

## **“Postgraduate Medical Journal Using Author Productivity And Lotka’s Law” : Info-Metrics Study**

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### **ABSTRACT**

What direction does the current rush of activity in medical education appear to be heading, and what kind of future is anticipated? This paper examines pathogenic research trends. There are four themes in all, with two trends for each topic. It covers the curriculum of medical (PG), education, technology, and learning, skills, and abilities to perform the tasks in the field. It highlights the current trends in the area. The goal of this study is to see if the productivity patterns of authors in Pathogenic research publication follow "Lotka's inverse square law" of scientific productivity. This law is being put to the test in a variety of sectors, with varying results. The current study used the above-mentioned law to explore the relevancy of open access journals related to the Pathogenic research from 2001 to 2020. The study also concludes with a result, so that opens avenues for future research on the productivity of authors who have published their thoughts, ideas, and research in open-access journals that are related to LIS.

### **INTRODUCTION**

Publishing studies and papers in the journals; and presenting papers in conferences are trending in the education and industry as well. Researchers and practitioners are following this trend and the result of the same has brought out lots of publications. The Flood of such publications has confused researchers while selecting and referring to appropriate publications to widen their knowledge. Although, UGC the supreme statutory body in education has established UGC-CARE, Academic Integrity regulations to improve research’s quality. Further, INFLIBNET has been creating awareness among users and providing infrastructure to Indian educational organizations. Further, it has been focusing on suggestions, recommendations, and the future of the research. Therefore, Shodhganga a repository of Indian thesis has included the above-mentioned requirements in its platform. The purpose of such activity is to create awareness among the researchers, policymakers and others so that advantages of such studies can be taken.

Use of these recommendations in the forms of citation by a research scholar or implementation by policymakers can reveal the impact of work or an author in a specific field. Like another field, the productivity of an author's work highlights the value of his/her research. Similarly, Lotka's Law in Pathogenic research Publications will be useful in finding out the best practices, treatments, diagnosis, required skills in the field and areas for further development. There are many research metrics that are used to evaluate the value, impact of a published study. These are JIF, SNIP, SJR Indicator, Cite Score, i10, g index, IPP - Impact per publication. The well-established and well-known metrics to evaluate the publication are JIF which is published through JCR (Clarivate). These metrics are the traditional ways for evaluation. However, alternative metrics like altmetrics and article-level metrics (ALM ) are also trending, and their coverage is social media. The purpose behind all research metrics is to evaluate, assess and measure the quality of a publication. Except for JIF, believers of these metrics have been justifying the supremacy of these metrics because the formulas and concepts for finding out these metrics are different.

Basic laws of Scientometric analysis are Bradford's Law, Zipf's Law, and Lotka's Law Alfred James Lotka, a mathematician, chemist, demographer, and ecologist. In 1926, he published a paper in the Washington Academy of Science's Journal 1. The study looks at the frequency distribution of authors' scientific activity based on 'Chemical Abstracts' publications from 1907 to 2016. He reported an inverse square relationship between authors and their publications. He demonstrated that a power law of the form  $c/n^2$  'where 'c' is a constant, describes the number of authors with 'n' publications in a bibliography. "...the Zinumber (of writers) making 'n' contributions is roughly  $1/n^2$  of those making one, and the proportion of all authors who make a single contribution is about 60%...", according to the law. It means that 60% of the authors in a field or discipline create 1 publication, 15% produce 2 publications ( $1/2^2 * 60$ ), 7% produce 3 publications ( $1/3^2 * 60$ ), and so on. Lotka's law can be correct in general but not statistically exact when applied to vast quantities of literature over a lengthy period. According to the legislation, if the number of writers writing one article is known, the number of authors writing two, three, or more papers may be predicted. The following equation can be used to express Lotka's law. This law helps us to find the frequency of an author's publications. Journals are the primary source of information. The library journal, according to Kohl and Davis, is the most used source of information by LIS practitioners. Egghe defines info metrics as "the science concerned with the quantitative characteristics of information.". Citation analysis is a type of bibliometric study that is often utilized by librarians for reasons such as acquisition, collection development, and tenure and promotion. Over the previous several decades, several studies have been done to examine librarians' publication trends. Academic librarians publish more articles, according to the findings.

