Authorship Collaboration of Scientific Publications on Spinal Stenosis: A Scientometric Study

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ABSTRACT-

The study concentrated on authorship patterns and collaboration in spinal stenosis exploration as reflected in the Web of Science database for 2017 – 2021. The data was interpreted using software similar to Bibexcel and Vosviewer and tabulated using MS Excel. The results indicated that 3044 papers were published during 2017 – 2021, and the loftiest number of publications, 667(21.91), was produced in 2020. The study uses colorful scientometrics approaches to present authorship and cooperative patterns for authors, keywords, time series analysis, Relative growth rate and doubling time, and co-authorship indicator. We find multi- and mega-author benefactions that are added and dominate the Spinal stenosis exploration. In the case of cooperative patterns, we set up a domestic collaboration, which dominates the spinal stenosis exploration compared to transnational collaborations. The publication geste of experimenters shows that they're primarily picky in publishing the exploration results in specialized papers. The collaborative indicator (5.008) was produced in 2020. And also, collaborative co-efficient papers have increased (0.76) thrice in 2017, 2020, and 2021.

Keywords: Scientometric, Spinal Stenosis, Surgery, Low back pain, Web of

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INTRODUCTION

Scientometrics is the field of study concerned with measuring and analyzing scholarly literature. Scientometrics is a sub-field of informetrics. Major research issues include:

- Measuring the impact of research papers and academic journals.
- Understanding scientific citations.
- Using such measurements in policy and management contexts.

The method overlaps significantly with other scientific areas, such as knowledge systems, information science, and the science of science procedure, sociology, and metascience. Critics have reasoned that over-reliance on scientometrics has developed a system of depraved incentives, producing a publish-or-perish environment that leads to low-quality research.

Spinal stenosis, which can stress the spinal cord and nerves within the backbone, typically appears in the neck and lower back. It's often caused by age-related wear and tear and injury. If manifestation occurs, they may have discomfort, numbness, muscle fault, and bladder or bowel management issues. It's important to note that treatment options for spinal stenosis include medication, activity modification, and potentially surgery.

The most common cause of spinal stenosis is wear-and-tear changes related to arthritis. However, there's hope for those with severe cases. Surgery, a potential treatment option, can create more space inside the spine. This can significantly ease the symptoms caused by pressure on the spinal cord or nerves, offering potential relief.

Spinal stenosis arises when one or more bony openings (foramina) within the backbone begin to check and lower the area for the nerves. This method can appear within the spinal canal (where the spinal cord operates down the center) and in the intervertebral foramina, where spinal nerves retreat the spinal canal. Depending on the area and how much narrowing appears over time, a spinal nerve or the spinal cord could evolve compressed and cause pain, tingling, numbness, and feebleness.

Range of Spinal Stenosis Signs and Symptoms
Spinal stenosis can significantly differ from person to person. Indications and manifestations may have one or more of the following:

Pain: The ache might be dull and specific to the narrow or lower back, or it could be an electric-like pain radiating into the arm(s) or leg(s). The discomfort can vary over time, possibly flaring up during certain activities. Sometimes, it is more of a pins-and-needles tingling sensation.

Numbness: Decreased sensation or total numbness may occur in the arm, leg, and other body areas.

Weakness: Declined strength or issues with coordination may affect the arm, leg, and other body parts. Powerful compression of the spinal cord or cauda equina (nerve sources running below the spinal cord) could result in bowel and bladder dysfunction.

Spinal stenosis does not always cause pain. While rare, numbness or liability might be current with little or no distress.

REVIEW OF LITERATURE

Konur, O. (2018) conducted a scientometric analysis to assess the distribution and breadth of publications in global spine research. The study utilized a sample of 13,115 papers published between 2004 and 2013. The retrieval process involved accessing "articles" and "reviews" published in English in journals indexed by the primary Web of Science databases from 1980 to 2017. This was achieved by applying an optimized keyword set for paper titles and ten specific spine journals. The research output steadily increased, with the number of papers rising from 1375 in 1980 to 9357 in 2016. Notably, 69.2% of the documents were published after 2000.

