

MYELOMA RESEARCH: A BIBLIOMETRIC ASSESSMENT OF WORLD PUBLICATIONS OUTPUT DURING 2008-2012

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Abstract

This study deals with the analysis of 14052 contributions on myeloma research during 2008-2012 based on the total publication output, its growth rate, quality of papers published and rank of India in the global context. This paper discusses the bibliometric assessment of year-wise distribution of articles, category-wise classification of papers, authorship pattern, subject-wise distribution of articles, language wise, country wise and institutions-wise contributions and also prolific authors have been analyzed. This study analysed among the top 15 most productive countries in myeloma disease, the result shows that India ranks 13th (with 280 papers) with a global publication share of 1.99% during 2008-2012. Out of 14052 contributions, only 12.97% (1823 papers) of single authored and rest 87.03% is multi authored. The degree of collaboration ranges between 0.84 to 0.89 and the mean value is 0.87. The most of the authors from all over the world prefer to publish their research papers on the journal of Blood (3.88%).

Keywords: Bibliometrics, Myeloma, Degree of Collaboration, Authorship Pattern and Publications Output

1. INTRODUCTION

Myeloma is a type of cancer that develops from plasma cells, which are found in the bone marrow it is found in multiple areas of the body; the disease is often called multiple myeloma¹. Myeloma has a unique propensity to develop and expand almost exclusively in the bone marrow and generates devastating bone destruction². An important clinical feature of multiple myeloma is the development of a bone disease characterised by the presence of

osteolytic lesions, bone pain and pathological fractures. Patients with myeloma also develop generalised bone loss, or osteoporosis, independent of the focal osteolytic bone lesions³. Although a large amount of research has been done to scrutinize the potential causes of myeloma, nothing has been proven to date. In 1969, Pritchard coined the term bibliometrics, which deals with the application of mathematics and statistical methods to book and other media of communication. In 1969, Fairthorne defined the same as quantitative treatment of properties of recorded discourse and behaviour appearing to it. Bibliometric studies help to know the research trends of a particular field of research i.e. year wise distribution of research productivity, authorship pattern and the trends of research collaboration, preferred journal by scientists and ranked list of most cited papers and source etc.

2. LITERATURE SUPPORTS

A bibliometric study done by Jeysankar and Rameshbabu (2013)⁴ examined that the overall growth rate of literature output is found to be positive with an increasing trend in leukemia research throughout the study period. Two and more authored papers constitute majority of the contribution and degree of collaboration had a maximum value of 0.96. The result shows that research development activities are on increasing trend in leukemia research in India.

A bibliometric study dealt with the HIV/AIDS research on Uganda and Kenya. The study covered 1045 documents, 369 (35.3 percent) were on HIV/AIDS in Kenya and 676 (64.7percent) were on Uganda. Seven (0.7 percent) documents were shared by the two countries most publications are co-authored and focus on women, and a large proportion of HIV/AIDS documents are published outside Africa (Omwoyo et al., 2004)⁵.

Another bibliometric study is Mapping of AIDS/HIV Research in India during 1999–2008. It has been found that India ranks at 12th position among the top 20 countries and its global publication share (2.07%) is higher than Brazil (1.74%), but lower than China (2.24%) and South Africa (2.52%) (Gupta, Adarsh Bala & Har Kaur, 2011)⁶.

Maharana, (2014)⁷ studied that a total of 2,020 documents about malaria research were indexed in WoS during 2003 to 2012. Malaria Journal is the most favored research journal among the Indian research community which covers 97 papers. A.P. Dash contributed maximum number of 136 (6.74 percent) papers. Council for Scientific and Industrial Research (CSIR) is the largest Indian funding agency with 184 (9.11 percent) research grants.

Cesar et al. (2002)⁸ examined the bibliometric analysis of aids literature in central Africa. The results found that high pattern of collaboration of multiple authored and the study found that documents were published in English (84.50%) and French (14.73%). Over 57% corresponded to journal articles. Comparison of results among Central African countries and among other developing countries is made by the authors.

