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Mapping of Tuberculosis (TB) research in India during 2004-2013: a bibliometric analysis

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Abstract

Purpose – The purpose of this paper is to analyze Indian researchers' publications on tuberculosis (TB) which were indexed in *Web of Science* (*WoS*) database during the from 2004 to 2013. It also emphases the performance of publication covering annual outputs, mainstream journals, leading Indian research institutions, *h-index*, etc.

Design/methodology/approach – The present study is a bibliometric analysis of all Indian TB publications over the past 10 years, in the national/international journals of repute. Utilizing the *WoS* database, 5,073 documents of Indian researcher's publications data on TB research were used for the study; various statistical techniques and bibliometric measures have been used for further analysis.

Findings – The present study found out 5,073 documents published by the Indian researchers and indexed in *WoS* during the period from 2004 to 2013, with an average of 507-508 documents per year, and majority of them were research articles (79.85 per cent); *Science Citation Index Extended* alone consists 5,055 documents. *International Journal of Tuberculosis and Lung Disease*, All India Institute of Medical Sciences and D. Sriram were the most favoured research journal, major contributing organization/institution and most prolific contributor, respectively.

Research limitations/implications – The study exclusively examines 5,073 research outputs of Indian researchers on TB which have been indexed in Thomson Reuters *WoS* during 2004-2013. Thus, documents published in any other different channels and sources which have not indexed in *WoS* are excluded from the purview of research.

Originality/value – It is the first attempt and unique study of its kind which apply bibliometric techniques to analyse TB research by Indian researchers with compared to affected Asian countries which are very badly affected by the disease. To understand India's strength and capability, the present bibliometric study was conducted to portray India's research and development profile in TB research.

Keywords India, Web of science, *h-index*, Bibliometrics, Tuberculosis

Paper type Research paper

Introduction

Tuberculosis (TB) remains a major global health problem. It causes ill health among millions of people each year and ranks as the second leading cause of death from an infectious disease worldwide, after the human immunodeficiency virus (HIV). In 2012, an estimated 8.6 million people developed TB and 1.3 million died from the disease (WHO, 2013). Most of these TB cases and deaths occur among men, but the burden of disease among women is also high. According to the WHO report (2012), there were an estimated 2.9 million cases and 410,000 TB deaths among women as well as an estimated 530,000 cases and 74,000 deaths among children. The number of TB deaths is unacceptably large given that most are preventable if people can access health care for a diagnosis and the right treatment is provided.

Bibliometrics is a useful tool to map the literature around a research field (Vergidis *et al.*, 2005), which has been used in many global studies of specific fields recently (Falagas *et al.*, 2006). It refers to the research methodology used in library and information sciences, which utilizes quantitative analysis and statistics to describe distribution patterns of articles within a given topic, field, institution and country (Rahman *et al.*, 2005). Many scientists have tried to evaluate the research trend in the publication outputs of countries, research institutions, journals and subject category (Garcia-Rio *et al.*, 2001; Zhou *et al.*, 2007), the citation analysis (Cole, 1989) and the peak year citation per publication (Chuang *et al.*, 2007). During the past few decades, more information closer to the research itself, such as distribution of different words in the title (Xie *et al.*, 2008; Li *et al.*, 2009), keywords and keyword plus (Chiu and Ho, 2007) and words in abstracts (Zhang *et al.*, 2009) to maximize retrieval of important, relevant articles. The purpose of this study is to bibliometrically analyse the literatures of Indian researchers on TB which were indexed in *Web of Science* (*WoS*) during the period from 2004 to 2013. These documents were analysed and evaluated according to annual growth and development of TB literature in Asia and in the world, most contributing organization/institution, author, prolific journal, their *h-index*, international collaboration, Indian funding agencies, etc.

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Objectives

The objectives included:

- to examine the annual growth and development of TB research in India and in the world during the period from 2004 to 2013;
- to identify major TB-affected Asian countries with their world rank;
- to find out the most favoured research area identified by *WoS*;
- to find out the core research journals using Bradford's distribution;
- to calculate the *h-index* for TB research in Asian countries;
- to identify the most contributing Indian author and funding agency; and
- to find out Indian researchers' collaboration with foreign researchers.