The study conducted by Kiliçaslan, Ö. F., Nabi, V., et al. (2021) aimed to perform a bibliometric analysis to discern prevalent trends and focal points in lumbar spinal stenosis (LSS) research over the last decade. The objective was to assist researchers in identifying potential avenues for future exploration. The analysis encompassed all English-language research articles on LSS indexed in the Web of Science database (WoS) between 2010 and 2020. Utilizing CiteSpace, the researchers visualized the network and conducted an in-depth bibliometric analysis, scrutinizing the number of publications, countries, institutions, journals, authors, cited references, and keywords. The study encompassed 4033 papers, comprising 3577 original articles and 476 reviews. It concluded that research on minimally invasive surgery, outcomes, and gene therapies in LSS will likely emerge as prominent areas of focus in the future.

Victoria, P. & Gomathi P (2021) studied to measure the number of contributions and highlight the contributions made by the researchers in the field of leprosy and published on the Web of Science database during 2010-2020 using scientometric analysis. Data were interpreted by using software such as Bibexcel, Vosviewer, and tabulated using MS Excel. The results indicated that 4544 papers were published

during 2010 - 2020 and the highest number of publications 456 (10.03%) was produced in 2020. The study inferred that the rate of growth is relation by the year wise publications of leprosy research.

Research to address its status as a prevalent health concern and the primary indication for spinal surgery. The study aimed to elucidate the comprehensive knowledge structure and developmental trends of LSS through bibliometric analysis and state-of-the-art visualization tools. Research datasets were obtained from the Web of Science, covering the period from 2000 to 2019. VOSviewer and Citespace software were employed for data analysis and the creation of visualization knowledge maps. The study encompassed an analysis of annual publication trends, distribution, H-index status, co-authorship status, and research hotspots, with a total of 1934 publications meeting the specified criteria. It is anticipated that the findings will contribute to the advancement of international LSS research.

Muthu, S., Jeyaraman, M., & Jeyaraman, N. (2022) conducted a bibliometric analysis to examine the landscape of spine surgery research. Their study aimed to provide a comprehensive summary of the research process and identify potential areas for future exploration. The analysis focused on randomized controlled trials (RCTs) published between 1990 and 2019 in spinal surgery, sourced from the Web of Science Core Collection database. The findings revealed vital research domains and hot topics that have the potential to advance the management of degenerative spinal disorders. This research contributes valuable insights for refining future directives and enhancing spinal care practices.

OBJECTIVES OF THE STUDY

This paper aims to understand the Authorship pattern and collaboration in Spinal Stenosis research. The study seeks to achieve these objectives by (i) examining the various Co-authorship patterns and (ii) the type of collaboration in Spinal stenosis research, concen--trating on the Year, Co-authorship index, Time series analysis, Activity index at the global and Indian levels, Degree of collaboration and author wise.

METHODOLOGY

The research conducted focused on Spinal Stenosis publications between 2017-2021. Data was received from the Web of Science database, containing the Science Citation Index Expanded (SCI-EXPANDED), (SSCI), and (A&HCI). The primary search query utilized the term "Spinal Stenosis" and was limited to the Title, Abstract, and Keywords of the publications. A total of 3044 publications related to Spinal Stenosis were retrieved. The acquired data underwent analysis using Bibexcel and Histcite, and the findings were organized in MS Excel spreadsheets to extract vital insights.

Collaborative Index (CI)

The collaborative index was computed utilizing the formula provided by Lawani in 1980.

$$CI = \sum_{(j=1)}^{A} = jfj / N$$

Collaboration Coefficient (CC)

We also integrated the measure proposed by Ajiferuke et al. in 1988, based on fractional productivity as defined by Price and Beaver in 1966. (Price & Beaver, 1966).

$$CC = 1 - \sum_{(j=1)}^{k} \left(\frac{1}{j}\right) fj / N$$

Where,

fj- denotes the number of j-authored research papers,

N- denotes the total number of research papers published,

k- is the most significant number of authors per paper.

According to Ajiferuke, CC tends to zero as single author papers dominated and to 1-1/j as j-authored papers dominated. This implies that the higher the value of CC, the Higher the probability of multi or mega-authored documents

Degree of Collaboration

The level of authorship collaboration was determined using the formula specified by Subramanyam in 1983.

$$C = \frac{NM}{(NM + NS)}$$

C= Degree of Collaboration.
NM= No. of Multi-authored papers.
NS= No. of Single author papers.