A recent study by Gupta et al, (2014)⁹ analysed a total of 37049 publications about mouth cancer, indexed in Scopus database during 2003-12, experiencing an annual average growth rate of 5.15 % and citation impact of 9.72. He reports that 15 most productive countries account for 88.14 % share in world output, with largest share (26.79 %) from USA.

A Study conducted (Gupta and Adarsh Bala, 2013)¹⁰ by Indian publications output on bone marrow research consisted of 2613 papers during 2003-12, which increased from 174 papers in 2003 to 397 papers in 2012, witnessing an annual average growth rate of 10.04%. The international collaborative share of India in overall bone marrow research was 11.56% during 2003-12, which increased from 10.43% during 2003-07 to 12.18% during 2008-12.

Another Scientometric study is dementia research in India. It is found that among the top 20 most productive countries in dementia research, India ranks 16th (with 1109 papers) with a global publication share of 1.24% and an annual average publication growth rate of 25.58% during 2002-2011 (Gupta et al., 2011)¹¹.

Gupta and Bala (2014)¹² analysed the top 20 most productive countries in Parkinson's disease, India ranks 16th (with 458 papers) with a global publication share of 1.47% and an annual average publication growth rate of 26.05% during 2002-2011. Its global publication share has increased over the years, rising from 1.08% during 2002-2006 to 1.74% during 2007-2011.

Singh, Ahmad and Nazim (2008)¹³ conducted a study on a bibliometric study of *Embelia ribes*. They were analysed growth of literature, authorship pattern, most prolific authors, core journals of the subject, most productive institutes and countries. It has been found that most articles involved collaboration between two or three authors Author productivity was not found exactly fit to Lotka's law with a value of $n = 2$.

Jeyshankar and Chithra (2012)¹⁴ were studied the growth of neuroscience literature globally during the periods 1972-2011. The study revealed that 71% of the research outputs were of collaborative in nature. USA obtains 1st rank in world research output, only 0.59% of the articles were contributed by authors in India ranking 18th among top 20 countries.

The research output of lung cancer in the G7 and the BRIC countries by Scientometric method have been evaluated by Chitra, Jeyshankar and Abu (2014)¹⁵. They were analysed growth rate, Collaboration Coefficient and Publication Activity of the countries of both the groups. Two relative indicators– Absolute Citation Impact and Relative Citation Impact have been adopted to compare the quality and impact of the lung cancer research.

3. OBJECTIVES OF THE STUDY

The main objective of this study is to analyze the research output on myeloma disease in the national and global contexts, as reflected in its publications output during 2008-2012. The study has the following objectives:

- (i) To study the global research output, and citation impact.
- (ii) To study the contribution by sub-fields.
- (iii) To study the most productive institutions.
- (iv) To study the high productive country.
- (v) To identify the most prolific authors and their institutions.
- (vi) To identify the characteristics of highly cited papers.

4. METHODOLOGY & SOURCES OF DATA

The data for this study has been obtained from Scopus International Database (<http://www.scopus.com/search/>) to extract relevant data on myeloma in global and other most productive countries for the five years (2008-2012). An advanced search strategy involving myeloma as the keyword was used to search and download data using Title, Abstract, and Keywords fields together, resulting in downloading of 14052 records on global related to myeloma disease. A total of 14052 records were 135775 citations received to these publications were transferred into Microsoft Excel 2007, and data were analysed and tabulated based on the objectives.

5. DATA ANALYSIS

5.1 Year-wise distribution of publications and citations

Table 5.1 observed that, a total of 14052 research papers were published during the period 2008-2012, which have received 135775 citations and the highest numbers of publications (3058) was in 2012, which have received 7115 citations with an average of 5.24 citations per publications. The second highest number of publications (2994) was in 2011, which have received 2994 citations with an average of 13.61 citations per publication in the year 2011. The highest number of citations (41060) was recorded in the year 2008, followed by (39846) 2009. It is observed that the least number of publications have received highest number of citations during the period 2008-2012.

