Invited Article

Liver disorders: A scientometric study of publication outputs from India during 2003-2012

Abstract

Objectives: Analyses were done on the Indian publication outputs on liver disorder research during 2003-2012, on several parameters, including contribution and citation impact of the most productive countries, India's overall contribution, its growth pattern, citation impact, the share of international collaboration, identification of the significant participating countries in India's international collaboration, contribution and impact of different types of liver disorders, productivity and impact of leading Indian institutions and authors, and pattern of communication of Indian output in most productive journals. **Materials and Methods:** The Scopus Citation Database has been used to retrieve the data for 10 years (2003-2012) by searching with the keyword 'liver,' in the combined Title, Abstract, and Keywords field. **Results:** The Indian publication's output in the liver disorder research consisted of 2380 articles during 2003-2012, which increased from 143 articles in 2003 to 378 articles in 2012, witnessing an annual average growth rate of 11.92%. The average citation impact per article registered by the Indian publications for liver disorder research was 4.68 during 2003-2012, which decreased from 6.43 during 2003-2007 to 3.71 during 2008-2012. The international collaborative share of India in the overall liver disorder research was 15.34% during 2003-2012, which increased from 12.65% during 2003-2007 to 16.84% during 2008-2012. **Conclusions:** Keeping in view the severity of liver disorders in India, there is a need to increase the investment in Research and Development (R and D) to bring about improvements in supportive care and a need to set up a Hepatitis Registry. Efforts must be made to develop state- and government-supported prevention and control strategies, including conducting mass awareness programs, formulation of universal guidelines for immunization, promotion of partnerships, development of an evidence-based policy, and development of programs for prevention of transmission, along with better financial and social support initiatives.

Key words: Bibliometrics, India, liver, publication output, scientometrics

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INTRODUCTION

The liver is one of the major metabolizing organs in the human body. It plays a pivotal role in providing important nutrients from the food to the blood. Changes in liver function due to infection or any other associated diseases, causes an imbalance in the above-mentioned functions leading to irreversible severe hepatic diseases/disorders, such as, liver cirrhosis, liver cancer, hepatitis, and the like.[1] A large number of liver-associated disorders or diseases are still unknown.[2-5]

One of the most severe and common liver disease is attributed to Hepatitis, which occurs due to inflammation caused by different types of hepatitis viruses. Hepatitis B and C lead to chronic disease in hundreds of millions of people; they are the most common cause of liver cirrhosis and cancer.[6] As per the World Health Organization (WHO) fact sheet, there are an estimated 1.4 million cases of hepatitis globally every year;[7] two billion people worldwide have been infected, and about 600 000 people die every year due to the consequences of Hepatitis B.[8] About 150 million people are chronically infected, and more than 350 000 people die every year from Hepatitis C-related liver diseases.[9] Every year there are 20 million Hepatitis E infections, over three million acute cases of Hepatitis E, and 70 000 hepatitis E-related deaths.[10] In India, about 250 000 people die of viral hepatitis,[11-12] 300 000 of

cirrhosis, about 20 000 liver cancers may be occurring annually,[13] and the community prevalence of nonalcoholic fatty liver diseases varies from 5 to 28%.[14]

According to the latest WHO data published in April 2011, liver disease deaths in India reached 208 185 or 2.31% of the total deaths. The age-adjusted death rate is 23.59 per 100 000 of the population, which ranks India as twenty-seventh in the world.[15] It is estimated that liver diseases are among the top ten killer diseases in India. Many studies have reported that liver-related diseases like Hepatitis B and Hepatitis C virus could multiply into an epidemic that is greater than HIV.

In India, few non-profitable organizations play a significant role in the prevention and treatment of liver diseases. The Indian Association for Study of the Liver (INASL)[16] fulfills the educational and scientific needs of many health professionals, as well as, researchers and basic scientists. The National Liver Foundation (NLF)[17] is involved in promoting awareness about preventable hepatic diseases among people suffering from chronic or advanced diseases through various educational and training programs, including seminars, patient support groups, mobilizing funds for providing treatment to patients at considerably subsidized rates, campaigns for promoting organ donation, and other activities such as vaccinating all medical students and paramedical entrants with the Hepatitis B vaccine. The Liver Care Foundation[18] works at the national level with patients, caregivers, and professionals associated with a liver disease.

