. The different types of primary liver cancer originate from the various cells that make up the liver. Hepatocellular carcinoma (HCC), also known as hepatoma, is the most common type of liver cancer, accounting for 75 percent of all liver cancers. This condition develops in the hepatocytes, which are the predominant liver cells. It can spread from the liver to other parts of the body, such as the pancreas, intestines, and stomach [1]. It occurs predominantly in patients with underlying chronic liver disease and cirrhosis (caused by hepatitis B or hepatitis C infection) or exposure to toxins such as alcohol or aflatoxin. Certain diseases, such as hemochromatosis and alpha 1-antitrypsin deficiency, markedly increase the risk of developing HCC. Metabolic syndrome and NASH are also increasingly recognized as risk factors for HCC [2,3].

The incidence of HCC is highest in Asia and Sub-Saharan Africa, where the endemic high prevalence of hepatitis B and hepatitis C strongly predisposes to the development of chronic liver disease and subsequent development of HCC. The incidence of HCC in the United States and other developing countries is increasing due to an increase in hepatitis C virus infections. It is more common in males than females for unknown reasons [2,3].

There were 854,000 incident liver cancer cases and 810,000 deaths globally in 2015, contributing to 20,578,000 DALYs. Liver cancer was the sixth most common-incident cancer worldwide and the fourth most common cause of cancer death. Eighty-eight percent of incident liver cancer cases and 86% of liver cancer deaths occurred in middle-SDI, high-middle-SDI, and high-SDI countries compared with low-middle-SDI and low-SDI countries. Age-standardized incidence rates (ASIR) were the highest in middle-SDI countries, followed by low-SDI countries. Hepatitis B virus infection accounted for 265,000 liver cancer deaths (33%), alcohol for 245,000 (30%), hepatitis C virus infection for 167,000 (21%), and other causes for 133,000 (16%) deaths [4].

Literature Review

Only one study as yet is available per se on the subject of scientometric assessment of Hepatocellular Carcinoma research at international level. Miao, Zhang and Yin [5] analyzed the global scientific outputs of hepatocellular carcinoma research. Data of publications were downloaded from the Web of Science Core Collection. The authors used CiteSpace IV and Excel 2016 to analyze literature information, including journals, countries/regions, institutes, authors, citation reports and research frontiers. Another study made a bibliometric assessment of Indian liver research (includes liver cancer research) by Gupta, Adarsh, Mueen Ahmed and Gupta [6] with the objective to study the contribution and citation impact of 20 of the most productive countries, India's overall contribution, its growth pattern, and citation impact, the share of international collaboration in India's overall research output and the identification and contribution of leading countries, Indian contribution and impact of different types of liver diseases, liver disorder researches by subfields and by different age groups, productivity and impact of leading Indian institutions and authors and the pattern of communication of the Indian output in the most productive journals.

However, a few other similar bibliometric studies are also available on cancer research in areas such as breast cancer [7], blood cancer (lymphoma) [8], cervical cancer [9], colorectal cancer [10], gall bladder cancer [11], lung cancer [12], mouth cancer [13,14], oral cancer [15], pancreatic cancer [16], prostate cancer [17] and stomach cancer [18].

Objectives of the Study

The study aims to evaluate India's research performance in Hepatocellular Carcinoma research by examining publications data, using select bibliometric indicators. Given this context, the objectives of the present study are:

- To study the global research output and of the top 15 most productive countries in Hepatocellular Carcinoma research;
- To study the growth rate, global publication share, citation impact, and collaboration profile of India in the subject;
- To study India's output by broad subject areas and the dynamics of research growth and decline across the subject areas and to study India's output by treatment methods;
- To study the publication productivity and citation impact of top 15 most productive Indian organizations and authors in the subject;
- To identify highly productive journals and to study the bibliographic characteristics of highly cited papers.

