Leading Journals in ChatGPT Articles with More References Co-citations Using Slope Graphs in R with Web R-Platform: Bibliometric Analysis

Julie Chi Chow, Yu-Tsen Yeh, Willy Chou

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Abstract

Background: ChatGPT has sparked numerous innovative applications in healthcare, with PubMed currently indexing 2,692 articles on the topic. However, there is no available information on which journals have more references co-citations in ChatGPT articles and their thematic features.

Objective: This study aims to answer three key questions: (1) How can major themes be extracted from ChatGPT-related articles to respective journals? (2) Does the number of Chinese publications in ChatGPT merely lag behind that of American authors? (3) Which journals have more references co-citations in ChatGPT articles, and what characteristics do these articles share based on ChatGPT keywords?

Methods: We collected 2,489 articles with "ChatGPT" in their titles from the Web of Science core collection, gathering metadata from 2022 onwards. To analyze these articles, we employed various visualization methods, focusing on slope graphs to compare trends in prestigious journals based on three aspects: the overall number of publications, the top 100 cited articles, and references co-citations on journals. We created performance sheets, network charts of author collaborations and co-words for 2,489 articles, and an impact beam plot for the top 100 cited articles. Additionally, we used the follower-leading clustering algorithm (FLCA) for clustering analysis, which efficiently identified research focal points and emerging trends.

Results: The study revealed the following findings: (1) Three major themes emerged from the top 20 keywords: ARTIFICIAL-INTELLIGENCE, IMPACT, and QUALITY; (2) The number of ChatGPT research publications by Chinese authors still merely lagged behind those by US authors; (3) The prestigious journals leading in references co-citations among ChatGPT articles were Nature and the Journal of Medical Internet Research(JMIR); (4) Both journals were classified as ARTIFICIAL-INTELLIGENCE in nature.

Conclusions: The study identified three major themes (ARTIFICIAL-INTELLIGENCE, IMPACT, QUALITY), confirmed US dominance in ChatGPT research over China, and highlighted Nature and JMIR as leading journals in references co-citations among ChatGPT articles, both focusing on artificial intelligence. Based on the results of this study, slope graphs created in R on web R-platform can be applied to research, not just ChatGPT articles.

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Leading Journals in ChatGPT Articles with More References Co-citations Using Slope Graphs in R with Web R-Platform: Bibliometric Analysis

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Keywords: web R-platform; ChatGPT; slope graph; follower-leading clustering algorithm; impact beam plot; network chart; performance sheet

Highlights:

1. Major themes identified in ChatGPT research: ARTIFICIAL-INTELLIGENCE, IMPACT, and QUALITY.
2. US leads in ChatGPT research publications, with China in second place.
3. Nature and the JMIR are the leading journals having more references co-citations among ChatGPT articles, focusing on artificial intelligence.
4. A slope graph can be used to compare trends between elements based on two or more stages.

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ChatGPT has been w

Introduction

ChatGPT[1] has sparked many potential innovative applications in healthcare[2-6] since its release in November 2022[7]. In November 2023, OpenAI released ChatGPT-4V for images and text[7-9]. Large Language Models (LLMs)[9-15] evolve rapidly. PubMed currently has over 2,692 articles indexed[16]. There is no information available about which journals having more references co-citations among ChatGPT articles and their article features classified by themes.

1.1 Clusters and Classifications are Common in Bibliometrics

Recently, managing references and expanding research scope have gained increased attention[17]. Bibliometric analysis, which examines social and structural relationships between research components, helps reorient research and identify popular issues. It reveals how research in a field is distributed and evolving, tracking popular topics and predicting promising technologies. Bibliometric analysis, commonly applied in academia and industry, often uses keyword-focused strategies like co-word analysis to reduce computational demands and improve accuracy[18]. This method uncovers intrinsic connections and trends in articles, benefiting fields such as medicine and business[17]. Clusters and Classifications are thus commonly and frequently applied to bibliometrics[19,20].

Keywords in ChatGPT-related articles are expected to be analyzed by coword analysis[17] via social network analysis (SNA)[21,22] or specific algorithms, such as following leader cluster algorithm(FLCA)[23-25]. Bibliographical studies have, however, rarely examined article features categorized by themes to respective journals in the past. A first research question is how major themes can be extracted from ChatGPT articles and then applied to respective journals.

1.2 ChatGPT is not Available in All Countries Worldwide

Many dictatorships around the world, along with Italy, have banned ChatGPT[26]. ChatGPT was launched by OpenAI in November 2022[7]. By early 2023, its impressive capabilities had gained widespread recognition. However, this resulted in a surge of negative stories. UK universities expressed concerns about students using ChatGPT to cheat, and company managers expressed frustration about employees using it to write emails. As a result, the AI-driven service was able to demonstrate its power[26]. In total, 12 countries have banned ChatGPT, including China, Russia, Iran, Syria, Chad, South Sudan. Eswatini, Central African Republic, Eritrea, North Korea, Cuba, and Italy[26]. Besides governments controlling internet access, conflicts between nations and the U.S. are another reason ChatGPT is not available everywhere[27]. Historically, China has placed second behind the United States in many academic fields[28,29]. A second research question is whether Chinese authors still merely lag behind US authors in publishing ChatGPT research when ChatGPT is banned in China.

1.3 Prestigious Journals Published ChatGPT Articles

As of July 20, 2024, PubMed indexed 2,692 articles with "ChatGPT" in their titles, published across 353 journals[16]. Research is needed to identify which journals had the most number of references co-citations among ChatGPT articles.

In bibliometric analysis, it is common to disclose the leading elements in each article entity(e.g., county, institute, department, author, and journal) by Tables or visuals. None used the slope graph[30] to compare their trends based on the three aspects(i.e., overall total number of publications, 100 top-cited articles, and references co-citations on journals).

A slope graph visually represents changes in data points between two time periods or categories. It uses parallel lines connecting points on two vertical axes, each representing a different time or category[31]. The slope of the lines indicates the direction and magnitude of change. Slope graphs effectively highlight trends, comparisons, and relative changes, making them ideal for illustrating before-and-after scenarios or shifts in rankings[32]. They are particularly useful for showing changes in performance metrics, rankings, or other comparative data over time, providing a clear and intuitive way to observe trends and variations. Nonetheless, the slope graph in R [34] is necessary to introduce[33].

Additionally, it would be valuable to investigate the themes of these prestigious journals based on keywords from ChatGPT-related articles using the theme-to-article-and-then-to-journal (TAJ) method proposed in the previous study [19].

A third question is which journals have the most number of references co-citations among ChatGPT articles using the slope graphs and what characteristics they share with ChatGPT keywords using the TAJ method.

1.4 The study aims

This study aims to answer the three research questions: (1) how major themes can be extracted from ChatGPT articles and then applied to respective journals, (2) whether the number of publications of ChatGPT research by Chinese authors still only lags behind that of the US, and (3) which journals have most reference co-citations among ChatGPT articles and what characteristics they share with ChatGPT keywords.

Methods

2.1 Data source

We conducted a search on the Web of Science core collection (WoSCC) database to collect article metadata, with "ChatGPT" in their titles as of July 20, 2024. A total of 2,489 articles were analyzed. We downloaded additional plain text containing references citations from WoSCC to capture the citation relationships between documents and cited journals in 100 top-cited articles.

Since all data shown in Multimedia Appendix 1 were retrieved from Web of Science, ethical approval was not required for this study.

2.2 Four Types of Visuals Applied to This Study

The introduction dates for the different versions of ChatGPT are as follows[7-9,35]: (1) ChatGPT-3.5: Introduced in November 2022; (2) ChatGPT-4.0: Launched in March 2023; (3) ChatGPT-4V (Vision): Launched as part of the broader GPT-4 capabilities for image-based input and processing; (4) ChatGPT-4o (omni)**:** Released in May 2024. We collected 2,489 ChatGPT articles with metadata from 2022 onwards. Four kinds of visualizations were applied to achieve the study goals, including performance sheets, network charts of author collaborations and co-words for 2,489 articles, an impact beam plot(IBP)[36,37] for the top 100 cited articles, and slope graphs [30] to compare trends of ChatGPT research by prestigious journals on the three aspects(i.e., overall total number of publications, 100 top-cited articles, and references co-citations on journals). Additionally, we used the follower-leading clustering algorithm (FLCA)[38-40] for clustering analysis of author collaborations and coword occurrences. All visuals were produced in R [34] generated on a web-based R-platform[41]. The study flowchart is shown in Figure 1.

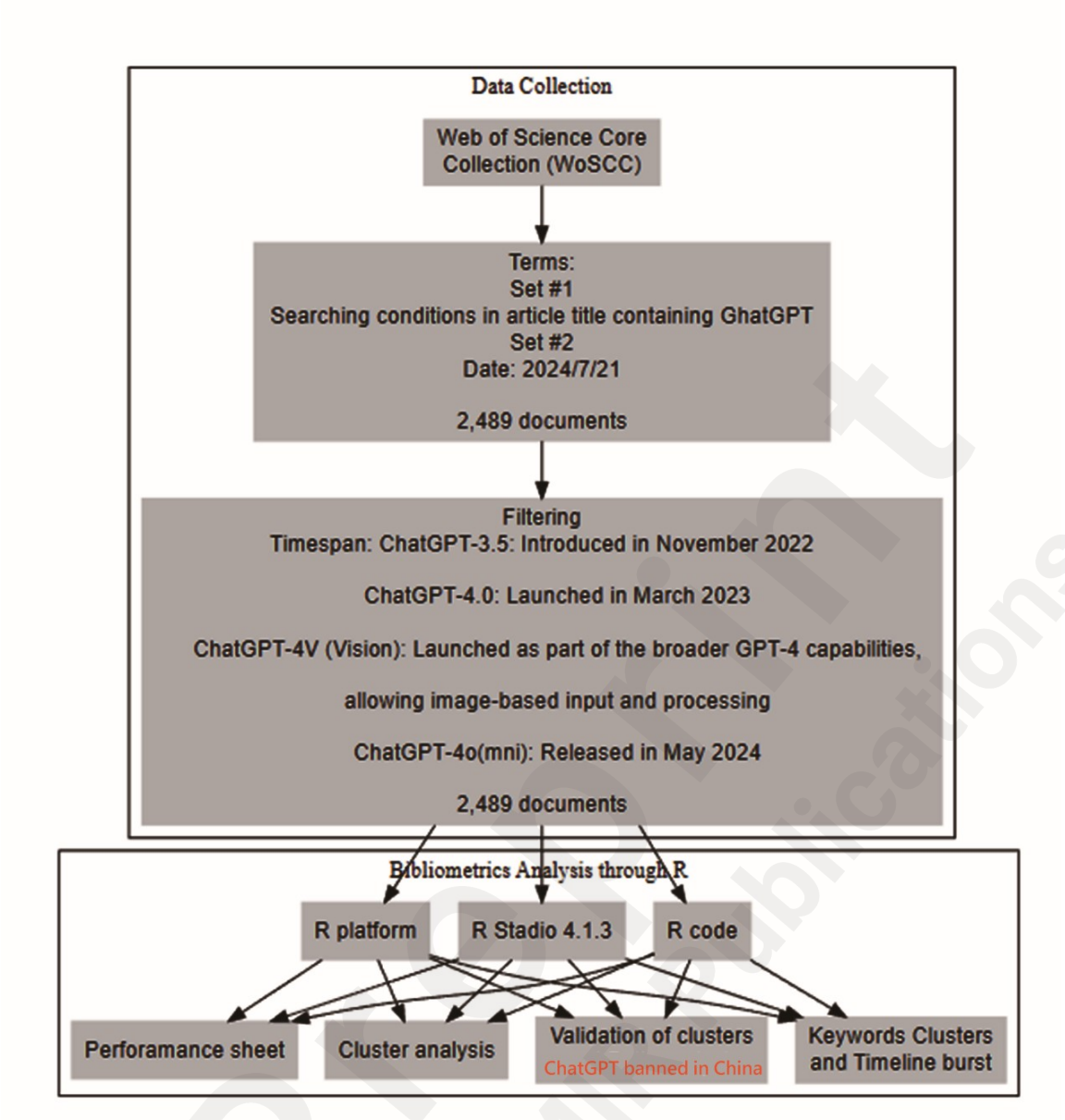


Figure 1 Study flowchart for the goal to verify the China's role in ChatGPT-related articles when ChatGPT has been banned in China.