## **OBJECTIVES**

- Aim to assess year-wise contributions to Pathogenic research
- To determine the distribution of authors in the selected area
- Testing of Lotka's law

## **METHODOLOGY**

Past research and studies that have been done on the related topics were reviewed to provide an overview of the literature on author productivity trends and the use of Lotka's Law in the publication of Pathogenic research s. Author Productivity and Application of Lotka's Law in Pathogenic research Publication research, as well as other papers relating to various diseases, were consulted and placed here. Primary Periodicals, Secondary Databases, Conference Proceedings, Technical Reports, Web resources, and books, all published in India and overseas, were used to compile the contents. Some comprehensive studies are reported in India and abroad on all aspects of Author Productivity and Application of Lotka's Law in the sample data, 155399 papers, were collected from the homepages of Pathogenic research s from 2001 to 2020.

**Table 1 : Showing the Authorship Patterns on Pathogenic research output**

Year		1	2	3	4	5	6	7	8	9	10	11+	Total	AAPP	PPA
2001	articles	242	454	<b>486</b>	435	409	333	207	141	107	75	138	3027	2.44	0.41
	authors	242	908	1458	1740	<b>2045</b>	1998	1449	1128	963	750	1975	14656		
2002	articles	261	484	<b>537</b>	494	401	368	215	176	128	67	162	3293	4.89	0.204
	authors	261	968	1611	1976	2005	<b>2208</b>	1505	1408	1152	670	2336	16099		
2003	articles	291	497	<b>577</b>	516	450	381	272	182	149	75	193	3583	4.948	0.202
	authors	291	994	1731	2064	2250	2286	1904	1456	1341	750	<b>2662</b>	17729		
2004	articles	357	501	<b>566</b>	527	493	425	297	227	140	114	225	3872	5.074	0.197
	authors	357	1002	1698	2108	2465	2550	2079	1816	1260	1140	<b>3170</b>	19645		
2005	articles	312	575	610	627	526	444	307	247	205	125	261	4239	5.280	0.189
	authors	312	1150	1830	2508	2630	2664	2149	1976	1845	1250	4068	22382		
2006	articles	305	624	621	674	617	492	350	292	206	140	380	4701	5.481	0.182
	authors	305	1248	1863	2696	3085	2952	2450	2336	1854	1400	5578	25767		
2007	articles	315	621	713	725	682	595	444	334	241	168	371	5209	5.439	0.183
	authors	315	1242	2139	2900	3410	3570	3108	2672	2169	1680	5127	28332		
2008	articles	373	752	818	798	695	676	506	379	249	193	476	5915	5.539	0.181
	authors	373	1504	2454	3192	3475	4056	3542	3032	2241	1930	6965	32764		
2009	articles	350	700	883	828	797	670	526	420	298	191	594	6257	0.017	5.827
	authors	350	1400	2649	3312	3985	4020	3682	3360	2682	1910	9112	36462		
2010	articles	326	798	848	923	850	790	543	446	340	233	688	6785	0.169	5.914
	authors	326	1596	2544	3692	4250	4740	3801	3568	3060	2330	10223	40130		
2011	articles	310	813	978	1008	972	864	633	552	379	301	812	7622	0.164	6.072
	authors	310	1626	2934	4032	4860	5184	4431	4416	3411	3010	12072	46286		
2012	articles	330	868	980	1036	1019	942	684	601	419	316	987	8182	0.159	6.275
	authors	330	1736	2940	4144	5095	5652	4788	4808	3771	3160	14922	51346		
2013	articles	298	861	1021	1162	1083	934	757	634	468	362	1111	8691	0.155	6.439

	authors	298	1722	3063	4648	5415	5604	5299	5072	4212	3620	17017	55970		
2014	articles	309	812	1108	1146	1155	1017	830	685	519	443	1205	9229	0.151	6.604
	authors	309	1624	3324	4584	5775	6102	5810	5480	4671	4430	18842	60951		
2015	articles	287	885	1060	1222	1211	1101	930	765	565	405	1406	9837	0.148	6.733
	authors	287	1770	3180	4888	6055	6606	6510	6120	5085	4050	21685	66236		
2016	articles	322	866	1162	1231	1276	1177	1017	840	656	490	1670	10707	0.142	7.032
	authors	322	1732	3486	4924	6380	7062	7119	6720	5904	4900	26750	75299		
2017	articles	313	932	1161	1307	1352	1261	1160	936	751	584	1894	11651	0.138	7.218
	authors	313	1864	3483	5228	6760	7566	8120	7488	6759	5840	30697	84118		
2018	articles	311	946	1189	1416	1447	1433	1218	997	829	688	2195	12669	0.133	7.469
	authors	311	1892	3567	5664	7235	8598	8526	7976	7461	6880	36515	94625		
2019	articles	304	990	1334	1567	1707	1642	1426	1218	937	790	2838	14753	0.126	7.927
	authors	304	1980	4002	6268	8535	9852	9982	9744	8433	7900	49949	116949		
2020	articles	314	948	1374	1602	1729	1702	1467	1326	1027	866	2822	15177	0.128	7.798
	authors	314	1896	4122	6408	8645	10212	10269	10608	9243	8660	47975	118352		
Total	articles	6230	14927	18026	19244	18871	17247	13789	11398	8613	6626	20428	155399	1553.99	0.00064
	%	4.01	9.61	11.6	12.38	12.14	11.1	8.87	7.33	5.54	4.26	13.15	100		
	authors	6230	29854	54078	76976	94355	103482	96523	91184	77517	66260	327640	1024098	10240.98	0.000097
	%	0.61	2.92	5.28	7.52	9.21	10.1	9.43	8.9	7.57	6.47	31.99	100		

