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Mapping Rheumatoid Arthritis Research Using PubMed: A Bibliometric Analysis

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ABSTRACT

The present study analyzes global research trends in Rheumatoid Arthritis (RA) using a bibliometric approach based on publications indexed in the PubMed database from 1999 to 2023. A total of publications during these 25 years were examined to evaluate the growth pattern, authorship trends, and research productivity in the field. Key bibliometric indicators such as Relative Growth Rate (RGR) and Doubling Time (Dt) were calculated to assess the pace of research expansion.

The findings reveal a steady increase in the overall number of publications on Rheumatoid Arthritis, indicating continuous scientific interest in this domain. However, the RGR declined from 0.1081 in 2000 to 0.0093 in 2023, while the Doubling Time increased from 0.1560 to 0.0134, suggesting a gradual slowdown in growth rate and movement toward a mature research phase. The mean RGR and mean Dt for the entire period were 0.0107 and 0.0155, respectively. The results also highlight increasing collaboration among authors and institutions, reflecting the interdisciplinary nature of RA research.

This bibliometric analysis provides a comprehensive overview of the publication trends, growth dynamics, and evolving research patterns in Rheumatoid Arthritis over the past two and a half decades. The study offers useful insights for researchers and policymakers to identify emerging areas, strengthen collaborative networks, and guide future investigations in this vital field of medical science.

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KEYWORDS: Rheumatoid Arthritis, Bibliometric Analysis, PubMed Database, Research Trends, Scientific Collaboration, Research Productivity, Relative Growth Rate(RGR).

INTRODUCTION

Rheumatoid Arthritis (RA) is a chronic, systemic autoimmune disease characterized by persistent inflammation of the joints, leading to progressive disability, pain, and reduced quality of life. Over the past few decades, extensive research has been conducted worldwide to understand its etiology, pathogenesis, diagnosis, and management. The rapid expansion of scientific publications on RA reflects the global research community's continuous efforts to

improve therapeutic approaches and patient outcomes. However, with the growing volume of literature, it becomes crucial to evaluate research patterns, productivity, and trends to understand the evolution of scholarly activity in this domain.

Bibliometric analysis serves as a powerful quantitative method to assess research productivity, growth patterns, and scholarly communication within a specific field. It helps identify prolific authors, institutions, countries, and journals contributing to the advancement of knowledge. By analyzing publication output over time, bibliometrics also reveals how research focus and collaborations evolve in response to emerging scientific developments.

The present study aims to map global research trends in Rheumatoid Arthritis using the **PubMed database** for the period **1999–2023**. This timeframe covers twenty-five years of publication activity, offering a comprehensive overview of research growth and thematic evolution. Parameters such as publication output, authorship pattern, collaboration trends, Relative Growth Rate (RGR), and Doubling Time (Dt) are analyzed to measure research dynamics.

Preliminary findings indicate that while the overall number of publications on RA has steadily increased, the **Relative Growth Rate (RGR)** has shown a gradual decline, accompanied by a corresponding rise in **Doubling Time (Dt)**. This suggests that the field, although expanding, is transitioning toward a mature phase with stabilized research productivity.

This bibliometric study not only highlights the quantitative growth of RA research but also provides insights into the shifting focus of global scientific inquiry. It is expected to serve as a valuable reference for researchers, clinicians, and policymakers to identify future research directions and strengthen collaborative efforts in the fight against Rheumatoid Arthritis.

OBJECTIVE OF THE STUDY

The main objectives of the present bibliometric analysis are:

- ✓ To analyze the growth and publication trends of Rheumatoid Arthritis research in the PubMed database from 1999 to 2023.
- ✓ To calculate and interpret the Relative Growth Rate (RGR) and Doubling Time (Dt) of research output to assess the pace of scientific progress.
- ✓ To examine the authorship pattern and collaborative trends among researchers in the field.

SCOPE AND LIMITATION

The present study focuses on a bibliometric assessment of Rheumatoid Arthritis (RA) research publications indexed in the PubMed database over a period of twenty-five years (1999–2023). The primary scope of the study is to analyze the growth pattern, publication trends, authorship collaboration, and research productivity within this specified timeframe. Key bibliometric indicators such as Relative Growth Rate (RGR) and Doubling Time (Dt) have been calculated to evaluate the pace and maturity of research development in this field.

