AUTHORSHIP PATTERN AND DEGREE OF COLLABORATION RESEARCH IN MULTIPLE MYELOMA: A SCIENTEOMETRIC STUDY

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Abstract: - *The study deals with the research publications output in Multiple Myeloma cancer diseases over the period of 10 years i.e. 2007-2016 as reflected in web of science citation database. This study has highlighted the year wise distribution of paper, growth rate, and citation index, authorship pattern, degree of collaboration, top 10 prolific authors, and sources of publications. The result shows that, in total 5,723 research publications by 47,583 authors with an average of 11.08 authors per paper. It is found that the articles published by multiple authors are high in percentage i.e. 97.56%. The average mean value degree of collaboration is 0.97%.*

1. Introduction

Cancer is a deadly disease, in which abnormal cells divide uncontrollably and destroy body tissue. Cancer starts when cells in the body begin to grow out of control. The cells in nearly any part of the body can become cancer and it can be spread to any parts of the body. [1] There are many types of cancers; Multiple Myeloma is also one of the cancer cells. **Multiple Myeloma** is a cancer formed by malignant plasma cells. Normal plasma cells are found in the bone marrow and are an important part of the immune system. In multiple myeloma, the overgrowth of plasma cells in the bone marrow can crowd out normal blood-forming cells. This can cause anaemia – a shortage of red blood cells.[9] People with anaemia

become pale, weak, and fatigued. Multiple Myeloma can also cause the level of platelets in the blood to become low.[2] This can lead to increased bleeding and bruising. Scientometric analysis is employed by the research scientists to study the growth of scientific publications in given field specifically. This study is based on the Bibliometric analysis which was first used the term by Pritchard (1969) as the application of statistical and mathematical methods to books and other communications

2. Review of Literature

Number of scientometric related studies have already examined on various diseases by eminent research scholars and scientists. A few of them were chosen for the present study. **Padmamma and Walmiki (2016)** have investigated research literatures on uterus cancer during 2006-2016 in reflected web of science database. The total 3,197 articles indexed in web of science database and highest 434 articles published in the year 2014. Multi author's papers are more than the single authors and highest 13.98 % (447) of the articles contributed by six authors, 804 articles contributed by anonymous and only 143 articles published by single authors, highest number of articles contributed by USA and highest 902 research articles on oncology.[4] **Lakshmi and Raja** (2015) studied on leukemia research in India during 2005-2014 in reflected in web of science database. Total 2,410 literatures published and relative growth rate of publications is decreased from 4.55 to 0.20 in 2005 and 2014 respectively, the lowest growth rate and doubling time in the year 2013 i.e. 0.19 and 0.28 respectively. The most profitable journal is pediatric blood and malignancy with publishing 161 papers and highest number (64) papers published by Bakshsi Sameer. Research on leukemia is gradually increased in year by year.[5] **Vellaichamy and Jeyshankar (2015)** analyzed the research growth on myeloma during 2008-2012 in India. Among the top most 15 productive countries, India occupied the 13th rank with contributing of 280 papers out of 14,052 in global publications, highest 87.03% of the papers published by multi authors and only 12.97% of the paper published by single author, the degree of collaboration ranges between 0.84 to 0.89 and the average values is 0.87. Highest 547 articles published in Blood journal and highest 265 research paper published by K.C. Anderson among the top 12 authors.[6]

3. Objectives of the Study

3.1 To find the year wise distribution of publications and growth rate of Multiple Myeloma Research

3.2 To analyze the authorship pattern and degree of collaboration

3.3 To identify the top 10 Prolific authors contribution

3.4 To find the sources of publication

4 Methodology

The data for the study were retrieved from the Web of Science citation database which is maintained by Thomson Reuters. Web of Science citation database covering more than 18,000 international peer reviewed journals of the world. For downloading data, the search term was used in advance search option "TS= Multiple Myeloma" year span "2007-2016", Language "English", publication type "Articles" and categories "Oncology". The total 5,273 unique records has been downloaded and exported to the MS-Excel for further analysis. Each record contains English language abstract with the bibliographic information, like, year of publication, name of journals, affiliation, h-index and citations etc

5 Data Analysis & Interpretation

Growth Rate: Growth rate refers to the percentage change of a specific variable within a specific period with certain context.

