

Patterns of Authorship and Research Collaboration on Cardiovascular Disease in Science Citation Index Expanded

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ABSTRACT

This study has tried to identify the patterns of authorship and Research Collaboration through scholarly publications of Indian Scientists on Cardiovascular Disease. A total number of 2029 scientific publications with 25259 global citations indexed in Science Citation Index Expanded (SCIE) of Web of Science (WoS) database were retrieved for analysis from 2005 to 2014. The study observes the various dimensions of characteristics of authors and their research productivity, authorship pattern, most prolific authors and many other features are discussed. The study includes ten years span between 2005 and 2014, both the years inclusive. The research output of faculties from India, which comes to 2029 publications, was taken as a base to measure these parameters. The results revealed that the major proportion of documents was found in 2014 followed by the year 2013. The analysis of Relative Growth Rate and Doubling Time of Cardiovascular Disease during 2005-2014 output has shown an increasing trend, and doubling time for publications has shown progressively decreasing trend. The journal article records the first rank, and it occupies more than 75 percent of total output of Indian scientists on cardiovascular disease.

Key Words: Scientometrics, Bibliometrics, Cardiovascular disease, SCIE, WoS, publication analysis

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INTRODUCTION

Collaboration has divided into two such as domestic as well as international collaboration. Cheng et al. (2013) have rightly quoted in his paper that "Collaboration is a going concern in the knowledge-based economy. Through joint efforts, individuals can compete better in this increasingly dynamic, complex and interactive economy. Research collaboration is the multi-facet concept. Not only is collaboration among researchers encouraged, but fostering

collaboration across different sectors, particularly among universities, governments, and industries, and international collaboration is increasingly becoming key agenda in many countries." The significance of research collaboration is explained by Hausmann et al. (2011, p.15) who maintain that "the amount of knowledge embedded in a society, however, does not depend mainly on how much knowledge each holds". Hence, Research collaboration bridges the different pieces of knowledge and integration allows for the creation of new idea. Thus, research collaboration is greatly emphasized and encouraged.

It is known that Cardiovascular disease (CVD) is a category that involve the heart or blood vessels. The common CVDs include ischemic heart disease (IHD), stroke, hypertensive heart disease, rheumatic heart disease (RHD), aortic aneurysms, cardiomyopathy, atrial fibrillation, congenital heart disease, endocarditis, and peripheral artery disease (PAD), among others. It estimates that 90% of CVD is preventable. The cardiovascular system, also known as the circulatory system, is an organ system that encompasses the heart and blood vessels of the body. The cardiovascular system carries blood, oxygen, and nutrients to organs and tissues of the body, and carries waste and carbon dioxide from these tissues for removal from the body. The cardiovascular system can also be subject to disease. High cholesterol levels can accumulate in inflamed areas of blood vessels, reducing or blocking blood flow to affected tissues in the body. There are other types of Cardiovascular Disease such as Heart failure, Arrhythmia, and Heart valve problems. Some of the risk factors for CVD, including high blood pressure (hypertension), smoking, high blood cholesterol diabetes, lack of exercise, being overweight or obese, family history of heart disease and ethnic background. The most deaths caused by cardiovascular disease are premature and could easily prevent by making change of lifestyle, like healthy eating, fitness, and stopping smoking. This study has tried to identify the Research Output of Indian Scientists on Cardiovascular Disease from 2005 to 2014 to observe the various dimensions of characteristics of authors and their research productivity, authorship pattern, most prolific authors and many other features. The study includes ten years span between 2005 and 2014, both the years inclusive.

RELATED WORK

Gal et al. (2015) examined the cardiovascular research during 1993-2013 with 565 journals and found only 50% of core cardiovascular journals such as the Journal of American College of Cardiology. It was noted that the growth rate of the clinical journal community and merged into one broad journal community suggested a decreasing dichotomy between basic/preclinical and clinical research during the study period. Velmurugan and Radhakrishnan (2015) investigated scientometric observations on the pattern of authorship, and collaborative research trends of DESIDOC Journal of Library and Information Technology and found the highest author productivity was in 2012 and lowest was in 2007. The majority of scholarly papers were from multi-authors, and the remaining was from solo authors, and the average degree of collaboration was 0.59. Cunningham and Dillon (1997) carried out a study to examine the authorship patterns in information systems which was published Scientometrics journals, and found the collaborative authors are predominant and multi-authored research publications found huge amount of record count.