## ANALYSIS AND INTERPRETATION

Table 1 analysis reveals the following results by the authorship pattern of Pathogenic research output; such that overall sample data is 155399 by 1024098 authors. Among those 6230 (4.01%) of articles were written by 6230 (0.61%) of authors as single authored; followed by 14927 (9.61%) of articles were written by 29854 (2.92%) of authors as two authored team; 18026 (11.6%) of articles were written by the 54078 (5.28%) of authors as three authored team; 19244 (12.38%) of articles were written by 76976 (7.52%) of authors as four authored team; 18871 (12.14%) of articles were written by 94355 (9.21%) of authors as five authored team; 17247 (11.1%) of articles were written by 103482 (10.1%) of authors as six authored team; 13789 (8.87%) of articles were written by 96523 (9.43%) of authors as seven authored team; 11398 (7.33%) of articles were written by 91184 (8.9%) of authors as eight authored team; 8613 (5.54%) of articles were written by 77517 (7.57%) of authors as nine authored team; 6626 (4.26%) of articles were written by 66260 (6.47%) of authors as ten authored team; 20428(13.15%) of articles were written by 327640 (31.99%) of authors as above ten authored team respectively.

It could be identify the four **authored** articles were higher than other kind of collaborative production and **more than ten authored** team is highest than other team followed by the six authored team is highest than other team.

Table 1 also shows the average number of authors per paper and productivity per author for the Pathogenic sample data during 2001 - 2020.

## AUTHOR PRODUCTIVITY AND LOTKA'S LAW

Scientific data was analysed statistically long before the Lotka law came into existence. In 1926, his study that was based on decennial index (1907-1916) made available new ways to find out author's productivity. As per laws "the number of authors making n contributions is about 1/n<sup>2</sup> of those making one" and "the proportion of all contributors who make one contribution is about 60%.". Finding of the study are considered best tool even in the digital age.

$$P = \text{number of X items} = 77$$

$$N = \text{maximum number of contributors} = 1024098$$

N: Observed value

$$n = \frac{N \sum XY - \sum X \sum Y}{N \sum X^2 - (\sum X)^2} \quad (1)$$

Pao (1989) proposed the way to calculate n-value and c- value of Lotka's law as in (1) and (2)

N = number of pairs of data

X = logarithm of x, i.e. number of articles

Y = logarithm of y, i.e. number of authors

Pao (1989) proposed the way to calculate n-value and c- value of Lotka's law as in

$$n = 77 (1664.856) - (204.628) (469.977) / 77(1168.76) - (204.628) (204.628) = 0.665465$$

N is the maximum contribution of an author. X is log (x) and Y is log (y) where y are the authors who have x number of contribution.

The value of constant c is calculated using the following formula:

$$c = \frac{1}{\sum_{x=1}^{P-1} \frac{1}{x^n} + 1 / ((n-1)(P^{n-1})^{+1} / 2 * P^{n+n} / 24 * (P-1)^{n+1}} \quad \dots (3)$$

$$\sum_{x=1}^{P-1} \frac{1}{x^n} = \text{obtained by summing the first 19 terms of } \frac{1}{x^n}$$

With  $x = 1, 2, 3, \dots 51$

Here, P = 77; n = value obtained using formula (2); x = number of articles

Deriving the value of n and c by Sen's Method (2010)

$$x^n y = c \quad \text{Lotka Equation}$$

N is the maximum contribution of an author. X is log (x) and Y is log (y) where y are the authors who have x number of contribution.