2.3 Steps to Draw Visuals on Web R-Platform

The study flowchart can be drawn on the Web R-platform [41] using the link [42] to generate the R script shown at the bottom of the website. The ten-facet performance sheet was produced by the link [43], involving the top 10 elements' contributions to the field in each entity by country, institute, department, author, journal, year, article type, research category, keywords plus, and top cited articles, which are most concerned in bibliometrics, with a concise graph at a glance. Additionally, individual and overall h-index [44] were computed for each element based on all 2,489 articles. The

absolute advantage coefficient (AAC) [45-47] was applied to determine the large effect of dominance strength over the next two counterparts when AAC is not less than 0.70 [46,47].

Cluster analyses of author collaborations and co-word occurrences were performed using the 4-quadrant plot with the link [48]. Five pieces of information were presented, including occurrence count (=n) and average co-word (or collaboration) rate (=connections ÷ n) on axes y and x, respectively; bubbles are sized by connection count and colored by cluster; the thickness of connection curves is denoted by the relation strength between two elements. In the concept of the thematic map [49-51], four features are involved in the 4-quadrant plot: motor, niche, emerging or declining, and co-work.

The IBP [36,37] was drawn according to the instruction [52]. The method to draw the slope graph in R refers to the link [33].

2.4 The TAJ Method Used to Classify Joural Features

The theme-to-article-and-then-to-journal (TAJ) method proposed in the previous study [19] was used to classify journal features by theme using keywords. This method was applied when major themes were extracted from ChatGPT articles and then associated with respective journals.

Using co-word analysis via FLCA [38-40], major keywords related to the classifications of ChatGPT research were identified. Each article was then grouped into themes based on the leading keyword in each cluster, as determined by equation 1.

$$THEME¿ = At¿ , \quad (1)$$

where L is the number of major keywords in article i and n is the number of keywords denoted by keyword k belonging to ChatGPT research. Accordingly, the THEME# is redirected to the maximal number of keywords (=m) via equation 1. Similarly, The equation 1 can be applied to journal features by collecting article themes related to the maximal number of themes (m).

2.5 Visuals to Verify the Study Goals

This study aims to answer the three research questions by visuals:

(1) **TAJ method**: how major themes can be extracted from ChatGPT articles and then applied to respective journals.

(2) **Performance Sheet and Collaboration Network**: whether the number of publications of ChatGPT research by Chinese authors still only lags behind that of the US.

(3) **Slope graph**: which journals have most reference co-citations among ChatGPT articles.

(4) **Cowork network and TAJ method**: what characteristics they share with ChatGPT keywords.

2.6 Web R-Platform Used to Draw Visuals

All visuals, except IBP, were drawn in R using the web R-platform[41]. Multimedia Appendix 2 contains details about how this study was conducted. For this study, the links [33,42,45,48] are used to generate R scripts for drawn visuals.

Results

3.1 Performance Sheet in 2,489 articles

Figure 2 shows that the US almost dominates ChatGPT research with AAC=0.67, near to the large effect(≥0.70). Other top 1 elements in each entity are Chandigarh University in India, Medicine or Medical School among departments, the author Viroj Wiwanitkit from India, the journal of Annals of Biomedical Engineering, the year of 2023, the type of Article, the research category of Surgery, the keyword plus of ARTIFICIAL-INTELLIGENCE(AI), and the most cited article by Yogesh K Dwivedi from UK, with 619 citations. The overall h-index in these 2,489 articles reaches 61.

Performance analytics of 10-element entities regarding counts, h-indexes, and AAC for top 1 element's count over the next two in dominance for each entity (n=2,489)

Entity	RP	FP	n	h
Country AAC=0.67				
U.S	585	625	644	35
China	245	254	261	22
India	173	203	212	12
Germany	103	106	108	16
U.K	99	96	105	16
Turkiye	94	96	98	10
Italy	84	89	91	13
South Korea	68	69	75	10
Australia	61	70	74	15
Canada	54	61	63	10
Institure AAC=0.62				
Chandigarh Univ(India)	24	46	46	3
Sikkim Univ(India)	25	25	25	2
Med Ctr(U.S)	22		22	9
Mayo Clin(U.S)	17	19	21	8
Saveetha Univ(India)		20	20	1
Univ Pittsburgh(U.S)	3	15	16	4
Icahn Sch Med Mt Sinai(U.S)	13	16	16	4
Sichuan Univ(China)	1	15	15	5
Stanford Univ(U.S)	13	13	15	6
Private Acad Consultant(Cambodia)	14	14	15	2
Departmen AAC=0.63				
Med	108	80	153	21
Urol	30	50	55	10
Radiol	22	23	34	10
Med Ctr	31	1	32	11
Nursing	19	29	30	7
Plast Surg	11	25	28	10
Surg	15	20	27	8
Punjab		26	26	4
Private Acad Consultant	26		26	2
Chandigarh Univ	24		24	3
Author AAC=0.52				
Wiwanitkit Viroj(India)	52		52	3
Daungsupawong Hinpetch(India)	11	40	40	2
Kleebayoon Amnuay(India)	5	33	33	3
Ray Partha Pratim(India)	23	23	23	2
Kleebayoon Amnuay(Cambodia)	21	15	22	2
Daungsupawong Hinpetch(Laos)	20	16	20	
[Anonymous]			10	3
Egro Francesco M.(U.S)	10		10	5
Surapaneni Krishna Mohan(India)	10	1	10	3
Seth Ishith(Australia)	8	5	9	6
Keyword AAC=0.46				
ARTIFICIAL-INTELLIGENCE			29	19
IMPACT			24	6
INFORMATION			20	6
QUALITY			18	6
TECHNOLOGY			16	7
MODEL			14	5
EDUCATION			13	7
USER ACCEPTANCE			13	4
ACCEPTANCE			11	5
PERFORMANCE			9	6

Entity	n	h
Journal AAC=0.54		
Ann. Biomed. Eng.	57	13
Int. J. Surg.	38	
Educ. Inf. Technol.	30	
Nature	28	11
J. Med. Internet Res.	25	9
Aesthet. Plast. Surg.	24	6
Eur. Arch. Oto-Rhino-Laryn.	24	6
Sci Rep	22	
IEEE Access	20	
Aesthet. Surg. J.	20	
Year AAC=0		
2023	1262	59
2024	1225	20
2022	1	
2025	1	
Article type AAC=0.61		
Article	1279	47
Letter	579	22
Editorial Material	415	37
Review	90	17
Meeting Abstract	90	2
News Item	26	5
Correction	9	1
Retraction	1	
Research are AAC=0.57		
Surgery	175	16
Education & Educational Research	124	17
General & Internal Medicine	116	13
Science & Technology - Other Topics	103	16
Radiology, Nuclear Medicine & Medical	101	20
Urology & Nephrology	75	12
Engineering	64	13
Ophthalmology	59	9
Computer Science	50	7
Dermatology	49	7

Article AAC=0.55		citation
Dwivedi, Yogesh K.(U.K),2023	1	619
Sallam, Malik(Jordan),2023	1	526
Bockting, Claudi(Netherlands),2023	1	504

h-index=61

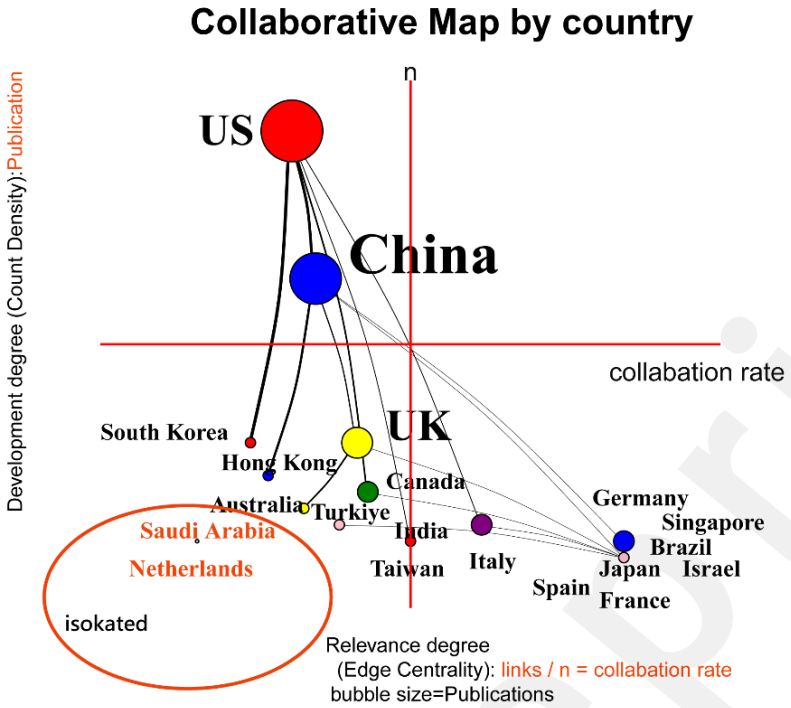
Note:
RP=n of responding author;FP=n of 1st author; n = publication
r1=counts(=n) in top 1 over top 2 by n1/n2; r2=n2 in top 2 over to[3 by n2/n3
r12= r1/r2; AAC=r12/(1+r12)

Figure 2 Performance sheet used for display top 10 elements in each article entity

3.2 Cluster analysis of author collaborations and coword cooccurrences in 2,489 articles

Figures 3 through 7 highlight the results of cluster analysis shown on the 4-quadratn plot, indicating that (1) the number of publications of ChatGPT research by Chinese authors still only lags behind that of the US; (2) Chandigarh University in India and Medicine(or Medical School) are

unique with the most number of ChatGPT articles compared to counterparts in institutes and departments; (3) most prolific authors are from India; (4) three themes of AI, IMPACT, and QUALITY are determined by coword analysis based on the top 20 keywords plus.



Top 20 countries

Country	n	cluster	link
US	13.5	1	6
China	9	2	5
South Korea	4	1	1
UK	4	2	3
Hong Kong	3	2	1
Canada	2.5	1	2
Australia	2	2	1
Italy	1.5	1	2
Turkiye	1.5	3	1
India	1	1	1
Taiwan	1	1	1
Germany	1	2	2
Saudi Arabia	1	4	0
Netherlands	1	5	0
Singapore	0.5	2	1
France	0.5	2	1
Israel	0.5	2	1
Spain	0.5	3	1
Japan	0.5	1	1
Brazil	0.5	1	1