ANALYSIS AND INTERPRETATIONS OF DATA

Table 1: Year wise publications

Sr. No.	Year	Records	Percentage
1	2017	528	17.34%
2	2018	563	18.49%
3	2019	620	20.36%
4	2020	667	21.91%
5	2021	666	21.87%
Total		**3044**	**100%**

Table 1 shows the distribution of articles published on Spinal Stenosis research during 2017–2021 (5 years), including 2017 and 2021. It can be observed that from 2020 to 2021, there was a frequent change, an increase, and a decrease in publications. From 2020 to 2021, there has been a gradual decrease in Spinal Stenosis publications from 21.91% to 21.87%. The highest number of papers was published in 2020, with 667 (21.91%) records; the following highest publication could be observed in 2021, with 666 (21.87%) records. The least number of articles was observed in 2017, with 528 (17.34%) records.

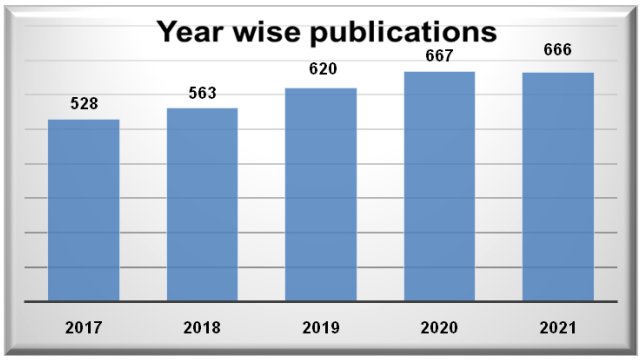

Figure 1: Year wise publications

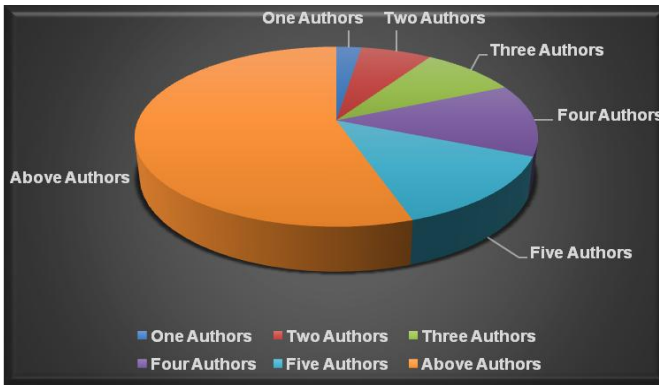

Figure 2: Authorship Pattern

Table 2: Year wise Authorship pattern

Year	1*	2*	3*	4*	5*	5+*	Total
2017	10	38	53	78	68	281	528
2018	12	45	56	73	66	311	563
2019	26	34	59	84	88	329	620
2020	15	44	53	80	91	384	667
2021	10	45	57	82	98	374	666
Total	**73**	**206**	**278**	**397**	**411**	**1679**	**3044**

1*Single Author 2* Two Author 3* Three Author 4* Four Author 5* Five Author 5+* above Five Author

Table 3: Co-Authorship Index

Year	1	CAI*	2	CAI*	3	CAI	4	CAI*	5	CAI*	5+	CAI*	Total
2017	10	78.97	38	106.34	53	109.91	78	113.27	68	95.38	281	96.48	528
2018	12	88.87	45	118.10	56	108.91	73	99.41	66	86.82	311	100.14	563
2019	26	174.86	34	81.03	59	104.19	84	103.88	88	105.12	329	96.20	620
2020	15	93.77	44	97.47	53	87.00	80	91.96	91	101.04	384	104.37	667
2021	10	62.61	45	99.84	57	93.71	82	94.40	98	108.98	374	101.81	666
Total	**73**		**206**		**278**		**397**		**411**		**1679**		**3044**

(*__CAI- Co-Authorship Index__)

Table 2 shows the authorship pattern of publications by year based on collaborative research. It indicates that out of 3044 articles, the maximum number is 1679, which were published by the above five authors. The lowest number of articles 73, were published by one author.