Methodology

The Hepatocellular Carcinoma research publications of the world and India in particular covering the period 2004 to 2017 was determined using international Scopus database (http://www.scopus.com). Using "hepatocellular carcinoma*" OR "hepatic cell carcinoma*" OR "liver cell carcinoma*" OR "primary liver cancer*" OR "primary liver carcinoma*" OR "malignant hepatoma*" OR "hepatocarcinoma*" OR "hepatoma*" as the keywords search term in the " TITLE-ABS-KEY" tag and restricting the search string to the period 2004-17 in "date range tag", global publication output (90110) in Hepatocellular Carcinoma was identified. The above main search string was further restricted to individual country name in "country tag", in order to obtain publication data on individual top 15 most productive countries (including on India). The search string on India was further refined by using analytical provisions in Scopus database such as "subject area tag", "country tag", "source title tag", "journal title name" and "affiliation tag", to obtain information on distribution of publications by subject, collaborating countries, author-wise, organization-wise and journal-wise. For citation data, citations to publications were collected from date of publication till 30.10. 2018.

TITLE-ABS-KEY(("hepatocellular carcinoma*") OR ("hepatic cell carcinoma*") OR ("liver cell carcinoma*") OR ("primary liver cancer*") OR ("primary liver carcinoma*") OR ("malignant hepatoma*") OR ("hepatocarcinoma*") OR ("hepatoma*")) AND PUBYEAR > 2003 AND PUBYEAR < 2018

TITLE-ABS-KEY(("hepatocellular carcinoma*") OR ("hepatic cell carcinoma*") OR ("liver cell carcinoma*") OR ("primary liver cancer*") OR ("primary liver carcinoma*") OR ("malignant hepatoma*") OR ("hepatocarcinoma*") OR ("hepatoma*")) AND PUBYEAR > 2003 AND PUBYEAR < 2018 AND (LIMIT-TO (AFFILCOUNTRY, "India")).

Analysis

Hepatocellular Carcinoma Research in India and the world cumulated to 90110 and 1731 publications respectively in the 14-year period during 2004-17, as seen from publications indexed in Scopus database. India registered 19.43% annual average growth in the subject, more than twice that of the world average growth 7.66% during the same period. The annual output of India increased from 28 to 227 publications, and of the world it increased from 3594 to 9305 publications during 2004-17. The 7-year absolute growth of India in the subject was 222.2%, and of the world it was 78.59% during 2004-10 to 2011-17. India's 14-year global publication share in the subject was 1.92% during 2006-17 and its 7-year global share increased from 1.27% to 2.29% between 2004-10 and 2011-17. The citation impact of Hepatocellular Carcinoma Research by India averaged to 15.52 citations per publication (CPP) during 2004-17; its 7-year impact dropped from 28.63 CPP to 11.45 CPP during the period between 2004-10 and 2011-17 (Table 1). Of the total global publications output, 73.71% (1276) was published as articles, 15.83% (274) as reviews, 3.58% (62) as letters, 2.02% (35) as conference papers, 1.68% (29) as editorials, 1.21% (21) as book chapters, 0.92% (16) as notes, 0.58% (10) as short surveys, 9.29% (5) as erratum, 0.12% (2) as articles in press and 0.06% (1) as retracted.

International collaboration

India contributed 366 papers in Hepatocellular Carcinoma through international collaboration, which accounted for 21.14% national publications share, cumulated 9716 citations, and averaged 26.54 citations per paper during the 14-year period 2004-17. India's 7-year share of international collaborative papers (ICP) in the subject increased from 17.32% to 22.33% between 2004-10 and 2011-17. India's collaboration was the largest the USA (44.54% share of 366 ICP papers), followed by South Korea, Saudi Arabia and Singapore (13.11%, 12.30% and 11.75%), Australia and Singapore (10.66% and 10.11%), U.K.(8.20%), China, Germany and Taiwan (7.92% each) during 2004-17. The international collaborative papers share increased in U.K., Saudi Arabia, Australia and Germany (from 1.1% to 8.42%), as against decrease in Singapore, USA, China, South Korea and Taiwan (from 0.65% to 11.92%) from 1994-10 to 2011-17 (Table 2).

