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Open Access scholarly literature on Gastritis (2002-2021) in Web of Science: A Scientometric Analysis

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***Abstract*---**The present study is an endeavor to quantify the publication productivity on worldwide gastritis research output (open access) with the help of the available scientometric indicators and tools. The study discovered that there is an improvement in the Priority Index/Activity Index value of India from 2010. The RGR and DT values are calculated as 0.18 and 4.81 respectively while as the Degree of Collaboration is 0.967. Yamaoka Y, Malfertheiner P and Graham DY are the top three contributing authors, World Journal of Gastroenterology, Plos One and Alimentary Pharmacology & Therapeutics are the top three journals that contributed most open access publications on gastritis. The top 20 most productive journals form the core zone journals which contribute to 33.26% of the total publications. USA, China and Japan occupy the top three positions in the list of prolific nations while as India ranks 16th. 35% of the total publications received citations in the range of 1-10 while as 3 publications received more than 1000 citations each.

***Keywords*---** Activity Index, Degree of Collaboration, gastritis, helicobacter pylori, relative growth rate and doubling time, Bradford's law, web of science.

Introduction

Gastritis disease is a serious concern to human life. It not only affects the health of an individual but also nation progress and development in terms of economic and social aspect. Scientometric study is one of the effective ways to understand

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the growth and impact of scientific literature in a given discipline, contribution of individuals, organizations and nations in the given discipline and linkage among authors, organizations and countries in terms of citation and collaboration in a given discipline. This study is an endeavor to quantify the Worldwide Open Access Scientific Literature On Gastritis using available scientometric indicators and tools.

Review of Literature

(Loomes & Zanten, 2013) Studied the top "100 highly cite articles on digestive diseases" and found that for the period of study the top most article received 3446 citations, the 2nd ranked paper received 3191 citations, third 2611 citations and fourth article received 2597 citations. The paper at the rank of 100 received 668 citations. (Arti, et al, 2020) Studied publication output of Pancreatic Cancer and found that 2567 and 2495 publications appeared in the year 2018 and 2017 respectively and ranks to 1st and 2nd position productivity list year wise. Out of 19662 total publications 78% appeared as articles while as 2 publications appeared as data papers. The analysis of publications by subject wise show that Medicine subject ranks 1st with 14597 publications followed by biochemistry, pharmacology and chemistry. United States ranks first followed by China, Japan, Germany and United Kingdom.

(Chen & Leimkuhler, 1986) studied relationship among the empirical laws of library science and resulted in deriving a "common functional relationship" among them and secondly they formulated useful formulation. (González-albo et al, 2012) studied the activity index or priority index of CSIC. They propounded the relationship in the publications produced in a particular field by CSIC to the publications produced by the country in that field in lines with the priority index calculation of a nation. They found that journals of level 1 &2 carry 35% of articles. The highest collaboration is seen in the field of physical science and technology. The highest number of articles is produced in Humanities and social science area followed by biology biomedicine and natural resources. (Karki & Garg, 1997) in their research calculated the activity index for India year wise and found that of the 10 years, India's activity index is more than 100 thus infer that Indian research on Alkaloid Chemistry is on priority. They also calculated the collaborative coefficient. (Mathankar, 2018) studied and explained the impact of the empirical laws of bibliometrics.

(Glänzel, 2000) found that internationally collaborated publication receive more citations than the local one. The international collaboration effect the national citation impact in different ways for different nations and for different areas of research of the same country. (Kundra & Tomov, 2000) in their study highlighted the "Cancer" is one of the international journal with publications from both Indian and Bulgarian authors followed by "International Journal of Cancer" and Neoplasma. "Journal of Surgical Oncology", "Cancer" and "British Journal of Cancer" are the most preferred foreign journals for Indian authors where they contributed 39, 26 and 26 articles each. (Priya & Ponnudurai, 2011) studied the "relative growth rate and doubling time" of the "neural network research" appearing in conference papers. For India they found that highest number of articles is produced in the 2007 followed by 2006 and 2005. The authors found

that a mean relative growth of 0.31 is shown and doubling time of 2.93 and for the world publications they found mean relative growth rate equals 0.27 and doubling time is 4.78.