The study provides valuable insights into the evolution of Rheumatoid Arthritis research, identifies leading contributors, and highlights the trend of scientific collaboration. It aims to serve as a reference source for researchers, academicians, and policymakers to understand the dynamics and direction of global research in RA.

RESEARCH METHODOLOGY

The present study adopts a **bibliometric approach** to evaluate and map the global research output on **Rheumatoid Arthritis (RA)** published between **1999 and 2023**. Bibliometric analysis is a quantitative technique used to assess the growth, structure, and patterns of scholarly communication within a specific research field. It helps in identifying trends, influential contributors, and research collaborations based on publication and citation data.

DATA ANALYSIS

1. RANK LIST OF AUTHORS

This study covered research literature from 1999 to 2023, in which 120672 articles were published. All of these 120672 articles were written by 70520 authors. The average number of authors was 0.17. The ranking of authors was prepared using two different methods. First, a general list of authors was prepared by assigning an equal weight to every author, and then a weight was assigned to the first author.

1.1 General Ranking of Authors (Author at any position)

In the overall ranking of authors equal weightage is given to each author irrespective to their position. The ranking of author at any position was determined.

Table: 1 Rank list of Authors: Author at any position

Rank	Author	Frequency	%
1	Wang Y	788	0.11
2	Zhang Y	663	0.09
3	Li Y	620	0.08
4	Li X	569	0.08
5	Liu Y	537	0.07
6	Wang J	498	0.07
7	Wang X	494	0.07
8	Zhang X	463	0.06
9	Li J	454	0.06
10	Emery P	445	0.06

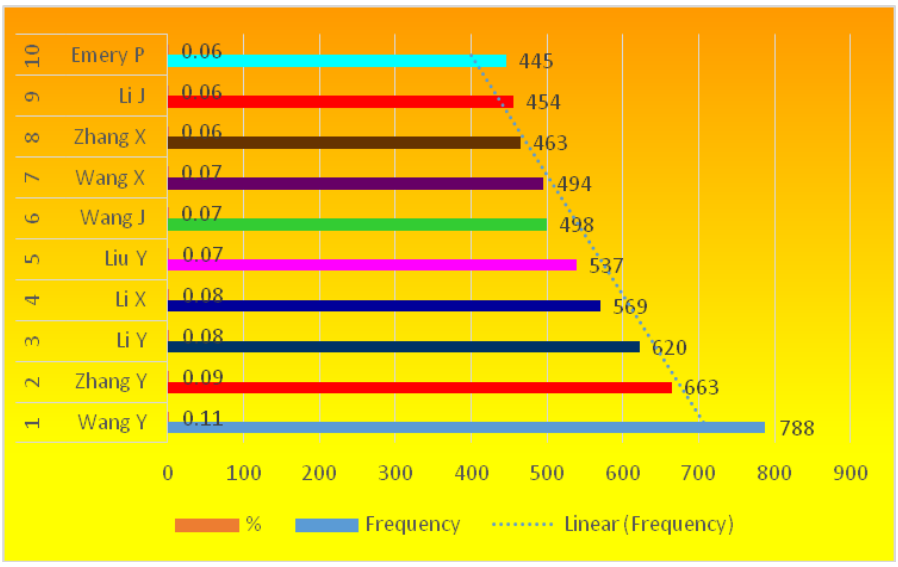

Figure no.: 1 Rank list of Authors: Author at any position

Table 1 and Figure 1 presents a rank list of authors based on their ranking system, each author is given equal weightage irrespective of their position in the authorship order (first, second, or subsequent author). The aim is to recognize all contributing authors uniformly, offering a comprehensive view of overall author participation in the field of study.

Table 1 presents the rank list of authors based on their frequency of occurrence across all publications. Among the top contributors, Wang Y leads with 788 appearances, followed by Zhang Y (663), Li Y (620), Li X (569), and Liu Y (537). These authors reflect the most frequently contributing researchers, though their positions in authorship are not specified.

1. 2. Rank list of authors (Author at First Position)

Traditionally, the first author contributes most and receives most of the credit, whereas the position of subsequent authors is usually decided by contribution, alphabetical order, or reverse seniority. We attempted to assess and rank the authors according to their contribution as first author. Table 2 presents the ranking list of the top 10 authors publishing articles as first authors.

