

India's Contribution to Neglected Tropical Diseases: A Scientometrics Study

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ABSTRACT

Neglected Tropical Diseases (NTDs) are a group of parasitic and bacterial infections that are prevalent in tropical and sub-tropical regions. These diseases mainly affect improvised people of developing countries living in abject poverty. These are called "neglected" because they are often overlooked by the mainstream healthcare systems, despite their significant impact on public health. India has a large burden of NTDs and has made significant progress in developing and implementing interventions to control and eliminate these diseases. It is important to note that Indian researchers and institutions contribute to global research efforts in various fields, including neglected tropical diseases (NTDs). In this context, this paper is a scientometric assessment of Indian authors' contribution to NTDs. For this purpose, scholarly publication data was downloaded from the Scopus® database of Elsevier science. The study observed that developed countries particularly the US and UK are predominant in research on NTDs. Among the 'Global South' Brazil and India ranked third and fourth respectively. Indian scholarly output contributes about 6 percent of the global contribution. For some diseases, Indian researchers contribute significantly. For example, in Leprosy research, India is at the top with 18 percent of publications. For some diseases, Indian contributions are comparatively less. This is due to the variation in disease conditions and also in local or regional focus in research. Hence 'South-South' cooperation is required for a detailed investigation and prevention of NTDs.

Keywords: Neglected Tropical Diseases, Global South, NTD, India, Scientometrics, Bibliometrics.

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INTRODUCTION

According to the World Health Organization, "Neglected Tropical Diseases (NTDs) are a diverse group of 20 disease conditions that are mainly prevalent in tropical areas of the globe".¹ Neglected Tropical Diseases are identified as 'neglected' because in the global health agenda these diseases are almost absent or neglected. These diseases never got much attention from the past, and are mostly seen in the poor and under-developed countries of the global south. These diseases are thriving in the regions where water quality, sanitation and access to health care are of very poor standard, and are also ignored by global funding agencies. India being a developing country also suffers from various neglected diseases. These diseases are caused by a variety of pathogens including viruses, bacteria, parasites, fungi, and toxins. NTDs affect more than one billion people from impoverished communities globally. These diseases cause devastating health, social and economic consequences as there are no available or affordable products for prevention or treatment. Research and

development (R&D) for these diseases is still a low priority on the global health agenda (Bai, Huang, Gao, 2016).

Research on NTDs is critical for the development of effective treatments and prevention strategies. There are ongoing efforts to improve understanding of the biology and transmission of NTDs, as well as to develop new drugs, vaccines, and diagnostic tools. Research on NTDs is often carried out through collaborative efforts involving government agencies, non-governmental establishments, universities and academic institutions, pharmaceutical companies, and the private sector. Funding for NTD research is provided by various sources, including government agencies, philanthropic organizations, and private industry. The World Health Organization (WHO) has also established a Global Health Observatory to monitor the progress towards NTD control and elimination of the diseases and facilitate the sharing of research findings and best practices.²

There are several Scientometrics research available on Neglected Tropical Diseases (NTDs) covering various countries. There are



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1. Neglected tropical diseases, World Health Organization available at: https://www.who.int/health-topics/neglected-tropical-diseases#tab=tab_1.

2. The Global Health Observatory, Available at: <https://www.who.int/data/gho>.

many studies dealing with NTDs in a particular country's context. However, there are no significant studies covering all NTDs mainly in the Indian context. In this background, this paper is adding value to the existing field of knowledge by investigating the global research trends in terms of scholarly literature publication patterns and Indian contribution in this area.

The article has the following sections; literature review, objectives, methodology, results and concluding remarks.

LITERATURE REVIEW

There are several bibliometrics studies available on neglected diseases. For example, there are studies on global research trends on Mycetoma (Musa *et al.*, 2021), publication trends of NTDs from Latin America and the Caribbean (Fontecha, Sanchez, Ortiz, 2021) Leishmaniasis (Soosaraei *et al.*, 2021) Schistosomiasis research in Southeast Asia (Tantengco, Rojo, 2022) and so on. In terms of productivity, the bibliometric studies on Neglected Tropical Diseases (NTDs) shows that Sudan, India, the Netherlands, and Mexico were the top-ranking productive countries (Bai, Huang, Guo, 2016). The publication trend of NTDs globally is increasing in recent years. For example, Schistosomiasis research shows that between 1908 and 2020 from the South-East Asian (SEA) countries shows that the number of publications have increased (Tantengco, Rojo, 2022).

