Application of Lotka's Law in the field of Congestive Heart Failure in India – A Scientometric Analysis

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ABSTRACT

This study examines Lotka's law of authorship distribution in the field of Congestive Heart Failure from 1989 to 2023. The data were retrieved from the Web of Science database. A total of 2565 documents were retrieved and analyzed through Histcite and Bibexcel software. Graphs and Charts are made through Microsoft Excel. The data were examined by type of document, year-wise distribution, journal-wise distribution, and Prolific author. The applicability of Lotka's law and Kolmogorov-Smirnov (K-S) test has been analyzed to find out the scientific productivity. The findings of the study revealed that congestive heart failure articles gradually increasing and the highest publications are recorded in the year 2021. Journal articles have the highest impact on types of documents. The most productive journals are the European Journal of Heart Failure and the International Journal of Cardiology with 124 and 63 articles on Congestive Heart Failure. The most productive author is Kumar A with 73 contributions followed by Yusuf S with 56 contributions. The study reveals that Lotka's law applies to the authors of congestive heart failure where the Dmax value is lower than the critical value.

KEYWORDS: Heart attack, Congestive Heart failure, Scientometrics, Lotka's law, Productivity, K-S test, Prolific author.

INTRODUCTION

A heart attack, also called myocardial infarction, occurs when the blood flow that supplies oxygen to part of the heart muscle is suddenly blocked. Your heart isn't getting enough oxygen. If blood flow is not restored quickly, the heart muscle begins to die. A heart attack is not the same as cardiac arrest, which occurs when the heart suddenly and unexpectedly stops beating. A heart attack can lead to sudden cardiac arrest. Most heart attacks are caused by coronary heart disease. Age, lifestyle, and other health conditions can increase the risk of a heart attack. Symptoms of a heart attack include chest and upper body pain, shortness of breath, dizziness, sweating, and nausea. Women often experience various heart attack symptoms.

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According to the Centers for Disease Control and Prevention, more than 800,000 people in the United States have a heart attack each year. (*Heart Attack - What Is a Heart Attack? | NHLBI, NIH*, n.d.). The number of heart attacks in young people has increased in recent years, which is a worrying trend. Heart disease is a leading cause of death worldwide and its incidence has increased in India in the last five years. This increase in cardiac arrests and related problems is attributed to a hectic lifestyle and changing habits. While it was previously believed that a heart attack only affected older people, it now affects every second young person between the ages of 30 and 40. Several factors contribute to this health risk, including inactivity, stress, insomnia, smoking, alcohol consumption, diabetes, high blood pressure, and obesity. (Why Is There a Rise in Heart Attacks among Young People? - India Today, n.d.).

The study of bibliometrics involves examining the various structural elements of texts, documents, books, and information. Pritchard coined the term "bibliometrics" in 1969 to describe the application of mathematical and statistical techniques to analyze books and other forms of communication. Scientometrics analyses the quantitative aspects of the production, dissemination, and use of scientific information to achieve a better understanding of the mechanisms of scientific research as a social activity.(Chellappandi Ph Assistant Professor & Vijayakumar, n.d.)

Lotka's Law

Alfred J. Lotka derived an equation in 1926 to analyze the frequency distribution of the author's productivity. He collected data from chemical abstracts from 1907 to 1916 for his study. He concluded that 60% of the single article contributions were made by a single author followed by 15% contributed by two authors 7% by three authors and so on. He formed an inverse relationship between the number of authors and publication.

Lotka's law equation as

$$x^n * y = c \quad \text{------------------------------------ (1)}$$

'x' revealed the number of articles (1, 2, 3, 4….) 'y' denoted as the number of authors. The exponent value is denoted as 'n" and c as constant.

For the inverse square method, commonly n and c are denoted as 2 and 0.6079.

General square root method of n and c value derived from Pao equation. He defined the linear least square method equation to calculate the value of n is given below as

$$n = \frac{N \sum xy - \sum x \sum y}{N \sum x^2 - (\sum x)^2} \quad \text{------------------------------------ (2)}$$

X (number of contributions) is the logarithm value of "x"; Y (number of authors) is the logarithm value of "y" and N is denoted as the total count of the dataset.

