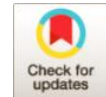


# A Multidimensional Assessment of Scholarly and Societal Impact: Integrating Bibliometric, Book Citation, and Altimetric Indicators for Mazandaran University of Medical Sciences



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## ABSTRACT

Research evaluation is increasingly moving beyond traditional citation-based metrics to incorporate alternative indicators that capture broader dimensions of scholarly and societal impact. This study evaluated the multidimensional impact of research outputs from Mazandaran University of Medical Sciences (MazUMS) using bibliometric, book-based citation, and altimetric indicators. A retrospective bibliometric and altimetric analysis was conducted on publications affiliated with MazUMS from 1997 to early 2024. Initial retrieval identified 8,173 records from Web of Science and 10,928 from Scopus. Following a three-stage data refinement process in ScientoPy v3.1.2—including within-database cleaning, cross-database DOI matching, and final deduplication—11,534 unique publications were retained for analysis. Citation metrics, citing-source characteristics, and altimetric indicators were extracted, and associations between bibliometric and altimetric measures were examined using Spearman's rank correlation. Research output increased from two publications in 1997 to 845 publications indexed in Web of Science and 1,117 in Scopus in 2024. Articles constituted 84.9% of all publications ( $n = 9,788$ ). The publications received 280,896 citations, of which 95.9% originated from journal sources, while book- and book chapter-based citations represented a smaller but distinct component of research influence. Altimetric data were available for 3,263 publications (28.3%), of which 3,025 (92.7%) received measurable online attention. Dimensions citation counts showed the strongest correlation with Scopus citation counts ( $\rho = 0.981$ ,  $p < 0.01$ ), followed by Mendeley readership ( $\rho = 0.759$ ,  $p < 0.05$ ), whereas mentions on X and in news outlets showed comparatively weak correlations. MazUMS research has demonstrated substantial growth and broad scholarly visibility over the study period. Bibliometric, book-based citation, and altimetric indicators capture complementary dimensions of research impact, and their combined use provides a more comprehensive assessment of scholarly influence, educational uptake, and broader research engagement than conventional citation metrics alone.

**Keywords:** Altimetric, Retrospective Studies, Social Media, Attention, Books, Mazandaran University of Medical Sciences.

## Introduction

Evaluating research performance has become a central component of research governance and policy development in higher education institutions. In Iran, medical universities are assessed through the national

Research and Technology Evaluation system of the Ministry of Health and Medical Education (MOHME), which evaluates institutional performance across domains such as governance and leadership, knowledge production, technology development, and societal impact.



Within this framework, the visibility and influence of scientific outputs are critical indicators for strengthening research capacity and supporting evidence-based decision-making in the health sector.

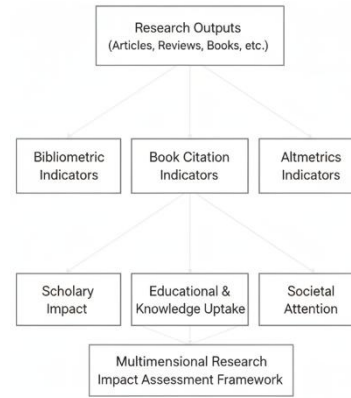
Traditionally, research performance has been assessed using citation-based bibliometric indicators derived from international databases such as Web of Science (WoS) and Scopus. Citation analysis has long been considered a standard method for measuring scholarly influence within academic communities [1]. Numerous studies have examined the meaning and limitations of citation counts, indicating that citations primarily reflect scholarly recognition among researchers and may not fully represent the broader dissemination or societal engagement of research outputs [2].

With the rapid expansion of digital communication platforms, new approaches have emerged to complement traditional bibliometric indicators. The concept of altmetrics was introduced to capture online attention and engagement with scholarly outputs across diverse platforms such as social media, news outlets, blogs, and policy documents [3, 4]. Subsequent research has explored the reliability, coverage, and potential applications of altmetric indicators for evaluating research impact beyond the academic sphere [5, 6]. These metrics provide insights into the immediate dissemination and broader visibility of research outputs within digital environments [7].

In addition to altmetric indicators, citations in books and book chapters represent another dimension of scholarly influence that is often overlooked in traditional journal-based citation analysis. Book-based citations may reflect educational use, knowledge diffusion, and the integration of research findings into academic literature beyond journal publications (8). Previous studies have demonstrated that book citation data can complement journal citation metrics and provide additional insights into patterns of scholarly communication and knowledge dissemination [8].