In the field of neglected tropical disease India is the most extensive hotspot. However, among the developing countries Brazil came in second position in terms of scholarly publications (Bai, Huang, Guo, 2016). There is some significant research on dengue and Scientometrics measurements show that the research on dengue is consistent (Reidpath, Allotey, Pokhrel, 2011); and the USA, India, Brazil, UK published the highest number of articles (Bhardwaj, 2014; Gupta & Tiwari, 2014). There was a negative growth rate shown in Buruli ulcer from the past few years (Bansal, 2019). On chagas disease (Gonzalez Alcaide, Salinas, Ramos, 2018) Brazil and USA are currently leading the research on this subject, with very little contributions from the developing countries (Carbajal-de-la-Fuente, Yadon, 2013).

On leishmaniasis, Brazil has the most scientific production, followed by the USA and India (Dwivedi, 2018). NTDs with the highest number of publications in the world were dengue and leishmaniasis, in the last decade; the USA and UK, had the most collaboration in performing the studies of these diseases with each other (Fontecha, Sanchez, Ortiz, 2021; Soosaraei *et al.*, 2018). Especially Canadian researchers have produced significant numbers of researches on leishmaniasis, African sleeping Sickness and Leprosy (Phillips *et al.*, 2013; Bhardwaj, 2014).

Although there are many Scientometrics research articles on various disease conditions in global context. There are comparatively a smaller number of research articles available from Indians on various disease conditions. In the Indian

context, there are studies on HIV/ AIDS (Patra & Chand, 2007), leishmaniasis (Dwivedi, 2018), Dengue (Gupta & Tiwari, 2014; Sachithanatham & Raja, 2015), rabies (Thiruppathi & Nagaiah, 2018). Further analysis shows a strong growth of publications observed on lymphatic filariasis during 2009 to 2018 (Thiruppathi, Nagaiah, & Ayyanar, 2021). Studies show that Indian researchers did significant research on Mycetoma. India was the second most producing country followed by Sudan. For the neglected disease rabies, National Institute of Mental Health, and Neurosciences (NIMHANS) Bangalore was the most productive institution from India (Thiruppathi & Nagaiah, 2018).

Scientometrics assessment involves analysis and quantification of scientific research, such as publication patterns, citation analysis, authorship, collaboration and so on. Although there are many Scientometrics research available on this topic, comprehensive research including all neglected diseases in the Indian context is significantly limited. In this context this research is a Scientometrics assessment of all tropical neglected diseases in the Indian context. Scientometrics study on this topic aims at a deep understanding of the dynamics of scientific research in this field. While doing so, this study is going to ask the following research questions: What is the total publication count of all the NTDs? What is the year-wise trend in publications? What are the trends of publications from India and where Indian research is situated in NTD research?

OBJECTIVES

To address those research questions raised above, this study will be guided by the following research objectives:

- Global growth of scholarly literature in all identified NTDs.
- Year-wise cumulative growth of publications globally.
- Year-wise growth of publications from India in all NTDs.
- India's publication ranking in various diseases.

METHODOLOGY

Scholarly literature data for this research was searched and retrieved from the Scopus® database of Elsevier science. Scopus is a bibliographic database of peer-reviewed scholarly literature, indexing articles, book series, conference proceedings, and trade publications and so on. Scopus has a very wide coverage encompassing many scholarly journals, books and other forms of publications from the universe of subjects, including science, technology, medicine, social sciences, and humanities. The database provides information on citations, abstracts, and references from over 24,000 peer-reviewed journals from more than 5,000 publishers, as well as other types of content, such as books and conference proceedings. Scopus is widely used by researchers, universities, and institutions to search, track, and evaluate research literature. From the World Health Organization's

website (<https://www.who.int/health-topics/neglected-tropical-diseases>) the list of NTDs were collected and records were searched for each disease and the disease-causing microorganisms. The Boolean Logic “OR” applied to combine search strings to retrieve the publications records of the respective disease conditions. The total publication records both from global as well as Indian context were searched by combining the search strings. The detailed search strings are presented in Appendix I.

RESULTS

Scholarly literature was searched for the respective disease conditions using the “Keyword” search field. The search was refined from the search results using various search filters. For example, the publication records for the year 2023 were removed because the year is not complete. Finally, a total of 523,389 records were retrieved using the search terms for each disease and the causative microorganism for each disease. The country wise contribution of articles shows that the United States has 115,624 (22.09%) articles followed by the United Kingdom 42,466 (8.11%) and Brazil 36,964 (7.06%). For an in-depth analysis, Indian records were filtered. A total of 30,694 (5.86%) records were retrieved from the publications of Indian authors.

