

APPLICATION OF LOTKA'S LAWS USING STRAIGHT COUNT METHOD ON HEALTH LITERACY RESEARCH OUTPUT DURING 2017-2021

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ABSTRACT

This paper aims to study and analyze the research output and test Lotka's law of author productivity using the straight count method in the field of Health Literacy research. The data was collected from the PubMed database during the period (i.e. 2007-2021). A total of 9976 records were examined to identify the year, authors, countries, institutions, journals, and keywords-wise distribution of Health Literacy research output. According to the institutions, wise distribution the University of Sydney contributed the highest number of 842 (8.44%) records on Health Literacy. International Journal of Environmental Research and Public Health ranked first position with 544 (5.45%) records in journal-wise productivity and Humans is the keyword highly occurred (7776) in Health Literacy research output. The study also examined the applicability of Lotka's law using the Chi-Square test method.

Keywords: Lotka's law, Health Literacy, PubMed, Straight Count Method, Scientometrics

Introduction

Health Literacy was defined as the degree to which an individual can seek to obtain, process, examine, evaluate, and understand the basic health-related information sources and services required to obtain a correct decision to cure health-related issues. There are two types of Health Literacy addressed in society. They are (i) Personal Health Literacy and (ii) Organizational Health Literacy. Personal Health Literacy is defined as a person for himself and others needed information related to health decisions, he has the ability to collect, understand and use the information sources and services. Organizational Health Literacy means an organization helps to enable individuals to find, understand and use information sources and services for health-related decision action.

Review of Literature

Thamaraiselvi, Lakshmi, and Manthiramoorathi (2022) attempted to examine the application of scientometrics indicators in a Scientometric journal. They found that Lotka's law fit the dataset whereas Price's square root law and Pareto's principle do not fit the scientometric journal. Kushairi and Ahmi (2021) tested Lotka's law on the flipped classroom. They used Lotka's law to predict the future growth of the flipped classroom dataset. Tran and Aytac (2021) verified the applicability of Lotka's law in STEM

librarianship journals. Thamaraiselvi et al. (2020) examine the applicability of bibliometrics laws in scientometric journal publications from 2010 to 2019. They found that Lotka's law, Price's square root law, and Pareto's principle do not fit the dataset. Manthiramoorathi, Saravanakumar, and Thirumagal (2019) applied Lotka's law to the research productivity of information literacy. They verified Lotka's law using Kolmogorov – Smirnov test method and found that Lotka's law fit the information literacy data set.

Objectives

1. To examine the year-wise distribution of Health Literacy research output.
2. To find the most impact authors on Health Literacy research output.

Dr.R.R.SARAVANAKUMAR

*Librarian & Research Supervisor,
Sadakathullah Appa College(Autonomous),
Tirunelveli, Tamilnadu, India.*

M.MANTHIRAMOORTHI

*Librarian and Information Assistant Grade II,
Anna Centenary Library, Chennai, Tamil Nadu, India*

R.S.JAYA SURIYA DHEVA

*Ph.D. Research Scholar, Department of Library and
Information Science, Bharathidasan University,
Tiruchirappalli, Tamilnadu, India.*

3. To identify the most contributed countries to Health Literacy research output.
4. To know the most contributed institutions on Health Literacy research output.
5. To identify the most contributed journals on Health Literacy research output.
6. To find the keywords frequently occurring in Health Literacy research output.
7. To examine the applicability of Lotka's law on Health Literacy research output.

Hypothesis

1. Asian countries dominated Health Literacy research productivity.
2. Lotka's law fits the dataset of Health Literacy research output.

Methodology

The present study aims to identify the distribution of Health Literacy research output. The required data was retrieved and downloaded from the PubMed database for the period of 5 years from 2017 to 2021 [accessed on 15.07.2022]. A total of 9976 records were retrieved from the database using the search string 'Health Literacy'. The collected data was analyzed and tabulated using Biblioshiny software. This study explores the year-wise distribution, authors, countries, and institutions and tested the fitness of Lotka's law on health literacy research output.