Period	World	India					
	TP	TP	TC	CPP	ICP	%ICP	%TP
2004	3594	28	964	34.43	4	14.29	0.78
2005	3833	33	748	22.67	4	12.12	0.86
2006	4128	53	1784	33.66	10	18.87	1.28
2007	4492	55	1375	25.00	6	10.91	1.22
2008	5036	81	2362	29.16	18	22.22	1.61
2009	5505	72	1807	25.10	13	18.06	1.31
2010	5757	88	2699	30.67	16	18.18	1.53
2011	6449	111	1893	17.05	17	15.32	1.72
2012	7228	162	3537	21.83	32	19.75	2.24
2013	8144	189	3508	18.56	43	22.75	2.32
2014	8555	227	2471	10.89	54	23.79	2.65
2015	8991	187	1792	9.58	40	21.39	2.08
2016	9093	218	1250	5.73	52	23.85	2.40
2017	9305	227	680	3.00	57	25.11	2.44
2004-10	32345	410	11739	28.63	71	17.32	1.27
2011-17	57765	1321	15131	11.45	295	22.33	2.29
2006-17	90110	1731	26870	15.52	366	21.14	1.92

Table 1: *Global and India Research Output in Hepatocellular Carcinoma Research during 2004-17.*

S. No	Collaborative Country	Number of ICP			Share of ICP		
		2004-10	2011-17	2004-17	2004-10	2011-17	2004-17
1	USA	38	125	163	53.52	42.37	44.54
2	South Korea	10	38	48	14.08	12.88	13.11
3	Saudi Arabia	5	40	45	7.04	13.56	12.30
4	Japan	13	30	43	18.31	10.17	11.75
5	Australia	6	33	39	8.45	11.19	10.66
6	Singapore	14	23	37	19.72	7.80	10.11
7	U.K.	1	29	30	1.41	9.83	8.20
8	China	8	21	29	11.27	7.12	7.92
9	Germany	5	24	29	7.04	8.14	7.92
10	Taiwan	6	23	29	8.45	7.80	7.92
	India Total	71	295	366			

Table 2: *Publication share of leading foreign countries in India's Collaborative Papers (ICP) research output in hepatocellular carcinoma research during 2004-17.*

ICP: International Collaborative Papers.

Top 15 most productive countries in global hepatocellular carcinoma research

The Hepatocellular Carcinoma research had originated from as many as 169 countries during 2004-17. Of these, 111 countries contributed 1 - 50 papers each, 11 countries 51 - 100 papers each, 31 countries 100 - 1000 papers each, 13 countries 1001 - 6000 papers each, 2 countries 10,000 - 20,000 papers each and 1 countries 23903 papers each during the period.

Top 15 most productive countries in global Hepatocellular Carcinoma research had contributed 1205 to 23903 publications each during 2004-17 and together they accounted for 98.04% global publication share during the period. Their 7-year productivity in the subject increased marginally from 93.03% to 101.41% between 2004-10 and 2011-17. Their global publications share ranged from 1.34% to 26.53% global publication share. The China is the global leader in Hepatocellular Carcinoma research accounting for the highest publication share (26.53%), followed by USA (20.90%), Japan (11.6%), Italy and Germany (5.72% and 5.37%), South Korea, Taiwan and France (4.99%, 4.25% and 4.14%), U.K. (3.38%), and other 6 countries (from 1.34% to 2.70%) during 1994-2017. Some of the countries like China, Egypt, India, South Korea and Australia showed increase (from 0.12% to 13.94%), while all other countries showed decease in their global publication share from 2004-10 to 2011-17 (Table 3).

S. No	Name of the Country	Number of Papers			Share of Papers		
		2004-10	2011-17	2004-17	2004-10	2011-17	2004-17
1	China	5688	18215	23903	17.59	31.53	26.53
2	USA	6912	11921	18833	21.37	20.64	20.90
3	Japan	4755	5695	10450	14.70	9.86	11.60
4	Italy	1860	3292	5152	5.75	5.70	5.72
5	Germany	1964	2872	4836	6.07	4.97	5.37
6	South Korea	1407	3088	4495	4.35	5.35	4.99
7	Taiwan	1448	2380	3828	4.48	4.12	4.25
8	France	1472	2261	3733	4.55	3.91	4.14
9	U.K.	1146	1903	3049	3.54	3.29	3.38
10	Spain	936	1497	2433	2.89	2.59	2.70
11	Canada	700	1198	1898	2.16	2.07	2.11
12	Hong Kong	777	1034	1811	2.40	1.79	2.01
13	India	410	1321	1731	1.27	2.29	1.92
14	Egypt	207	1105	1312	0.64	1.91	1.46
15	Australia	407	798	1205	1.26	1.38	1.34
	Total	30089	58580	88669	93.03	101.41	98.40
	World Total	32345	57765	90110			
	Share of 10 Countries in World Total						