(Dutt et al, 2003) calculated the value of activity index for each themes for the publications published between 1978 to 2001in "Scientometric" journal. They also calculated activity index value for the nations and found that in recent years the activity index of USA show decline while as value of activity index for India is highest in the last block of study 1994-2001. While studying the authorship pattern they came to know that single authored paper makes the highest share of publications followed by two authored papers and multi authored papers. (Singh et al, 2007) studied the applicability of "Lotka's Law" and "Bradford's law" on research output on digital library and found that the "Lotka's Law" doesn't gets fit in their studies because of a gap in actual no of authors and expected authors. The applicability of "Bradford's law of scattering" is tested on the journal productivity on the given topic and found that the zones marked and scattering of articles in these zones are relevant to Bradford's zone and scattering of article in these zones.

(MacRoberts & MacRoberts, 1982) states that Lotka in his findings pointed out that persons contributing 2 papers is about one fourth of those producing one paper. This law after remaining dormant for decades become popular when Price in one of his popular books stated that Lotka's law as actually an inverse square law. Price also generalized that "50% of scientific publications are produced by 6% of scientific community" and also "on an average scientists produce only three papers in life time". (Dutt & Nikam, 2015) used indicators like citation per paper, co authorship index, domestic collaborative index, international collaborative index, collaborative coefficient and citation gain to study the "global solar cell research". After studying the value of CAI for the authors found that there was a negative progress in production of single authored and two authored articles. The study show a decline in CAI values for USA and England while as China, Italy and Korea show upward growth in CAI. The citation gain for USA, India and England showed show negative trend while as China, Germany, France and Italy etc show a positive citation gain.

(Elango & Rajendran, 2012) studied authorship pattern and discussed Collaborative Index, Collaboration rate, collaboration coefficient and Lotka's law applicability on "Marine science literature". They found highest Collaborative Index value for the year 2005 followed by 2003 and 2008.the study suggest that strong collaboration within the institution is found followed by collaboration with other institutions (of the same country). (Jahina et al, 2020) assessed the applicability of Lotka's law and analyzed modulated collaborative coefficient, collaborative index, doubling time, relative growth rate and authorship pattern for brain concussion research. they found that highest percentage of publications counting to 14.33% are 4 authored paper while as single authored paper contribute to 5.36 percent of the total production. Their study revealed that the CI has highest value in 2008 while as DC, CAI and CC all have highest value in 2017.

Objectives of the study

a) To calculate the Relative Growth Rate and Doubling Time of global Gastritis research during the given period.
b) To find out India's Priority Index/Activity Index in Gastritis research.
c) To analyze the performance of the core zone journals in gastritis research in block year wise.
d) To find out the prolific authors and their year wise contribution to know the consistency.
e) To calculate prolific nations in gastritis research and comparison of India's performance with global performance.
f) To find out Degree of Collaboration in global gastritis research.
g) To find out citations received by the records with citation range analysis.
h) To find the applicability of Bradford's Law to the present study
i) To find out most contributing organizations in gastritis research.

Methodology

In order to attain the objectives of the study appropriate methods and procedures are used. Data for the study has been harvested for one of the popular Indexing database, "Web of Science". The search is done using following method;
Search term = gastritis (in topic)
Time Period = 2002 to 2021
Access type= only Open Access
Date of data collection: 10th of March, 2022
The harvested data was handled using software like "Bibexcel", "Histcite", MS Excel, MS Paint and VoSViewer and are tabulated as per the objectives of the study. Appropriate bibliometric tools and indicators have been used to attain the said objectives.

Analyses and Discussion

1.1. Relative Growth Rate and Doubling Time
Relative Growth Rate: Mahapatra[12] introduced a model for calculation of RGR. RGR is the decrease or increase in the number of pages/publications in a given field of study. Mahapatra proposed the following equation for calculation of Mean Relative Growth Rate and Doubling Time

$$R(1-2) = \frac{\mathrm{W2} - \mathrm{W1}}{\mathrm{T2} - \mathrm{T1}}$$

In the above equation W1 and W2 are the natural logs of number of publications on the starting and end of the time period, while as T2-T1 simply show the unit difference.
Doubling Time: The direct relationship between RGR and DT is calculated by the following formula
Doubling Time=0.693/R

$$Doubling\ Time\ (DT) = \frac{0.693}{\mathrm{R}}$$

Here R=Relative growth rate

0.693 is a constant (a constant calculated as natural log of number 2) and is the outcome of difference between the natural logs of publications at the beginning and at the end of the time period for which calculation is made.

