

## Exploring Diabetes Research Trends in India: A Comprehensive Bibliometric Analysis Using VOSviewer

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Diabetes has become a pressing public health issue in India, prompting the need for a comprehensive understanding of research trends to effectively guide interventions. This study conducted a bibliometric analysis (BA) of diabetes research publications in India spanning from 2014 to 2023 to elucidate the research landscape. Through a systematic literature search using databases, a vast corpus of 498,138 publications was identified, predominantly comprising research and review articles. Temporal analysis of the data revealed a consistent publication output over the years, with a notable increase in recent years, indicating a growing research interest and focus on diabetes-related topics. Keyword analysis shed light on prevalent themes within the literature, such as experimental models and clinical aspects, showcasing the diversity of research focuses within the field. Top-cited articles predominantly addressed clinical studies, suggesting an emphasis on evidence-based research to inform clinical practice and policymaking. Co-authorship networks highlighted collaborative efforts among researchers, with the All India Institute of Medical Sciences emerging as a prominent contributor, reflecting the importance of collaborative research initiatives in tackling complex health challenges. Further analysis through bibliographic coupling and co-citation analysis revealed thematic clusters within the literature, providing insights into specific research areas such as complications and case reviews. These thematic concentrations offer valuable directions for future research and intervention strategies.

**Keywords:** BA; Diabetes research; India; Publication trends; Research landscape; VOSviewer.

Diabetes mellitus, a chronic metabolic disorder characterized by elevated blood glucose levels, represents a significant public health challenge worldwide. In India, the prevalence of diabetes has reached alarming levels, making it one of the leading causes of morbidity and mortality in the country. Understanding the landscape of diabetes research in India is crucial for informing

healthcare policies, guiding research priorities, and developing effective interventions to combat this growing epidemic<sup>1</sup>.

This bibliometric analysis aims to provide a comprehensive overview of diabetes research in India, utilizing advanced visualization techniques with VOSviewer software. By systematically mapping the scientific literature, this study

seeks to identify key research themes, influential publications, collaboration networks, and emerging trends in diabetes research within the Indian context.

Previous bibliometric studies on diabetes research have predominantly focused on global trends or specific aspects of the disease, such as treatment modalities or risk factors. However, to the best of our knowledge, there has been limited research specifically examining the diabetes research landscape in India using bibliometric analysis. Therefore, this study fills a crucial gap in the literature by offering insights into the quantity, quality, and impact of diabetes-related research conducted by Indian scholars and institutions<sup>2</sup>.

Furthermore, the findings of this study have practical implications for various stakeholders involved in diabetes prevention, management, and policy formulation. By identifying research gaps, hotspots, and areas of collaboration, policymakers can prioritize funding for targeted research initiatives, healthcare providers can tailor interventions to address specific needs, and researchers can identify potential collaborators and interdisciplinary opportunities to advance diabetes research in India<sup>3</sup>. Overall, this study contributes to the ongoing efforts to combat diabetes and improve health outcomes for millions of individuals affected by this debilitating condition in India and beyond.

## METHODS

The database was systematically scanned for global literature on “Diabetes” and “India” published between 2014 and 2023. The search utilized keywords “Diabetes” or “India” within the title to identify closely matching publications. The retrieved information for qualifying documents included title, abstract, source title, publication year, volume, issue, pagination, authors, authors affiliations, country of research organization, citations, cited references, which were exported into CSV format<sup>4-5</sup>. Data retrieval was conducted on March 17, 2024. VOSviewer version 1.6.20 for Microsoft Windows systems was employed to analyze various bibliometric parameters such as citation, co-authorship, bibliographic coupling and co-citation. Two standard weight attributes, namely “Links attribute” and “Total link strength (TLS) attribute,” were utilized<sup>6-7</sup>.

## RESULTS

### BA of publication output

Between 2014 and 2023, a total of 498,138 (Figure 1) publications related to Diabetes and India were identified in the Dimensions database which included 343453 (68.94) were articles both research and review, 95309 (19.13) were chapters, 25573 (5.13) were Edited Books, 13761 (2.76) were preprints, 10280 (2.06) were monographs and 9762 (1.95) were conference proceedings (Table 1). Out of 498138, 76424 (15.34) were published in 2023, 76239 (15.30) in 2022, 73367 (14.72) in 2021, 57221 (11.48) in 2020, 43023 (8.63) in 2019, 45357 (9.10) in 2018, 34941 (7.01) in 2017, 32650 (6.55) in 2016, 27232 (5.46) in 2015 and 31684 (6.36) in 2014 (Table 2). In all the published papers, 214475 are indexed in PubMed. 3581 and 280642 are indexed in UGC Journal Lit Group I and II respectively (Table 3).

