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IDENTIFICATION OF PREFERRED SOURCES FOR THE SCHOLARLY COMMUNICATIONS OF THE INDIAN CORPORATE MEDICAL INSTITUTIONS USING BRADFORD'S LAW OF SCATTERING

Susama Nanda¹, Kamal Lochan Jena², Manoj Mishra^{1}, D B Ramesh³*

Introduction: Health science research focuses to generate new knowledge through new techniques, research design and organizational interventions to serve the whole community. The number of documents published during a stipulated time is measured as the research strength of the concerned institutions to judge their performance.

Objective: The prime aim of this study is to find the prominent Indian corporate medical institutions and analyze their scholarly outputs with justification of Bradford's law.

Method: The authors choose 50 Indian corporate medical institutions to analyze their scholarly outputs during the studied period.

Discussion: The publication count, citations, h-index and citation per paper of the top 50 Indian corporate medical institutions are discussed with the help of textual and graphical formulation of Bradford's law of scattering.

Conclusion: As the error percentage is very negligible, the Bradford's law fits in this data set. The analysis identified 10 journals as the nucleus journals which are mostly referred by the researchers at Indian corporate medical institutions.

Key Words: h-index, Bradford's law, Corporate Medical Institutions, Leimkuhler model, Bradford multiplier

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Introduction:

The corporate Medical institutions were emerged in India during last three decades. Before that the institutions funded by government only provides the health care education. As per the website of Medical Council of India (MCI), it is found that there are 226 corporate Medical institutions provide health care education throughout India in every regions like: south, north, east and western territories of Indian sub-continent. There are 35 corporate Medical institutions in Karnataka, which is highest in the country and the southern region and 27 corporate Medical institutions in Maharashtra of Western region and Uttar Pradesh has 21 of such institutions in Northern part of India, whereas only 4 corporate medical institutions are situated in Odisha in the Eastern India^{1, 2, 3}.

The outcome of research satisfies the need of one segment whilst the other one satisfies different segments as per need. Good health is essential for all due to which Health management is essential. So, research in healthcare becomes the social need. The importance of Healthcare management can be envisaged as it emerged from the primitive time and gradually upgraded through continuous research works and combination of technologies in form of poison and therapeutics. So many discoveries / inventions are the outcome of these researches in various fields. The general practitioners are determined to improve the quality of life which is directly related to the new research of medical sciences in their concerned field. Health science research focuses to generate new knowledge through new technique, research design and organizational interventions to serve the whole community.

The number of documents published during a stipulated time is measured as the research strength of the concerned institution on a particular subject and reflected in various sources. The research outputs can be analyzed by various bibliometrics parameters, where Bradford's law of scattering is used to analyze the sources where the documents are published and the core journals are find out. S. C. Bradford first discussed on the thought of core journals in 1934 and it is accepted by the researchers as Bradford's law later on⁴. The core journal concept helps the researchers to identify and select the scholarly information sources⁵.

There are many studies formulated on Bradford's law of scattering in different aspects. Many researchers from various field also examined, contributed and re-verified the law with different

mathematical models as they felt there is some discrepancies in its verbal and graphical presentation. Vickery is the first man who modified the Bradford's law of scattering with his algebraic interpretation⁶. Some other researchers also interpret the verbal formulation of this law where as some of them also demonstrate the graphical design^{7, 8, 9, 10, 11, 12}.

The Bradford's law of scattering is applied in many research activities and published over a long time. In a study, Sengupta¹³ put a remarkable statement that expansion of knowledge in the subject helps the authors to publish their research papers in some sources which are not related to the concerned field. Gupta¹⁴ has made a study about Bradford's law of scattering on reference cite in Ethiopian medical journal where Everett and Pecotich¹⁵ have made their research on citation pattern of "The Journal of Psychology" which is a product of American Psychological Association (APA). In the citation analysis pattern, zone one show a clear idea of the citation pattern on the particular subject during a studied period. Smith¹⁶ indicates about some cited articles published in journals during their period of research. Smith also found in another study that a single research paper is cited more than 50% in 10 years, which is the maximum occurrence between 10 and 15 years¹⁷. In another interesting study, Lariviere et al. found the decreasing citation pattern in certain period and mentioned that 33% of journal articles in health science received 80% of citations in 2005 whereas only 24% was in 1990¹⁸. As disease outbreaks, the citation analysis varies from time to time. It is observed from the previous studies that the 1 to 5 years old articles have received half of all citation in public health, where as 10 or fewer year old research documents received 75% of all citations^{19, 20, 21, 22, 23}. In the year 2001, another study by Maher et al²⁴ identified 49 core journals out of 519 in the subject of evidence based physical therapy. The Bradford's law of scattering identifies the core journals which are accountable for a disproportionate number of literatures in any subject and publish highest articles on that topic^{25, 26}.

