Information Research Communications, 2025; 2(1):127-134.
https://inforescom.org

Research Article

Mapping the Research Footprint of Women in Computer Science and Engineering at IITs: A Decade of Bibliometric Insights (2014-2023)

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ABSTRACT

Aim/Background: This study investigates the research contributions of female faculty in Computer Science and Engineering (CSE) departments across 23 Indian Institutes of Technology (IITs) over the past decade. The objective is to map their research footprint and assess gender representation through bibliometric and scientometric analysis. **Methodology:** Data on female faculty members were collected from the official websites of all IITs as of August 2024. Publication records from 2014 to 2023 were retrieved from the Scopus database. A total of 1,738 publications authored by female faculty were analyzed and visualized using Bibliometrix (R package), VOSviewer, and Microsoft Excel. The analysis included publication trends, top authors and sources, keyword analysis, and co-authorship patterns. **Results:** Out of the total faculty analyzed, 12.48% were female, contributing to 11.72% of the publications. IIT Patna recorded the highest average research output and the most publications in 2023. Dr. Sriparna Saha (IIT Patna) was identified as the most prolific author. Lecture Notes in Computer Science (Springer Verlag) emerged as the most frequent publication source, with deep learning as the top trending keyword. The majority of contributors held Assistant Professor positions, and most publications were in the form of conference papers. **Conclusion:** The findings highlight a notable gender disparity in research output and faculty representation in CSE departments of IITs. While there are standout individuals and institutions, overall female research participation remains limited. The study underscores the need for policy interventions, inclusive hiring, and stronger mentorship programs to promote gender equity in India's premier engineering institutions.

Keywords: Bibliometrics, Scientometrics, CSE, Gender, Faculty, IIT, Engineering, Computer Science, Women.

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Received: 21-02-2025;
Revised: 17-03-2025;
Accepted: 06-05-2025.

INTRODUCTION

Computer Science and Engineering (CSE) remains one of the most sought-after disciplines across the Indian Institutes of Technology (IITs), attracting the highest number of students each year through the Joint Entrance Examination (JEE). Since the establishment of IIT Kharagpur in 1951, the IIT system has expanded to serve as India's premier network of technical institutions, contributing significantly to research, innovation, and academic excellence (Singh and Singh, n.d.). However, despite this progress, gender disparity in technical education persists. While the number of male students and faculty in CSE departments remains high, female representation continues to be significantly low. This study focuses on understanding this imbalance by examining the research output and faculty distribution of female CSE faculty members across 23 IITs. As of August 2024, only 12.48% of CSE faculty in these institutions are women, with the majority holding Assistant Professor positions. This highlights challenges in both recruitment and career progression for women in academia.

The compiled data (see Table 1) reveals that Assistant Professor is the most common designation for women faculty (42), suggesting either early-career recruitment trends or limited upward mobility. Institutions like IIT Bombay show relatively higher female faculty strength, while IIT Bhilai and IIT Tirupati have none, indicating geographic and administrative variation in hiring practices. This uneven distribution raises critical questions about recruitment, retention, and support mechanisms for women in CSE academia. By employing bibliometric and scientometric methods, this study aims to investigate the publication performance, authorship trends, and research visibility of female faculty over a decade (2014-2023). Through this analysis, the paper seeks to contribute to ongoing discussions around gender equity, research productivity, and institutional inclusiveness in India's top engineering institutes.