### BA of the keywords

In the BA of keywords, a total of 49,201 keywords were extracted from the papers. Among them, 1,706 keywords met the threshold of occurring more than 10 times in the Dimensions database and were included in the final analysis. The most frequently occurring keywords were “rat” with a TLS of 397, followed by “Streptozotocin” with a TLS of 361, and “diabetic rat” with a TLS of 327. It was indicated that “Diabetes” and “India” was most frequently followed by “rat, streptozotocin and diabetic rat (Figure 2).

### Bibliometric Examination of Citations and Publications

Table 4 presents the top 10 most cited articles in the field of Diabetes. The majority of these articles encompass clinical studies,

**Table 1.** Research Type, number and % of publications

Research Type	No. of Publications	% of Publications
Articles	343453	68.94
Chapters	95309	19.13
Edited Books	25573	5.13
Preprints	13761	2.76
Monographs	10280	2.06
Conference proceedings	9762	1.95

including descriptive studies, case series, and case reports, with the remainder being research articles. The emergence of COVID-19 associated mucormycosis: A review of cases from 18 countries. Published in *The Lancet Microbe* in 2022, with the main author affiliated with Austria. This article has received 271 citations. A Novel Diabetes Healthcare Disease Prediction Framework Using Machine Learning Techniques. Published in the *Journal of Healthcare Engineering* in 2022, with the main author affiliated with Ethiopia. This article has received 120 citations. Prevalence of chronic kidney disease in Asia: A systematic review and analysis. Published in *BMJ Global Health* in 2022, with the main author affiliated with Australia. This article has received 76 citations. Diabetes mortality and trends before 25 years of age: An analysis of the Global Burden of Disease Study 2019. Published in *The Lancet Diabetes & Endocrinology* in 2022, with the main author affiliated with China. This

article has received 72 citations. Estimates, trends, and drivers of the global burden of type 2 diabetes attributable to PM2.5 air pollution, 1990–2019: An analysis of data from the Global Burden of Disease Study 2019. Published in *The Lancet Planetary Health* in 2022, with the main author affiliated with the United States. This article has received 68 citations. The highest cited paper, published in 2022 in *The Lancet Microbe Journal*, was authored by an Austrian researcher.

**BA of the citations and authors**

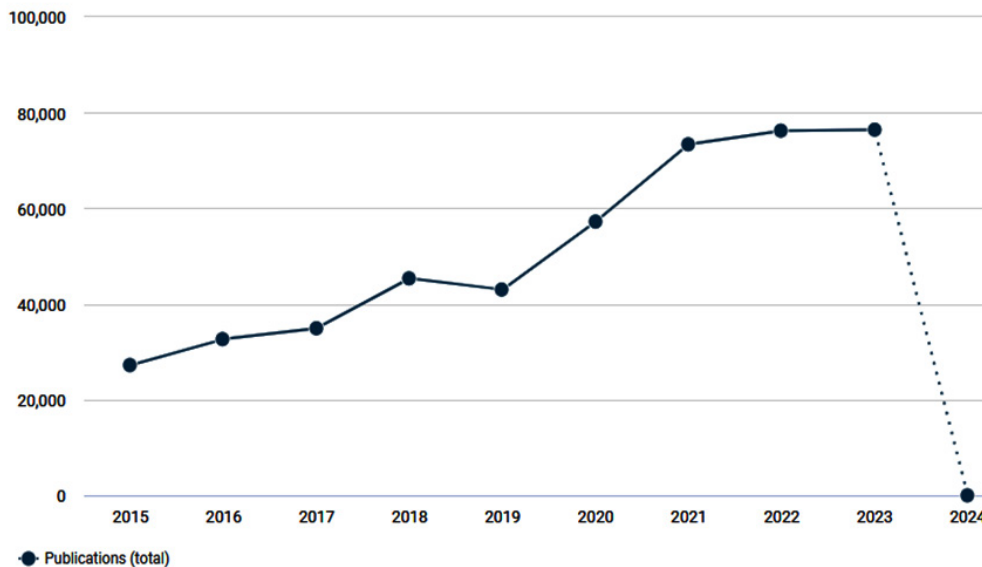
The results of the analysis involving 12,563 authors are displayed in table 5 and figure 3. The total strength of citation links with other authors was computed, and the top 30 authors with the highest TLS were identified. Among these authors, Chakrabarti, Arunaloke stands out with a TLS of 42, derived from 22 links across 4 documents.