There are few studies conducted on hepatitis and liver transplantation. Miri, Raoofi, and Heidari[19] evaluated the citation parameters of 104 articles published in the *Hepatitis Monthly,* in 2010, and covered three databases, including Web of Science, Scopus, and Google Scholar. Carvalho and Araújo[20] made a bibliographic study of the thesis published during 2000-2006, focusing on Hepatitis B, to identify where the studies had been undertaken, their nature, type, and the emphasis of these studies. Trapero, Pérez, Pajares, and Moreno[21] analyzed 1051 scientific publications on Hepatitis C virus infection, derived from the Medline database of Spanish hospitals, from 1980-2002. It noticed that the number and impact factor of scientific publications on Hepatitis C virus had grown significantly during the last two decades. Bas, Dayangac Yaprak, Yuzer, and Tokat[22] studied the Turkish publications on liver transplantation from 1980 to 2011, as covered by the Science Citation Index (SCI). Ramakrishnan and Babu[23] studied world literature on hepatitis during the period 1984-2003, as covered in three bibliographic databases. It found that 85.17% of the contributions were collaborative in nature, with different degrees of collaborations. However, no specific studies have been undertaken in India on liver disorder research. Nevertheless, authors have carried out similar studies on other diseases in the Indian context, such as, tuberculosis,[24] malaria,[25] asthma,[26] measles,[27] and diabetes.[28]

OBJECTIVES

The main objective of this study is to analyze the liver disorder research output in India during 2003-2012. The study has the following objectives:

1. To study the contribution and citation impact of 20 of the most productive countries,
2. To study India's overall contribution, its growth pattern, and citation impact,
3. To study the share of international collaboration in India's overall research output and the identification and contribution of leading countries,
4. To study the Indian contribution and impact of different types of liver diseases, liver disorder researches by subfields and by different age groups,
5. To study the productivity and impact of leading Indian institutions and authors, and
6. To study the pattern of communication of the Indian output in the most productive journals.

MATERIALS AND METHODS

This study used the Scopus International Database [http://www.scopus.com/search/] to extract relevant data on the liver disorder research of the world and other 20 most productive countries, for a period of 10 years (2003-2012). An advanced search strategy, involving 'liver' as the keyword, was used to search and download data by using the Title, Abstract, and Keywords fields, resulting in the downloading of 2380 records related to the Indian liver disorder research. Separate strategies were developed in terms of keywords for identifying different types of liver diseases, liver disorder research outputs by subfields, and by different age groups. For analyzing significant institutions and authors, separate search strategies were developed, which later combined with the main string to lead to the generation of the desired output. For the citation data, three years, two years, one year, and zero year citation windows had been used for computing average citations per article on liver disorder research during 2003-2009, 2010, 2011, and 2012. For example, for articles published in 2003, the citation window was three years, from 2003-2006. For articles published in 2010, the citation window was two years, from 2010-2012, and for articles published in 2011, the citation window was one year, 2011-2012.

RESULTS

Global publication share and rank

The global publication share of the top 20 most productive countries in liver disorder research varies from 0.88 to 25.55% during 2003-2012. The United States tops the list, with a publication share of 25.55% during 2003-2012. China ranks at the second position with a 11.67% publication share, followed by Japan (10.88% share, third rank), Italy (6.62% share, fourth rank), Germany (6.21% share, fifth rank), U.K. (5.23% share, sixth rank), France (5.09% share, seventh rank), Spain, South Korea, Taiwan, Canada, and India with publication shares ranging from 2.19 to 3.86% and ranking from eighth to twelfth positions. Australia, Turkey, Switzerland, Brazil, Belgium, Greece, Poland, and Austria rank from the thirteenth to twentieth positions, with publication shares ranging from 0.88 to 1.98%. The developed countries showing an increase in their publication share are Italy by

0.43%, followed by Switzerland (0.28%), U.K. (0.17%), Australia (0.12%), Canada (0.11%), Austria. (0.08%), Belgium (0.05%), and Greece (0.04%), as against a decrease in Japan by 1.90%, followed by USA (0.40%), France (0.30%), Germany (0.15%), Spain (0.14%), Turkey (0.07%), and Poland (0.02%) from 2003-2007 to 2008-2012. All developing countries on the other hand, have shown a rise in their publication share in liver disorder research: China by 4.92%, followed by South Korea (1.46%), India (0.58%), Brazil (0.25%), and Taiwan (0.14%) from 2003-2007 to 2008-2012 [Table 1].

