J Data Sci. Info. Citation Studies., 2026; 5(3):261-275.
https://www.jcitation.org

Research Article

A Generalizable Framework and Open Web Application for Subnational Bibliometric Analysis: An Empirical Example with Publications from India

Yiren Hou[1,#], Evan Cohen[1,2,#], Jackson Higginbottom[1], Lillian Rountree[1], Yi Ren[1], Brian Wahl[3], Kate Nyhan[4], Bhramar Mukherjee[1,5,6,*]

[1]Department of Biostatistics, Yale School of Public Health, New Haven, CT 06510, USA.
[2]Computer Science and Engineering Division, University of Michigan, Ann Arbor, MI 48109, USA.
[3]Department of Epidemiology of Microbial Diseases, Yale School of Public Health, New Haven, CT 06510, USA.
[4]Harvey Cushing/John Hay Whitney Medical Library, New Haven, CT 06510, USA.
[5]Department of Chronic Disease Epidemiology, Yale School of Public Health, New Haven, CT 06510, USA.
[6]Department of Statistics and Data Science, Yale University, New Haven, CT 06511, USA.
[#]These authors contributed equally to this work.

ABSTRACT

National publication trends can obscure variation in research participation and capacity. We present a reproducible framework for subnational bibliometric analysis that integrates scholarly metadata, institutional identifiers, demographic benchmarks, and development indicators to quantify and visualize geographic and temporal patterns of publication output. We illustrate this framework through **Indiapub**, a web application analyzing publication output across Indian states and Union Territories (UTs) using OpenAlex. The application automates data retrieval, cleaning, and aggregation, providing five interactive modules: a map of publication distribution; time trends at national and state/UT levels; publication-share versus population-share comparisons highlighting over- and under-representation; stacked bar plots of state/UT contributions over time benchmarked against population shares; and bubble plots relating subnational Human Development Index estimates to publication volume over time. **Indiapub** also allows filtering by bibliometric characteristics. We illustrate analyses of all-topic publications (2014-2025) and six domain-specific case studies: electronic health records, genome-wide association studies, artificial intelligence, development economics, environmental science, and COVID-19. Publication output was concentrated in Tamil Nadu, Maharashtra, Uttar Pradesh, Karnataka, and the National Capital Territory of Delhi (Delhi). Tamil Nadu and Delhi were consistently overrepresented relative to their population shares. This framework supports scalable, country-adaptable subnational research evaluation and evidence-informed policy analysis.

Keywords: Bibliometrics, Data visualization, Human Development Index, OpenAlex, Publication trends, Research capacity.

Correspondence:
Dr. Bhramar Mukherjee, PhD[1,2,3]
[1]Department of Biostatistics, Yale School of Public Health, New Haven, CT 06510, USA.
[2]Department of Chronic Disease Epidemiology, Yale School of Public Health, New Haven, CT 06510, USA.
[3]Department of Statistics and Data Science, Yale University, New Haven, CT 06511, USA.
Email: bhramar.mukherjee@yale.edu

Received: 11-08-2026;
Revised: 07-09-2026;
Accepted: 21-10-2026.

INTRODUCTION

Subnational analysis of publication output is an underexplored area in bibliometrics. Although national-level comparisons are well supported by existing tools, few open-access platforms allow users to examine how research capacity is distributed within a country, particularly in relation to demographic and development indicators. This gap is especially important in large, heterogeneous countries, where aggregated national totals can obscure substantial within-country variation in publication output and, by extension, in research participation and capacity.

Global scientific output has expanded rapidly in the last decade. In 2022, six countries—China, the United States, India, Germany, the United Kingdom, and Japan—each produced more than 100,000 Scopus-indexed publications in science and engineering, including peer-reviewed journal articles and conference papers (National Science Board & National Science Foundation, 2023). India is a major contributor to this growth, yet national publication totals can mask large differences across states and Union Territories (UTs). In a country that is so diverse in its socioeconomic (Nandy, 2019), linguistic (Debbarma, 2025), and institutional landscapes (NITI Aayog, 2025), variation in research capacity and infrastructure across regions is inevitable, but the granular details of how these variations impact research

OPEN ACCESS

Manuscript TECHNOMEDIA

DOI: 10.5530/jcitation.20260280

Copyright Information :
Copyright Author (s) 2026 Distributed under Creative Commons CC-BY 4.0

Publishing Partner : Manuscript Technomedia. [www.mstechnomedia.com]

outcomes are unknown and difficult to quantify. A clearer understanding of subnational variation in publication output may help inform equitable research and education policy, identify region-specific centers of excellence, and guide investments to strengthen research capacity where gaps exist.

LITERATURE REVIEW

Several tools can help analyze heterogeneity in research output. Bibliometric platforms such as CiteSpace II (Chen, 2006; Synnestvedt *et al.*, 2005), VOSviewer (van Eck & Waltman, 2010), and CitNetExplorer (van Eck & Waltman, 2014) help researchers map the research landscape by retrieving records from large databases (e.g., PubMed, Web of Science) and generating visual maps that reveal the growth of research topics and the connections among publications, authors, and keywords. The R package **bibliometrix** (Aria & Cuccurullo, 2017) and its companion Shiny interface **biblioshiny** offer a comprehensive open-source toolkit for science mapping, including citation analysis, collaboration networks, and geographic mapping of author affiliations at the country level. However, these tools are primarily geared toward technical users and are not designed to visualize subnational publication trends over time.

Research-intelligence platforms such as SciVal (Elsevier, 2026) and InCites (Clarivate, 2026) offer research performance assessment via publication and citation data, but they both require institutional subscriptions, and subnational analyses—for example, at the state and UT levels in India—are not clearly available as standard built-in outputs. While regional visualizations exist on discovery platforms, such as Scinapse.io (Little, 2023; Pluto Inc., 2026), Dimensions.ai (Dimensions, 2019), and Lens.org (The Lens, 2019), access can be restricted (e.g., subscription requirements), and state- and territory-level publication trajectories across time are often limited. In addition, these platforms do not seamlessly link to external data sources, limiting the exploration of how research productivity relates to regional population size or other metrics of human development, such as the Human Development Index (HDI) (United Nations Development Programme, 2024).

Regarding India in particular, India-focused dashboards like Harvard's India Policy Insights (Jain *et al.*, 2025) provide accessible spatiotemporal views for health, education, and development indicators, while Data for India (Data for India, 2025) is a public platform that analyzes population, health, economy, living conditions, work, and measurement across the nation. However, neither Harvard's India Policy Insights nor Data for India includes research publication data or offers tools to track or analyze publication output at the subnational level, leaving policymakers, funders, and institutional leaders without an India-specific tool to examine publication patterns across states and UTs.

Scope of our present study

To address this gap, we developed a reproducible framework for subnational bibliometric analysis using open scholarly metadata, standardized institutional identifiers, and contextual demographic and development indicators. We implement this framework through an example in India via **Indiapub**, an open-access web application that quantifies and visualizes academic publication output across India at the national, state, and union territory levels using publications with at least one author affiliated with an Indian institution. India provides a strong empirical setting because of its large scale, institutional diversity, and substantial research participation. **Indiapub**, accessible at indiapub.org and bharatresearch.org, is designed for ease of use, as data retrieval, cleaning, and aggregation are automated. We intend to maintain the **Indiapub** web application and its public access through at least December 2027.

Users can interactively filter publications by topic of interest, year range, author position, publication type, minimum number of citations, state and UT, and population groups (high/medium/low). Beyond simple publication counts, the application provides five visualizations: (i) a map that shows geographic distribution of publications; (ii) a time trend plot that shows temporal distribution of publications for national totals and for each state/UT; (iii) a plot of publication-share versus population-share by state and UT that highlights over and under-representation; (iv) a stacked bar plot showing relative publication contribution of state/UT over time with reference to relative population benchmark; and (v) a bubble plot relating state/UT-level HDI to publication output over time. These analyses are not supported in standard publication databases.