Table - 5.1: Year-wise distribution of Publications and Citations, 2008-2012						
Sl. No	Year	TP	% age of TP	TC	% age of TC	ACPP
1	2008	2435	17.33	41060	30.24	30.24
2	2009	2964	21.09	39846	29.35	29.35
3	2010	2871	20.43	29277	21.56	21.56
4	2011	2994	21.31	18477	13.61	13.61
5	2012	3058	21.76	7115	5.24	5.24
Total		14052	100.00	135775	100.00	100.00
TP-Total Publication; TC-Total Citation; ACPP-Average Citation Per Publication						

5.2 Document Type

Table 5.2 observed that the majority (59.83%) of the papers were published in articles, followed by 22.94% of papers in reviews, 5.96% of papers were published in letters, 3.57% of papers in notes, 2.49% of papers published in conference proceedings, 2.34% of papers were published in short surveys and 1.81% of papers were published in editorials whereas other types perform a poor (below 1%) show with negligible numbers.

Sl. No	Type of document	NP	% age	CP
1	Articles	8407	59.83	59.83
2	Reviews	3224	22.94	82.77
3	Conference papers	350	2.49	85.26
4	Letters	837	5.96	91.22
5	Notes	502	3.57	94.79
6	Article in Press	66	0.47	95.26
7	Editorials	255	1.81	97.08
8	Short Survey	329	2.34	99.42
9	Erratum	79	0.56	99.98
10	Conference Review	1	0.01	99.99
11	Book	2	0.01	100
Total		14052	100	
NP-Number of papers; CP-Cumulative Percentage				

5.3 Year-wise Authorship Pattern

Authorship studies provide valuable information concerning characteristics of authors, their collaboration, assessing and monitoring research activities among others (Kwadzo and Grace, 2008)¹⁶. Collaboration among scientists implies that they are working together and pursuing a common scientific goal (Kundra, 1996)¹⁷. Table 5.3 shows that highest number of papers is collaborative research in the field of myeloma. Majority of the papers published are two authored (1990), followed by single authored (1823), three authored papers (1745), above 10 authored papers (1689), four authored (1507), five authored papers (1302) and six authored papers (1185). Rest of the authored contributed less than 1000 papers. The least number of papers (492) are ten authored.

Year	1 Au	2 Au	3 Au	4 Au	5 Au	6 Au	7Au	8Au	9 Au	10 Au	> 10 Au	Total
2008	382	333	314	248	256	204	165	107	82	65	279	2435
2009	304	396	343	286	259	224	198	156	120	98	310	2694
2010	397	418	348	288	260	254	208	143	118	102	335	2871

2011	379	434	375	323	269	260	203	157	117	105	372	2994
2012	361	409	365	362	258	243	218	197	130	122	393	3058
Total	1823	1990	1745	1507	1302	1185	992	760	567	492	1689	14052

5.4 Degree of Collaboration

In order to determine the strength of Collaboration (DC), the following formula Suggested by Subramanyam (1983)¹⁸ has been employed. The degree of collaboration in different years calculated as per the equation proposed by Subramanyam is presented in Table 5.4 and it shows that the degree of collaboration ranges from 0.84 to 0.89. The mean value is found to be 0.87.

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

Sl. No	Year	NS	NM	NS+NM	DC
1	2008	382	2053	2435	0.84
2	2009	304	2390	2694	0.89
3	2010	397	2474	2871	0.86
4	2011	379	2615	2994	0.87
5	2012	361	2697	3058	0.88
Total		1823	12229	14052	0.87 (MV)

DC= Degree of Collaboration; NM= Number of Multi authored papers; NS= Number of Single authored papers; NS+NM= Number of Single authored papers+ Number of Multi authored papers ; MV=Mean Value

5.5 Most Productive Authors

Table 5.5 depicts that twelve authors have been identified as most productive authors who have published 100 or more research papers on myeloma disease. These 12 authors together contributed 1627 papers during 2008-2012. Table 5 found that K.C. Anderson is the leading author contributing 265 articles followed by S.V. Rajkumar with 168 articles each securing the second position. A. Palumbo contributed 140 articles and ranked third. R. Hajek and P.G. Richardson contributed 139 articles each securing fourth rank. S. Kumar who contributed 120 articles each are bracketed in the fifth rank. A. Dispenzieri and B. Barlogie contributed 118 articles and ranked sixth.