India ranks twelfth among the top 20 most productive countries in liver disorder research, with its global publication share of 2.19% during 2003-2012. China, South Korea, Taiwan, and Brazil rank second, ninth, tenth, and sixteenth, with global publication shares of 11.67, 3.14, 2.92, and 1.23%, respectively, during 2003-2012. India's global publication share increased from 0.86 to 2.44%, compared to China's, which rose from 8.83 to 13.75%, South Korea from 2.30 to 3.76%, Taiwan from 2.84 to 2.98%, and Brazil from 1.08 to 1.33%, from 2003-2007 to 2008-2012 [Table 1].

India's publication output in liver disorder research

The world cumulative publication output in liver disorder consists of 108 623 articles during 2003-2012, increasing from 7874 articles in 2003 to 13200 articles in 2012, witnessing an annual average growth rate of 5.97%. India's cumulative publication output in liver disorder consists of 2380 articles, accounting for 2.44% of the share in the global publication output, during 2003-2012. It increased from 143 articles in 2003 to 378 articles in 2012, with an average number of articles per year at 238, and an annual average growth rate of 11.92%. The cumulative publication output of India in liver disorder research increased from 854 articles during 2003-2007 to 1526 articles during 2008-2012, witnessing a growth of 78.69%. India's global publication share increased from 1.82% in 2003 to 2.85% in 2012. In terms of impact and citation quality, the average citation per article registered by India's publications was 4.68 during 2003-2012, which decreased from 6.43 during 2003-2007 to 3.71 during 2008-2012 [Table 2].

International collaboration in India's publication output

The total number of Indian articles on liver disorder involving international collaboration during 2003-2012 was 365, which accounted for a 15.34% share in the cumulative publication output of India in research. The share of India's international collaborative publications increased from 12.65% during 2003-2007 to 16.84% during 2008-2012 [Table 3].

Among the major Indian international collaborators, 18 countries have published 10 or more collaborative articles with India during 2003-2012. United States was the major collaborating partner for India during 2003-2012, accounting for a 54.79% share of the total collaborative publications, followed by Japan (with 12.33% share), U.K.(10.41% share), Singapore (9.04% share), China (7.40% share), Germany (7.12%), Australia and South Korea (6.85% each), Taiwan and Thailand (5.75%each), Saudi Arabia (4.93%), France (4.38%), and other countries between 2.74 and 3.84%.

Among the 18 collaborating countries, the publication share has increased by 4.95% in Singapore, followed by Japan (4.36%), Spain (3.89%), South Korea (3.15%), Belgium (2.57%), France (2.28%), Australia (1.83%), Saudi Arabia (1.75%), Canada (1.50%), Malaysia

Table 1: Publications output, share, and rank of top 20 countries in liver disorder, 2003-2012

Country	Number of articles			Share of articles		
	2003-2007	2008-2012	2003-2012	2003-2007	2008-2012	2003-2012
USA	11851	15904	27755	25.78	25.38	25.55
China	4059	8614	12673	8.83	13.75	11.67
Japan	5504	6309	11813	11.97	10.07	10.88
Italy	2929	4258	7187	6.37	6.80	6.62
Germany	2895	3853	6748	6.30	6.15	6.21
UK	2358	3319	5677	5.13	5.30	5.23
France	2422	3111	5533	5.27	4.97	5.09
Spain	1813	2383	4196	3.94	3.80	3.86
South Korea	1059	2356	3415	2.30	3.76	3.14
Taiwan	1306	1865	3171	2.84	2.98	2.92
Canada	1211	1714	2925	2.63	2.74	2.69
India	854	1526	2380	1.86	2.44	2.19
Australia	877	1269	2146	1.91	2.03	1.98
Turkey	800	1048	1848	1.74	1.67	1.70
Switzerland	582	973	1555	1.27	1.55	1.43
Brazil	498	834	1332	1.08	1.33	1.23
Belgium	517	733	1250	1.12	1.17	1.15
Greece	508	718	1226	1.11	1.15	1.13
Poland	466	618	1084	1.01	0.99	1.00
Austria	382	570	952	0.83	0.91	0.88
World	45970	62653	108623	100.00	100.00	100.00