Objective of the study:

The prime aim of this study is –

- To find the prominent Indian corporate medical institutions and their publications thereof.
- To critically analyze the scholarly outputs of Indian corporate medical institutions and its applicability to the Bradford's law.

Methods used:

The data for this study is retrieved from SCOPUS database with a limitation to the year 2007 – 2016 and different tables are drawn accordingly. The authors have chosen only 50 corporate medical institutions with more than 250 publications to their credit during 10 years of study.

Discussion:

The research output of any academic organizations helps the institutions to establish themselves among their competitors. The performance and the comparison analysis can be judged with the published articles taken into consideration. The overall ranking of the institutions are measured with many variable where research activity cannot be ignored.

The collected data is tabulated here for a better understanding about the scholarly outputs of the Indian corporate medical institutions during the period of study and analyzed carefully the published sources with the help of Bradford's law of scattering. The detail analysis is given below.

Table - 1: Publication details of top 50 Indian Corporate Medical Institutions

SL. No	Name of the Institute	Publication	Citation	h-index	C/P
1	Christian Medical College, Vellore	4080	49765	79	12.20
2	Kasturba Medical College, Manipal	3239	18594	42	5.74
3	Tata Memorial Hospital, Mumbai	3011	48573	72	16.13
4	Kasturba Medical College, Mangalore	1845	12469	40	6.76
5	L. V. Prasad Eye Institute, Hederabad	1593	17345	49	10.89
6	Amrita Institute of Medical science, Kochi	1536	31653	77	20.61
7	Pandit Bhagawat Dayal Sharma Postgraduate Institute, Rohtak	1522	6964	31	4.58
8	Jamia Hamdard Faculty of Pharmacy, New Delhi	1516	27497	73	18.14
9	Sir Ganga Ram Hospital, New Delhi	1228	9989	41	8.13
10	Sri Rama Chandra University,	1173	26351	44	22.46
11	BYL Naire Charitable Hospital & TN medical college,	881	4252	27	4.83

12	Christian Medical College, Ludhiana	834	16519	33	19.81
13	PD Hinduja National Hospital & Medical Research Centre, Mumbai	801	9413	40	11.75
14	Shree Balaji Medical College and Hospital, Chennai	781	1526	18	1.95
15	Manipal College of Dental Science,	770	2983	25	3.87
16	Regional Institute of Medical Science, Manipur	711	1262	14	1.77
17	Bharati Vidyapitha University, Pune	708	7189	37	10.15
18	SRM University, Tamilnadu	693	3804	29	5.49
19	Jawaharlal Medical College, Belgaum	691	5004	29	7.24
20	M.S. Ramiah Medical College, Bangalore	682	2902	23	4.26
21	Indraprastha Appollo Hospitals, New Delhi	669	5723	32	8.55
22	Fortis Healthcare, New Delhi	667	27012	54	40.50
23	JSS Medical College, Mysore	663	6629	27	10.00
24	School of Medical Sciences and Research Centre (Sharada University), Noida	651	4888	33	7.51
25	Jagatguru University, Bangalore	634	7139	27	11.26
26	Dayananda Medical College & Hospital, Ludhiana	628	6736	33	10.73
27	Mahatma Gandhi Medical College & Research Institute, Pondicherry	594	2084	20	3.51
28	Fr. Muller Medical College & Hospital, Mangalore	540	3053	28	5.65
29	K.S. Hegede Medical Academy, Mangalore	536	4383	31	8.18
30	St. John's Medical College, Mangalore	521	4988	31	9.57
31	Arabind Eye Hospital, Madurai	515	5917	36	11.49
32	Siksha O Anusandhan University, Bhubaneswar	508	2254	22	4.44
33	Himalayan Institute of Medical Science, Dehradun	472	3838	18	8.13
34	Jaslok Hospital & Research Centre, Mumbai	448	7921	41	17.68
35	Bombay Hospital & Medical Research Centre, Mumbai	445	5343	32	12.01
36	Bharatidarsan University, Trichy	436	4078	30	9.35
37	Krishna Institute of Medical	433	2109	21	4.87