Where p is the number of publication groups which authors were contributed the same amount of publications. Besides, Pao also used Kolmogorov–Smirnov (K–S) test to verify if Lotka's law is matched or not under the condition that p-value is greater than thirty five.

$$K-S = \frac{1.63}{\sqrt{N}}$$

Square root value of total authors 37893 is 194.66; and verify the K-S statistic value to see if Lotka's law be capable of hold for Management Information System research output. For N value is -0.6046, therefore, K-S statistics method can be used to verify if Lotka's law could hold for the sample area publications.

$$K - S = 1.63 / 1011.9773$$

$$K-S = 0.00161 \quad \text{for } N = 1024098$$

Where p is the number of publication groups which authors were contributed the same amount of publications. Besides, Pao also used Kolmogorov–Smirnov (K–S) test to verify if Lotka’s law is matched or not under the condition that p-value is greater.

A total of 1024098 authors contributed to Pathogenic research productivity. Each year, there were 51204.9 authors calculating the mean value and there were 6.59 authors calculated for each article. There are 1024098 contributors to Pathogenic research productivity, which explains the majority of author contributions. 51204.9 authors were counted in calculating the mean value of every year's contributions, while 6.59 numbers of authors were counted for individual articles. Therefore, the majority of authors have contributed to more papers.

**Table 2: Showing Lotka’s (n – value) Law of Author Productivity in Pathogenic Research Output**

No. of	%of X	Cum. % of X	No. of contrib	Y	% of Y	Cu m.	$\sum X =$	$\sum Y =$	$\sum X^*$ X	$\sum X^*$ Y
1	0.0001	0.0001	118	118	0.012	0.0	0	4.77	0	0
1	0.0001	0.0002	117	117	0.011	0.0	0	4.76	0	0
1	0.0001	0.0004	107	107	0.010	0.0	0	4.67	0	0
1	0.0001	0.0005	106	106	0.010	0.0	0	4.66	0	0
1	0.0001	0.0006	103	103	0.010	0.0	0	4.63	0	0
1	0.0001	0.0007	101	101	0.010	0.0	0	4.61	0	0
1	0.0001	0.0009	93	93	0.009	0.0	0	4.53	0	0
1	0.0001	0.0010	91	91	0.009	0.0	0	4.51	0	0
1	0.0001	0.0011	88	88	0.009	0.0	0	4.47	0	0
2	0.0003	0.0014	84	168	0.016	0.1	0.69	5.12	0.480	3.552
2	0.0003	0.0016	78	156	0.015	0.1	0.69	5.05	0.480	3.500
2	0.0003	0.0019	77	154	0.015	0.1	0.69	5.03	0.480	3.491
1	0.0001	0.0020	76	76	0.007	0.1	0	4.33	0	0
3	0.0004	0.0024	75	225	0.022	0.1	1.09	5.41	1.207	5.950
1	0.0001	0.0025	71	71	0.007	0.1	0	4.26	0	0
2	0.0003	0.0027	69	138	0.013	0.1	0.69	4.92	0.480	3.415
3	0.0004	0.0031	68	204	0.020	0.2	1.09	5.31	1.207	5.843
2	0.0003	0.0034	66	132	0.013	0.2	0.69	4.88	0.480	3.385
2	0.0003	0.0036	63	126	0.012	0.2	0.69	4.83	0.480	3.352
1	0.0001	0.0037	62	62	0.006	0.2	0	4.12	0	0
1	0.0001	0.0039	61	61	0.006	0.2	0	4.11	0	0
1	0.0001	0.0040	60	60	0.006	0.2	0	4.09	0	0
1	0.0001	0.0041	58	58	0.006	0.2	0	4.06	0	0
3	0.0004	0.0045	57	171	0.017	0.2	1.09	5.14	1.207	5.649
2	0.0003	0.0048	55	110	0.011	0.2	0.69	4.70	0.480	3.258
5	0.0006	0.0054	54	270	0.026	0.3	1.60	5.59	2.590	9.010
4	0.0005	0.0059	52	208	0.020	0.3	1.38	5.33	1.922	7.399
3	0.0004	0.0063	51	153	0.015	0.3	1.09	5.03	1.207	5.527
4	0.0005	0.0068	49	196	0.019	0.3	1.38	5.27	1.922	7.317