Data Analysis and Interpretation

Year-wise Distribution of Health Literacy Research Output

Table 1

Year-wise Distribution of Health Literacy Research Output

Year	No. of Records	%	Cumulative Records	%
2017	1402	14.05	1402	14.05
2018	1692	16.96	3094	31.01
2019	1828	18.32	4922	49.34
2020	2324	23.3	7246	72.63
2021	2730	27.37	9976	100
Total	9976	100		

Table 1 shows the year-wise distribution of Health Literacy research output from 2017 to 2021. A total of 9976 records were published during the study period. It is observed that the most productive year is 2021 with 2730 (27.37%) records followed by 2020 with 2324 (23.30%), in 2019 is 1828 (18.32%), in 2018 it is 1692(16.96%) and 1402 (14.05%) of publications was recorded in the year 2017. Hence it concluded that there is an increasing trend in the publication of Health Literacy throughout the study period.

Most Impact Authors on Health Literacy Research Output

Table 2

Top 10 Most Impact Authors

Authors	No. of Records	%
MCCAFFERY K	60	0.6
WOLF MS	57	0.57
OSBORNE RH	50	0.5
ANONYMOUS	43	0.43
MUSCAT DM	41	0.41
MCCAFFERY KJ	40	0.4
OKAN O	36	0.36
SØRENSEN K	36	0.36
SCHILLINGER D	35	0.35
NUTBEAM D	34	0.34

Table 2 reveals the most impact authors on Health Literacy research output. Out of 10 authors, McCaffery K contributed the highest number of records (60, 0.60%) followed by Wolf MS (57, 0.57%), Osborne RH (50, 0.50%), Muscat DM (43, 0.43%) and McCaffery KY (40, 0.40%). Anonymous contribution is in fourth place in the above table with 43 (0.43%) records.

Most Contributed Countries on Health Literacy Research Output

Table 3

Top 10 Most Contributed Countries

Country	No. of Records	SCP	MCP	Freq	MCP_Ratio
ANONYMOUS	3260	3081	179	0.326	0.055
USA	1841	1648	193	0.184	0.105
AUSTRALIA	953	763	190	0.095	0.199
CHINA	428	314	114	0.043	0.266
CANADA	381	290	91	0.038	0.239
GERMANY	250	188	62	0.025	0.248
IRAN	215	188	27	0.021	0.126
NETHERLANDS	171	111	60	0.017	0.351
INDIA	144	118	26	0.014	0.181
JAPAN	133	114	19	0.013	0.143

Table 3 shows the most contributed countries on Health Literacy research output. Out of the top 10 countries, Anonymous occupied the top of the table with 3260 records followed by the USA with 1841 records, Australia (953), China (428), Canada (381), and German (250). India occupied 9th place in the table with 144 records. The highest number of single-author contributions is 3081 from Anonymous and the multiple authors' contributions are 193 from the USA. Asian countries contributed 920 (0.7%) records from the total contribution. Hence Hypothesis-1 "Asian countries dominated on Health Literacy research productivity" is statistically not proved.

Most Contributed Institutions on Health Literacy Research Output

Table 4

Top 10 Most Contributed Institutions

Affiliation	No. of Records	%
THE UNIVERSITY OF SYDNEY	842	8.44
UNIVERSITY OF CALIFORNIA	650	6.52
UNIVERSITY OF SYDNEY	396	3.97
VANDERBILT UNIVERSITY MEDICAL CENTER	313	3.14
UNIVERSITY OF TORONTO	294	2.95
MONASH UNIVERSITY	280	2.81
NORTHWESTERN	270	2.71
HARVARD MEDICAL SCHOOL	262	2.63
DEAKIN UNIVERSITY	249	2.5
UNIVERSITY OF MELBOURNE	227	2.28

Table 4 reveals the top 10 most contributed institutions on

Health Literacy research output. Out of 9976 records, the University of Sydney contributed the highest number of 842 (8.44%) records followed by the University of California with 650 (6.52%) publications, the University of Sydney with 396 (3.97%) records, Vanderbilt University Medical Center with 313 (3.14%) publications; the University of Toronto had 294 (2.95%) publications and so on.