To demonstrate the application's capabilities and information provided, we present a sample analysis. We first describe the overall publication distribution from 2014 to 2025 for any topics. Then, we provide six illustrative case studies on topics of broad academic interest: Electronic Health Records (EHR), Genome-Wide Association Studies (GWAS), Artificial Intelligence (AI), development economics, environmental science, and COVID-19, based on the publication activity in India from 2014 to 2025. Using the application's core functions, we identify variations across domains and across states/UTs. A state/UT's publication share often diverges from its population share, inducing over and under-representation. We identify such variations by comparing the publication share versus population share of states/UTs across population groups. We also relate publication patterns to state/UT-level HDI values over the period 2014 to 2025. The web application benefits multiple user communities, including scholars seeking to analyze geographic publication patterns, students and emerging academics exploring regional research opportunities, and higher education administrators, funders and policymakers aiming to identify underrepresented regions for building research capacity in India. By providing transparent

metrics and an intuitive interface, our application serves as a practical starting point for evidence-informed planning, capacity building, and cross-regional collaboration in India, with a framework that is adaptable to other countries.

METHODOLOGY

Data retrieval and keyword-based searches

Publication data from 2014 to 2025 were obtained from the OpenAlex Application Programming Interface (API) (Priem *et al.*, 2022), an open access scholarly metadata database. For predefined topics and custom keyword searches, **Indiapub** retrieves publications by applying keyword-based queries to the title and abstract fields in OpenAlex. By contrast, when users select "Any Topics," the application does not rely solely on a live keyword-based API query; instead, it uses a precomputed India-wide publication dataset, with optional background loading of the full publication-level records. We used the default OpenAlex data version available via the API at the time of extraction (Walden / Data Version 2). The **Indiapub** application includes a set of recommended topics (including but not limited to those used in our case studies): EHR, GWAS, AI, digital health, COVID-19, development economics, international trade, public finance, macroeconomics, game theory, and environmental science. These topics are implemented as keyword-based searches across the title and abstract fields. In addition to these predefined topics, the application allows users to explore all publications from India when selecting "Any Topics". Users can also construct their own queries through a "Custom Keyword Search" option in the topic filter. All queries were restricted to publications with at least one affiliation with an institution in India.

When selecting "Any Topics," users choose between two data loading modules. The choice "Snapshot Only" renders plots instantly using pre-aggregated data and provides a top institutions list, but it does not provide access to the individual publication table; author position is fixed to "Any author"; and publication type and citation filters are unavailable. The choice "Snapshot + Live API Loading" displays plots immediately from pre-aggregated data while progressively loading the complete publication dataset in the background, which typically takes two to three hours. Once loading completes, all filters become available, plots update to reflect selected filters, and users gain full access to the data table with export functionality.

Institutional affiliation and geographic mapping

For each publication, we extracted author institutional affiliations using the Research Organization Registry (ROR) identifiers provided by OpenAlex. We matched all RORs to Indian institutions and their corresponding state/UT using metadata from the ROR registry (Research Organization Registry, 2025). We define an India-affiliated author as any author with at least one affiliation with an institution in India. Authors with only non-Indian RORs were not considered India-affiliated. If OpenAlex returned no ROR for an affiliation, or the ROR could not be matched to an Indian institution, we did not attribute that author to India or to any state/UT.

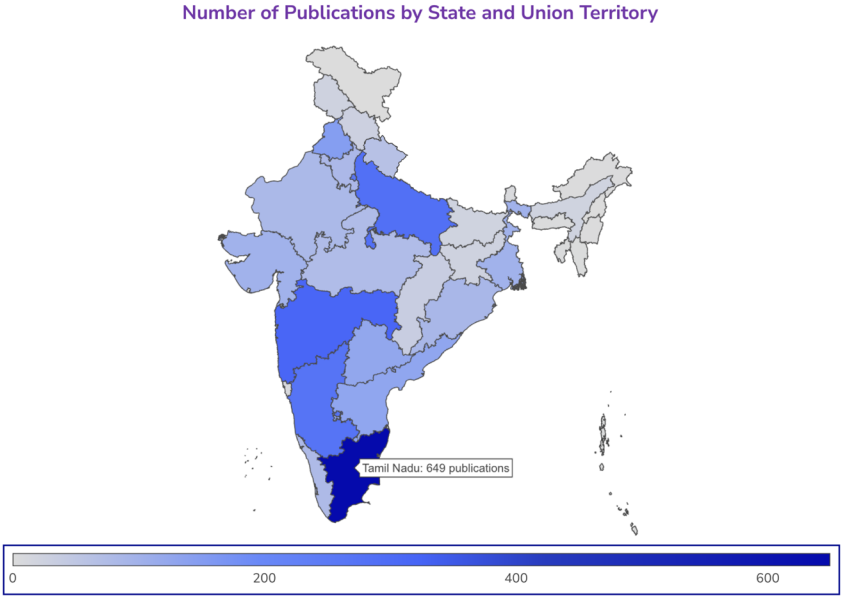
Application design

Users can interactively filter publications by topic of interest, year range, author position, publication type, minimum number of citations, state and UT, and population-size group (high/medium/low). Counts are computed per publication-state/UT pairing: a given publication can add one publication count to multiple states/UTs, but never more than one publication count to any given state/UT. For attribution, we use each author's first Indian institution (i.e., the first listed affiliation with an institution in India). The interface allows users to choose among four author position counting rules (Table 1):

- **First author (default for searches other than "Any Topics"):** a state/UT receives one count if the first author's first Indian institution is located there.
- **Last author:** a state/UT receives one count if the last author's first Indian institution is located there.
- **First or last author:** a state/UT receives one count if either the first or the last author's first Indian institution is located there (a publication contributes a maximum of one count to a state/UT under this rule, even if both authors are from the same state/UT). Because first and last authors may be based in different states/UTs, a single publication can contribute one count to two different states/UTs.
- **Any author (default for "Any Topics" search):** a state/UT receives one count for every author whose first Indian

Table 1: Indiapub application author position rules and their interpretations.

Author Position setting	Rules and interpretations
First author (default)	Counts the state/UT of the first author's first Indian institution. Interprets where the publication's research lead is based and is a good proxy for early-career location.
Last author	Counts the state/UT of the last author's first Indian institution. Interprets where senior or supervising leadership is based.
First or last author	Counts the state(s)/UT(s) of the first or last author's first Indian institution. Interprets leadership presence at either end of the author line.
Any author	Counts the state(s)/UT(s) of every author's first Indian institution. Interprets participation footprint or breadth of collaboration and is more inclusive but less specific about who led the work.



Note: This plot shows the number of publications under Electronic Health Records between the years of 2014 and 2025. A total of 3106 publications were retrieved. The population data is based on 2025 estimates.

Figure 1: Geographic distribution of publications in the electronic health records research domain from 2014 to 2025. The results derived from the application are as of March 10, 2026.

institution is located there; thus, a single publication can contribute multiple counts when co-authors are based in different states/UTs. A publication contributes a maximum of one count to a given state/UT under this rule, even if there are multiple authors from the same state/UT. In "Snapshot Only" mode for "Any Topics" search, this rule is fixed and cannot be changed. In "Snapshot + Live API Loading" mode, users may switch to other author position rules after the data loading process completes.

To allow for meaningful comparisons across states/UTs of varying population sizes, our application classifies Indian states and UTs into three population groups. Users can select population group(s) of interest by selecting any combination of low, medium, or high population groups. A high population group is defined as states/UTs with an estimated population share of over 5.0% of India's total population. A medium population group is defined as states/UTs with an estimated population share between 1.0% and 5.0% (inclusive) of India's total population, and a low population group is defined as those with less than 1.0% of the national population. We chose these *a priori* cutoffs to (i) separate a set of very large states whose totals can dominate national patterns (>5.0%), (ii) create a middle band where most states and the National Capital Territory of Delhi (Delhi) lie (1.0%-5.0%), and (iii) distinguish smaller states and UTs (≤1%). This allows our tool to highlight both absolute and relative contributions to publication output. The population estimates were extracted from tables reporting projected total populations of states and UTs from the *Population Projections for India and States 2011-2036* report published by the National Commission on Population under the Ministry of Health and Family Welfare, Government of India (National Commission on Population *et al.*, 2020).

The application includes key interactive modules and a data table that explore publication data:

1. Map of geographic distribution of publications: This is a map that displays state/UT-level publication counts, where states and UTs are shaded with a color gradient. A darker hue represents a greater number of publications. The display metric can be either total publication counts or per 1,000,000 people. By default, the map displays total publication counts.

2. Data table: This is a downloadable table listing publication metadata, including year, publication type, title, citation count, author name, author position, affiliated institution, and state/UT. A list of the top 50 institutions is readily available to download as well. Note that the data table is not available when using "Snapshot Only" mode for "Any Topics" search: instead, only the list of top 50 institutions is available.