**Table 2.** Year, Number and % of Publications

Year	No. of Publications	% of Publications
2023	76424	15.34
2022	76239	15.30
2021	73367	14.72
2020	57221	11.48
2019	43023	8.63

**Table 3.** Index and Number of Publications

Index	No. of Publications
PubMed	214475
UGC Journal Lit Group I	3581
UGC Journal Lit Group II	280642

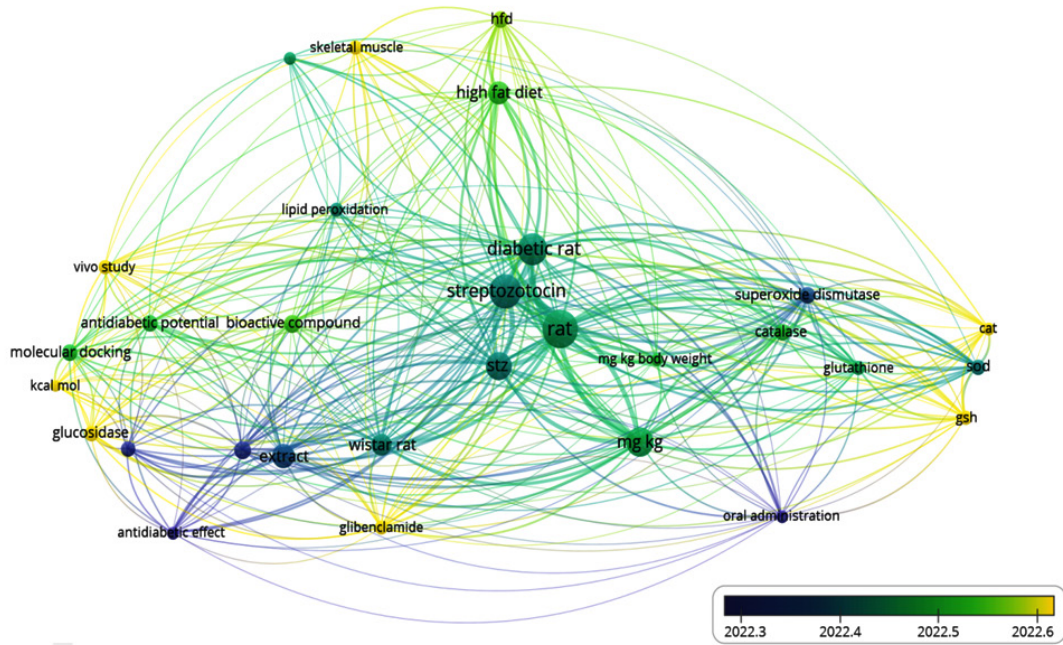


**Fig. 1.** Graphical presentation of year and number of publications

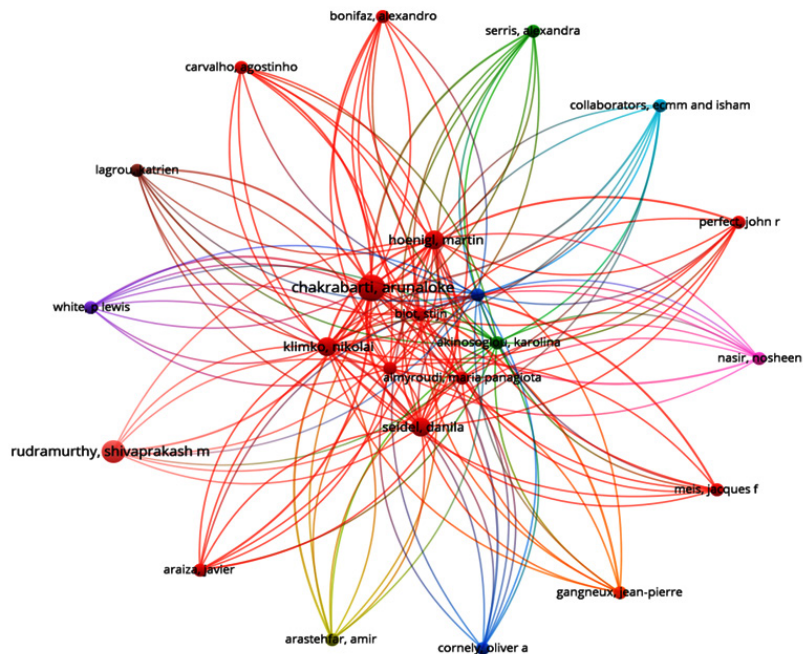
**BA of the citations and organizations**

Table 5 and Figure 4 showcase the analysis conducted on 4,464 organizations. The

total strength of citation links with organizations was computed, leading to the identification of the top 30 organizations with the highest TLS. Notably,