DOI: 10.5530/irc.2.1.9

REVIEW OF LITERATURE

IITs are regarded as India's top engineering institutes, especially in research and development, as described by Singh and Singh (n.d.) in their study. Under the IT Act of 1961, they are considered of national importance and given more funding than other universities. They analyze publication and bibliometric metrics to assess the performance of IITs. An ethnographic study conducted by Saxena (n.d.) explores the experiences of Indian female enrolled in Computer Science and Engineering (CSE) programs at IIT Madras and IIT Kanpur. It looks at their obstacles, future goals, and reasons for doing so (Dicko *et al*., 2024). To improve information analysis in the ICT era, Wijk (n.d.) addresses the significance of visualization. In this work, he explores the consequences of visualization in technology, art, and science by thoroughly examining it using a variety of models and approaches. Number of citations received by faculty members of HSS at IIT Kharagpur for their journal publications Bhui and Sahu (2018). This study shows trends in citation counts, favorite journals, and publications using data from bio-sketch, annual reports, and the Web of Science. Using data from the Scopus database of Das and Sahu (2020), this study examines the research publications of five older IITs to assess research output. They highlight the analysis and visualization of bibliometric networks using automated bibliometric tools such as VOSviewer and Bibliometrics. Hosseini and Sharifzad (2021) show a comparison of male colleagues, female researchers in the Faculty of Computing and Engineering at Dublin City University. The gender gap in computer science is discussed by Yamamoto and Frachtenberg (2022). The suitability of publicly accessible open-source software for libraries addresses by Dey (2022) in his paper. He compares the properties of many fully free and open-source software solutions, concentrating on how they might be used in diverse library operations contexts. The study authors analysis explores how collaboration patterns contribute to these differences. The study by Fietta *et al*., (2023) focused on the gender gap in STEM at the University of Padua to emphasize strategies to advance gender equality while pointing out gender prejudices, preconceptions, and barriers. Dicko K. *et al*., and Mueen Ahmed K. (2024) discussed bibliometrics analysis on various subjects in their research paper, where they used different uses of bibliometrics tools for core content analysis.

OBJECTIVES OF THE STUDY

Considering the observed gender imbalance and limited visibility of women in Computer Science and Engineering (CSE) faculty roles at the IITs, this study is designed to explore their academic presence and research contributions over the past decade. The specific objectives are as follows:

- To assess the presence and publication output of female CSE faculty across 23 IITs;
- To analyze publication trends, growth rates, and average productivity;
- To identify top-performing faculty, institutions, and publication sources;
- To examine trending research topics and co-authorship patterns.

METHODOLOGY

This paper studies the publication status of female faculty members in computer science and engineering departments as on August 02, 2024 from the websites of 23 IITs. Faculty publications for 10 years from 2014-2023 were collected from Scopus database. The strings AF-ID AND AU-ID AND PUBYEAR>2013 AND PUBYEAR<2024 yielded an initial total of 1738 publications. The extracted data were analyzed and visualized by Bibliometrix R (ver. 4.4.0), MS Excel and VOSviewer (ver. 1.6.20) software to complete the objects. The extract data presents key information about the distribution of 1,738 documents of different types. The majority are conference papers (1,134), followed by articles (540). There are also a small number of book chapters (28), editorials (15), reviews (14), and other document types, each with very few entries, such as errata (2), brief surveys (2), books (1), data papers (1), and note (1). The website's crawled data were tabulated for total list of faculty, total publications, average publications and annual growth publications, top 10 faculty publications, top 10 sources, top 10 trending terms analyzed by Bibliometrix R and MS Excel. On the other hand, co-authorship analysis visualized by VOSviewer.

DATA ANALYSIS AND DISCUSSION

Total List of Faculties

In the distribution of female faculty members (see Table 1) in Computer Science and Engineering (CSE) departments across 23 IITs; out of a total of 521 faculty members, only 65 are female, reflecting a national average of 12.48% female representation. While institutions like IIT Goa (36.36%), IIT Jodhpur (20.83%), and IIT Jammu (20.00%) have comparatively higher proportions, IIT Bhilai and IIT Tirupati report zero female faculty, raising serious concerns about gender inclusion. Older and more established IITs such as IIT Bombay (17.39%), IIT Delhi (12.82%), and IIT Kharagpur (9.52%) show moderate to low representation, indicating that prestige does not always correlate with diversity.

The data reflects a stark gender imbalance in premier technical institutions of India, particularly in CSE. IIT Patna, despite recording the highest average publication output, has only one female faculty member (5.56%), underscoring the imbalance between research excellence and gender diversity. Such disparities highlight the urgent need for inclusive hiring policies, mentorship programs, and institutional support systems to improve the presence of women in technical academia. Addressing these gaps

is critical not only for equity but also for enriching research and innovation through diverse perspectives.