n = article number collaborated within top 20 counris

Figure 3 Collaborative map for country-based collaborations

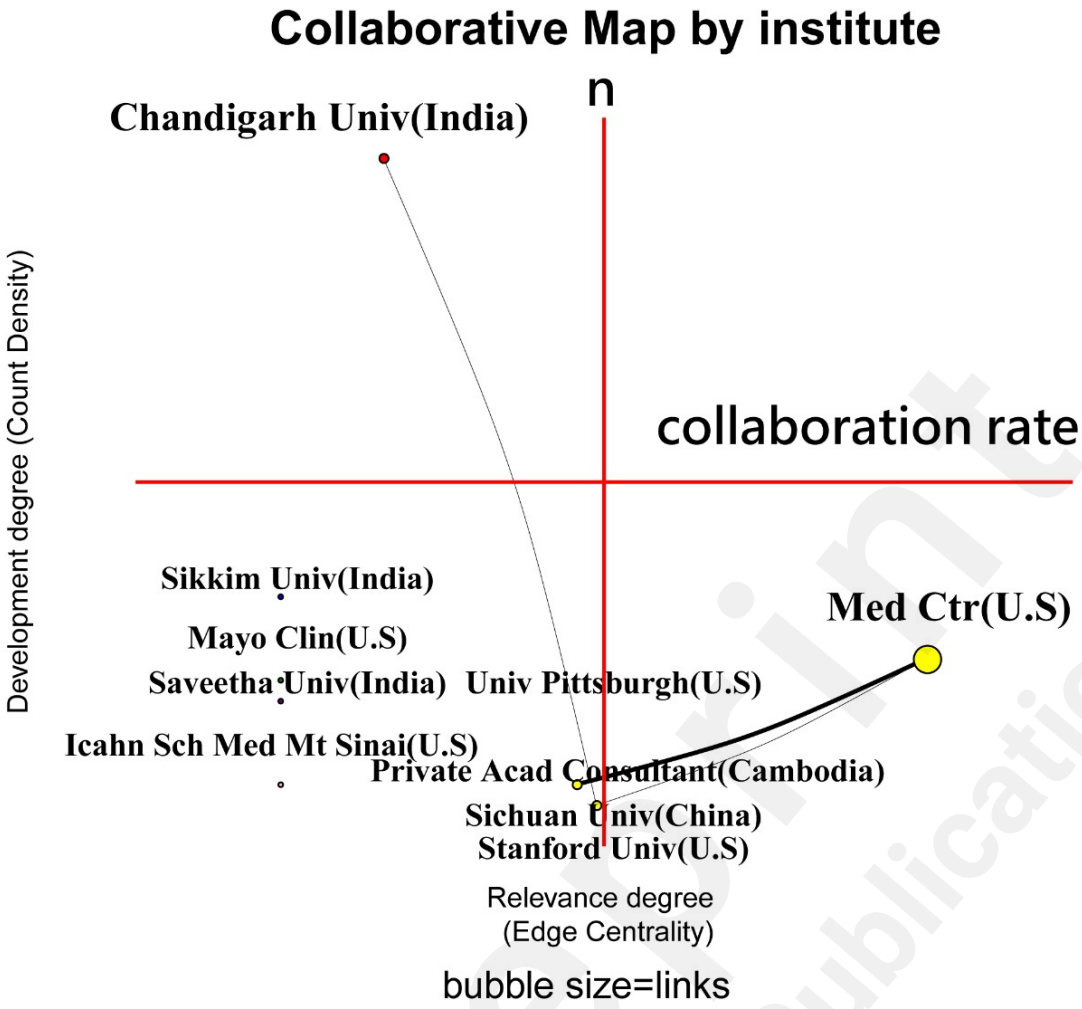


Figure 4 Collaborative map for institute-based collaborations

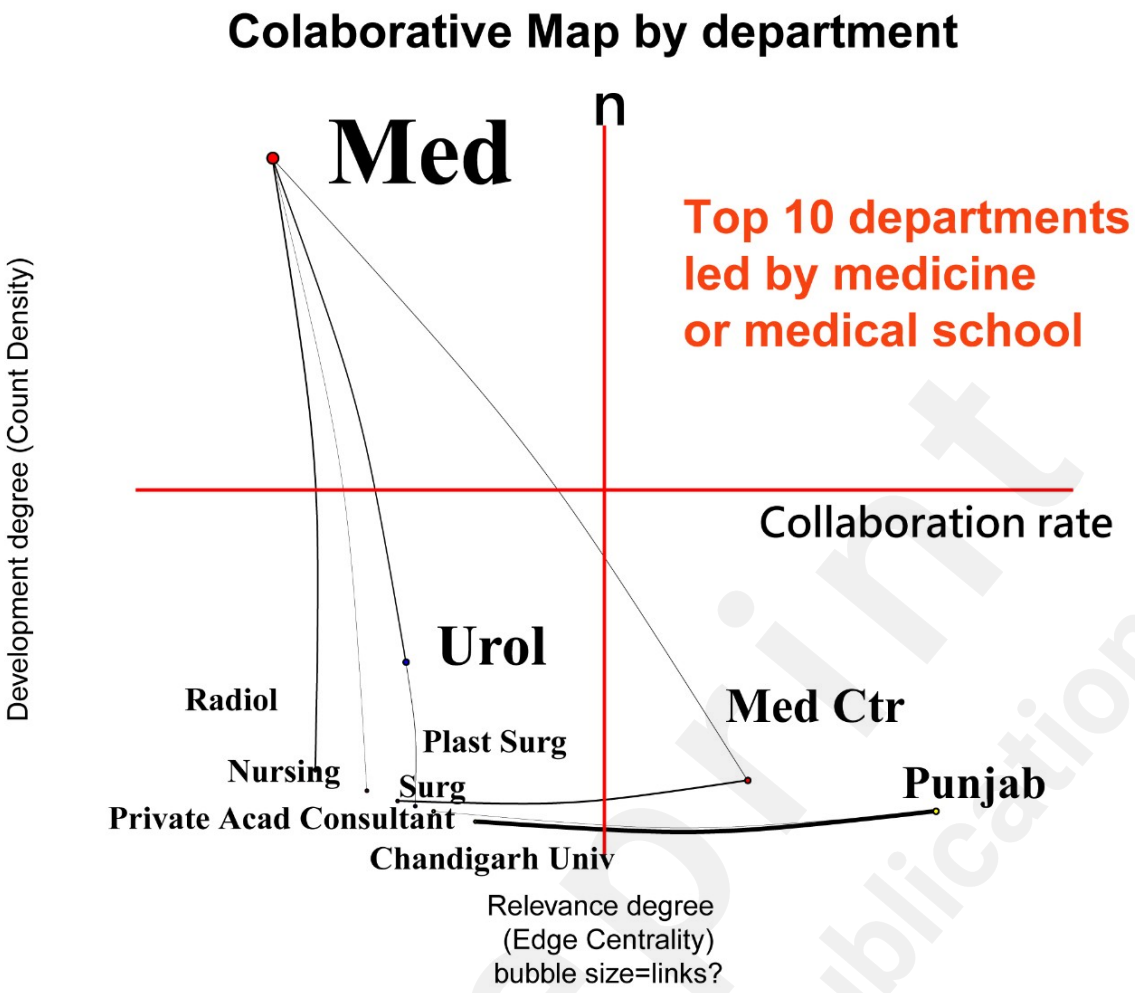
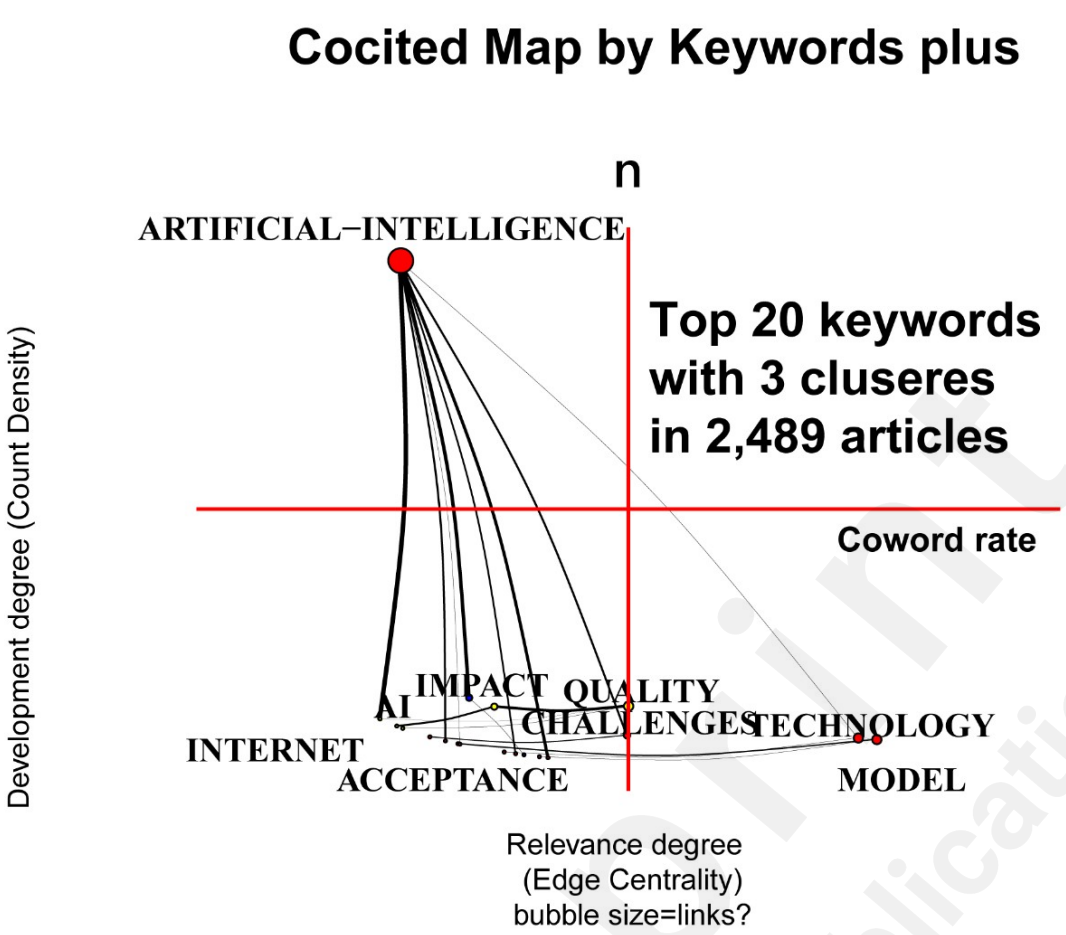


Figure 5 Collaborative map for department-based collaborations

Top 10 authors	n	cluster	link
Wiwanitkit, Viroj(India)	26	1	2
Kleebayoon, Amnuay(India)	16.5	1	2
Kleebayoon, Amnuay(Cambodia)	11	1	1
Daungsupawong, Hinpetch(India)	20	2	2
Daungsupawong, Hinpetch(Laos)	10	2	1
Ray, Partha Pratim(India)	11.5	3	0
Surapaneni, Krishna Mohan(India)	5	4	0
Egro, Francesco M.(U.S)	5	5	0
Seth, Ishith(Australia)	4.5	6	0
Dwivedi, Yogesh K.(U.K)	0.5	7	1
Dwivedi, Yogesh K.(Australia)	0.5	7	1

Figure 6 Collaborative map for author-based collaborations



Journal	n	cluster	link
ARTIFICIAL-INTELLIGENCE	51.97	1	8
AI	7.36	1	1
CHALLENGES	5.74	1	2
HEALTH	5.59	1	1
TECHNOLOGY	5.48	1	3
MODEL	5.33	1	3
GPT-4	5.20	1	1
ACCEPTANCE	4.92	1	1
STUDENTS	4.89	1	1
MANAGEMENT	4.10	1	1
MEDICINE	3.96	1	1
USER ACCEPTANCE	3.66	1	1
HIGHER-EDUCATION	3.57	1	1
IMPACT	9.40	2	2
CARE	3.85	2	1
QUALITY	8.58	3	3
INFORMATION	8.53	3	2
PERFORMANCE	7.35	3	1
INTERNET	6.65	3	1
EDUCATION	6.43	3	1

Figure 7 Thematic map for coword keywords

3.3 Slope graphs and IBP for 100 Top-Cited articles on IBP

All of the 100 top-cited articles are depicted by bubbles on the IBP in Figure 8, with larger bubbles representing more citations. The most cited article, authored by Yogesh K Dwivedi from the UK, is located on the far-right side, with 619 citations. Readers can manipulate the dashboard on their own and view the abstract on the website when they click the bubble of interest if the QR-code on Figure 8 is scanned.

Two clusters are shown in Figure 9. The journals Nature and the Journal of Medical Internet Research (JMIR) stand out exceptionally based on reference co-citations, indicating they have the most number of cited papers among the 100 top-cited articles.

The slope graphs in Figure 10 highlight that both Nature and JMIR have fewer publications among the 2,489 ChatGPT articles but a higher number of articles in the 100 top-cited category, and they rank top 2 in reference co-citations.

After applying the TAJ method [19] to assign major themes from ChatGPT articles to respective journals, it was found that both Nature and JMIR focus on the theme of artificial intelligence. Among the top 10 journals, only the European Archives of Oto-Rhino-Laryngology was assigned to the theme of QUALITY.