Previous institutional studies have primarily relied on traditional bibliometric indicators or altmetric measures to evaluate research performance (7,10,11). However, despite increasing attention to multidimensional research evaluation, institutional-level studies integrating bibliometric indicators, book-based citations, and altmetric measures remain limited, particularly within medical universities. Therefore, this study aimed to provide a multidimensional assessment of the scholarly and societal impact of research outputs affiliated with Mazandaran University of Medical Sciences (MazUMS) by integrating these complementary indicators within a unified analytical framework. Unlike previous institutional studies, the present study combines bibliometric indicators, book-based citations, and altmetric measures to characterize complementary dimensions of research impact, including scholarly influence, educational and knowledge dissemination,

and broader societal attention. Although the empirical analysis focuses on a single institution, the multidimensional analytical approach employed in this study may serve as a useful reference for future institutional research assessments seeking to integrate scholarly, educational, and societal dimensions of research impact.



**Figure1.** Conceptual framework for multidimensional institutional research impact assessment

## Methods

### Study Design

This study employed a retrospective bibliometric and altmetric design to evaluate the scholarly production and online visibility of publications affiliated with Mazandaran University of Medical Sciences (MazUMS) from 1997 to 2024. (Date of search: Oct 18 2025)

The analysis was conducted within a multidimensional evaluation framework comprising four components: (A) bibliometric analysis to examine publication trends and document characteristics; (B) science mapping and collaboration analysis to explore research collaboration patterns; (C) citation and book-based citation analysis to assess scholarly impact using traditional citation indicators and citations originating from books and book chapters; and (D) altmetric analysis to evaluate online attention and broader research visibility across digital platforms, with particular attention to how altmetric indicators complement and relate to citation-based measures of scholarly impact.

### Data Sources and Search Strategy

Publication records were retrieved from the Web of Science Core Collection and Scopus databases. The search strategy was based on the institutional affiliation field and included all known variants and abbreviations of Mazandaran University of Medical Sciences to maximize retrieval sensitivity.

The initial search identified 8,173 records from Web of Science and 10,928 records from Scopus. These datasets were subsequently subjected to a rigorous filtering and deduplication process to ensure the accuracy and relevance of the final corpus for bibliometric analysis.

### Data Cleaning and Final Corpus Construction

The retrieved records were processed using ScientoPy (version 3.1.2) through a three-stage refinement procedure consisting of duplicate removal, bibliographic data cleaning and standardization, and final screening to construct the analysis dataset.

### Inclusion and Exclusion Criteria

To construct a comprehensive analytical corpus, the following document types, indexed in both databases, were included in the study. The other type of documents such as editorials, notes, retracted papers, data papers, and undefined document types were excluded original research articles, review articles and conference papers.

### Deduplication

Duplicate records were identified using exact DOI matching across databases. For records lacking DOI information, duplicate detection was conducted through manual verification based on combinations of title similarity, author names, publication year, and source metadata.

### Final Dataset

After data cleaning and deduplication, the final bibliographic dataset comprised 11,534 unique publications. This dataset was used for bibliometric analyses. Citation and altimetric analyses were subsequently conducted on the subset of publications for which the required citation and altimetric data were available.

### Bibliometric and Science Mapping Analysis

Bibliometric performance was evaluated using annual publication trends, document type distribution, citation impact, and growth indicators, including Average Growth Rate (AGR), Average Documents per Year (ADY), Percentage of Documents Published in the Last Years (PDLY), and the H-index. AGR reflects the average annual growth of publications, ADY indicates the mean annual publication output, and PDLY represents the proportion of publications appearing in the most recent years of the study period. Science mapping techniques were applied to examine international collaboration patterns. All analyses and visualizations were performed using ScientoPy (v 3.1.2) and VOSviewer. During data preprocessing, document-type classifications retrieved from Web of Science and Scopus were harmonized to ensure consistency in the analysis of publication document types. Database-specific document types were retained only when no equivalent category existed.

### Citing Document and Book Citation Analysis

Citing documents were identified using both Web of Science and Scopus within a unified citation window up to December 2024 to ensure temporal consistency across data sources. In Web of Science, the Citation Report feature was used to retrieve citation counts and WoS-indexed citing records. Scopus was also used to identify citing documents, particularly book-related citing sources, through its “Cited by” function, as book

citations are not consistently represented in Web of Science. To reduce cross-database inconsistency, all retrieved citing records were standardized and deduplicated using DOI-based matching as well as bibliographic verification of titles, authors, publication years, and source information. Although the database search was conducted on October 18, 2025, citation data were limited to December 2024 to allow complete annual indexing and to avoid partial citation accumulation for the most recent year. Due to the Scopus export limitation of 10,000 citing records per query, the most recent exportable citing records were retrieved at the time of data collection. This approach maximized coverage of retrievable citation data within platform-imposed export constraints.