Total Publications of Faculties

Table 2 presents a comparative analysis of female faculty publication output across 23 IITs from 2014 to 2023. Notably, IIT Jodhpur (35.48%), IIT Patna (31.62%), and IIT Palakkad (29.03%) lead in terms of the highest percentage of female-authored publications, suggesting stronger female research participation in these institutes. Mid-ranking performers like IIT Bombay (20.73%) and IIT Ropar (20%) also show promising gender representation. These numbers indicate pockets of progress in gender inclusivity within the CSE research ecosystem.

In contrast, several established IITs-including IIT Kharagpur (5.65%), IIT Delhi (5.19%), and IIT Kanpur (7.48%)-reflect lower contributions from female faculty, despite having high overall publication outputs. Alarmingly, IIT Bhilai and IIT Tirupati reported no publications from female faculty during the study period, and others like IIT Hyderabad (0.87%) and IIT Mandi (0.71%) show minimal representation. Overall, female faculty accounted for only 11.72% (1,746 out of 14,900) of total publications across all IITs, highlighting a significant gender gap in research productivity within India's premier technical institutions.

Average Publications of Faculties

The table on average publications (see Table 2) reveals significant variation in research productivity among female CSE faculty across 23 IITs from 2014 to 2023. IIT Patna stands out with the highest average of 364 publications by a single faculty member, followed by IIT Roorkee and IIT Gandhinagar, both averaging 56 publications. Other IITs like Guwahati (48.67), Varanasi (39.00), and Kharagpur (36.75) also show relatively strong research output. Interestingly, IIT Bombay has the highest number of female faculty (8) but a moderate average of 30.63, suggesting wider faculty distribution with varied productivity.

On the lower end, several newer or smaller IITs show minimal to no representation or research output. IIT Mandi has the

Table 1: Female Faculty Positions and Representation across IITs.

Sl. No.	Name of IITs	Professor (Female)	Associate Professor (Female)	Assistant Professor (Female)	Total Faculty (Female)	Total Faculty (Male+Female)	% of Faculty (Female)
1	IIT Bombay	5	3	0	8	46	17.39
2	IIT Jodhpur	1	1	3	5	24	20.83
3	IIT Delhi	0	1	4	5	39	12.82
4	IIT Kharagpur	2	0	2	4	42	9.52
5	IIT Madras	1	1	2	4	33	12.12
6	IIT Ropar	0	0	4	4	23	17.39
7	IIT Kanpur	0	0	4	4	34	11.76
8	IIT Goa	0	0	4	4	11	36.36
9	IIT Guwahati	1	0	2	3	28	10.71
10	IIT Varanasi	0	1	2	3	21	14.29
11	IIT Indore	1	0	2	3	19	15.79
12	IIT Jammu	0	0	3	3	15	20
13	IIT Roorkee	1	0	1	2	19	10.53
14	IIT Palakkad	0	2	0	2	12	16.67
15	IIT Dhanbad	0	0	2	2	20	10
16	IIT Hyderabad	0	0	2	2	26	7.69
17	IIT Dharwad	0	0	2	2	16	12.5
18	IIT Mandi	0	0	2	2	27	7.41
19	IIT Patna	0	1	0	1	18	5.56
20	IIT Gandhinagar	0	1	0	1	13	7.69
21	IIT Bhubaneswar	0	0	1	1	11	9.09
22	IIT Bhilai	0	0	0	0	15	0
23	IIT Tirupati	0	0	0	0	9	0
Total Positions		12	11	42	65	521	12.48

lowest average with 2.00, while institutes like IIT Hyderabad, Dharwad, and Bhubaneswar also report averages below 3.00. Most notably, IIT Bhilai and IIT Tirupati have no female faculty in CSE, highlighting a stark gender gap. Across all 65 female faculty members, the overall average stands at 26.86 publications per person. This disparity underscores the need for institutional support, equitable opportunities, and policy-level interventions to strengthen women's academic and research presence in IITs' CSE departments.

Year-Wise Growth of Publications

Figure 1 presents the year-wise growth in research publications by female faculty in CSE across 23 IITs from 2014 to 2023. The data shows a clear upward trend over the decade, with a gradual rise in research output from 64 articles in 2014 to a peak of 320 in 2023. Notably, a significant acceleration is observed from 2020 onwards, indicating increased research engagement or improved institutional support in recent years.