3. Time trend plot of publication count: This is a line graph showing the number of publications per year. The plot can show national data or break it down by state/UT. By default, the plot shows national publication trend.

4. Publication versus population share by state and UT: This visualization compares each state/UT's share of publications with its share of population under the selected states/UTs. For each state/territory, a circle denotes its publication share. We compute each state/UT's publication share as the count of publications in that state/UT over the selected year range divided by the total publications within the selected states/UTs over the same time

range and filters. A square denotes its estimated population share. We compute each state/UT's population share as the state/UT's population divided by the total population within the same selected states/UTs at the latest year of the selected time range. Points are colored green when the publication share exceeds the estimated population share (positive percentage point difference). Points are colored orange when the estimated population share exceeds the publication share (negative percentage point difference). The vertical distance between the circle (publication share) and the square (population share) represents the magnitude of over or underrepresentation for that state or UT.

5. Stacked bar plot of state and UT publication percentage by year: For each year, the bar sums to 100% of publications under the selected filters. Each colored segment shows a state/UT's share of that year's total publications. A population benchmark can be displayed, either a single bar showing population shares for the selected states/UTs in the final year or the year-by-year population shares across the time range. This view allows users to examine who contributes to what publication share each year and how that compares to population share.

6. Bubble plot of publications versus HDI over time: This is a scatter plot displaying publication counts (represented by bubble size) against the HDI, with year on the x-axis and HDI on the y-axis. The HDI dataset for Indian states and UTs was retrieved from the Global Data Lab (Global Data Lab, 2025), which provides estimates of subnational human development from 1990 to 2022. The HDI estimates for 2023 to 2025 were extrapolated based on the average growth rate. Each bubble within the plot represents a state/UT.

Table 2: Details of findings from visualizations from the Indiapub web application covering any topics from 2014 to 2025, in which "Any author" position is the default in this case. The results derived from the application are as of February 2, 2026.

Visualizations and top three institutions list	Any Topics, covering all publications regardless of keywords
Geographic distribution of publications †	Tamil Nadu (531K+ publications), Maharashtra (379K+ publications), Delhi (370K+ publications), Uttar Pradesh (364K+ publications), Karnataka (364K+ publications).
Temporal distribution of publications‡	There is an increasing trend in the number of publications from India from 2014 to 2025; Tamil Nadu follows a similar trend and consistently leads among the states and UTs.
Publication versus population by state and UT§	HP: Tamil Nadu (+18.3 pp), Bihar (–12.4 pp) MP: Delhi (+17.1 pp) LP: Chandigarh (–16.5 pp), Jammu and Kashmir (–13.0 pp)
State and UT publications percentage by year¶	The main contributors by publication count within their respective population groups were Tamil Nadu, Maharashtra, Uttar Pradesh, and West Bengal (HP), Delhi and Karnataka (MP), and Uttarakhand and Chandigarh (LP).
Publications versus HDI over time#	There is a positive association between HDI and publication volume. Uttar Pradesh in HP and Uttarakhand in LP have a relatively higher output despite lower HDI.
Top three institutions by their publication counts	Vellore Institute of Technology (Tamil Nadu), All India Institute of Medical Sciences (Delhi), Indian Institute of Technology Delhi (Delhi)

Abbreviations: Thousands (K), High population group (HP), medium population group (MP), low population group (LP), Human Development Index (HDI), National Capital Territory of Delhi (Delhi), percentage points (pp), union territory (UT).

Note:

*High population group is defined as states/UTs with an estimated population share of over 5.0% of India's total population; medium population group is defined as states/UTs with an estimated population share between 1.0% and 5.0% (inclusive) of India's total population; and low population group is defined as those with less than 1.0% of the national population. The population estimates were extracted from tables reporting projected total populations of states and UTs from the Population Projections for India and States 2011-2036 report published by the National Commission on Population under the Ministry of Health and Family Welfare, Government of India (National Commission on Population *et al.*, 2020).

What each row reports:

† Report top five states/UTs by their publication counts.

‡ Report national and state/UT time trends.

§ Report states/UTs where the absolute difference between their share of publications and their share of population is greater than ±10.0 pp in their respective population groups; positive values indicate overrepresentation and negative values indicate under-representation.

¶ Describe how each state/UT's share of publications changes over time within its population group (high, medium, low), highlighting states/UTs that contribute consistently.

Describe the relationship between HDI and publication volume over time, noting whether higher-HDI states/UTs tend to contribute more publications and identifying any notable exceptions or outliers.

RESULTS

As an empirical demonstration of our application, we first selected "Any topics" and the period 2014 to 2025 with no citation threshold. Under this specification, India produced about 4 million publications in this period. In Table 2, we identify the top five states/UTs by their publication counts; describe temporal trends; list states/UTs where the absolute difference between their share of publications and their share of population is greater than ±10.0 percentage points (pp) in their respective population groups; describe how each state/UT's share of publications changes over time within its population group; report the main contributors by publication count within their respective population groups; summarize the relationship between HDI and publication volume over time; and report top three institutions by their publication counts. We found that Tamil Nadu, Maharashtra, Delhi, Uttar Pradesh, and Karnataka were the leading contributors to the overall publication count from 2014 to 2025. Stratified by population group, the main contributors by publication count in their respective groups were Tamil Nadu, Maharashtra, Uttar Pradesh, and West Bengal in high population group, Delhi and Karnataka in medium population group, and Uttarakhand and Chandigarh in low population group.

We then conducted six case studies on publications from the topics of EHR, GWAS, AI, development economics, environmental science, and COVID-19, covering the period from 2014 to 2025, inclusive. These areas were chosen to focus on a mix of mature and emerging topics across the health and economics fields. For each case study, we state the top five state/UT contributors; describe the temporal distribution of publications; report over or under-representation within high, medium, and low population groups only when a state/UT's publication share differs from its population share by at least an absolute difference of 10.0 pp; and summarize the relative contributions by state/UT over time and nuances in the relationship between the HDI and publication output. We use the application's default settings: First author for publication counts, all publication types, and no minimum

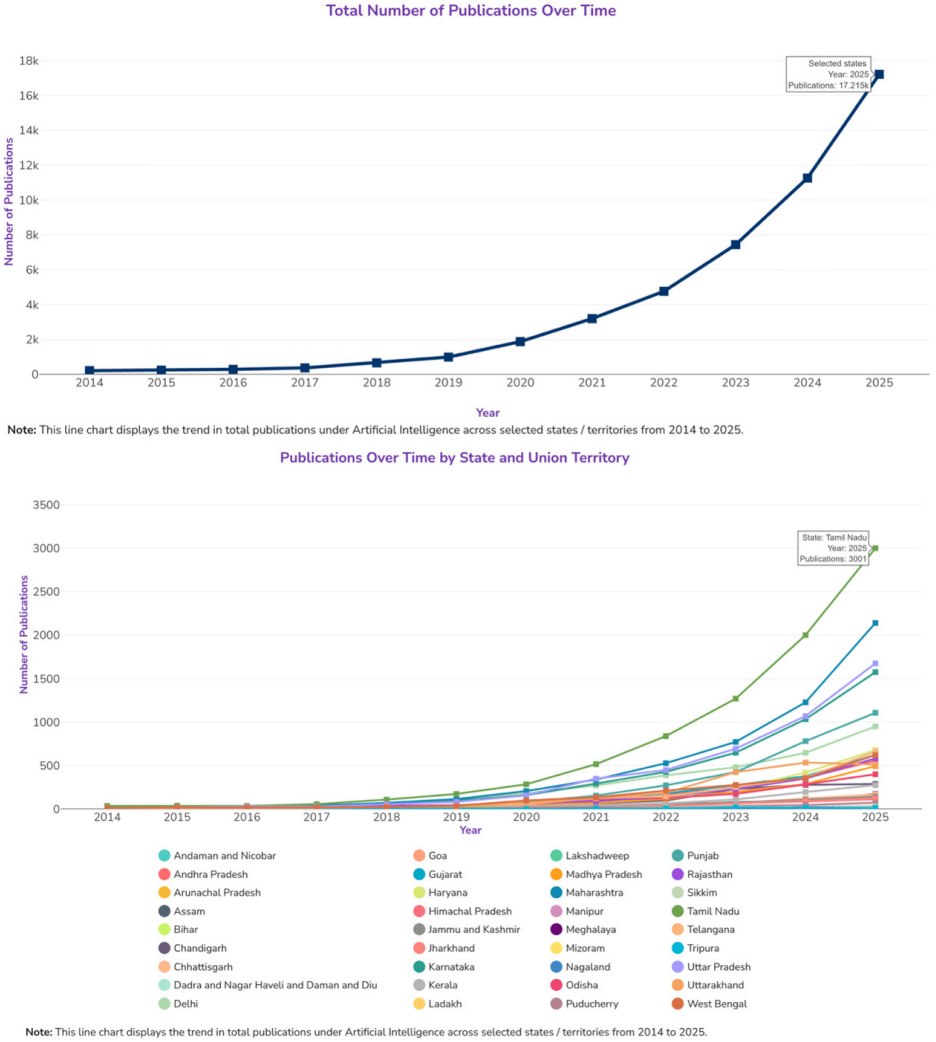


Figure 2: Temporal distribution of publications in the artificial intelligence research domain from 2014 to 2025. The upper panel shows the national trend, and the lower panel shows the state/UT trends. The results derived from the application are as of March 10, 2026.