Methodology

The *WoS* database was used for this study, which is one of the most complete and widely used databases for bibliometric analyses or literature reviews (Leydesdorff, 2012; Xu *et al.*, 2011; Rojas-Sola and de San-Antonio-Gomez, 2010; Yang, 2012; Markusova, 2012). The *WoS*'s core collection comprises *Science Citation Index Expanded (SCIE)*, *Social Sciences Citation Index* (*SSCI*) and *Arts & Humanities Citation Index* (*A&HCI*). For retrieval of information, the term "tuberculosis*" was used as topic/subject, and "India" was selected as contributors/authors address/affiliation, and the year "2004-2013" was used as the time span for the present study. As a result, 5,077 documents were retrieved and matched with the query, out of which, 5,073 documents were published in "English" language and taken for further analysis. The literature growth percentage (*r*) in TB research by the Indian and Global researchers was calculated with the help of following formula:

$$r = \frac{p_1 - p_0}{p_0} \times 100$$

Where,

r = annual literature growth in percentage;
p_0 = number of research papers produced in the base year; and
p_1 = number of research papers produced in the year for which r% is to be calculated.

Analysis and discussion

TB-affected Asian countries

TB is an infectious disease caused by the bacillus mycobacterium tuberculosis. It typically affects the lungs (pulmonary TB) but can affect other sites as well (extra pulmonary TB). The disease is spread in the air when people who are sick with pulmonary TB expel bacteria, for example, by coughing. However, the probability of developing TB is much higher among people infected with HIV. TB is also more common among men than women and affects mostly adults in the economically productive age groups (WHO, 2013). Table I gives an overview of TB-affected Asian countries with their world ranks, average death rate and number of deaths in 2012. It shows India is the 58th world TB-affected country and 13th in Asia. Timor-Leste is very badly affected with TB and keeps first position in Asia and second in the World.

Table I TB affected Asian countries

Rank (in Asia)	World rank[a]	Country	Average death rate per 100.000[a]	Deaths in 2012 per 100.000[b]
1	2	Timor-Leste	145.9	74
2	5	Cambodia	125.4	63
3	21	Tajikistan	72.1	8
4	23	Bangladesh	69.3	45
5	25	Afghanistan	63.8	37
6	31	Pakistan	56.6	34
7	34	Philippines	52.8	24
8	36	Laos	51.5	22
9	43	Vietnam	38.9	20
10	49	North Korea	34.8	9
11	53	Indonesia	31.9	27
12	54	Nepal	31.9	20
13	58	India	28.8	22
14	59	Kyrgyzstan	25.6	10
15	61	Turkmenistan	24.4	8
16	62	Kazakhstan	23.4	8
17	66	Uzbekistan	22.0	2
18	70	Yemen	20.4	6
19	72	Bhutan	18.8	14
20	73	Thailand	18.5	14
21	76	Malaysia	17.8	5
22	82	Qatar	13.5	0
23	83	Azerbaijan	13.2	4
24	84	China	11.4	3
25	86	Armenia	11.1	6
26	87	Mongolia	10.8	7
27	90	Sri Lanka	10.1	7
28	101	South Korea	6.1	7
29	105	Georgia	4.9	5
30	112	Turkey	3.6	1
31	114	Maldives	3.7	2
32	115	Iran	3.6	3
33	119	Syria	3.3	2

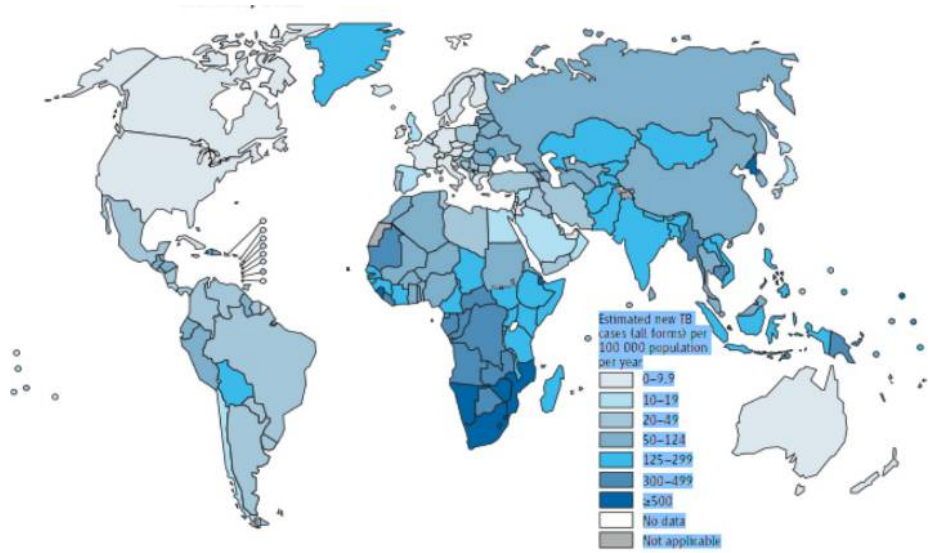
Sources: [a]World Life Expectancy Report (2013); [b]WHO Report (2012)

World top 10 TB research producing and affected countries

Figure 1 shows TB-affected countries of the world, which shows that most of the regions of Africa are very badly affected by TB with most of the countries of Europe, Americas, Asia and Western Pacific.