The COVID-19 pandemic period (2020-2021) still shows resilience in output, with 231 and 269 articles respectively, possibly reflecting a shift toward digital research methods and virtual collaboration. The steep rise between 2019 (171) and 2023 (320) may also suggest improved visibility of female researchers, increased conference participation, or greater encouragement for publication efforts. The consistently higher outputs post-2018 could correlate with broader national initiatives on research excellence and gender equity. This upward trend not only reflects growing research productivity among female faculty but also highlights their evolving contribution to the field of computer science and engineering within the IIT system.

Top Ten Faculty Publications

Table 3 highlights the top ten female faculty members in Computer Science and Engineering (CSE) departments across 23 IITs based on their total number of publications from 2014 to 2023. Sriparna Saha of IIT Patna leads the list with an outstanding 364 publications, 3707 citations, and an h-index of 28, indicating both high productivity and significant scholarly impact. Richa Singh of IIT Jodhpur follows with 99 publications, 819 citations, and an h-index of 14, reflecting strong research performance. Faculty like Durga Toshniwal (IIT Roorkee), Tanima Dutta (IIT BHU Varanasi), and Aruna Tiwari (IIT Indore) also show impressive outputs, with high citation counts and solid h-indices, suggesting their contributions are both frequent and influential.

The rest of the list features faculty from older IITs like Kharagpur, Bombay, and Guwahati, as well as newer ones like Gandhinagar, showcasing a diverse geographical spread of research excellence. Despite the variation in institutional age and size, these women have made significant scholarly contributions to CSE. However, the gap between the top-ranked and others is notable-Sriparna Saha's output surpasses others by a considerable margin, indicating the potential for growth and the need for more structured support for emerging female researchers. This data not only sheds light on individual achievements but also underscores broader patterns of gendered participation and impact in India's premier technical institutions.

Top Ten Sources and Publishers

The analysis of the top ten sources (see Table 4) reveals that female CSE faculty in IITs primarily publish in conference proceedings, with Lecture Notes in Computer Science (Springer Verlag) leading at 215 papers, reflecting its popularity and accessibility despite a moderate impact score (1.27) and SJR (0.32). LIPIcs (Schloss Dagstuhl) ranks second with 61 papers and a relatively

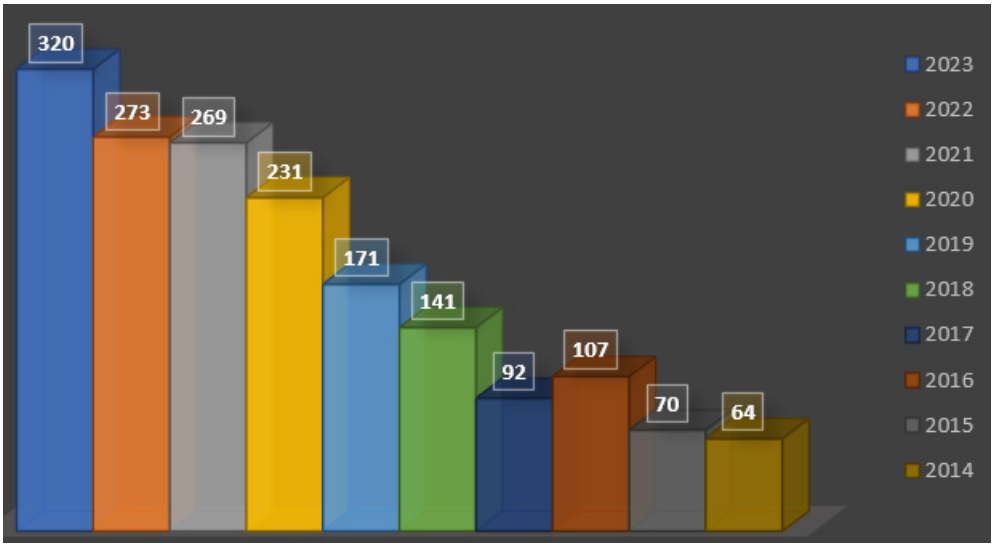

Figure 1: Year-wise Publications Growth.

high SJR of 0.832, indicating a strong presence in theoretical domains. Other major sources include IEEE's International Joint Conference on Neural Networks (36 papers), ACM Conference Series (32), and Springer's CCIS (29). High-impact journals like Expert Systems with Applications (Impact: 10.35) and Applied Intelligence (Impact: 7.04) appear with fewer entries, suggesting selective contributions to quality journals. Overall, Springer and IEEE dominate as preferred publishers, and the data reflects a conference-centric publication trend among IIT women in CSE.