(0.72%), UK (0.32%), and Taiwan (0.28%), as against a decrease in United States by 10.29% followed by Philippines (3.23%), Germany (3.03%), Thailand (2.35%), Pakistan (1.52%), and China (1.33%) from 2003-2007 to 2008-2012 [Table 3].

Indian liver disorder research output in context of different subjects

India's publication output in liver disorder during 2003-2012 has been published in the context of nine subjects (as reflected in the database classification of the Scopus database, based on the journal subject content), with the highest publication output coming from medicine (1608 articles and 67.56% publication share), followed by biochemistry, genetics, and molecular biology (581 articles and 24.41% publication share), pharmacology, toxicology, and pharmaceutics (556 articles and 23.36% publication share), immunology and microbiology (134 publications, 5.63% publication share), agricultural and biological sciences (106 articles and 4.45% publication share), chemistry (67 articles and 2.82% publication share), environmental science (49 publications, 2.06% publication share), veterinary science (26 publications, 1.09% publication share), and health profession (24 publications, 1.01% publication share). On analyzing the quality and citation impact of liver disorder research under different subjects, it was found that immunology and microbiology had scored the highest impact (6.22 citations per article), followed by chemistry (6.15 citations per article), pharmacology, toxicology, and pharmaceutics (5.41 citations per article), biochemistry, genetics, and microbiology (5.03 citations per article), medicine (4.27 citations per article), health profession (3.96 citations per article), agricultural and biological sciences (3.77 citations per article), environmental science (3.71 citations per article), and veterinary science (3.24 citations per article). In terms of the h-index, biochemistry, genetics, and molecular biology have achieved the highest h-index of 51, followed by medicine (44), pharmacology, toxicology, and pharmaceutics (35), immunology and microbiology (20), and so on. On the basis of high-cited articles, biochemistry, genetics, and molecular biology depict the highest number of high-cited articles as nine, followed by medicine (five), pharmacology, toxicology, and pharmaceutics (three), and chemistry (one) [Table 4].

Table 2: Contribution and impact of liver disorder research in India, 2003-2012

Period	World	India					
	TP	TP	TP %	TC	ACPP	ICP	ICP %
2003	7874	143	1.82	595	4.16	16	11.19
2004	8600	147	1.82	896	6.10	20	13.61
2005	9347	157	1.71	727	4.63	22	14.01
2006	9888	197	1.68	1301	6.60	22	11.17
2007	10261	210	1.99	1971	9.39	28	13.33
2008	11169	230	2.05	1488	6.47	38	16.52
2009	12028	246	2.06	1721	7.00	42	17.07
2010	12605	286	2.05	1396	4.88	50	17.48
2011	13551	386	2.27	909	2.35	54	13.99
2012	13200	378	2.85	144	0.38	73	19.31
2003-2007	45970	854	2.86	5490	6.43	108	12.65
2008-12	62653	1526	1.86	5658	3.71	257	16.84
2003-2012	108623	2380	2.44	11148	4.68	365	15.34

TP = Total articles, TC = Total citations, ACPP = Average citations per article, ICP = International collaborative articles

Indian research output by different types of liver disorder

Among the various types of liver disorders in India, the largest number of articles was on viral hepatitis (1286 articles, 54.03% publication share), followed by liver cancer (729 articles, 30.63% share), fatty liver disorder (496 articles, 20.84% share), autoimmune

Table 3: Indian collaboration with different countries in liver disorder, 2003-2012