citations. Details of our findings based on our interactive plots and available data table for each case study are listed in Table 3.

KEY FINDINGS

1. Publication output overall is highly concentrated in a small set of states/UTs, including Delhi, Tamil Nadu, Maharashtra, and Uttar Pradesh.

2. Most research domains show publication growth from 2014 to 2025.

3. Tamil Nadu and Delhi were persistently overrepresented in the high and medium population groups, respectively, with publication shares more than 10.0 pp higher than their population shares. Bihar was underrepresented in all research domains, with publication shares more than 10.0 pp lower than its population share. Chandigarh and Uttarakhand were frequently overrepresented within the low population group.

4. Tamil Nadu, Uttar Pradesh, Maharashtra, Delhi, Chandigarh and Uttarakhand account for a consistent share of publications over time in their respective population groups, in which first author leadership roles are repeatedly anchored in a few research hubs.

5. Higher HDI states generally publish more, but notable exceptions (e.g., Uttar Pradesh and Uttarakhand) show high output despite lower HDI, indicating spaces where capacity and collaboration may outweigh development levels.

6. In EHR- and AI-related research, most of the top three institutions by publication count were based in Tamil Nadu (EHR: Vellore Institute of Technology and SRM Institute of Science and Technology both from Tamil Nadu, and Chandigarh University from Punjab; AI: Vellore Institute of Technology, Chandigarh University from Punjab, and SRM Institute of Science and Technology). In GWAS, environmental science, and COVID-19-related research, the top three institutions were distributed across a mix of different states and union territories. In development economics, all three top institutions were based in Delhi (University of Delhi, Jawaharlal Nehru University, Indian Institute of Technology Delhi).

DISCUSSION

The primary contribution of this study is the development of a reproducible framework for subnational bibliometric analysis that integrates scholarly metadata, institutional identifiers, demographic benchmarks, and development indicators to characterize geographic and temporal patterns of publication

Table 3: Details of case study findings from visualizations in the Indiapub web application covering the topics of Electronic Health Records (EHR), Genome-Wide Association Studies (GWAS), Artificial Intelligence (AI), development economics, environmental science, and COVID-19 across the period 2014-2025. The results derived from the application are as of March 10, 2026.

Case studies (total publications) / Visualization and top three institutions list	Electronic Health Records (3,106 publications)	Genome-wide Association Studies (1,431 publications)	Artificial Intelligence (48,472 publications)	Development Economics (1,750 publications)	Environmental Science (6,432 publications)	COVID-19 (55,777 publications)
Geographic distribution of publications †	Tamil Nadu, Maharashtra, Uttar Pradesh, Karnataka, Delhi (Figure 1).	Delhi, Tamil Nadu, Uttar Pradesh, Punjab, Karnataka.	Tamil Nadu, Maharashtra, Uttar Pradesh, Karnataka, Delhi.	Delhi, Uttar Pradesh, Maharashtra, Tamil Nadu, West Bengal.	Tamil Nadu, Uttar Pradesh, Delhi, Maharashtra, Karnataka.	Delhi, Maharashtra, Tamil Nadu, Uttar Pradesh, Karnataka.
Temporal distribution of publications‡	Exponential growth in national publication count from 2014 to 2025; Tamil Nadu follows a similar trend and consistently leads among the states and UTs.	Gradual national buildup from 2014 to 2025; Delhi follows a similar trend and consistently leads.	Exponential growth in national publication count from 2014 to 2025 (Figure 2A); Tamil Nadu follows a similar trend and leads among states/UTs (Figure 2B).	Gradual growth to 2021, sharp peak in 2023, followed by an increase of publications from 2024 to 2025; no single state/UT dominates over time.	Exponential growth in national publication count from 2014 to 2025; no single state/UT dominates over time.	Sudden peak in 2021, followed by a rapid decline from 2022 to 2025. Delhi follows a similar trend and leads.

Case studies (total publications) / Visualization and top three institutions list	Electronic Health Records (3,106 publications)	Genome-wide Association Studies (1,431 publications)	Artificial Intelligence (48,472 publications)	Development Economics (1,750 publications)	Environmental Science (6,432 publications)	COVID-19 (55,777 publications)
Publication versus population by state and UT[§]	HP: Tamil Nadu (+31.3 pp); Bihar (–12.8 pp) MP: Delhi (+15.4 pp) LP: Chandigarh (+25.5 pp); Jammu and Kashmir (–12.6 pp)	HP: Tamil Nadu (+25.9 pp); Bihar (–12.6 pp) (Figure 3A) MP: Delhi (+31.6 pp) (Figure 3B) LP: Chandigarh (+16.0 pp); Uttarakhand (–10.0 pp) (Figure 3C)	HP: Tamil Nadu (+24.7 pp); Bihar (–12.5 pp) MP: Delhi (+11.7 pp) LP: Uttarakhand (+22.8 pp); Chandigarh (+20.7 pp); Jammu and Kashmir (–14.1 pp)	HP: Tamil Nadu (+10.9 pp); Bihar (–11.7 pp) MP: Delhi (+25.1 pp) LP: Uttarakhand (+16.6 pp)	HP: Tamil Nadu (+17.0 pp); Bihar (–11.6 pp) MP: Delhi (+17.3 pp) LP: Uttarakhand (+16.6 pp)	HP: Tamil Nadu (+14.3 pp); Bihar (–12.3 pp) MP: Delhi (+27.9 pp) LP: Chandigarh (+26.1 pp)
State and UT publications percentage by year[¶]	Over 2014-2025, the most consistent contributors by publication count in their respective population groups were Tamil Nadu (HP), Delhi and Karnataka (MP), and Chandigarh and Uttarakhand (LP).	Consistent contributors were Tamil Nadu and Uttar Pradesh (HP), Delhi (MP), and Chandigarh and Jammu and Kashmir (LP).	Tamil Nadu and Maharashtra (HP), Delhi and Karnataka (MP), and Chandigarh and Uttarakhand (LP) contributed most steadily.	Most HP states contributed steadily except Bihar and Madhya Pradesh; Delhi (MP) and Uttarakhand (LP) contributed most steadily (Figures 4A-C).	Maharashtra, Tamil Nadu, Uttar Pradesh, and West Bengal (HP), Delhi (MP), and Uttarakhand (LP) contributed most steadily.	Maharashtra, Tamil Nadu, and Uttar Pradesh (HP), Delhi (MP), Chandigarh and Uttarakhand (LP) contributed most steadily.
Publications versus HDI over time[#]	There is a positive association between HDI and publication volume. Uttar Pradesh in HP and Uttarakhand in LP are outliers, with relatively higher output despite lower HDI.	There is a positive association between HDI and publication volume, with Uttar Pradesh again as an outlier within HP, showing relatively higher output despite lower HDI.	There is a positive association between HDI and publication volume. Uttar Pradesh in HP and Uttarakhand in LP are again outliers, with relatively higher output despite lower HDI.	There is some positive association observed; however, higher HDI states (e.g., Delhi, Maharashtra, Tamil Nadu) account for a large share of output.	There is a positive association between HDI and publication volume. Uttar Pradesh and Uttarakhand are the exceptions (Figure 5).	There is some positive association between HDI and publication volume observed, with Uttar Pradesh as an outlier within HP, with relatively higher output despite lower HDI.