GR= Present Value-Past Value/Past value*100

Table 1 Year wise Distribution of Publications & Growth Rate

Table 1 Year wise Distribution of Publications & Growth Rate

Sl. No.	Year	No. of Articles	%	Cumulative	Cumulative %	GR
1	2007	432	8.19	432	8.19	
2	2008	397	7.53	829	15.72	-8.1
3	2009	464	8.80	1293	24.52	16.88
4	2010	461	8.74	1754	33.26	-0.65
5	2011	485	9.20	2239	42.46	5.21
6	2012	478	9.07	2717	51.53	-1.44
7	2013	551	10.44	3268	61.97	15.27
8	2014	592	11.23	3860	73.20	7.44
9	2015	704	13.35	4564	86.55	18.92
10	2016	709	13.45	5273	100.00	0.71
Total		**5273**	**100**	**Mean**		**5.24**

Note: GR= Growth Rate

Table 1 highlights the year wise distribution of publications in multiple myeloma research. It is observed that, total of 5,273 articles were published during 2007-2016 and indexed in web of science database. Research on multiple myeloma disease tremendously increased from 8.19% in 2007 to 13.45% in 2016. The highest number 709 articles published in 2016 and lowest 397 articles published in 2008. During

the first 5 years 42.46% has published and in the second 5 years has 54.54 % articles published. The study indicates that, nowadays more researchers are showing their interest in research and publications.

Table 2 Year wise distribution of authorship Pattern

Sl. No.	Year	No. of Articles	%	No. of Authors	AAPP
1	2007	432	8.19	3492	12.37
2	2008	397	7.53	3254	12.20
3	2009	464	8.80	3997	11.61
4	2010	461	8.74	3832	12.03
5	2011	485	9.20	4283	11.32
6	2012	478	9.07	4291	11.14
7	2013	551	10.44	4985	11.05
8	2014	592	11.23	5598	10.58
9	2015	704	13.35	6728	10.46
10	2016	709	13.45	7123	9.95
Total		**5273**	**100.00**	**47583**	**11.08**

(*Note: AAPP= Average Author per Paper)*

Table 2 represents year wise number of authors per paper in multiple myeloma research. The study found that, total 5,273 articles contributed by 47,583 authors during 2007-2016. The average number of authors per paper is 11.08.

Table 3 Year wise distribution of Authorship Pattern

Sl. No.	Year	Single Author	Two Authors	Three Authors	Four Authors	Five Authors	More than 5 Authors	Total
1	2007	17	50	66	120	180	3058	3492
2	2008	14	32	66	144	195	2803	3254
3	2009	9	32	69	160	180	3547	3997
4	2010	11	60	96	144	185	3336	3832
5	2011	11	54	99	148	165	3806	4283
6	2012	16	30	78	128	180	3859	4291
7	2013	12	50	108	160	185	4470	4985
8	2014	9	60	93	120	245	5071	5598
9	2015	16	28	81	172	275	6156	6728
10	2016	13	64	111	164	250	6521	7123
Total (%)		**128 (0.27)**	**456 (0.96)**	**869 (1.83)**	**1456 (3.06)**	**2040 (4.29)**	**42634 (89.60)**	**47583 (100)**

Table No.3 highlights the year wise authorship pattern participated in research on Multiple Myeloma over the period of 10 years i.e. from 2007 to 2016. It shows that, year wise number of single author, two

authors, three authors, four authors, five authors and more than 5 authorship patterns. The study highlights that 89.60% of authors have collaborated in more than 5 authorship pattern, followed by 4.29 % (2040) of authors have in group of five authors, 3.06% (1456) of authors in four authors, 1.83%(869) of authors in three authors, 1.83% (869) of authors in two authors and only 0.27% (128) of authors in single authorship pattern. The study represents the multi author's collaboration research during this period.

Table 4 Year wise Distribution of publications classified by number of authors

Sl. No.	Year	Single Author	Two Authors	Three Authors	Four Authors	Five Authors	More 5 Authors	Total no. of Articles
1	2007	17	25	22	30	36	302	432
2	2008	14	16	22	36	39	270	397
3	2009	9	16	23	40	36	340	464
4	2010	11	30	32	36	37	315	461
5	2011	11	26	33	37	33	345	485
6	2012	16	15	26	31	36	354	478
7	2013	12	25	36	40	37	401	551
8	2014	9	30	31	30	49	443	592
9	2015	16	14	27	43	55	549	704
10	2016	13	32	37	41	50	536	709
Total		**128**	**229**	**289)**	**364**	**408**	**3855**	**5273**
Average		**2.43**	**4.34**	**5.48**	**6.90**	**7.74**	**73.11**	**100**