Velmurugan and Radhakrishnan (2017) carried out a study on Malaysian Journal of Library and Information Science (MJLIS) with research output during 1996-2014 with a total of 315 articles. The results depicts that 8.89% was the maximum number of research output in 2011 whereas the lowest number 4.13% was in 1998, and the average authors per paper was 2.90

in 2012, and the average Exponential growth rate was 1.007. Velmurugan and Radhakrishnan (2016) observed the literature growth on Nanotechnology in Canada and identified the average number of literature output per year was 33.88 and the highest number of publications published during 2013 – 2014. The maximum number of authors was 364 with the mean value of 4.77. Velmurugan and Radhakrishnan (2016) explored to identify the research growth on Nanotechnology with 1088 research output during 1994-2015, and found the average number of literature output published per year was 927.70. Kumar, S from Indian Institute of Science, Department of Chemical Engineering, Bangalore, India contributed 20 research papers (1.8%), and the majority of highly cited research papers were produced by Sastry M from National Chemical Laboratory, Maharashtra, India with 12 records (1.1%).

Gupta and Gupta (2014) examined with 2508 scientific publications from Indian pneumonia research which were indexed in Scopus database during 2004-2013, witnessing an annual average growth rate of 19.86%, an average citation impact per paper of 2.85, and international collaborative publication share of 14.19%. The global share of Indian pneumonia research was 2.74% during 2004-2013, which increased from 1.83% to 3.39% from 2004-08 to 2009-13. Medicine contributed the largest publications share (76.28%) in Indian pneumonia research, followed by pharmacology, toxicology & pharmaceuticals (16.27%), biochemistry, genetics & molecular biology (13.12%), immunology & microbiology (7.19%) and chemistry (3.99%) etc. The study conducted by Velmurugan (2013) to identify the scholarly output in *Annals of Library and Information Studies* with 203 contributions published in the journal for a period of selected six years from 2007 to 2012. Further, Velmurugan and Radhakrishnan (2017) conducted a study on authorship pattern and collaborative research on Nephrology literature in India and found most of the scholarly publications were from multi-authored, and they were the predominant during the study period. It observed from the study that the highest number of contributions 43 (21.19%) published in the year 2010. Sudhier and Priyalakshmi (2013) examined with bibliographic details of 1076 research articles which were obtained from the annual reports of Central Tuber Crops Research Institute (CTCRI) studied and found that the highest number of 169 papers published in 2006 and the average number of publications per year was 97.82. Most of the contributions were multi-authored (87.68%). The degree of collaboration of scientists of CTCRI was 0.87.

MATERIALS AND METHODS

This study was an attempt to find out the “Research Output of Indian Scientists on Cardiovascular Disease from 2005 to 2014: A Scientometric Study”. The data collected from the web of science database by using the ‘document search’ provision. The search conducted for the term Cardiovascular Disease, search field selected was core journals. The study evaluates the overall literature output over a period of ten years’ time (i.e., 2005-2014). This study covers ten years span between 2005 and 2014, both the years inclusive. All the records downloaded exclusively from the Web of Science online database. The objectives framed for the studies with the exclusive notion are to examine the growth of research productivity on Cardiovascular Disease from 2005 to 2014. To identify the Relative Growth Rate and Doubling Time, forms of publications, subject-wise publication output, Ranking of Journals, the law of Scattering, Year-wise authorship pattern and the degree of collaboration over the study period.

ANALYSIS AND RESULTS

Relative Growth Rate and Doubling Time of Cardiovascular Disease

Table 1 shows the relative growth rate and doubling time for the productivity of Indian scientists on Cardiovascular Diseases. It can observe that the relative growth rate of Cardiovascular Disease in research literature output 0.57 till 2006. Within the period of study, an increased trend has been observed from 2007 to 2014, which calculated 0.86 to 1.71. The overall study period has witnessed a mean relative growth rate of 1.12. The doubling time for publication of all sources are noted to 1.21 to 0.40 between 2006 and declared to 0.40 in 2014. The finding shows that the doubling time for the periods 2005- 2014 has registered as 1.12. It means the whole study period has shown an average doubling time for publication as 1.12 years. As far as the research papers are concerned, that Cardiovascular Disease in research literature output has shown an increasing trend, and doubling time for publications has shown decreasing trend.