The top ten TB research publishing countries/territories of the world were ranked by their number of research publications, including their world rank are listed in Table II, which shows that there were five European countries, two North American and Asian countries and one South American country. These ten countries occupied represents 81.33 per cent documents of TB research out of total 48,444 documents published in English language during the period under study.

Figure 1 World TB-affected countries



Source: WHO report (2013)

Table II Top ten most research productive countries during 2004-2013

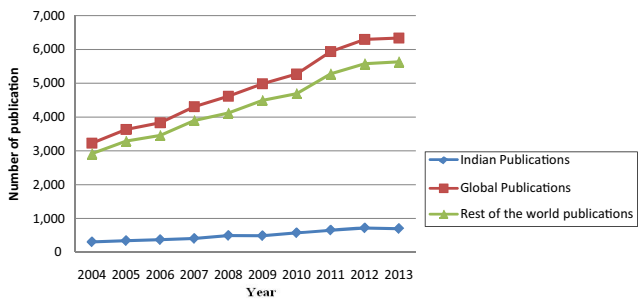
Rank in research production	World rank[a]	Country name	No. of contributions (n = 48,444)	(%)
1	191	USA	14,039	28.98
2	170	England	5,717	11.81
3	58	India	5,073	10.47
4	84	People's Republic of China	2,685	5.54
5	165	France	2,604	5.37
6	179	Germany	2,230	4.61
7	189	Canada	1,918	3.96
8	121	Brazil	1,791	3.7
9	186	Switzerland	1,672	3.45
10	177	Italy	1,667	3.44
Grand total			39,396	81.33

Notes: [a]World Life Expectancy Report (2013)

USA with 14,039 (28.98 per cent) documents stood at the first position followed by England (5,717, 11.81 per cent). India and People's Republic of China are the only two Asian countries who come under the 100 most TB-affected countries, with world ranks of 58 and 84, respectively, producing nearly 16 per cent research outputs. Figure 1 clearly shows that Africa is the most TB-affected continent but still there are no African countries getting into the top ten research productive countries list.

Figure 2 depicts the Indian and global publication data on TB research during the period under study. It shows that the difference between the global publications and rest of the world publications (rest of the world publications = global publications – Indian publications) is increasing continuously, which implies that the number of Indian research contribution is increasing day by day.

Figure 2 Annual growth and development of publication



WoS database details

For creating awareness among society, social science, behavioural science researchers, etc. play a vital role. Hence, for the purpose of the study, social science and behavioural science researchers' work which have been indexed in *SSCI* and *A&HCI* were taken into account. Table III shows 5,073 documents distribution of *WoS*'s core collection during the period under study, out of which *SCIE* alone covers 5,055 (99.65 per cent) documents, followed by *SSCI* (17, 0.33 per cent) and *A&HCI* covers only 1 (0.02 per cent) document.

Annual growth and distribution of publication

To obtain an overview of TB research, the annual number of documents published during 2004-2013 was displayed in Table IV, which shows a variation in research productivity. A

Table III Web of science database details

Rank	Name of database	No. of documents	(%)
1	SCIE	5,055	99.65
2	SSCI	17	0.33
3	A&HCI	1	0.02
Grand total		5,073	100

Table IV Annual growth and distribution of publication

Year	No. of publication (India)	(%)	AAGRP (India)	No. of publication (global)	(%)	AAGRP (global)
2004	308	6.07	–	3,228	6.66	–
2005	344	6.79	11.69	3,632	7.5	12.52
2006	373	7.35	8.44	3,831	7.91	5.48
2007	408	8.04	9.39	4,307	8.89	12.43
2008	497	9.8	21.82	4,617	9.53	7.2
2009	490	9.66	−1.41	4,985	10.29	7.98
2010	576	11.35	17.56	5,272	10.88	5.76
2011	656	12.93	13.89	5,936	12.25	12.6
2012	720	14.19	9.76	6,299	13.01	6.12
2013	701	13.82	−2.64	6,337	13.08	0.61
Total	5,073	100	Average 8.85	48,444	100	Average 7.07

Note: *AAGRP = annual average growth rate percentage

total of 5,073 documents were published by the Indian researchers with annual average growth rate percentage (AAGRP) of 8.85. A positive growth in scientific research was seen except in 2009 and 2013, whereas 48,444 documents were published globally with 7.07 AAGRP, and there is a continuous and positive growth in publication which can be observed during the period under study. The number of publications increased nearly double from 2004 to 2013.