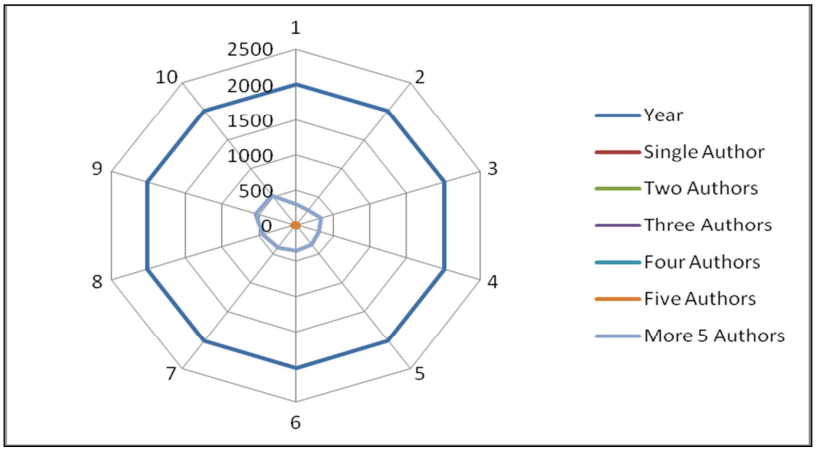

Table 4 represent the authorship pattern of publications. Among total 5,273 articles, highest number of 3855 (73.11) publications contributed by more than six authors and followed by 408 (7.74) publications as five authors, 364 (6.90) publications as four authors, 289(5.48) publications as three authors, 229 (4.34)

publications as two authors and only least 128 (2.43) publications by single author. It indicates that 97.56 % of papers were contributed by multi authors.

Analyzing the contribution of individual types of co-authored publications, a systemic change is observed in all the categories of co-authored publications. The study is also identified that, the proportion of single author publications has decreased from 17 to 13 publications in 2007 and 2016 respectively. The proportion of two authors' publications has increased from 25 publications in 2007 to 32 publications in 2016. The proportion of three authors publications has increased from 22 in 2007 to 37 in 2016, the four authors publications has increased from 30 publications in 2007 to 41 in 2016, five authors publications from 36 in 2007 to 50 publications in 2016 and more than 5 authors publications has also increased from 302 to 536 publication in 2007 and 2016 respectively. It can be seen that multi authors are predominant than the single authors.

Degree of Collaboration (DC)

Degree of collaboration in respect of a discipline or an organization is the ratio of multi-authored papers published during the period and total number of papers published during that year. The formula proposed by K. Subramanyam (1983).

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

Where,

DC= Degree of Collaboration in a discipline

Nm= Number of multi authored papers in a discipline

Ns= Number of single authored papers in a discipline

$$DC = \frac{5145}{5145+128} = 0.97$$

Table 5 Year wise Degree of Collaboration (DC)

Sl. No.	Year	Single Author	Multi Authors	Total	DC
1	2007	17	415	432	0.96
2	2008	14	383	397	0.96
3	2009	9	455	464	0.98
4	2010	11	450	461	0.98
5	2011	11	474	485	0.98
6	2012	16	462	478	0.97
7	2013	12	539	551	0.98
8	2014	9	583	592	0.98
9	2015	16	688	704	0.98
10	2016	13	696	709	0.98
Total		**128**	**5145**	**5273**	**0.97**

Table 5 shows the degree of collaboration on authorship research in Multiple Myeloma over the period of 10 years i.e. 2007-2016. The degree of collaboration ranges from 0.96 in 2007 to 0.98 in 2016 and the average degree of collaboration is 0.97.

Collaborative Index

Collaborative index is defined as the number of authors per paper, the formula first suggested by Lawani (1986).

Formula:

$$CI = \frac{\text{Total no. of Authors}}{\text{Total no. of Papers}}$$

Table 6 Year wise Collaborative Index

Sl. No.	Year	No. of Articles	No. of Authors	CI
1	2007	432	3492	8.08
2	2008	397	3254	8.20
3	2009	464	3997	8.61
4	2010	461	3832	8.31
5	2011	485	4283	8.83
6	2012	478	4291	8.98
7	2013	551	4985	9.05
8	2014	592	5598	9.46
9	2015	704	6728	9.56
10	2016	709	7123	10.05
Total		**5273**	**47583**	**8.91**

The table 6 shows the collaborative index has been evaluated among the total research articles and total number of authors on multiple myeloma diseases over the period of 10 years i.e. 2007-2016. The study indicates that, the range of collaborative index increased from 8.08 in 2007 to 10.05 in 2016. The collaborative index mean value is 8.91 over the period of 10 years.

