



Anatomical bias in extrapulmonary tuberculosis research: Implications for knowledge structures and research evaluation

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Abstract: -

Background: Bibliometric analyses in biomedical research often treat diseases as homogeneous entities, overlooking internal heterogeneity. In extrapulmonary tuberculosis (EPTB), diverse anatomical manifestations are typically aggregated, potentially obscuring structural imbalances in knowledge production. This study introduces the concept of *anatomical bias*, referring to systematic disparities in research attention and visibility across anatomical sites.

Methods: We conducted a comprehensive bibliometric analysis of 3,963 Scopus-indexed publications on EPTB from 2000 to 2025. Publications were classified into seven anatomical categories. Analytical approaches included co-citation analysis, keyword co-occurrence, thematic evolution, collaboration network analysis, and ordered logistic regression to assess citation-based outcomes. Bibliometric impact was measured using normalized citation scores and journal prestige indicators.

Results: The distribution of research output was highly skewed, with lymphatic (59.5%) and skeletal (17.7%) tuberculosis dominating the literature, while other anatomically significant forms each accounted for less than 6%. Knowledge structures were centered on disease-level themes such as diagnosis, treatment, and HIV co-infection, with anatomical topics remaining peripheral and weakly integrated. Regression analysis showed no significant citation advantage for dominant anatomical sites (OR=0.967), indicating that their prominence is driven by publication volume rather than higher impact. In contrast, international collaboration (OR=2.701) and larger author teams (OR=1.806) were strong predictors of higher citation outcomes.

Conclusions: Anatomical bias in EPTB research is structural rather than performance-based, reflecting disparities in research attention and visibility rather than intrinsic scholarly impact. These findings highlight limitations of aggregated bibliometric indicators and support the need for anatomy-sensitive evaluation frameworks in heterogeneous biomedical fields.

Keywords: Extrapulmonary tuberculosis, Anatomical bias, Bibliometric analysis, Knowledge structure, Research evaluation.

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1. Introduction

Prejudice in knowledge production has emerged as a significant issue in current scientific research, particularly in the skewed distribution of attention, visibility, and evaluative recognition across topics and domains (Nettasinghe et al., 2026). They not only procedurally exclude people through explicit exclusion or discrimination, but these biases also emerge from how knowledge creation is organized over time (in terms of epistemic frameworks, around communities and types of evidence, etc.) as well as from what it primarily values. Understanding these structural biases is crucial because they impact the evolution of scientific fields and the interpretation of research performance indicators (Reibold, 2025; Stroupe et al., 2025).

The importance of the mechanism where aggregation decisions (i.e., how you define or establish relations between research objects) affect what we ultimately observe in knowledge structures has been emphasized more recently in the bibliometric literature (Marzi et al., 2025; Öztürk et al., 2024). In biomedical research, diseases are commonly treated analytically as unitary and uniform, despite rich internal heterogeneity in presentation, diagnostic pathways, and related research foci. Such a bias threatens to conceal systematic imbalances across disease-specific literatures and can thus distort conclusions inferred in bibliometric analyses (Z. Liu et al., 2025; van de Laar et al., 2018).

Research on tuberculosis (TB) is a concrete example of this dilemma. The fact that pulmonary TB has upstaged the others for a very long time in research and scientific activities, extrapulmonary tuberculosis is composed of many other patterns with various types in regions such as lymphatic, skeletal, central nervous system, genitourinary, abdominal, and cutaneous. These manifestations vary not only in clinical presentations, but also in research agenda, methodological methods and cooperation (Gopalswamy et al., 2021; Kim et al., 2026). However, while bibliometric analyses of TB research have been conducted about extrapulmonary forms of the disease, these studies typically treated extrapulmonary TB as an aggregated category only, making it impossible to discern how the production and dissemination of knowledge varies across anatomical areas.

This accumulation can lead to what we refer to as anatomical bias: a systematic skew in the distribution of research attention and influence among anatomical sites within a disease-specific literature. In recent works within the field of science mapping, it has been demonstrated that such structural merits, be they thematic, methodological, or geographical, can have a strong impact on citation flows, topical dominance, and collaboration networks (Bascur et al., 2025; Mejia et al., 2021). In episodic knowledge formats, the imaginary body in which the tubercle bacillus is lodged would also affect which subfields are epistemically central, with implications for scientific visibility and research evaluation.

The treatment of these issues has become relevant to the field from a research evaluation perspective. More recently, bibliometric metrics have become firmly integrated in the allocation of funds, benchmarking of institutions and systems and national research assessment. The risk that evaluation systems based on consolidated indicators may inadvertently reinforce structural biases, particularly across disciplines and heterogeneous areas, has recently been underlined (Jappe et al., 2018; Krüger & Petersohn,

2023). If bias in anatomy follows research, the disease-level bibliometric indicators could distort the distribution of scientific contributions across anatomically defined subdomains.

While there is an increasing number of bibliometric studies about tuberculosis, recent reviews revealed that most analyses are limited to trends in publication productivity by country or theme-specific clustering, with no anatomical stratification being specifically undertaken (Abdelwahab et al., 2024; Igwaran & Edoamodu, 2021). Therefore, little is known about whether extrapulmonary TB research demonstrates unique knowledge paths, thematic developments or collaboration trends when examined in a finer granularity—by anatomical site.

Redressing this imbalance resonates with recent science of science research that has been calling for departures from traditional topic-based mapping approach and to focus instead on analytically meaningful units that correspond better to domain-specific variation (Rafols et al., 2023; Hammarfelt & Rushforth, 2023). An anatomical bibliometric approach provides a new perspective to analyze the internal structure of astronomical knowledge production and influence patterns.

Against this backdrop, the present study explores anatomical bias in research on EPT and considers its implications for the structures of knowledge and research assessment. In this project, we profile the intellectual landscape of research on extrapulmonary TB (cohort 2) using bibliometric analyses of Scopus-indexed publications from 2000 through 2025 to characterize its scholarly roots, thematic change and collaboration networks with an explicit focus on anatomical site. This approach enables us to evaluate how scientific attention and influence is distributed over anatomical domains, and how such regularities change in time.

In particular, the research questions for this study are:

- (1) How is research focus spread among anatomical sites in the field of extrapulmonary tuberculosis?
- (2) How are knowledge structures and thematic trajectories varying for anatomically defined subfields across time?
- (3) What do these patterns mean for research evaluation based on bibliometrics?

The emphasis on anatomical bias as a research object contributes to the recent developments in science of science (SoS) and bibliometric methodology. Moreover, it provides a general view for policy makers and research evaluators who are interested in critically interpreting bibliometric indicators, as well as to design evaluation frameworks that capture more effectively the structural heterogeneity across different fields of biomedical research.

2. Literature review

2.1. Explicit and implicit bias in science production of scientific knowledge

Prejudice in science is not only about deliberate exclusion or strategic neglect, but more usually develops implicitly through everyday scientific practices, dominant paradigms, and evaluative standards. Recent literature in the science of science distinguishes between explicit bias, which implies a deliberate prioritization or marginalization, and implicit bias, where relegation occurs subconsciously as it follows the norms and shared assumptions within scientific communities (Sugimoto et al., 2021; Hammarfelt

& Rushforth, 2023). This difference is significant because implicit biases tend to be more widespread, less visible, and less amenable to correction.