	Sciences, Karad (Maharashtra)				
38	Madras Diabetes Research Foundation, Chennai	432	15834	56	36.65
39	Amity University, Uttarpradesh	394	3274	28	8.31
40	Vision Research Foundation, Chennai	389	5774	35	14.84
41	SASTRA University, Tamilnadu	380	2890	25	7.61
42	SBKS Medical Institute and Research Centre, Vadodara	375	1623	19	4.33
43	Manipal Hospital, Bangaluru	374	4733	33	12.66
44	PSG Institute of Medical Science and Research, Coimbatore	366	1899	19	5.19
45	J.J.M. Medical College, Karnataka	340	1057	14	3.11
46	Kalawati Saran Children's Hospital, New Delhi	324	2315	21	7.15
47	Escorts Heart Research Institute, New Delhi	317	5700	23	17.98
48	Sikkim Manipal Institute of Medical Science, Gangtok	278	1403	18	5.05
49	Narayan Medical College, Nellore	260	1065	17	4.10
50	Kempegowda Institute of Medical Sciences, Karnataka	257	1231	15	4.79

The complete information about the publication, citation, h-index and citation per paper of the top 50 Indian corporate medical institutions are tabulated in table -1. This study reveals that Christian Medical College, Vellore has received highest h-index of 79 and J J M Medical College, Mysore has the h-index of 14, which is the lowest among all. Table - 1 indicates the highest citation per paper goes for Fortis Healthcare, New Delhi and the lowest is for Regional Institute for Medical Science, Manipur.

Application of Bradford's law:

Bradford's law of scattering helps to rank the cited core sources which are shown in the table given below.

Rank List of Core Cited Sources

Table 2 - Ranking of Sources

Sl. No	Rank	Source Title	No of Citations	% of Citations	Cumulative Citations	Cumulative Citations %
1	1	Journal of Clinical and Diagnostic Research	2157	5.113	2157	5.113
2	2	Journal of Association of Physicians of India	879	2.083	3036	7.196
3	3	BMJ Case Reports	871	2.064	3907	9.260
4	4	Research Journal of Pharmaceutical Biological And Chemical Sciences	821	1.946	4728	11.206
5	5	Indian Journal of Ophthalmology	535	1.268	5263	12.475
6	6	Indian Pediatrics	526	1.247	5789	13.721
7	7	Indian Journal of Pathology and Microbiology	518	1.228	6307	14.949
8	8	Indian Journal of Pediatrics	515	1.221	6822	16.170
9	9	Neurology India	452	1.071	7274	17.241
10	10	Indian Journal of Medical Research	443	1.050	7717	18.291
11	11	Plos One	429	1.017	8146	19.308
12	12	Journal of Cancer Research and Therapeutics	415	0.984	8561	20.292
13	13	Indian Journal of Cancer	406	0.962	8967	21.254
14	14	Indian Journal of Dermatology	398	0.943	9365	22.197
15	15	Asian Journal of Pharmaceutical And Clinical Research	396	0.939	9761	23.136
16	16	Indian Journal of Anaesthesia	394	0.934	10155	24.070
17	17	Indian Journal of Gastroenterology	377	0.894	10532	24.963
18	18	Indian Journal of Community Medicine	372	0.882	10904	25.845
19	19	JMS Journal of Medical Society	364	0.863	11268	26.708
20	20	Indian Journal of Medical Microbiology	361	0.856	11629	27.563
21	21	Indian Journal of Dermatology Venereology and Leprology	358	0.849	11987	28.412
22	22	Journal of Anaesthesiology Clinical Pharmacology	354	0.839	12341	29.251
23	23	National Medical Journal of India	353	0.837	12694	30.088