Table 3 shows the co-authorship index from 2017 to 2021. The table shows the co-author index for single authors, which declined from 62.61 in 2021 to 174.86 in 2019. The CAI for the two authors declined from 99.84 to 118.10, the three authors' contributions declined from 93.71 to 109.91, and the four authors' contributions declined from 94.40 to 113.27. Five authors' contributions declined from 108.98 to 95.38 starting from 2017 to 2021 using the formula

CAI = {(N_{ij}/N_{io}) / (N_{0j}/N_{oo})} × 100

For Example,10/73/411/3044 = 0.1369/0.1350
= 98.56

In this study, the straight-line equation under time series analysis is used to identify and evaluate the future development of Type 1 Spinal literature.

Straight line Yc = a+Bx

$$\frac{\sum Y}{N} = \frac{3044}{05} = 608.8$$

$$b = \left(\frac{\sum XY}{\sum X2}\right) = \frac{380}{10} = 38$$

Estimated literature in 2023 is when
X = 2033 – 2023 = 10
= 608.8+38 x 10
= 646.8 x 10
= 6468

Table 4: Times Serious Analysis

Year	No. of Publications (Y)	X	X^2	XY
2017	528	-2	4	1056
2018	563	-1	1	563
2019	620	0	0	0
2020	667	1	1	667
2021	666	2	4	1332
Total	**3044**		**10**	**380**

Table 5: Activity Index in India

Year	Global output	Indian output	Activity index in India
2017	528	9	71.30
2018	563	4	171.08
2019	620	1	753.61
2020	667	17	47.69
2021	666	6	134.92
Total	**3044**	**37**	

Table 6: Keywords wise Distribution

Sr.No.	Keywords	Records	Percentage
1.	Surgery	613	20.13
2.	Spinal Stenosis	397	13.04
3.	Outcomes	370	12.15
4.	Stenosis	346	11.36
5.	Decompression	305	10.01
6.	Low-Back-Pain	289	9.49
7.	Fusion	284	9.32
8.	Management	273	8.96
9.	Complications	236	7.75
10.	Laminectomy	217	7.12
11.	Diagnosis	173	5.68
12.	Pain	160	5.25
13.	Lumbar Spinal Stenosis	152	4.99
14.	Diskectomy	135	4.43
15.	Risk-Factors	135	4.43
16.	Prevalence	130	4.27
17.	Surgical-Treatment	125	4.10
18.	Spondylolisthesis	116	3.81
19.	Interbody Fusion	110	3.61

Estimated literature in 2030 is when
X = 2038 – 2023 = 15
= 608.8 + 38 x 15
= 646.8 x 15
= 9702

The predicted value of scientific publications for 2033 is 6468, and the expected amount of publications for 2038 is 9702.

Our time series analysis formula reveals the predicted value of literature output in spinal stenosis for the period between 2033 and 2038. These results reflect the future growth and research trends in publications on spinal stenosis and underscore the global impact of this research. The inferences drawn from this data highlight a gradually decreasing trend in the publications of spinal stenosis research, emphasizing the need for more attention and study for the betterment of spinal stenosis.

$$\text{Activity Index} = \left[\frac{C_i / C_o}{W_i / W_o} \right] * 100$$

Where,
C_i is the number of publications of the specific country in the "i" block
C_o is the total number of pubs in a particular country during the study period.
W_i is the number of publications of all countries in the "i" union
W_o is the number of publications in all the countries during the study period.

If the Activity Index is 100, a country's research effort in the given field is precisely aligned with the world average.

If the activity index is 100, it reflects higher than average activity.

If the activity index is 100, it indicates lower-than-average activity.

For Example,
528/3044/9/37 * 100 = 0. 173/0.243 * 100 = 71.30

Table 5 indicates India's activity index from 2017–2021. In India, the most publications were

