Mapping of Scholarly Research in Open Science: A Scientometrics Study-1979 to 2024

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Abstract

This study attempts to assess the patterns of authorship and collaboration in the open science sector from 1979 to 2024. A total of 1459 research articles were published during this period, of which 385 were published by single authors, 58 articles without any authorship, and the remaining 1016 articles were published jointly by two or more authors. These observations indicate that the pattern of multi-authorship is dominant in the open science sector. The study also found that about 59 percent of research articles were published between 2021 and 2024, compared to 38.54 percent in the previous decade from 2011 to 2020.

Keywords: Relative Growth Rate, Doubling Time, Authorship Pattern, Collaboration Index, Degree of Collaboration, Collaboration Coefficient

Introduction

The global scientific community is moving towards 'open science'. Open science is a movement that seeks to make scientific research, data, code and publications openly available to everyone. The aim of this movement is to make scientific knowledge more accessible and effective, as well as to increase transparency, collaboration and reproducibility of experiments. It emphasizes making scientific information and research easily accessible to every curious person in society. (Orion Open Science)

In recent times scientometrics study is an integral part of library and information science research. Scientometrics analysis is the quantitative analysis of a particular scientific research area. It will help to critically review the growth, patterns and impact of the research publications concerned with the research area under study. Recent developments in visualization mapping tools have helped to validate a large amount of bibliographic data to analyse and understand thoroughly. Thus the present study on Open Science is conducted using the scientometric methods. (Shettar & Hadagali, 2022)

Objectives of Study

The main objectives of the present study of open science research are to:

1. To find out of year wise research publication of Open science during the 1979 to 2024.
2. To measure the relative growth rate and doubling time of open science research.
3. To analyze authorship patterns, collaboration status, collaboration index, and collaboration coefficient over the study period.

Methodology

A sientometric study is statistical study of counting to examine the growth of subject. The present study based on 1459 articles published on open science between the years 1979 to 2024. The data was downloaded from the Scopus database. For downloading the data the search term applied was "open science". The data were analysed with the help of MS-Excel software.

Literature Review

Wu, Y., et all. (2023) This scientific analytical study reviews global research on the foot and ankle from 1980 to 2019. In particular, there has been a significant increase in research in the last decade, with the United States contributing the most, both quantitatively and qualitatively. This study serves as a cornerstone for further research.

Vaitsi, G. A et all (2024)This study conducted a scientometric analysis of the scientific literature in the field of veterinary and animal sciences. It evaluated 163 research papers from 1988 to 2024 to track global research trends across countries, institutions, animal species, and research topics. This type of analysis is useful for understanding the quality and direction of research.

Basumatary et al. (2023b)This study reviews the progress of genomics research in India through scientific analysis. India contributed 4.46% of global research between 2012 and 2021. ICAR and DBT were the major research and funding contributors. The study provides an in-depth analysis of research collaborations, trends in the subject matter, and impactful publications.

Alotaibi et al. (2025)conducted an in-depth study on the concepts of Sensory Integration Theory (SIT) and Sensory Processing Measure (SPM) based on scientific and narrative analysis. A total of 238 research records from 1983 to 2024 were studied using CiteSpace and VOSviewer software. This included differences in sensory processing between children with and without autism, classroom behavior, use of EEG technology, and various treatment modalities.

Shukla and Verma (2019)This scientific analysis by has conducted an in-depth study of the progress of digital library research in India from 1989 to 2018. The year of publication, document type, level of author

collaboration (0.81), and key researchers were reviewed by studying 1068 publications on the Scopus database. This study is important for understanding the direction of Indian research on digital libraries.

Ay et al. (2022)This study compared the publication policies and scientific indices of 48 ophthalmology journals. The performance of full open access (OA) and hybrid OA models was evaluated using Journal Impact Factor (JIF), SJR, Eigenfactor Score (ES), and Hirsch Index (HI). In conclusion, although the OA model did not provide significant benefits, some hybrid OA journals did have more cited articles.

Rajavi et al. (2023)This research paper conducted a scientific analysis of global scientific publications in the field of glaucoma based on Scopus and Web of Science databases. Five major subject areas (such as intraocular pressure, optic disc) were identified through synonym analysis. Universities and researchers in the United States emerged as the leaders. This study highlights research trends and future research needs.