Case studies (total publications) / Visualization and top three institutions list	Electronic Health Records (3,106 publications)	Genome-wide Association Studies (1,431 publications)	Artificial Intelligence (48,472 publications)	Development Economics (1,750 publications)	Environmental Science (6,432 publications)	COVID-19 (55,777 publications)
Top three institutions by their publication counts	Vellore Institute of Technology (Tamil Nadu), SRM Institute of Science and Technology (Tamil Nadu), Chandigarh University (Punjab).	Punjab Agricultural University (Punjab), Indian Agricultural Research Institute (Delhi), International Crops Research Institute for the Semi-Arid Tropics (Telangana).	Vellore Institute of Technology (Tamil Nadu), Chandigarh University (Punjab), SRM Institute of Science and Technology (Tamil Nadu).	University of Delhi (Delhi), Jawaharlal Nehru University (Delhi), Indian Institute of Technology Delhi (Delhi).	University of Delhi (Delhi), University of Petroleum and Energy Studies (Uttarakhand), Vellore Institute of Technology (Tamil Nadu).	All India Institute of Medical Sciences (Delhi), Postgraduate Institute of Medical Education and Research (Chandigarh), Government Medical College (Kerala).

Abbreviations: High population group (HP), medium population group (MP), low population group (LP), Human Development Index (HDI), National Capital Territory of Delhi (Delhi), percentage points (pp), union territory (UT).
Note:
*Unless otherwise stated, counts use the First author rule. A state/UT receives 1 count if the first author's first Indian institution is located there. Publications with no India-affiliated first author do not contribute to any count.
*High population group is defined as states/UTs with an estimated population share of over 5.0% of India's total population; medium population group is defined as states/UTs with an estimated population share between 1.0% and 5.0% (inclusive) of India's total population; and low population group is defined as those with less than 1.0% of the national population. The population estimates were extracted from tables reporting projected total populations of states and UTs from the Population Projections for India and States 2011-2036 report published by the National Commission on Population under the Ministry of Health and Family Welfare, Government of India (National Commission on Population *et al.*, 2020).
What each row reports:
† Report top five states/UTs by their publication counts.
‡ Report national and state/UT time trends.
§ Report states/UTs where the absolute difference between their share of publications and their share of population is greater than ±10.0 pp in their respective population groups; positive values indicate overrepresentation and negative values indicate under-representation.
¶ Describe how each state/UT's share of publications changes over time within its population group (high, medium, low), highlighting states/UTs that contribute consistently.
# Describe the relationship between HDI and publication volume over time, noting whether higher-HDI states/UTs tend to contribute more publications and identifying any notable exceptions or outliers.

output. We operationalized this framework through **Indiapub**, a web application designed to support transparent, reusable, and scalable analysis of publication trends across Indian states and UTs. Using India as an empirically rich demonstration, we show that this framework can reveal persistent regional differences in research participation, benchmark publication output against population share, and contextualize subnational publication trends using the HDI. Accordingly, **Indiapub** serves not only as an interactive descriptive platform, but also as an informetric tool for comparative subnational research evaluation and evidence-informed policy analysis.

By identifying broad patterns in research participation across India, **Indiapub** can help researchers, trainees, administrators, and policymakers recognize areas of concentration and potential under-representation within the national research landscape. Our 2014 to 2025 "Any Topics" snapshot shows that the states/UTs that had a large research participation footprint were among the larger and more populated states and union territories: Tamil Nadu, Maharashtra, Delhi, Uttar Pradesh, and Karnataka. The clustering is also institutional, as the top three publishing institutions were in Tamil Nadu and Delhi, underscoring state and UT-level dominance in research participation and collaboration in India.

The mix of mature and emerging topics allows for a holistic comparison of publication volume at national and state/UT levels, revealing states/UTs with long-established research capacities and those that are pioneers in new research areas. From 2014 to 2025, COVID-19-related research constitutes the largest volume overall, driven by the surge in publications after the outbreak in late 2019. This pattern underscores India's ability to leverage research capacity and promptly respond to pressing scientific inquiries. AI-related research shows the next highest publication output, followed by environmental science, while EHR, development economics, and GWAS appear as smaller, more specialized areas with comparatively fewer publications.

Comparing each state's/UT's share of publications with its share of the national population within its population-size peer group (high, medium, or low) showed that publication output is not proportional to demographic weight. Applying an absolute threshold of 10.0 percentage points between a state's/UT's publication share and its population share, we revealed that

Table 4: Details of case study findings from visualizations in the Indiapub web application covering the topics of Electronic Health Records (EHR), Genome-Wide Association Studies (GWAS), Artificial Intelligence (AI), development economics, environmental science, and COVID-19 across the period 2014-2025. The minimum citations threshold is 50. The results derived from the application are as of March 10, 2026.

Case studies (total publications) / Visualization and top three institutions list	Electronic Health Records (86 publications)	Genome-wide Association Studies (98 publications)	Artificial Intelligence (1,650 publications)	Development Economics (74 publications)	Environmental Science (285 publications)	COVID-19 (2,749 publications)
Geographic distribution of publications †	Tamil Nadu, Delhi, Maharashtra, Gujarat, Uttar Pradesh	Delhi, Uttar Pradesh, Telangana, Punjab, Karnataka	Tamil Nadu, Maharashtra, Delhi, Uttar Pradesh, Karnataka	Delhi, Tamil Nadu, Uttar Pradesh, Maharashtra, Rajasthan	Delhi, Tamil Nadu, Uttar Pradesh, Maharashtra, Karnataka	Delhi, Uttar Pradesh, West Bengal, Maharashtra, Tamil Nadu
Temporal distribution of publications‡	An unsteady national increase that peaked in 2022.	A cyclical pattern from 2014 to 2022, followed by a decline to 2024.	Accelerated growth from 2014 to 2022, followed by a steep decline through 2025, reflecting incomplete indexing of recent years; Tamil Nadu follows a similar trend and leads among states/UTs.	A cyclical pattern from 2014 to 2023.	Fluctuating patterns from 2016 to 2023 with a peak in 2021, followed by a decline to 2025.	A steady decline from 2020 to 2025.
Publication versus population by state and UT§	HP: Tamil Nadu (+36.7 pp), Gujarat (+11.7 pp), Uttar Pradesh (−14.1 pp), Bihar (−14.3 pp) MP: Delhi (+40.7 pp) LP: Uttarakhand (+15.4 pp), Himachal Pradesh (−13.3 pp)	HP: Uttar Pradesh (+20.3 pp), Tamil Nadu (+16.6 pp), Bihar (−14.2 pp) MP: Delhi (+35.8 pp) LP: Jammu and Kashmir (+25.7 pp), Chandigarh (+22.8 pp), Meghalaya (+19.0 pp), Himachal Pradesh (−13.3 pp), Uttarakhand (−20.9 pp)	HP: Tamil Nadu (+20.9 pp), Bihar (−11.0 pp) MP: Delhi (+23.5 pp) LP: Uttarakhand (+21.4 pp), Chandigarh (+12.5 pp)	HP: Tamil Nadu (+17.3 pp), Bihar (−14.2 pp) MP: Delhi (+37.3 pp), Andhra Pradesh (−12.3 pp), Karnataka (−12.7 pp) LP: Mizoram (+47.8 pp), Jammu and Kashmir (+25.7 pp), Himachal Pradesh (−13.3 pp), Uttarakhand (−20.9 pp)	HP: Tamil Nadu (+17.6 pp), Bihar (−12.7 pp) MP: Delhi (+26.8 pp) LP: Chandigarh (+18.8 pp), Himachal Pradesh (+15.7 pp), Jammu and Kashmir (−13.8 pp)	HP: Bihar (−12.4 pp) MP: Delhi (+34.5 pp) LP: Chandigarh (+29.5 pp)
State and UT publications percentage by year¶	Over 2014-2025, the most consistent contributors by publication count in their respective population groups were Tamil Nadu (HP) and Delhi (MP).	Consistent contributors were Uttar Pradesh (HP) and Delhi (MP).	Consistent contributors were Maharashtra and Tamil Nadu (HP), Delhi (MP), and Uttarakhand (LP).	The only consistent contributor to its respective population group was Delhi (MP).	Consistent contributors were Maharashtra, Tamil Nadu, and Uttar Pradesh (HP), Delhi (MP), Uttarakhand, Chandigarh, and Himachal Pradesh (LP).	Consistent contributors were Maharashtra, Tamil Nadu, Uttar Pradesh, and West Bengal (HP), Delhi (MP), and Chandigarh and Uttarakhand (LP).