Collaborating Country	Number of international collaborative articles			Share of international collaborative articles		
	2003-2007	2008-2012	2003-2012	2003-2007	2008-2012	2003-2012
USA	67	133	200	62.04	51.75	54.79
Japan	10	35	45	9.26	13.62	12.33
UK	11	27	38	10.19	10.51	10.41
Singapore	6	27	33	5.56	10.51	9.04
China	9	18	27	8.33	7.00	7.40
Germany	10	16	26	9.26	6.23	7.12
Australia	6	19	25	5.56	7.39	6.85
South Korea	5	20	25	4.63	7.78	6.85
Taiwan	6	15	21	5.56	5.84	5.75
Thailand	8	13	21	7.41	5.06	5.75
Saudi Arabia	4	14	18	3.70	5.45	4.93
France	3	13	16	2.78	5.06	4.38
Canada	3	11	14	2.78	4.28	3.84
Pakistan	5	8	13	4.63	3.11	3.56
Philippines	6	6	12	5.56	2.33	3.29
Malaysia	3	9	12	2.78	3.50	3.29
Belgium	1	9	10	0.93	3.50	2.74
Spain	0	10	10	0.00	3.89	2.74
Total	108	257	365	100.00	100.00	100.00

Table 4: Broad subject-wise distribution of liver disorder research in India, 2003-2012

Subject	India, 2003-2012					
	TP	TC	ACPP	H-index	HCP	HCP %
Medicine	1608	6859	4.27	44	5	0.31
Biochemistry, genetics, and molecular Biology	581	2922	5.03	51	9	1.55
Pharmacology, toxicology, and pharmaceutics	556	3008	5.41	35	3	0.54
Immunology and Microbiology	134	833	6.22	20	0	0.00
Agricultural and biological sciences	106	400	3.77	15	0	0.00
Chemistry	67	412	6.15	17	1	1.49
Environmental science	49	182	3.71	11		0.00
Veterinary science	26	33	1.27	4	0	0.00
Health profession	24	95	3.96	8	0	0.00
Total	2380	14744	6.19	25.62	18	0.00

TP = Total articles, TC = Total citations, ACPP = Average citations per article, HCP= High cited papers

disorder (106 articles, 4.45%), and genetic liver disorder (129 articles, 5.42% share). In terms of citation impact per article, the largest impact (5.69) was made by fatty liver disorder, followed by viral hepatitis (4.95), genetic liver disorder (4.47), liver cancer (4.40), and autoimmune disorder (4.40) [Table 5]. Within viral hepatitis, the largest emphasis was on hepatitis A (1096 articles), followed by hepatitis B (599 articles), hepatitis C (457 articles), drug- or toxic-induced hepatitis (308 articles), hepatitis E (287 articles), hepatitis D (104 articles), alcoholic hepatitis (89 articles), hepatitis delta virus (27 articles), and hepatitis G virus (five articles). Among liver cancer disorders, the maximum emphasis was on liver cell cancer (668 articles), squamous cell carcinoma (80 articles), cholangiocarcinoma and hepatoblastoma (28 articles each), angiosarcoma (11 articles), fibrolamellar carcinoma (six articles) and epithelial hemangioendothelioma (one article). Among autoimmune liver disorders, the largest emphasis was on autoimmune hepatitis (70 articles), followed by primary sclerosing cholanoitis (15 articles), and biliary cirrhosis (five articles). Among genetic liver disorders, the largest emphasis was on Wilson disease (73 articles), followed by glycogen storage disease (30 articles), hemochromatosis (23 articles), tyrosinemia (eight articles) and alpha 1 antitrypsin deficiency (seven articles) [Table 6].

Lliver disorder research in india by type of population group

In the liver disorder research in India on population by age group, the largest emphasis was on adults (740 articles, 31.09% share), followed by the middle-aged (365 articles, 15.34% share), aged (227 articles, 9.54% share), adolescent (223 articles, 9.37% share), and child (212 articles, 8.91% share) [Table 7].