With this number India's contribution is 4th globally. The results are presented in Table 1.

As seen in Table 1 Chromoblastomycosis and other deep mycoses have the highest number of publications (74,461) followed by Dengue (51,707), Leishmaniasis (48,684), Yaws and other endemic treponematoses (47,907) and so on. However, from India, Leprosy (Hansen's Disease) tops with (6,137) publications followed by Dengue (5,295), Leishmaniasis (4,448), and Chromoblastomycosis and other deep mycoses (3,221). With respect to the global publications, in terms of percentage, research articles on Leprosy (Hansen's Disease) constitute about 18.04% followed by Chikungunya 14.09%, Snake bite envenoming 11.20%, Mycetoma 10.40%, and Dengue 10.24%.

Hence, there is a clear trend emerging from the publication pattern. Indian research focus is not aligned with the global research trends. This is because Indian research may have a local or regional focus. However, Indian researchers and institutions contribute to global research efforts, including research on neglected tropical diseases. In this context, collaboration and partnerships between Indian and international researchers are critical for advancing research and control efforts for NTDs and improving public health outcomes globally.

Table 1: The Number of Publications in Neglected Tropical Diseases and the Contributions from India.

Sl. No	Name of the neglected disease	Total records globally	Top producer country (Number of records)	Records from India	Indian rank with respect to global publications	% of publications from India
1	Buruli Ulcer	1,898	United States (487)	48	14 th	2.53
2	Chagas Disease	27,942	Brazil (9670)	266	19 th	0.95
3	Dengue	51,707	United States (14925)	5295	2 nd	10.24
4	Chikungunya	7793	United States (2167)	1098	2 nd	14.09
5	Dracunculiasis (Guinea Worm Disease)	1273	United States (278)	84	4 th	6.60
6	Echinococcosis	27,541	Turkey (2253)	1325	4 th	4.81
7	Food borne trematodes diseases	11,621	United States (1132)	433	10 th	3.73
8	Human African Trypanosomiasis (African Sleeping Sickness)	16,517	United States (4400)	219	22 nd	1.33
9	Leishmaniasis	48,684	United States (8741)	4448	3 rd	9.14
10	Leprosy (Hansen's Disease)	34,016	India (6137)	6137	1 st	18.04
11	Lymphatic Filariasis	37,339	United States (8518)	2962	3 rd	7.93
12	Mycetoma	2991	United States (494)	311	2 nd	10.40

13	Chromoblastomycosis and other deep mycoses	74,461	United States (21537)	3221	8 th	4.33
14	Onchocerciasis (river blindness)	8,131	United States (2154)	148	17 th	1.82
15	Rabies	20,555	United States (4780)	1053	5 th	5.12
16	Scabies and other Ectoparasitosis	7,188	United States (1403)	482	3 rd	6.71
17	Schistosomiasis	42,891	United States (8849)	440	22 nd	1.03
18	Soil-transmitted Helminths (STH)	46,314	United States (10788)	1867	8 th	4.03
19	Snake bite envenoming	5,339	United States (942)	598	2 nd	11.20
20	Taeniasis/Cysticercosis	13,360	United States (2066)	1288	2 nd	9.64
21	Trachoma	38,469	United States (11642)	707	13 th	1.84
22	Yaws and other endemic treponematoses	47,907	United States (11265)	1338	6 th	2.79

Growth of Research Publications

Among the total 523,389 research articles available globally on these diseases, the earliest record was available in the year 1829. A significant number of publications are available from the year 1945 onwards. So, it can be observed from the literature growth pattern, the research on NTDs is quite old and got world focus even before the term "Neglected Tropical Disease" was used by the WHO in the early 2000s.

From India, the three research articles were available in 1946. Between 1946-1972 there was not much growth in research articles. Perhaps, at that time Indian research was not that much emphasized or Research and Development infrastructure was not that developed. However, it is perhaps inconclusive and requires further investigations. After that, there was a visible growth of publications from India as well as globally. From the last couple of years' trends, it can be concluded that India is contributing about 1,700 articles annually in the global research landscape (Table 2).