After extraction, the citing records underwent data cleaning and deduplication, primarily through DOI matching and comparison of bibliographic fields (title, authors, year, and source), to eliminate overlapping records and ensure dataset accuracy. To characterize the broader citation landscape of MazUMS publications, citing documents were analyzed according to Scopus document type and source type classifications. Particular attention was given to book-related source categories (Book and Book Series), which were examined separately to assess the presence and visibility of MazUMS publications within book-based scholarly outputs.

Country-level citation networks were constructed using VOSviewer. Countries were identified based on author affiliations in the citing publications. A minimum threshold of five citations per country was applied to visualize the geographic distribution and international diffusion of citing sources.

### Altimetric and Scholarly Impact Analysis

A total of 11,534 Mazandaran University of Medical Sciences (MazUMS) publications indexed in Web of Science and Scopus were retrieved by extracting Digital Object Identifiers (DOIs) and PMID (PubMed identifier) from the Altimetric Explorer platform; then altimetric data were obtained and analyzed. In total, 3,263 publications were identified, of which 3,025 (92.7%) exhibited measurable online attention at the time of data collection. The extracted altimetric indicators included mentions across several online sources, such as social media platforms (e.g., X/Twitter), news outlets, blogs, policy documents, clinical guidelines, patent documents, and Wikipedia. In addition, Mendeley readership counts were collected as indicators of scholarly engagement and early academic attention. Citation counts used in the correlation analysis were derived from the Scopus-based citation data processed in ScientoPy and subsequently integrated with the altimetric dataset using Digital Object Identifiers (DOIs) and PMID as unique matching keys to link corresponding publications across the two datasets.

Records lacking a DOI or PMID, or presenting unmatched identifiers, were excluded to ensure accurate linkage and dataset reliability.

Given the non-normal and highly skewed distribution commonly observed in citation and altimetric indicators, Spearman’s rank-order correlation analysis was employed to examine the relationships between citation-based metrics and altimetric indicators. Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 26.0.

**Results**

The findings of this study are organized according to the research objectives. First, we examine the bibliometric profile of Mazandaran University of Medical Sciences (MazUMS), focusing on publication growth trends, document type distribution, and growth indicators across different document types. Second, we analyze the citation landscape of MazUMS research by characterizing citing documents and source types, with particular emphasis on citations originating from books and book chapters, as well as country level citation networks. Third, we assess the online attention and broader scholarly visibility of MazUMS publications using altimetric indicators, including social media mentions, news coverage, policy and clinical references, Growth indicators varied across document types (Table 2). Articles constituted the largest share of MazUMS publications (N = 9,788) and demonstrated steady growth with an Average Growth Rate (AGR) of 5.0%. Review articles represented the second-largest category (N = 1,634) and showed notable recency, with the highest Percentage of Documents Published in the Last Years (PDLY) at 26.4%. Early Access documents displayed the highest AGR (10.5%), which likely reflects recent indexing practices rather than sustained long term growth. Other document types, including proceedings papers, conference papers, and book chapters, accounted for only a small proportion of the overall output. Overall, these findings indicate that the publication profile of MazUMS is driven primarily by article and review based outputs.

**Table 2.** Growth indicators of MazUMS publications by document type after data filtering (1997–2024).

Document Type	Total (N)	AGR (%)	ADY	PDLY (%)
Article	9,788	5.0	929.5	19.0
Review	1,634	3.5	216.0	26.4
Early Access	33	10.5	15.0	90.9
Proceedings Paper (WoS)	32	0.0	0.0	0.0
Conference Paper (Scopus)	26	-3.5	1.5	11.5
Book Chapter	21	2.0	2.0	19.0

Note. AGR = Average Growth Rate; ADY = Average Documents per Year; PDLY = Percentage of Documents Published in the Last Years of the study period.

Growth indicators varied across document types (Table 2). Articles constituted the largest share of MazUMS publications (N = 9,788) and demonstrated steady

and Mendeley readership. Finally, we evaluate the statistical relationships between citation based indicators and alternative metrics using Spearman’s rank order correlation analysis. The relationship between the study objectives, analytical approaches, and corresponding outputs is summarized in Table 1.