Published document types

The publications related to TB research by the Indian researchers identified by the *ISI WoS* during the period from 2004 to 2013 included nine document types (Table V). Out of total 5,073 documents, 4,051 (79.85 per cent) were articles followed by reviews (302, 5.95 per cent), letters (291, 5.74 per cent), meeting abstracts (207, 4.08 per cent), editorial material (135, 2.66 per cent), proceedings papers (66, 1.3 per cent), corrections (10, 0.2 per cent), book chapters (9, 0.18 per cent) and news items (2, 0.04 per cent)

WoS major research areas

For subject category analysis, 5,073 documents including nine documents without subject category information were analysed statistically. All the documents were published in 94 research disciplines in *WoS*. Subjects which included more than 100 documents are included in Table VI, which shows that pharmacology and pharmacy, with 709 (13.98 per cent) documents, are the most favoured research disciplines among the Indian research community, followed by infectious diseases (677, 13.35 per cent), immunology (661, 13.03 per cent), biochemistry molecular biology (639,12.6 per cent), etc.

Table V Document types

Rank	Document types	No. of papers	(%)
1	Article	4,051	79.85
2	Review	302	5.95
3	Letter	291	5.74
4	Meeting abstract	207	4.08
5	Editorial material	135	2.66
6	Proceedings paper	66	1.3
7	Correction	10	0.2
8	Book chapter	9	0.18
9	News item	2	0.04
Grand total		5,073	100

Table VI Major research areas

Rank	Subject areas	No. of papers (n = 5,073)	(%)
1	Pharmacology and pharmacy	709	13.98
2	Infectious diseases	677	13.35
3	Immunology	661	13.03
4	Biochemistry molecular biology	639	12.6
5	Microbiology	580	11.44
6	Chemistry	464	12.74
7	Respiratory system	439	8.66
8	General internal medicine	416	8.21
9	Science technology and other topics	257	5.07
10	Research experimental medicine	243	4.8
11	Public environmental occupational health	208	4.11
12	Surgery	197	3.89
13	Pediatrics	193	3.81
14	Biophysics	183	3.61
15	Neurosciences neurology	171	3.38
16	Tropical medicine	148	2.92
17	Pathology	144	2.84
18	Biotechnology applied microbiology	139	2.74
19	Cell biology	133	2.63
20	Gastroenterology hepatology	118	2.33
21	Orthopedics	117	2.31

Favoured research journal

Bradford stated that:

> [. . .] if scientific journals are arranged in order of decreasing productivity of papers on a given subject, they may be divided into a nucleus of periodicals more particularly devoted to the subject and several groups or zones containing the same number of papers as the nucleus, when the numbers of periodicals in the nucleus and succeeding zones will as $1:n:n^2$ [. . .]

The journal distribution in Table VII shows that there is a tremendous scattering of literature in TB research of Indian researchers. According to Bradford's law, the first zone or nucleus contains only 16 journals covering about one-third of the total articles, followed by the second zone with 68 journals accounted for another one-third and the third zone with 316 journals covered remaining one-third during the period under study.

Bradford's distribution of core journals on TB research by the Indian researchers during the period 2004 to 2013 is listed in Figure 3, which shows a total of 400 journals presented by 4,051 articles with an average of 10-11 papers per journal. Further, it shows that *International Journal of Tuberculosis and Lung Disease* is the most favoured research journal among the Indian research community with 221 (5.46 per cent) papers (Table VII). According to Bradford's law of scattering, the journals which lay before on the initial curved part of the "*S*" shaped plot until it tangentially becomes a straight line are considered as the core journals of TB research by the Indian researchers during the period under study. Hence, in Figure 3, the curve decreases slightly after the 16th journal (*Current Science*). Thus, these 16 journals may be considered as the core journals on TB research published by Indian researchers and indexed in *WoS* during 2004-2013.

WoS *h-index*

The *h-index* has been used to characterize both the quantity and significance of a scientist's research publications, as first proposed by Hirsch (2005). *H-index* is defined by the h of N_p papers having at least "h" citations each and the other (N_p-h) papers have ≤ h citations each (Hirsch, 2005). Although *h-index* is generally applied to quantify the scientific output of a single researcher, Rousseau (2000) argued that the index can also be applied to any publication set. The *h-index* is automatically calculated by most of the citation databases such as *WoS*, *Scopus*, etc. (Maharana, 2014). As data for the present study have been collected from *WoS*, its citation tracker was used to count *h-index* for documents published on TB by the Asian affected countries. Table VIII shows that India is the most productive Asian country with 5,073 TB research publications and *h-index* of 67, followed by People's Republic of China with 2,851 research publications and *h-index* of 53. It also shows that three Asian TB-affected countries, namely, Philippines, North Korea and Turkmenistan, without any publications on TB research during the period under study stood at the last position.