Table 1: Relative Growth Rate and Doubling Time of Cardiovascular Disease

Year	No. of Output	Cumulative	W1	W2	R(a) RGR	Mean R(a)1-2	DT(A)	M Dt (a) 1-2	
2005	64	64	-	4.16		-	-	0.65	
2006	83	147	4.42	4.99	0.57		1.21		
2007	108	255	4.68	5.54	0.86	0.72	0.80		
2008	142	397	4.95	5.98	1.03		0.67		
2009	179	576	5.19	6.36	1.17		0.59		
2010	203	779	5.31	6.66	1.35	1.52	0.51	0.45	
2011	274	1053	5.61	6.96	1.35				0.51
2012	292	1345	5.68	7.2	1.52				0.45
2013	320	1665	5.77	7.42	1.65				0.42
2014	364	2029	5.9	7.61	1.71				0.4
Total	2029					1.12		0.55	

Analysis of Document wise distribution

Table 2 presents a complete scenario of different forms of periodical and non-periodical literature of Indian Scientists on Cardiovascular Disease for their research publications. It is clear from the analysis that the share of journal articles is the most predominant is a bibliographic form of publications and it occupies 75.061percentage (1523) of total publications. The other ranked sources include Reviews18.33 percent (272) contributions, Editorial materials, and Meeting Abstract with 2.02 percent (42) contributions, Letter with 22 (1.084 percent and followed by remaining bibliographic forms. The remaining document types scored very less number of outputs which shows below one percentage.

Table 2: Document wise distribution

S. No	Source	Records	Percent	TLCS	TGCS
1	Article	1523	75.061	1189	17200
2	Review	372	18.33	363	7594
3	Editorial Material	41	2.02	30	219
4	Meeting Abstract	41	2.02	0	2
5	Letter	22	1.084	5	36
6	Article; Proceedings Paper	20	0.985	3	164

7	Review; Book Chapter	4	0.2	2	30
8	Correction	2	0.1	0	0
9	News Item	2	0.1	0	0
10	Article; Book Chapter	1	0.05	0	1
11	Reprint	1	0.05	0	13
Total		2029	100	1592	25259

We have also analyzed the language wise distribution of research output of Indian scientists on Cardiovascular Diseases. There are three languages observed in the study yet English is found to be predominant one (99.9%) compared to others. The Spanish and Chinese have recorded only one each (0.05%).

Analysis of Authorship pattern

Table 3 and figure 1 projects the overall analysis of the pattern of authorship and its percentage in contributing research output to the field of Cardiovascular Disease. The authors classified based on publications that they have produced. It is a natural reflection of complexity, scale and cost of recent investigations in the field of library and information science. The study reveals that a total number of 7743 authors had contributed 2029 articles.

Table 3: Analysis of Authorship pattern

S. No	Authors	No. of Papers	%
1	Single authors	78	3.84
2	Double authors	299	14.74
3	Three authors	317	15.63
4	Four authors	323	15.92
5	Five authors	261	12.86
6	>Five authors	751	37.01
Total		2029	100

Figure 1: Bar Chart Analysis of Authorship pattern

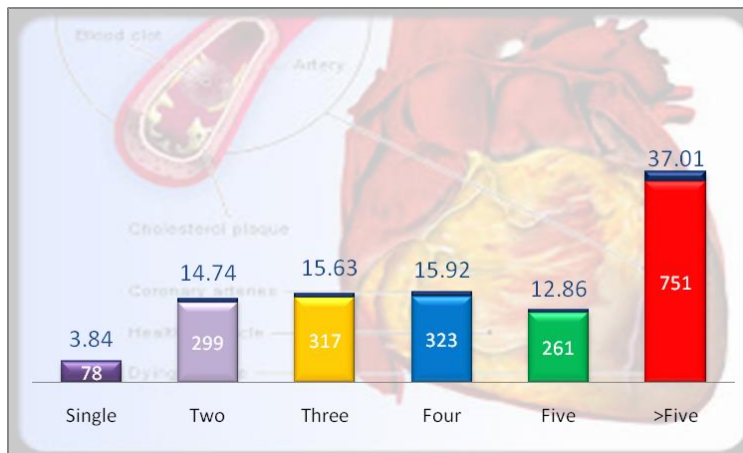


Table 3 indicates it that more than five authored publications rank first in order sharing 37.01 percent of the total research output. The four authored papers follow second in order taking 15.92 percent of the total research contributions. Three authored papers take the third position in order sharing 15.64 percent of the total research output during the study period.