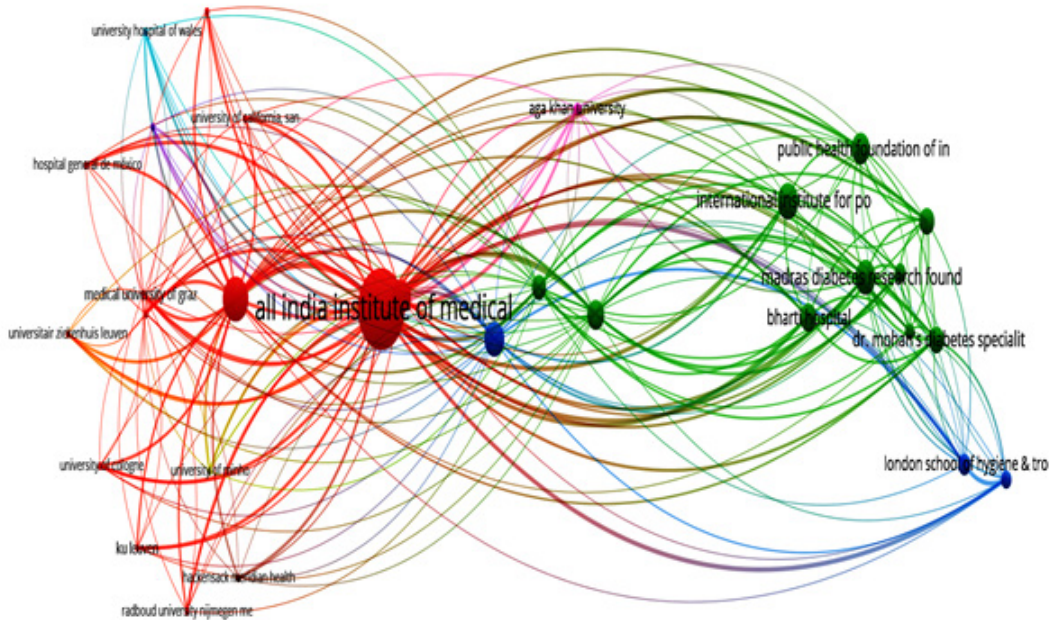
**Fig. 2.** Bibliometric Assessment of Keywords in Publications on Diabetes and India



**Fig. 3.** BA of the citations of authors

**Table 4.** The top 10 most cited articles in the field of “Diabetes” and “India”

Title	Journal	Publication Year	Main author Affiliation	Citations
The emergence of COVID-19 associated mucormycosis: A review of cases from 18 countries	The Lancet Microbe	2022	Austria	271
A Novel Diabetes Healthcare Disease Prediction Framework Using Machine Learning Techniques	Journal of Healthcare Engineering	2022	Ethiopia	120
Prevalence of chronic kidney disease in Asia: A systematic review and analysis	BMJ Global Health	2022	Australia	76
Diabetes mortality and trends before 25 years of age: An analysis of the Global Burden of Disease Study 2019	The Lancet Diabetes & Endocrinology	2022	China	72
Estimates, trends, and drivers of the global burden of type 2 diabetes attributable to PM2.5 air pollution, 1990–2019: An analysis of data from the Global Burden of Disease Study 2019	The Lancet Planetary Health	2022	United States	68
Pathophysiology, phenotypes and management of type 2 diabetes mellitus in Indian and Chinese populations	Nature Reviews Endocrinology	2022	Canada	67
Metabolic non-communicable disease health report of India: the ICMR-INDIAB national cross-sectional study (ICMR-INDIAB-17)	The Lancet Diabetes & Endocrinology	2022	India	63
Prevalence, Awareness, Treatment and Control of Diabetes in India From the Countrywide National NCD Monitoring Survey	Frontiers in Public Health	2022	India	62
Multimorbidity of non-communicable diseases in low-income and middle-income countries: A systematic review and meta-analysis	BMJ Open	2022	Belgium	61
An updated practical guideline on use of molnupiravir and comparison with agents having emergency use authorization for treatment of COVID-19	Diabetes & Metabolic Syndrome Clinical Research & Reviews	2022	India	52



**Fig. 4.** BA of the citations of organizations

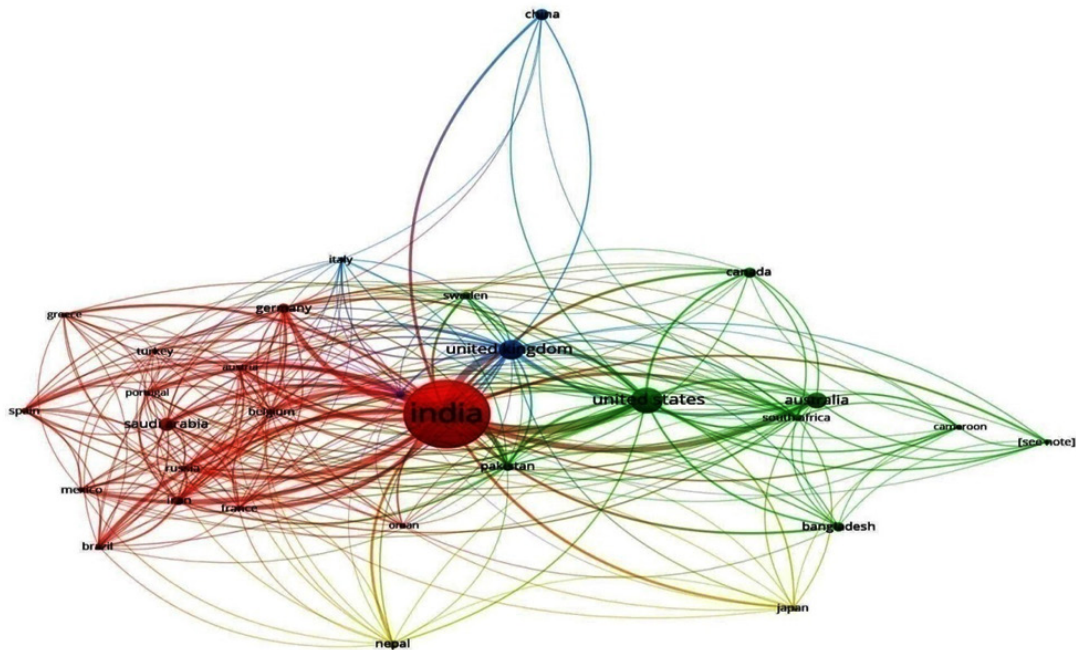
among these organizations, the All India Institute of Medical Sciences stands out with a TLS of 286, stemming from 29 links across 322 documents.