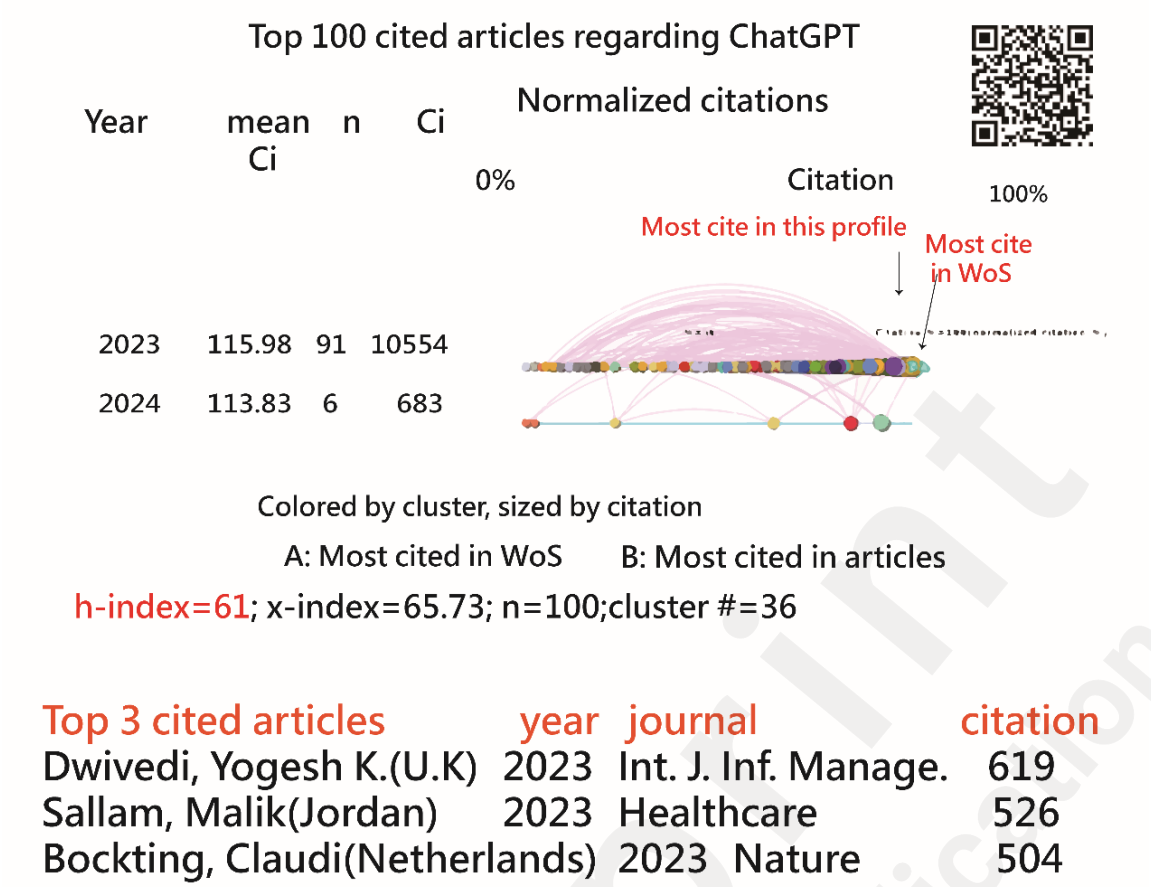
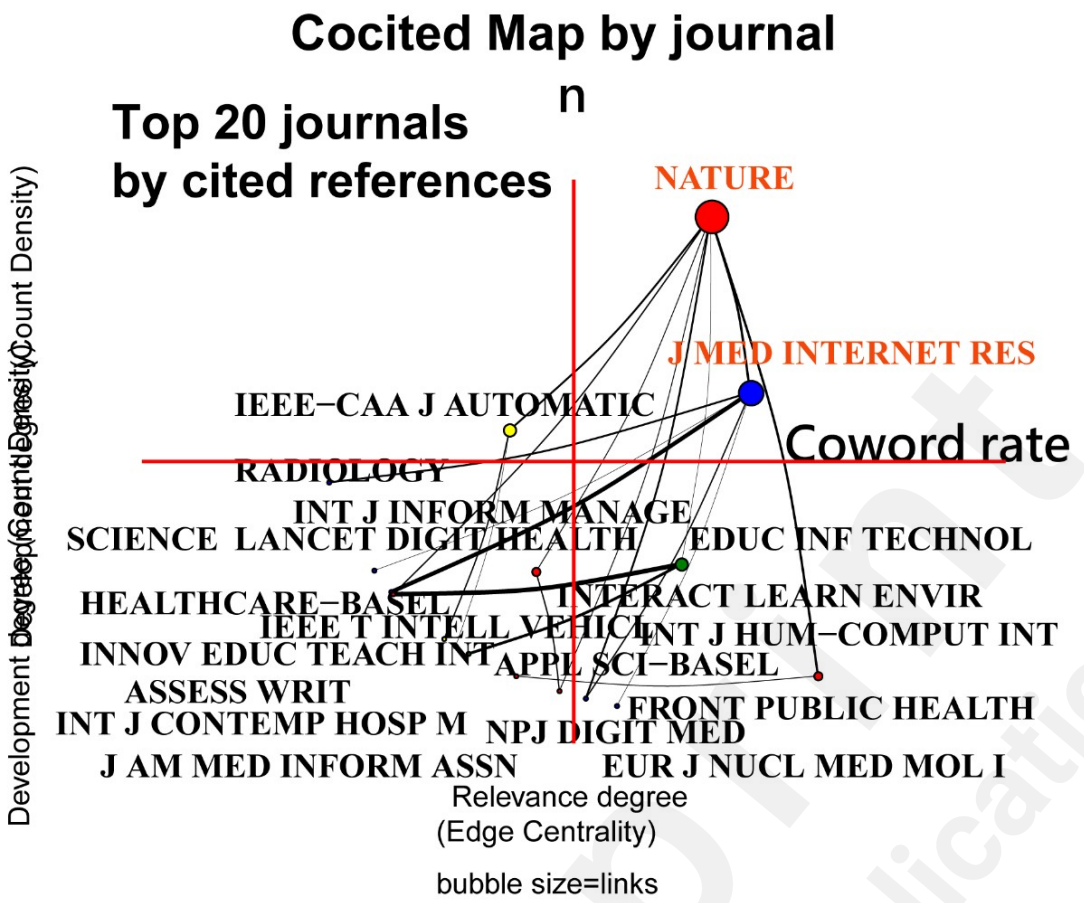


Figure8 Top100 cited articles related to ChatGPT since the introduction on November 31, 2022



Journal	n	cluster	link
NATURE	38.83	1	8
IEEE-CAA J AUTOMATIC	24.50	1	3
EDUC INF TECHNOL	15.50	1	3
INT J INFORM MANAGE	15.00	1	2
HEALTHCARE-BASEL	13.50	1	1
INTERACT LEARN ENVIR	13.50	1	1
IEEE T INTELL VEHICL	10.50	1	1
INNOV EDUC TEACH INT	10.00	1	1
INT J HUM-COMPUT INT	9.50	1	1
FRONT PUBLIC HEALTH	8.00	1	2
APPL SCI-BASEL	8.00	1	1
INT J CONTEMP HOSP M	7.00	1	1
ASSESS WRIT	7.00	1	1
EUR J NUCL MED MOL I	6.50	1	1
J MED INTERNET RES	27.00	2	6
RADIOLOGY	21.00	2	1
SCIENCE	15.09	2	1
LANCET DIGIT HEALTH	13.65	2	1
NPJ DIGIT MED	6.50	2	1
J AM MED INFORM ASSN	6.00	2	1

Figure 9 100 top cited articles related to ChatGPT are led by Nature and JMIR

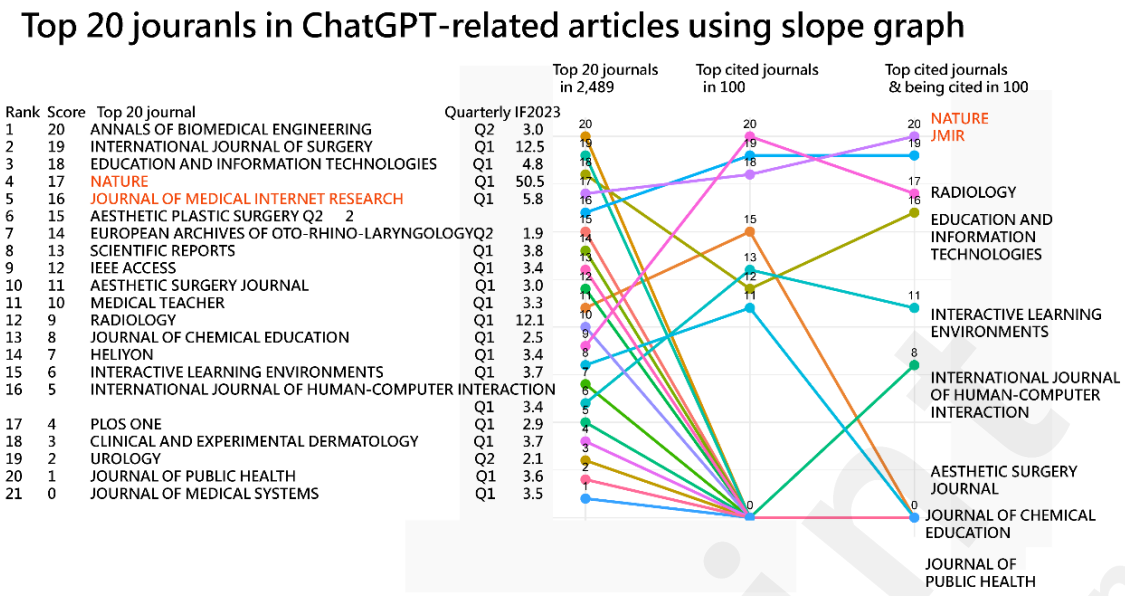


Figure 10 Top 20 journals in ChatGPT-related articles using the slope graph to display

Discussion

4.1 Principal Findings

The study revealed the following findings: (1) Three major themes emerged from the top 20 keywords: ARTIFICIAL-INTELLIGENCE, IMPACT, and QUALITY; (2) ChatGPT research publications by Chinese authors still slightly lagged behind those by US authors; (3) The leading prestigious journals in ChatGPT articles were Nature and JMIR; (4) Both journals focused on the theme of ARTIFICIAL-INTELLIGENCE.

Accordingly, the three research questions were achieved: (1) major themes can be extracted from ChatGPT articles and then applied to respective journals, (2) the number of publications of ChatGPT research by Chinese authors still only lags behind that of the US, and (3) Nature and JMIR have most references co-citations among ChatGPT articles and both focusing on artificial intelligence.

4.2 What this Knowledge Adds to What We Already Knew

There are several aspects worthy of discussion in this contemporary bibliometrics study based on resaerch goals. First, themes classified by co-word analysis are common in bibliometrics. However, no techniques, such as the TAJ method [19], have been applied to determine journal features based on the principal keyword in each cluster. The TAJ method, which is based on themes extracted from keywords through cluster analysis (e.g., FLCA [38-40] applied in this study), categorizes themes first by keywords, then by articles, and finally by journals, as shown in Equation 1. As a result of this approach, Nature and JMIR in ChatGPT articles are focused on artificial intelligence. For readers interested in submitting to journals based on the perception of journal-focus topics, future bibliometric research should investigate themes to journals.

Second, many dictatorships around the world, along with Italy, have banned ChatGPT [26]. In total, 12 countries, including China, have imposed such bans [26]. Although some governments control internet access due to conflicts with the US [27], the number of ChatGPT research publications by Chinese authors still lags only behind the US. This is notable given that China often ranks second to the US in many academic fields [28,29]. Despite ChatGPT being banned in China, our findings reveal that many Chinese authors have published ChatGPT articles in the past two years, indicating that access to ChatGPT is excluded from these academic restrictions.

Third, few bibliographical studies have utilized reference co-citation data for journals. In WoSCC, plain text data is available for download, but programming techniques are required to organize the reference co-citation data for analysis and comparison. This involves extracting references related to active journals or articles and linking them based on their connections. Subsequently, cluster analysis can be performed to draw the 4-quadrant plot in R [48] on the Web R-platform [41]. Traditionally, many bibliometric researchers have used professional software like CiteSpace [53] and VOSviewer [54] for visualizations, which serve more as exploratory tools for researchers than for readers. These visuals often become cluttered with tiny fonts, distracting readers.