Two authored papers rank next in order reporting 299 contributions that amount of 14.74 percent of total research output followed by five and single-authored contributions sharing 12.86 percent and 3.84 percent respectively. It is interesting to note that single-authored papers stand at the last position in order witnessing 78 literature outputs which represent only 3.84 percent of total research output.

The results reveal that the above discussion, the research publication brought out by Cardiovascular Disease researchers in the Indian Scientists intended to take collective participation in research and problem-solving activities. The authorship pattern reveals a remarkable difference between the number of single and five authors very few of the articles written by single-authored. Thus, the study shows that more than five authorship researches is predominant and compared to a single author of the area of cardiovascular diseases.

Year Wise Analysis of Authorship Pattern

It highlights from the above table 4 represents the year wise authorship pattern of Cardiovascular Disease during the period of study. Out of 2029 research papers, the majority of articles 364 (17.94%) contributed by authors in the year 2014 which is got in the first rank, and followed by 320 research papers were contributed by the authors in the year 2013 which occupies in the second position and 292 (14.4%) research articles produced and placed in the third position in 2012 and the minimum number of research outputs 64 (3.15%) contributed by the authors in the least rank in the year 2005.

Table 4: Year Wise Analysis of Authorship Pattern

S.No	Year	1	2	3	4	5	M5	Total	Percent
1	2005	2	8	11	11	7	25	64	3.15
2	2006	4	12	11	16	13	27	83	4.09
3	2007	8	17	16	22	17	28	108	5.32
4	2008	8	26	34	14	19	41	142	7
5	2009	7	33	24	32	30	53	179	8.8
6	2010	6	39	42	39	20	57	203	10
7	2011	12	37	43	46	32	104	274	13.5
8	2012	10	33	42	42	31	134	292	14.4
9	2013	12	52	39	36	42	139	320	15.8
10	2014	9	42	55	65	50	143	364	17.94
Total		78	299	317	323	261	751	2029	100

1= Single Author 2= Two Author 3= Three Author 4= Four author 5= Five Author M5= More than Five Author

Out of 78 articles, the highest numbers of research papers (12) were contributed by single authors in the year 2011 as well as 2013 and the least figure of papers (2) distributed by solo authors in the year 2005. Out of 299 research articles published by the two authors, the most number of papers (52) were produced in the year 2013 and the lowest numbers of articles (8) were contributed in the year 2005. Out of 317 scholarly publications gave by the three authors, the maximum numbers (55) published in the year 2014 and the minimum numbers of articles (11) contributed in the year 2005 and 2006 respectively. Out of 323 articles contributed by four authors, the majority of papers (65) were done by the year 2014 and the lowest numbers (11) were contributed in the year 2005. Out of 261 research outputs produced by the five authors, the uppermost numbers of research papers (50) analyzed in the year 2014, and the least number of papers (7) published in the year 2005. Out of 751

articles gave by more than five authors, the majority of output (143) done by the year 2014, and the lowest numbers (25) got in the year 2005.

Table 4 represents authorship pattern and its percentage by distribution to research. The authors grouped in terms of their contribution that they have published. The whole papers published by Indian scientists on cardiovascular disease calculated, and that comes to 2029 records over the period of study. From the above analysis in the finding shows that performs the authors contributed to the current research Multi authors produced 751 records of Cardiovascular Disease. The lowest level of publications produced in the earlier study single authors published to 78 records.

Analysis of Co-Authorship Index (CAI)

Many indicators used for measuring the co-authorship pattern. Here, in this study we have used Co-Authorship Index (CAI) formulated by Garg and Pathi (2000), to study the prototype of author collaboration. CAI is calculated using their formula

$$C A I (\text{Co Authorship Index}) = \{ (N_{ij} / N_{io}) / (N_{oj} / N_{oo}) \} * 100$$

Here,

N_{ij} represents number of papers having j authors in particular period/year

N_{io} indicates total output of particular period/year

N_{oj} denotes number of articles having j authors in all the periods/year

N_{oo} identifies total number of publications by all authors in all the periods/years