Table No 1

Year wise Document Publications on Open Science

Sr.NO.	Year of Publications	No.Of Publications	Percentage
1	1979 to 2000	4	0.27
2	2001 to 2010	30	2.05
3	2011 to 2020	558	38.24
4	2021 to 2024	867	59.42
	Total	1459	100

Table no. 1 shows of Year wise growth of Publications on Open Science research since 1979 to 2024. Out of the 1459 publications during the study period, Most of research was published in 2021 to 2024 that accounts for almost 59 percentage and followed by 38.54% research publications in the year of 2011- 2020. The lowest research was published in 2021 to those accounts for 027%.
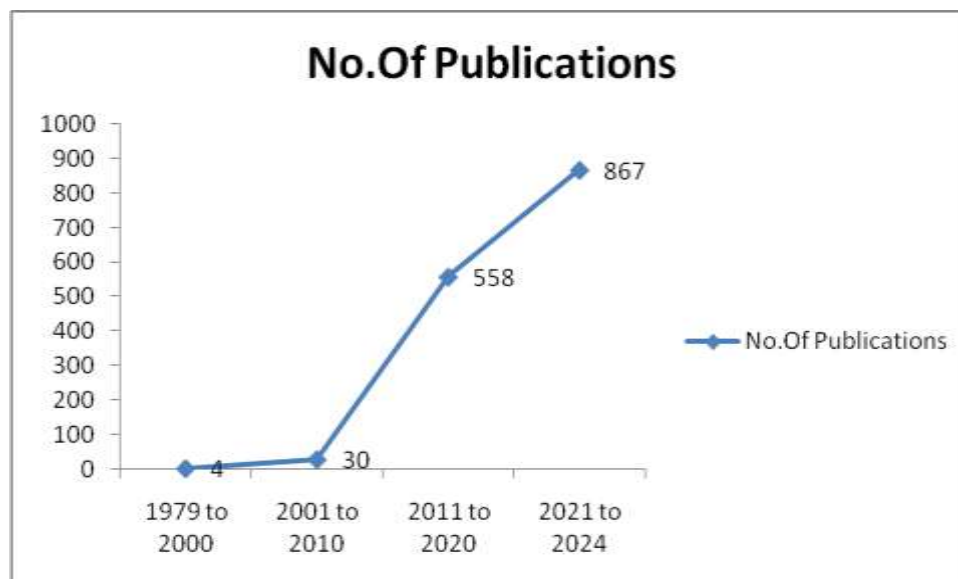
Table No 2
Relative Growth Rate and Double Time of Publication

| Publication Year	No. Of Publication	Total Number of Articles	Log^{1e}	Log^{2e}	RGR	Mean RGR	Double Time	Mean Dt
1979	1	1	0	0	-	0.24	-	2.39
1985	1	2	0	0.69	0		0	
1997	1	3	0.69	1.09	0.4		1.73	
1998	1	4	1.09	1.38	0.29		2.38	
2002	1	5	1.38	1.60	0.22		3.15	
2004	3	8	1.60	2.07	0.47		1.47	
2005	4	12	2.07	2.48	0.41		1.69	
2006	1	13	2.48	2.56	0.08		8.66	
2007	4	17	2.56	2.83	0.27		2.56	
2008	6	23	2.83	3.13	0.3		2.31	
2009	5	28	3.13	3.33	0.2	0.26	3.46	2.76
2010	6	34	3.33	3.52	0.19		3.64	
2011	11	45	3.52	3.80	0.28		2.47	
2012	15	60	3.80	4.09	0.29		2.38	
2013	12	72	4.09	4.27	0.18		3.85	
2014	22	94	4.27	4.54	0.27		2.56	
2015	31	125	4.54	4.82	0.28		2.47	
2016	37	162	4.82	5.08	0.28		2.47	
2017	56	218	5.08	5.38	0.3		2.31	
2018	88	306	5.38	5.72	0.34		2.03	
2019	140	446	5.72	6.1	0.38	0.26	1.82	2.84
2020	146	592	6.1	6.38	0.28		2.47	
2021	205	797	6.38	6.68	0.3		2.31	
2022	195	992	6.68	6.9	0.22		3.15	
2023	229	1221	6.9	7.10	0.2		3.46	
2024	238	1459	7.10	7.28	0.18		3.85	