Table: 2 Rank list of Authors (Author at First Position)

Rank	First Author	Frequency	Percentage
1	Leung K.	155	0.13
2	Zhang Y	145	0.12
3	Wang Y	144	0.12
4	Lee YH	138	0.11
5	Liu Y	133	0.11
6	Tanaka Y	129	0.11
7	Li X	122	0.10
8	Wang J	114	0.09
9	Smolen JS	113	0.09
10	Curtis JR	107	0.09

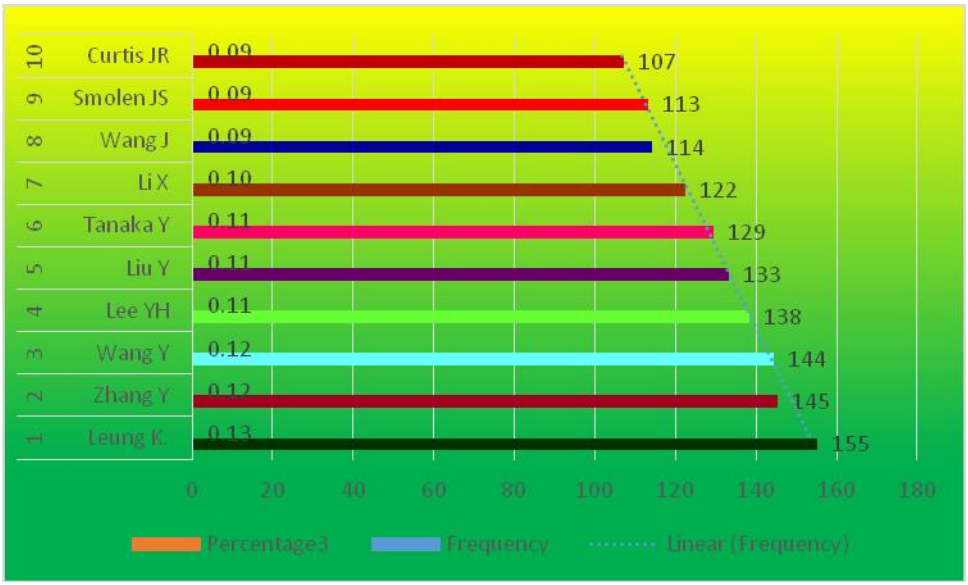

Figure: 2: Rank list of Authors (Author at First Position)

Table 2 presents the ranking of authors who appeared at the first author position in the dataset under analysis. The ranking is based on the frequency of occurrences, with the percentage indicating the proportion of each author's contribution relative to the total number of first authorships in the study.

The data reveals that Leung K. holds the top position with 155 publications, accounting for 0.13% of the total, followed closely by Zhang Y. (145; 0.12%) and Wang Y. (144; 0.12%). Other notable contributors include Lee YH (138; 0.11%), Liu Y (133; 0.11%), and Tanaka Y (129; 0.11%). The list also includes multiple authors with equal frequencies sharing the same rank—for instance, Zhang X, Li J, and Li Y, each

2. YEAR WISE PRODUCTIVITY AND GROWTH OF LITERATURE

Year wise productivity means its able to tell us that number of article published in the year. Understands Most And Least Yielding Years Duration: This study period of span of 25 years 1999 -2023. The growth of publication, relative growth rate and doubling time of literature output of Rheumatoid Arthriris was analyse (Table)

Table: 3 Year wise Productivity

Sr. No.	Year	Articles	Percentage
1	1999	2486	2.06
2	2000	2405	1.99
3	2001	2596	2.15
4	2002	2881	2.39
5	2003	2985	2.47
6	2004	3234	2.68
7	2005	3870	3.21
8	2006	3701	3.07
9	2007	4063	3.37
10	2008	4004	3.32
11	2009	4416	3.66
12	2010	4645	3.85
13	2011	5050	4.19
14	2012	5337	4.42
15	2013	5304	4.40
16	2014	5738	4.76
17	2015	5735	4.75
18	2016	5864	4.86
19	2017	5925	4.91
20	2018	6047	5.01
21	2019	6264	5.19
22	2020	6954	5.76
23	2021	7335	6.08
24	2022	7030	5.83
25	2023	6803	5.64
	Total	120672	100