Table 5: Analysis of Co-Author index on Cardiovascular Disease

Year	Single Author	CAI	Two Author	CAI	Three Author	CAI	>Three Author	CAI	Total
2005	2	81	8	84	11	110	43	102	64
2006	4	125	12	98	11	84	56	102	83
2007	8	192	17	106	16	94	67	94	108
2008	8	146	26	124	34	153	74	79	142
2009	7	101	33	125	24	85	115	97	179
2010	6	76	39	130	42	132	116	86	203
2011	12	113	37	91	43	100	182	100	274
2012	10	89	33	76	42	92	207	107	292
2013	12	97	52	110	39	78	217	103	320
2014	9	64	42	78	55	96	258	107	364
Total	78		299		317		1335		2029

In the above table, there are only 78 single author articles, CAI falls between 64 and 192. But in case of two author records 299 papers have produced, whose CAI falls between 76 and 130. Followed by three author articles, CAI falls between 78 and 153. CAI for more than three author articles falls between 79 and 107. Hence, it observed that single author articles are less in number, about the research on Cardiovascular Disease. From the above analysis, the finding shows that Co-Index Author at the current study observed for the last five year is very high (2005-2009). The lowest output of Co-author Index found less in the next five years on Cardiovascular Disease research output (2010-2014).

Analysis of Degree of Collaboration

Table 6 shows the details about the degree of collaboration which indicate a single and multiple authorship during 2005 – 2014 as shown in Table 6. The degree of collaboration ranges from 0.97 to 0.96, and the average degree of collaboration is 0.96. The DC calculated by using the formula K.Subramaniyam, 1982. The mathematical equation is where DC = Degree of Collaboration, NM = Number of Multi Authors and NS = Number of Single Authors.

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

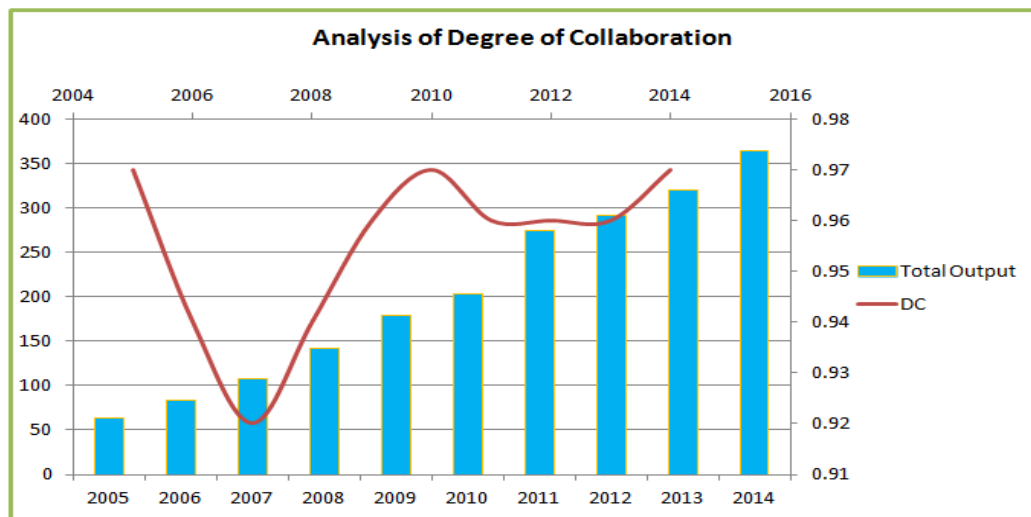
$$DC = \frac{1951}{1951+78} = 0.96$$

Hence, the degree of collaboration is 0.96

Table 6: Analysis of Degree of Collaboration

Year	No of Authors		Total	Degree of Collaboration
	Single	Multiple		
2005	2	62	64	0.97
2006	4	79	83	0.94
2007	8	100	108	0.92
2008	8	134	142	0.94
2009	7	172	179	0.96
2010	6	197	203	0.97
2011	12	262	274	0.96
2012	10	282	292	0.96
2013	12	308	320	0.96
2014	9	355	364	0.97
Total	78	1951	2029	0.96
Percentage	3.84	96.16	100	

Figure 2: Analysis of Degree of Collaboration



Based on the table analysis, the results reveal that the degree of collaboration observed in the present study shows the value of 0.96. The findings of a single author found only 3.84, which shows the collaborations of multiple authors is found high, and it migrated at India level. The table 6 showed that out of 2029 articles, single authors had contributed only 78 (3.84percent) articles while the rest of 1951 (96.16 %) articles contributed by joint authors. The table presents very low publication output published by single authors in particular in the year 2005 (2) articles. The high-level output is noted in 2011 and 2013 (12) articles respectively multiple authors output observed at the maximum level.