**BA of the citations and countries**

Table 5 and Figure 5 present the analysis conducted on 95 countries. The total strength of citation links between countries was computed,

**Table 5.** Top 5 most active authors, organizations and countries of diabetes publications

Subject	Number of Publications	Number of Citations	TLS
<b>Author</b>			
Chakrabarti, Arunaloke	4	291	42
Chattopadhyay, Kaushik	8	29	34
Kinra, Sanjay	9	25	32
Prabhakaran, Dorairaj	28	70	29
Hoeningl, Martin	2	293	26
<b>Organiation</b>			
All India Institute of Medical Sciences	322	874	286
Post Graduate Institute of Medical Education And Research	101	726	166
Institute of Post Graduate Medical Education and Research	43	252	81
Government Medical College	55	225	80
Madras Diabetes Research Foundation	59	261	73
<b>Countries</b>			
India	1939	5725	1131
United states	268	1439	361
United Kingdom	167	986	308
Australia	103	500	170
Pakistan	31	419	142



**Fig. 5.** BA of the citations of countries

leading to the identification of the top 30 countries with the highest TLS. Notably, among these countries, India emerges with a TLS of 1,131, derived from 29 links across 1,939 documents.

Chakrabarti, Arunaloke has authored 4 publications with a total of 291 citations and a TLS (Total Link Strength) of 42. Chattopadhyay, Kaushik, with 8 publications, Chattopadhyay has received 29 citations and has a TLS of 34. Kinra, Sanjay has 9 publications, 25 citations, and a TLS of 32. Prabhakaran, Dorairaj has the highest number of publications at 28, with 70 citations and a TLS of 29. Hoenigl, Martin has 2 publications, but a high number of citations at 293, with a TLS of 26 (Table 5).

All India Institute of Medical Sciences has the highest number of publications at 322, has 874 citations and a TLS of 286. Post Graduate Institute of Medical Education and Research with 101 publications, this institute has received 726 citations and a TLS of 166. Institute of Post Graduate Medical Education and Research have

43 publications, 252 citations, and a TLS of 81. Government Medical College has 55 publications, 225 citations, and a TLS of 80. Madras Diabetes Research Foundation has 59 publications, this foundation has 261 citations and a TLS of 73 (Table 5).

India has the highest number of publications at 1939, with 5725 citations and a TLS of 1131. United States has 268 publications, 1439 citations, and a TLS of 361. United Kingdom has 167 publications, 986 citations, and a TLS of 308. Australia has 103 publications, Australia has 500 citations and a TLS of 170. Pakistan has 31 publications, 419 citations, and a TLS of 142 (Table 5).

**BA of the co-authorship**

Table 6 and Figure 6 showcase the analysis conducted on 12,563 authors. The total strength of co-authorship links with other authors was computed, leading to the identification of the top 30 authors with the highest TLS. Notably, among these authors, Mohan, Viswanathan stands

