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PUBLICATIONS AND CITATIONS ANALYSIS OF LEUKEMIA RESEARCH OUTPUT IN INDIA FROM THE SCOPUS DATABASE DURING THE PERIODS 2011-2020: A SCIENTOMETRIC ANALYSIS

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ABSTRACT

The present study of scientometric analysis of Leukemia research output 2011-2020 an Indian perspective. The year-wise growth of leukemia research publications during the 10-year study period between 2011 and 2020 with 5,474 research publications and 86,869 citations. The maximum of 692 (12.64%) research publications are contributed in the year 2020, and the study out of 5,474 publications, 4,228 research publications are cited publications, and 1,246 research publications are uncited publications. The maximum of citation per paper is 47.69 in the year 2015, and the CAGR is 5.37. Authorship pattern more than five authorship mode with 1,910 (34.89%) publications, the average degree of collaboration is 0.97. The average collaborative coefficient value is 0.76, the average collaboration index value 4.30, and the average value is 4.32. Maximum of 128(17.16%) research publications are contributed by Malhotra, P. India. a maximum of 3837(70.09%) research publications are contributed by Article. The maximum number of 404(23.82%) publications are contributed by All India Institute of Medical Sciences, New Delhi. The Maximum of 266(24.14%) research publications are contributed by Indian Journal of Hematology and Blood Transfusion. Collaborator country the maximum of 462(37.90%) research publicatons are collaborated by United States of America. The highly cited paper of 18098 citations are received by Ferlay, J (2015) Cancer incidence and mortality worldwide:

Sources, methods and major patterns in GLOBOCAN 2012, International Journal of Cancer, 136(5): 359-386.

KEYWORDS: Scientometrics, Degree of collaboration, Relational citation index, Leukemia Research, Time series analysis, Relative Growth Rate, Collaborative index CI, CC, and MCC.

INTRODUCTION

Cancer starts when cells in the body change (mutate) and grow out of control. Your body is made up of tiny building blocks called cells. Normal cells grow when your body needs them. They die when your body doesn't need them anymore. Cancer is made up of abnormal cells that grow even though your body doesn't need them. In most types of cancers, the abnormal cells grow to form a lump or mass called a tumor. Leukemia is different from most other cancers. Leukemia cells don't always form a tumor. This cancer starts in the bone marrow. The bone marrow is the thick, spongy liquid inside your bones. It's where new blood cells are made. Leukemia starts in early forms of blood cells, often white blood cells, which help fight infections. When you have leukemia, your body makes too many "bad" blood cells that don't work like they should. Instead of forming tumors, leukemia cells travel in the blood and go all over the body. This means they can reach almost any organ. Leukemia can cause problems and be found in many different ways, depending on which organs are affected.

Blood is made up of liquid, called plasma, and 3 main kinds of cells. Each kind of cell has a special task: **White blood cells.** These help the body fight infection and disease. **Red blood cells.** These carry oxygen from the lungs to the body's tissues and carry carbon dioxide from the tissues to the lungs. **Platelets**. These help form blood clots and control bleeding. Blood cells are made in the soft center of the bones called the bone marrow. In adults, active bone marrow is found mostly in the hip bones, ribs, spine, and skull. Normal cells in the bone marrow develop from very immature cells into mature, working cells ready to go out in the blood. Early, less mature, non-working forms of new blood cells are called blasts. As cells mature in the bone marrow, they become smaller and more compact. They're better able to do their special jobs. Some new blood cells stay in the bone marrow to grow, while others move to other parts of the body to grow. More blood cells are made when the body needs them, such as when a person has an infection or low numbers of red blood cells (anemia). This process keeps the body healthy.[1]

Scientometric Study

Scientometric is a study to measure the performance of researchers as well as the research publications. The research activities contain major changes over the last few decades and emerged as an established research in the discipline of "Library and Information Science". The study of scientific literature has a long history dating back to the early decades of the past century. However, despite in the number of research literature in this area it was not until 1969, that the term bibliometrics first appeared in print (**Pritchard 1969**).[2] Definition of bibliometric was 'application of mathematical and statistical methods to books and other media of communication', particularly in North America, the term was quickly adopted and used (**Wilson, 1999**).[3] At the same time, **Nalimov and Mulchenko (1969)**[4] coined the term scientometrics to refer to 'the application of quantitative methods which are dealing with the analysis of science viewed as an information process'. In contrast, this term was widely used in Europe (**Wolfram, 2003**).[5] Initially, therefore, scientometrics was restricted to the measurement of science communication, whereas bibliometrics was designed to deal with more general information processes, **Andres A (2009**).[6]