The "c" value is calculated from the below equation

$$c = \frac{1}{\sum x^n} \quad \text{------------------------------------ (3)}$$

Pao verified the scientific productivity of the author by applying a non-parametric Kolmolgorov- Smirnov (K-S) goodness-of-fit test. He stated that the maximum deviation value of the dataset must compared with the

critical value to verify Lotka's law. The critical value (C.V.) is calculated by the equation derived from Nicholls as shown below.

$$\text{Critical Value (C.V.)} = \frac{1.63}{[\sum yx + (\sum yx/10)^{1/2}]^{1/2}} \quad \text{----------------------(4)(Shanmugam et al., 2020)}$$

REVIEW OF LITERATURE

Chen Yun-Hu, Yin Mo-Qing, Fan Li-Hua, et al. (2023) conducted a study on the frontiers of traditional Chinese medicine research on heart failure in the 21st century using Bibliometric methods. The literature covered in the database from the years 2000-2022. The study identifies key researchers, institutions, countries, and journals in this field. The study analyzed 437 publications with a total of 4570 cited articles and 5832 citations. The average number of citations per item was 13.48 and H-index was 37. The number of publications and citations showed a changed with a significant increase after 2010. Evidence-based complementary and Alternative medicine was identified as an important journal for authors in this field. (Chen et al., 2023)

Pang Yan, Huang Mingjian, Lu Janshen, et al. (2023) examined the oxidative stress related to heart failure from 2012 to 2021 using Bibliometric analysis. This study covered 5616 published papers with an average number of citations of 29.57 per article and an H-index is 148 indexed in the Web of Science Core collection. The United States of America contributed 1616 articles with 116 H-index. In terms of productivity the USA, China, Italy, and Japan were in the highest position. The highly productive authors are Kang Yuming with 28 publications followed by Ren Jun with 27 publications and Okoshi Katashi with 26 publications.(Pang et al., 2023)

Kuang Xuyuan, Zhong Zihao, Liang Wei, et al. (2023) examined the top 100 cited articles on heart failure-associated disease in combination with machine learning using bibliometric analysis. The data were retrieved from the Web of Science database during the period 1985 to 2023. The study examined the co-authorship, citation maps, and keyword co-occurrence analysis by using Vos viewer software. The study shows among the top 100 cited articles, the most cited articles had 1189 citations, while the least cited articles had 47 citations. Harvard University and the University of California emerged as the leading institutions, with both having 10 papers each. The United States shares 50 articles out of 100 top-cited articles. It is observed that the growth rate of heart failure-related machine learning publications has gradually increased over the past two decades.(Kuang et al., 2023)

Lam Mei Leng, Chen Pan, Xie Xiao-Meng, et al. (2023) examined the bibliometric analysis of heart failure and depression for the period 1983 to 2022. The study shows a gradual increase in research output from 1989 to 2021. The United States contributed 36% of publications followed by China, Germany, Italy, and Japan. The most productive author is Moser and the most productive institution was Duke University. The most productive journals were Circulation, the American Journal of Physiology Heart and Circulatory Physiology, and the American Journal of Cardiology. The result revealed that the heart failure and depression literature is gradually increasing with an annual growth rate of 14.79%. They concluded that future research directions should be considered exploring publications on self-care and anxiety about heart failure.(Lam et al., 2023)

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Tao Shiyi, Tang Xianwen, Yu Lintong, et al. (2023) studied the prognosis of coronary heart disease after percutaneous coronary intervention using bibliometric analysis for the period 2004 to 2022. The study aimed to analyze the scientific output and development trends in the field of prognosis of coronary heart disease (CHD) using Citespace software. The study revealed that the USA has produced 3326 papers followed by Italy, Japan, China, and Germany. The high-frequency keywords used in publications are "percutaneous coronary intervention", "outcome", "mortality" etc. Gregg W Stone is the most prolific author with 368 publications. The study concluded that research papers will be more comprehensive in the future if more accurate software and analytical techniques are developed.(Tao et al., 2023)