Presenting concise graphs with more information is essential and necessary (e.g., Figures 3 through 7 compared to traditional thematic maps [49,50]). Figure 10 shows which journals have the most reference co-citations among ChatGPT articles based on the reference co-citation data.

Forth, many bibliometric researchers have used professional software like CiteSpace [53] and VOSviewer [54] for visualizations. Although some have used R scripts to draw visuals, such as the Bibliometrix R package [55], these can sometimes fall short in achieving concise graphs. The FLCA [38-40] on the Web R-platform [41] highlights the principal links between elements and is recommended for use in bibliometrics.

4.3 Worthy Reading Articles Related to ChatGPT

The most cited article entitled “So what if ChatGPT wrote it?” is authored by Yogesh K Dwivedi and colleagues from UK**,** with 619 citations [56]. Authors addressed that ChatGPT, an advanced AI tool, generates human-like text and offers benefits across various fields such as banking, hospitality, and IT, enhancing productivity and business activities. However, it also presents ethical, legal, and security challenges. Experts highlight the need for further research in knowledge, transparency, ethics, digital transformation, and education.

The only one article published in 2022 entiled “ChatGPT Goes to Law School” is authored by Jonathan H Choi from US**,** with 69 citations [57]. Authors addressed that ChatGPT was tested on four real law school exams at the University of Minnesota Law School. It answered 95 multiple choice and 12 essay questions, performing at a C+ student level. The study discusses the implications for legal education and provides prompts and advice for using ChatGPT in legal writing.

There are 25 ChatGPT articles in JMIR. These studies collectively illustrate the growing integration of AI in healthcare, emphasizing both the potential benefits and the critical need for further development to address reliability, ethical concerns, and practical applicability in clinical settings:

(1) The study[58] compared the diagnostic accuracy of ChatGPT (GPT-3.5 and GPT-4) with resident physicians in an Emergency Department (ED). It found that GPT-4 outperformed both GPT-3.5 and resident physicians, particularly in cardiovascular and endocrine or gastrointestinal diseases, demonstrating the potential of AI as a supportive diagnostic tool in ED settings.

(2) Reproducibility in Scientific Writing was evaluated for the reproducibility of abstracts generated by ChatGPT and Bard compared to human-written abstracts in spine surgery [59]. It concluded that while AI-generated abstracts met journal formatting guidelines more often, they had high plagiarism and AI-detection rates, indicating ethical concerns in using AI for scientific writing.

(3) ChatGPT's proficiency was compared with trained and untrained doctors for Triage Performance in the context of ED triage[60]. Although GPT-4-based ChatGPT showed substantial agreement with professional triage, it did not significantly enhance the performance of untrained doctors, highlighting the need for further development.

(4) ChatGPT's role in thematic analysis within medical research was explored[61], suggesting that while it can enhance efficiency and provide additional insights, human intervention remains crucial to capture the full context of qualitative data.

(5) The performance of ChatGPT and Bard in producing references for systematic reviews[62] was assessed. Both models showed high hallucination rates, and the study recommended thorough validation by researchers before deploying LLMs as primary tools for systematic reviews.

(6) The capabilities of ChatGPT-4V in interpreting electrocardiogram (ECG) waveforms were evaluated[63]. While promising, the study noted limitations and the need for further refinement to ensure reliability in clinical practice.

(7) ChatGPT-4 outperformed its predecessors in providing relevant and reliable information

for Hematopoietic stem cell transplantation (HSCT) [64], but the presence of mistakes and lack of clear references indicated that AI is not yet suitable for unsupervised clinical use or patient counseling.

(8) The accuracy of SOAP notes generated by ChatGPT-4 from audio recordings of physician-patient encounters was assessed [65]. The study found significant variability in errors and quality, suggesting that AI-generated notes do not meet the standards required for clinical use.

(9) ChatGPT's accuracy in following ACLS guidelines for cardiac arrest and bradycardia was explored[66]. The study highlighted issues with consistent guidance and potential medical errors, emphasizing the need for reliable AI applications in clinical scenarios.

4.4 Strengths and Implications of This Study

(1) Strengths of This Study:

We identified major themes in ChatGPT research: ARTIFICIAL-INTELLIGENCE, IMPACT, and QUALITY. The US leads in ChatGPT research publications, with China in second place, despite the ban on ChatGPT access for academic researchers in China. By focusing on slope graphs and using reference co-citation data, we found that Nature and JMIR are the leading journals, both with a strong emphasis on artificial intelligence. For enhanced bibliometric analysis, the web R-platform [41] is recommended.

(2) Implications of This Study:

References co-citations should be accentuated using the slope graph in future bibliometrics. The slope graph effectively showcases the trends and leading journals in ChatGPT research. These findings underscore the value of bibliometric analysis in identifying influential journals by reference co-citations, rather than traditional prolific journals by counts in overall or 100 top-cited articles. In

this way, researchers and stakeholders can gain insights into ChatGPT research trends and influences by journal.

4.5 Limitations and Directions for future study

This study has certain limitations that may motivate further research. First, the data was extracted from WoSCC, which includes some but not all ChatGPT articles, limiting the generalization to articles in WoSCC only. Future studies should involve a broader range of ChatGPT articles for more comprehensive research.

Second, studies have shown that the R-platform [41] is highly suitable for visualizations. Further research is needed to identify which types of visuals are most useful, and then provide the approach to copy and paste data into the input frame to generate the R script. Making the R-platform more user-friendly and accessible for general researchers is essential.

Third, although slope graphs can be created in MS Excel [32], using R through the R-platform [33] offers a simpler and more flexible approach. Some knowledge of R is necessary to make adjustments for an aesthetically pleasing graph. For more reliable and concise presentations, future research should incorporate additional visuals created in R.

Fourth, this study introduced a 10-facet performance sheet to provide a comprehensive overview of the results in bibliometric analysis. This concise sheet offers valuable information, with significant efforts in data arrangement, ensuring accuracy and clarity for readers. The slope graphs in R[43] is too simple to involve all elements shown in Figure 2.

Fifth, The graph provided with code in R available for readers at the link[33] is not unique and irreplaceable. Several other software packages, including the way in MS Excel [32], make it easy to draw them as well.

Conclusions

The study identified three major themes in ChatGPT research: ARTIFICIAL-INTELLIGENCE, IMPACT, and QUALITY. It confirmed the dominance of the US in ChatGPT research over China and highlighted Nature and JMIR as leading journals in reference co-citations, both focusing on artificial intelligence. The results suggest that slope graphs created in R on the web R-platform can be effectively applied to various research areas, not just ChatGPT articles.

List of abbreviations:

AAC: Absolute Advantage Coefficient
AI: Artificial Intelligence
FLCA: Follower-Leading Clustering Algorithm
IBP: Impact Beam Plot
JMIR: Journal of Medical Internet Research
LLMs: Large Language Models
MS: Microsoft
SNA: Social Network Analysis
TAJ: Theme-to-Article-and-then-to-Journal
US: United States
WoSCC: Web of Science Core Collection

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Data Availability

All data generated or analyzed during this study are included in this published article and its Multimedia Appendices.

Authors' Contributions

JCC conceived and designed the study. YT, and WC performed the statistical analyses and oversaw the recruiting of study participants. JCC and WC contributed to the idea. WC helped design the study and collected information, and JCC interpreted the data. AWu monitored the research. All authors read and approved the final article.

Conflicts of Interest

None declared.

Multimedia Appendices:

Multimedia Appendix 1: (PDF) Data used in this study
Multimedia Appendix 2: (PDF) How to conduct this study

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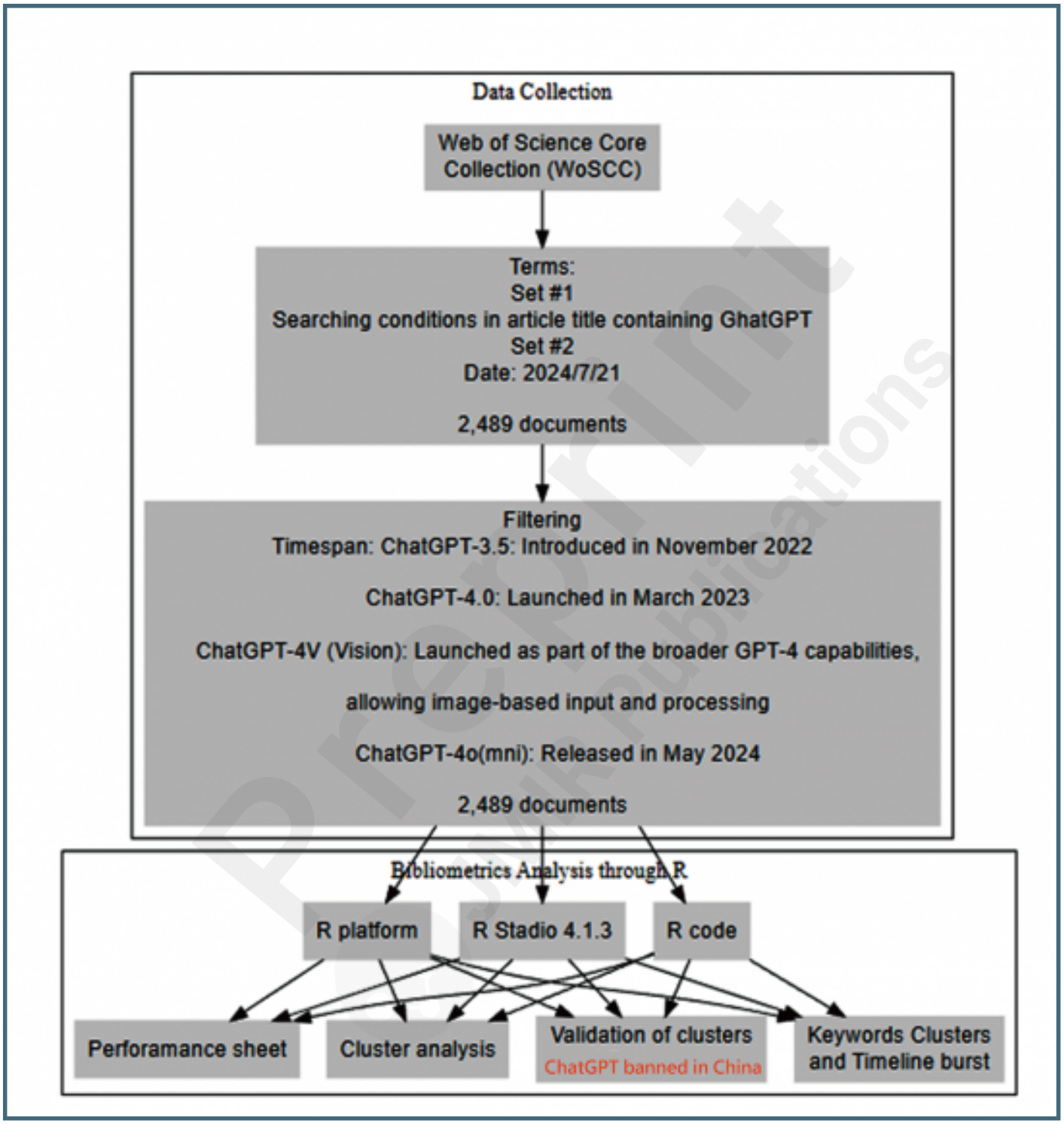
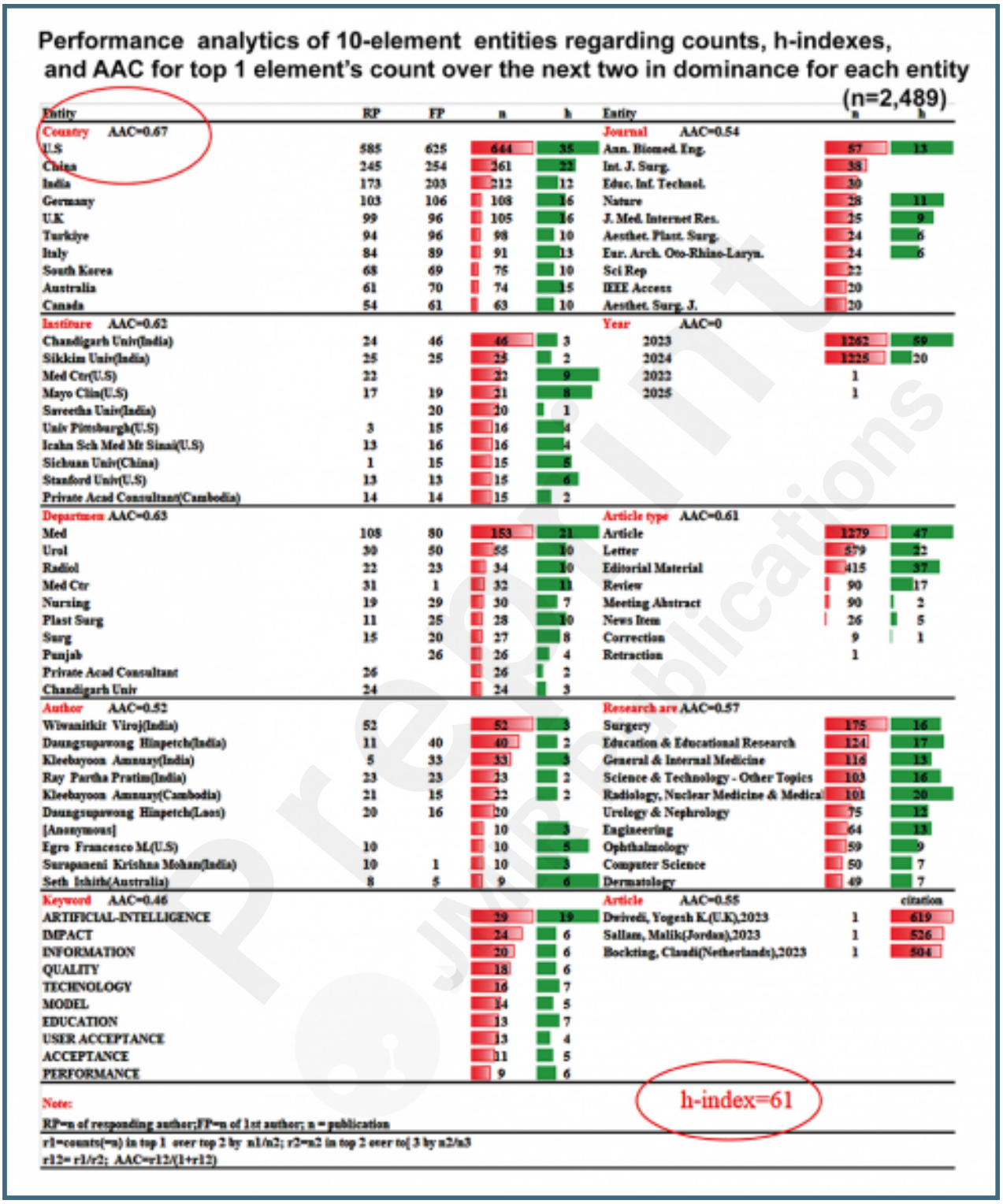
Supplementary Files