Growth Pattern

The year-wise growth patterns of literature on the NTDs show that there was an initial incubation stage. After that, there was an exponential growth of literature globally. The drop in publications in the last year was due to the incomplete coverage of the database (Figure 1).

The growth of publications from India was always linear (Figure 1). Indian researchers have contributed to important discoveries and advancements in NTD research. Indian researchers have also been involved in the development of a new vaccine and diagnostic tools for many NTDs.

It has been observed from various studies that Indian institutions and researchers are also involved in global partnerships and collaborations focused on various diseases. For example, the Indian Council of Medical Research (ICMR) collaborates with the World Health Organization (WHO) on research and control initiatives for NTDs (Patra & Chand, 2007). Studies have observed that about one-third of new drugs and two-thirds of new vaccines (including the world's first leprosy vaccine) for NTDs have been registered since 2000 and are contributed by Indian researchers (Thomas et.al., 2019).

CONCLUSION

The term "neglected diseases" was coined in the early 2000s by the WHO to describe a group of infectious diseases. These types of diseases disproportionately affect people in developing countries,

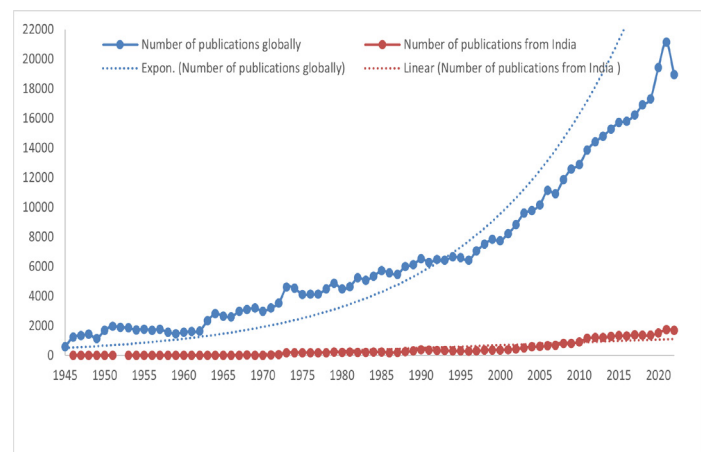


Figure 1: Research publication trends of NTDs

Table 2: Year-Wise Growth of Publications.

Year	Number of publications globally	Number of publications from India	Year	Number of publications globally	Number of publications from India
2022	18946	1701	1984	5348	223
2021	21142	1753	1983	5069	219
2020	19417	1525	1982	5247	211
2019	17325	1358	1981	4652	227
2018	16902	1368	1980	4502	202
2017	16221	1401	1979	4867	241
2016	15802	1329	1978	4497	195
2015	15714	1341	1977	4137	189
2014	15283	1295	1976	4126	177
2013	14800	1213	1975	4110	187
2012	14419	1228	1974	4541	190
2011	13850	1162	1973	4605	195
2010	12882	923	1972	3537	52
2009	12567	803	1971	3203	20
2008	11877	808	1970	2990	14
2007	10919	697	1969	3212	18
2006	11145	662	1968	3093	27
2005	10161	600	1967	2967	16
2004	9776	594	1966	2611	16
2003	9599	517	1965	2663	10
2002	8813	439	1964	2818	12
2001	8218	386	1963	2348	5
2000	7744	366	1962	1648	8
1999	7833	368	1961	1616	5
1998	7504	354	1960	1573	5
1997	7051	307	1959	1474	5
1996	6418	286	1958	1577	8
1995	6602	303	1957	1764	5
1994	6645	313	1956	1706	6
1993	6425	326	1955	1777	4
1992	6475	335	1954	1722	1
1991	6285	349	1953	1863	1
1990	6530	396	1952	1907	
1989	6116	299	1951	1975	1
1988	5996	259	1950	1703	1
1987	5475	204	1949	1147	2
1986	5564	178	1948	1443	1
1985	5732	243	1947	1349	3
			1946	1247	3
			1945	574	

particularly in low-income countries in the global south. For these types of diseases, there are inadequate prevention and treatment options. NTDs pose a significant burden on public health globally. Predominantly in developing and low-income countries, these diseases often cause deformity, disability, and loss of productivity. This in the long run causes a heavy increase in healthcare costs for the nation. Efforts to control and eliminate these diseases require a multidisciplinary approach, including improved access to healthcare, preventive measures, and effective treatments.