Double Time of Publication and Relative Growth Rate

Table 2shows that the relative growth rate and doubling time of publications published onopen science1979-2024. It has been noticed that the relative growth rate decreasing from the rate of 0.4 to 0.2 from 1979 to 2024. For the next ten years, 1979-2008, the average relative growth rate was 0.24, while the average growth rate increased to 0.26 in the block 2009-2018. Also, the average growth rate in the next block 2019-2024 is 0.26, which shows an increased growth rate compared to the first block. The corresponding doubling times for different years are gradually increasing from 1.73 to 3.85 from 1979 to 2024. The mean rate of doubling time for the first four years is 2.39. Remaining two blocks for ten and six years has been taken within first a ten-year time span and it increased from 2.76 to 2.84 from 2008 to 2024. The rate of relative growth rate is decreasing when corresponding doubling time is increasing during the study period.

Table No 3

Authorship Pattern on Open Science

Sr.NO.	Authorship Pattern	Number of Articles
1	Single	385
2	Two	287
3	Three	196
4	Four	132
5	Five	95
6	six	58
7	Seven	52
8	Eight	29
9	Nine	24
10	10 TO 20	93
11	21 TO 30	26
12	31 TO 40	7
13	41 TO 50	3
14	51 TO 60	8
15	More Than 60	6
16	NA	58
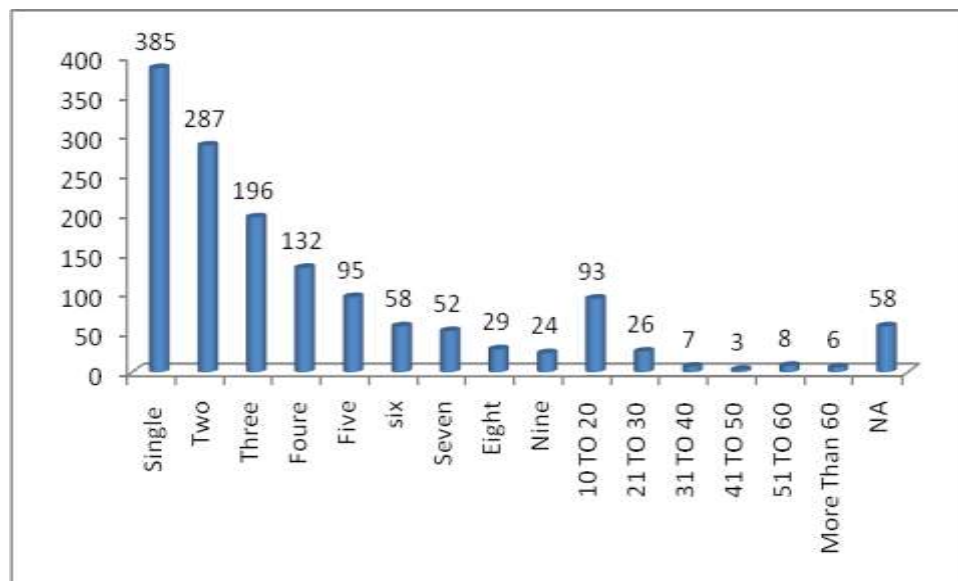
Degree of Collaboration: Table No. 4 displays the authors' degree of collaboration. K. Subramaniam used the following formula to find the Degree of Collaboration in open science research articles.

$$DC = \frac{Nm}{Nm + Ns}$$

$$DC = \frac{14}{14 + 16}$$

$DC = 0.46$

During the 1979–2024 study period, the average degree of collaboration was 0.72. 2021–2024 has the most average degree of collaboration, at 0.75, while 2011–2020 has the second-highest, at 0.69. Between 1979 and 2000, the average level of collaboration was at its lowest, at zero.