Table 7 Top 10 Prolific Author's wise distribution of articles

Sl. No	Name of the Authors	No. of Articles	%	TC	ACPP	H-index
1	Anderson K.C	134	2.54	6787	50.65	49
2	Rajkumar S.V	86	1.63	5391	62.69	38
3	Dispenzieri A	82	1.56	3817	46.55	31
4	Goldschmidt H	79	1.50	3219	40.75	32
5	Moreau P	79	1.50	4227	53.51	33
6	Palumbo A	75	1.42	4648	61.98	33
7	Dimopoulos M.A	71	1.35	3876	54.60	33
8	Munshi N.C	68	1.29	2652	39.00	30
9	Gertz M.A	63	1.20	2358	37.43	26
10	Kumar S	62	1.18	3118	50.30	26
Total		**799**	**15.15**	**40093**	**49.75**	**33.1**

Table 7 enumerates the top 10 prolific authorship pattern in research on Multiple Myeloma diseases based on their highest publications over the period of 10 years. It is also analyses the total citations and h-index value. These top 10 authors have together contributed 799 articles with an average 79.9% of papers per author and account for 15.15% share in the cumulative publications output during 2007-2016. Only three authors have published highest number of articles than the group average (79.9%). Anderson K.C. with 134 publication has occupied the 1st place, followed by Rajakumar S.V. with 86 publications, Dispenzieri A with 82 publications, Goldschidt H and Moreau P have contributed 79 papers each, and Kumar S have occupy the 10th place with 62 publications among these 10 group of authors. These 10 authors have received a total 40093 citations for 799 publications with an average of citation per paper is 49.75 and the mean value of h-index is 33.1 during this period.

Table 8 Top 20 sources of publications

Sl. No.	Rank No.	Name of the Journals	Place of Publication	No. of Articles	%
1	1	Clinical Cancer Research	USA	310	5.88
2	2	Leukemia	U.K	293	5.56
3	3	Leukemia & Lymphoma	UK	292	5.54
4	4	Oncotarget	USA	262	4.97
5	5	Leukemia Research	USA	227	4.31
6	6	Bone Marrow Transplantation	USA	188	3.57
7	7	Journal of Clinical Oncology	Netherland	173	3.28
8	8	Clinical Lymphoma Myeloma Leukemia	Netherland	172	3.26
9	9	Cancer Research	USA	168	3.19
10	10	Molecular Cancer Therapeutics	USA	137	2.60
11	11	International Journal of Cancer	Australia	110	2.09
12	12	Cancer	USA	90	1.71
13	13	Anticancer Research	USA	86	1.63
14	14	BMC Cancer	USA	85	1.61
15	15	Blood Cancer Journal	UK	84	1.59
16	16	Oncology Letters	UK	74	1.40
17	17	International Journal of Oncology	Greece	70	1.33
18	18	British Journal of Cancer	Greece	69	1.31
19	19	Oncogene	USA	68	1.29
20	20	Clinical Lymphoma Myeloma	USA	67	1.27
			Total	3025	57.39
			From other sources	2248	42.61
			Total	**5273**	**100**

Table 8 highlights the top 20 sources of publication and their rank based on publications during 2007-2016. The study reveals that these top 20 journals have together contributed 57.39% of publications in total publications during 2007-2016. Most productive journal is Clinical Cancer Research is occupy the 1st rank with publishing 310 which published in United States, followed by Leukemia 293 publications, Leukemia & Lymphoma 292 publications. These 20 journals have published more than the average publications.

6 Findings and Conclusion

This paper analyzed research publication output on Multiple Myeloma diseases during 2007-2016. It revealed that total 5273 publications indexed in web of science database and highest number of 709 publications published in the year 2016 and the mean values of growth rate is 5.24 during this study period. The mean value of

collaboration research is 11.27. The author productivity is 97.56 % of the papers were contributed by multi authors. The degree of collaboration ranges from 0.96 in 2007 to 0.98 in 2016 and the average degree of collaboration is 0.97. The collaborative index mean value is 8.91 over the period of 10 years. These 10 authors have received a total 40093 citations for 799 publications with an average of citation per paper is 49.75 and the mean value of h-index is 33.1 during this period. The study reveals that these top 20 journals have together contributed 57.39% of publications in total publications during 2007-2016.

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