Most Contributed Journals on Health Literacy Research Output

Table 5

Top 10 Most Contributed Journals

Name of the Journal	No. of Records	%
INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH	544	5.45
BMC PUBLIC HEALTH	210	2.11
PLOS ONE	183	1.83
BMJ OPEN	176	1.76
PATIENT EDUCATION AND COUNSELING	172	1.72
JOURNAL OF MEDICAL INTERNET RESEARCH	169	1.69
HEALTH LITERACY RESEARCH AND PRACTICE	166	1.66
HEALTH PROMOTION INTERNATIONAL	99	0.99
FRONTIERS IN PUBLIC HEALTH	96	0.96
STUDIES IN HEALTH TECHNOLOGY AND INFORMATICS	89	0.89

Table 5 indicates that International Journal of Environmental Research and Public Health occupied top position in the above table with 544 (5.45%) records followed by BMC Public Health with 210 (2.11%) publications, PLOS One published 183 (1.83%) records, BMJ Open journal with 176 (1.76%) publications, Patient Education and Counseling with 172 (1.72%) records and Journal of Medical Internet Research, Health Literacy Research and Practice, Health Promotion International, Frontiers in Public Health and Studies in Health Technology and Informatics journals contributed below 1.70% of the total contribution of sources on Health Literacy research output.



Most Keywords Occurrence on Health Literacy Research Output



Table 6

Top 10 Most Keywords Occurrence

Keywords	Occurrences	%
Humans	7776	9.32
Female	3860	4.62
Male	3254	3.9
Health Literacy	3248	3.89
Adult	2554	3.06
Middle Aged	2092	2.51
Surveys And	1786	2.14
Aged	1646	1.97
Cross-Sectional Studies	1594	1.91
Adolescent	1339	1.6

Table 6 explains the top 10 most occurred keywords on Health Literacy research output. Humans are the

keyword highly occurred (7776) in Health Literacy research output followed by female (3860) times, male (3254) occurrence, Health Literacy (3248) times, adult (2554) times, and so on. Middle-aged, surveys and questionnaires, aged, cross-sectional studies, and adolescent are the keywords that occurred below 3% of the total occurrence of keywords on Health Literacy research output.

Lotka’s Law of Author Productivity on Health Literacy Research Output

Lotka’s law was first proposed by Alfred J. Lotka, a US mathematician and Statistician in 1926 from the author's productivity of chemical abstract. He defined it as the number of authors making n contributions is about 1/xn of those making a single contribution, where n=2 is often used as a general method which helps to identify the fitness of Lotka’s law for a dataset.