Co-Authorship Analysis

The co-authorship analysis (see Figure 2) focuses on 2,159 authors, from which 223 were selected for further examination due to their publication of at least 5 documents each. The study examines 132 items and identifies 20 clusters of co-authorship relationships. There are 344 links between these authors, with a total link strength of 1,977, using a full counting method to account for the connections.

Top Ten Trend Words

The word analysis reveals the dominant research areas among female CSE faculty at IITs from 2014 to 2023. As shown in Figure 3, Deep learning leads with 84 occurrences, followed by Machine learning (53) and Clustering (45), highlighting a strong focus on AI and data-driven methods. Keywords like Classification (27), Feature selection, multi-objective optimization, and Parameterized complexity (each with 24) indicate interests in model development and algorithmic efficiency. The presence of Cellular automata reflects work in computational theory. Terms such as Big data (20) and Data mining (18) emphasize large-scale data processing and analytics. Overall, the trend words reflect a concentration on contemporary topics in machine learning, optimization, and data science-suggesting both research alignment with global trends and potential scope for diversification.

Table 2: Total and Average Research Output of Female Faculty across IITs.

Sl. No.	Name of IITs	Total Faculty (Female)	Total Faculty Publications (Female)	Average Publications (Female)	Total Faculty Publications (Male+Female)	% of Faculty Publications (Female)
1	IIT Bombay	8	245	30.63	1182	20.73
2	IIT Jodhpur	5	143	28.6	403	35.48
3	IIT Delhi	5	46	9.2	886	5.19
4	IIT Kharagpur	4	147	36.75	2602	5.65
5	IIT Madras	4	82	20.5	987	8.31
6	IIT Ropar	4	77	19.25	385	20
7	IIT Kanpur	4	48	12	642	7.48
8	IIT Goa	4	13	3.25	71	18.31
9	IIT Guwahati	3	146	48.67	904	16.15
10	IIT Varanasi	3	117	39	735	15.92
11	IIT Indore	3	88	29.33	562	15.66
12	IIT Jammu	3	16	5.33	127	12.6
13	IIT Roorkee	2	112	56	1030	10.87
14	IIT Palakkad	2	18	9	62	29.03
15	IIT Dhanbad	2	10	5	1033	0.97
16	IIT Hyderabad	2	6	3	686	0.87
17	IIT Dharwad	2	5	2.5	62	8.06
18	IIT Mandi	2	4	2	561	0.71
19	IIT Patna	1	364	364	1151	31.62
20	IIT Gandhinagar	1	56	56	346	16.18
21	IIT Bhubaneswar	1	3	3	232	1.29
22	IIT Bhilai	0	0	0	152	0
23	IIT Tirupati	0	0	0	99	0
Total and Average Publication Records		65	1746	26.86	14900	11.72

Table 3: Leading 10 Publishing Female Faculty in CSE across IITs.

Rank	Faculty Name	Affiliation	Total No. of Published Paper	Total Citations	h-index
1	Sriparna Saha	IIT Patna	364	3707	28
2	Richa Singh	IIT Jodhpur	99	819	14
3	Durga Toshniwal	IIT Roorkee	96	2591	22
4	Hemangee K. Kapoor	IIT Guwahati	93	371	10
5	Tanima Dutta	IIT BHU Varanasi	90	905	15
6	Aruna Tiwari	IIT Indore	87	2099	18
7	Krishna Shankar Narayanan	IIT Bombay	67	200	8
8	Preethi Jyothi	IIT Bombay	60	585	12
9	Sudeshna Sarkar	IIT Kharagpur	58	473	13
10	Neeldhara Misra	IIT Gandhinagar	56	240	9

Table 4: Leading 10 Sources by Publication Count with Publisher.