Table 3: *Publication share of top 15 most productive countries in global hepatocellular carcinoma research during 2006-17.*

Subject-wise distribution of research output

The Hepatocellular Carcinoma research output by India is distributed across six sub-fields (as identified in Scopus database classification). Medicine accounts for the highest publications share (54.36%), followed by biochemistry, genetics and molecular biology (32.70%), pharmacology, toxicology and pharmaceutics (23.80%) and 3 other subjects from 4.45% to 8.03% during the period 2004-17. Seven-year

change in research across these disciplines was measured and compared on activity index. The world average activity index of a given subject is taken as 100. The discipline which witnessed increase in their activity index include: biochemistry, genetics and molecular biology (from 94.73 to 101.63), pharmacology, toxicology and pharmaceutics (from 86.08 to 104.32) and chemistry (from 39.49 to 118.78). The discipline which witnessed drop in activity index include: medicine (from 116.20 to 94.97), immunology and microbiology (from 125.76 to 92.0) and agricultural and biological sciences (from 104.18 to 98.70) from 2004-10 to 2011-17. Biochemistry, genetics and molecular biology, among nine subjects registered the highest citation impact per paper (19.95), followed by immunology and microbiology (18.99), pharmacology, toxicology and pharmaceutics (18.89), chemistry (17.80), agricultural and biological sciences (15.69) and medicine (14.20) during 2004-17 (Table 4).

S. No	Subject*	Number of Papers (TP)			Activity Index		TC	CPP	%TP
		2004-10	2011-17	2004-17	2004-10	2011-17	2004-17	2004-17	2004-17
1	Medicine	259	682	941	116.20	94.97	13365	14.20	54.36
2	Biochemistry, genetics and molecular biology	127	439	566	94.73	101.63	11293	19.95	32.70
3	Pharmacology, toxicology and pharmaceutics	84	328	412	86.08	104.32	7782	18.89	23.80
4	Chemistry	13	126	139	39.49	118.78	2474	17.80	8.03
5	Immunology and microbiology	28	66	94	125.76	92.00	1785	18.99	5.43
6	Agricultural and biological sciences	19	58	77	104.18	98.70	1208	15.69	4.45
		410	1321	1731					

Table 4: *Subject-wise breakup of Indian publications in hepatocellular carcinoma research during 2004-17.*

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

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

Indian on hepatocellular carcinoma research by treatment methods

Among the treatment methods used in Hepatocellular Carcinoma research, diagnosis contributed the largest share (14.67%), followed by pathology (14.15%), genetics (10.05%), screening (9.30%), prognosis (7.28%), chemotherapy (7.16%), surgery (5.95%), Quality of life (1.33%) and palliative care (0.64%) during 2004-17. The publication activity showed increasing trends in pathology by 8.96%, followed by genetics (4.54%), prognosis (2.5%), surgery (2.36%), diagnosis (1.97%) and screening (0.68%), as against decreasing trends in quality of life (1.14%), chemotherapy (0.52%) and palliative care (0.12%) from 1994-10 to 2011-17 (Table 5).

Profile of top 15 most productive Indian organizations

Four Hundred Fifty Eight (458) organizations contributed to India's output in Hepatocellular Carcinoma research during 2004-17, of which 330 organizations contributed 1 - 5 papers each, 73 organizations 6 - 10 papers each, 33 organizations 11 - 20 papers each, 18 organizations 21 - 50 papers each, 3 organizations 51 - 100 papers each and 1 organizations 104 papers.