Table No 4
Degree of Collaboration

Sr. NO.	Year of Publications	Single Authored Paper (Ns)	%	Multi authored Paper (Nm)	%	Ns+Nm	DC
1	1979 to2000	4	1.0	0	0	4	0
2	2001 to 2010	16	4.1	14	1.3	30	0.46
3	2011 to 2020	160	41.5	370	36.4	530	0.69
4	2021 to 2024	205	53.2	632	62	837	0.75
	Total	385	100	1016	100	1401	0.72

Collaboration Index (CI):

Table 5 shows that the collaboration index of the publications which are published during the study period. The average collaboration index 3.13 has been counted during the study period 1979-2024. The highest collaboration index3.35 found in the year 2021-2024 and the lowest collaboration index 1found in the year 1979 to 2000. The collaboration Index counted by the formula which is suggested by the Lawani (1980) as:

$$CI = \frac{\sum_{j=1}^{A} jfj}{N}$$

$$CI = \frac{(1 \times 16) + (2 \times 5) + (3 \times 2) + (4 \times 2) + (5 \times 0) + (6 \times 5)}{30}$$

$$CI = \frac{(16) + (10) + (6) + (8) + (0) + (30)}{30}$$

$$CI = \frac{70}{30}$$

Collaboration Index (CI)=2.33

Table No.5
Collaboration Index

Sr. NO.	Year of Publications	Authorship Pattern						Total	Collaboration Index
		Single Authored Paper	Two Authored Paper	Three Authored Paper	Four Authored Paper	Five Authored Paper	More Than Five Authored Paper		
1	1979 to2000	4	0	0	0	0	0	4	1
2	2001 to 2010	16	5	2	2	0	5	30	2.33
3	2011 to 2020	160	127	79	55	25	84	530	2.83
4	2021 to 2024	205	155	115	75	70	217	837	3.35
	Total	385	287	196	132	95	306	1401	3.13

Collaboration Coefficient

Table 6 has been shaped with the assessment to give a better understanding of collaboration coefficient during the period of study.Most of research was published in 2021 to 2024 that accounts for almost 59 percentages. The average collaboration coefficient 0.50 has been counted during the year 1979-2024. The highest collaboration coefficient is counted in the year 2021-24 with 0.53, followed by the year 2011-20 with 0.46 and the lowest collaboration coefficient is in the year 1979-2000 with 0. The collaboration coefficient (CC) counted by the formula suggested by the Ajiferuke et al. (1988) as mention below:

$$CI = \frac{\sum_{j=1}^{A} \left(\frac{1}{j}\right) fj}{N}$$

$$\text{Collaboration Coefficient} = 1 - \frac{\left(\frac{1}{1} \times 16\right) + \left(\frac{1}{2} \times 5\right) + \left(\frac{1}{3} \times 2\right) + \left(\frac{1}{4} \times 2\right) + \left(\frac{1}{5} \times 0\right) + \left(\frac{1}{6} \times 5\right)}{30}$$

$$\text{Collaboration Coefficient} = 1 - \frac{(16) + (2.5) + (0.66) + (0.5) + (0) + (0.83)}{30}$$

$$\text{Collaboration Coefficient} = 1 - \frac{20.49}{30}$$

Collaboration Coefficient $= 0.32$

Table No 6
Collaboration Coefficient

Sr. NO.	Year of Publications	Authorship Pattern						Total	Collaboration Coefficient
		Single Authored Paper	Two Authored Paper	Three Authored Paper	Four Authored Paper	Five Authored Paper	More Than Five Authored Paper		
1	1979 to2000	4	0	0	0	0	0	4	0
2	2001 to 2010	16	5	2	2	0	5	30	0.32
3	2011 to 2020	160	127	79	55	25	84	530	0.46
4	2021 to 2024	205	155	115	75	70	217	837	0.53
	Total	385	287	196	132	95	306	1401	0.50

Conclusion:

Open science refers to the movement that aim to make research data, code and research publication freely accessible to everyone without barriers. Total number of research literature published in "open science" from the web of science for the year 1979 to 2024 was 1459. Single authorship is 385 and multiple authorship patterns are 1016. The degree of collaboration is at 0.72. Relative growth rate for open science decreased 0.4 to 0.18 for the year 1979 to 2024. The doubling Time has increased from 1.73 to 3.85. The study of authorship pattern shows the majority of multiple authored papers in open science literature.

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