Sl.No	Name of the Author	Address	Total Pub.	Rank
1	K.C. Anderson	Dana Farber Cancer Institute, United States	265	I

2	S.V. Rajkumar	Mayo Clinic, United States	168	II
3	A. Palumbo	University of Torino, Italy	140	III
4	R. Hajek	Czech Myeloma Group, Czech Republic	139	IV
5	P.G. Richardson	Dana Farber Cancer Institute, United States	139	IV
6	S. Kumar	Mayo Clinic, United States	120	V
7	A. Dispenzieri	Mayo Clinic, United States	118	VI
8	B. Barlogie	University of Arkansas for Medical Sciences, United States	118	VI
9	N.C. Munshi	Dana-Farber Cancer Institute, United States	108	VII
10	J.F. San Miguel	Hospital Universitario de Salamanca, Spain	108	VII
11	M.A. Dimopoulos	University of Athens School of Medicine, Athens	102	VIII
12	H. Goldschmidt	National Center for Tumor Diseases, Germany	102	VIII
Total			1627	

5.6 Preferred Journals

Table 5.6 shows the list of Preferred Journals of Scientists to publish their research papers during, 2008-2012. It is identified that the Blood secured first rank with 3.88% of the total periodical literature output during the period under study. Second rank is secured by British journal of Hematology with 1.81%, third rank is secured by Leukemia and Lymphoma with 1.72% and Bone marrow Transplantation secured fourth rank with 1.54. Rest of the journals are having produces less than (100 articles) 1.5 percentage.

Sl.No	Name of the Journal	No. of Publications	% age
1	Blood	545	3.88
2	British journal of Hematology	254	1.81
3	Leukemia and Lymphoma	242	1.72
4	Bone marrow Transplantation	216	1.54
5	Leukemia	196	1.39
6	Leukemia research	187	1.33
7	Journal of clinical oncology	185	1.32
8	European journal of Hematology	153	1.09
9	Annals of Hematology	148	1.05
10	Biology of blood and marrow Transplantation	146	1.04
11	Clinical cancer research	145	1.03
12	American journal of Hematology	142	1.01
13	Haematologica	128	0.91
14	International journal of Hematology	126	0.90

15	Hematology Chinese association of Path physiology	124	0.88
16	Hybridoma	108	0.77
17	Journal of Leukemia and Lymphoma	102	0.73

5.7 Languages-wise distribution

Table 5.7 depicts that the majority of the papers are published in English language (88.25%) followed by Chinese (3.18%), German (1.66%), Japanese (1.35%), French (1.33%), and rest of the articles were published in less than one percentage like, Spanish, Czech, Polish, Italian and other languages.

Sl. No	Languages	No. of Publications	% age	Cumulative % age
1	English	12401	88.25	88.25
2	Chinese	447	3.18	91.43
3	German	233	1.66	93.09
4	Japanese	189	1.35	94.44
5	French	187	1.33	95.77
6	Spanish	129	0.92	96.69
7	Czech	123	0.88	97.57
8	Polish	85	0.60	98.17
9	Italian	43	0.31	98.48
10	Russian	42	0.30	98.78
11	Portuguese	34	0.24	99.01
12	Turkish	27	0.19	99.2
13	Dutch	26	0.19	99.39
14	Korean	23	0.16	99.55
15	Bulgarian	10	0.07	99.62
16	Hungarian	10	0.07	99.69
17	Slovak	10	0.07	99.76
18	Norwegian	6	0.04	99.8
19	Serbian	6	0.04	99.84
20	Croatian	5	0.04	99.88
21	Danish	5	0.04	99.92
22	Greek	5	0.04	99.96
23	Romanian	3	0.02	99.98
24	Swedish	3	0.02	100.00
Total		14052	100.00	

5.8 Subject-wise research output

It is evident from the Table 5.8, highest publications output coming from Medicine with 11871 papers, followed by Biochemistry, Genetics and Molecular Biology (5396), Pharmacology, Toxicology and Pharmaceutics (1544), Immunology and Microbiology (1356), Chemistry (170), Health Professions (167), Agricultural and Biological Sciences (164), Nursing (154), Neuroscience (148), Engineering (118), Dentistry (117) and Chemical Engineering 108). Other subject's contribution on myeloma research is less than hundred papers.