Rank	Sources	Publishers	Total No. of Published Papers	Impact Score	SJR
1	Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	Springer Verlag	215	1.27	0.32
2	Leibniz International Proceedings in Informatics, LIPIcs	Schloss Dagstuhl-Leibniz-Zentrum fur Informatik GmbH, Dagstuhl Publishing	61	0.96	0.832
3	Proceedings of the International Joint Conference on Neural Networks	Institute of Electrical and Electronics Engineers Inc.	36	1.39	0.422
4	ACM International Conference Proceeding Series	Association for Computing Machinery (ACM)	32	0.5	0.209
5	Communications in Computer and Information Science	Springer Science and Business Media Deutschland GmbH	29	0.53	0.194
6	Expert Systems with Applications	Elsevier Ltd.	22	10.35	…
7	Advances in Intelligent Systems and Computing	…	19	…	…
8	Proceedings - International Conference on Pattern Recognition	Institute of Electrical and Electronics Engineers Inc.	19	1.67	0.405
9	Proceedings of the Annual Conference of the International Speech Communication Association, Interspeech	…	18	…	…
10	Applied Intelligence	Springer Netherlands	17	7.04	1.145

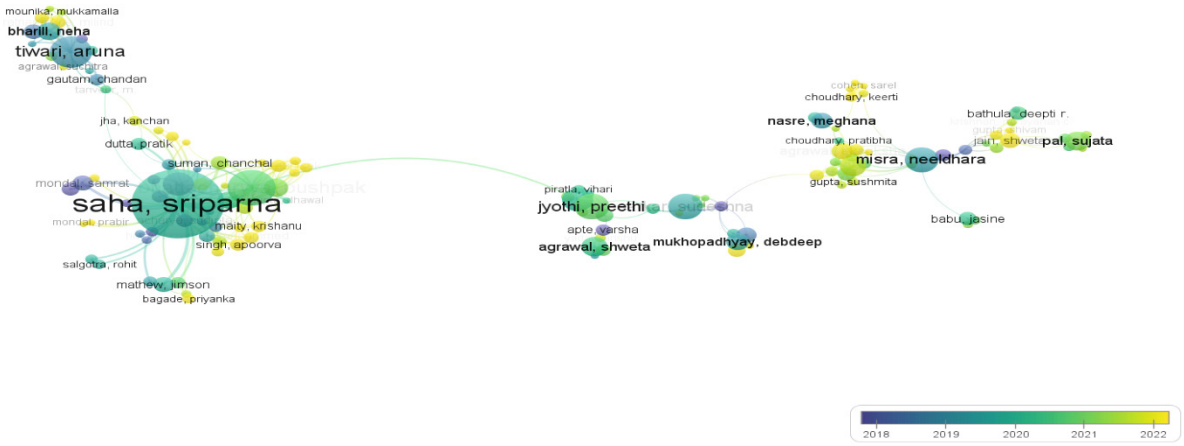

Figure 2: Co-authorship Analysis through VOSviewer.

