

# Research Trends in Visual Impairment: A Bibliometric Analysis of Indian Contributions

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## Abstract

This bibliometric study analyzes **visual impairment research in India** using Web of Science data. Globally, vision impairment is a major health issue with rising numbers. Our quantitative analysis reveals a strong interdisciplinary focus, dominated by **Computer Science Information Systems, Engineering Electrical & Electronics, and Ophthalmology**. Publications show a consistent upward trend from 2020 to 2024. Key contributors include the **LV Prasad Eye Institute** and **IITs**, with **Springer Nature** as the leading publisher. Significant international collaborations, especially with the **USA**, highlight global efforts. Highly cited works cover **epidemiological studies** and **assistive technologies** like smart devices. The findings highlight India's dynamic research in combining technological innovation with clinical and rehabilitative approaches to address this global health challenge.

**Keywords:** Visual Impairment, India, Bibliometrics, Assistive Technology, Ophthalmology, Research Trends

## Introduction

Visual impairment remains one of the greatest global health challenges, affecting people's ability to access education, work, and social life. Globally, at least 2.2 billion people have near or distance vision impairment, and in at least 1 billion of these cases the impairment could have been prevented or is yet to be addressed (World Health Organization, 2021).

In 2020, an estimated 596 million people had distance vision impairment worldwide, of whom 43 million were blind; uncorrected refractive error and cataract together accounted for the majority of these cases (Flaxman et al., 2021). Despite advances in eye care services, demographic shifts and ageing populations mean the absolute number of people living with visual impairment continues to rise.

Addressing visual impairment requires a multidisciplinary approach. Reviews of assistive-technology research highlight developments in electronic travel aids, wearable obstacle-avoidance systems, and sensory-substitution interfaces (Bhowmick & Hazarika, 2017). Earlier surveys of electronic travel aids emphasize obstacle-detection devices and wearable haptic feedback as core areas of innovation (Dakopoulos & Bourbakis, 2010). Together, these studies demonstrate how engineering, computer science, and rehabilitation sciences intersect to create tools that enhance independence and safety for visually impaired users.

## Literature Review

The most common causes include uncorrected refractive errors, cataract, glaucoma, diabetic retinopathy,

and age-related macular degeneration (Flaxman et al., 2021). A meta-analysis by Bourne et al. (2021) projected that by 2050, nearly 895 million people will experience some form of vision loss, highlighting the urgency of coordinated public health strategies and technological interventions.

The development of assistive technology for visually impaired individuals has expanded rapidly in recent years, with researchers focusing on creating inclusive digital tools and smart navigation systems. Bhowmick and Hazarika (2017) reviewed advances in assistive technology and categorized them into electronic travel aids (ETAs), reading and writing devices, and sensory substitution systems. Their study identified significant growth in wearable technology using computer vision, machine learning, and haptic feedback.

Dakopoulos and Bourbakis (2010) similarly classified wearable ETAs into systems based on sonar, computer vision, and infrared sensors. More recent innovations include self-powered smart canes, AI-powered object recognition tools, and mobile applications integrated with GPS and obstacle detection (Song et al., 2024). These innovations are aimed at improving independent mobility, environmental awareness, and accessibility to digital content.

The multidisciplinary nature of visual impairment research reflects growing interest from fields such as computer science, ophthalmology, rehabilitation science, and biomedical engineering. Studies such as those by Bhowmick & Hazarika (2017) and Abidi et al. (2024) emphasize that a cross-disciplinary approach is crucial to designing effective assistive systems. Bibliometric analyses have shown that most research output in the last decade has originated from the USA, India, England, and Australia, often through international collaboration (Leasher et al., 2016; Bourne et al., 2017).

Further, high-impact research institutions such as the LV Prasad Eye Institute in India, Johns Hopkins University in the USA, and Moorfields Eye Hospital in the UK have contributed substantially to this domain. Their work ranges from epidemiological modeling to the design of functional vision assessment tools (Gothwal et al., 2003).

Visual impairment research also focuses significantly on education and rehabilitation, especially in developing countries. The use of Braille systems, screen readers, and customized learning materials has been widely adopted to support inclusive education. According to Aroonsakool et al. (2020), access to accessible information technology in libraries and schools remains uneven, calling for institutional support and policy intervention. Gothwal et al. (2003) developed the LV Prasad Functional Vision Questionnaire (LVP-FVQ), which measures the impact of vision loss on daily activities among children and has been widely cited in clinical and educational contexts.