24	24	International Journal of Pharma and Bio Sciences	348	0.825	13042	30.913
25	25	Indian Heart Journal	344	0.815	13386	31.728
26	26	Journal Indian Academy of Clinical Medicine	324	0.768	13710	32.496
27	27	Indian Journal of Psychiatry	312	0.740	14022	33.235
28	28	Australasian Medical Journal	305	0.723	14327	33.958
29	29	Indian Journal of Urology	300	0.711	14627	34.669
30	30	Indian Journal of Public Health Research and Development	279	0.661	14906	35.331
31	31	Journal of Postgraduate Medicine	278	0.659	15184	35.990
32	32	Indian Journal of Critical Care Medicine	276	0.654	15460	36.644
33	33	Journal of Forensic and Legal Medicine	259	0.614	15719	37.258
34	34	Indian Journal of Surgery	258	0.612	15977	37.869
35	35	Indian Journal of Medical and Paediatric Oncology	244	0.578	16221	38.447
36	36	International Journal of Pharmacy and Pharmaceutical Sciences	241	0.571	16462	39.019
37	37	Indian Journal of Surgical Oncology	232	0.550	16694	39.569
38	38	Online Journal of Health and Allied Sciences	230	0.545	16924	40.114
39	39	Lung India	223	0.529	17147	40.642
40	40	Indian Journal of Pharmacology	211	0.500	17358	41.142
41	41	International Journal of Biological Macromolecules	210	0.498	17568	41.640
42	42	Tropical Doctor	197	0.467	17765	42.107
43	43	Indian Journal of Otolaryngology And Head And Neck Surgery	193	0.457	17958	42.565
44	44	Annals of Indian Academy of Neurology	188	0.446	18146	43.010
45	45	Indian Journal of Nuclear Medicine	186	0.441	18332	43.451
46	46	Biomedicine India	183	0.434	18515	43.885
47	47	International Journal of Pharmaceutical Sciences Review And Research	180	0.427	18695	44.311
48	48	Medico Legal Journal	178	0.422	18873	44.733
49	49	Journal International Medical Sciences Academy	177	0.420	19050	45.153

50	50	Indian Journal of Palliative Care	176	0.417	19226	45.570
51	51	Asian Pacific Journal of Cancer Prevention	173	0.410	19399	45.980
52	52	Journal of Indian Academy of Forensic Medicine	172	0.408	19571	46.388
53	53	Indian Journal of Orthopedics	167	0.396	19738	46.784
54	54	Clinical Nuclear Medicine	164	0.389	19902	47.172
55	55	Annals of Pediatric Cardiology	158	0.374	20060	47.547
56	=55	Carbohydrate Polymers	158	0.374	20218	47.921
57	56	Lancet	148	0.351	20366	48.272
58	57	Asian Pacific Journal of Tropical Disease	146	0.346	20512	48.618
59	58	Indian Journal of Radiology and Imaging	143	0.339	20655	48.957
60	59	Journal of Biomedical Nanotechnology	140	0.332	20795	49.289
61	60	Indian Journal of Physiology and Pharmacology	138	0.327	20933	49.616
62	=60	Nuclear Medicine Communications	138	0.327	21071	49.943
63	61	Haemophilia	137	0.325	21208	50.268
64	62	European Journal of Nuclear Medicine and Molecular Imaging	136	0.322	21344	50.590
65	=62	Indian Journal of Plastic Surgery	136	0.322	21480	50.913
66	=62	Journal of Clinical and Experimental Hepatology	136	0.322	21616	51.235
67	63	Indian Journal of Clinical Biochemistry	133	0.315	21749	51.550
68	64	Cochrane Database of Systematic Reviews	130	0.308	21879	51.858
69	65	Indian Journal of Endocrinology and Metabolism	127	0.301	22006	52.159
70	66	Biomedicine	126	0.299	22132	52.458
71	67	British Journal of Ophthalmology	123	0.292	22255	52.749
72	68	Journal of The Indian Medical Association	119	0.282	22374	53.032
73	=68	Singapore Dental Journal	119	0.282	22493	53.314
74	69	Indian Journal of Nephrology	114	0.270	22607	53.584
75	70	Journal of Pharmacy and Bioallied Sciences	109	0.258	22716	53.842
76	71	Journal of South India	108	0.256	22824	54.098

		Medicolegal Association				
77	72	Indian Journal of Forensic Medicine and Toxicology	107	0.254	22931	54.352
78	=72	Ophthalmic Plastic and Reconstructive Surgery	107	0.254	23038	54.605
79	73	Annals of Cardiac Anaesthesia	104	0.247	23142	54.852
80	74	New England Journal of Medicine	103	0.244	23245	55.096
81	75	Indian Journal of Practical Pediatrics	102	0.242	23347	55.338
82	76	Journal of Obstetrics and Gynecology of India	101	0.239	23448	55.577
83		Others (2490 Journals)	18742	44.423	42190	100.00

Citation Trend of Journal Literature in Health Science

The decreasing citation of journals are arranged and analyzed in table - 3.