Growth of literature in top ten Asian countries

Figure 4 shows that India having maximum number of publications during all the years from 2004 to 2013 followed by the People's Republic of China is the most TB research producing Asian country. However, India's annual publication growth rate was negative in 2009 and 2013, but the People's Republic of China maintained a positive growth rate in publication pattern during the entire studied period.

Crown indicators

Crown indicators (Van Raan, 2005; Moed, 2002) are relative impact indicators for a given entity that are normalized in relation to the entity research field(s) globally. Table IX analyses the Field Crown Indicator (FCI). FCI is the ratio between the real number of citations received by a given unit during a given period (diachronic analysis) and the global diachronic citation impact weighted according to the research profile (in terms of fields) displayed by the unit during the same period. It is calculated as:

$$\sum c \Big/ \sum (C/P_{field} \times p_{field}) \quad (1)$$

Where,

- c = the citations received by the unit;
- C/P_{field} = the global citation impact of a research field of the unit's research profile; and
- p_{field} = the number of publications produced in that field by the unit.

Putting the value in equation (1), we can observe that FCI = 1,991/2,765 = 0.72.

Table IX calculates the comprehensive FCI for India. It outlines the TB research by the Indian and global researchers during the period from 2004 to 2013. Next are the global and Indian corresponding field impact factors (C/P; c/p), the number of citations and publications per field and the research profile given in per cent of the total research output. The last column named "Weighted Citations" demonstrates the result of the calculation of the expected number of citations India should have had per year, i.e. in 2010, instead of 259 citations, India should have 328 citations.

WoS major contributing institutions/organizations

Table X gives a detailed list of major contributing Indian institution/organization to TB research during 2004-2013, which shows contributors affiliated to All India Institute of Medical Sciences, New Delhi, with 443 (8.74 per cent) documents stood in the first position. Again, it shows contributors affiliated to Indian Institute for Science, Postgraduate Institute of Medical Education and Research and Indian Council of Medical Research (ICMR) with 281, 215 and 188 contributions stood at the second, third and fourth position, respectively. Contributors from University of Hyderabad with 51 contributors stood at the 17th position of the table.

WoS most prolific contributor

Table XI illustrates a detailed list of most prolific Indian contributors in the field of TB research during the period from 2004-2013. Contributors with having 55 or more contributions were taken for study, which shows D. Sriram with 109 (2.15 per cent) contributions stood in the first position followed by S. Kumar with 107 (2.11 per cent) contributions.

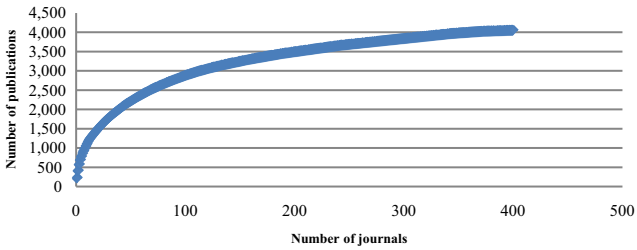
Indian researcher's collaboration

Research collaboration has been established by means of co-authorship which shows the size of research groups and the strength of links between them. Table XII illustrates the collaboration of foreign countries researchers with Indian researchers on TB research during the period under study, which was limited to countries with minimum of 20 affiliations and listed 23 countries out of 112 countries. It shows a healthy sign of Indian researcher's collaboration