Explicit bias in research knowledge production can manifest in several ways, including planned funding preferences, the strategic setting of agendas, or editorial policies that favor certain research fields and methods. In biomedical research, there may be systematic preferencing of given subfields over others based on overt forms of prioritisation that relate to the (perceived) burden of disease, technical ability, or policy visibility, etc., all motives which are either unsystematically dispersed in relation to fields with potential for exploration or empirically feasible hypotheses. However, overt bias is still a rarity in academic research these days and is continually mitigated by access standards and checks on credibility.

Implicit bias, in contrast, stems from the accumulated behaviour of scholars: things like long-term habits of citation, inherited ways of classifying knowledge, or our disciplines' traditions about what is seen as core or marginal knowledge. These biases will shape which topics are picked, with whom we collaborate, and how to determine what is worth publishing without explicit intent (Milojević 2022; Waltman 2024). Bibliometrically speaking, implicit bias is particularly important as it shapes long-term citation cascades and thematic prominence through self-reinforcement.

2.2. Aggregation bias and disease-level heterogeneity in bibliometric analysis

An increasing literature in bibliometrics has shed light on how options to aggregate can determine observable structures of knowledge (Leydesdorff, 2022; Rafols, Chen & Ping, 2023). One problem is that if the objects of research are lumped together on a high level category, there may be internal spread which can blur an accurate representation of the science actually practiced. This phenomenon, commonly known as aggregation bias, is particularly critical in the context of biomedicine, where diseases include complex biological mechanisms and clinical phenotypes.

Tuberculosis research exemplifies this issue. Although extrapulmonary tuberculosis is a conglomerate of different anatomical expressions, it has been largely considered as one category in bibliometric investigations. It could lead to the distortion of an unbalance focus on researches across different anatomical sites and differences in thematic progression, methods applied and vitality cooperation paradigm (Zyoud & Al-Jabi, 2022; Shah et al., 2021). As a result, some regions of anatomy become epistemic fulcra while others may be underrepresented despite their clinical importance.

Science mapping has shown empirically that alternative stratifications, based on organs, methods or epistemic communities could unveil latent structures which stay hidden in the more traditional topic-based analyses (Wagner et al., 2018; Rafols et al., 2023). An anatomical stratification of extrapulmonary tuberculosis research therefore provides a mechanism for unwinding unstated biases in disease-level aggregation.

2.3. The orientations of knowledge structures, citation dynamics and collaboration patterns

Epistemic structures are formed when citation networks, patterns of co-authorship, and thematic clustering in science combine to exhibit how research communities organize, legitimize and disseminate knowledge (Larivière et al., 2020; Milojević, 2022). Citation-flavored signals of regard are critical to this process, indicating not just intellectual influence, but helping promote accumulative advantage effects that perpetuate attentional hierarchies."¹

Key findings Recent bibliometric research has shown that significant subdomains may receive a disproportionate amount of citation flows and cooperative investment, despite reflecting any underrepresentation in the larger field (Waltman et al., 2021; Bornmann & Tekles, 2023). In the heterogeneous biomedical sciences, this can lead to persisting imbalances in which research on some biological systems achieves centre stage while others retain their marginal status.

These effects are further magnified when we examine collaboration networks. High visibility subfields are often intertwined with scattered international collaboration networks, while peripheral areas can be investigated in more fragmented or regionally confined contexts (Kwiek, 2021; Wagner et al., 2022). Here, within the domain of extrapulmonary tuberculosis, these trends beg the question as to whether anatomical discrimination might be self-reinforcing but unequal participating opportunities and superior access to high-impact publication avenues.

2.4. Implications for bibliometric-based research evaluation

The proliferation of bibliometric indicators used to evaluate research has accentuated worries about structural biases embedded in science metrics. The use of citation-based indicators to distribute funding, to compare institutions and in national evaluations of research has multiplied over time even though the contextual limitations have become increasingly evident (Wouters et al., 2022; Hammarfelt et al., 2023). When evaluation reportage depends on aggregate disease-level indicators, this may inadvertently reinforce the dominance of particular anatomic subfields and skew perceptions as to the full range of scientific contributions.

Current discussions on research evaluation emphasise the importance of more context-sensitive bibliometric approaches which take into account field heterogeneity and internal differentiation (Kouis et al., 2025; Rousseau & Daraio, 2025). Unrecognised anatomical bias could skew assessments by conflating high-impact subfields with overall research quality, putting anatomically marginal but clinically significant study areas at a disadvantage.

That said, little is known about the empirical impact of anatomical stratification on the structures of knowledge or evaluation outcomes. Few of the current bibliometric studies on tuberculosis research have yet focused on what anatomical bias might imply for citation dynamics or collaboration. This void highlights the need for anatomically informed bibliometric analyses that support both the science of science research and the responsible evaluation of research.

2.5. An integrated framework linking anatomical bias, observability, and evaluative incentives

We introduce an organizing framework (as conceived in some of our research) to combine three key axes that condition anatomical bias in knowledge production and evaluation the type of bias (implicit versus explicit thematic preferences); observability of anatomical focus by evaluators in a given paper; and incentives and costs involved in privileging or marginalizing specific 'anatomical instantiations' within publication, citation and evaluation practices.

Anatomical specialization is often readily apparent in biomedical research evaluations. Isolated reports of rarer anatomic presentations for diseases are frequently identified in the titles, abstracts, keywords, and indexing terms. In the context of extrapulmonary TB, anatomic predominance categories, such as lymphatic or skeletal TB, are immediately recognizable to editors, reviewers, and readers, while less common forms (e.g., genitourinary, cutaneous, or disseminated) are readily identified as specialized areas. This high observability reduces the cognitive and institutional costs for evaluators in drawing on known anatomical framings when making judgments about relevance, impact, and publishability.

It is important to note that peer review and bibliometric indicators do not measure the same aspects. Indeed, while 'quality' typically appears as a criterion to be evaluated by peer reviewers, alongside innovations and the suggested (though most often not made explicit) importance of writings for particular clinical narratives or research agendas, it serves here as an ideological device producing intentions in relation to the. In opposition to citation-based indicators are those that measure scholarly uptake after a paper is published, which can be indicative of collective attention and accumulated visibility rather than evaluative purposes per se. Thus, the differences between these two evaluations are likely to be influenced by non-scientific factors, such as journal status, topical familiarity, audience size, and integration with mainstream research currents (Abramo et al., 2024; Calò, 2022).

Empirically, the science of science should also inform us that biases in research evaluation do not need to be direct to result in systematic inequities. Unconscious biases, reflected as a tendency to favour routine, well-established topics, may influence what editors choose to publish or what AEs and reviewers recommend for publication, as well as whose papers are cited without our realizing it. In extrapulmonary tuberculosis, such biases may systematically favor clinically dominant presentations that are considered anatomically central or methodologically standardized

and more universally applicable, but work against organ-centric or rare manifestations that require specific expertise.