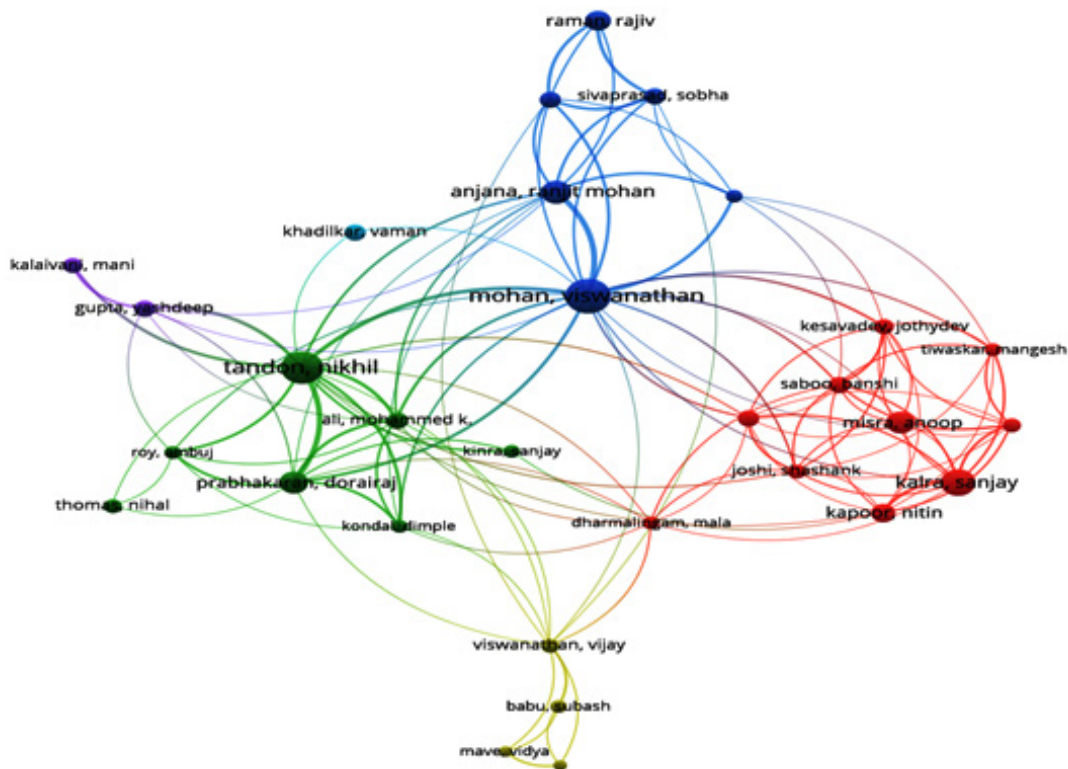


Fig. 6. Co-authorship Networks in Diabetes Research: Authors

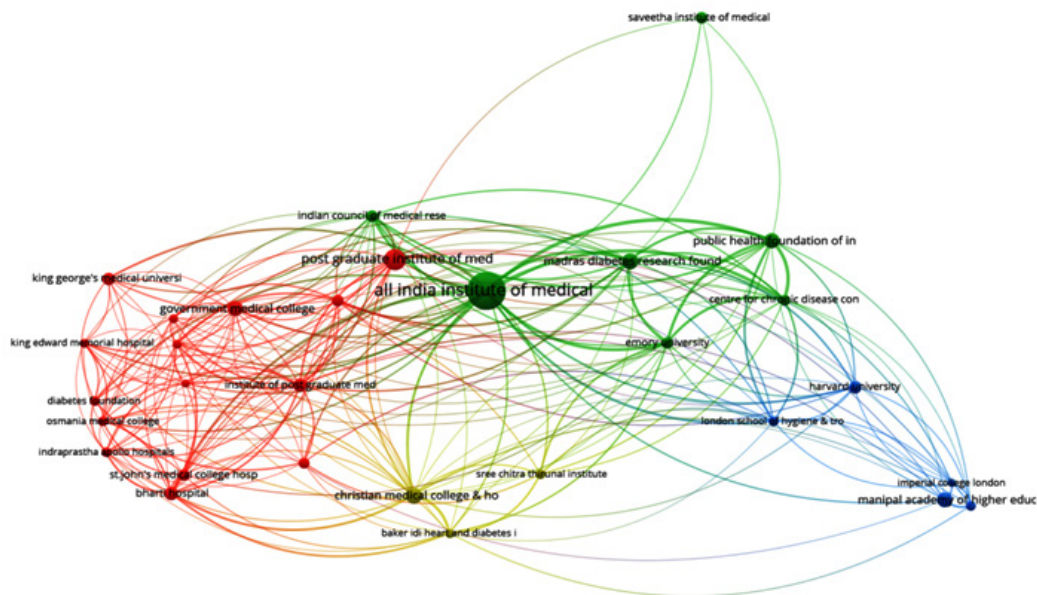
out with a TLS of 123, stemming from 21 links across 67 documents.

Table 6 and Figure 7 present the analysis conducted on 4,464 organizations. The total strength of co-authorship links with other organizations was

calculated, leading to the identification of the top 30 organizations with the highest TLS. Notably, among these organizations, the All India Institute of Medical Sciences stands out with a TLS of 242, derived from 27 links across 322 documents.

**Table 6.** Co-authorship Analysis of Authors, Organizations, and Countries in Diabetes Research

Subject	Number of Publications	Number of Citations	TLS
<b>Author</b>			
Mohan, Viswanathan	67	224	123
Tandon, Nikhil	58	129	115
Prabhakaran, Dorairaj	28	70	69
Anjana, Ranjit Mohan	30	142	67
Ali, Mohammed K.	14	23	44
<b>Organization</b>			
All India Institute of Medical Sciences	322	874	242
Public Health Foundation of India	51	121	112
Madras Diabetes Research Foundation	59	261	104
Emory University	34	181	94
Centre for Chronic Disease Control	28	69	89
<b>Countries</b>			
Australia	103	500	223
Austria	6	313	30
Bangladesh	32	320	74
Belgium	10	357	34
Brazil	16	344	37



**Fig.7.** Co-authorship Networks in Diabetes Research: Organizations



Table 6 and Figure 8 display the analysis conducted on 95 countries. The total strength of co-authorship links with other countries was computed, resulting in the identification of the top 30 countries with the highest TLS. Remarkably, among these countries, India emerges with a TLS of 708, stemming from 29 links across 1,939 documents.