**Table 1.** Relationship between study objectives, analytical approaches, and outputs

Objective	Analysis	Output
Publication growth	Bibliometric analysis	Figure 2, Table 2
Citation landscape	Citation/source analysis	Table 3, Figure 3
Altimetric visibility	Altimetric analysis	Table 4, Table 5
Metric relationships	Spearman correlation	Figure 4 / Appendix 2

**Bibliometric Profile and Publication Growth**

The scientific output of Mazandaran University of Medical Sciences (MazUMS) increased substantially between 1997 and 2024. As shown in the figure 2, annual publication output indexed in Web of Science (WoS) and Scopus rose from just two publications in 1997 to 845 in WoS and 1,117 in Scopus by 2024. While early years exhibited modest growth, publication output expanded rapidly after 2015, reflecting a marked increase in the university’s research productivity over the last decade . In total, 10,928 MazUMS publications were indexed in Scopus and 8,182 in Web of Science (WoS) during the study period (1997–2024).

growth with an Average Growth Rate (AGR) of 5.0%. Review articles represented the second-largest category (N = 1,634) and showed notable recency, with the highest Percentage of Documents Published in the Last Years (PDLY) at 26.4%. Early Access documents displayed the highest AGR (10.5%), which likely reflects recent indexing practices rather than sustained long-term growth. Other document types, including proceedings papers, conference papers, and book chapters, accounted for only a small proportion of the overall output. Overall, these findings indicate that the publication profile of MazUMS is driven primarily by article- and review-based outputs.

Objective 2: To examine the distribution and characteristics of citation sources to MazUMS publications, with particular emphasis on book-related citations. To characterize the citation profile of MazUMS publications across different source types and the geographic origin of citing publications, citing documents were analyzed according to source category and country of origin (Table 3; Figure 3).

Overall, 280,896 citing documents indexed in Scopus were identified. Because Scopus limits the export of citing records to a maximum of 10,000 documents per query, detailed analyses of citing document characteristics were performed using the most recent exportable citing records, which accounted for more than 95% of all indexed citing documents. This dataset provided a highly representative basis for analyzing citation source characteristics. The distribution of citing source types is presented in Table 3.

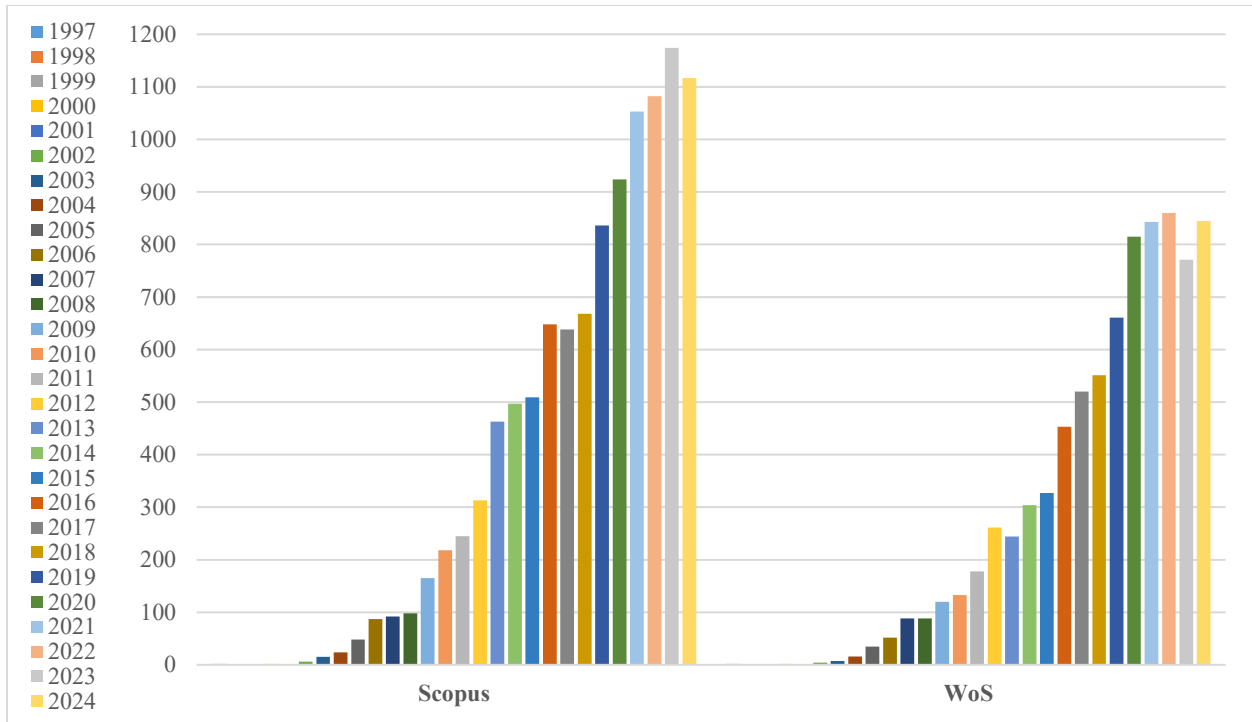


Figure 2: Annual publication output of MazUMS publications indexed in Web of Science and Scopus (1997–2024).