Research profile of the most productive indian institutions in liver disorder research in india

The top 15 most productive Indian institutions involved in liver disorder research have together published 919 articles (with productivity of each institution varying from 23 to 155) during 2003-2012, accounting for 38.61% of the share in the cumulative publication output of India, with an average of 61.26 articles per institution. The publication profiles of these 15 Indian institutions along with their research output, citations received, and h-index values are presented in Table 8.

Table 5: Type of liver disorder research in India, 2003-2012

Type of disorder	TP	TC	ACPP	TP %
Viral Hepatitis	1286	6367	4.95	54.03
Liver cancer	729	3207	4.40	30.63
Fatty liver disorder	496	2824	5.69	20.84
Autoimmune disorder	106	466	4.40	4.45
Genetic liver disorder	129	577	4.47	5.42
Total	2380			

TP = Total articles, TC = Total citations, ACPP = Average citations per article

Only six institutions have registered a higher publication share than the group average productivity. These are All India Institute of Medical Sciences, New Delhi, with 155 articles, followed Postgraduate Institute of Medical Education and Research, Chandigarh (114 articles), University of Madras (92 articles), Annamalai University (79 articles), GB Pant Hospital, Delhi (74 articles) and Sanjay Gandhi Postgraduate Institute of Medical Sciences Lucknow (67 articles). The average citation per article registered by the total articles of these 15 institutions is 6.17 during 2003-2012. Five Indian institutions have registered a higher citation impact than the group average citation impact. Among these five Indian institutions, the highest impact of 17.37 citations per article was scored by the University of Delhi, followed by G B Pant Hospital, Delhi (9.91 citations per article), King Edward Memorial Hospital, Mumbai (7.58 citations per article), Jadavpur University, Kolkata (7.20), and All India Institute of Medical Sciences, New Delhi (6.20). The average h-index value of these 15 most productive institutions was 12.4 during 2003-2012. Six Indian institutions have scored a higher h-index value than the group's average of 12.4. Among these six Indian institutions, the highest h-index value (20 each) was achieved by All India Institute of Medical Science, New Delhi and University of Madras, followed by G B Pant Hospital, Delhi (18), Postgraduate Institute of Medical Education and Research, Chandigarh and Annamalai University (15 each), and Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow (14) [Table 8].

Table 6: Research output in India under various liver disorders, 2003-2012

Type of disorder	TP	Type of disorder	TP	Type of disorder	TP
Genetic liver disorder		**Liver cancer**		**Type of viral hepatitis**	
Hemochromatosis	23	Hepatocellular carcinoma	668	Hepatitis A	1096
Wilson Disease	73	Cholangiocarcinoma	28	Hepatitis B	599
Tyrosinemia	8	Fibrolamellar carcinoma	6	Hepatitis C	457
Alpha 1 antitrypsin deficiency	7	Squamous cell carcinoma	80	Hepatitis D	104
Glycogen Storage Disease	30	Epithelial Hemangioendothelioma	1	Hepatitis E	287
Type of autoimmune liver disorder		Angiosarcoma	11	Hepatitis delta virus	27
Autoimmune hepatitis	70	Hepatoblastoma	28	Hepatitis G Virus	5
Primary sclerosing cholanoitis	15	Hepatocellular adenoma	4	Drug or toxic-induced hepatitis	308
Billary cirrhosis	5			Alcoholic hepatitis	89

Note. There is an overlapping of literature in sub-categories under each type of liver disorder, TP = Total articles

Table 7: Liver disorder research in india by type of population group, 2003-2012

Population age group	No of Articles	% of Articles
Child	212	8.91
Adolescent	223	9.37
Adult	740	31.09
Middle-aged	365	15.34
Aged	227	9.54
Total	2380	

Table 8: Productivity and impact of the top fifteen indian institutions in liver disorder research, 2003-2012