Wang Huan, Shi Jingjing, Shi Shuging, et al. (2022) examined the bibliometric analysis of the progress of chronic heart failure during the study period from 2009 to 2019. The data has been retrieved from the Web of Science Core collection. The result showed that the United States of America was the leading country in CHF research and Duke University was the leading institution. The finding of the result indicated that the research growth was from 2009 to 2019. Stefan D Anker was the most productive author. The most highly used keyword is "heart failure", "mortality", "risk", "outcome" and "association".(Wang et al., 2022)

Zhang Xue Song, ZhouYu, Wei Namin, et al. (2022) in their article they examined heart failure with preserved ejection fraction (HFpEF) from 2000 to 2021 using bibliometric analysis. The findings highlight the importance of international cooperation and exchanges, particularly for developing countries to strengthen their HFpEF studies. The USA is in a leading position than other countries. The findings reveal that developed countries have conducted more HFpEF studies compared to developing countries.(Zhang et al., 2022)

Wei Kangkang, Liao Jiangquan, Chang Jiangmeng, et al. (2020) studied the bibliometric analysis of cardio-oncology research and examined the development and achievements in this field from 1970 to 2019. A total of 356 records were retrieved from the Web of Science database. It was observed that the number of publications has steadily increased during the study period with the greatest number of publications occurring in the year 2018. Cardiologia Ospedale San Vincenzo and University Hospital Essen were the top institutions with the highest research output. International Journal of Cardiology with 30 articles is a highly productive journal.(Wei et al., 2020)

Din Ye, Chen Dingwan, Ding Xufen, et al. (2020) evaluated a bibliometric analysis of income and cardiovascular disease during the period between 1990 and 2018. Science Citation Index Expanded and Social Science Citation Index were used for data collection. They analyzed the leading countries, institutions, research areas journals, etc. Derwent Date Analyzer software was used for analysis. Out of 158 countries, the top 3 countries were the USA, the UK, and Canada contributed a maximum number of publications. The USA contributed 5254 publications and 255638 total citations and Harvard University, the University of California San Francisco, and the University of Michigan have the highest productivity in this field. The study finds that research related to income and cardiovascular disease has a greater focus in developed countries than in developing countries. (Ding et al., 2020)

Shahzeh Khan Muhammad, Ullah Waqa, Riaz Irbaz Bin, et al. (2016) in their article discussed the top 100 cited articles in cardiovascular magnetic resonance using bibliometric analysis from 2000 to 2014. The study aimed to

identify the trends and characteristics of the top 100 cited articles on CMR research. The US contributed over half of the publications with 52 articles, followed by the UK with 29 articles. The most productive journal is Circulation and Journal of the American College of Cardiology. The top-cited articles had a wide range of citation counts, with a median of 319.5.(Khan et al., 2016)

Al-Kindi Sadeer, Al-Juhaishi Taha, Haddad Fadi, et al. (2015) studied the cardiovascular disease research activity in the Middle East using bibliometric analysis from the year 2003 to 2012. The study shows only 3% of the cardiovascular disease research is conducted in Middle East countries. Turkey and Iran contributed the highest research output. The study revealed Middle East had a ratio of 0.05 to 0.23 for CVD and Non-CVD publications, with Qatar having the highest ratio. The result confirms a recent global cardiovascular bibliometric analysis showing a 36% increase in CVD publications over the last decade.(Kindi et al., 2015)

OBJECTIVE OF THE STUDY

The objectives of the study are as follows:

- ✓ To identify the document-wise distribution pattern
- ✓ To investigate the year-wise distribution of publications.
- ✓ To identify the most preferred journals in this field.
- ✓ To find out the prolific author.
- ✓ To verify the Lotka's law of scientific productivity of authors
- ✓ To apply the Kolmogorov-Smirnov (K-S) Goodness of fit test to confirm Lotka's Law.

RESEARCH METHODOLOGY

The data for the study is retrieved from the Web of Science database in plain text format. The data was accessed on 15 September 2023 for the period between January 1989 to September 2023. The following keywords were used for data collection "Congestive Heart Failure", "Heart Attack" OR "Heart Failure". For this study, 'India' is used as a country for analysis. A total of 2565 records were collected for analysis. Lotka's law was tested with 3206 unique authors. The data is analyzed using Bibexcel, Histcite, and Microsoft Excel. The charts and graphs are made with the help of Microsoft Excel.