Several theoretical frameworks can help explain why these patterns persist. According to cognitive schema theory, evaluators use oversimplified mental frameworks to analyze complex information and, as a result, they favor conventional anatomical categories over atypical ones. System justification theory also posits that performers' behavior is unconsciously driven to retain established hierarchies of knowledge, playing on dominant anatomical framings in a discipline. These processes lead to cumulative advantage: anatomically dominant subfields receive increasing attention, resources and citations, while more peripheral work is marginalised.

From an incentive driven viewpoint, there are very few costs and many benefits to favoring the existent anatomical categories. When supporting established anatomical subjects that are within scope of the journal, when such conduct meets the expectations for what target readership will find relevant, the risk to reputation of editors and reviewers is small. The relative cost of citing studies on leading manifestations (which are more likely to have become well established, to be methodologically standardized and authoritative) must also surely be in favour of the former. On the other hand, systematically working with marginal anatomical subfields may be more costly in terms of labour, skill needs and justification length, with uncertain returns.

We posit that when such circumstances hold, anatomically dominant subfields will tend to be positioned more centrally in both peer-review outcomes and citation-based knowledge structures, whereas anatomically focused expressions will make only weak connections. This is not to suggest any conspiracy of exclusion, but rather that the current pattern reflects a strategic response to institutional rewards and cognitive limits. Like other areas of structural bias, such inequalities are emergent features of the evaluative system, not intentionally produced by individual actors.

This framework offers a theoretical foundation for interpreting our empirical results and makes clear how such compound bibliometric indicators can unwittingly promote anatomic bias in mixed biomedicine fields. These indicators thereby run the risk of reinforcing dominant anatomical framings as well as marginalising more specialist but clinically important research areas by conflating visibility with importance. Therefore, acknowledging the interaction between bias, observability and incentives is necessary in order to explore more sophisticated, anatomy-sensitive systems of research evaluation.

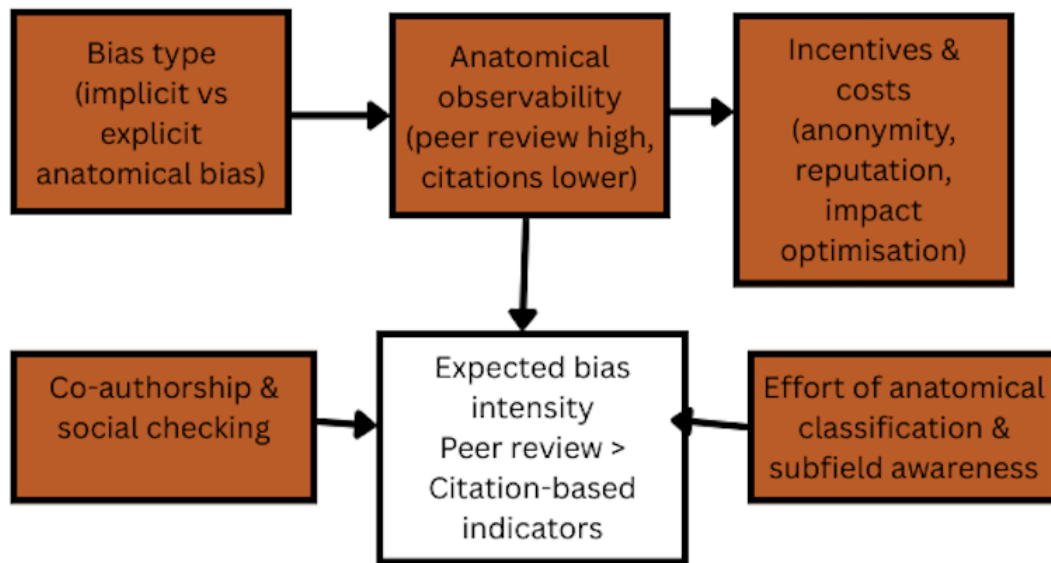


Fig. 1. Conceptual pathways linking anatomical bias, identifiability of anatomical focus, and evaluative incentives to observed gaps in peer-review outcomes and citation-based indicators.

3. Data and Methodology

3.1. Data

The dataset comprising scientific publications on extra-pulmonary tuberculosis was compiled for analysis in this study. Scopus was searched for papers following a clear search strategy, which included the terms Scopus record identifier, Author Names, Source title (publication name), Document Type (for the publication type), and Year of Publication. The time frame considered for the observation phase is overall 2000–2025, taking into account long-term trends of knowledge production and collaboration activities. Scopus was chosen for its comprehensive international coverage of biomedical and global health journals, as well as its feasibility for use in conducting large-scale bibliometric studies.

Following the first search, a total of 3,963 records were obtained after applying filters for document type (articles and reviews) and language (English). Datasets were current as of the date of retrieval to ensure dataset consistency. Each article was considered an individual analytic unit; duplicate articles and non-research material were removed by the Scopus database's own indexing system and by post-data cleaning.

For anatomically stratified analysis, publications were categorized by main anatomic focus using title, abstract, and author keywords. Anatomical sites were lymphatic, skeletal, CNS, genitourinary, abdominal, cutaneous and disseminated EPT. Publications involving multiple anatomic sites were categorized by predominant focus, determined by keyword frequency and contextual relevance. This grouping facilitated segmentation of the dataset into structure-specific subregions for comparison.

The final data set contains a large proportion of the extrapulmonary tuberculosis investigations that were published through the period of observation and an adequate volume to permit strong co-citation analysis, thematic mapping and collaboration network analysis.

The descriptive statistics with anatomical distribution of the sample are presented in Table 1.

3.2. Methodology

To investigate knowledge structures and evaluative patterns across anatomically defined subfields, we employed a multi-method bibliometric approach combining citation analysis, co-word analysis, and network analysis. All comparisons were analyzed using Bibliometrix (R) and VOSviewer, with additional verification analyses conducted in CiteSpace for temporal dynamics. We conducted a co-citation comparison using cited references, then generated co-citation networks for the entire set of articles and for each anatomical subfield, enabling comparisons of similarities and differences in knowledge representations. We used term clustering to identify the most significant intellectual groupings and their relative importance to one another.

Second, to examine the thematic structures of literature, we conducted keyword co-occurrence analysis using author keywords and index keywords. A thesaurus-based cleaning step pre-processed the data by combining synonymous anatomical terms (e.g., spine, spinal, and vertebral) and standardizing anatomical categories, before making these available for analysis. A thematic map was produced to illustrate motor themes, basic sub-themes, recurring sub-themes and dying-away sub-themes in extrapulmonary tuberculosis research.

Third, to illustrate temporal dynamics, we performed a thematic evolution analysis by partitioning the study period into 3 phases (2000–2009, 2010–2017, and 2018–2025). This method enabled the analysis of changes over time in anatomical subfields and their relevance to thematic terminology within our analysis framework.

Fourth, country- and institution-level cooperation networks were studied using co-authorship data. Network density, centrality, and clustering were examined to identify differences in the network organization between anatomically dominant and peripheral subdivisions.

Lastly, for the assessment of bibliometric visibility, citation-based indicators were examined descriptively across anatomical subcategories. Citation levels were not treated as direct proxies for research quality but rather as measures of relative scholarly attention and cumulative advantage within anatomically partitioned subfields.

For articles with co-occurrence across more than one extrapulmonary site, a predominant anatomical location was assigned based on the primary site most frequently mentioned in the title, abstract, and core analytic focus, in keeping with previous bibliometric approaches to field demarcation to maintain thematic consistency and analytical tractability.