Table 3 – Citation Trend of Journals

Sl. No	No of Citations	No of Journals	Cumulative Journals	Cumulative Journals %	Total No of Citations of equal Rank	Cumulative Citations	Cumulative Citations %
1	2157	1	1	0.039	2157	2157	5.113
2	879	1	2	0.078	879	3036	7.196
3	871	1	3	0.117	871	3907	9.260
4	821	1	4	0.156	821	4728	11.206
5	535	1	5	0.194	535	5263	12.475
6	526	1	6	0.233	526	5789	13.721
7	518	1	7	0.272	518	6307	14.949
8	515	1	8	0.311	515	6822	16.170
9	452	1	9	0.350	452	7274	17.241
10	443	1	10	0.389	443	7717	18.291
11	429	1	11	0.428	429	8146	19.308
12	415	1	12	0.467	415	8561	20.292
13	406	1	13	0.505	406	8967	21.254
14	398	1	14	0.544	398	9365	22.197
15	396	1	15	0.583	396	9761	23.136
16	394	1	16	0.622	394	10155	24.070
17	377	1	17	0.661	377	10532	24.963
18	372	1	18	0.700	372	10904	25.845
19	364	1	19	0.739	364	11268	26.708

20	361	1	20	0.778	361	11629	27.563
21	358	1	21	0.816	358	11987	28.412
22	354	1	22	0.855	354	12341	29.251
23	353	1	23	0.894	353	12694	30.088
24	348	1	24	0.933	348	13042	30.913
25	344	1	25	0.972	344	13386	31.728
26	324	1	26	1.011	324	13710	32.496
27	312	1	27	1.050	312	14022	33.235
28	305	1	28	1.089	305	14327	33.958
29	300	1	29	1.128	300	14627	34.669
30	279	1	30	1.166	279	14906	35.331
31	278	1	31	1.205	278	15184	35.990
32	276	1	32	1.244	276	15460	36.644
33	259	1	33	1.283	259	15719	37.258
34	258	1	34	1.322	258	15977	37.869
35	244	1	35	1.361	244	16221	38.447
36	241	1	36	1.400	241	16462	39.019
37	232	1	37	1.439	232	16694	39.569
38	230	1	38	1.477	230	16924	40.114
39	223	1	39	1.516	223	17147	40.642
40	211	1	40	1.555	211	17358	41.142
41	210	1	41	1.594	210	17568	41.640
42	197	1	42	1.633	197	17765	42.107
43	193	1	43	1.672	193	17958	42.565
44	188	1	44	1.711	188	18146	43.010
45	186	1	45	1.750	186	18332	43.451
46	183	1	46	1.788	183	18515	43.885
47	180	1	47	1.827	180	18695	44.311
48	178	1	48	1.866	178	18873	44.733
49	177	1	49	1.905	177	19050	45.153
50	176	1	50	1.944	176	19226	45.570
51	173	1	51	1.983	173	19399	45.980
52	172	1	52	2.022	172	19571	46.388
53	167	1	53	2.061	167	19738	46.784
54	164	1	54	2.100	164	19902	47.172
55	158	2	56	2.177	316	20218	47.921
56	148	1	57	2.216	148	20366	48.272
57	146	1	58	2.255	146	20512	48.618
58	143	1	59	2.294	143	20655	48.957
59	140	1	60	2.333	140	20795	49.289
60	138	2	62	2.411	276	21071	49.943

61	137	1	63	2.449	137	21208	50.268
62	136	3	66	2.566	408	21616	51.235
63	133	1	67	2.605	133	21749	51.550
64	130	1	68	2.644	130	21879	51.858
65	127	1	69	2.683	127	22006	52.159
66	126	1	70	2.722	126	22132	52.458
67	123	1	71	2.760	123	22255	52.749
68	119	2	73	2.838	238	22493	53.314
69	114	1	74	2.877	114	22607	53.584
70	109	1	75	2.916	109	22716	53.842
71	108	1	76	2.955	108	22824	54.098
72	107	2	78	3.033	214	23038	54.605
73	104	1	79	3.072	104	23142	54.852
74	103	1	80	3.110	103	23245	55.096
75	102	1	81	3.149	102	23347	55.338
76	101	1	82	3.188	101	23448	55.577
77		2490	2572	100.00	18742	42190	100.00

Implementation of Bradford's Law:

Using the verbal formulation of Bradford's Law, the appropriateness of distribution of journals could be observed and the following explanations are made. The data consisting of whole journal references arranged in descending order of frequency is dealt with verbal formulation and the graphical formulation based on the same data is dealt in application of Leimkuhler Model.