S. No	Treatment Method	Number of Papers			Share of Papers		
		2004-10	2011-17	2004-17	2004-10	2011-17	2004-17
1	Diagnosis	54	200	254	13.17	15.14	14.67
2	Pathology	30	215	245	7.32	16.28	14.15
3	Genetics	27	147	174	6.59	11.13	10.05
4	Screening	36	125	161	8.78	9.46	9.30
5	Prognosis	22	104	126	5.37	7.87	7.28
6	Chemotherapy	31	93	124	7.56	7.04	7.16
7	Surgery	17	86	103	4.15	6.51	5.95
8	Quality of Life	9	14	23	2.20	1.06	1.33
9	Palliative Care	3	8	11	0.73	0.61	0.64
		410	1321	1731			

Table 5: *Distribution of Indian output on hepatocellular carcinoma research by treatment methods during 2004-17.*

The productivity of 15 most productive organizations varied from 23 to 1043 publications and together they contributed 36.80% (637) national publication share and 43.60% (11714) national citation during the period. The scientometric profile of these 15 organizations is presented in table 6.

- Five organizations registered publications output above the group average of 42.47: Postgraduate Institute of Medical Education and Research, Chandigarh (104 papers), All India Institute of Medical Research, New Delhi (97 papers), University of Madras (65 papers), Institute of Liver and Biliary Sciences, New Delhi (56 papers) and Tata Memorial Hospital (TMH), Mumbai (48 papers);
- Six organizations registered impact and relative citation index above the group average of 18.39 citations per publication and 1.18: G.B. Pant Hospital, Delhi (51.64 and 3.33), University of Delhi (39.92 and 2.57), University of Madras (24.49 and 1.58), International Centre for Genetic Engineering and Biotechnology, New Delhi (23.78 and 1.53), Postgraduate Institute of Medical Education and Research, Chandigarh (19.87 and 1.28) and Indian Institute of Chemical Biology, Kolkata (18.71 and 1.21);
- Eight organizations contributed international collaborative publications share above the group average of 20.57%: Aligarh Muslim University(51.72%), Banaras Hindu University, Varanasi (38.46%), Jadavpur University, Kolkata (37.5%), G.B. Pant Hospital, Delhi (32.14%), Indian Institute of Science, Bangalore (29.17%), Annamalai University (26.92%), Indian Institute of Chemical Biology, Kolkata (21.43%) and Institute of Liver and Biliary Sciences, New Delhi (21.43%).

Profile of top 15 most productive authors

Seven Hundred Sixty Seven (767) authors contributed to India's output in Hepatocellular Carcinoma research in India during 2004-17, of which 656 authors contributed 1 - 5 papers each, 84 authors 6 - 10 papers each, 22 authors 11 - 20 papers each and 5 authors 21 - 41 papers each. The productivity of top 15 most productive authors from India in the subject varied from 12 to 41 publications, and they accounted for 16.58% (287) national publication share and 23.17% (6226) national citation share during the period. The scientometric profile of these 15 authors is presented in table 7:

S. No	Name of the Organization	TP	TC	CPP	HI	ICP	%ICP	RCI
1	Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh	104	2066	19.87	21	8	7.69	1.28
2	All India Institute of Medical Research (AIIMS), New Delhi	97	1533	15.80	22	18	18.56	1.02
3	University of Madras	65	1592	24.49	24	9	13.85	1.58
4	Institute of Liver and Biliary Sciences (ILBS), New Delhi	56	653	11.66	16	12	21.43	0.75
5	Tata Memorial Hospital (TMH), Mumbai	48	521	10.85	12	8	16.67	0.70
6	Sir Ganga Ram Hospital (SGRH), New Delhi	34	224	6.59	8	5	14.71	0.42
7	Aligarh Muslim University (AMU)	29	383	13.21	11	15	51.72	0.85
8	G.B. Pant Hospital (GBPH), Delhi	28	1446	51.64	17	9	32.14	3.33
9	Indian Institute of Chemical Biology (IICB), Kolkata	28	524	18.71	12	6	21.43	1.21
10	Banaras Hindu University (BHU), Varanasi	26	266	10.23	8	10	38.46	0.66
11	Annamalai University	26	368	14.15	10	7	26.92	0.91
12	University of Delhi	25	998	39.92	12	5	20.00	2.57
13	Indian Institute of Science (IISc), Bangalore	24	190	7.92	9	7	29.17	0.51
14	Jadavpur University, Kolkata	24	403	16.79	9	9	37.50	1.08
15	International Centre for Genetic Engineering and Biotechnology (ICGEB), New Delhi	23	547	23.78	15	3	13.04	1.53
	Total of 15 organizations	637	11714	18.39	13.73	131	20.57	1.18
	Total of India	1731	26870	15.52				
	Share of top 15 organizations in India total output	36.80	43.60					