To assess the bibliometric impact of each publication, we matched all records retrieved from Scopus using their Digital Object Identifiers (DOIs) and indexed metadata. For each publication, we extracted citation counts and journal-level indicators directly from the Scopus database. Publications were classified by year of publication and anatomical site, based on dominant anatomical assignment derived from titles, abstracts, and author keywords.

Citation impact was operationalised using normalized citation indicators calculated over multiple citation time windows. Specifically, for each publication i , the normalized citation score for time window t was computed as:

$$x_i^t = \frac{c_i^t}{\bar{c}_t} \quad (1)$$

where c_i^t denotes the number of citations received by publication i within t years after publication, and $\bar{c}_t$ represents the average number of citations received within the same time window by all publications published in the same year. Citation windows were defined as $t = 1, 2, 3$, and 5 years following publication, allowing for both short- and medium-term impact assessment.

To account for journal-level visibility effects, we additionally computed a normalized journal prestige indicator based on CiteScore:

$$y_i = \frac{CS_i}{\bar{CS}} \quad (2)$$

Where CS_i is the CiteScore of the journal hosting publication i at the year of publication, and $\bar{CS}$ is the mean CiteScore of all journals included in the dataset for the same publication year.

A composite bibliometric impact score (BIS) was then calculated as a weighted linear combination of normalized citation impact and journal prestige:

$$BIS_i = \beta_1 x_i^t + \beta_2 y_i \quad (3)$$

Where coefficients β_1 and β_2 assign relative importance to citation-based and journal-based components. In line with prior scientometric research, greater weight was assigned to normalized citations to reflect scholarly impact, while journal prestige was included to account for differential visibility at the time of publication.

For regression analysis, the bibliometric impact score was converted into ordered outcome categories based on percentile ranks within publication year. Publications were classified as follows:

- Percentile rank $\geq 80 \rightarrow$ Very high impact
- $60 \leq$ Percentile rank $< 80 \rightarrow$ High impact
- $40 \leq$ Percentile rank $< 60 \rightarrow$ Moderate impact
- Percentile rank $< 40 \rightarrow$ Low impact

These ordered categories served as the dependent variable in ordered logistic regression models examining whether dominant anatomical focus is associated with differential bibliometric evaluation outcomes, while controlling for year effects, international collaboration, and team size.

All bibliometric analyses were conducted using the R statistical computing environment. Data processing, descriptive analyses, network construction, and visualization were primarily performed using the bibliometrix package and related R libraries. Network mapping and clustering were additionally conducted using VOSviewer. Selected interactive data exploration and validation steps were implemented using R Shiny to facilitate inspection of anatomical classifications, network structures, and robustness checks.

4. Result

4.1. Temporal growth and anatomical distribution of the literature

This section presents the empirical results of the bibliometric analysis, focusing on research attention across anatomical sites, structures, and dynamics of knowledge in extrapulmonary tuberculosis, as well as the consequences for evaluation from a bibliometric perspective. First, trends in publication output and the anatomical composition of the literature are described. We take a closer look at contributions by country, top journals and authors, and co-citation structures to map dominant and peripheral subfields. Lastly, a thematic and network approach is employed to describe how anatomical expressions are located within the intellectual and normative field of research.

Table 1. Descriptive statistics and anatomical distribution of extrapulmonary tuberculosis research (2000–2025)

Anatomical site	Number of publications	Percentage (%)
Lymphatic TB	2,357	59.5
Skeletal TB	702	17.7
Central nervous system TB	214	5.4
Genitourinary TB	203	5.1
Abdominal TB	197	5.0
Cutaneous TB	172	4.3
Disseminated / miliary TB	118	3.0
Total	3,963	100.0

Table 1 Anatomical distribution of extrapulmonary tuberculosis research indexed in Scopus from 2000 to January 2025. The dataset contains 3,963 studies, which demonstrate a highly skewed distribution of research focus across different anatomical areas. Lymphatic is, as could be expected, prevalent in the literature, with nearly three-fifths of all publications (59.5%), followed by bone TB (17.7%). Taken together, 2 anatomic domains account for over three-quarters of extrapulmonary TB publications.

In the literature, studies on the Central Nervous System (CNS), genitourinary, abdominal, cutaneous, and disseminated forms of EPTB contribute around 3–5% each. These sites are known for their clinical severity and diagnostic difficulty, yet they still appear to be under-represented in the literature.

This striking imbalance is an early empirical demonstration of anatomical bias in extrapulmonary tuberculosis research. The tendency for research output to become concentrated in a small number of anatomical regions suggests that disease-level aggregation may mask significant internal heterogeneity, with implications for knowledge bases and bibliometric analyses.

4.2. Country-level contributions and collaboration patterns

International collaboration is common among highly cited publications and is strongly associated with higher citation-based outcomes. Articles produced through cross-national collaboration exhibit greater visibility and impact, reinforcing the role of global research networks in shaping citation dynamics and knowledge diffusion within the field.

Table 2. Top 10 most productive countries in extrapulmonary tuberculosis research (2000–2025)

Order	Country	Number of publications	Number of citations	Average citation
1	India	829	11,657	14.06
2	United States	513	19,144	37.32
3	China	363	4,664	12.85
4	United Kingdom	270	12,831	47.52
5	South Africa	211	10,248	48.57
6	Turkey	176	1,942	11.03
7	Spain	146	3,159	21.64
8	France	126	3,070	24.37
9	Germany	120	3,652	30.43
10	Switzerland	119	4,816	40.47

Table 2 shows averages of citation rates for papers published in the USA and the UK are significantly higher than those in other highly productive countries, largely because these reflect the individuals responsible for a larger portion of international visibility, as well as a much stronger cumulative scholarly impact. On the other hand, high-volume publishers such as those in India and China have comparatively low citation values, suggesting dissimilar output but also a lack of knowledge centrality. This contrast underscores the importance of distinguishing productivity and impact in bibliometric science assessment.

Table 3. Leading 10 journals and their co-cited counterparts.

Sources	Articles
PLOS ONE	109
INTERNATIONAL JOURNAL OF TUBERCULOSIS AND LUNG DISEASE	102
INDIAN JOURNAL OF TUBERCULOSIS	81
BMC INFECTIOUS DISEASES	63
BMJ CASE REPORTS	51
INTERNATIONAL JOURNAL OF MYCOBACTERIOLOGY	51
PEDIATRIC INFECTIOUS DISEASE JOURNAL	44
INTERNATIONAL JOURNAL OF INFECTIOUS DISEASES	40
CLINICAL INFECTIOUS DISEASES	39
TUBERCULOSIS	39

As demonstrated in Table 3, research on EPTB is reported predominantly in a small proportion of journals, including some high-yielding multidisciplinary and specialized TB or ID journals. PLOS ONE would be the most prolific publisher, in line with their wide-ranging scope and capacity to publish many anatomy- and methodology-related papers; specialised journals such as International Journal of Tuberculosis and Lung Disease, Indian Journal of Tuberculosis, and Tuberculosis then act as large epistemic attractors that establish a field's intellectual foundations. Results from clinically relevant and case-based journals in our studies also mirror the importance of diagnostic difficulty, disease complexity, and rare anatomical presentations included in extrapulmonary TB. In general, this distribution highlights a

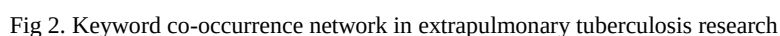
4.3. Journals, authors, and intellectual structure

Analysis of leading journals indicates that research on extrapulmonary tuberculosis is primarily disseminated through broad-scope infectious disease and general medical journals. These outlets serve as central nodes in the co-citation network, facilitating cross-fertilization between tuberculosis research and adjacent domains, such as HIV, pediatric infectious diseases, and clinical epidemiology. Anatomically specialised journals, where present, occupy more peripheral positions within the intellectual structure.

bimodal, or dual publication system in which volume of circulation and epistemic influence are not necessarily equal and has implications for the use of journal-based metrics as an evaluative tool.