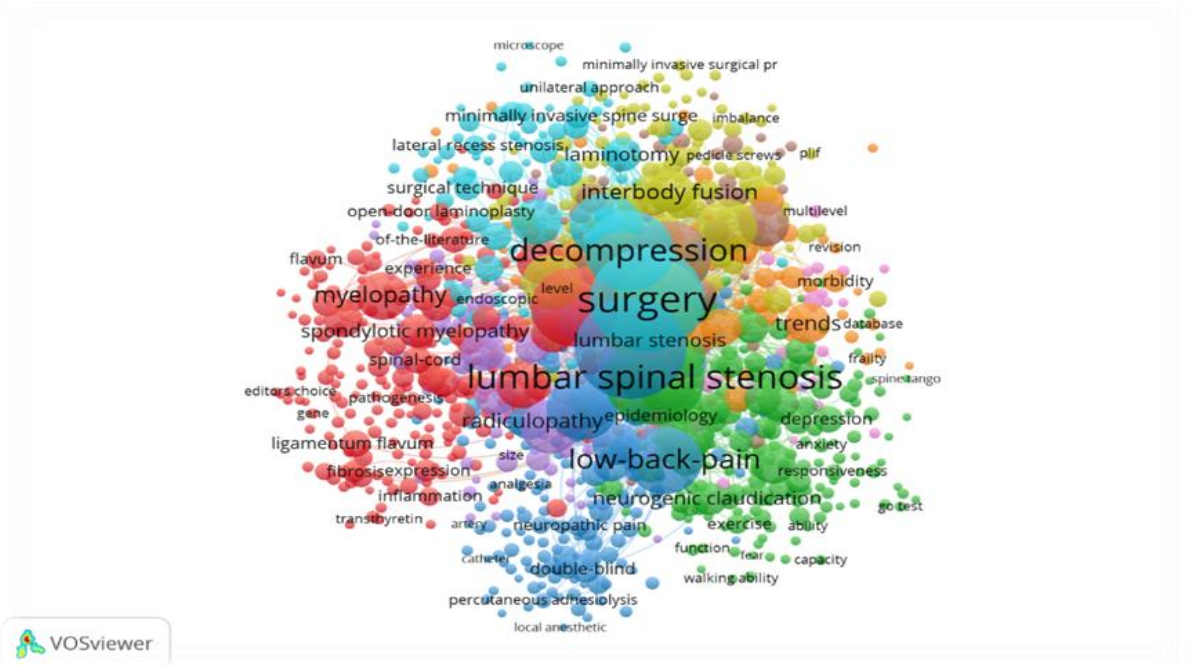

Figure 3: Visualization Map on Keyword Analysis

Table 7: Prolific Authors wise Distribution

Authors	Records	Percentage
Watanabe K	32	1.048%
Kim HS	31	1.016%
Kim DH	29	0.950%
Manchikanti L	28	0.917%
Kim HJ	27	0.885%
Wang Y	27	0.885%
Kaye AD	26	0.852%
Lee JH	24	0.786%
Tanaka S	24	0.786%
Burgstaller JM	22	0.721%
Kim CH	22	0.721%
Kim JS	22	0.721%
Lee CK	22	0.721%
Lee SH	22	0.721%
Liu Y	22	0.721%

published in the year 2020, with 17 records, and the highest activity index value was 753.61 in the year 2019, and the lowest activity index contributed in the year 2020 (47.69) in India.

Table 6 reveals the frequency of Spinal Stenosis research. The research has taken up the words that are occurring. The word "Surgery" has been repeatedly used 613 (20.13%) times by Spinal Stenosis research scientists during the study period, followed by "Spinal Stenosis" 397 (13.04%) times. The word "Outcomes" occupies the third position, using 370 (12.15%) times.

In table 7 prolific authors were recognized in Spinal Stenosis research. They have published 32 or more papers during 2017–2021. The identified 22 authors had published about 380 papers. Watanabe K became the most productive author, contributing 32 (1.048%) articles, followed by Kim HS 31 (1.016%).

Table 8 amounts to calculating the degree of collaboration in Nephrology research by using the formula given by (K. Subramanyam, 1982), which was,

DC = NM/NM+NS

Where,

DC - The degree of collaboration
NM- No. of multi-authored papers
NS- No. of single-authored papers

The degree of collaboration varied from 0.98 to 0.98 throughout the study. The average mean value was 0.95, suggesting an increase and decrease in collaborative research in Spinal Stenosis.