Review of Literature

Jose Luis Martin Perez-Santos and Maricruz Anaya-Ruiz (2013)[7] Mexican breast cancer research output, 2003-2012. The objective of this study was to explore a bibliometric approach to quantitatively assess current research trends with regard to breast cancer in Mexico. Data were retrieved from the Web of Science database from 2003 to 2012; A total of 256 articles were retrieved. The institutions with the majority of publications were the National Autonomous University of Mexico (22.3%), the National Institute of Cancerology (21.9%), and the Social Security Mexican Institute (20.3%); clinical observation studies were the dominant investigation type (64%), and the main types of research were metabolics (24.2%) and pathology (21.5%). This article demonstrates the usefulness of bibliometrics to address key evaluation questions and establish priorities, define future areas of research, and develop breast cancer control strategies in Mexico.

Alí Ruiz-Coronel et al (2020)[8] National Cancer Institute scientific production scientometric analysis, the using the LabSOM software and the ViBlioSOM methodology based on artificial neural networks, the INC a scientific production indexed in the Web of Science from 2007 to 2017 was analyzed. The multidimensional scientometric profile of the Institute was obtained and compared with that of other national health institutions. In terms of

productivity, INC ranks fourth among the 10 Mexican public health institutions indexed in the Web of Science; in the normalized impact ranking, it ranks sixth. Although out of 1323 articles 683 (51.62 %) did not receive citations, 11 articles classified as excellent (0.83 %) obtained 24 % of 11,932 citations and, consequently, INC a normalized impact rate showed mean productivity higher than the world mean.

Jeyshankar and Ramesh babu (2013)[9] examined the scientometric analysis of leukemia research output (1960-2011): an Indian perspective. The data was collected from the Scopus database. The leukemia research output from India a total of 2120 research papers were published during the period 1960-to 2011. The growth rate is found to be at a maximum during the period 1992-1996 and the minimum during the period 1982-1986. The average growth rate works out to be 1.12 and Dt is in a fluctuation trend. The largest number (1524) of the journal articles 97.89%) used for publication indicates a continued trend of relying primarily on this form of publication. The future trend of leukemia will have an increasing trend in the year 2015 and may gain an increasing trend in 2020. A single-authored publication from form 6.37% and the average degree of collaboration the 0.96. The Journal of leukemia ranks first with 6.37%.

Rabiya Mushtaq & Fayaz Ahmad Loan (2021)[10] examined the lung cancer research in India and Iran: The top 10 countries contribute 89.77% of the total research productivity in a scientometric study. The lung cancer 151,903 (35.75%) publication productivity of the USA. the RGR is found to exhibit the highest value of 0.71 and the lowest of 0.10. Year-wise calculated values of RGR for India depict that year 1989 has the highest RGR of 0.71 however, later shows a decreasing trend dipping as low as 0.10 for the years 1998 and 2000. Both countries very high of the degree of collaboration in (0.98 for Iran and 0.97 for India). The value of the collaboration coefficient (CC) is above 0.50, i.e. (0.89 for India and 0.91 for Iran). This also confirms that both nations prefer multiple authorship patterns.

Sudhakar and Thanuskodi (2018)[11] analyzed the scientometric analysis of Marine Pollution Bulletin Journal research publications from 2008 to 2017 with 5416 publications. Maximum numbers of 905(16.71%) publications are contributed in the year 2017. This study identified RGR has been decreased from 0.63 to 0.18 and the same time doubling time has been increased from 1.10 to 3.85. The degree of collaboration was 0.94, which clearly indicates its dominance of multiple author's contributions. Liu J. was the top ranked authors

with 49 articles. Maximum numbers of 910 (12.06%) publications are contributed by United States.