4.4. Thematic evolution and keyword clustering

Keyword co-occurrence and thematic clustering analyses reveal that dominant research themes focus on diagnosis, treatment outcomes, HIV co-infection, and paediatric tuberculosis. These themes form the core of the knowledge structure and show strong temporal continuity. In contrast, anatomically defined topics emerge as smaller, more fragmented clusters that remain weakly integrated into the central thematic trajectory.



meningitis, genitourinary tuberculosis, abdominal tuberculosis, and osteoarticular tuberculosis, constitute less central yet more homotypic clusters adjacent to *Mycobacterium tuberculosis*. This cleavage suggests that anatomical subfields have evolved as specialised thematic niches, rather than integrated dialogues within the overarching, disease-level discourse, and presents another case for anatomical bias in the structuring of extrapulmonary tuberculosis research.

Rank	Authors	Publications	Rank	Co-cited authors	Citations
1	Mustafa, Tehmina	24	1	Sharma	361
2	Schaaf, Hendrik Simon	17	2	Lee	167
3	Sterling, Timothy R.	14	3	Lawn	161
4	Hesseling, Anneke Catharina	14	4	Marais	155
5	Sharma, Surendra Kumar	13	5	Gupta	134

nodes that connect different subfields with a shared intellectual history. This discrepancy indicates that productivity in terms of production may not translate into centrality within a field's knowledge structure. Rather, co-cited authors serve as epistemic beacons, informing conceptual architectures and clinical storylines through various anatomical expressions in EPTB.

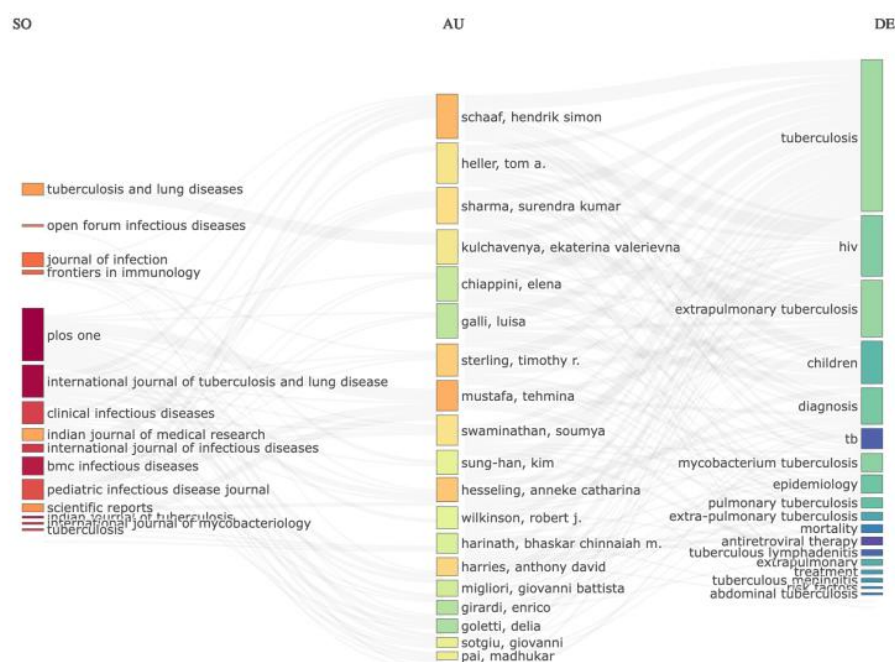


Fig 3. Three-field plot linking sources, authors, and keywords in extrapulmonary tuberculosis research.

Figure 3 Three-field (Sankey-style) visualization linking publication sources (SO), authors (AU), and keywords (DE): Knowledge production in extrapulmonary tuberculosis research by journals, key contributors, and thematic foci. However, there appears to be a relatively small group of specialized TB and infectious disease journals (e.g., PLoS One, International Journal of Tuberculosis and Lung Disease, Clinical Infectious Diseases) that are major disseminators which have been linked to what could be considered a core set of highly prolific authors. These authors have their own relation to a restricted set of high-frequency disease-level and population-oriented keywords such as tuberculosis, HIV, extrapulmonary tuberculosis, and children. Anatomically specific terms are more weakly linked and situated at the periphery, suggesting that anatomical themes are less central along main publication–author–topic pathways. Overall, the figure illustrates a structured yet uneven flow of knowledge in which journal prominence and author productivity cluster around broad disease-level themes and, in so doing, reify anatomically defined subfields as marginal to research on extrapulmonary tuberculosis.

4.5. Regression analysis of citation-based outcomes

As illustrated, operationalizing our main explanatory variable, dominant anatomical site, enables us to test whether articles on lymphatic and skeletal TB tend to have a systematic advantage over other extrapulmonary manifestations in citation-based evaluations. Table 5 summarizes the estimated coefficients from ordered logistic regressions for the likelihood of publication being categorized into higher citation-based outcome categories (controlling for year effects, international collaboration, and team size). In all model specifications, the odds ratio for the dominant anatomical site is not statistically significant, suggesting that

publications focusing on lymphatic or skeletal TB do not receive a citation bonus after adjusting for structural covariates.

This finding indicates that the reported predominance of lymphatic and skeletal tuberculosis in the literature is not due to superior citation performance on an article level. Rather, anatomical bias seems to predominantly operate through volume biases and structural visibility, with specific forms of anatomical expression attracting relatively more research attention without this being reflected in greater impact per publication. In this case, anatomic dominance mirrors agenda-setting and cumulative production practices rather than divergent scholarly recognition.

In contrast, the control variables have strong and, in many cases, consistent effects. International collaboration shows a strong, statistically significant positive effect on citation-based outcomes across all models. Papers with authors from different countries are much more likely to fall into the higher citation categories, highlighting the importance of international collaboration for gaining visibility and impact in biomedical research. This result aligns with existing scientometric evidence that international co-authorship increases dissemination, network centrality, and citation receipt.

Likewise, the number of authors, whose natural logarithm is used to control for diminishing returns to scale (between academic output and number of authors in hyper-author big science; Waltman & Van Eck 2011), generates a robust positive effect on citation-based assessment. These estimated odds ratios indicate that larger increases in team size are significantly associated with a higher probability of achieving higher citation success. These effects map onto proportional gains in team size (instead of marginal contributions on the level of authors) given a logarithmic transformation. This is likely due to broader professional networks,

greater opportunities for dissemination, and a higher level of collective visibility.