Name	TP	TC	ACPP	h-Index
All India Institute of Medical Sciences, New Delhi	155	961	6.20	20
Postgraduate Institute of Medical Education and Research, Chandigarh	114	586	5.14	15
University of Madras	92	520	5.65	20
Annamalai University	79	400	5.06	15
GB Pant Hospital, Delhi	74	733	9.91	18
Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow	67	372	5.55	14
Maulana Azad Medical College, Delhi	60	271	4.52	12
Christian Medical College, Vellore	53	270	5.09	10
Tata Memorial Hospital, Mumbai	46	126	2.74	9
Jadavpur University, Kolkata	45	324	7.20	11
Sir Ganga Ram Hospital, Delhi	30	164	5.47	6
Jawaharlal Nehru University, New Delhi	28	155	5.54	9
University of Delhi	27	469	17.37	11
King Edward Memorial Hospital, Mumbai	26	197	7.58	10
Banaras Hindu University, Varanasi	23	122	5.30	6

TP = Total articles, TC = Total citations, ACPP = Average citations per article

Contributions and impact of the most productive indian authors in liver disorder research

Fifteen authors have been identified as the most productive, who have published 17 and above articles in liver disorder research in India. These 15 authors together contributed to 479 articles, with an average of 31.93 articles per author, and accounted for 20.13% of the share in the cumulative Indian publications output during 2003-2012. The publication profiles of these 15 authors along with their research output, citations received, and h-index values are presented in Table 9.

Four authors have published a higher number of articles than the group average (31.93). These are: S.K. Sarin with 79 articles, followed by Y.K. Chawla (58 articles), P. Kar (49 articles), and S.K. Acharya (32 articles). Considering the citation impact of articles, these 15 productive authors have received a total of 4330 citations for 479 articles, with an average of 9.04 citations per article. Six authors have registered a higher impact than the average impact of articles of all authors (9.04). These are: K. Madan with 21.10 citations per article, followed by B.C.Sharma (17.21 citations per article), P. Sakhuja (13.66 citations per article), S.K. Panada (11.86 citations per article), S.K.Sarin (10.81 citations per article), and R. Aggarwal (10.50 citations per article). Measuring the performance of these authors on the basis of the h-index, five authors have achieved the higher h-index value than the group average of 10.47. These authors are, S.K.Sarin with h-index of 19, followed by P. Kar (14), Y.K. Chawla (13), B.C.Sharma (12), and T. Devaki (11) [Table 9].

Research communication in high productive journals

The 15 most productive journals publishing Indian research articles on liver disorder research together contributed 441 articles, which accounted for 18.53% of the share of the total output of India during 2003-2012. The cumulative publication output share of these 15 most productive journals showed a decrease in India's publications output from 24.82% during 2003-2007 to 15.01% during 2008-2012 [Table 10]

DISCUSSION

The Indian publications in liver disorders research consisted of 2380 articles during 2003-2012, which increased from 143 articles in 2003 to 378 articles in 2012, witnessing an annual average growth rate of 11.92%. The average citation impact per article registered by the Indian publications in liver disorders research was 4.68 during 2003-2012, which has decreased from 6.43 during 2003-2007 to 3.71 during 2008-2012. India is ranked in the twelfth position among the top 20 most productive countries in liver disorder research, with

Table 9: Productivity and impact of fifteen most productive indian authors in liver disorder research, 2003-2012

Name	Address	TP	TC	ACPP	h-Index
S.K.Sarin	G.B. Pant Hospital, Delhi	79	854	10.81	19
Y.K. Chawla	Postgraduate Institute of Medical Education and Research, Chandigarh	58	437	7.53	13
P. Kar	Maulana Azad Medical College, Delhi	49	269	5.49	14
S.K. Acharya	All India Institute of Medical Sciences, New Delhi	32	175	5.47	9
R.K. Dhiman	Postgraduate Institute of Medical Education and Research, Chandigarh	31	173	5.58	8
P. Sakhuja	G.B. Pant Hospital, Delhi	29	396	13.66	10
Ajay Duseja	Postgraduate Institute of Medical Education and Research, Chandigarh	29	155	5.34	8
B.C.Sharma	G.B. Pant Hospital, Delhi	26	450	17.31	12
D. Sakthisekaran	Postgraduate Institute of Basic Medical Research, Chennai	26	121	4.65	10
R. Aggarwal	Sanjay Gandhi Postgraduate Institute of Medical Sciences Lucknow	22	231	10.50	10
A. Das	Postgraduate Institute of Medical Education and Research, Chandigarh	22	131	5.95	7
S.K. Panada	All India Institute of Medical Sciences, New Delhi	21	249	11.86	10
K. Madan	All India Institute of Medical Sciences, New Delhi	20	422	21.10	8
B.C.Das	Institute of Cytology and Preventive Oncology, New Delhi1	18	123	6.83	8
T. Devaki	University of Madras	17	144	8.47	11