Table 7

Lotka’s Law of Author Productivity

Documents written	Observed Authors	Log of Observed Authors	% of Observed Authors	Expected Authors	Log of Expected Authors	% Expected Authors	(O-E) ² /E
1	29201	10.281958	100	29201	10.282	100	0
2	4479	8.4071551	15.3385158	7300.25	8.89566	25	1090.3
3	1367	7.2203738	4.681346529	3244.555556	8.08473	11.11111	1086.5
4	576	6.3561077	1.972535187	1825.0625	7.50937	6.25	854.851
5	312	5.7430032	1.06845656	1168.04	7.06308	4	627.38
6	206	5.3278762	0.705455293	811.1388889	6.69844	2.777778	451.455
7	111	4.7095302	0.380123968	595.9387755	6.39014	2.040816	394.614
8	87	4.4659081	0.297935002	456.265625	6.12308	1.5625	298.855
9	63	4.1431347	0.215746036	360.5061728	5.88751	1.234568	245.516
10	39	3.6635616	0.13355707	292.01	5.67679	1	219.219
11	35	3.5553481	0.119858909	241.3305785	5.48617	0.826446	176.407
12	26	3.2580965	0.089038047	202.7847222	5.31214	0.694444	154.118
13	15	2.7080502	0.051368104	172.7869822	5.15206	0.591716	144.089
14	13	2.5649494	0.044519023	148.9846939	5.00384	0.510204	124.119
15	18	2.8903718	0.061641725	129.7822222	4.86586	0.444444	96.2787
16	14	2.6390573	0.047943564	114.0664063	4.73678	0.390625	87.7847
17	6	1.7917595	0.020547242	101.0415225	4.61553	0.346021	89.3978
18	4	1.3862944	0.013698161	90.12654321	4.50121	0.308642	82.3041
19	5	1.6094379	0.017122701	80.88919668	4.39308	0.277008	71.1983
20	8	2.0794415	0.027396322	73.0025	4.29049	0.25	57.8792
21	5	1.6094379	0.017122701	66.2154195	4.19291	0.226757	56.593
22	1	0	0.00342454	60.33264463	4.09987	0.206612	58.3492

23	6	1.7917595	0.020547242	55.20037807	4.01097	0.189036	43.8525
24	1	0	0.00342454	50.69618056	3.92585	0.173611	48.7159
25	1	0	0.00342454	46.7216	3.84421	0.16	44.743
26	2	0.6931472	0.006849081	43.19674556	3.76577	0.147929	39.2893
27	2	0.6931472	0.006849081	40.05624143	3.69028	0.137174	36.1561
28	1	0	0.00342454	37.24617347	3.61755	0.127551	35.273
29	2	0.6931472	0.006849081	34.72175981	3.54737	0.118906	30.837
30	1	0	0.00342454	32.44555556	3.47956	0.111111	30.4764
33	1	0	0.00342454	26.81450872	3.28894	0.091827	24.8518
34	1	0	0.00342454	25.26038062	3.22924	0.086505	23.3
35	1	0	0.00342454	23.83755102	3.17126	0.081633	21.8795
36	2	0.6931472	0.006849081	22.5316358	3.11492	0.07716	18.7092
40	1	0	0.00342454	18.250625	2.9042	0.0625	16.3054
41	1	0	0.00342454	17.37120761	2.85481	0.059488	15.4288
50	1	0	0.00342454	11.6804	2.45791	0.04	9.76601
57	1	0	0.00342454	8.98768852	2.19586	0.030779	7.09895
60	1	0	0.00342454	8.111388889	2.09327	0.027778	6.23467
	36617			47239.24097			6920.12

Table 7 shows the scientific productivity of authors on Health Literacy research output. The applicability of Lotka’s law was examined with the Chi-Square test to calculate the observed values with the expected values of the data set. The calculated Chi-Square test value is 6920.12 which was higher than the Chi-Square table value i.e. 53.38 at a degree of freedom 38 and the level of significance is 0.05. Hence it was confirmed that Lotka’s law did not fit the research output of health literacy. Hence Hypothesis-2 “Lotka’s law fits the dataset of health literacy research output” is statistically not proven.

Conclusion

The study examined the research output of Health Literacy over the study period of five years (2017-2021). The study identified the trends of research output in authors, countries, institutions, the contribution of journals, and keywords occurrences on Health Literacy research productivity. The growth rate of Health Literacy research output increased from 14.05% to 27.37% from 2017 to 2021. McCaffery K contributed highest number of records 60 (0.60%). Anonymous occupied the topper with 3260 records in country-wise contribution and India occupied the 9th position in the table with 144 records. According

to the institutions, wise distribution the University of Sydney contributed the highest number of 842 (8.44%) records on Health Literacy. International Journal of Environmental Research and Public Health ranked first position with 544 (5.45%) records in journal-wise productivity and Humans is the keyword highly occurred (7776) in Health Literacy research output. The applicability of Lotka’s law using the Chi-Square test does not fit the Health Literacy research output.

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