Verbal Formulation:

The number of cited journals is arranged in the descending order of citations. The rank number of journals, number of citations, cumulative number of citations is given to test the applicability of Bradford' law verbal formulation.

The total 2572 journals are divided into three zones to test the algebraic interpretation of Bradford's law. By dividing the journals of a zone by its preceding zone the Bradford's multiplier factor is found. The ratio of the number of journals in any group to the number of journals in any immediately preceding group is known as Bradford's multiplier. The percentage error in distribution of citations, among the three zones should be minimum which the basis for selection of three zones is.

The value of Bradford's multipliers, the distribution of journals and the corresponding number of citations are calculated as follows

Total Citations are = 42190

Zone =3

Approximate citations should be = $42190 / 3 = 14063.33$

Table – 4: Scattering of Journals and Citations in Bradford's Zone (Verbal Formulation)

Zone	No of Journals	% of Journals	No of Citations
1	28	1.089	14327
2	127	4.938	14069
3	2417	93.974	13794
Total	2572	100	42190

According to Bradford the zones that are identified forms an approximately geometric series in the form $1: n: n^2$. In the present study the relationship of each zone is 28: 127: 2417, which does not fit with the Bradford's distribution.

In the failure of above distribution, the Leimkuhler model is tested for the suitability of Bradford's Law of Scattering.

Application of Leimkuhler Model:

Bradford did not suggest any mathematical model for his law. The different models were suggested by Brookes, Vickery and Leimkuhler. Different models of Bradford's law were formulated by different authors during their explanation of scattering of articles in journals. However Leimkuhler had developed the following model on the basis of verbal formulation.

$$R_{(r)} = a \log (1+br) \dots \dots \dots \text{eq1}$$

Where $r = 1, 2, 3$

During analysis of Leimkuhler's Law, Egghe found that

$$A = y_0 / \log k$$

$$B = k^{-1} / r_0$$

Where, r_0 is the number of sources in the first Bradford's group, Y_0 is the number of items in every Bradford group (all these group of item being of equal sizes) and k is the Bradford's multiplier.

$R_{(r)}$ is the cumulative number of items produced by the sources of rank 1, 2, 3..... r and a and b are constants appearing in Leimkuhler law. In Bradford groups, it is exhibited that the number of group p is a parameter which can be preferred.

Egghe had exhibited the mathematical formula for calculating the Bradford Multiplier k as

$$k = (e^g y_m)^{1/p} \dots\dots\dots \text{eq 2}$$

Where g is Euler's number ($e^g = 1.781$)

While the sources are ranked in decreasing order of productivity then y_m is the number of items in the most productivity sources.

Then y_m and r_0 are

$$Y_0 = y_m^2 \log k$$

$$r_0 = (k-1) y_m$$

Once p is chosen, the value of k can be calculated as

$$k = (e^g y_m)^{1/p}$$

$$\text{and } y_0 = A/P$$

Where A denotes the total number of articles, Let denote the total number of journals in Bradford group is $r_0 k^{i-1}$ where ($i=1, 2, 3 \dots p$)

$$T = r_0 + r_0 k + r_0 k^2 + r_0 k^{p-2}$$

$$\text{So, } r_0 = \frac{T}{1 + k + k^2 + \dots \dots \dots + k^{p-1}} = \frac{T(k-1)}{(k^p-1)}$$

Since, A and T could be derived from the data set r_0 and y_0 are calculated, once p is determined by the eq 2

For the application of Bradford's Law the citation distribution were divided into three zones ($p = 3$ where ' p ' denotes the Number of Zones). By applying the mathematical formula

$$k = (e^g y_m)^{1/p}$$

$$\text{Where } k = (1.781 \times y_m)^{1/p}$$

$$e^g = 1.781 \text{ (Constant)}$$

y_m = number of items in the most productive source

$p=3$ where p denote the Number of Zones

In the present instance y_N = numbers of items in the preferred productive source = 2157