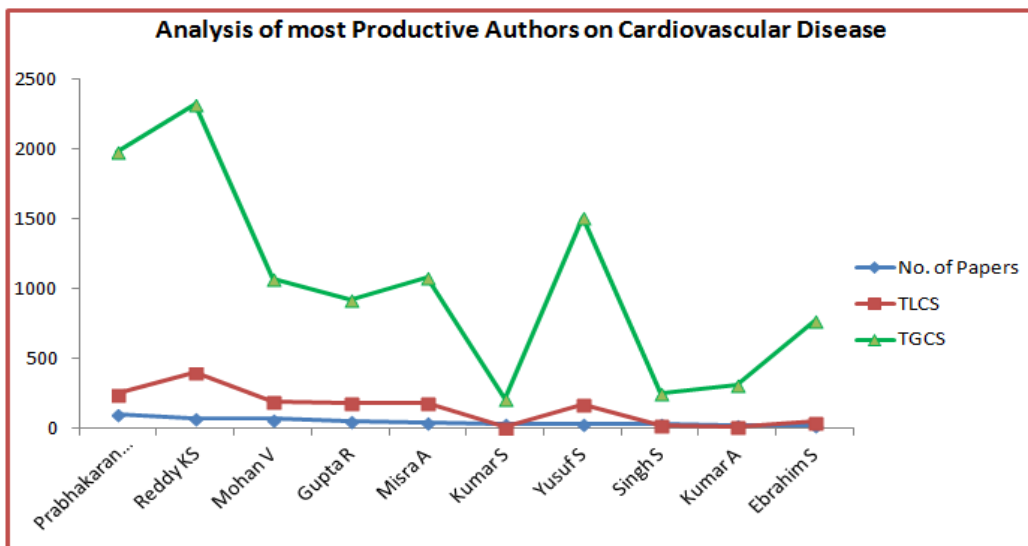
Analysis of most Productive Authors

Here, author wise number of publications had analyzed. We have selected only top ten authors. Table 7 shows that the D. Prabhakaran (Centre for Chronic Disease Control, New Delhi, India) has published maximum number 100 research articles in 'Indian Scientists on Cardiovascular diseases during the study period 2005-2014, and he got the first rank. Next to him Reddy, KS from Public Health Foundation of India, New Delhi 110070, India, has published 72 articles during the study period and he stood in the second place. The third place goes to Mohan V (Madras Diabetes Research Foundation, Madras, Tamil Nadu, India), who has contributed 70 research articles. The above table listed out the top 10 productive scientists who produced number of articles on Cardiovascular Disease research output. The next place taken by R.Gupta (Fortis Escorts Hospital, Department of Internal Medicine, Jaipur, Rajasthan, India). He has published 54 articles during the study period 2005-2014, and he attains the fourth rank in 'Indian Scientists on Cardiovascular Disease,' and he followed by A. Misra (Safdarjung Development Area, Diabetes Foundation in India, New Delhi 110016, India.), has published 43 research articles and he attains the fifth rank. The sixth and seventh ranks occupied by Mr. S. Kumar and S. Yusuf, and they published 36 and 31 research publications respectively. From the above table analysis, the finding shows that the most productive scientist found in the study is D. Prabhakaran (Centre for Chronic Disease Control, New Delhi, India) his contribution calculated is 100 publications, and he is in the first position. KS. Reddy (Public Health Foundation of India, New Delhi 110070, India), has published 72 articles during the study period and he stood in the second place. The third place in occupied by Mohan V (Madras Diabetes Research Foundation, Madras, Tamil Nadu, India) who has brought out 70 publications on Cardiovascular Disease research output.

Table 7: Analysis of most Productive Authors on Cardiovascular Disease

S. No	Name	No. of Papers	TLCS	TGCS
1	Prabhakaran D	100	249	1985
2	Reddy KS	72	401	2315
3	Mohan V	70	194	1075
4	Gupta R	54	185	925
5	Misra A	43	184	1084
6	Kumar S	37	9	209
7	Yusuf S	36	177	1510
8	Singh S	31	22	251
9	Kumar A	27	16	309
10	Ebrahim S	25	48	774