In combination, the findings from the two regression models support the idea that the anatomic bias in extrapulmonary TB research is more a matter of structure than of performance. The largest ranks are achieved by the categorical sections: dominant anatomical categories do not rank higher than peripheral ones in citation-based evaluations after controlling for essential covariates.

Rather, citation advantage is predominantly a consequence of collaboration relationships and the composition of author teams, in a manner that largely decouples with respect to anatomical focus. These results bolster the claim that aggregate bibliometric indicators could indirectly favor dominant subfield in terms of volumes and visibility rather than the appropriateness of their academic impact, with specific implications for research evaluation in complex biomedical domains.

Table 5. Ordered logistic regression results for citation-based outcomes, controlling for anatomical focus and structural covariates.

Variable	OR (SE)
Dominant anatomical site (lymphatic/skeletal)	0.967 (0.056)
International collaboration	2.701*** (0.219)
No. of authors (ln)	1.806*** (0.086)

Statistical significance: *p-value <0.10, **p-value <0.05, ***p-value <0.01.

† with statistical significance and, in brackets, standard error.

The ordered logistic regression results indicate that, after controlling for year effects, international collaboration, and team size, publications focusing on dominant anatomical sites (lymphatic and skeletal tuberculosis) do not exhibit a statistically

significant citation advantage. In contrast, international collaboration and larger author teams are strongly associated with higher citation-based outcomes.

Table 6. Marginal effects of dominant anatomical focus on citation-based evaluation outcomes.

Outcome	Score	Non-dominant	Dominant	Difference
Bibl. score (3Y proxy)	Limited	0.281	0.288	0.007
Bibl. score (3Y proxy)	Acceptable	0.28	0.282	0.001
Bibl. score (3Y proxy)	Good	0.247	0.244	-0.003
Bibl. score (3Y proxy)	Excellent	0.191	0.186	-0.005
Bibl. score (Long proxy)	Limited	0.281	0.288	0.007
Bibl. score (Long proxy)	Acceptable	0.28	0.282	0.001
Bibl. score (Long proxy)	Good	0.247	0.244	-0.003
Bibl. score (Long proxy)	Excellent	0.191	0.186	-0.005

Table 6 presents the marginal effects of focusing on dominant anatomical sites (lymphatic or skeletal tuberculosis) on citation-based evaluation outcomes, comparing predicted probabilities across ordered impact categories. For both the short-term (3-year) and long-term citation proxies, differences between dominant and non-dominant anatomical foci are consistently small across all outcome categories. Publications centred on dominant sites show a slightly higher probability of falling into the *Limited* and *Acceptable* categories, while exhibiting marginally lower probabilities of being classified as *Good* or *Excellent*. However, these differences are minimal in magnitude and virtually identical across citation horizons, indicating no substantive citation advantage associated with anatomical dominance. Overall, the results suggest that while dominant anatomical sites attract a larger share of research attention, this prominence does not translate into

systematically higher article-level citation performance once structural factors are held constant. This finding reinforces the interpretation that anatomical bias in extrapulmonary tuberculosis research is primarily structural, reflected in publication volume and visibility, rather than evaluative in terms of bibliometric impact.

5. Discussion

The aim of this study was to investigate the patterns, trends, and evaluative meaning of extrapulmonary tuberculosis research through a comprehensive bibliometric analysis from 2000 to 2025. Combining productivity measures, citation-based rankings, co-citation methods, and thematic mapping, the results demonstrate a consistent, recurring anatomical bias in the structuring of the literature. Instead of being spread equally across clinical extrapulmonary manifestations, research focus is heavily

concentrated on a few anatomical sites, with lymphatic and skeletal TB featuring prominently in both publication volume and thematic centrality. Analogous concentration profiles have been observed in other biomedical and scientific contexts, where internal heterogeneity is also concealed beneath a veneer of aggregate disease labels or discipline boundaries (Bian et al., 2022; C. Liu et al., 2025).

The pervasiveness of this imbalance across levels of analysis indicates that anatomical bias is not simply an artifact of the clinical distribution of diseases, but a structural characteristic of knowledge generation itself. When some types of anatomical representations become epistemically central, they also benefit from cumulative advantage, receiving disproportionate attention, funding, and opportunities for publication (Balzer & Benlahlou, 2025; Ross-Hellauer et al., 2022). These feedback mechanisms are consistent with preferential attachment and path-dependence theories for the social construction of a science that early visibility influences scientific trajectories in the long term, regardless of societal need or clinical demand (Xue, 2024)

The knowledge network of extra-pulmonary tuberculosis research even further underlines this pattern. This publication population is quite broad in terms of its collection of authors, but co-citation analysis reveals that the collective knowledge base also has a relatively narrow core set of contributors. This discrepancy between the productivity and co-citation prominence indicates a difference between, on one hand, knowledge propagation and reception and on the other hand, knowledge accumulation - something that is at the core of science-of-science research (Kohus et al., 2025; Li et al., 2022). Crucially, anatomically peripheral topics tend to contribute fewer co-citation core links that bridge the gap between themselves and the anatomical core, and thus are not well integrated into the dominant epistemic framework in question and have lower long-term influence.

Journal-level examination identifies a bimodal publication pattern that perpetuates anatomical inequity. Generalist journals with higher volumes and a multidisciplinary focus predominantly serve as a dissemination platform for specialised journals, whereas specialist tuberculosis and infectious disease titles become epistemic bedrocks that fixate dominant narratives around the level of a disease. Analogous hierarchies have been found within biomedical research as well, wherein the centrality of journals directly influences citation dynamics and thematic visibility (Balzer & Benlahlou, 2025; Du et al., 2025). Therefore, studies that are anatomically specific may be structurally disadvantaged in achieving high-visibility publications and therefore further entrench disparities on perceived impact.

Thematic analyses also suggest that extrapulmonary tuberculosis scholarship is largely constructed through population labels, general disease terms and treatment conceptions as opposed to anatomical distinctions. Even those in anatomy, however, would tend to be peripheral and fragmented in keyword networks. This follows a broader general trend of perspective in biomedical research that prioritises translatable disease constructs over granular biological or anatomical specificity, particularly in disciplines reliant on international public health priorities and standardised reporting architectures (Khakimova et al., 2022; Nicholson et al., 2023)

From the perspective of research assessment, these results should be a major concern. Bibliometric measures at a high level which emphasis output, journal prestige or aggregated disease entities, can potentially exacerbate anatomical bias by reinforcing subfields that were already dominant (Meho, 2025; Thelwall et al., 2023a). We argue such bias is most likely to be observable in pre-publication evaluative environments, such as peer review (where observations of regional anatomical focus are especially salient) and where the reputational costs associated with disadvantaging peripheral topics are minor (Horchani, 2025; Ross-Hellauer & Horbach, 2024).

In contrast, after-publication citation behavior implicates stronger penalties to systematized exclusion as a result of norms promoting scholarly completeness, author-credit rivalry dynamics and prospective adverse effects on one's own output. However, recent evidence on citation-based indicators suggests that these imperfect proxies potentially attenuate some kinds of thematic and social biases compared with peer-review-based judgments (Abramo & D'Angelo, 2026; Thelwall et al., 2023b). Such an unrecoverable asymmetry means one must interpret evaluation in light of the biases they are at best less likely to exacerbate.