## **Research Methodology**

This study adopts a **bibliometric analysis** approach to investigate research trends related to visual impairment in India. Bibliometric methods are widely used to map scientific knowledge, evaluate research output, and identify thematic patterns within a specific field (Donthu et al., 2021). The approach is quantitative and descriptive in nature, aimed at evaluating the distribution of scholarly publications by subject category, year, author, institution, country, and publisher.

## **Data Source**

The primary data for this study were retrieved from **Web of Science**, one of the largest and most reliable abstract and citation databases of peer-reviewed literature. Web of Science was selected for its comprehensive coverage of journals across disciplines, including health sciences, engineering, computer

science, and social sciences. To identify relevant literature, the following keywords were used in the Scopus advanced search “visually impaired” OR “blindness” OR “visual disability” OR “Visually challenged”. The search was restricted to the title, abstract, and keyword fields to ensure relevance. Additional filters were applied to include:

- **Document type:** Research articles and reviews
- **Language:** English
- **Country of focus:** Articles either authored by Indian researchers or involving collaboration with Indian institutions

### Data Extraction and Analysis

The retrieved data were exported in CSV format and analyzed using Microsoft Excel for:

- Year-wise distribution of publications
- Subject area classification
- Authorship patterns and h-index analysis
- Institutional affiliations
- Publisher distribution
- International collaboration
- Citation analysis of high-impact articles

Percentage values were calculated to determine the relative contribution of each category. Visual charts and tables were used to illustrate trends across categories.

### Data Analysis and Interpretation

**Table 1: Category wise distribution of articles**

Categories	Total No. of Articles	Percentage
Computer Science Information System	24	19.2
Engineering Electrical Electronics	22	17.6
Ophthalmology	15	12
Computer Science Software Engineering	13	10.4
Rehabilitation	13	10.4

In the field of visual impairment, the dominant research areas are Computer Science Information System (19.2%), Engineering Electrical & Electronics (17.6%), Ophthalmology (12%), Software Engineering and Rehabilitation also show notable interest (10.4% each). This indicates a strong technological and medical orientation in research concerning the visually impaired.

**Table 2: Year wise distribution of articles**

Year	Total no. of articles	Percentage
2024	16	12.8
2023	16	12.8
2022	22	17.6
2021	10	08
2020	11	8.8

There has been a consistent rise in research output from 2020 to 2024, peaking in 2022 (17.6%). Notably, 2023 and 2024 saw sustained publication activity (12.8% each), indicating continued interest and momentum in the field.

**Table 3: Author wise distribution of articles**

Authors	Total no. of articles	H-index	Percentage
Gupta S	07	22	5.6
Jonas JB	07	168	5.6
Pesudovs K	07	20	5.6
Resnikoff S	07	79	5.6
Taylor HR	07	36	5.6

Dominant authors in this field are Gupta S, Jonas JB, Pesudovs K, Resnikoff S, and Taylor HR each contributed 7 articles. Jonas JB stands out with the highest h-index (168), reflecting substantial influence and high citation impact.

**Table 4: Affiliation wise distribution of articles**

Affiliation	Total no. of articles	Percentage
LV Prasad Eye Institute	15	12
IIT System	09	7.2
Amity University, Noida	06	4.8
AIIMS - Jodhpur	05	04

LV Prasad Eye Institute leads with 15 articles (12%), followed by IITs with 09 articles (7.2%) and Amity University, Noida with 06 papers (4.8%). This suggests a blend of specialized eye care institutions and technology institutes are driving research in this particular area.

**Table 5: Countries Collaborated with India**

Countries	No. of articles in collaboration	Percentage
USA	12	9.6
Saudi Arabia	11	8.8
England	11	8.8
Australia	10	08
South Africa	07	5.6

India collaborated most frequently with USA (9.6%), Saudi Arabia and England (8.8% each), Australia and South Africa also feature prominently. This reflects strong global research networks around visual impairment.

**Table 6: Publisher wise distribution of articles**

Publisher	Total No. of articles	Percentage
Springer Nature	28	22.4

IEEE	12	9.6
Wiley	08	6.4
Elsevier	08	6.4
Taylor & Francis	07	5.6

Springer Nature is the leading publisher with 28 articles (22.4%), followed by IEEE (9.6%), Wiley, Elsevier, and Taylor & Francis. The data suggests a preference for established, high-impact publishers in science and engineering.