Figure 3: Analysis of most Productive Authors



Lotka’s Law of Author Productivity

Based on the over argument, it is appropriate to examine and analyze the implications of Lotka’s Law about the author productivity on the publication of articles. Lotka’s Law describes the frequency of publication by authors in a given field. It states, “the number of authors making n contribution is about 1/n² of those making one; and the proportion of all contributors that make a single contribution, is about 60 percent” (Lotka 1926, cited in potter 1988). It shows that out of all the authors in a given field, 60 percent will have just one publication, and 15 percent will have two schoalry papers (1/22 times.60). 7 percent of authors will have three research articles (1/32 times.60), and so on. According to Lotka’s Law of scientific productivity, only a six percent of the authors in a field will produce more than ten articles. Table 8 indicates that the application of Lotka’s Law concerning author productivity of Cardiovascular disease research output. It could be seen clearly from the table that proportion of all contribution that makes a single output is high in numbers. It means when the number of publications increases the number of authors decreases and vice versa.

Table 8: Analysis of Lotka’s Law of Authors Productivity on Cardiovascular Disease

No .of contributions	Observed (an) or F	Observed % of authors 100/an/a1	P Expected No authors a1*1/n2	Expected % of authors Predicate by Lotka/n	(f-p)2/p
1	6004	100	6004	100	0
2	973	16.21	1501	25	185.73
3	330	5.5	667.11	11.11	170.35
4	154	2.56	375.25	6.25	130.45
5	76	1.27	240.16	4	112.21
6	47	0.78	166.78	2.78	86.02
7	38	0.63	122.53	2.04	58.31
8	20	0.33	93.81	1.56	58.07

9	24	0.4	74.12	1.23	33.89
10	9	0.15	60.04	1	43.39
11	8	0.13	49.62	0.83	34.91
12	12	0.2	41.69	0.69	21.14
13	5	0.08	35.53	0.59	26.23
14	7	0.12	30.63	0.51	18.23
15	9	0.15	26.68	0.44	11.71
16	5	0.08	23.45	0.39	14.52
17	3	0.05	20.78	0.35	15.21
18	3	0.05	18.53	0.31	13.02
19	1	0.02	16.63	0.28	14.69
20	3	0.05	15.01	0.25	9.61
23	2	0.03	11.35	0.19	7.7
25	1	0.02	9.61	0.16	7.71
27	1	0.02	8.24	0.14	6.36
31	1	0.02	6.52	0.1	4.67
36	1	0.02	4.63	0.08	2.85
37	1	0.02	4.39	0.07	2.62
43	1	0.02	2.06	0.05	0.55
54	1	0.02	1.23	0.03	0.04
70	1	0.02	1.16	0.02	0.03
72	1	0.02	1.16	0.02	0.03
100	1	0.02	0.6	0.01	0.26
	7743			X²	36.35

Institution wise distribution of articles

The table includes only the top 20 institutions which have contributed number of contributions for Cardiovascular Disease. The research productivity of institutions may vary depending on their nature and involvement in research activities. So, there is a need to examine institution-wise research output of Indian Scientists on cardiovascular disease faculties in India for the present empirical validation. The analysis in table 9 shows that institution wise contributions. A total number of institutions observed 2790. It noted that 'All Indian Institute of Medical Science' ranks first and noted to be the most productive institution that has published a maximum number of articles (211) on the Cardiovascular disease. It followed by Public Health Foundation India which has produced 101 articles and it placed to the second rank. The third place had taken by Centre of Chronicle Disease Control which published 68 outputs in this study period. The fourth place occupied by Postgrad Institution of Medical Education & Research which has produced 61 publications on Cardiovascular Disease. The next place taken by Madras Diabetes Research Foundation has produced 56 records on Cardiovascular Disease. The above table lists the top twenty most productive Institutions in ascending order. It found that the analysis reveals that the research publications contributed across the Indian Level. From the above analysis, the finding shows that out of 2790 institutions. The predominant institution noted as 'All Indian Institute of Medical Science' with 211 output in the present study, followed by Public Health Foundation India which has produced 101 articles and placed to the second rank. The third place got by CtrChron Dis Control which has published 68 outputs in this study period.