Figures

Study flowchart for the goal to verify the China's role in ChatGPT-related articles when ChatGPT has been banned in China.



Performance sheet used for display top 10 elements in each article entity .



Performance analytics of 10-element entities regarding counts, h-indexes, and AAC for top 1 element's count over the next two in dominance for each entity

(n=2,489)

Entity	RP	FP	n	h
Country AAC=0.67				
U.S	585	625	644	35
China	245	254	261	23
India	173	203	212	12
Germany	103	106	108	16
U.K	99	96	105	16
Turkiye	94	96	98	10
Italy	84	89	91	13
South Korea	68	69	75	10
Australia	61	70	74	15
Canada	54	61	63	10
Institute AAC=0.62				
Chandigarh Univ(India)	24	46	46	3
Sikkim Univ(India)	25	25	25	2
Med Ctr(U.S)	22		22	9
Mayo Clin(U.S)	17	19	21	8
Saveetha Univ(India)		20	20	1
Univ Pittsburgh(U.S)	3	15	16	4
Icahn Sch Med Mt Sinai(U.S)	13	16	16	4
Sichuan Univ(China)	1	15	15	5
Stanford Univ(U.S)	13	13	15	6
Private Acad Consultant(Cambodia)	14	14	15	2
Department AAC=0.63				
Med	108	80	153	21
Urol	30	50	55	10
Radiol	22	23	34	10
Med Ctr	31	1	32	11
Nursing	19	29	30	7
Plast Surg	11	25	28	10
Surg	15	20	27	8
Punjab		26	26	4
Private Acad Consultant	26		26	2
Chandigarh Univ	24		24	3
Author AAC=0.52				
Wiwanitkit Viroj(India)	52		52	3
Daungsupawong Hinpetch(India)	11	40	40	2
Kleebayoon Amnuay(India)	5	33	33	3
Ray Partha Pratim(India)	23	23	23	2
Kleebayoon Amnuay(Cambodia)	21	15	22	2
Daungsupawong Hinpetch(Laos)	20	16	20	
[Anonymous]			10	3
Egro Francesco M.(U.S)	10		10	5
Surapaneni Krishna Mohan(India)	10	1	10	3
Seth Ishith(Australia)	8	5	9	6
Keyword AAC=0.46				
ARTIFICIAL-INTELLIGENCE			29	19
IMPACT			24	6
INFORMATION			20	6
QUALITY			18	6
TECHNOLOGY			16	7
MODEL			14	5
EDUCATION			13	7
USER ACCEPTANCE			13	4
ACCEPTANCE			11	5
PERFORMANCE			9	6

Entity	n	h
Journal AAC=0.54		
Ann. Biomed. Eng.	57	13
Int. J. Surg.	38	
Educ. Inf. Technol.	30	
Nature	28	11
J. Med. Internet Res.	25	9
Aesthet. Plast. Surg.	24	6
Eur. Arch. Oto-Rhino-Laryn.	24	6
Sci Rep	22	
IEEE Access	20	
Aesthet. Surg. J.	20	
Year AAC=0		
2023	1262	59
2024	1225	20
2022	1	
2025	1	
Article type AAC=0.61		
Article	1279	47
Letter	579	22
Editorial Material	415	37
Review	90	17
Meeting Abstract	90	2
News Item	26	5
Correction	9	1
Retraction	1	
Research are AAC=0.57		
Surgery	175	16
Education & Educational Research	124	17
General & Internal Medicine	116	13
Science & Technology - Other Topics	103	16
Radiology, Nuclear Medicine & Medical	101	20
Urology & Nephrology	75	12
Engineering	64	13
Ophthalmology	59	9
Computer Science	50	7
Dermatology	49	7
Article AAC=0.55		citation
Dwivedi, Yogesh K.(U.K),2023	1	619
Sallam, Malik(Jordan),2023	1	526
Bockting, Claudi(Netherlands),2023	1	504

h-index=61

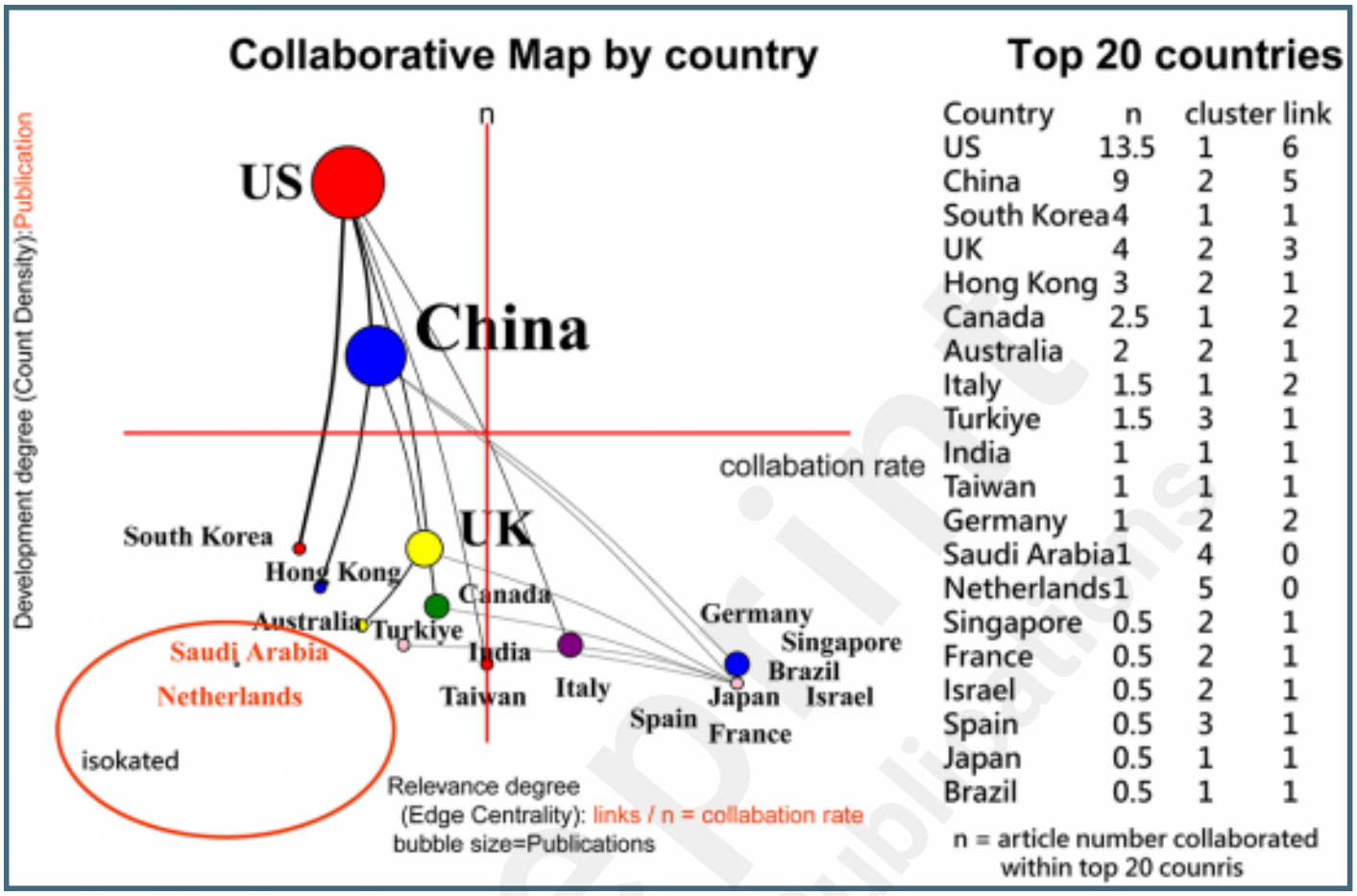
Note:

RP=n of responding author;FP=n of 1st author; n = publication

r1=counts(=n) in top 1 over top 2 by n1/n2; r2=n2 in top 2 over to[3 by n2/n3

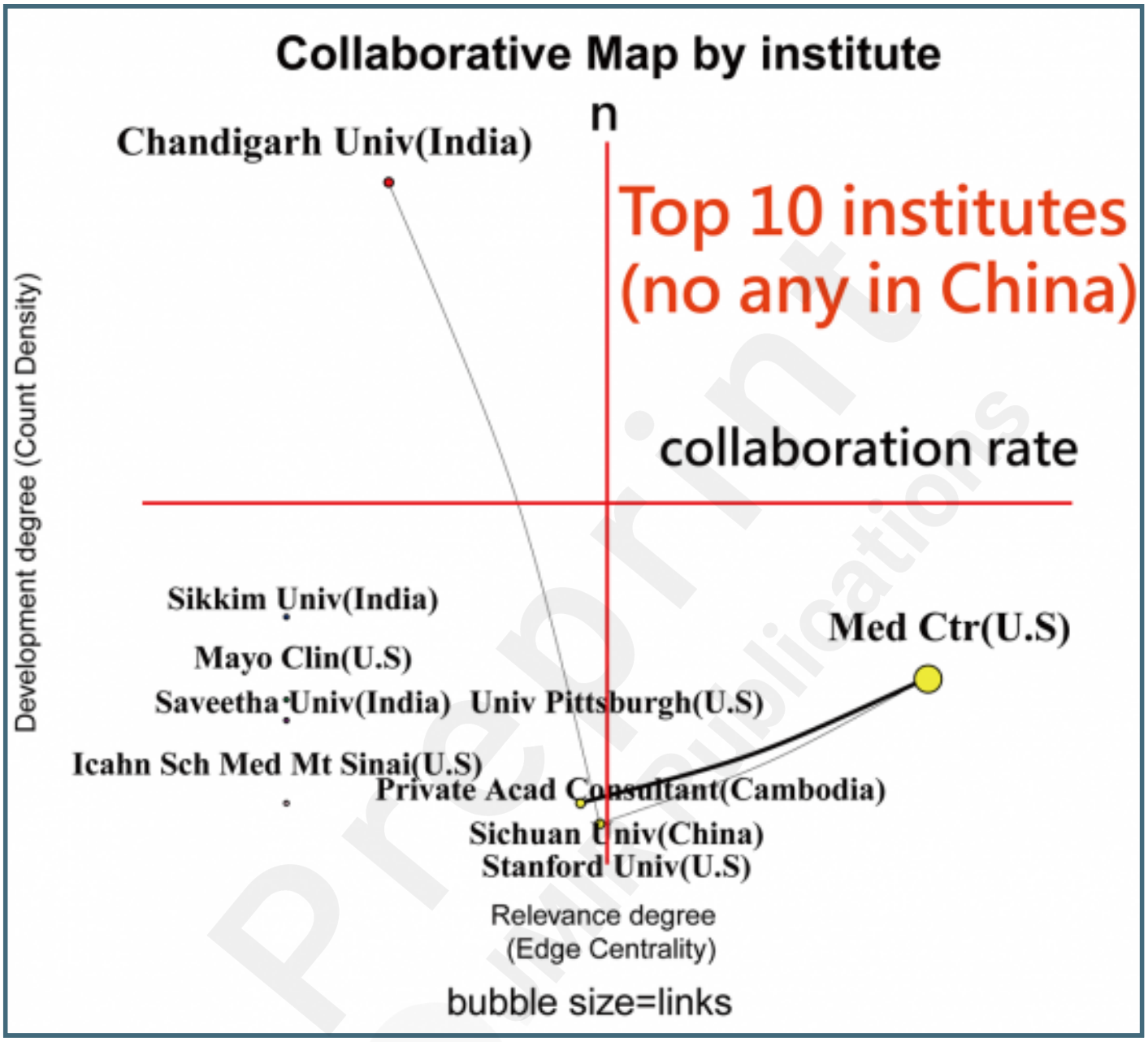
r12= r1/r2; AAC=r12/(1+r12)

Collaborative map for country-based collaborations.

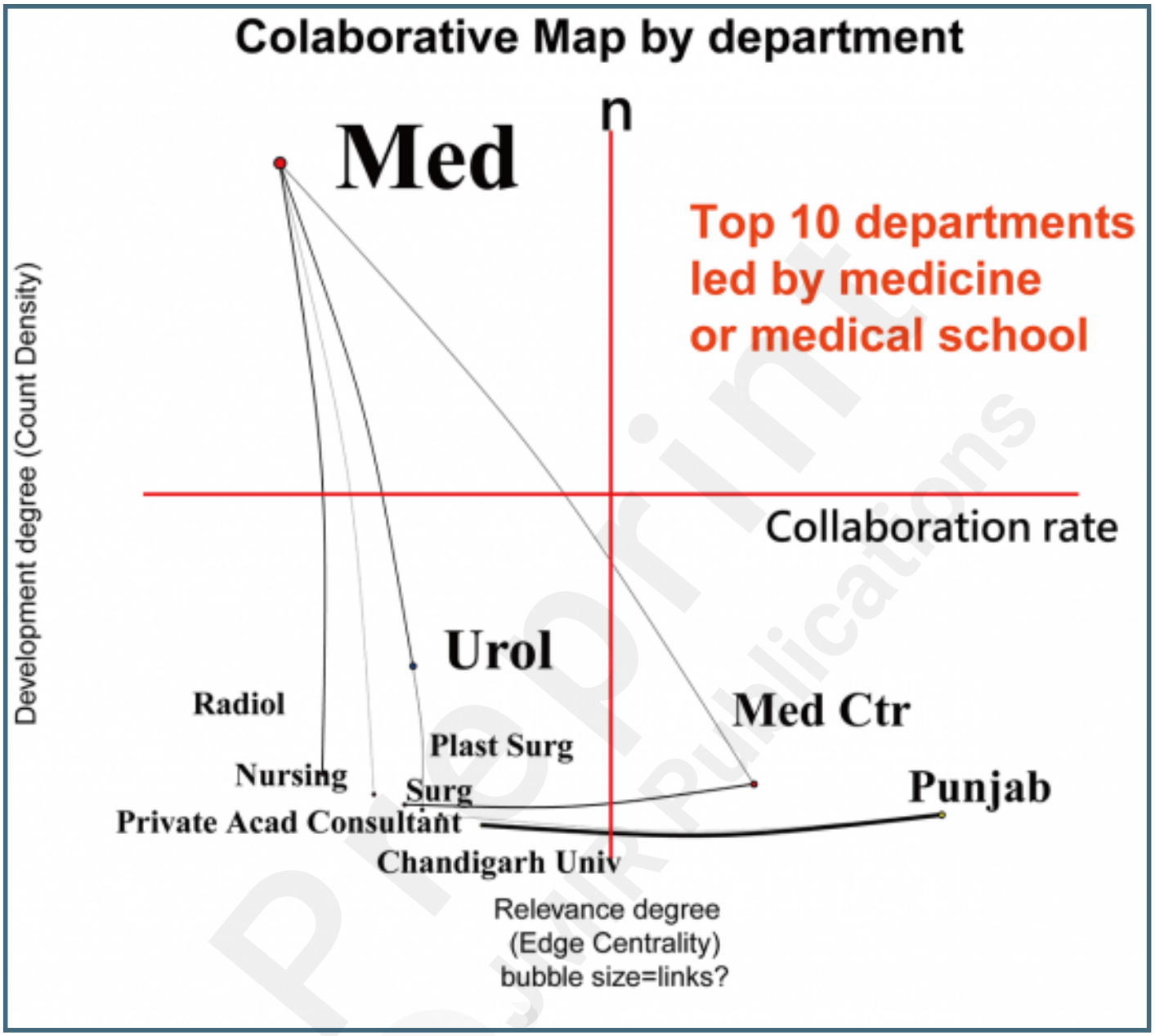


Country	n	cluster	link
US	13.5	1	6
China	9	2	5
South Korea	4	1	1
UK	4	2	3
Hong Kong	3	2	1
Canada	2.5	1	2
Australia	2	2	1
Italy	1.5	1	2
Turkiye	1.5	3	1
India	1	1	1
Taiwan	1	1	1
Germany	1	2	2
Saudi Arabia	1	4	0
Netherlands	1	5	0
Singapore	0.5	2	1
France	0.5	2	1
Israel	0.5	2	1
Spain	0.5	3	1
Japan	0.5	1	1
Brazil	0.5	1	1

Collaborative map for institute-based collaborations.



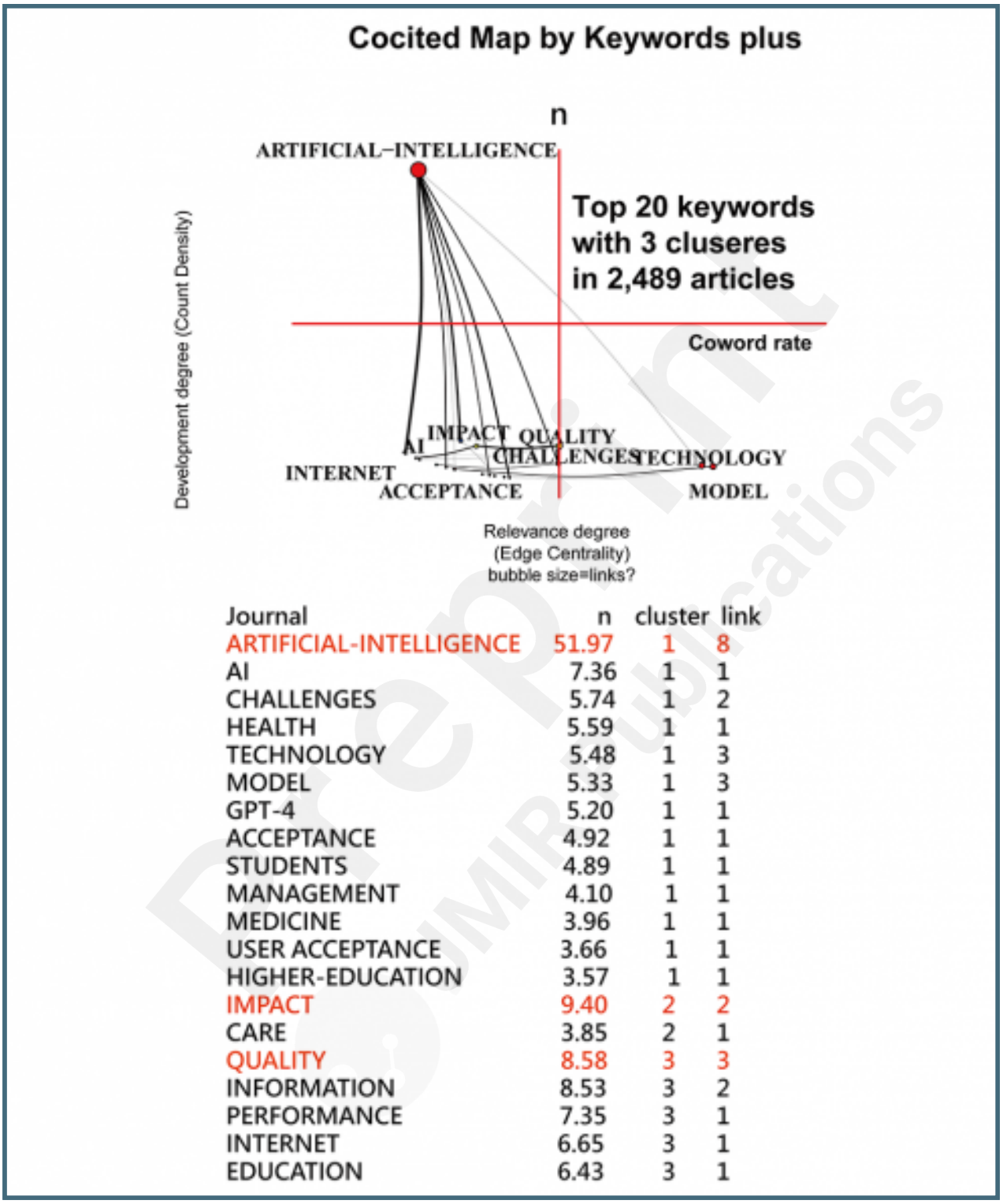
Collaborative map for department-based collaborations.



Collaborative map for author-based collaborations.