Table 6: *Scientometric profile of top 15 most productive organizations in hepatocellular carcinoma research by India during 2004-17.*

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

- Five authors registered publications output above the group average of 19.13: S.K. Sarin (41 papers), Y.K. Chawla (31 papers), A.K. Acharya (28 papers), R.K. Dhiman (24 papers) and N. Kalra (22 papers);
- Four authors registered impact and relative citation index above the group average of 21.69 citations per publication and 1.40: Y.K. Chawla (41.87 and 2.70), T. Devaki (41.42 and 2.67), S.K. Sarin (36.73 and 2.37) and A. Duseja (23.06 and 1.49);
- Four authors contributed international collaborative publications share above the group average of 8.36% of all authors: S.K. Sarin (24.39%), T. Devaki (16.67%), Y.K. Chawla (12.90%) and A.K. Acharya (10.71%).

Medium of research communication

Of the total India's publications output in Hepatocellular Carcinoma research, 97.46% (1687) appeared in journals, 1.04% (18) as books, 0.98% (17) in conference proceedings and 0.52% (9) in book series. Three Hundred Forty Nine (349) journals reported India's research in Hepatocellular Carcinoma during 2004-17, of which 299 journals contributed 1 - 5 papers each, 31 journals 6 - 10 papers each, 13 journals 11 - 20 papers each, 5 journals 21 - 50 papers each, and 1 journal 70 papers.

The top 15 most productive journals accounted for 13 to 70 papers each, accounting for 20.75% share (350 papers) of total journal publication output during 2004-17. Their 7-year publication soared marginally from 24.32% to 19.61% between 2004-10 and 2011-17. The top most productive journal (with 70 papers) was *Journal of Clinical and Experimental Hepatology*, followed by *Indian Journal of Gastroenterology* (36 papers), *International Journal of Pharmacy and Pharmaceutical Sciences* (30 papers), *Journal of Clinical and Diagnostic Research* (25 papers), etc. during 2004-17 (Table 8).

S. No	Name of the author	Affiliation of the author	TP	TC	CPP	HI	ICP	%ICP	RCI
1	S.K. Sarin	G.B. Pant Hospital, New Delhi	41	1506	36.73	18	10	24.39	2.37
2	Y.K. Chawla	PGIMER, Chandigarh	31	1298	41.87	17	4	12.90	2.70
3	A.K. Acharya	AIIMS, New Delhi	28	336	12.00	11	3	10.71	0.77
4	R.K. Dhiman	PGIMER, Chandigarh	24	450	18.75	9	0	0.00	1.21
5	N. Kalra	PGIMER, Chandigarh	22	351	15.95	10	0	0.00	1.03
6	A. Duseja	PGIMER, Chandigarh	17	392	23.06	11	1	5.88	1.49
7	V. Kumar	ICGEB, New Delhi	16	202	12.63	10	1	6.25	0.81
8	P. Kar	MAMC, New Delhi	15	193	12.87	9	1	6.67	0.83
9	N. Khandelwal	PGIMER, Chandigarh	15	291	19.40	7	0	0.00	1.25
10	S.B. Paul	AIIMS, New Delhi	15	174	11.60	7	0	0.00	0.75
11	A. Rastogi	ILBS, New Delhi	14	103	7.36	5	1	7.14	0.47
12	K. Madan	AIIMS, New Delhi	13	262	20.15	8	1	7.69	1.30
13	T. Devaki	University of Madras	12	497	41.42	8	2	16.67	2.67
14	D. Jain	Sir Ganga Ram Hospital, New Delhi	12	108	9.00	6	0	0.00	0.58
15	A. Kumar	Sir Ganga Ram Hospital, New Delhi	12	63	5.25	4	0	0.00	0.34
		Total of 15 authors	287	6226	21.69	9.33	24	8.36	1.40
		Total of India	1731	26870	15.52				
		Share of 15 authors in India's total	16.58	23.17					