Research articles published in the peer reviewed journals are one of the indicators of research and development (R&D) activities. From the scholarly publication records of Scopus database, it is observed that globally there is a significant growth in the scholarly publications on NTDs. So, it can be said that research on NTDs is getting world attention. However, as it is evident from the analysis of scholarly publication data that the US and UK are the two top most publishing countries. Brazil and India are the countries ranked third and fourth respectively in terms of publications. As these types of diseases affect developing countries' population, focused research might be emphasized to solve local problems with local solutions. The countries where these types of diseases are prevalent, should put more research emphasis and research funding.

While it is true that research conducted in India may have a more local or regional focus, as seen from the research productivity of various diseases. It is important to note that Indian researchers and institutions also contribute to global research efforts in various fields, including NTDs

Developing countries in the Global South have a large burden of NTDs hence concentrated south-south cooperation is required to make progress in developing and implementing interventions to control and eliminate these diseases. Particularly South-south cooperation between India and Brazil is required to promote research and other development programs to address the challenges of NTDs. Various forms of partnership and solidarity between countries in the Global South particularly among Brazil, Russia, India, China, and South Africa (BRICS) group of countries, which share similar socio-economic backgrounds will help to address the issue further.

This paper is a scientometric study of NTDs in terms of the growth of literature and publication patterns. It also further analyzed India's contribution to this field of research. A further study using various bibliometrics tools including the core journals, author's productivity patterns, collaboration patterns (using social network analysis tools), major funding agencies and other issues will add further value to understand the dynamics of the NTDs research globally as well as country-specific.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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APPENDIX I

Search string(KEY (buruli AND ulcer) OR KEY (mycobacterium AND ulcerans)) OR (KEY (chagas AND disease) OR KEY (trypanosoma AND cruzi) OR KEY (american AND trypanosomiasis)) OR KEY (dengue OR aedes) OR KEY (chikungunya) OR (KEY (guinea AND worm AND disease) OR KEY (dracunculus AND medinensis) OR KEY (dracunculiasis)) OR (KEY (echinococcosis) OR KEY (echinococcus) OR KEY (cystic AND echinococcosis) OR KEY (alveolar AND echinococcosis)) OR (KEY (foodborne AND trematodes) OR KEY (clonorchis OR opisthorchis OR fasciola OR paragonimus)) OR (KEY (african AND trypanosomiasis) OR KEY (sleeping AND sickness) OR KEY (trypanosoma AND brucei)) OR (KEY (leishmaniasis) OR KEY (leishmania)) OR (KEY (leprosy) OR KEY (hansen's AND disease) OR KEY (mycobacterium AND leprae)) OR (KEY (lymphatic AND filariasis) OR KEY (filariasis) OR KEY (lymphedema OR elephantiasis OR hydrocele)) OR (KEY (mycetoma) OR KEY (actinomycetoma) OR KEY (eumycetoma)) OR (KEY (chromoblastomycosis) OR KEY

(fonsecaea AND pedrosoi) OR KEY (cladophialophora AND carrionii) OR KEY (phialophora AND verrucosa) OR KEY (mycoses)) OR (KEY (onchocerciasis) OR KEY (river AND blindness) OR KEY (onchocerca AND volvulus) OR KEY (blackflies) OR KEY (simulium)) OR KEY (rabies) OR (KEY (scabies) OR KEY (ctoparasitoses) OR KEY (sarcoptes AND scabiei AND mite)) OR (KEY (schistosomiasis) OR KEY (bilharzia) OR KEY (cercariae) OR KEY (schistosoma)) OR (KEY (soil-transmitted AND helminths) OR KEY (helminth) OR KEY (ascaris) OR KEY (whipworm) OR KEY (trichuris AND trichiura) OR KEY (hookworm) OR KEY (ancylostoma AND duodenale) OR KEY (necator AND americanus)) OR (KEY (snake AND bite AND envenoming) OR KEY (snake AND bite)) OR (KEY (taeniasis) OR KEY (taenia AND saginata) OR KEY (taenia AND solium) OR KEY (taenia AND asiatica) OR KEY (cysticercosis) OR KEY (taenia)) OR (KEY (trachoma) OR KEY (chlamydia AND trachomatis) OR KEY (chlamydia)) OR (KEY (yaws) OR KEY (endemic AND treponematoses) OR KEY (treponema) OR KEY (syphilis OR bejel OR pinta)) AND (EXCLUDE (PUBYEAR, 2024) OR EXCLUDE (PUBYEAR, 2023)).

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