2	0.0003	0.0070	48	96	0.009	0.3	0.69	4.56	0.480	3.164
4	0.0005	0.0075	47	188	0.018	0.3	1.38	5.23	1.922	7.259
3	0.0004	0.0079	46	138	0.013	0.4	1.09	4.92	1.207	5.413
1	0.0001	0.0080	45	45	0.004	0.4	0	3.80	0	0
6	0.0008	0.0088	44	264	0.026	0.4	1.79	5.57	3.210	9.991
3	0.0004	0.0092	43	129	0.013	0.4	1.09	4.86	1.207	5.339
6	0.001	0.0099	42	252	0.025	0.4	1.79	5.52	3.210	9.907
5	0.001	0.0105	41	205	0.020	0.4	1.60	5.32	2.590	8.567
1	0.000	0.0107	40	40	0.004	0.4	0	3.68	0	0
6	0.001	0.0114	39	234	0.023	0.5	1.79	5.45	3.210	9.775
10	0.001	0.0127	38	380	0.037	0.5	2.30	5.94	5.302	13.67
6	0.001	0.0134	37	222	0.022	0.5	1.79	5.40	3.210	9.680
4	0.001	0.0139	36	144	0.014	0.5	1.38	4.97	1.922	6.890
8	0.001	0.0149	35	280	0.027	0.6	2.07	5.63	4.324	11.71
15	0.002	0.0168	34	510	0.050	0.6	2.70	6.23	7.334	16.88
11	0.001	0.0182	33	363	0.035	0.7	2.39	5.89	5.750	14.13
15	0.002	0.0201	32	480	0.047	0.7	2.70	6.17	7.334	16.71
14	0.002	0.0219	31	434	0.042	0.7	2.63	6.07	6.965	16.02
10	0.001	0.0231	30	300	0.029	0.8	2.30	5.70	5.302	13.13
10	0.001	0.0244	29	290	0.028	0.8	2.30	5.67	5.302	13.05
16	0.002	0.0264	28	448	0.044	0.8	2.77	6.10	7.687	16.92
20	0.003	0.0289	27	540	0.053	0.9	2.99	6.29	8.974	18.84
19	0.002	0.0313	26	494	0.048	0.9	2.94	6.20	8.670	18.26
22	0.003	0.0341	25	550	0.054	1.0	3.09	6.31	9.555	19.50
23	0.003	0.0370	24	552	0.054	1.1	3.13	6.31	9.831	19.79
26	0.003	0.0402	23	598	0.058	1.1	3.25	6.39	10.61	20.83
31	0.004	0.0441	22	682	0.067	1.2	3.43	6.52	11.79	22.40
40	0.005	0.0492	21	840	0.082	1.3	3.68	6.73	13.60	24.83
44	0.006	0.0547	20	880	0.086	1.3	3.78	6.78	14.32	25.65
47	0.006	0.0606	19	893	0.087	1.4	3.85	6.79	14.82	26.16
57	0.007	0.0678	18	1026	0.100	1.5	4.04	6.93	16.34	28.03
70	0.009	0.0766	17	1190	0.116	1.7	4.24	7.08	18.05	30.08
77	0.010	0.0863	16	1232	0.120	1.8	4.34	7.11	18.86	30.91
104	0.013	0.0993	15	1560	0.152	1.9	4.64	7.35	21.57	34.14
109	0.014	0.1130	14	1526	0.149	2.1	4.69	7.33	22.00	34.38
213	0.027	0.1398	13	2769	0.270	2.3	5.36	7.92	28.74	42.49
220	0.028	0.1675	12	2640	0.258	2.6	5.39	7.87	29.09	42.49
293	0.037	0.2044	11	3223	0.315	2.9	5.68	8.07	32.26	45.88
371	0.047	0.2510	10	3710	0.362	3.3	5.91	8.21	35.00	48.62
559	0.070	0.3213	9	5031	0.491	3.8	6.32	8.52	40.02	53.92
789	0.099	0.4206	8	6312	0.616	4.4	6.67	8.75	44.49	58.37
1237	0.156	0.5761	7	8659	0.846	5.2	7.12	9.06	50.70	64.55
2163	0.272	0.8482	6	12978	1.267	6.5	7.67	9.47	58.97	72.73
3870	0.487	1.3349	5	19350	1.889	8.4	8.26	9.87	68.24	81.54
8324	1.047	2.3818	4	33296	3.251	11.	9.02	10.4	81.48	93.99
2211	2.782	5.1634	3	66348	6.479	18.	10.0	11.1	100.0	111.0
8402	10.567	15.730	2	16804	16.40	34.	11.3	12.0	128.5	136.4
6700	84.269	100	1	67001	65.42	100	13.4	13.4	179.9	179.9

<b>7950</b>	100		<b>3386</b>	<b>10240</b>	100		<b>204.</b>	<b>469.</b>	<b>1168.</b>	<b>1664.</b>
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### DIMENSIONS OF THE GEO METRICS

The table 3 reveals that the number of contributing countries and its frequencies, numbers of single country productivity (SCP), Multiple country publication (MCP) that means collaborated with other countries and its ratio. It is calculated by dividing the total number of contributing articles published in a Pathogenic research from specific country, in a given period of time and in a specific field with the total number of articles published in the world in the same field over the sample periods.