Table VII Bradford's distribution of core journals

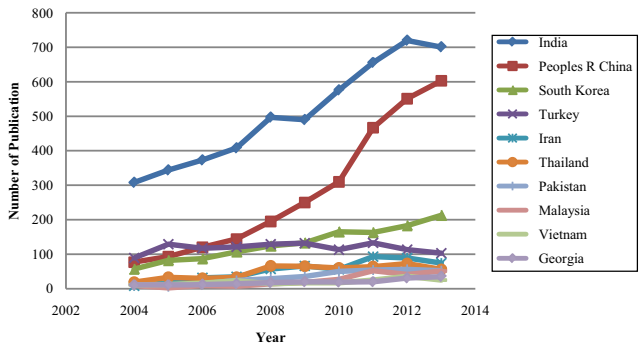
Rank	Name of the journal	No. of papers	(%)	Cumulative No. of papers	Cumulative (%)
1	*International Journal of Tuberculosis and Lung Disease*	221	5.46	221	5.46
2	*Plus One*	188	4.64	409	10.1
3	*Indian Journal of Medical Research*	161	3.97	570	14.07
4	*Bioorganic Medicinal Chemistry Letters*	119	2.94	689	17.01
5	*European Journal of Medicinal Chemistry*	87	2.15	776	19.16
6	*Tuberculosis*	76	1.88	852	21.04
7	*Indian Journal of Medical Microbiology*	64	1.58	916	22.62
8	*Medicinal Chemistry Research*	63	1.56	979	24.18
9	*Indian Pediatrics*	61	1.51	1,040	25.69
10	*International Journal of Infectious Diseases*	59	1.46	1,099	27.15
11	*Journal of Biological Chemistry*	58	1.43	1,157	28.58
12	*Indian Journal of Pediatrics*	50	1.23	1,207	29.81
13	*Journal of Clinical Microbiology*	37	0.91	1,244	30.72
14	*National Medical Journal of India*	37	0.91	1,281	31.63
15	*Chest*	36	0.89	1,317	32.52
16	*Current Science*	35	0.86	1,352	33.38
17	*Journal of Bacteriology*	35	0.86	1,387	34.24
18	*Acta Crystallographica Section F Structural Biology and Crystallization Communications*	34	0.84	1,421	35.08
19	*Bioorganic Medicinal Chemistry*	33	0.81	1,454	35.89
20	*Indian Journal of Pathology and Microbiology*	33	0.81	1,487	36.7
21	*Microbiology (SGM)*	32	0.79	1,519	37.49
22	*Asian Pacific Journal of Tropical Medicine*	31	0.77	1,550	38.26
23	*Journal of Gastroenterology and Hepatology*	31	0.77	1,581	39.03
24	*Journal of Infectious Diseases*	31	0.77	1,612	39.8
25	*Infection Genetics and Evolution*	29	0.72	1,641	40.52
26	*Tropical Doctor*	29	0.72	1,670	41.24
27	*Journal of Postgraduate Medicine*	28	0.69	1,698	41.93
28	*Vaccine*	28	0.69	1,726	42.62
29	*BMC Infectious Diseases*	26	0.64	1,752	43.26
30	*Lancet*	26	0.64	1,778	43.9
31	5 journals with 24 papers	120	2.96	1,898	46.86
32	3 journals with 23 papers	69	1.7	1,967	48.56
33	4 journals with 22 papers	88	2.17	2,055	50.73
34	2 journals with 21 papers	42	1.04	2,097	51.77
35	2 journals with 20 papers	40	0.99	2,137	52.76
36	1 journals with 19 papers	19	0.47	2,156	53.23
37	5 journals with 18 papers	90	2.22	2,246	55.45
38	4 journals with 17 papers	68	1.68	2,314	57.13
39	6 journals with 16 papers	96	2.37	2,410	59.5
40	5 journals with 15 papers	75	1.85	2,485	61.35
41	4 journals with 14 papers	56	1.38	2,541	62.73
42	7 journals with 13 papers	91	2.25	2,632	64.98
43	7 journals with 12 papers	84	2.07	2,716	67.05
44	9 journals with 11 papers	99	2.44	2,815	69.49
45	9 journals with 10 papers	90	2.22	2,905	71.71
46	9 journals with 9 papers	81	2	2,986	73.71
47	9 journals with 8 papers	72	1.78	3,058	75.49
48	12 journals with 7 papers	84	2.07	3,142	77.56
49	25 journals with 6 papers	150	3.7	3,292	81.26
50	31 journals with 5 papers	155	3.83	3,447	85.09
51	54 journals with 4 papers	216	5.33	3,663	90.42
52	101 journals with 3 papers	303	7.48	3,966	97.9
53	29 journals with 2 papers	58	1.43	4,024	99.33
54	27 journals with single papers	27	0.67	4,051	100
Grand total		4,051	100	–	–

Figure 3 Bradford's distribution of core journals



with foreign researchers. Indian researcher's collaboration with the researchers of USA is much higher compared to other foreign countries. Researchers geographically affiliated to England, 165; France, 106; Switzerland, 96; and Canada with 81 contributors affiliations were the second, third, fourth and fifth most collaborative country.