**BA of the bibliographic coupling and co-citation**

Table 7 illustrate the analysis conducted on 2,500 documents. The total strength of bibliographic coupling links with other documents was calculated, resulting in the identification of

**Table 7.** Bibliographic Coupling Analysis of Documents in Diabetes Research

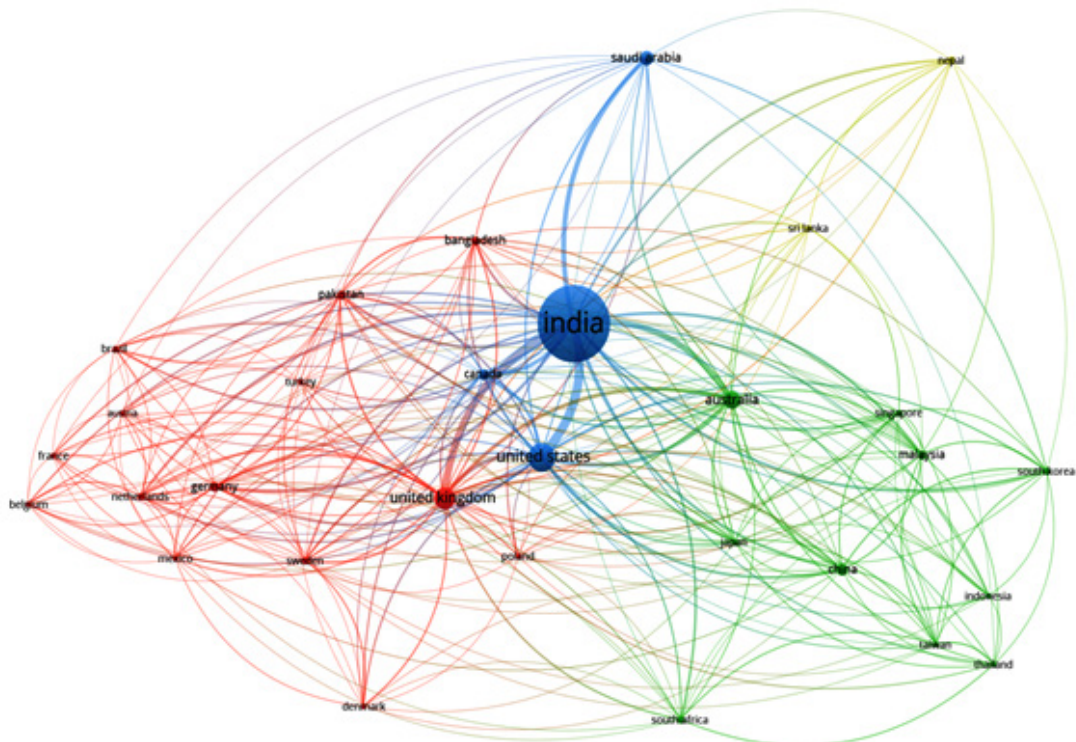
Documents	Number of Citations	TLS
Hoenigl (2022)	271	511
Seyedalinaghi (2022)	28	596
Sharma (2022a)	27	567
Chao (2022)	25	686
Watanabe (2022)	23	408

the top 30 documents with the highest TLS. From this analysis, two clusters were derived. Cluster 1, highlighted in green, encompasses 15 items focusing on the review of cases, with a representative paper published in *The Lancet Microbe* in 2022 by Hoenigl. Cluster 2, highlighted in orange, comprises 15 items discussing mucomycosis.

Analysis conducted on 68,067 cited references, the total strength of co-citation links with other cited references was calculated, resulting in the identification of the top 30 cited references with the greatest TLS. Additionally, Figure 9 visually represents the findings, showcasing four clusters obtained from the analysis. Cluster 1, depicted in orange, comprises 11 items. Cluster 2, shown in green, consists of 10 items. Cluster 3, highlighted in blue, includes 5 items, while Cluster 4, illustrated in yellow, encompasses 4 items.

**DISCUSSION**

The BA of publications focusing on Diabetes and India from 2014 to 2023 presents



**Fig. 8.** Co-authorship Networks in Diabetes Research: Countries

several notable findings that shed light on the research landscape in this area<sup>8</sup>.