Table 9: Institution wise distribution of articles

S. No	Institution	Recs	Percent	TLCS	TGCS
1	All India Inst Medical Science	211	10.4	467	3311
2	Public Health Foundation India	101	5	201	2328
3	CtrChron Dis Control	68	3.4	60	811
4	Postgrad Inst Med Educ& Res	61	3	31	481
5	Madras Diabet Research Foundation	56	2.8	135	739
6	University of Delhi	54	2.7	36	609
7	Harvard University	40	2	69	2866
8	University of Sydney	40	2	105	2386
9	McMaster University	37	1.8	172	1545
10	Annamalai University	35	1.7	25	582
11	London SchHyg& Trop Med	35	1.7	65	1937
12	Fortis Escorts Hospital	31	1.5	109	588
13	Govt Med College	31	1.5	184	624
14	CSIR	30	1.5	8	720
15	SreeChitraTirunalInst Med Sci&Technol	30	1.5	96	338
16	Christian Med College & Hospital	27	1.3	93	514
17	University of Madras	27	1.3	2	217
18	University of Glasgow	25	1.2	16	753
19	NizamInst Med Science	24	1.2	68	269
20	Sanjay Gandhi Postgrad Inst Med Science	24	1.2	19	199

Analysis of Sub-field wise Distribution

The table discusses the sub-field that where highly concentrated by the scientists while analyzing the sub-field. About 286 records observed in the sub-field of Pharmacology Pharmacy. The next subject taken by the Indian cardiovascular scientists is Medicine General Internal. The output measured in this sub-field in 217, which accounted in, percentage of 0.69 and the next subject concentration noted in Cardiac Cardiovascular Systems which calculated to 194 (9.56%). Endocrinology Metabolism is the other focused sub-field by the scientists which identified 192 (9.46%) records in numbers. The next place taken by Biochemistry Molecular Biology the output measured in this sub-field in 170, which is accounted in the percentage of 8.37. From the above analysis, the finding shows that the majority of the scientists concentrated on Pharmacology Pharmacy which observed at the maximum number of articles, i.e. 286 records in top-most level. It appeared in the current study of Cardiovascular Disease, and the second place was taken by the Indian cardiovascular scientists is Medicine General Internal. The output measured in this sub-field in 217, which is accounted in, the percentage of 0.69.

Table 10: Analysis of Sub field wise Distribution of Cardiovascular Disease

S. No.	Subject	Recs	%
1	Pharmacology Pharmacy	286	14.09
2	Medicine General Internal	217	10.69%
3	Cardiac Cardiovascular Systems	194	9.56%
4	Endocrinology Metabolism	192	9.46%
5	Biochemistry Molecular Biology	170	8.37%
6	Medicine Research Experimental	145	7.15%

7	Peripheral Vascular Disease	116	5.72%
8	Nutrition Dietetics	111	5.47%
9	Immunology	97	4.78%
10	Public Environmental Occupational Health	91	4.48%
11	Chemistry Medicinal	83	4.09%
12	Food Science Technology	77	3.79%
13	Multidisciplinary Sciences	77	3.79%
14	Cell Biology	69	3.40%
15	Toxicology	59	2.91%
16	Genetics Heredity	55	2.71%
17	Urology Nephrology	42	2.07%
18	Engineering Biomedical	41	2.02%
19	Clinical Neurology	40	1.97%
20	Biology	30	1.87%

SUGGESTIONS AND CONCLUSION

The present study has led to suggest some measures to improve the Cardiovascular Disease research. The suggestions of the present study are listed below:

- It is necessary to establish more interdisciplinary research institutions to encouraging the development of the Cardiovascular Disease research.
- The Indian scientists should be encouraged to produce good quality of Cardiovascular Disease research literature to publishing more reputed Indian Journals.
- Universities and colleges need to provide with more financial assistance in the form of research grants and sophisticated equipment to increase the volume of research as they lay behind the research institutes.

The scientometric technique is applied to identify the scientific publications of Indian Scientists on Cardiovascular Disease From 2005 – 2014 which published through Web of Science and this study highlighted the contribution of institutions, journals, and individual researchers. In the productivity analysis of Cardiovascular Disease, it found out that a total of 2029 records published from the period 2005-2014. In the contribution of journals, the journal “Indian Journal of Medical Research” stands with 70 records, having a global citation score of 547 and a local citation score of 100. It could be seen clearly from the table that proportion of all contribution that makes a single output is high in numbers. It means when the number of publications increases the number of authors decreases and vice versa. This study concludes that a majority of the research papers published in the year of 2014. This data collected from the web of science database by using the document search provision in science citation index and analyzed from Histecite software. It concluded that the research publications in Cardiovascular Disease research output are increasing every year at the considerable rate.

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