Data in Table-1 shows the doubling time and relative growth rate trend for the given years in blocks. The mean RGR for block-1 remains at 0.35, while the DT for the said block is 1.55. The direct relationship between the RGR and DT is seen in block-2 where the RGR decreases and the DT increases. The overall trend show a consistent decrease in mean relative growth rate and increase in doubling time. The mean of means of RGR and DT is recorded 0.18 and 4.81 respectively.

Table-1: Relative Growth Rate and Doubling Time of Gastritis research Output

Block	Year	Records	Cumulative	W1	W2	R(a)	Mean R(a)	Dt(a)	Mean Dt
Block 1 (2002-2006)	2002	140	140		4.94	0	0.35	0	1.55
	2003	169	309	4.94	5.73	0.79		0.88	
	2004	144	453	5.73	6.12	0.38		1.81	
	2005	176	629	6.12	6.44	0.33		2.11	
	2006	165	794	6.44	6.68	0.23		2.97	
Block 2 (2007-2011)	2007	182	976	6.68	6.88	0.21	0.16	3.36	4.33
	2008	187	1163	6.88	7.06	0.18		3.95	
	2009	173	1336	7.06	7.20	0.14		5.00	
	2010	236	1572	7.20	7.36	0.16		4.26	
	2011	229	1801	7.36	7.50	0.14		5.10	
Block 3 (2012-2016)	2012	258	2059	7.50	7.63	0.13	0.12	5.18	5.84
	2013	313	2372	7.63	7.77	0.14		4.90	
	2014	310	2682	7.77	7.89	0.12		5.64	
	2015	314	2996	7.89	8.01	0.11		6.26	
	2016	301	3297	8.01	8.10	0.10		7.24	
Block 4 (2017-2021)	2017	333	3630	8.10	8.20	0.10	0.09	7.20	7.51
	2018	319	3949	8.20	8.28	0.08		8.23	
	2019	367	4316	8.28	8.37	0.09		7.80	
	2020	472	4788	8.37	8.47	0.10		6.68	
	2021	455	5243	8.47	8.56	0.09		7.63	

	Total	5243	5243				0.18		4.81

1.2. Activity Index of India in gastritis research:
Activity Index: Activity Index shows a country's priority in a given discipline. It is calculated by the ratio of share of a given discipline in country's total output and share of the given discipline in the world output as propounded by Frame[16] and later used in different ways by Karki[17] The present study uses the model as proposed by Karki[17] and the formula is given below.

$$Activity\ Index\ (India) = \frac{India's\ output\ in\ a\ particular\ year \Big/ India's\ total\ output}{World's\ output\ in\ a\ particular\ year \Big/ World's\ Total\ output} X100$$

Regarding the activity index of the present study, Table-2 shows the activity index of India in particular years. India's priority is more than that of the world in the years of 2006, 2011, 2012, 2014, 2015, 2016, 2017 and 2021. This shows that India's priority inn gastritis is increasing since last 3 to 4 years.

Table-2: Activity Index of India in Gastritis research

year	World Output	India output	World Output per year /Total World output	India output per year /total India output	India/ World	India Activity Index or Priority Index
2002	140	1	0.03	0.01	0.54	54.28
2003	169	2	0.03	0.03	0.90	89.92
2004	144	0	0.03	0.00	0.00	0.00
2005	176	1	0.03	0.01	0.43	43.17
2006	165	3	0.03	0.04	1.38	138.16
2007	182	1	0.03	0.01	0.42	41.75

2008	187	2	0.04	0.03	0.81	81.27
2009	173	2	0.03	0.03	0.88	87.84
2010	236	3	0.05	0.04	0.97	96.59
2011	229	6	0.04	0.09	1.99	199.09
2012	258	5	0.05	0.07	1.47	147.26
2013	313	3	0.06	0.04	0.73	72.83
2014	310	9	0.06	0.13	2.21	220.60
2015	314	6	0.06	0.09	1.45	145.20
2016	301	5	0.06	0.07	1.26	126.22
2017	333	5	0.06	0.07	1.14	114.09
2018	319	0	0.06	0.00	0.00	0.00
2019	367	3	0.07	0.04	0.62	62.11
2020	472	6	0.09	0.09	0.97	96.59
2021	455	6	0.09	0.09	1.00	100.20
Total	5243	69				