Table 7*: Scientometric profile of top 15 most productive authors in hepatocellular carcinoma research by India during 2004-17. TP: Total Papers; TC: Total Citations; CPP: Citations Per Paper; HI: h-index; ICP: International Collaborative Papers; RCI: Relative Citation Index.*

Highly cited papers

All of such papers that have received 100 to 100+ citations in 14-year since their publication are defined as highly cited papers. Of the 1731 papers in the field of Hepatocellular Carcinoma research by India during 2004-17, the country share of highly cited papers has been found to be very small, 1.85% (32) of its national output.

- These 32 papers received 100 to 715 citations per paper since their publication, cumulated 7681 citations, and averaged 140.03 citations per paper.
- A total of 391 authors from 283 organizations spread across 50 countries contributed to these 32 highly cited papers.

S. No	Name of the Journal	Number of Papers		
		2004-10	2011-17	2004-17
1	*Journal of Clinical and Experimental Hepatology*	10	60	70
2	*Indian Journal of Gastroenterology*	14	22	36
3	*International Journal of Pharmacy and Pharmaceutical Sciences*	1	29	30
4	*Journal of Clinical and Diagnostic Research*	2	23	25
5	*Indian Journal of Medical Research*	6	16	22
6	*Molecular and Cellular Biochemistry*	8	13	21
7	*PLOS One*	2	18	20
8	*World Journal of Gastroenterology*	12	8	20
9	*Indian Journal of Pathology and Microbiology*	11	8	19
10	*Indian Journal of Cancer*	6	11	17
11	*Journal of Gastroenterology and Hepatology Australia*	13	2	15
12	*Medicinal Chemistry Research*	0	15	15
13	*RSC Advances*	0	14	14
14	*Hepatitis B Annual*	10	3	13
15	*Hepatology International*	4	9	13
	Total of 15 journals	99	251	350
	Total India journal output	407	1280	1687
	Share of top 15 journals in Indian journal output	24.32	19.61	20.75

Table 8: *Top 15 most productive journals in hepatocellular carcinoma research by India during 2004-17.*

- Of the 32 highly cited papers, 19 received 100-193 citations each, 7 received 208-973 citations each, and 4 papers each re ceived 619 to 715 citations.
- The USA accounted for the highest number of highly cited papers (14), followed by Japan (8), Australia, South Korea and China (7 papers each), Italy (6 papers), U.K., Canada and Singapore (5 papers each), France, Germany, Taiwan and Hong Kong (4 pa pers each), Pakistan (3 papers), Denmark, Greece, Philippines, South Africa, Sweden and Switzerland (2 papers each) etc.
- Among the Indian participating organizations, All India Institute of Medical Sciences, New Delhi, G.B. Pant, Delhi, Institute of Life Sciences, Bhubaneswar, Institute of Genome and Integrated Biology, Delhi, Jaslok Hospital, Bombay, Postgraduate Institute of Medical Education and Research, Chandigarh and University of Madras contributed 2 papers and 25 other Indian organiza tions 1 paper each. Of the 32 highly cited papers, 10 were non-collaborative papers and 22 collaborative papers (including 3 as national collaborative and 19 as international collaborative).
- Of the 32 highly cited papers, 15 appeared as articles, 16 as reviews and 1 as short survey.
- These 32 highly cited papers appeared across 30 journals, with 2 papers each Chemical-Biological Interactions and Nanome dicine and 1 paper each in *AAPS Journal, Advanced Drug Delivery Review, American Journal of Roentgenology, Annals of Surgery, Asian Journal of Andrology, Biochemica et Biophysica Acta, Biorganic and Medicinal Chemistry Letters, Blood, Bulletin of WHO, Chemistry-A European Journal, Digestive Disease and Sciences, Cytokine and Growth Factor Review, Environmental Health Per spectives, Expert Opinion on Therauptics Targets, Hepatology, Hepatology International, Indian Journal of Medical Research, Inter national Journal of Nanomedicine, Journal of Clinical Gastroenterology, Journal of General Virology, Journal of Controlled Devise, Molecular Cancer, Seminar in Cancer Biology, Ultrasound in Medicine and Biology* and *Ultraschall in der Medizine.*