**Table 3: Overall Country wise Productivity of Pathogenic Research**

S.No	Country	Articles	%	SCP	%	MCP	%
1	USA	31185	20.0677	25152	80.654	6033	19.346
2	CHINA	15694	10.0992	14511	92.462	1183	7.538
3	UK	12286	7.9061	2433	19.803	9853	80.197
4	GERMANY	7532	4.8469	5337	70.858	2195	29.142
5	ITALY	6826	4.3926	5184	75.945	1642	24.055
6	JAPAN	5606	3.6075	5572	99.394	34	0.606
7	FRANCE	5913	3.8050	4394	74.311	1519	25.689
8	INDIA	5848	3.7632	5191	88.765	657	11.235
9	SPAIN	4794	3.0850	3646	76.053	1148	23.947
10	KOREA	4649	2.9917	3987	85.760	662	14.240
11	BRAZIL	3627	2.3340	3158	87.069	469	12.931
12	CANADA	3604	2.3192	3304	91.676	300	8.324
13	AUSTRALIA	2270	1.4608	1654	72.863	616	27.137
14	NETHERLANDS	1864	1.1995	1160	62.232	704	37.768
15	POLAND	2663	1.7137	2598	97.559	65	2.441
16	IRAN	2424	1.5599	2156	88.944	268	11.056
17	SWITZERLAND	2381	1.5322	1787	75.052	594	24.948
18	SWEDEN	2310	1.4865	1741	75.368	569	24.632
19	BELGIUM	2201	1.4164	1693	76.920	508	23.080
20	TURKEY	2116	1.3617	2059	97.306	57	2.694
21	MEXICO	2103	1.3533	1840	87.494	263	12.506
22	DENMARK	2020	1.2999	1641	81.238	379	18.762
23	ISRAEL	1960	1.2613	1628	83.061	332	16.939
24	THAILAND	1911	1.2297	1601	83.778	310	16.222
25	RUSSIA	1877	1.2079	1689	89.984	188	10.016
26	ARGENTINA	1701	1.0946	1546	90.888	155	9.112
27	EGYPT	1692	1.0888	1490	88.061	202	11.939
28	PORTUGAL	1589	1.0225	1492	93.896	97	6.104
29	SOUTH AFRICA	1331	0.8565	1475	110.819	-144	-10.819
30	AUSTRIA	1204	0.7748	1347	111.877	-143	-11.877
31	CZECH	1076	0.6924	1471	136.710	-395	-36.710

32	IRELAND	955	0.6145	726	76.021	229	23.979
33	PAKISTAN	853	0.5489	663	77.726	190	22.274
34	FINLAND	744	0.4788	458	61.559	286	38.441
35	MALAYSIA	638	0.4106	427	66.928	211	33.072
36	NORWAY	599	0.3855	384	64.107	215	35.893
37	GREECE	536	0.3449	356	66.418	180	33.582
38	SAUDI ARABIA	597	0.3842	276	46.231	321	53.769
39	HUNGARY	473	0.3044	315	66.596	158	33.404
40	CHILE	461	0.2967	315	68.330	146	31.670
41	SINGAPORE	418	0.2690	238	56.938	180	43.062
42	NEW ZEALAND	386	0.2484	243	62.953	143	37.047
43	TUNISIA	366	0.2355	190	51.913	176	48.087
44	ROMANIA	321	0.2066	276	85.981	45	14.019
45	COLOMBIA	263	0.1692	164	62.357	99	37.643
46	SERBIA	239	0.1538	170	71.130	69	28.870
47	SLOVAKIA	207	0.1332	151	72.947	56	27.053
48	BANGLADESH	180	0.1158	92	51.111	88	48.889
49	SLOVENIA	173	0.1113	113	65.318	60	34.682
50	NIGERIA	164	0.1055	110	67.073	54	32.927
51	CROATIA	162	0.1042	107	66.049	55	33.951
52	BULGARIA	151	0.0972	107	70.861	44	29.139
53	MOROCCO	146	0.0940	88	60.274	58	39.726
54	LITHUANIA	104	0.0669	74	71.154	30	28.846
55	VIETNAM	103	0.0663	53	51.456	50	48.544
56	ALGERIA	101	0.0650	40	39.604	61	60.396
57	VENEZUELA	97	0.0624	72	74.227	25	25.773
58	URUGUAY	77	0.0495	34	44.156	43	55.844
59	KENYA	75	0.0483	25	33.333	50	66.667
60	U ARAB	74	0.0476	33	44.595	41	55.405
61	INDONESIA	73	0.0470	38	52.055	35	47.945
62	PHILIPPINES	68	0.0438	47	69.118	21	30.882
63	ETHIOPIA	66	0.0425	45	68.182	21	31.818
64	ESTONIA	60	0.0386	29	48.333	31	51.667
65	JORDAN	57	0.0367	38	66.667	19	33.333
66	CAMEROON	52	0.0335	19	36.538	33	63.462
67	CYPRUS	51	0.0328	29	56.863	22	43.137
68	UKRAINE	50	0.0322	33	66.000	17	34.000
69	CUBA	48	0.0309	28	58.333	20	41.667
70	KUWAIT	47	0.0302	31	65.957	16	34.043
71	IRAQ	43	0.0277	32	74.419	11	25.581
72	LEBANON	43	0.0277	20	46.512	23	53.488
73	ECUADOR	41	0.0264	17	41.463	24	58.537
74	PERU	36	0.0232	12	33.333	24	66.667
75	SRI LANKA	34	0.0219	20	58.824	14	41.176