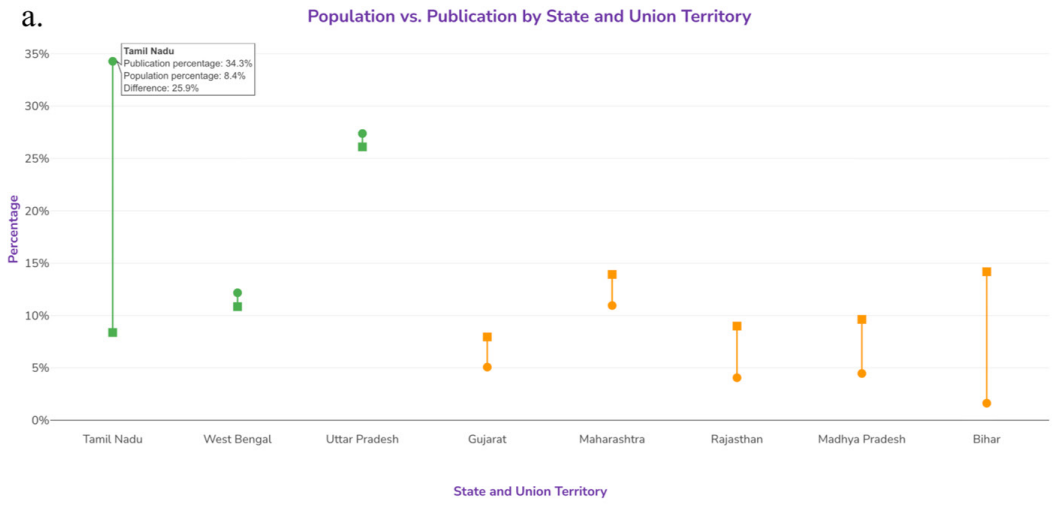
Case studies (total publications) / Visualization and top three institutions list	Electronic Health Records (86 publications)	Genome-wide Association Studies (98 publications)	Artificial Intelligence (1,650 publications)	Development Economics (74 publications)	Environmental Science (285 publications)	COVID-19 (2,749 publications)
Publications versus HDI over time#	There is a slight positive association between HDI and publication volume.	There is a slight positive association between HDI and publication volume.	There is a positive association between HDI and publication volume, with Uttar Pradesh as an outlier within HP, showing relatively higher output despite lower HDI.	There is no strong or apparent overall association between HDI and publication volume.	There is a positive association between HDI and publication volume, with Uttar Pradesh again as an outlier within HP, with relatively higher output despite lower HDI.	There is a positive association between HDI and publication volume, with Uttar Pradesh as an outlier within HP, with relatively higher output despite lower HDI.
Top three institutions by their publication counts	Nirma University (Gujarat), Anna University, Chennai (Tamil Nadu), Vellore Institute of Technology (Tamil Nadu).	Punjab Agricultural University (Punjab), International Crops Research Institute for the Semi-Arid Tropics (Telangana), Indian Agricultural Research Institute (Delhi).	Vellore Institute of Technology (Tamil Nadu), Symbiosis International University (Maharashtra), Jamia Millia Islamia (Delhi).	Malaviya National Institute of Technology Jaipur (Rajasthan), Anna University, Chennai (Tamil Nadu), Indian Institute of Technology Kharagpur (West Bengal).	Vellore Institute of Technology (Tamil Nadu), University of Delhi (Delhi), Jamia Millia Islamia (Delhi).	Postgraduate Institute of Medical Education and Research (Chandigarh), All India Institute of Medical Sciences (Delhi), Jamia Millia Islamia (Delhi).

Abbreviations: High population group (HP), medium population group (MP), low population group (LP), Human Development Index (HDI), National Capital Territory of Delhi (Delhi), percentage points (pp), union territory (UT).
Note:
*Unless otherwise stated, counts use the First author rule. A state/UT receives 1 count if the first author's first Indian institution is located there. Publications with no India-affiliated first author do not contribute to any count.
*High population group is defined as states/UTs with an estimated population share of over 5.0% of India's total population; medium population group is defined as states/UTs with an estimated population share between 1.0% and 5.0% (inclusive) of India's total population; and low population group is defined as those with less than 1.0% of the national population. The population estimates were extracted from tables reporting projected total populations of states and UTs from the Population Projections for India and States 2011-2036 report published by the National Commission on Population under the Ministry of Health and Family Welfare, Government of India (National Commission on Population *et al.*, 2020).
What each row reports:
† Report top five states/UTs by their publication counts.
‡ Report national and state/UT time trends.
§ Report states/UTs where the absolute difference between their share of publications and their share of population is greater than ±10.0 pp in their respective population groups; positive values indicate overrepresentation and negative values indicate under-representation.
¶ Describe how each state/UT's share of publications changes over time within its population group (high, medium, low), highlighting states/UTs that contribute consistently.
# Describe the relationship between HDI and publication volume over time, noting whether higher-HDI states/UTs tend to contribute more publications and identifying any notable exceptions or outliers.

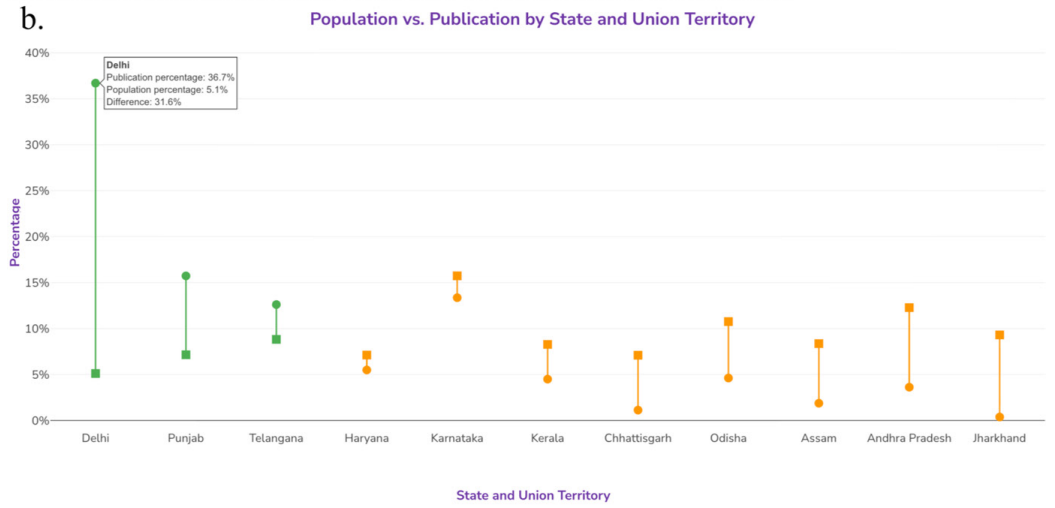
Tamil Nadu was consistently overrepresented, while Bihar was consistently underrepresented across all six research domains in the high population group. Delhi was overrepresented for all research domains within the medium population group. Chandigarh and Uttarakhand were frequently overrepresented relative to the states and UTs belonging to the low population group, suggesting that concentrated institutional resources supported certain states and UTs with smaller populations (Table 3).

Longitudinal analyses showed that publication counts were driven by population-dense states/UTs such as Tamil Nadu, Uttar Pradesh, Maharashtra, and Delhi. Higher HDI was generally associated with greater publication output. Within the high population group, Uttar Pradesh was a notable outlier: despite a relatively low HDI (ranging from 0.56 to 0.60), it showed large publication output, unlike other low-HDI, high population states such as Bihar (ranging from 0.56 to 0.58) and Rajasthan (ranging from 0.64 to 0.66). These patterns illustrate how **Indiapub** can support evidence-informed planning for research capacity building across states and UTs in India.