Figure 4 Growth of literature in top ten Asian countries



Major funding agencies

Out of total 5,073 research documents, 1,515 (29.85 per cent) were fully/partially funded or financial assisted by various Indian Government institution/organizations. Table XIII

Table VIII *WoS* h-index

Rank[a]	Country	No. of publication	Sum of time cited	Sum of time cited without self-citations	Citing articles	Citing articles without self-citations	Average citations per item	h-index
1	India	5,073	41,550	34,192	26,743	23,959	8.38	67
2	People's Republic of China	2,851	23,248	19,688	17,232	15,847	8.27	53
3	South Korea	1,314	13,449	12,017	10,060	9,480	10.24	49
4	Turkey	1,179	7,746	7,046	6,392	9,013	6.57	36
5	Iran	525	3,078	2,804	2,721	2,567	5.86	24
6	Thailand	501	6,641	6,207	5,593	5,406	13.26	36
7	Pakistan	328	2,337	2,131	2,122	2,028	7.12	22
8	Malaysia	236	1,517	1,457	1,464	1,415	6.43	15
9	Vietnam	198	3,755	3,421	2,766	2,645	18.96	31
10	Georgia	190	1,694	1,630	1,573	1,532	8.92	22
11	Indonesia	188	2,165	1,970	1,786	1,710	11.52	21
12	Bangladesh	129	1,728	1,601	1,512	1,458	13.4	20
19	Cambodia	85	814	77	677	637	9.58	13
14	Qatar	26	143	140	143	140	5.5	5
15	Sri Lanka	23	513	510	465	462	22.3	6
16	Laos	22	113	100	98	91	5.14	5
16	Kazakhstan	22	175	168	165	160	7.95	7
16	Uzbekistan	22	345	328	300	288	15.68	10
17	Yemen	14	72	70	60	58	5.14	4
18	Nepal	13	88	1,682	1,652	1,543	15.19	19.11
19	Afghanistan	12	217	213	213	210	18.08	6
19	Kyrgyzstan	12	52	50	50	48	4.33	5
19	Azerbaijan	12	833	829	667	664	69.42	6
19	Mongolia	12	47	47	47	47	3.92	4
20	Armenia	10	26	26	26	26	2.6	3
21	Syria	7	30	30	30	30	4.29	3
22	Tajikistan	6	31	24	25	22	5.17	4
23	Bhutan	3	2	2	2	2	0.67	1
24	Timor-Leste	2	23	22	23	22	11.5	2
25	Maldives	1	1	1	1	1	1	1
26	Philippines	–	–	–	–	–	–	–
26	North Korea	–	–	–	–	–	–	–
26	Turkmenistan	–	–	–	–	–	–	–

Note: [a]Rank is arranged according to number of publications

Table IX Indian and global TB research during 2004-2013 with field citation impacts and the weighted expected Indian citations

Year	India (p)	India (c)	India c/p	Global (P)	Global (C)	Global C/P	FCI	Weighted citations
2004	308	88	0.286	3,228	1,412	0.437	0.654	135
2005	344	106	0.308	3,632	1,694	0.466	0.661	160
2006	373	133	0.357	3,831	2,054	0.536	0.666	200
2007	408	149	0.365	4,307	2,466	0.573	0.637	234
2008	497	137	0.276	4,617	2,472	0.535	0.516	266
2009	490	179	0.365	4,985	2,844	0.571	0.639	280
2010	576	259	0.45	5,272	3,002	0.569	0.791	328
2011	656	324	0.494	5,936	3,495	0.589	0.839	386
2012	720	345	0.48	6,299	3,580	0.568	0.845	409
2013	701	271	0.39	6,337	3,359	0.53	0.736	372
	5,073	1991	0.392	48,444	26,378	0.545	0.719	2,765

Notes: P and p represent number of publications; C and c are the number of citations

Table X *WoS* major contributing institution/organization

Rank	Organization	No. of contributions	(%)
1	All India Institute of Medical Sciences (AIIMS), New Delhi	443	8.74
2	Indian Institute of Sciences (IISc)	281	5.54
3	Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh	215	4.24
4	Indian Council of Medical Research (ICMR), New Delhi	188	3.71
5	TB Research Centre, Chennai	144	2.84
6	University of Delhi, Delhi	136	2.69
7	CSIR – Central Drug Research Institute, Lucknow	134	2.65
8	Other Council for Scientific and Industrial Research (CSIR) Affiliated Institutes	122	2.41
9	Birla Institute of Technology and Science, Pilani	111	2.19
10	Indian Institute of Technologies (IITs)	105	2.07
11	Christian Medical College and Hospitals, Vellore	98	1.94
12	National Institute of Immunology, New Delhi	88	1.74
13	Sanjay Gandhi Post-Graduate Institute of Medical Science, Lucknow	76	1.49
14	Maulana Azad Medical College, Delhi	71	1.39
14	World Health Organizations (WHO) in India	71	1.39
15	Center DNA Fingerprinting Diagnostics, Hyderabad	61	1.21
15	International Centre for Genetic Engineering and Biotechnology, New Delhi	61	1.21
16	Banaras Hindu University (BHU)	60	1.19
16	National Jalma Institute of Leprosy and Other Mycobacterial diseases (NJILMOD), Uttar Pradesh	60	1.19
17	University of Hyderabad, Hyderabad	51	1.01