1.3. Degree of Collaboration in gastritis research:

Degree of Collaborations (DC) shows the extent of collaborative research and can be calculated by Subarmanyam's formula given below. Subarmanyam[18]

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

Where

DC = degree of collaboration in gastritis

Nm = number of articles with multiple authors

Ns = Number of articles with single authors

An analysis is made regarding authorship pattern in the present study. The calculation is made to find out the ratio as per the formula put forth by Subarmanyam[18] of the multiauthored and single authored articles

$$DC = \frac{5069}{5069 + 174}$$

DC= 0.967

1.4. Year-wise Analyses of output of Prolific Authors:

Data in table-3 shows the publication output of top 20 prolific authors. Yamaoka Y is the top ranked author with publications in each of the years of study followed by Malfertheiner P and Graham DY both having continuous publications. These top 20 authors contributed to
13.6% of the total publications.

Table-3: Prolific Authors (Author publication Consistency year wise)

Year Authors	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	G Total
Yamaoka Y	1	1	2	2	1	2	4	7	3	3	2	5	6	6	5	6	5	5	5	5	76
Malfertheiner P	5	3	4	1	2	1	1		2	3	2	5	2	4	2	7	4	4	6	3	61
Graham DY	2	1	1	6	3	3	1	3	3	3	1	4	5	5	2	6	3	2	2	2	58
Peek RM	2			2	1	1	7	3	6	5	1	2	3	2	7	2	3	7	2	1	57
Yuan Y	1	2		1		1				1		3	7	4	4	9	6	1	4	2	46
Fox JG	3	2	2	2		6	3	3	2	6	2	4	3	2		2		1	2		45
Piazuelo MB				1	2		6		4	4	1	1	3	1	8	1	2	4	3	4	45
Kim JH		3			2	1			4		1	1	2	4	4	4	2	7	6	4	45
Zhang L		1		1	1	1	1	2	3		5	2	2	6	3	1	5	4	2	2	42
Wilson KT	2	1	1		1		1		3	4	1	1	3	1	6	2	2	3	2	4	38
Annibale B		1	1	3	2		3	3	1	1	3	1	1	2	1	3	2	2	3	3	36
Correa P		1	1	2	2		6		4	4	2	2	3	1	3	1	1		1	1	35
Haruma K	2	4	2	3	1	3	1	1			1	1	1	4		1	1	1	2	3	32
Suzuki H	2		1		2	1	2	1	1	2	1	2	2	3		2	3	1	3	2	32
Rugge M		3			1	2			1	3	3	3	2	3	2	2		1	2	4	32

Li Y							1	1		2		1	2	2	2	3	3	4	8	3	32

1.5. Applicability of Bradford's Law of Scattering to the present study:
Bradford's law of journal productivity: one of the empirical laws of library science was proposed by Bradford. He made three zones and distributed journals in these zones in a fashion that each zone contributes 1/3rd of the total. The 1st zone produced one third of articles with fever journals, the second zone produced same number of articles with more journals and the third zone produced same proportion of articles but with even higher number of journals. He calculated the relation and found that there is a relationship among the zones in the form of 1: n: n^2.

Pertinent to mention that the top 20 journals given in the table-4 and table-5 contributes to 33.26% of the total output thereby forms Core Journals (Bradford's 1st zone journals) in gastritis research. The distribution of journals in the zones does not comply Bradford's law of scattering.

Table-4: Zone wise Journal Distribution	
Zone	No of Journals
Zone 1	20
Zone 2	113
Zone 3	871

1.6. Analyses of Prolific Journals in Block-Year Wise:
The data in table-5 suggest that the rank 1st, 2nd and 3rd are occupied by "World Journal of Gastroenterology", "Plos One" and "Alimentary Pharmacology & Therapeutics" which all together contribute to 13.83% of the total output. The TLSC and TGSC are also given in the table. The 1st, 2nd and 3rd rank for TGCS is held by journals appearing on 1st, 4th and 3rd rank in output list. This suggests that there is no relation between productivity and citation in the present study.