Discussion and Conclusion

Discussion

The present paper provides a quantitative and qualitative description of Hepatocellular Carcinoma research in India vis-à-vis the world. The bibliometric analysis in the paper is based on publications data in the subject as seen from Scopus database covering 14-year period during 2004-17. India ranks as the 13th top ranking country amongst top 15 world countries ranked, with a global publications share of 1.92%. India registered annual average growth rate of contributed 19.43%, international collaborative publication share of 21.14% and average to 15.52 citations per paper during 2004-17.

The top 15 most productive countries in global Hepatocellular Carcinoma research together contributed 98.04% global publication share. The China has emerged as the world leader in the subject followed by USA, Japan, Italy, Germany, South Korea, Taiwan, France etc. India registered 19.43% annual growth in the subject, more than twice the world growth rate of 7.66%. In terms of qualitative analysis, India's citation impact has been high, 15.52 citations per paper, and it contributed 1.85% share of its national output as highly cited papers (32 papers).

Medicine accounted for the highest publications share (54.36%), followed by biochemistry, genetics and molecular biology (32.70%), pharmacology, toxicology and pharmaceutics (23.80%) and 3 other subjects from 4.45% to 8.03% during the period 2004-17. The productivity of 15 most productive organizations and authors together contributed 36.80% and 16.58% share of national publication share and 43.60% and 23.17% share of national citation during 2004-17. The leading Indian research organizations in Hepatocellular Carcinoma research include: Postgraduate Institute of Medical Education and Research, Chandigarh (104 papers), All India Institute of Medical Research, New Delhi (97 papers), University of Madras (65 papers), Institute of Liver and Biliary Sciences, New Delhi (56 papers) and Tata Memorial Hospital (TMH), Mumbai (48 papers. In terms citation impact per paper and relative citation index, the leading Indian organizations were G.B. Pant Hospital, Delhi (51.64 and 3.33), University of Delhi (39.92 and 2.57), University of Madras (24.49 and 1.58), International Centre for Genetic Engineering and Biotechnology, New Delhi (23.78 and 1.53), Postgraduate Institute of Medical Education and Research, Chandigarh (19.87 and 1.28) and Indian Institute of Chemical Biology, Kolkata (18.71 and 1.21). The top 15 journals that contributed 20.75% publication share include: *Journal of Clinical and Experimental Hepatology* (70 papers), followed by *Indian Journal of Gastroenterology* (36 papers), *International Journal of Pharmacy and Pharmaceutical Sciences* (30 papers), *Journal of Clinical and Diagnostic Research* (25 papers), etc. These 32 papers received 100 to 715 citations per paper since their publication, cumulated 7681 citations, and averaged 140.03 citations per paper. The 32 papers involved 391 authors from 283 organizations spread across 50 countries and are published in across 30 journals, with 2 papers each Chemical-Biological Interactions and Nanomedicine and 1 paper each in other journals.

Conclusion

Although there are many consensus guidelines on management of Hepatocellular Carcinoma from USA, Europe and Asia, however, most of these fail to address India specific issues on management of HCC. The Indian National Association for Study of the Liver (INASL) felt a need to develop 'India-specific' consensus guidelines for diagnosis and management of HCC. Therefore, INASL set up a Task-Force on HCC in 2011 and developed guidelines with a mandate to develop consensus guidelines on various clinical aspects of HCC, relevant to disease patterns and clinical practices in India. These guidelines were helping in developing a framework for future research on affordable treatment options for HCC in India. These guidelines are evidence -based and are aimed at providing the best possible care to the patients of HCC in India according to the current evidence. They also ensure a uniformity of diagnostic and treatment approaches of HCC in the entire country and also serve as framework for future research on HCC in India. As more evidence is generated, especially from India, in next 3-4 years, these guidelines will need to be updated and revised.

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