**Table 7: Research Area wise distribution of articles**

Research Area	No. of articles	Percentage
Computer Science	42	33.6
Engineering	29	23.2
Ophthalmology	15	12.0
Rehabilitation	13	10.4
Telecommunication	12	9.6

The prominent research domains are Computer Science with 42 articles (33.6%) and Engineering with 29 articles (23.2%), followed by Ophthalmology (12%) which reflects a cross-disciplinary approach combining tech innovations with clinical research and rehabilitation.

**Table 8: Articles with highest no. of citations**

Article	No. of citations	Author	Journal	Year
Global Estimates on the number of people or visually impaired by Diabetic Retinopathy: A Meta Analysis from 1990-2010	433	Leasher J. L. et al.	Diabetic Care	2016
Number of people blind or Visually Impaired by Glaucoma worldwide and in world regions 1990-2020: A Meta Analysis	156	Bourne, RRA et. al.	PLOS ONE	2016
An Insight into Assistive technology for the Visually Impaired and blind people: State of the Art and Future Trends	142	Bhowmick, A & Hazarika, SM	Journal of multimodal user interfaces	2017
The Development of the LV Prasad Functional Vision Questionnaire: A Measure of Functional Vision Performance of Visually Impaired Children	100	Gothwal, VK, Lovie-Kitchin, Nuthehi, R.	Investigative Ophthalmology & Visual Science	2003

Design and Construction Electronic Aid for Visually Impaired People	62	Patil, K., Jawadwala, Q., Shu, FC	IEEE	2018
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The most cited work in the field related to visual impairment is “Global Estimates on Visually Impaired by Diabetic Retinopathy” with 425 citations, indicating significant global attention to epidemiological data. Other high-impact studies span areas of assistive technology, functional vision assessment, and mobility aids.

## Emerging Trends in 2024

**Table 9: Highly cited articles in 2024**

Article	No. of citations	Author	Journal
Global estimates on the number of people blind or visually impaired by cataract: a meta-analysis from 2000 to 2020	22	Pesudovs, K. et al.	EYE
Global estimates on the number of people blind or visually impaired by glaucoma: A meta-analysis from 2000 to 2020	12	Bourne, RRA et. al.	EYE
Global estimates on the number of people blind or visually impaired by diabetic retinopathy: a meta-analysis from 2000 to 2020	09	Curran, K et. al.	EYE
A Self-Powered Smart White Cane for Improving Mobility of Visually Impaired Person Using a Triboelectric Nanogenerator	04	Song, H. et.al.	Energy Technology
A comprehensive review of navigation systems for visually impaired individuals	03	Abidi, MH, et. al.	HELIYON

Recent articles published in 2024 with high citations focus on global estimates by disease (cataract, glaucoma, diabetic retinopathy) and smart assistive devices. Reflects a shift toward data-driven public health insights and technological solutions for improving quality of life.

## Findings and Conclusion:

The research findings highlight a robust and growing interdisciplinary focus on visual impairment in India, heavily influenced by computer science and engineering alongside traditional ophthalmology and rehabilitation. There's a clear upward trend in publications, with leading contributions from specialized eye institutes and technological universities, further bolstered by strong international collaborations.



Epidemiological studies and advancements in assistive technology, particularly smart devices, represent key areas of impact and emerging interest, collectively indicating a comprehensive and evolving approach towards addressing the challenges of visual impairment.

The research landscape surrounding visual impairment in India is dynamic, multidisciplinary, and increasingly focused on technological interventions alongside clinical and rehabilitative approaches. The consistent growth in publications, strong institutional involvement from both specialized eye care centers and technology institutes, and robust international collaborations indicate a maturing research ecosystem. The emphasis on computer science and engineering reflects a strategic effort to develop innovative assistive technologies, while continued high citations for epidemiological studies underscore the importance of understanding the global burden of visual impairment. The emerging trends in 2024, particularly the focus on data-driven public health insights and advanced smart assistive devices, suggest a promising future for enhancing the independence and quality of life for visually impaired individuals through integrated research efforts. India, with its strong institutional base and collaborative spirit, is poised to continue playing a significant role in addressing this global health challenge.

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