Table 3. Source types of documents citing MazUMS publications indexed in Scopus

Source Type	N	%
Journal	269,301	95.9
Book	7,829	2.8
Conference Proceedings	1,942	0.7
Book Series	1,784	0.6
Trade Journal	40	<0.1
Total	280,896	100.0

Note. Percentages may not sum exactly to 100% due to rounding. The total (280,896) includes records with defined source types, regardless of their publication type classification.

As shown in Table 3, journal publications accounted for the vast majority of citing sources (95.9%), followed by books (2.8%), conference proceedings (0.7%), book series (0.6%), and trade journals (<0.1%). These findings indicate that the scholarly impact of MazUMS publications is primarily reflected in journal-based academic communication. Figure 3 presents the country-level citation network of publications citing MazUMS outputs. The overlay visualization, generated using VOSviewer, represents node size according to citation frequency, link thickness according to the strength of citation links between countries, and node

color according to the average publication year of the citing publications. The United States appears as the largest and most strongly connected node, indicating a high citation frequency and extensive citation linkages with other countries. Several other countries also occupy notable positions in the network, reflecting broad international citation connections. Overall, the dense pattern of inter-country links indicates that MazUMS publications are cited across a wide range of countries.

Altmetric Indicators and Online Attention  
To evaluate the broader online visibility and societal attention received by MazUMS publications, multiple altmetric indicators and scholarly usage metrics were analyzed.

The initial search retrieved 8,173 records from Web of Science and 10,928 from Scopus. After removing duplicates, 11,534 unique publications remained. Using DOI and PMID identifiers, altmetric data were retrieved from Altmetric Explorer. Among these, 3,263 publications had available altmetric data, and 3,025 (92.7%) received measurable online attention. Overall, approximately 28% of all MazUMS publications were mentioned by at least one source tracked by Altmetric Explorer. The distribution of online attention across different platforms is presented in Table 4.

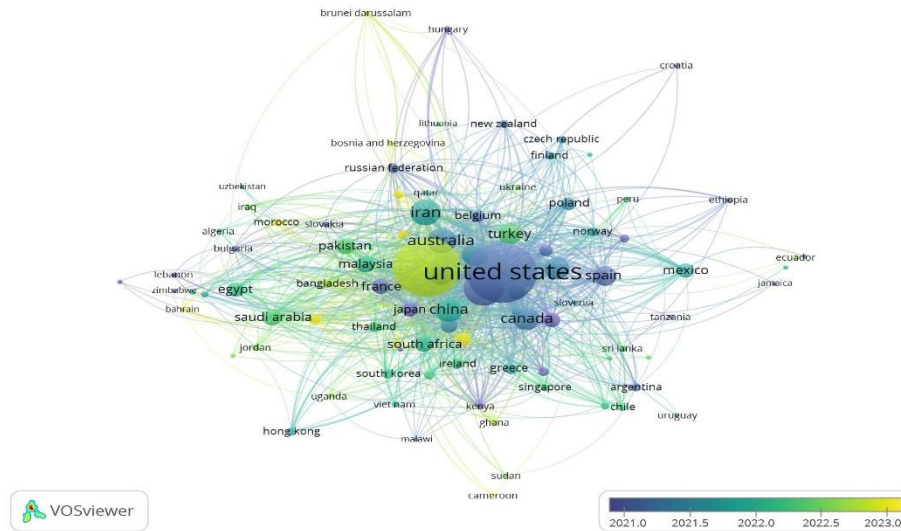


Figure 3. Country-level citation network of Scopus book and book-series citations to MazUMS publications.

Table 4. Distribution of altimetric attention sources for research outputs affiliated with Mazandaran University of Medical Sciences (1997–2024).

Category	Source	Total mentions	Mean per publication
Social media platforms	X (Twitter)	90,786	27.82
	Facebook	1,570	0.48
	Reddit	166	0.05
	Bluesky	187	0.06
News and blogs	News outlets	14,969	4.58
	Blogs	950	0.29
Knowledge and reference sources	Wikipedia	1,612	0.49
Policy and clinical documents	Policy documents	1,742	0.53
	Clinical guidelines	385	0.11
	Patent documents	566	0.17
Multimedia platforms	YouTube	310	0.10
	Podcasts	147	0.05
Scholarly evaluation platforms	Peer review platforms	77	0.23
	F1000	29	0.01

As shown in Table 4, social media platforms accounted for the largest share of online attention, with X (Twitter) representing the dominant source of mentions (90,786; mean = 27.82 per publication). Substantial visibility was also observed through news outlets and blogs, indicating dissemination beyond scholarly communication. In addition, MazUMS publications were cited in knowledge- and policy-related resources, including Wikipedia, policy documents, clinical guidelines, and patent documents, demonstrating broader societal and translational relevance. Overall, these findings indicate that MazUMS research has achieved measurable

visibility across both academic and public communication platforms. Social media platforms accounted for the largest share of attention, with X (Twitter) representing the dominant source of mentions (90,786; mean = 27.82 per publication). Additional visibility was observed through news outlets and blogs, indicating dissemination beyond academic communication. Mentions were also identified in knowledge and policy related resources such as Wikipedia, policy documents, clinical guidelines, and patent documents, reflecting broader societal and translational relevance.