Several limitations should be acknowledged. The study is based on Scopus-indexed, English-language publications and uses a rule-based method of anatomical classification derived from bibliographic metadata. While transparent and replicable, such methods have been criticized for potentially underrepresenting multisite disease presentations and non-English scholarship (Dagli et al., 2025). Additionally, citation metrics can lag behind and may underestimate the impact of recent work. Future studies might incorporate full-text classification, funding data, or peer-review decisions to better untangle anatomical bias at the various stages of the research lifecycle (Hoang, 2025; Pérez-Campdesuñer et al., 2025).

In conclusion, this analysis shows that research on extra-pulmonary tuberculosis is framed by persistent anatomical disparities built into its knowledge infrastructure, publication process, and evaluation systems. Understanding that anatomical bias is a phenomenon with structure, as opposed to an incidental or clinically stimulated trend, is an important point for developing more sophisticated and fair evaluation frameworks for research. More generally, these findings underpin the science-of-science approaches for understanding how visibility, institutional incentives, and historical paths shape biomedical knowledge production beyond its clinical relevance (Fortunato et al., 2018; Larivière et al., 2020; Waltman, 2023).

6. Conclusions

The findings indicate development of research output with a persistent anatomical imbalance, demonstrating that scholarly interest remains skewed towards lymphatic and skeletal but on other clinically significant forms is limited. Country-level analysis additionally demonstrates that a limited number of high-income countries are at the centre of knowledge production and citation impact, pointing to their structural role in shaping the research agenda of the field (Abdullah et al., 2022; Bian et al., 2022).

Journal, author, and keyword analyses reveal that the research field on extrapulmonary tuberculosis is mainly articulated at the levels of disease and population; anatomically oriented themes appear in

a peripheral position within the intellectual structure. Such pattern indicates that visibility and cumulative advantage, not differences in anatomy, drive the dynamics of the field over time (Mejia et al., 2021; Sampagnaro, 2023). Thematic clustering of 1,000 articles underlines diagnosis, treatment, HIV co-infection and paediatric tuberculosis as core topics, whereas anatomically defined manifestations appear more of specialized niches than related research frontiers, showing direct impact on bibliometric-driven research evaluation in multi-disciplinary domains.

More generally, this bibliometric analysis offers empirical insight into how anatomical bias is ingrained in the knowledge structures and evaluative mechanisms of extrapulmonary tuberculosis research. This has implications not only for papers exceeding the threshold but also is an example of the challenges when research attention is not equally assigned across anatomical sites and contributes to current debates about bibliometric evaluation at an aggregated level and argues for a more nuanced, bias-aware assessment framework (Hoang, 2025; Kouis et al., 2025).

Declaration of generative AI and AI-assisted technologies

ChatGPT was employed during manuscript preparation to support literature searching and language editing. The authors independently reviewed and revised all generated content and are solely responsible for the accuracy and integrity of the final published work.

Declaration of competing interest

The authors confirm that there are no competing interests or personal relationships that could reasonably be perceived as having influenced the content of this manuscript.

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References

1. Abdelwahab, S. I., Taha, M. M. E., Albasheer, O., Alharbi, A., Ahmed, A. A., Abdelmola, A., Ali, S. A., El Hassan, L. A. M., Darraj, M., Mohamed, A. H., Yassin, A., & Hakami, N. (2024). Tuberculosis research advances and future trends: A bibliometric knowledge mapping approach. *Medicine*, 103(30), e39052. <https://doi.org/10.1097/MD.00000000000039052>
2. Abdullah, M., Humayun, A., Imran, M., Bashir, M. A., & Malik, A. A. (2022). A bibliometric analysis of global research performance on tuberculosis (2011–2020): Time for a global approach to support high-burden countries. *Journal of Family and Community Medicine*, 29(2), 117–124. https://doi.org/10.4103/jfcm.jfcm_112_22
3. Abramo, G., & D'Angelo, C. A. (2026). Sex bias in peer review and citation practices: Implications for research evaluation. *Journal of Informetrics*, 20(1), 101762. <https://doi.org/10.1016/j.joi.2025.101762>
4. Abramo, G., D'Angelo, C. A., & Grilli, L. (2024). The role of non-scientific factors vis-à-vis the quality of publications in determining their scholarly impact. *Scientometrics*. <https://doi.org/10.1007/s11192-024-05106-z>

5. Balzer, M., & Benlahlou, A. (2025). Mitigating consequences of prestige in citations of publications. *Scientometrics*, 130(11), 6035–6062. <https://doi.org/10.1007/s11192-025-05455-3>
6. Bascur, J. P., Verberne, S., van Eck, N. J., & Waltman, L. (2025). Which topics are best represented by science maps? An analysis of clustering effectiveness for citation and text similarity networks. *Scientometrics*, 130(2), 1181–1199. <https://doi.org/10.1007/s11192-024-05218-6>
7. Bian, Y., Deng, M., Zhang, Q., & Hou, G. (2022). Global trends of research on tuberculous pleurisy over the past 15 years: A bibliometric analysis. *Frontiers in Cellular and Infection Microbiology*, 12. <https://doi.org/10.3389/fcimb.2022.937811>
8. Calò, L. N. (2022). Métricas de impacto y evaluación de la ciencia. *Revista Peruana de Medicina Experimental y Salud Pública*, 39(2), 236–240. <https://doi.org/10.17843/rpmesp.2022.392.11171>
9. Dagli, N., Haque, M., & Kumar, S. (2025). Bibliometric Analysis in Scientific Research: Applications, Limitations, and Key Considerations for Authors. *Bangladesh Journal of Medical Science*, 24(1), 7–10. <https://doi.org/10.3329/bjms.v24i1.78602>
10. Du, A., Head, M., & Brede, M. (2025). Journal publications in medicine: ranking vs. interdisciplinarity. *Applied Network Science*, 11(1), 11. <https://doi.org/10.1007/s41109-025-00769-w>
11. Gopalswamy, R., Dusthacker, V. N. A., Kannayan, S., & Subbian, S. (2021). Extrapulmonary Tuberculosis—An Update on the Diagnosis, Treatment and Drug Resistance. *Journal of Respiration*, 1(2), 141–164. <https://doi.org/10.3390/jor1020015>
12. Hoang, A.-D. (2025). Evaluating Bibliometrics Reviews: A Practical Guide for Peer Review and Critical Reading. *Evaluation Review*, 49(6), 1074–1102. <https://doi.org/10.1177/0193841X251336839>
13. Horchani, R. (2025). Impact of institutional affiliation bias in the peer review process. *Insights the UKSG Journal*, 38. <https://doi.org/10.1629/uksg.681>
14. Igwaran, A., & Edoamodu, C. E. (2021). Bibliometric Analysis on Tuberculosis and Tuberculosis-Related Research Trends in Africa: A Decade-Long Study. *Antibiotics*, 10(4), 423. <https://doi.org/10.3390/antibiotics10040423>
15. Jappe, A., Pithan, D., & Heinze, T. (2018). Does bibliometric research confer legitimacy to research assessment practice? A sociological study of reputational control, 1972–2016. *PLOS ONE*, 13(6), e0199031. <https://doi.org/10.1371/journal.pone.0199031>
16. Khakimova, A., Rahim, F., & Zolotarev, O. (2022). Bibliometric and Semantic Analysis of the Global Research on Biomarkers in Personalized Medicine. *The Open Biomarkers Journal*, 12(1). <https://doi.org/10.2174/18753183-v12-e220926-2022-3>
17. Kim, S., Jeon, D., Lee, T., Lee, S. J., Lee, H. Y., Kang, B. H., & Mok, J. (2026). Drug Resistance in Extrapulmonary Tuberculosis in Korea, 2010–2019: A Comparison With Pulmonary Tuberculosis. *Journal of Korean Medical Science*, 41. <https://doi.org/10.3346/jkms.2026.41.e60>
18. Kohus, Z., Lendvai, G. F., Vizvári, D., Demeter, M., Soós, S., Kerekes, B. B., & Lukács, E. (2025). Exploring the