76	COSTA RICA	33	0.0212	20	60.606	13	39.394
77	QATAR	32	0.0206	11	34.375	21	65.625
78	ICELAND	31	0.0199	14	45.161	17	54.839
79	OMAN	31	0.0199	21	67.742	10	32.258
80	UGANDA	29	0.0187	6	20.690	23	79.310
81	LATVIA	28	0.0180	22	78.571	6	21.429
82	GHANA	27	0.0174	19	70.370	8	29.630
83	BURKINA FASO	24	0.0154	7	29.167	17	70.833
84	NEPAL	23	0.0148	14	60.870	9	39.130
85	CAMBODIA	21	0.0135	4	19.048	17	80.952
86	GEORGIA	20	0.0129	7	35.000	13	65.000
87	KAZAKHSTAN	20	0.0129	12	60.000	8	40.000
88	LUXEMBOURG	20	0.0129	2	10.000	18	90.000
89	SENEGAL	20	0.0129	8	40.000	12	60.000
90	TANZANIA	18	0.0116	3	16.667	15	83.333
91	ZIMBABWE	18	0.0116	9	50.000	9	50.000
92	ARMENIA	17	0.0109	11	64.706	6	35.294
93	BENIN	17	0.0109	8	47.059	9	52.941
94	ERITREA	17	0.0109	9	52.941	8	47.059
95	LIBYA	14	0.0090	7	50.000	7	50.000
96	PANAMA	14	0.0090	6	42.857	8	57.143
97	SYRIA	14	0.0090	11	78.571	3	21.429
98	JAMAICA	12	0.0077	5	41.667	7	58.333
99	MALTA	12	0.0077	5	41.667	7	58.333
100	BELARUS	11	0.0071	9	81.818	2	18.182
101	MAURITIUS	10	0.0064	5	50.000	5	50.000
102	ANTIGUA	9	0.0058	6	66.667	3	33.333
103	BAHRAIN	9	0.0058	5	55.556	4	44.444
104	SUDAN	9	0.0058	4	44.444	5	55.556
105	ZAMBIA	9	0.0058	3	33.333	6	66.667
106	ALBANIA	8	0.0051	5	62.500	3	37.500
174	BOSNIA	8	0.0051	3	37.500	5	62.500
108	UZBEKISTAN	8	0.0051	7	87.500	1	12.500
109	MOZAMBIQUE	7	0.0045	0	0.000	7	100.000
110	CONGO	6	0.0039	1	16.667	5	83.333
111	MONTENEGRO	6	0.0039	0	0.000	6	100.000
112	YEMEN	6	0.0039	4	66.667	2	33.333
113	AZERBAIJAN	5	0.0032	4	80.000	1	20.000
114	GABON	5	0.0032	0	0.000	5	100.000
115	MACEDONIA	5	0.0032	4	80.000	1	20.000
116	MALAWI	5	0.0032	1	20.000	4	80.000
117	NICARAGUA	5	0.0032	1	20.000	4	80.000
118	BOLIVIA	4	0.0026	3	75.000	1	25.000
119	MADAGASCAR	4	0.0026	0	0.000	4	100.000