Citation and usage based indicators for MazUMS publications are summarized in Table 5 and illustrated in Figure 4.

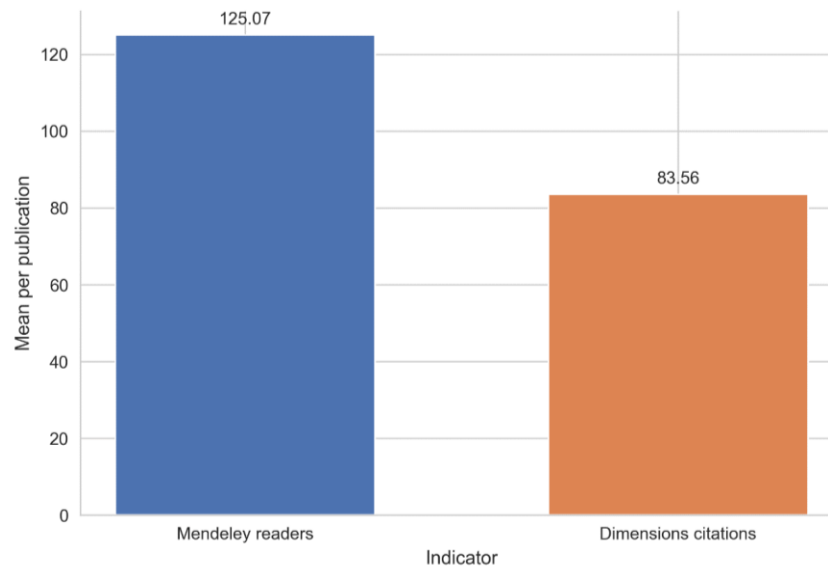
Table 5. Citation- and usage-based indicators for MazUMS research outputs.

Category	Indicator	Total count	Mean per publication
Usage-based indicator	Mendeley readers	408,134	125.07
Citation-based indicator	Dimensions citations	272,673	83.56

As shown in Table 5 and Figure 4, Mendeley readership values consistently exceeded Dimensions citation counts in both total and mean counts. This finding indicates substantial scholarly engagement with MazUMS publications at the readership level. This pattern aligns with previous bibliometric studies suggesting that usage-based indicators, such as Mendeley readership, tend to accumulate earlier than formal citation counts.

### Correlation Between Citations and Altimetrics

To investigate the relationship between scholarly impact and online attention, Spearman’s rank-order correlation analysis was conducted using citation data from Dimensions and Scopus alongside altimetric indicators.



**Figure 4.** Comparison of citation- and usage-based indicators for MazUMS research outputs.

As shown in Table 5 and Figure 4, Mendeley readership values consistently exceeded Dimensions citation counts, indicating early scholarly engagement at the readership level before formal citations accumulate.

The correlation analysis revealed significant positive associations between the examined indicators, ranging from weak to strong. Dimensions and Scopus citation counts showed a near-perfect correlation ( $\rho = 0.981$ ,  $p < 0.01$ ), confirming high database alignment. Mendeley readership also demonstrated a strong positive correlation with Scopus citations ( $\rho = 0.759$ ,  $p < 0.05$ ), suggesting that highly read papers on Mendeley eventually secure more formal citations. Conversely, mentions on X (formerly Twitter) and news outlets exhibited only weak correlations with citation counts, indicating that public social media attention captures distinct dimensions of research visibility rather than academic impact.

Note.  $\rho$  denotes Spearman's rank correlation coefficient.  $p < 0.05$  is considered statistically significant.

### Discussion

The principal contribution of this study lies in demonstrating that institutional research impact cannot be adequately characterized using citation indicators alone. By integrating bibliometric, book citation, and altimetric indicators within a unified framework, the study provides a multidimensional perspective on scholarly, educational, and societal research influence. Specifically, this study provides a comprehensive assessment of the research output of Mazandaran University of Medical Sciences (MazUMS) by analyzing 11,534 publications indexed in Web of Science and Scopus after a three-stage refinement and deduplication process. Three principal findings emerge from the analysis: first, MazUMS experienced substantial growth

in indexed scientific production between 1997 and 2024, with pronounced acceleration after 2015; second, the university's publications demonstrate strong integration within international journal-based literature; and third, MazUMS research outputs exhibit considerable online visibility across digital platforms, although altimetric indicators capture dimensions of attention that differ from traditional citation-based impact. These results align with the growing consensus in scientometrics that research influence is a multifaceted construct requiring evaluation through multidimensional frameworks rather than reliance on single indicators [9].