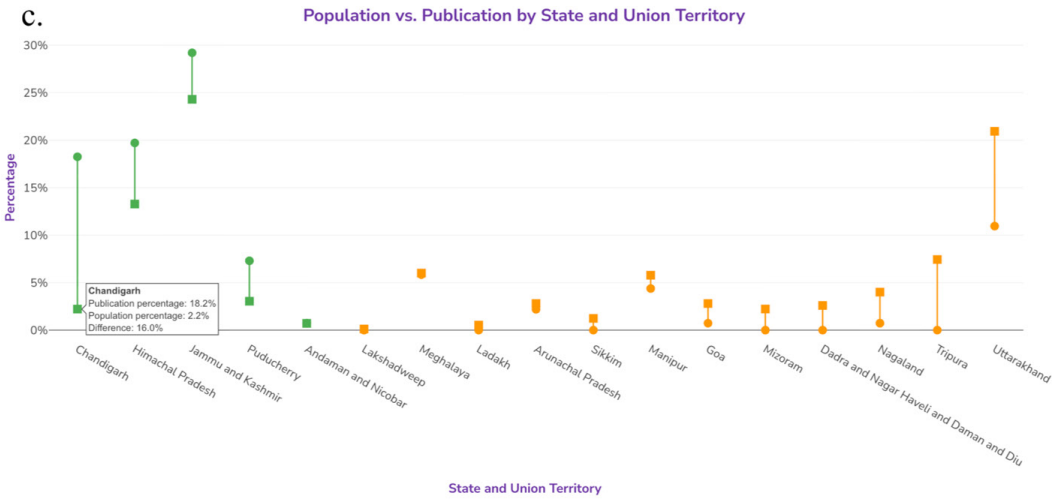
To examine whether these publication volume-driven patterns persist when focusing on higher-impact publications, we repeated our case study analyses restricting to publications with at least 50 citations (Table 4). This threshold substantially reduced publication



Note: This plot compares the publication share versus the population share across selected Indian states / territories for Genome-Wide Association Studies between the years of 2014 and 2025. The population percentage is based on 2025 population data. A total of 493 publications were retrieved for the selected states/UTs. Lines connect each state's publication share (circle) with its population share (square), highlighting over-representation (green) or under-representation (orange).



Note: This plot compares the publication share versus the population share across selected Indian states / territories for Genome-Wide Association Studies between the years of 2014 and 2025. The population percentage is based on 2025 population data. A total of 801 publications were retrieved for the selected states/UTs. Lines connect each state's publication share (circle) with its population share (square), highlighting over-representation (green) or under-representation (orange).



Note: This plot compares the publication share versus the population share across selected Indian states / territories for Genome-Wide Association Studies between the years of 2014 and 2025. The population percentage is based on 2025 population data. A total of 137 publications were retrieved for the selected states/UTs. Lines connect each state's publication share (circle) with its population share (square), highlighting over-representation (green) or under-representation (orange).

Figure 3: Publication versus population share across high (panel A), medium (panel B), and low (panel C) population groups in the genome-wide association studies research domain from 2014 to 2025. The results derived from the application are as of March 10, 2026.

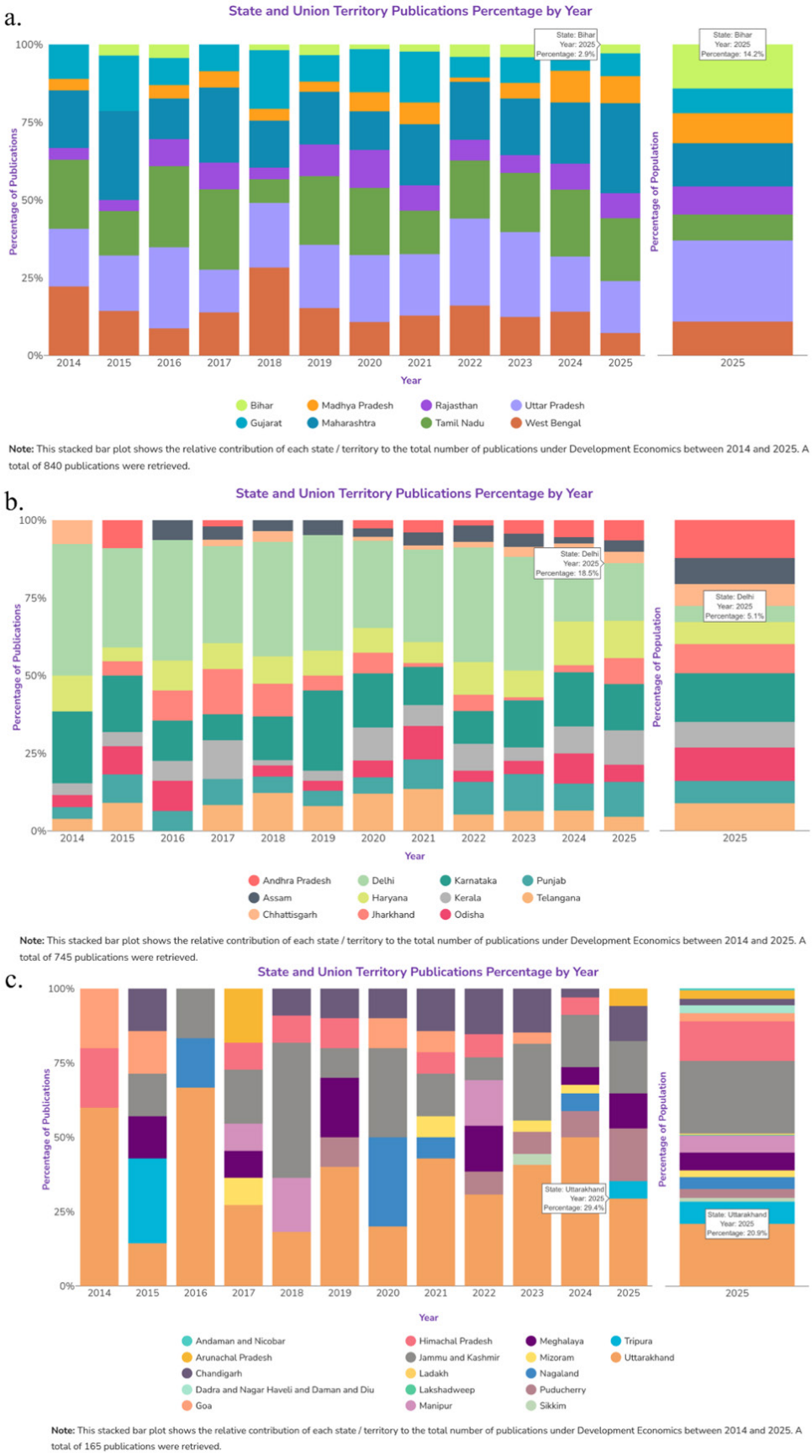
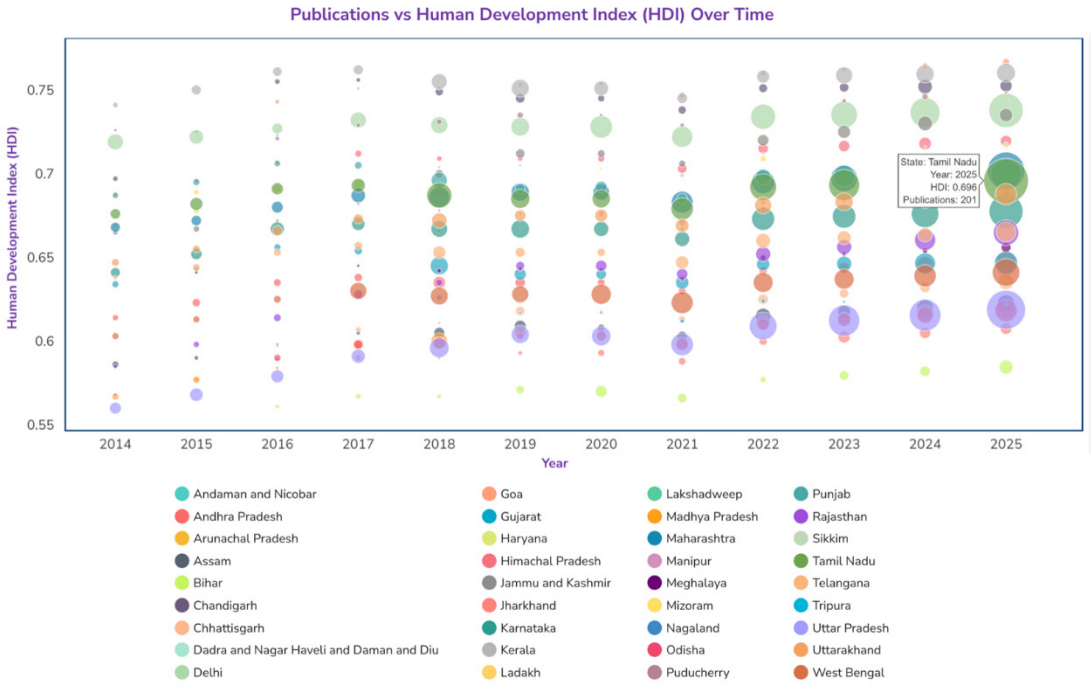


Figure 4: State and union territory publications percentages by year across high (panel A), medium (panel B), and low (panel C) population groups in the development economics research domain from 2014 to 2025. The results derived from the application are as of March 10, 2026.