Table-5: Block year wise analysis of top 20 journals (Core Journals)								
Journal	Block-1 2002-2006	Block2 2007-2011	Block -3 2012-2016	Block -4 2017-2021	Grand Total	Percentage share	TLCS	TGCS
World Journal Of Gastroenterology	117	102	152	59	430	8.20	1367	9580
Plos One	0	21	100	53	174	3.32	0	3468
Alimentary Pharmacology & Therapeutics	70	14	25	12	121	2.31	743	4994
Gut	55	14	14	16	99	1.89	1314	8757
Infection And Immunity	47	28	12	5	92	1.76	675	3968
Medicine	0	0	10	72	82	1.56	0	408
Bmc Gastroenterology	2	15	32	25	74	1.41	0	1197
Scientific Reports	0	0	19	51	70	1.34	0	1259
Internal Medicine	7	11	21	26	65	1.24	129	546
International Journal Of Cancer	14	25	14	11	65	1.24	595	3256
Helicobacter	3	22	18	19	62	1.18	202	1388
Gastroenterology Research And Practice	0	6	22	28	56	1.07	0	393
Evidence-Based Complementary And Alternative Medicine	0	2	17	35	54	1.03	0	386
Journal Of Immunology	29	13	10	2	54	1.03	416	3518
Gastroenterology	2	17	9	20	48	0.92	428	3528
Gut And Liver	1	11	18	16	46	0.88	116	676
Gastric Cancer	0	11	14	17	42	0.80	165	1073
Journal Of Clinical Microbiology	23	12	3	0	38	0.72	265	1500
Journal Of Gastroenterology And Hepatology	2	15	10	9	36	0.71	134	914

International Journal Of Molecular Sciences	0	0	5	29	34	0.65	8	387
Total	372	339	525	505	1742	33.26	6557	51196

1.7. Analysis of Country output Block Year wise:

The data in table-6 shows the top country output with block year wise breakup. These top 20 countries contribute 4445 publications making a huge share of 84.66% of the world output. The data trend shows that USA tops the list. China, Japan, South Korea and Italy are the next 4 nations producing most of the publications and all the four countries are showing positive growth with consistency. Data suggest that UK is the only country among the top 20 that is showing consistently negative growth. India ranks 16th in the world gastritis research.

Table-6: Country wise productivity in gastritis research Block year wise

Country	Block-1 20022006	Block-2 2007-2011	Block-3 20122016	Block-4 20172021	Grand Total	Percenta ge Share
USA	156	209	281	250	896	17.09
China	55	65	229	447	796	15.18
Japan	155	152	159	194	660	12.59
South Korea	31	55	122	149	357	6.81
Italy	29	50	63	109	251	4.79
Germany	49	39	45	60	193	3.68
Brazil	28	45	71	35	179	3.41
UK	43	34	33	30	140	2.67
Taiwan	18	33	27	38	116	2.21
Turkey	14	18	33	46	111	2.12
Australia	12	26	33	37	108	2.06
Iran	2	14	38	39	93	1.77
France	19	23	14	29	85	1.62
Spain	08	17	12	37	74	1.41
Sweden	22	23	17	12	74	1.41
India	07	14	28	20	69	1.32
Canada	21	14	18	15	68	1.30
Poland	04	06	21	29	60	1.14
Mexico	03	09	19	25	56	1.07
Netherlands	11	16	13	13	53	1.01

Top 20 Nations Total	687	862	1276	1614	4439	84.66
World Total	802	1012	1491	1938	5243	

1.8. Comparison of India with the world in gastritis research performance (Block year wise): figure-1 shows the graphical representation of gastritis output of India and the world in block-year wise. The world graph shows an upward trend depicting consistent positive growth while the graph for India's output show a steep rise in publications from block-2 to block-3. This is the area when India's activity Index was higher than that of the world (already discussed in table-2). A negative growth is seen in the last block-year.