### Trajectory of Research Growth and Productivity

The findings reveal a substantial and sustained increase in the research productivity of MazUMS over the past two decades. The growth from only two Scopus-indexed publications in 1997 to more than 1,000 publications by 2024 reflects a remarkable expansion in the university's research capacity and international scientific visibility. The pronounced acceleration in publication output after 2015 may be attributable to broader national research policy reforms, strengthened institutional incentives for international publishing, and the increased integration of Iranian medical universities into global scholarly indexing systems [10, 11]. Similar trends have been reported in topic-specific bibliometric studies in the medical sciences, where the evolution of clinical research areas and advances in medical technology have been associated with a growing number of highly cited publications, particularly since the early 2000s [12]. The growing trend of scientific publications in Iranian medical and pharmaceutical contexts has been documented in several recent bibliometric studies, which highlight the steady expansion of biomedical research output and the utility of visualization tools in assessing institutional or journal-specific performances [13].

Notably, this quantitative growth was accompanied by strong citation performance. Original research articles accounted for the largest share of the university's publication output and achieved the highest H-index, indicating sustained scholarly recognition and influence. Review articles also demonstrated substantial citation impact, consistent with well-established patterns in the biomedical literature, where evidence syntheses frequently serve as foundational references for subsequent research. Collectively, these findings suggest that MazUMS has strengthened its research profile and become increasingly integrated into the international scholarly communication landscape.

#### Citation Environment and Integration into the Global Scholarly Literature

A notable finding of this study is the predominance of peer-reviewed journals as the source of citations to MazUMS publications, with almost all citations originating from journal articles. This pattern highlights the central role of scholarly journals in biomedical communication, serving as the principal channel through which new research findings are disseminated, evaluated, and incorporated into the scientific literature [14, 15]. The predominance of journal-based citations suggests that MazUMS publications are contributing to the international scholarly literature rather than remaining confined to local or regional contexts. From a scientometric perspective, integration into international journal citation networks is widely regarded as an indicator of scholarly visibility, disciplinary recognition, and engagement with the global research community [16].

#### Book Citations: A Potential Indicator of Educational and Long-Term Research Influence

Although citations originating from books and book chapters accounted for only a small proportion (approximately 3%) of the overall citation landscape, they provide an additional perspective on scholarly influence that is often overlooked in conventional citation-based assessments. Most book-related citations originated from book chapters rather than standalone monographs, suggesting that MazUMS research has been incorporated into educational and reference resources.

Previous studies have suggested that citations in books may reflect intellectual influence within the academic community and capture dimensions of scholarly recognition that are not fully represented by journal-based citation metrics [17, 18]. In the medical sciences, such citations may also indicate the incorporation of research findings into textbooks, reference works, and professional training materials, representing a slower but potentially more enduring pathway for knowledge dissemination than that reflected by journal articles alone [19, 20].

The relatively small number of citations originating from books and book chapters should not be viewed as

evidence of limited research influence. Rather, these citations may reflect selective but meaningful uptake within educational and professional contexts, where research findings become incorporated into reference works, textbooks, and other knowledge resources [21-23]. Consequently, exclusive reliance on journal-based citation indicators may underestimate this dimension of research influence, particularly for institutions with strong educational missions [24, 25]. In this respect, book citations provide complementary evidence that MazUMS research has been incorporated into educational and scholarly resources beyond the journal literature.

#### Altmetric Visibility and the Decoupling of Research Impact Indicators

Altmetric data showed that 28% of MazUMS publications received attention from at least one tracked source, indicating a moderate level of online visibility. However, this attention was concentrated primarily within academic rather than public-facing platforms. Mendeley readership emerged as the most prevalent altmetric indicator, whereas mentions on X (formerly Twitter) and in news outlets were comparatively limited. This pattern suggests that MazUMS research has achieved greater visibility within scholarly and professional communities than among broader public audiences. The prominence of Mendeley readership is consistent with previous studies demonstrating that academically oriented platforms continue to play a central role in the online dissemination of biomedical research [26, 27].

The moderate correlation between Mendeley readership and Scopus citation counts suggests that Mendeley readership may serve as an early indicator of scholarly interest, often preceding the accumulation of formal citations. This observation is consistent with the findings of Tian et al. (2024), who reported that Mendeley readership captures early research attention before citation impact becomes fully established [23].