DATA ANALYSIS AND INTERPRETATION

1. Document-wise distribution

Table no- 01 Document-wise distribution of publications

Document Type	Records	Percentage	LCS	GCS
Article	1607	62.65	1084	80840
Review	479	18.67	173	14068
Meeting Abstract	265	10.33	0	57
Letter	62	2.42	11	219
Editorial Material	59	2.30	3	427
Article; Early Access	30	1.17	0	91

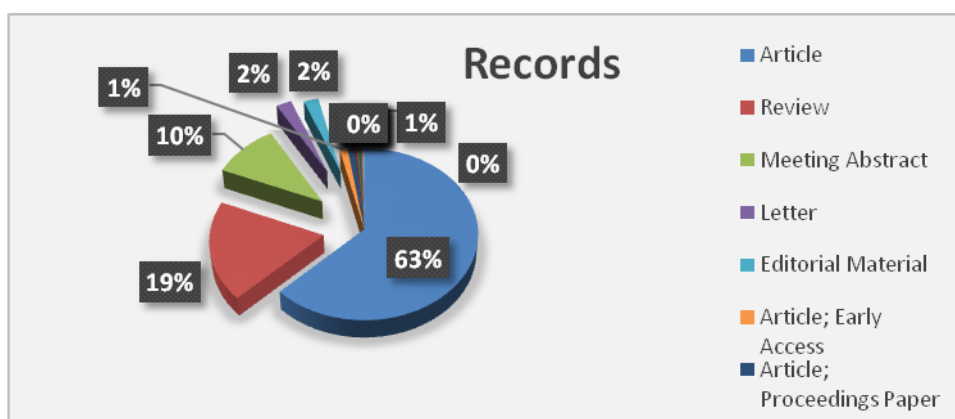|				
Article; Proceedings Paper	27	1.05	12	1476
Review; Early Access	8	0.31	0	0
Note	7	0.27	1	42
Correction	6	0.23	1	6
Review; Book Chapter	5	0.19	0	108
Article; Book Chapter	3	0.12	0	84
Article; Retracted Publication	2	0.08	0	80
Editorial Material; Early Access	2	0.08	0	2
Letter; Early Access	1	0.04	0	0
Retraction	1	0.04	0	1
Review; Retracted Publication	1	0.04	0	1
Total	**2565**	**100**		

Table no- 01 Document-wise distribution of publications. It is observed that the Journal article has the highest share of records with 1607 (63%) followed by Review with 479 (18.67%) records, Meetings Abstract with 265 (10.33%) records, Letters with 62 (2.42%), Editorial Material 59 (2.30%), Early access with 30 (1.17%) records and Letters; Early access, Retraction, and Review; Retracted publications have the lowest records.

2. Year-wise Distribution

Table No.- 02 Year-wise distribution of publications

Publication Year	Records	Percentage	LCS	GCS
1989	1	0.039	6	33
1990	2	0.078	2	81
1991	11	0.429	9	282
1992	8	0.312	4	244
1993	15	0.585	10	488
1994	8	0.312	1	274
1995	6	0.234	6	100
1996	8	0.312	9	387