Sl.No	Subject Area	No. of Publications
1	Medicine	11871
2	Biochemistry, Genetics and Molecular Biology	5396
3	Pharmacology, Toxicology and Pharmaceutics	1544
4	Immunology and Microbiology	1356
5	Chemistry	170
6	Health Professions	167
7	Agricultural and Biological Sciences	164
8	Nursing	154
9	Neuroscience	148
10	Engineering	118
11	Dentistry	117
12	Chemical Engineering	108

5.9 Geographical Distribution

Table 5.9 depicts the distribution of research output of different countries in the field of myeloma disease during 2008-2012. This table reveals that 33.92 % of the total articles were contributed by the authors from Unites States, followed by Italy (8.11%), Germany (7.19 %), United Kingdom (6.69%), China (5.76%), France (5.54%), Japan (4.78%), Spain (4.01), Canada (2.99%), Netherlands (2.54%), Australia (2.34%), and Greece (2.01%). Only 1.99% of the articles were contributed by authors in India ranking 13th among top fifteen countries. Generally speaking, the study indicates that the field has evolved considerably in different regions of the world.

Sl.No	Country	No. of Publications	% age
1	United States	4766	33.92
2	Italy	1140	8.11
3	Germany	1011	7.19
4	United kingdom	940	6.69

5	China	809	5.76
6	France	779	5.54
7	Japan	671	4.78
8	Spain	564	4.01
9	Canada	420	2.99
10	Netherlands	357	2.54
11	Australia	329	2.34
12	Greece	283	2.01
13	India	280	1.99
14	Czech Republic	250	1.78
15	South Korea	231	1.64

5.10 Highly Productive Institutions

The (top 15) most productive world institutions involved in myeloma research have published 100 and more papers each during 2008-2012. The most productive 15 institutions involved in myeloma research together have contributed 20.49% share (with 2879 papers) in the cumulative publications output of world research. In myeloma research four Indian institutions have registered higher publications (two hundred or above) than the group average. These are Mayo Clinic with 47 papers followed by University of Texas M. D. Anderson Cancer Center (334 papers), Dana-Farber Cancer Institute, (278 papers), Harvard Medical School, (228 papers) and National Cancer Institute, (213 papers). Rest of the institutions produced less than two hundred papers. The analysis shows that majority of the institutions are coming from United States and it occupies first ten ranks in myeloma research output 2008-12.

Table - 5.10: Institutions-wise research output, 2008-2012

Sl. No	Institutions	Country	No. of Publications	% age	Rank
1	Mayo Clinic	United States	417	2.97	I
2	University of Texas M. D. Anderson Cancer Center	United States	334	2.38	II
3	Dana-Farber Cancer Institute	United States	278	1.98	III
4	Harvard Medical School	United States	228	1.62	IV
5	National Cancer Institute	United States	213	1.52	V
6	University of Arkansas for Medical Sciences	United States	185	1.32	VI
7	University degli Studi di Torino	Italy	178	1.27	VII
8	VA Medical Center	United States	158	1.12	VIII
9	Inserm,	France	149	1.06	IX
10	Mayo Clinic Scottsdale-Phoenix	United States	142	1.01	X

11	Hospital Universitario de Salamanca	Spain	141	1.00	XI
12	Fred Hutchinson Cancer Research Center	United States	126	0.90	XII
13	Memorial Sloan-Kettering Cancer Center	United States	116	0.83	XIII
14	University of Athens Medical School	Greece	108	0.77	XIV
15	University of Heidelberg	Germany	106	0.75	XV