By contrast, the weak correlation with X mentions and the non-significant association with news mentions suggest that public-facing attention is influenced by factors beyond scholarly impact, including topical relevance, media coverage, and communication practices [28-30]. Collectively, these findings reinforce the value of multidimensional research evaluation, as citation-based indicators primarily reflect scholarly recognition, whereas altmetric indicators provide complementary evidence of early engagement and broader patterns of research visibility [9, 31].

#### Limitations

This study has several limitations that should be acknowledged. First, altmetric indicators are dynamic and platform-dependent, and their values may change over time as digital communication environments evolve.

Second, attention on social media and other online platforms should not be interpreted as a direct measure of scientific quality, as it may be influenced by factors beyond scholarly merit, including public interest and media exposure. Third, citations from books and book chapters are less comprehensively indexed and standardized than journal citations, which may result in an underestimation of the educational dimension of research impact. Finally, because this study was conducted at a single medical university, the findings should be generalized to other institutions and national settings with caution. Future research should validate these findings across multiple institutions and incorporate longitudinal and qualitative approaches to provide a more comprehensive understanding of scholarly and societal research impact.

### Implications for Policy and Practice

The findings of this study have several implications for Mazandaran University of Medical Sciences (MazUMS) and similar academic institutions. The predominance of journal-based citations underscores the importance of sustaining high-quality journal publications while recognizing that citations from books and book chapters may reflect educational uptake and the incorporation of research into scholarly and reference literature. Furthermore, the stronger association between Mendeley readership and citation counts, relative to other altimetric indicators, suggests that Mendeley readership may serve as a useful complementary indicator of early scholarly engagement. Accordingly, institutional research evaluation frameworks may benefit from adopting a multidimensional approach that integrates conventional bibliometric indicators with complementary measures of scholarly engagement, in line with the principles of the Leiden Manifesto. Such an approach would provide a more comprehensive assessment of research influence across scholarly communication, educational uptake, and broader knowledge dissemination.

### Conclusion

This study provides a comprehensive assessment of the scholarly and societal impact of research outputs from Mazandaran University of Medical Sciences (MazUMS) by integrating bibliometric, book-based citation, and altimetric indicators. The findings demonstrate substantial growth in the university's research output between 1997 and 2024 and indicate that its publications are primarily disseminated through and cited within the international journal literature. Although citations from books and book chapters accounted for a relatively small proportion of the overall citation landscape, they provide additional evidence that MazUMS research has been incorporated into educational and reference-oriented resources.

Among the altimetric indicators examined, Mendeley readership showed the strongest association with

citation counts ( $\rho = 0.759$ ,  $p < 0.05$ ), whereas mentions on X and in news outlets were only weakly correlated with citation impact. In addition, Dimensions citation counts were highly correlated with Scopus citation counts ( $\rho = 0.981$ ,  $p < 0.01$ ), highlighting the consistency of these complementary citation sources.

Overall, the findings suggest that bibliometric, book-based citation, and altimetric indicators capture complementary yet distinct dimensions of research impact. Their combined use can provide a more comprehensive assessment of scholarly influence, educational uptake, and broader research engagement than conventional citation metrics alone. Although this study focused on a single institution, the multidimensional analytical approach employed here may provide a useful reference for future institutional research assessments seeking to integrate scholarly, educational, and societal dimensions of research impact.

### Declarations

Consent for publication: not applicable.

Availability of data and materials: The bibliographic dataset used in this study is available from the corresponding author upon reasonable request.

Competing interests: The authors declare no competing interests.

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### Authors' contributions

Hasan Siamian: Conceived and designed the study and provided overall leadership of the research. He supervised the methodological framework, directed the data analysis and interpretation, and took primary responsibility for drafting the manuscript, coordinating revisions, and integrating feedback into the final version. He also oversaw the scientific integrity and coherence of the study throughout all stages of the research process

Aboozar Ramezani: Contributed to data collection, supported the statistical analysis, and assisted with methodological procedures, validation of results, and drafting and revising the manuscript.

Zahra Foroughi: Contributed to data interpretation and assisted in drafting and revising the manuscript.

Fatemeh Faraji: Contributed to data interpretation and assisted in drafting and revising the manuscript.

All authors critically reviewed the manuscript, approved the final version, and agree to be accountable for all aspects of the work.

### Ethical Statement

This study was approved by the Research Ethics Committee of Imam Khomeini Educational and Therapeutic Hospital, Mazandaran University of Medical Sciences, Iran (Ethics approval code: IR.MAZUMS.IMAMHOSPITAL.REC.1403.089; approved on 6 January 2025). The research was conducted using publicly available bibliographic and altimetric data retrieved from international databases and did not involve human participants, patients, biological samples, or identifiable personal information. Therefore, informed consent was not required.

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