1997	5	0.195	0	129
1998	7	0.273	1	278
1999	10	0.390	3	105
2000	10	0.390	4	316
2001	9	0.351	5	629
2002	10	0.390	2	336
2003	18	0.702	4	457
2004	16	0.624	4	438
2005	32	1.248	6	1438
2006	29	1.131	22	807
2007	44	1.715	22	1210
2008	35	1.365	26	1740
2009	61	2.378	28	2079
2010	77	3.002	56	3413
2011	77	3.002	71	4255
2012	75	2.924	62	5034
2013	98	3.821	60	5042
2014	98	3.821	55	4197
2015	92	3.587	116	7088
2016	155	6.043	143	6667
2017	177	6.901	122	9892
2018	197	7.680	167	18529
2019	193	7.524	109	6733
2020	239	9.318	74	8893
2021	291	11.345	57	4352
2022	279	10.877	17	1381
2023	172	6.706	2	175
TOTAL	**2565**	**100**		
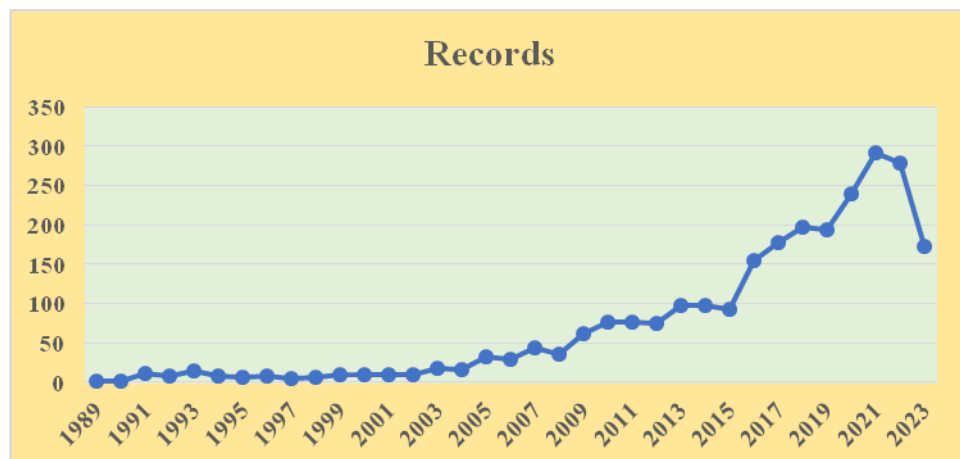
Records

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Table no- 02 shows the year-wise distribution of publications. Out of 2565 articles, 291 (11.345%) articles were published in 2021 with the highest number of publications followed by 279 (10.877%) articles in the year 2022, 239 (9.318%) articles published in 2020, 197(7.680%) articles published in the year 2018 and least articles published in the year 1989 with 1(0.039%). The study shows a gradual increase in publications from 2016 and the lowest publications seen from the beginning.

3. Journal wise distribution

Table no- 03 Top 15 Most Preferred Journal

S. No.	Journal	Records	LCS	GCS
1	European journal of heart failure	124	33	823
2	International journal of cardiology	63	38	1618
3	European heart journal	48	57	2529
4	Circulation	40	33	2021
5	Journal of the American college of cardiology	39	15	907
6	Plos one	32	0	841
7	Journal of Clinical Hypertension	30	63	745
8	Echocardiography-a journal of cardiovascular ultrasound and allied techniques	28	3	139
9	Journal of cardiac failure	27	19	350
10	Heart failure reviews	25	10	575
11	Molecular and cellular biochemistry	25	25	795
12	New england journal of medicine	24	176	24019
13	Lancet	21	88	19885
14	Value in health	21	0	4
15	Cardiology in the young	19	1	43

Table no- 03 reveals the top 15 contributing journals on Congestive heart failure. Out of 901 journals, 124 articles were published in the European Journal of Heart Failure followed by 63 articles in the International Journal of Cardiology, 48 articles published in the European Heart Journal, and 40 articles in Circulation journals.

4. Prolific Author

Table No .- 04 Top 10 Prolific Authors

S. No.	Author	Records	LCS	GCS
1	Kumar A	73	26	4962
2	Yusuf S	56	143	10686
3	Huang CY	54	37	1102
4	Kumar S	54	11	832
5	Anand IS	43	74	4929
6	Gupta R	39	162	35933

7	Diaz R	36	94	9165
8	Lopez-Jaramillo P	36	113	6532
9	Park S	36	117	6694
10	Lam CSP	34	38	2335

Table no- 04 shows the top 10 productive authors. Kumar A contributed 73 publications and comes in top topmost position followed by Yusuf S with 56 publications, Huang CY with 54 publications, Kumar S contributed 54 publications, and Lam CSP with 34 publications coming in 10th position respectively. From the table, it is seen that Kumar A has the lowest Local citation score than Yusuf S with 26 and 143, and also seen that Huang CY and Kumar S have the same number of publications that is 54.