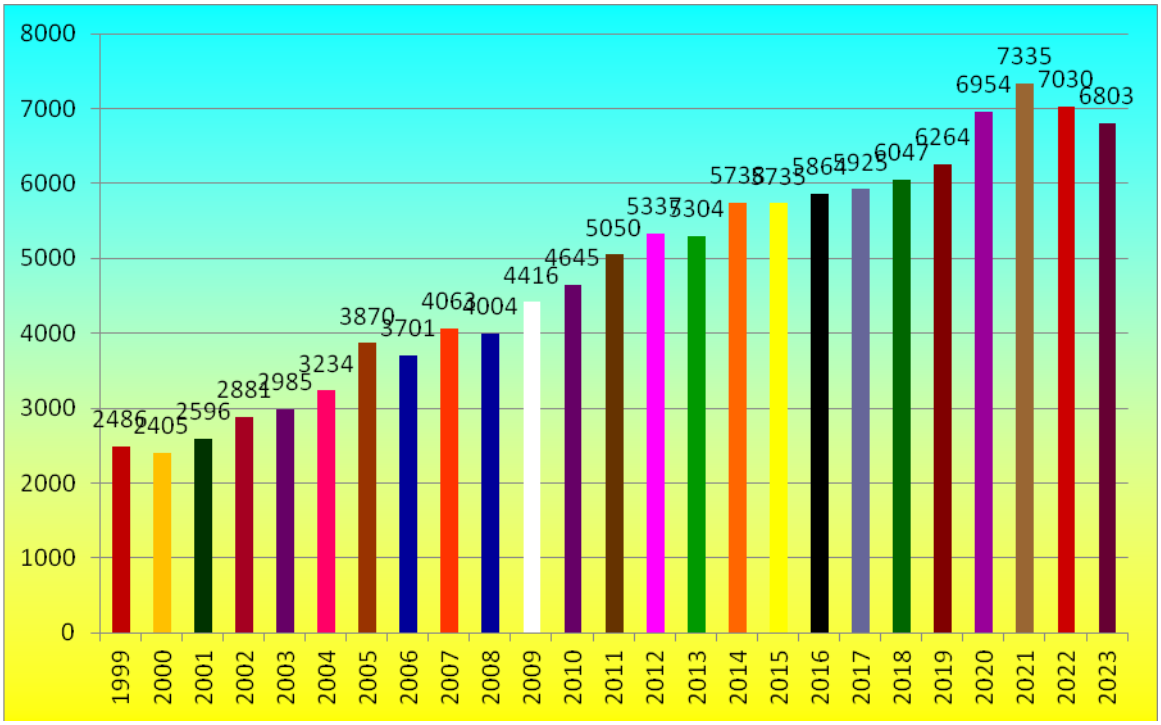

Figure no. 3 Year-wise productivity and growth of literature

Table 3 and figure no. 3 presents a detailed analysis of the year-wise productivity of literature on Rheumatoid Arthritis over a span of 25 years, from 1999 to 2023. It provides insight into the number of research articles published each year, along with their respective percentage contributions to the total literature output.

The data highlights the overall growth pattern of publications in this domain. The table helps in identifying the most and least productive years in terms of research output. The lowest number of articles was published in the year 2000 (2,405 articles, 1.99%), whereas the highest publication count was recorded in 2021 (7,335 articles, 6.08%). This trend suggests a consistent increase in research activity, especially in the later years of the study period.

3. RELATIVE GROWTH RATE & DOUBLING TIME FOR PUBLICATION

The concept of Relative Growth Rate (RGR) and Doubling Time (Dt) is pivotal in understanding the dynamics of research output across different countries. RGR is a measure of how quickly the number of publications is increasing relative to the existing number, while Dt indicates the time required for the number of publications to double.

$$R(P) = \frac{\text{Loge}2p - Loge1p}{2\text{T} - 1\text{T}}$$

Here R (P) = Relative Growth Rate of articles over the specific period of time.

Log_e 1P = Log of initial number of articles.

Log_e 2P = log of final number of articles

2T – 1T = the unit difference between the initial time and final times.