Table XI *WOS* most prolific contributor

Rank	Name of author/contributor	No. of contributions (n = 5,073)	(%)
1	D. Sriram	109	2.15
2	S. Kumar	107	2.11
3	S. Singh	106	2.09
4	S. Sharma	104	2.06
4	P. Yogeeswari	104	2.06
5	A. Kumar	98	1.94
6	S.K. Sharma	90	1.78
7	P.R. Narayanan	86	1.7
7	S. Swaminathan	86	1.7
8	V.M. Katoch	85	1.68
9	P. Kumar	84	1.66
10	P. Sharma	70	1.38
11	S. Gupta	64	1.27
12	R. Kumar	60	1.19
13	A. Gupta	57	1.13
14	D. Gupta	56	1.11
15	A. Sharma	55	1.09

gives *WoS* list of major Indian funding agencies to promote TB research or to the research which is helpful to eradicate the most dangerous disease from the country. It shows that Department of Biotechnology, Government of India is the most active agency/department with 647 (12.72 per cent) research grants followed by Council of Scientific and Industrial Research (388, 7.65 per cent), ICMR (179, 3.53 per cent) and University Grants Commission with 147 (2.9 per cent) research grants.

Conclusion

TB is one of the most dangerous diseases affecting India and may have a major impact on the overall spread of TB in Asia and the Pacific. India has a long and distinguished tradition of research in the field of TB. The research output and its growth indicate that research activities in this field are still in their infancy. India with its large population, infrastructure and facilities needs more focused R&D efforts in terms of scientific papers to mark its comparable global presence. The present study TB research in India is a preliminary study, which may

Table XII Indian research collaboration

Rank	Country	No. of contributions (n = 5,073)	(%)
1	India	5,073	100
2	USA	422	8.32
3	England	165	3.26
4	France	106	2.09
5	Switzerland	96	1.9
6	Canada	81	1.6
7	South Africa	74	1.46
8	Germany	53	1.05
8	Italy	53	1.05
9	Sweden	52	1.03
10	Australia	38	0.75
11	Malaysia	35	0.69
12	The Netherlands	32	0.64
13	Denmark	31	0.62
13	Norway	31	0.62
14	Japan	30	0.6
15	Saudi Arabia	28	0.56
16	People's Republic of China	25	0.49
17	Belgium	24	0.47
18	Singapore	23	0.46
18	Spain	23	0.46
19	South Korea	21	0.42
20	Brazil	20	0.39

Table XIII *WoS* Indian funding agencies

Rank	Name of funding agencies	No. of research grants	(%)
1	Department of Biotechnology, Government of India	647	12.72
2	Council for Scientific & Industrial Research (CSIR)	388	7.65
3	Indian Council of Medical Research (ICMR)	179	3.53
4	University Grants Commission (UGC)	147	2.9
5	National Institute of Health & Family Welfare	52	1.03
6	World Health Organization, New Delhi	38	0.75
7	All India Council for Technical Education (AICTE)	19	0.37
8	All India Institute of Medical Sciences (AIIMS), New Delhi	17	0.34
9	Indian Institute of Sciences (IISc)	12	0.24
10	Indian Institute of Technologies (IITs)	8	0.16
10	National Institute of Immunology, New Delhi	8	0.16
Grand total		1,515	29.85

trigger more bibliometric studies or indicators for the purpose of evaluating TB research in the country.

Based on 5,073 TB research documents dealing with Thomson Reuters *WoS*, the present study emphasized the perspective of the research activities of Indian researchers in TB study and research during the period under study. Furthermore, based on the publication pattern, it can be calculated that the number of documents is increasing more than doubled from 2004 to 2013.

TB is the second largest or dangerous infectious disease which causes high morbidity in the world. India is the 58th TB-affected country in the world and 13th in Asia, but for its research outputs, it comes at third in the world and first in Asia which proves Indian researchers awareness and cautiousness towards TB. In the study, it is surprisingly seen that most of the research were conducted by the developed countries, whereas the majority of the victims are from developing/underdeveloped countries. The initiative taken by Indian Government agencies to eradicate TB is quite appreciated, as nearly one-third of the total researches were funded by 11 Indian Government agencies. Nationwide involvement of government and private medical colleges, research centers and universities will yield better research output and helps to check and prevent TB completely.

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Further reading

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