5. Application of Lotka's Law in Congestive Heart Failure Studies

Lotka's law states that the number of authors making n contributions is about $1\backslash n\_\{2\}$ of those making a single publication. The contributions of authors making a single contribution are about 60% of the entire publication in a specific field. The basic lotka's formula outlines the number of authors yx each credited with x number

of papers is inversely proportional to x, which is the output of each author.

The relation is expressed as

$$X \text{ and } 1\{(n)\}Y - (x) = C$$

where yx is the number of authors making x contributions to the subject and n and c are the two constants to be estimated for the specific set of data. (Friedman, n.d.)

Lotka's formula for the scientific productivity of authors

$$Y = \frac{C}{X'^n}$$

Where,

Y = number of authors with X articles,

n = exponent and c = constant

The exponent 'n' can be calculated using the following formula: $= \frac{(20*11.6937)-(18.71766*19.63371)}{(20*20.15982)-(18.71766)^2}$ $n = \frac{-133.697}{52.9359}$

n = -2.522933

Therefore, using the value of n = 2.52, C can be calculated:

$$C = \frac{1}{1.326336} = \mathbf{0.75}$$

Table No.- 05 Calculation of 'n'

X	Y	X=log x	Y= log y	XY	X^2	X^n	$1/X^n$
1	1897	0	3.278067	0	0	1	1
2	1008	0.30103	3.003461	0.904132	0.090619	5.735821	0.174343
3	100	0.477121	2	0.954243	0.227645	15.93476	0.062756
4	64	0.60206	1.80618	1.087429	0.362476	32.89964	0.030395
5	42	0.69897	1.623249	1.134603	0.488559	57.73038	0.017322
6	22	0.778151	1.342423	1.044608	0.605519	91.39894	0.010941

7	25	0.845098	1.39794	1.181396	0.714191	134.7867	0.007419
8	12	0.90309	1.079181	0.974598	0.815572	188.7065	0.005299
9	8	0.954243	0.90309	0.861767	0.910579	253.9166	0.003938
10	1	1	0	0	1	331.1311	0.00302
11	5	1.041393	0.69897	0.727902	1.084499	421.0266	0.002375
12	5	1.079181	0.69897	0.754315	1.164632	524.2479	0.001907
13	4	1.113943	0.60206	0.670661	1.24087	641.4122	0.001559
14	4	1.146128	0.60206	0.690038	1.313609	773.1124	0.001293
15	4	1.176091	0.60206	0.708077	1.383191	919.9198	0.001087
16	1	1.20412	0	0	1.449905	1082.386	0.000924
18	1	1.255273	0	0	1.575709	1456.42	0.000687
21	1	1.322219	0	0	1.748264	2147.794	0.000466
22	1	1.342423	0	0	1.802099	2414.933	0.000414
30	1	1.477121	0	0	2.181887	5276.495	0.00019
TOTAL	**3206**	**18.71766**	**19.63771**	**11.69377**	**20.15982**	**16770.99**	**1.326336**

X =Number of publications; Y = Number of authors; □=Log x; □=Log y

From the above calculation,

$$n = 2.52, c = 0.75$$

$$\frac{1.63}{[\sum yx + (\sum yx/10)^{1/2}]^{1/2}}$$

$$= \frac{1.63}{[\sqrt{3206}+(\frac{\sqrt{3206}}{10})1/2]1/2} = 0.0287$$

C.V = **0.0287**

6. Kolmogorov-Smirnov (K-S) Test

K-S test is carried out by calculating the theoretical and observed cumulative frequency distribution of authors. The difference at each level of cumulative frequency distribution is counted. The maximum difference (Dmax) is observed and further, it is compared with the critical value. If the difference is less than the critical value, it is accepted otherwise rejected. (Kumar, 2019)

Table No.- 06 K-S test on observed and expected distribution of authors

X	Y	Observed author relative (yx/∑yx)	Cumulative (Fo)	Expected author relative C*(1/ xn)	Cumulative % (Fe)	Deviation (Fo-Fe)
1	1897	0.591703057	0.591703057	0.753957	0.753957	-0.162253943
2	1008	0.31441048	0.906113537	0.131447094	0.885404094	**0.020709443**
3	100	0.031191516	0.937305053	0.047315237	0.93271933	0.004585723
4	64	0.01996257	0.957267623	0.022916875	0.955636206	0.001631418
5	42	0.013100437	0.97036806	0.01305997	0.968696175	0.001671885
6	22	0.006862133	0.977230193	0.008249078	0.976945254	0.00028494