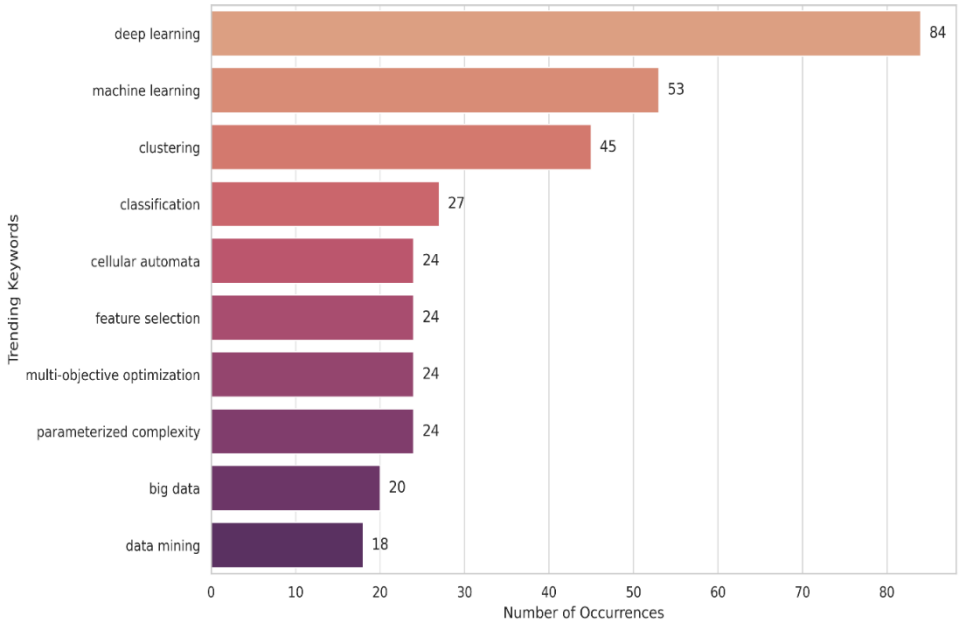

Figure 3: Top Ten Trending Research Keywords.

FINDINGS

This study presents a decade-long analysis of female faculty presence and publication performance in CSE departments across 23 IITs. The data analyzed in this study show major findings among female CSE faculty at IITs. These are - overall country has female faculty at 12.48%, IIT Bombay has maximum female faculty (8), IIT Jodhpur has maximum percentage (35.48%) of female faculty publications, highest number of the articles (320) published in 2023, Lecture Notes in Computer Science from Springer Verlag is the leading source of most publications (215), Sreeparna Saha from IIT Patna is the leading faculty of the publication (364), Deep Learning is the most trending term in CSE, Assistant Professor is the most professional faculty position (42) and most publications (65.25%) during the period (2014-2023) are in Conference papers. After analyzing the data this paper clearly shows the latest updates in CSE for IITs. The output of female faculty indicates their position in India. Lack of gender gap in CSE is enough for the underdevelopment of the society. Parents or students will know the status of their preferred subject domain in IITs and it will be easier to think ahead in their life.

CONCLUSION

This study analyzed the valuable data of female faculty and their publication direction on strength and the result will help faculty and institutions to think about disparity in this regard as well. Students can know the latest updates on the performance of specific domain scenario of their dream organization to further select through this research. Low performance of female faculty along with vacant faculty is the biggest hindrance in IITs for improvement of modern studies and growth of the country. These insights point to structural and institutional gaps that

hinder women's academic growth in CSE within IITs. Despite individual excellence, the overall contribution remains modest, underlining the need for targeted policies that promote hiring, retention, and progression of female faculty. Governing bodies and IIT councils must consider these findings seriously and implement measures that foster a more inclusive and balanced academic environment. Addressing this disparity is essential not just for institutional growth but also for ensuring that India's technological advancement is equitable and representative.

ACKNOWLEDGEMENT

I am deeply grateful to Dr. S. K. Jalal, Deputy Librarian, Central Library, IIT Kharagpur, West Bengal, INDIA for his valuable time, insightful ideas, and continuous support throughout this research. His guidance and encouragement were instrumental in shaping the direction of this study.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

ACM: Association for Computing Machinery; **BHU:** Banaras Hindu University; **CCIS:** Communication in Computer and Information Science; **CSE:** Computer Science and Engineering; **HSS:** Humanities and Social Sciences; **ICT:** Information and Communications Technology; **IEEE:** Institute of Electrical and Electronics Engineers; **IIT:** Indian Institutes of Technology; **IT:** Information Technology; **JEE:** Joint Entrance Examination; **LIPI:** Leibniz International Proceedings in Informatics; **SCI:** Science Citation Index; **SJR:** SCImago Journal Rank; **STEM:** Science, Technology, Engineering, and Mathematics.

SUMMARY

This study explores the research contributions of female faculty in Computer Science and Engineering departments across 23 Indian Institutes of Technology (IITs) over the past decade. Using data from Scopus database and faculty details from each website, the paper analyzes 1,738 publications by female faculty members from 2014 to 2023. The analysis reveals low overall participation by women in research, though some individuals and institutions show strong performance. IIT Patna had the highest average output, with Dr. Sriparna Saha as the top contributor. Most publications were conference papers, and deep learning was a key trending topic. The findings highlight gender disparities and suggest the need for more inclusive hiring, mentorship, and policy reforms to support women in India's top technical institutions.

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Cite this article: Dey K. Mapping the Research Footprint of Women in Computer Science and Engineering at IITs: A Decade of Bibliometric Insights (2014-2023). Info Res Com. 2025;2(1):127-34.