Note: This bubble plot displays the relationship between Human Development Index (HDI) and the number of publications under Environmental Science between 2014 and 2025. Bubble size represents the number of publications. A total of 6432 publications were retrieved.

Figure 5: Publications versus Human Development Index over time in the environmental science research domain from 2014 to 2025. The results derived from the application are as of March 10, 2026.

counts across all domains (e.g., from 3,106 to 86 publications in EHR, from 1,431 to 98 in GWAS, and from 48,472 to 1,650 in AI). Several broad patterns were similar to those observed without a citation threshold: Tamil Nadu and Delhi continued to be overrepresented in their respective population groups, and Bihar remained consistently underrepresented in the high population group. However, the top three institutional landscapes changed by at least one institution in research domains EHR, AI, development economics, environmental science, and COVID-19. For example, in development economics-related publications, the top three institutions shifted from being exclusively based in Delhi to Malaviya National Institute of Technology Jaipur (Rajasthan) as the leading institution among publications with at least 50 citations, followed by Anna University, Chennai (Tamil Nadu), and Indian Institute of Technology Kharagpur (West Bengal).

It should be noted that **Indiapub** is meant to characterize the research capacity of institutions and does not represent the distribution of the studied populations (for studies that involve empirical data on specific populations or geography). State- and UT-level publication counts should be interpreted as measures of institutional research participation and affiliation-based scholarly output, not necessarily as indicators of research focused on that same geography. Researchers based in one state or UT may conduct studies in other regions, use national or international data or no data, or collaborate across multiple institutions and locations. Accordingly, the geographic patterns displayed in **Indiapub** may not correspond directly to the beneficiaries of the research.

Additionally, our analysis relies on OpenAlex-indexed journals and ROR-based affiliations; therefore, publications or affiliations missing from these sources are not captured. Results are descriptive, as we report differences in publication share versus population share without uncertainty quantifications or formal statistical tests. State/UT-level HDI and population share offer only partial insight into structural research capacity in India. Additional factors, such as the number and density of research institutions, university budgets, faculty-to-student ratios, and institution collaborations, are likely influential to publication outcomes. Possible extensions, including incorporating district-level data, co-authorship networks, and funding flows, could provide a more granular view of India's research ecosystem. Integrating additional bibliographic sources, incorporating uncertainty summaries for comparative plots, and connecting data on social determinants can deepen interpretation of India's research development and growth. Applying this framework to other countries would require adequate ROR coverage, a mapping from institutional identifiers to subnational boundaries, and comparable demographic benchmarks at the relevant geographical level.

CONCLUSION

This study presents a reproducible framework for subnational bibliometric analysis that integrates publication data from an open-source scholarly database, geographic attribution through the Research Organization Registry, demographic information, and development indicators. Using India as a

strong empirical demonstration setting, our analysis of state- and UT-level publication trends from 2014 to 2025 across six research domains revealed persistent geographic concentration of publication output in a small number of states and union territories. These patterns were observed under both unrestricted and citation-filtered analyses. Because the framework is modular, it can be adapted to other countries with sufficient institutional coverage in scholarly metadata sources and registries, offering the bibliometrics community a replicable approach for moving beyond national-level publication comparisons toward subnational research evaluation.

CODE AVAILABILITY STATEMENT

The code used in this study is available through the Yale School of Public Health Data Science and Data Equity GitHub repository: https://github.com/ysph-dsde/india-publications. We intend to maintain the Indiapub web application and public access to it through at least December 2027, subject to continued server and institutional support.

REFERENCES

Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics, 11*(4), 959–975. DOI: 10.1016/j.joi.2017.08.007

Chen, C. (2006). CiteSpace II: Detecting and visualizing emerging trends and transient patterns in scientific literature. *Journal of the American Society for Information Science and Technology, 57*(3), 359–377. DOI: 10.1002/asi.20317

Clarivate. (n.d.). *InCites Benchmarking & Analytics*. Retrieved April 28, 2026, from https://clarivate.com/academia-government/scientific-and-academic-research/research-funding-analytics/incites-benchmarking-analytics/

Data For India. (n.d.). *Insights, charts and data to create shared knowledge and expand our understanding of India*. Retrieved April 28, 2026, from https://www.dataforindia.com

Debbarma, M. (2025). Linguistic diversity and national integration in India: Challenges, policies and pathways to inclusivity. *Journal of Asian and African Studies*. Advance online publication. DOI: 10.1177/00219096251400655

Dimensions. (n.d.). *Dimensions*. Retrieved April 28, 2026, from https://www.dimensions.ai/

Elsevier. (n.d.). *SciVal*. Retrieved April 28, 2026, from https://www.elsevier.com/products/scival

Global Data Lab. (2025). *Subnational Human Development Index* [Data set]. Institute for Management Research, Radboud University. https://globaldatalab.org/shdi/

Jain, D., Kachinovsky, J., Rodriguez, G., Chen, J., Kim, R., & Subramanian, S. V. (2025). India Policy Insights: A geospatial and temporal data science and visualization platform and architecture. *SoftwareX, 30*, 102149. DOI: 10.1016/j.softx.2025.102149

Nandy, S. N. (2019). Development disparities in India: An inter-state and intra-state comparison. *Journal of Land and Rural Studies, 7*(2), 219–235. DOI: 10.1177/2321024919844407

National Commission on Population, Ministry of Health and Family Welfare, Government of India. (2020). *Report of the technical group on population projections (2011–2036)*.

National Science Board, & National Science Foundation. (2023). Publications output: U.S. trends and international comparisons. In *Science and Engineering Indicators 2024* (NSB-2023-33). https://ncses.nsf.gov/pubs/nsb20233/

NITI Aayog. (2025, February). *Expanding quality higher education through states and state public universities*. https://www.niti.gov.in/sites/default/files/2025-02/Expanding-Quality-Higher-Education-through-SPUs.pdf

Pluto Inc. (n.d.). *Scinapse: Finding R&D trends and experts made simple*. Retrieved April 28, 2026, from https://www.scinapse.io

Priem, J., Piwowar, H., & Orr, R. (2022). *OpenAlex: A fully-open index of scholarly works, authors, venues, institutions, and concepts* (arXiv:2205.01833). arXiv. DOI: 10.48550/arXiv.2205.01833

Research Organization Registry. (2025). *ROR: Research Organization Registry*. Retrieved April 28, 2026, from https://ror.org/

Synnestvedt, M. B., Chen, C., & Holmes, J. H. (2005). CiteSpace II: Visualization and knowledge discovery in bibliographic databases. *AMIA Annual Symposium Proceedings*, 724–728.

The Lens. (n.d.). *The Lens – Free & open patent and scholarly search*. Retrieved April 28, 2026, from https://www.lens.org/

United Nations Development Programme. (2024). *Human development report 2023–24: Breaking the gridlock: Reimagining cooperation in a polarized world*. https://hdr.undp.org/

van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics, 84*(2), 523–538. DOI: 10.1007/s11192-009-0146-3

van Eck, N. J., & Waltman, L. (2014). CitNetExplorer: A new software tool for analyzing and visualizing citation networks. *Journal of Informetrics, 8*(4), 802–823. DOI: 10.1016/j.joi.2014.07.006

Cite this article: Hou Y, Cohen E, Higginbottom J, Rountree L, Ren Y, *et al*. A Generalizable Framework and Open Web Application for Subnational Bibliometric Analysis: An Empirical Example with Publications from India. Journal of Data Science, Informetrics, and Citation Studies. 2026;5(3):261-75.