- collaboration networks between highly cited researchers in highly cited papers. *Scientometrics*, 130(11), 6513–6540. <https://doi.org/10.1007/s11192-025-05443-7>
19. Kouis, D., Triperina, E., Drivas, I., Efthymiou, F., Koulouris, A., & Comas-Forgas, R. (2025). One Size Fits None: Rethinking Bibliometric Indicators for Fairer Assessment and Strategic Research Planning. *Metrics*, 2(4), 24. <https://doi.org/10.3390/metrics2040024>
20. Krüger, A. K., & Petersohn, S. (2023). ‘I want to be able to do what I know the tools will allow us to do’: Practicing evaluative bibliometrics through digital infrastructure. *Research Evaluation*, 31(4), 475–485. <https://doi.org/10.1093/reseval/rvac009>
21. Li, W., Zhang, S., Zheng, Z., Cranmer, S. J., & Clauset, A. (2022). Untangling the network effects of productivity and prominence among scientists. *Nature Communications*, 13(1), 4907. <https://doi.org/10.1038/s41467-022-32604-6>
22. Liu, C., Wang, X., & Cao, X. (2025). Research Trends of Ocular Tuberculosis: A Bibliometric Analysis. *Ocular Immunology and Inflammation*, 33(7), 1188–1200. <https://doi.org/10.1080/09273948.2024.2437124>
23. Liu, Z., Chen, Z., Xue, K., & Chen, M. (2025). BioBERT-powered synergy: advanced bibliometric and molecular insights into prostate cancer bone metastasis. *Frontiers in Immunology*, 16. <https://doi.org/10.3389/fimmu.2025.1562559>
24. Marzi, G., Balzano, M., Caputo, A., & Pellegrini, M. M. (2025). Guidelines for Bibliometric-Systematic Literature Reviews: 10 steps to combine analysis, synthesis and theory development. *International Journal of Management Reviews*, 27(1), 81–103. <https://doi.org/10.1111/ijmr.12381>
25. Meho, L. I. (2025). Gaming the metrics: bibliometric anomalies in global university rankings and the research integrity risk index (RI2). *Scientometrics*, 130(11), 6683–6726. <https://doi.org/10.1007/s11192-025-05480-2>
26. Mejia, C., Wu, M., Zhang, Y., & Kajikawa, Y. (2021). Exploring Topics in Bibliometric Research Through Citation Networks and Semantic Analysis. *Frontiers in Research Metrics and Analytics*, 6. <https://doi.org/10.3389/frma.2021.742311>
27. Nettasinghe, B., Alipourfard, N., Krishnamurthy, V., & Lerman, K. (2026). *Emergence of Structural Disparities in the Web of Scientific Citations*. <https://doi.org/10.1145/3774904.3792664>
28. Nicholson, D. N., Alquaddoomi, F., Rubineti, V., & Greene, C. S. (2023). Changing word meanings in biomedical literature reveal pandemics and new technologies. *BioData Mining*, 16(1), 16. <https://doi.org/10.1186/s13040-023-00332-2>
29. Öztürk, O., Kocaman, R., & Kanbach, D. K. (2024). How to design bibliometric research: an overview and a framework proposal. *Review of Managerial Science*, 18(11), 3333–3361. <https://doi.org/10.1007/s11846-024-00738-0>
30. Pérez-Campdesuñer, R., Sánchez-Rodríguez, A., Martínez-Vivar, R., De Miguel-Guzmán, M., & García-Vidal, G. (2025). Bias in Citation Visibility: Temporal Dynamics and the Unequal Life Cycle of Academic Articles—Evidence from SME and Internationalization Research. *Publications*, 13(4), 62. <https://doi.org/10.3390/publications13040062>
31. Reibold, K. (2025). Knowledge-specific epistemic injustice. *Inquiry*, 1–27. <https://doi.org/10.1080/0020174X.2025.2590055>
32. Ross-Hellauer, T., & Horbach, S. P. J. M. (2024). Additional experiments required: A scoping review of recent evidence on key aspects of Open Peer Review. *Research Evaluation*, 33. <https://doi.org/10.1093/reseval/rvae004>
33. Ross-Hellauer, T., Reichmann, S., Cole, N. L., Fessler, A., Klebel, T., & Pontika, N. (2022). Dynamics of cumulative advantage and threats to equity in open science: a scoping review. *Royal Society Open Science*, 9(1). <https://doi.org/10.1098/rsos.211032>
34. Rousseau, S., & Daraio, C. (2025). Research evaluation reform and the heterogeneity of researchers’ metric-wiseness. *Journal of Data and Information Science*, 10(1), 47–73. <https://doi.org/10.2478/jdis-2025-0012>
35. Sampagnaro, G. (2023). Keyword occurrences and journal specialization. *Scientometrics*, 128(10), 5629–5645. <https://doi.org/10.1007/s11192-023-04815-1>
36. Stroupe, D., Suárez, E., & Scipio, D. (2025). Epistemic injustice and the “Nature of Science.” *Journal of Research in Science Teaching*, 62(4), 901–941. <https://doi.org/10.1002/tea.21988>
37. Thelwall, M., Kousha, K., Stuart, E., Makita, M., Abdoli, M., Wilson, P., & Levitt, J. (2023a). Do bibliometrics introduce gender, institutional or interdisciplinary biases into research evaluations? *Research Policy*, 52(8), 104829. <https://doi.org/10.1016/j.respol.2023.104829>
38. Thelwall, M., Kousha, K., Stuart, E., Makita, M., Abdoli, M., Wilson, P., & Levitt, J. (2023b). In which fields are citations indicators of research quality? *Journal of the Association for Information Science and Technology*, 74(8), 941–953. <https://doi.org/10.1002/asi.24767>
39. van de Laar, L., de Kruif, T., Waltman, L., Meijer, I., Gupta, A., & Hagenaars, N. (2018). Improving the evaluation of worldwide biomedical research output: classification method and standardised bibliometric indicators by disease. *BMJ Open*, 8(6), e020818. <https://doi.org/10.1136/bmjopen-2017-020818>
40. Xue, H. (2024). Analysis of Effects on Scientific Impact Indicators Based on Coevolution of Coauthorship and Citation Networks. *Information*, 15(10), 597. <https://doi.org/10.3390/info15100597>