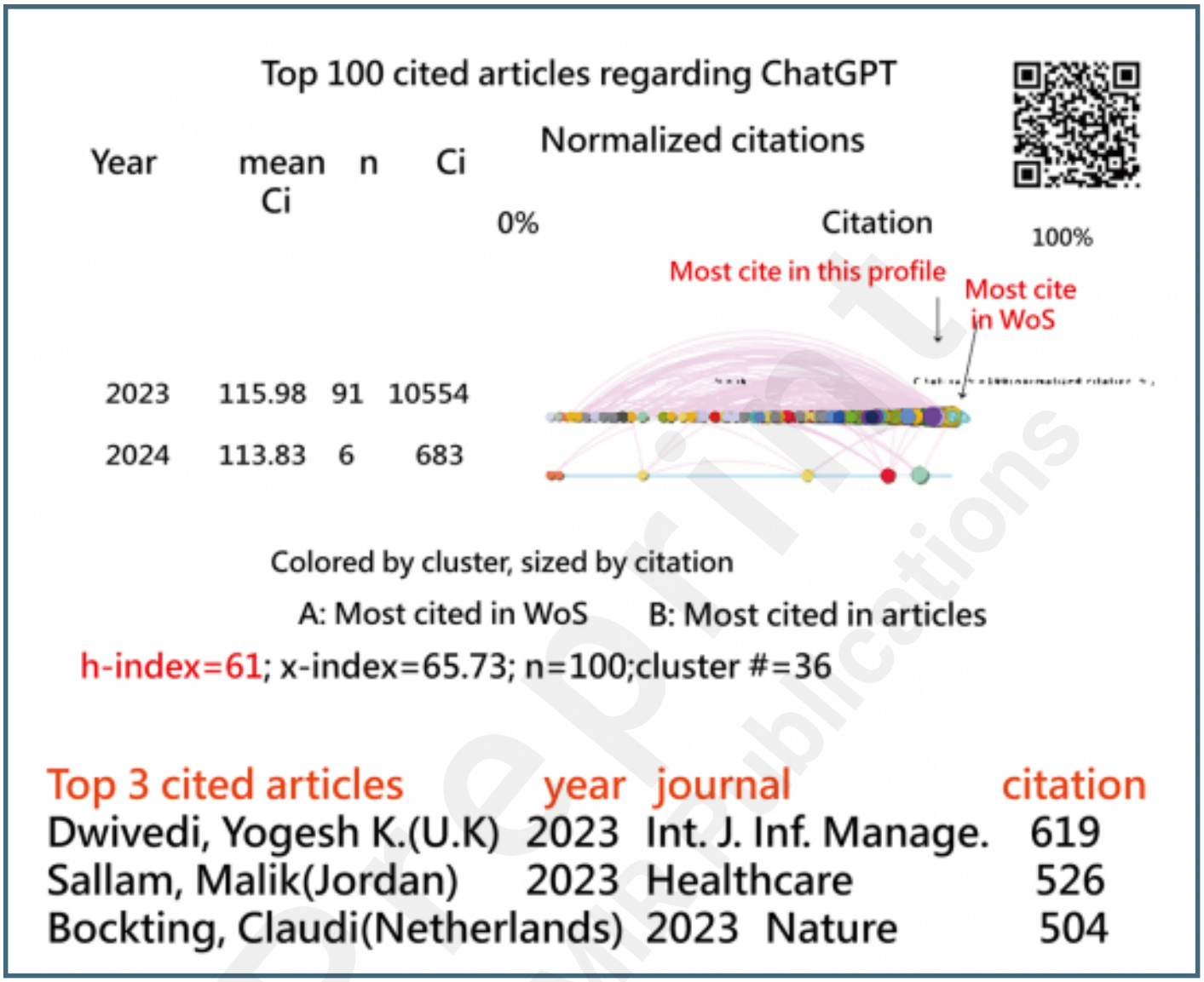
Top 10 authors	n	cluster	link
Wiwanitkit, Viroj(India)	26	1	2
Kleebayoon, Amnuay(India)	16.5	1	2
Kleebayoon, Amnuay(Cambodia)	11	1	1
Daungsupawong, Hinpetch(India)	20	2	2
Daungsupawong, Hinpetch(Laos)	10	2	1
Ray, Partha Pratim(India)	11.5	3	0
Surapaneni, Krishna Mohan(India)	5	4	0
Egro, Francesco M.(U.S)	5	5	0
Seth, Ishith(Australia)	4.5	6	0
Dwivedi, Yogesh K.(U.K)	0.5	7	1
Dwivedi, Yogesh K.(Australia)	0.5	7	1

Thematic map for coword keywords.

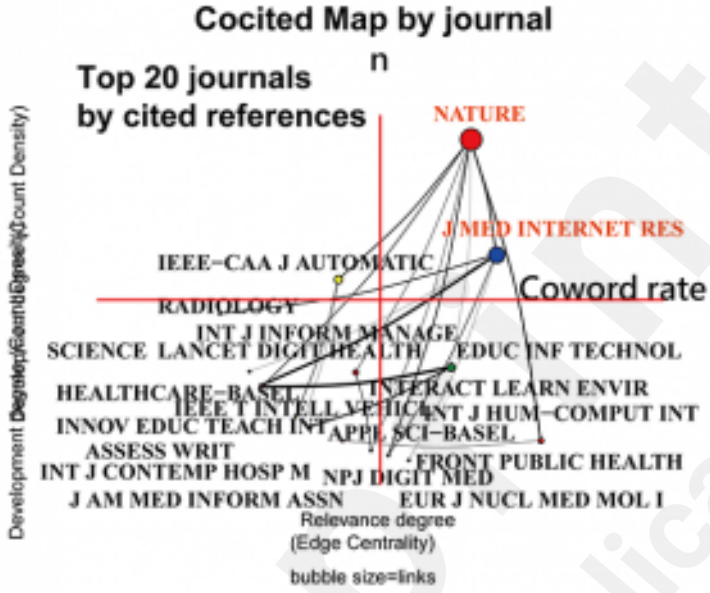


Journal	n	cluster	link
ARTIFICIAL-INTELLIGENCE	51.97	1	8
AI	7.36	1	1
CHALLENGES	5.74	1	2
HEALTH	5.59	1	1
TECHNOLOGY	5.48	1	3
MODEL	5.33	1	3
GPT-4	5.20	1	1
ACCEPTANCE	4.92	1	1
STUDENTS	4.89	1	1
MANAGEMENT	4.10	1	1
MEDICINE	3.96	1	1
USER ACCEPTANCE	3.66	1	1
HIGHER-EDUCATION	3.57	1	1
IMPACT	9.40	2	2
CARE	3.85	2	1
QUALITY	8.58	3	3
INFORMATION	8.53	3	2
PERFORMANCE	7.35	3	1
INTERNET	6.65	3	1
EDUCATION	6.43	3	1

Top100 cited articles related to ChatGPT since the introduction on November 31, 2022.

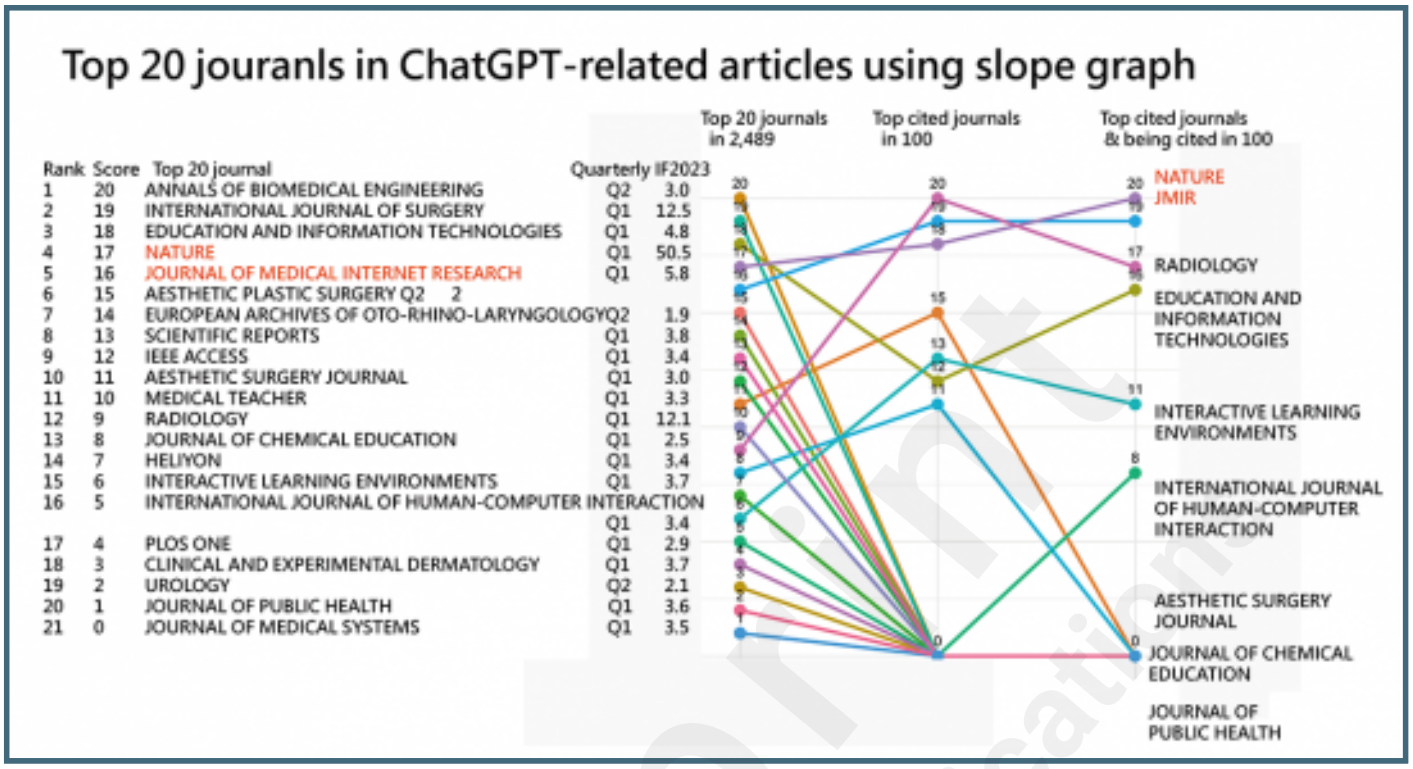


100 top cited articles related to ChatGPT are led by Nature and JMIR.



Journal	n	cluster	link
NATURE	38.83	1	8
IEEE-CAA J AUTOMATIC	24.50	1	3
EDUC INF TECHNOL	15.50	1	3
INT J INFORM MANAGE	15.00	1	2
HEALTHCARE-BASEL	13.50	1	1
INTERACT LEARN ENVIR	13.50	1	1
IEEE T INTELL VEHICL	10.50	1	1
INNOV EDUC TEACH INT	10.00	1	1
INT J HUM-COMPUT INT	9.50	1	1
FRONT PUBLIC HEALTH	8.00	1	2
APPL SCI-BASEL	8.00	1	1
INT J CONTEMP HOSP M	7.00	1	1
ASSESS WRIT	7.00	1	1
EUR J NUCL MED MOL I	6.50	1	1
J MED INTERNET RES	27.00	2	6
RADIOLOGY	21.00	2	1
SCIENCE	15.09	2	1
LANCET DIGIT HEALTH	13.65	2	1
NPJ DIGIT MED	6.50	2	1
J AM MED INFORM ASSN	6.00	2	1

Top 20 journals in ChatGPT-related articles using the slope graph to display.



Rank	Score	Top 20 journal	Quarterly	IF2023
1	20	ANNALS OF BIOMEDICAL ENGINEERING	Q2	3.0
2	19	INTERNATIONAL JOURNAL OF SURGERY	Q1	12.5
3	18	EDUCATION AND INFORMATION TECHNOLOGIES	Q1	4.8
4	17	NATURE	Q1	50.5
5	16	JOURNAL OF MEDICAL INTERNET RESEARCH	Q1	5.8
6	15	AESTHETIC PLASTIC SURGERY	Q2	2
7	14	EUROPEAN ARCHIVES OF OTO-RHINO-LARYNGOLOGY	Q2	1.9
8	13	SCIENTIFIC REPORTS	Q1	3.8
9	12	IEEE ACCESS	Q1	3.4
10	11	AESTHETIC SURGERY JOURNAL	Q1	3.0
11	10	MEDICAL TEACHER	Q1	3.3
12	9	RADIOLOGY	Q1	12.1
13	8	JOURNAL OF CHEMICAL EDUCATION	Q1	2.5
14	7	HELIYON	Q1	3.4
15	6	INTERACTIVE LEARNING ENVIRONMENTS	Q1	3.7
16	5	INTERNATIONAL JOURNAL OF HUMAN-COMPUTER INTERACTION	Q1	3.4
17	4	PLOS ONE	Q1	2.9
18	3	CLINICAL AND EXPERIMENTAL DERMATOLOGY	Q1	3.7
19	2	UROLOGY	Q2	2.1
20	1	JOURNAL OF PUBLIC HEALTH	Q1	3.6
21	0	JOURNAL OF MEDICAL SYSTEMS	Q1	3.5

Multimedia Appendixes

(XLSX) Data used in this study.
URL: http://asset.jmir.pub/assets/dba00f5dedd4cd17d59e73a67a6f609f.xlsx

(PDF) How to conduct this study.
URL: http://asset.jmir.pub/assets/e8b3687caad6ae875e32c8418e4a25d0.pdf