TP = Total articles, TC = Total citations, ACPP = Average citations per article

Table 10: India: Media of communication in liver disorder research, 2003-2012

Name of the Journal	Number of Articles		
	2003-2007	2008-2012	2003-2012
Indian Journal of Gastroenterology	62	25	87
Journal of Gastroenterology and Hepatology	32	21	53
Indian Journal of Pathology and Microbiology	17	20	37
Indian Journal of Medical Research	14	15	29
Indian Journal of Pediatrics	15	13	28
World Journal of Gastroenterology	16	9	25
Molecular and Cellular Biochemistry	16	9	25
Journal of Clinical and Experimental Hepatology	0	21	21
Journal of Ethnopharmacology	8	13	21
Digestive Diseases and Sciences	5	15	20
Chemicobiological Interactions	7	13	20
Hepatology International	0	20	20
Hepatology	4	15	19
Indian Pediatrics	7	11	18
Journal of Association of Physicians of India	9	9	18

its global publication share of 2.19% during 2003-2012. India's global publication share increased from 1.86% during 2003-2007 to 2.44% during 2008-2012. The international collaborative share of India in the overall liver disorder research was 15.34% during 2003-2012, which increased from 12.65% during 2003-2007 to 16.84% during 2008-2012. Among the international collaborator's, United States was India's major collaborator with 54.79% share of the international collaborative articles. Among the various types of liver diseases in India during 2003-2012, the largest contribution (1286 articles, 54.03% share) was from viral hepatitis and the highest citation impact (5.69 citations per article) was made by fatty liver disorder. The major focus of Indian liver disorder research by population age groups in terms of research output during 2003-2012 was on adults (740 articles, 31.09% share). Among the subfield-wise distribution of Indian liver disorder research during 2003-2012, the largest contribution (67.56% share) came from medicine. Immunology and microbiology had scored the highest citation impact (6.22 citations per article), and biochemistry, genetics, and molecular biology had achieved the highest h-index of 51 and maximum high-cited articles (nine).

The top 15 most productive Indian institutions involved in liver disorder research have together contributed 38.61% of the share in the cumulative Indian publication output, with an average of 61.26 articles per institution and registered the average citation per article and h-index as 6.17 and 12.4, respectively, during 2003-2012. The 15 most productive Indian authors together contributed 20.13% of the share in the cumulative Indian publication output of India during 2003-2012, with an average of 31.93 articles per author, average citation per article at 9.04, and h-index at 10.47, during 2003-2012. The 15 most productive journals publishing Indian research articles on liver disorder research together account for 18.53% of the share of the total Indian output during 2003-2012, which decreased from 24.82% during 2003-2007 to 15.01% during 2008-2012.

In conclusion it can be stated that the liver diseases are among the top ten killer diseases in India. Besides, those who suffer from chronic liver problems need recurrent hospitalization and prolonged medical attention. There are millions of cases of hepatic diseases that go unreported. Moreover, increasing poverty coupled with lack of education and awareness prevents people from seeking medical advice until it is too late. In addition, the high cost of treatment causes major obstacles in convincing people about

taking treatment. Control strategies must include development of mass awareness programs, development of universal guidelines for immunization, and hygienic handling of food and water, which can reduce the liver disease burden substantially in our country. There is a growing need for the government of India to focus on promoting partnerships, mobilizing resources, evidence-based policy, data for action, prevention of transmission, introduction of universal HBV vaccination, free testing and government funding for liver transplantation. Besides this, there is a need to undertake more R and D, develop trained manpower at different levels, and create sufficient infrastructure to handle the problems associated with liver disorder.

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