120	MALI	4	0.0026	3	75.000	1	25.000
121	NAMIBIA	4	0.0026	3	75.000	1	25.000
122	NIGER	4	0.0026	2	50.000	2	50.000
123	BARBADOS	3	0.0019	0	0	3	100.000
124	BRUNEI	3	0.0019	0	0	3	100.000
125	FIJI	3	0.0019	2	66.667	1	33.333
126	GUINEA	3	0.0019	1	33.333	2	66.667
127	MONACO	3	0.0019	2	66.667	1	33.333
128	ANDORRA	2	0.0013	0	0	2	100
129	ANGOLA	2	0.0013	0	0	2	100
130	BHUTAN	2	0.0013	2	100	0	0
131	BOTSWANA	2	0.0013	0	0	2	100
132	KYRGYZSTAN	2	0.0013	1	50	1	50
133	LIECHTENSTEIN	2	0.0013	2	100	0	0
134	MYANMAR	2	0.0013	1	50	1	50
135	PARAGUAY	2	0.0013	0	0	2	100
136	SIERRA LEONE	2	0.0013	0	0	2	100
137	TOGO	2	0.0013	0	0	2	100
138	AFGHANISTAN	1	0.0006	0	0	1	100
139	BELIZE	1	0.0006	0	0	1	100
140	CHAD	1	0.0006	0	0	1	100
141	EL SALVADOR	1	0.0006	1	100	0	0
142	HONDURAS	1	0.0006	0	0	1	100
143	KOSOVO	1	0.0006	1	100	0	0
144	LAOS	1	0.0006	0	0	1	100
145	MAURITANIA	1	0.0006	0	0	1	100
146	MOLDOVA	1	0.0006	0	0	1	100
147	MONGOLIA	1	0.0006	0	0	1	100
148	RWANDA	1	0.0006	0	0	1	100
149	TAJKISTAN	1	0.0006	0	0	1	100
	<b>Total</b>	<b>155399</b>	<b>100</b>	<b>121002</b>	<b>77.87</b>	<b>34397</b>	<b>22.13</b>

Table 3 shows that the global publications share of contributing countries in Pathogenic research during the sample periods. The result value varies from 0.000133 to 3.5691 period of study of different countries. Total 149 countries were contributed the research output in the subject of Pathogenic. Among those the country “USA” has contributed 32165 (20.69%) of documents with 3.5691 frequencies, out of 25152 were individual and 7013 articles were by multiple country productivity with 3.7143 MCP ratio value and stood in first rank position of the publications. Followed by “China” has contributed 17684 (11.38%) of documents with 0.849 frequencies, out of 14511 were individual and 3173 articles were by multiple country productivity with 3.0956 MCP ratio value and stood in second rank position of the publications. UK stood in third rank position.

Article Count: USA produce highest number of articles in Pathogenic research in the sample periods; followed by China (17684); UK (12286); Germany (7532); Italy (6826); Japan (5604); France (5913); India (5848); Spain (4794); Korea (4649); Brazil (3627); Canada (3604); Australia (2270); Netherlands (1864); Poland (2663); Iran (2424); Switzerland (2381); Sweden (2310); Belgium (2251); Turkey (2216); Mexico (2103); Denmark (2020); and remaining countries were produced below 2000 articles respectively. Next to that Israel (1960); Thailand (1911); Russia (1877); Argentina (1801); Egypt (1792); Portugal (1789); South Africa (1731); Austria (1704); and Czech Republic (1676); Ireland (955); Pakistan(853); Finland (744); Malaysia (638); Norway (599); Greece (536); Saudi Arabia(597);and the remaining countries were produced below 500 articles respectively. The countries of Hungary, Chile, Singapore, Newzealand, Tunisia, Romania, Colombia, Serbia, Slovakia, Bangladesh, Slovenia, Nigeria, Croatia, Bulgaria, Morocco, Lithuania, Vietnam and Algeria were contributed the research article between 500 to 100 in Pathogenic research during the sample periods. Remaining countries were produced below 100 articles.

SCP (Single Country Publication): In SCP, all authors belong to the same country and such publications represent intra-country collaboration. 78% of articles were produced as SCP by USA. MCP (Multiple Country Publication): scientists in Pathogenic research field were published with collaborate to another countries and such publications represent MCP.21.80 % of articles were produced as MCP by USA. It could identify from this analysis highest productivity countries were collaborated within other country are less number of articles during the sample periods.

## CONCLUSION

During the entire study period, the study result revealed a decline in growth rate and an increase in the number of contributed authors and cited references within Pathogenic research s from 2001 to 2020. The majority of articles were submitted by America and China. According to a K\_S test, Lotka's law can be applied to pathogenic research. In conclusion, Lotka's law can be viewed as a power function that predicts author distributions to Pathogenic research publications based on the inverse square.

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