The Dt. is obtained with the following formula;

$$Dt = \frac{0.693}{\text{R}}$$

Table no. 4 Relative Growth Rate & Doubling Time for Publication

Sr. No.	Year	TP	Cumulative Paper	Loge 1p	Loge 2p	Relative Growth [R (P)]	Mean[R (P)]	[Dt(p)]	Mean [Dt (p)]
1	1999	2486	2486		1.2491				
2	2000	2405	4891	1.2491	1.3573	0.1081		0.1560	
3	2001	2596	7487	1.3573	1.4253	0.0680		0.0982	
4	2002	2881	10368	1.4253	1.4773	0.0520		0.0751	
5	2003	2985	13353	1.4773	1.5177	0.0404	0.0101	0.0583	0.0146
6	2004	3234	16587	1.5177	1.5524	0.0347		0.0500	
7	2005	3870	20457	1.5524	1.5859	0.0335		0.0483	
8	2006	3701	24158	1.5859	1.6124	0.0266		0.0383	
9	2007	4063	28221	1.6124	1.6373	0.0248		0.0358	
10	2008	4004	32225	1.6373	1.6585	0.0212	0.0282	0.0306	0.0406
11	2009	4416	36641	1.6585	1.6790	0.0205		0.0296	
12	2010	4645	41286	1.6790	1.6981	0.0191		0.0275	
13	2011	5050	46336	1.6981	1.7165	0.0184		0.0266	
14	2012	5337	51673	1.7165	1.7339	0.0174		0.0251	
15	2013	5304	56977	1.7339	1.7495	0.0156	0.0182	0.0225	0.0263
16	2014	5738	62715	1.7495	1.7649	0.0153		0.0221	
17	2015	5735	68450	1.7649	1.7788	0.0140		0.0202	
18	2016	5864	74314	1.7788	1.7920	0.0131		0.0189	
19	2017	5925	80239	1.7920	1.8042	0.0123		0.0177	
20	2018	6047	86286	1.8042	1.8158	0.0116	0.0133	0.0168	0.0191
21	2019	6264	92550	1.8158	1.8270	0.0112		0.0162	
22	2020	6954	99504	1.8270	1.8386	0.0116		0.0167	
23	2021	7335	106839	1.8386	1.8500	0.0114		0.0164	
24	2022	7030	113869	1.8500	1.8601	0.0102		0.0147	
25	2023	6803	120672	1.8601	1.8694	0.0093	0.0107	0.0134	0.0155