7	25	0.007797879	0.985028072	0.005593704	0.982538958	0.002489114
8	12	0.003742982	0.988771054	0.003995396	0.986534354	0.0022367
9	8	0.002495321	0.991266376	0.002969309	0.989503663	0.001762712
10	1	0.000311915	0.991578291	0.002276914	0.991780577	-0.000202286
11	5	0.001559576	0.993137867	0.001790758	0.993571335	-0.000433469
12	5	0.001559576	0.994697442	0.001438169	0.995009504	-0.000312062
13	4	0.001247661	0.995945103	0.001175464	0.996184968	-0.000239865
14	4	0.001247661	0.997192764	0.000975223	0.997160191	0.000032573
15	4	0.001247661	0.998440424	0.00081959	0.997979781	0.000460643
16	1	0.000311915	0.998752339	0.000696569	0.99867635	0.000075989
18	1	0.000311915	0.999064255	0.000517678	0.999194028	-0.000129774
21	1	0.000311915	0.99937617	0.000351038	0.999545066	-0.000168896
22	1	0.000311915	0.999688085	0.000312206	0.999857272	-0.000169187
30	1	0.000311915	1	0.00014289	1.000000162	0.000000162
TOTAL	**3206**	**1**			**D$_{max}$ = 0.02079443**	

X =Number of publications; Y = Number of authors, n = 2.52, c = 0.753, c.v = 0.028

The critical value is found to be 0.028. From the above table it is found that with a critical value of 0.0287, it has been determined that the actual value of D$_{max}$ = 0.02079443 is below the critical value at a significance level of 0.01. As a result, Lotka's law applies to the authors of congestive heart failure and datasets confirm Lotka's law with a value of n = 2.52.

FINDINGS

The major findings of the study are

1. A total of 2565 research papers were published from 1989 to 2023 in the field of Congestive Heart Failure in India. A gradual increase in publication is seen from 2016.

2. The highest number of publications is in the year 2021 with 291 (11.345%) articles followed by 279 (10.877%) articles in the year 2022, 239 (9.318%) articles published in 2020, 197(7.680%) articles published in the year 2018 and least articles published in the year 1989 with 1(0.039%).

3. Journal article is the major source of publications i.e., 1607 (63%) followed by Review with 479 (18.67%) records, Meetings Abstract with 265 (10.33%) records, Letters 62 (2.42%) and Letters; Early access, Retraction, and Review; Retracted publications have the lowest records.

4. The most productive preferred journal in Congestive heart failure is the European Journal of Heart Failure with 124 articles published followed by 63 articles in the International Journal of Cardiology, 48 articles published in the European Heart Journal, and 40 articles in Circulation journals.

5. The most productive author in CHF is Kumar A contributed 73 publications and is in the top position followed by Yusuf S with 56 publications, Huang CY with 54 publications, Kumar S contributed 54 publications, and Lam CSP with 34 publications in 10th position respectively.

6. According to the applicability of Lotka's law and Kolmogorov-Smirnov (K-S) Test it is found that the Dmax value (0.0207) is lower than the Critical value (0.0287). Therefore, the present data set fits to the Lotka's law.

CONCLUSION

The present study reveals the output of congestive heart failure publications. A total of 2565 records were retrieved from the Web of Science database for analysis. The objective of this study was to investigate the publication trend, including year-wise publications, journal-wise distribution, prolific authors, and Lotka's law. The result showed that the highest number of publications was in the year 2021. The most productive author is found to be Kumar A contributed to 73 publications and is in the top position. According to the present analysis, the applicability of Lotka's law was tested with the Kolmogorov-Smirnov (K-S) test to evaluate the observed values with the expected values and found that Lotka's law fit literature of congestive heart failure in India with a value of 'n'= 2.52. Researchers and medical professionals are increasingly interested and dedicated to understanding and addressing the challenges associated with congestive heart failure.

REFERENCE

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