Table 9 describes the detailed study of the RGR and DT for the total research output of Spinal Stenosis globally. It is calculated that globally, 528 research publications were in the beginning year (2017), increasing gradually to 667 in 2020. It can be observed that the relative growth rate of Spinal Stenosis falls between 0.66 in 2017 and

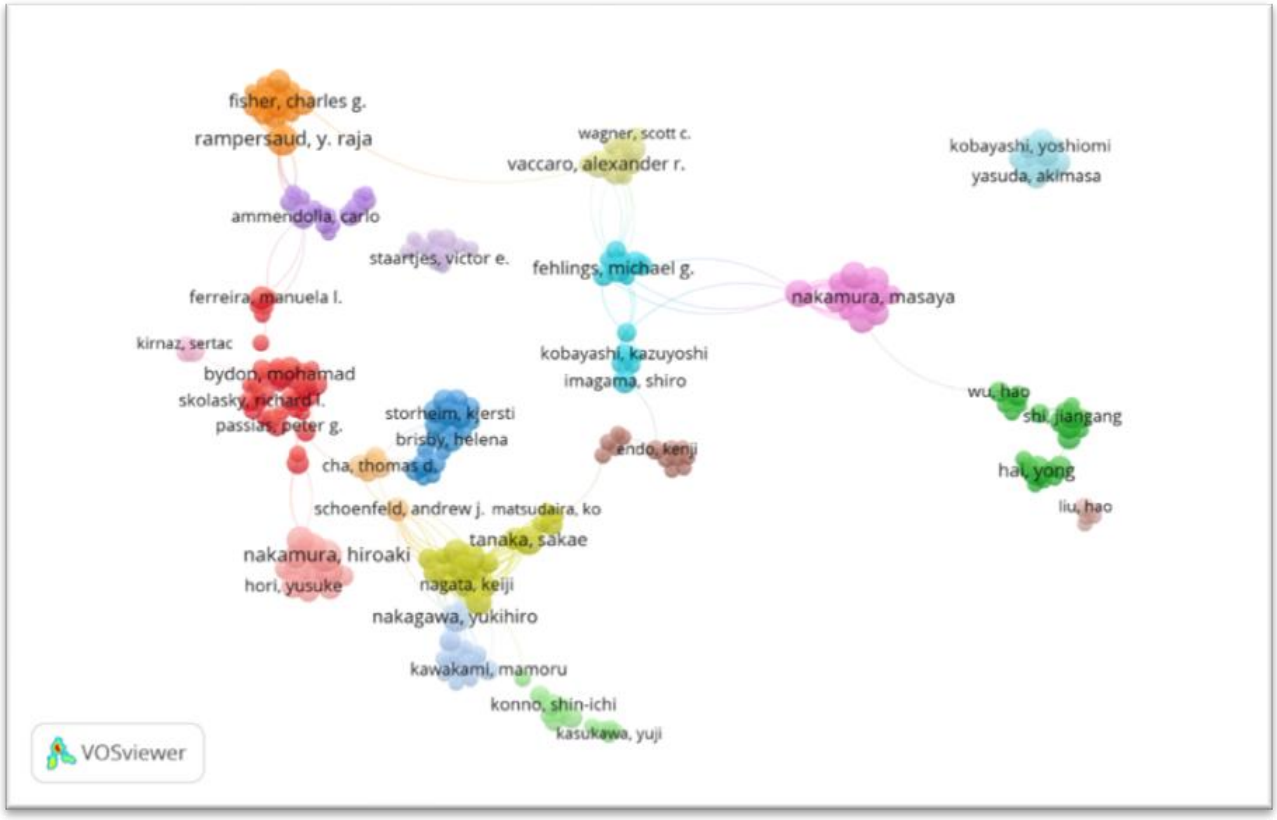

Figure 4: Visualization Map on Authorship Collaboration

Table 8: Degree of Collaboration

Year	Single Authors(NS)	Multi Authors(NM)	Total	DC= NM/NS+NM
2017	10	518	528	0.98
2018	12	551	563	0.97
2019	26	594	620	0.95
2020	15	652	667	0.97
2021	10	656	666	0.98
Total	**73**	**2971**	**3044**	**0.976**

1.52 in the year 2021. The doubling time for the literature output of Spinal Stenosis at the global level was also evaluated. It revealed that the declining trend and range was from 1.05 in 2017 to 0.45 in 2021. Therefore, the results show that the relative growth rate has a decreasing trend in terms of publications. In contrast, the doubling time has seen the increasing movement in Spinal Stenosis during the research period.