5.11 Highly Cited Papers

Table 5.11 shows the highly cited papers and its sources in myeloma disease during the period, 2008-12. It is evident from the table “*Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies (792)* -The Lancet” is highly cited , followed by *Bortezomib plus melphalan and prednisone for initial treatment of multiple myeloma (634)* - New England Journal of Medicine, *Causes and consequences of micro RNA dysregulation in cancer (610)* - Nature Reviews Genetics, *Improved survival of patients with human papillomavirus-positive head and neck squamous cell carcinoma in a prospective clinical trial (580)* - Journal of the National Cancer Institute and *Improved survival in multiple myeloma and the impact of novel therapies (539)* - Blood. Other papers have been cited less than five hundred times.

Sl. No	Title of the Paper	Journal Name	Citation
1	Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies	The Lancet	792
2	Bortezomib plus melphalan and prednisone for initial treatment of multiple myeloma	New England Journal of Medicine	634
3	Causes and consequences of micro RNA dysregulation in cancer	Nature Reviews Genetics	610
4	Improved survival of patients with human papillomavirus-positive head and neck squamous cell carcinoma in a prospective clinical trial	Journal of the National Cancer Institute	580
5	Improved survival in multiple myeloma and the impact of novel therapies	Blood	539
6	Targeting the phosphoinositide 3-kinase pathway in cancer	Nature Reviews Drug Discovery	475
7	Targeting cancer cells by ROS-mediated mechanisms: A radical therapeutic approach?	Nature Reviews Drug Discovery	398
8	Curcumin: From ancient medicine to current clinical trials	Cellular and Molecular Life Sciences	389
9	ABT-263: A potent and orally bioavailable Bcl-2 family inhibitor	Cancer Research	361
10	Strategies in the design of nano particles for therapeutic applications	Nature Reviews Drug Discovery	357

6. Summary and Conclusions

The present study explores the detailed quantitative analysis of the research output on myeloma disease globally, 14052 records over a five year period (2008-2012). This study analysed some bibliometric indicators like Degree of collaboration ranges from 0.84 to 0.89 and the mean value is found to be 0.87. Two authored publications are dominated single and multi authored. The 12 most productive authors in this study together contributed 1627 papers and 11.58% publications share during 2008-12. The most prolific author name is K.C. Anderson (contributing 265 articles) from Dana Farber Cancer Institute, United States and he has secured 1st rank in the present study.

The most of the authors from all over the world prefer the journal of Blood to publish their articles (3.88%), followed by British journal of Hematology (254 papers), Leukemia and Lymphoma (242 papers). Subject-Wise distribution shows that the maximum research output (11871 papers) came from Medicine, followed by Biochemistry, Genetics and Molecular Biology (5396 papers), Pharmacology, Toxicology and Pharmaceutics (1544 papers), etc. It is evident that the first rank is secured by Mayo Clinic, United States (417 papers) among the top 15 world Institutions based on its research output, followed by University of Texas M. D. Anderson Cancer Center, United States (334 papers), Dana-Farber Cancer Institute, United States (278). The country-wise distribution shows that Unites States occupies 1st place (33.92 %) followed by Italy (8.11%) and Germany (7.19%).

It is found that among the top 10 highly cited papers on myeloma disease research during 2008-2012, first three top cited papers are namely: *Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies* (with cited 792 times) from the journal of The Lancet, followed by *Bortezomib plus melphalan and prednisone for initial treatment of multiple myeloma* (with 694 times cited) from New England Journal of Medicine, *Causes and consequences of micro RNA dysregulation in cancer* (with 610 times cited) from the journal of Nature Reviews Genetics. It is also found that India ranked 13th among the top fifteen countries with a share of 1.99% during 2008-2012. It is concluded that the existing Indian research output is quite low in the world and its publication share (1.99%) during 2008-2012. In addition, the impact and quality of Indian research is low compared to that of select developed and developing countries. This study quietly emphasized low growth rate in India and need to increase its research output on myeloma and bring out the quality of research efforts.

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