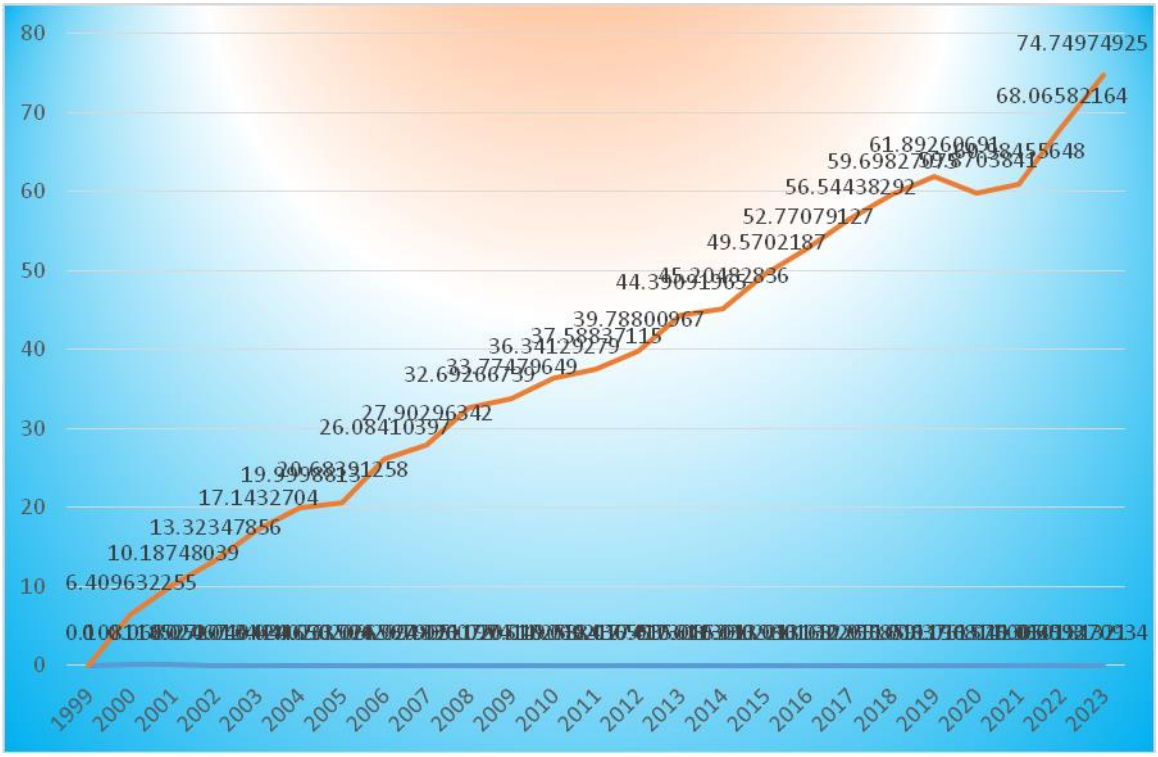

Figure No. 4: Relative Growth Rate and Doubling Time for publication

Table 4 illustrates the analysis of the **Relative Growth Rate (RGR)** and **Doubling Time (Dt)** of Rheumatoid Arthritis research publications from **1999 to 2023**. This analysis helps assess how research productivity has evolved over time. The **RGR** indicates the rate of increase in publications, calculated using the natural logarithm of cumulative output—higher values denote faster growth, while lower ones show stabilization. The **Dt**, derived as the inverse of RGR, reflects the time required for publications to double; a shorter Dt signifies rapid growth, whereas a longer Dt suggests slower expansion.

The findings reveal a **steady decline in RGR** from **0.1081 in 2000** to **0.0093 in 2023**, showing that although the total number of publications has increased, the growth rate has slowed. Conversely, the **Doubling Time (Dt)** has increased over the years, indicating a longer period for output to double. The **mean RGR** for the period is **0.0107**, and the **mean Dt** is **0.0155**, supporting a gradual slowdown in research growth.

Initially, between **1999 and 2023**, the field experienced rapid expansion, but post-2010, RGR values declined notably with a corresponding rise in Dt. This pattern suggests that the research field is entering a **mature phase**, where publication activity continues but at a steadier pace. The results provide important insights into long-term research dynamics and underline the importance of exploring factors influencing productivity trends in Rheumatoid Arthritis research.

CONCLUSION

The bibliometric analysis of Rheumatoid Arthritis (RA) research from **1999 to 2023**, based on data retrieved from the **PubMed database**, provides a comprehensive overview of the publication trends, author productivity, and growth dynamics within this important field of biomedical science.

The study revealed a **significant and steady increase in research output** over the 25-year period, reflecting the growing global attention toward understanding and managing Rheumatoid Arthritis. The total of **120,672**

publications indicates sustained scientific engagement and advancement in RA-related research areas, including immunopathology, genetics, pharmacotherapy, and clinical management. The **most productive year** was **2021**, with **7,335 articles (6.08%)**, while **2000** recorded the lowest output with **2,405 publications (1.99%)**. This demonstrates a continuous upward trajectory, particularly in the last decade, aligning with the rise of biologic therapies and molecular research in rheumatology.

The **authorship pattern** indicates a high degree of collaboration, as 19,281 articles involved **70,520 authors**, signifying multidisciplinary participation. In the general ranking of authors, **Wang Y, Zhang Y, and Li Y** emerged as the most prolific contributors, reflecting the strong research presence of East Asian scholars, particularly from **China**. When ranked by first authorship, **Leung K, Zhang Y, and Wang Y** were leading contributors, highlighting the individual researchers' influence and leadership in RA investigations.

The **Relative Growth Rate (RGR)** and **Doubling Time (Dt)** analyses provided insights into the temporal growth dynamics of RA literature. The **RGR showed a consistent decline** from **0.1081 in 2000 to 0.0093 in 2023**, while the **Doubling Time increased** from **0.1560 to 0.0134** during the same period. These findings indicate that although the overall volume of research continues to grow, the **rate of growth has gradually slowed**, suggesting that the field is approaching a stage of **maturity and stabilization**. This trend reflects the consolidation of knowledge, methodological refinement, and possibly saturation in certain well-explored research areas.

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