Therefore, the value of Bradford's multiplier 'k' is determined as follows:

$$k = (1.781 \times 2157)^{1/3}$$

$$K = 15.66$$

$$Y_0 = A/P$$

Where A = refers the total number of articles = 42190

$$P = \text{total number of Zones} = 03$$

$$Y_0 = 42190 / 3 = 14063.33$$

$$R_0 = T(k-1) / (k^p - 1) = \frac{2572(15.66 - 1)}{(15.66^3 - 1)} = 9.821$$

$$a = Y_0 / \log k = 11768.477$$

$$b = k - 1 / r_0 = 1.493$$

So the nucleus = $r_0 = 9.82$

$$1: n: n^2$$

$$9.82: (9.82 \times 15.66): (9.82 \times (15.66)^2)$$

$$9.82: 153.78: 2408.21 = 2571.814 \text{ (approx. 2572)}$$

% of error is negative and very negligible. Suggest very high scattering.

Scattering of Journals and Citations over Bradford's Zones according to Bradford's law is depicted in the table given below.

Table – 5: Scattering of Journals and Citations in Bradford’s Zone (Leimkuhler Model)

Zone	No of Journals	% of Journals	No of Citations
1	10	0.389	7717
2	154	5.99	21123
3	2408	93.624	13350
Total	2572	100	42190

The table - 5 depicted that the number of journals in the nucleus is 9.82 and the mean value of the Bradford multiplier is 15.66. Therefore, the Bradford’s distribution is written as: 1: n: n²

i.e. 9. 82: (9.82 x 15.66): (9.82 x (15.66)²)

9. 82: 153.78: 2408.21 =2571.81 (approx. 2572)

% of error is negative and very negligible. Suggest very high scattering.

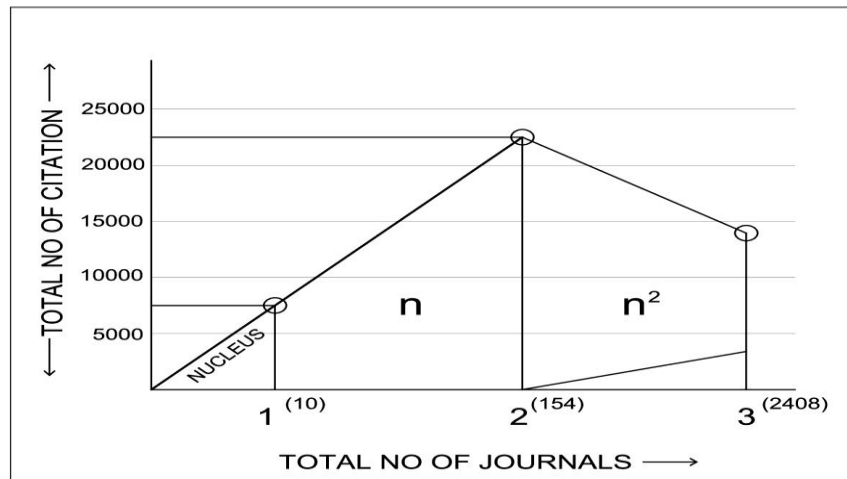


Fig 1 – Graphical presentation of Bradford’s law of scattering

From the study it is found that, the number of journals to each zone increases by multiplier of 15.66. The analysis of different zones show that the first zone having 10 journals contributed 7717 citations, the second zone have 21123 citations from 154 journals and the third zone have 2408 journals which produced 13350 citations. In this case the mean value of the Bradford's Multiplier (BM) is large i.e. two digits. Presumably larger the Bradford Multiplier, the scatter will be higher. Although the value of Bradford Multiplier depends on the size of the data, it is acceptable that smaller the data, smaller the value of Bradford Multiplier.

Conclusion:

Christian Medical College situated at Vellore has more number of publications and its h-index is 79 with citation per paper is 12.20. Kempegowda Institute of Medical Sciences situated at Bangalore listed in the bottom of the table with 257 publications and its h-index is 15 with citation per paper 4.79. Journal of Clinical and Diagnostic Research indexed in SCOPUS database published the highest number of article during these 10 years and followed by Journal of Association of Physicians of India (JAPI) with 879 published documents and BMJ Case Reports with 871 research articles. As the error percentage is very negligible, the Bradford's law fits in this data set. The analysis identified 10 journals as the nucleus journals which are mostly referred by the researchers.

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