Table 10 shows the authorship pattern and collaborative index (CI) in Spinal Stenosis over five years (2017–2021). The collaborative index, 4.89% in 2012, has increased to 5.008 in 2020 and 2021. The average CI was 4.87 during the study period. The distribution of the year-wise collaboration index has been presented in the table.

Table 9: Relative Growth Rate (RGR) and Doubling Time (DT)

Year	Records	Cumulative	W1	W2	W2-W1	Mean R(a) RGR	DT=0.693/R(a)	Mean DT
2017	528		6.26					
2018	563	1091	6.33	6.99	0.66		1.05	
2019	620	1711	6.42	7.44	1.02	1.11	0.67	0.68
2020	667	2378	6.5	7.77	1.27		0.54	
2021	666	3044	6.5	8.02	1.52		0.45	
Total	**3044**							

Table 10: Collaborative Index

Year	1*	2*	3*	4*	5*	5+*	Total	CI
2017	10	38	53	78	68	281	528	4.89
2018	12	45	56	73	66	311	563	4.89
2019	26	34	59	84	88	329	620	4.87
2020	15	44	53	80	91	384	667	5.008
2021	10	45	57	82	98	374	666	5.004
Total	**73**	**206**	**278**	**397**	**411**	**1679**	**8070**	

1*Single Author 2* Two Author 3* Three Author 4* Four Author 5* Five Author 5+*Above Five Author CI* Collaborative Index

Table 11: Collaborative Co efficient

Year	1	2	3	4	5	5+	Total	CC
2017	10	38	53	78	68	281	528	0.76
2018	12	45	56	73	66	311	563	0.75
2019	26	34	59	84	88	329	620	0.74
2020	15	44	53	80	91	384	667	0.76
2021	10	45	57	82	98	374	666	0.76
Total	**73**	**206**	**278**	**397**	**411**	**1679**	**8070**	

It is seen from Table 10 that the value for the collaboration index was calculated at a minimum of 4.89 in 2017 and a maximum of 5.008 in 2020, with an average of 4.87.

Table 11 shows that the collaborative co-efficiency has increased from 0.76 in 2017 to 0.76 in 2021, indicating that research among scientists is somewhat collaborative. The average CC is 0.74. There has been a constant increase in CC from 2017 to 2021. This table shows the high degree of collaboration observed in Spinal Stenosis research.

FINDINGS AND CONCLUSIONS

The distribution of articles includes Spinal Stenosis research during 2017–2021 (5 years), including 2017 and 2021. It can be observed that from 2020 to 2021, there was a frequent change, an increase, and a decrease in publications. From 2020 to 2021, there has been a gradual decrease in Spinal Stenosis publications from 21.91% to 21.87%. The authorship pattern of publications by year is based on collaborative research. The extended authors are explained under the authorship pattern. Out of 3044 articles, the maximum number of articles is 1679, published by the above five authors. And the lowest numbers of articles, 73, were published by one author. It is divided that the formula time series analysis shows the predicted value of literature output in spinal stenosis for the period between 2033 and 2038. The results represent future growth and research trends in publications on spinal stenosis all over the world. In India, most publications were published in 2020 with 17 records, and the highest activity index value was 753.61 in 2019. The lowest activity index contributed in the year 2020 (47.69) in India.

The word "Surgery" has been repeatedly used 613 (20.13%) times by Spinal Stenosis research scientists during the study period, followed by "Spinal Stenosis" 397 (13.04%) times. The word "Outcomes" occupies the third position, being used 370 times (12.15%). The degree of collaboration varied from 0.98 to 0.98 for the duration of the study. The average mean value was 0.95, suggesting increased and decreased collaborative research in Spinal Stenosis. Authorship pattern and collaborative index (CI) in Spinal Stenosis over the study period of five years (2017–2021). The collaborative index, 4.89% in 2012, has increased to 5.008 in 2020 and 2021. The average CI was 4.87 during the study period. Table 9 describes the detailed study of the RGR and DT for the total research output of Spinal Stenosis globally. It was calculated that there were 528 research publications in the beginning year (2017), which increased gradually to 667 in 2020. The collaborative co-efficiency has risen from 0.76 in 2017 to 0.76 in 2021, signifying that study among scientists is somewhat combined with an average CC of 0.74. There has been a constant increase in CC from 2017 to 2021.

Conflict of Interest

The authors declare that there is no conflict of interest.

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