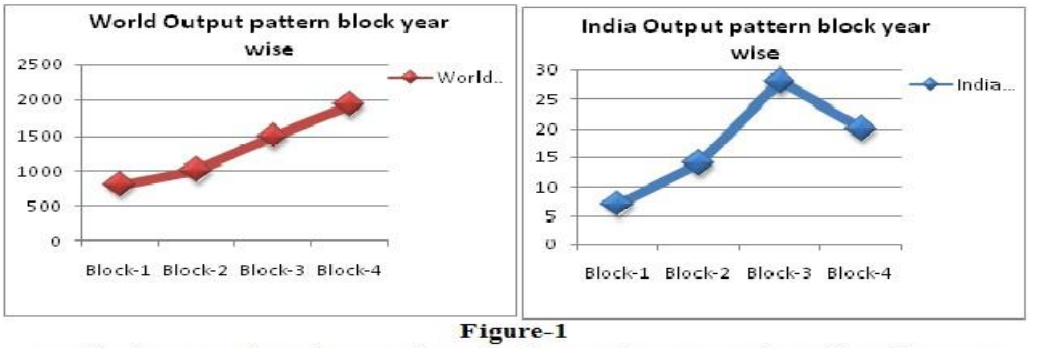
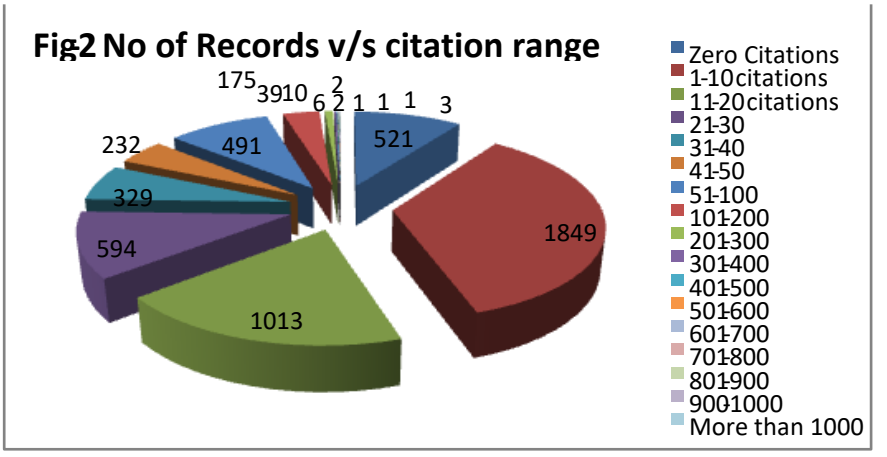


Figure-1

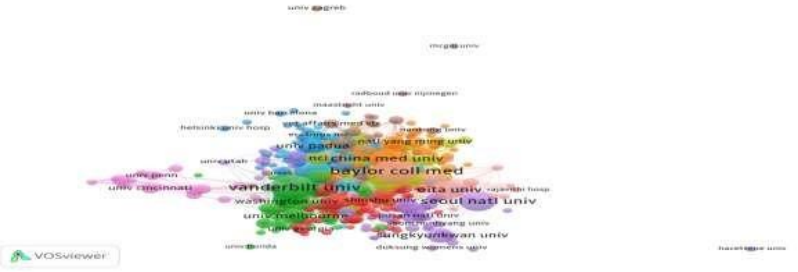
Graphical presentation of Comparison of India's Performance and World Performance

1.9. Analysis of Citation pattern (Range wise)

Figure-2 depicts the number of records falling in given citation ranges. The data suggests that 1849 (35%) records fall in the citation range of 1-10 followed by those receiving 10-20 citations, 1013 (19%) records. 3 papers are such which received more than 1000 citations while as 521 (9.93%) records received nil citations.



1.10. Analysis of Organization wise productivity:
The Viewer map in figure-3 shows the organization performances. The present study found that Vanderbilt University (link strength 4387), Bylor College of Med (link strength 3907) and Seoul national university (link strength 1063) are the rank 1st, 2nd and rank 3rd organizations in terms of productivity and citations.
Figure-3 Organization wise productivity map



Conclusion

The quantitative analyses of the gastritis research output, based on a number of scientometric indicators and tools, gives us the conception that considerable research has been carried out by different nations of the world. India ranks 16th in the world share of gastritis literature output while as USA, China and Japan are the top three nations contributing to the same. A steep growth is seen in the periods of 2nd and 3rd block for India and activity index in the same blocks is considerably high for India. The top 20 journals form the core zone journals while as Bradford's Law of Journal productivity misfits the current study. High degree of collaboration is seen among authors of gastritis research field. Prolific journals, prolific authors and prolific institutions were also studied and found that top 20 most prolific journals contribute 33.26% of world output, top 20 most prolific authors contribute 13.6% of the total output and top 20 most prolific institutions contribute to 24.1% of the global output.

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