Firstly, the significant volume of publications identified, totaling 498,138, indicates a substantial interest in the topic within the academic community. The distribution of publications across different document types reveals a predominant focus on articles (both research and review), underscoring the importance of scholarly discourse and knowledge dissemination in this field. Additionally, the presence of chapters, edited books, preprints, monographs, and conference proceedings highlights diverse modes of scholarly communication and collaboration<sup>9</sup>.

Temporal trends in publication output indicate a consistent level of activity over the past decade, with a notable increase in publications in recent years. This suggests a growing interest and possibly an increasing research focus on Diabetes in the context of India<sup>10</sup>.

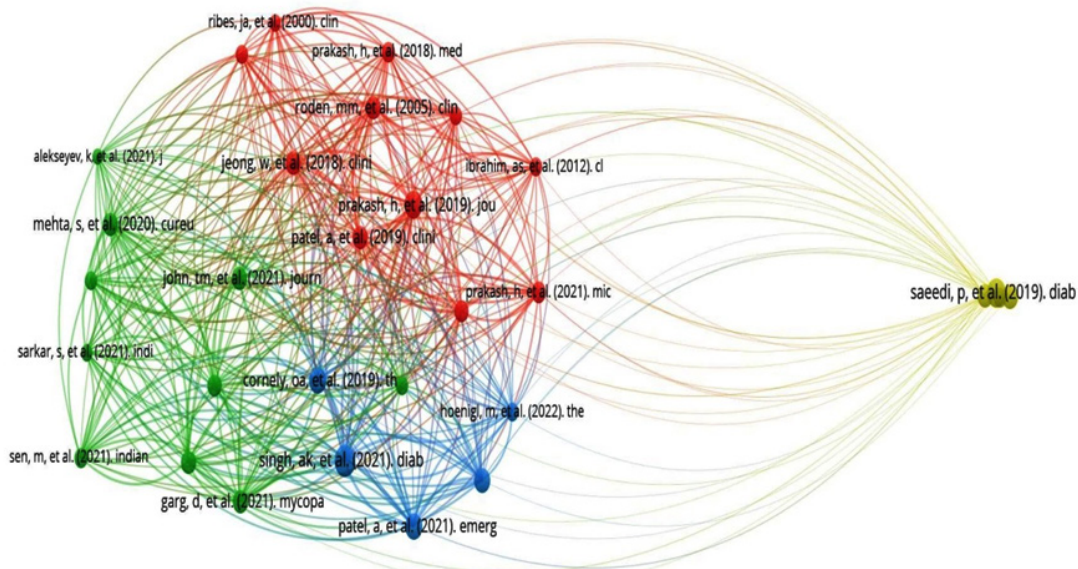
The analysis of keywords reveals common themes and areas of emphasis within the literature. Keywords such as “rat,” “Streptozotocin,” and “diabetic rat” indicate a significant emphasis on experimental models and pathophysiological mechanisms of Diabetes, particularly in animal studies. However, the prominence of keywords related to clinical aspects, such as “Diabetes” and “India,” underscores the relevance of

epidemiological, clinical, and public health dimensions of the disease in the Indian context<sup>11</sup>.

Examining citation patterns provides insights into the most influential articles, authors, organizations, and countries in the field. The top-cited articles predominantly comprise clinical studies, reflecting the importance of evidence-based research in informing clinical practice and public health interventions. Furthermore, the identification of key authors, organizations, and countries with high citation and co-authorship link strengths underscores the collaborative nature of research endeavors in addressing Diabetes-related challenges<sup>12-13</sup>.

The analysis of co-authorship networks reveals patterns of collaboration among researchers, organizations, and countries, highlighting the interconnectedness and knowledge exchange within the scientific community. Notably, the presence of distinct clusters based on bibliographic coupling and co-citation analysis indicates thematic concentrations within the literature, such as review of cases and discussions on specific complications like mucormycosis<sup>14-15</sup>.

Overall, the BA provides a comprehensive overview of the research landscape surrounding Diabetes and India, highlighting key themes, trends, and contributors shaping the field. The findings contribute to a deeper understanding of the



**Fig. 9.** Co-Citation Network of Cited References in Diabetes Research

current state of research, identify areas for further investigation, and inform strategies for addressing the multifaceted challenges posed by Diabetes in the Indian context<sup>16-19</sup>.

### CONCLUSION

In conclusion, the BA of Diabetes research in India from 2014 to 2023 reveals a thriving scholarly landscape characterized by significant publication volume and diverse research outputs. The findings highlight sustained research interest, with an increasing focus on Diabetes-related issues in recent years. Analysis of keywords underscores the multifaceted nature of research, encompassing experimental and clinical dimensions. Citation patterns illustrate influential contributions and collaborative networks, reflecting the interconnectedness of researchers, organizations, and countries. Thematic clustering identifies emerging research trends and areas for further exploration. Overall, the analysis provides valuable insights into the state of Diabetes research in India, guiding future research directions and informing strategies for addressing the complex challenges posed by the disease in the Indian context.

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#### Conflict of interest

The author(s) declares no conflict of interest.

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