Dhanya and Raja (2017)[12] analyzed the Indian research output of industrial pollution indexed in the Web of Science database with 805 publications during 2007-2016 which received 9699citations. Kumar A and Kumar R are the most productive authors with 13 (1.6%) publications. The most productive journal is Environmental Monitoring and Assessment with 103 (12.8%) publications and the maximum of articles are published in the year 2016 with 113(14%) publications. Relative Growth Rate is 0.16 in the year 2016 and Doubling Time is 4.58 in the year 2016.

Ravichandran and Vivekanandhan (2020)[13] analyzed the solid waste management research publications (2010-2019) using SCOPUS database with 5198 research publications. The maximum of 694 (13.35%) research publication in the year 2019, Compound annual growth ratio was 3.67.The maximum of 3907(75.16%) research publications are contributed by article, and the maximum of 43 (0.83%) research publications are contributed by Huang G.H, India. The study period identified that multi authors are dominated in this study field and the average degree of collaboration was 0.88. The relative growth rate was 0.63 in the year 2011 and 0.14 in the year 2019 at the same time doubling time was 1.10 in the year 2011 and 4.84 in the year 2019.

Shilpa & Padmamma (2020)[14] examined the growth of Literature on Oncology: A Scientometric Analysis. The study examines the growth of publications, annual growth rate, compound annual growth rate, authorship pattern in the oncology literature. The growth of publications was ranged from 7.90 in the year 2010 to 11.25 in the year 2018. In the year 2019, we can find a slight decrease in publications productivity. The study found that there is an increasing trend during the study. The annual growth rate was ranged from 0.91 and 1.09 during the study. The relative growth rate was decreasing and the doubling time was increasing from 2010 to 2019. The compound annual growth rate was registered in the year 2014 with 9.091.

Ravichandran and Vivekanandhan (2021)[15] examine the Scientometric analysis of wastewater management research publications during 2010-2019 from Scopus database. The study identified that maximum of 2842(14.31%) research publications with 19857 citations are contributed in the year 2019. Ngo, H.H contributed a maximum of 101(0.51%) research

publications, maximum of 19355 articles were contributed by joint authors and average degree of collaboration was 0.97. Maximum of 2102(10.58%) research publications are contributed in Bio resource technology, ministry of education, china with 863(22.32%) research publication and China has contributed maximum of 5919(29.80%) research publications.

OBJECTIVE OF THE STUDY

❖ To study the year wise growth of Leukemia research publications in India

❖ To examine the relative growth rate and doubling time.

❖ To study the authorship pattern.

❖ To study the degree of collaboration, and collaborative index of CC, CI and MCC

❖ To find out the co-authorship index.

❖ To identify the top 10 Authors, Institutions, Journals

❖ To identify the International Collaborated Countries in India

❖ To examine the time series analysis

❖ To identify the top 10 highly cited publications in India

Research methods

In the study of identified the leukemia research publications from 2011-2020 using the Scopus database. The keyword search is used to collect the data. The search key is: (TITLE-ABS-KEY ("Leukemia") AND PUBYEAR > 2010 AND PUBYEAR < 2021 AND (LIMIT-TO (AFFILCOUNTRY,"India"))) the data was collected for this study is 05.07.2021. The collected data's was analyzed using Micro soft excel work sheet.

Data Analysis and Interpretations

Compound Annual Growth Rate [CAGR]

The Compound Annual Growth Rate [CAGR] is one of the useful measures to identify the growth, over the multiple time periods. It can be measure from the initial number of publications to ending number of publications. The mathematical formula of CAGR is used **Ashok Kumar and Gopala Krishnan (2013)[16]**

The compound annual growth rate was calculated by the following formula,

$$CAGR = \left[\frac{\text{Ending Value}}{\text{Begining Value}}\right]^{\left[\frac{1}{\text{\# of Years}}\right]} - 1$$

During the ten year study period compound annual growth rate is calculated by the Leukemia research outputs in India from the beginning year and ending year. It is identified from the table 1 the compound annual growth rate is 5.37.

Relative Citation Index (RCI)

Relative citation index (RCI) was developed by the Institute of Scientific Information and examine the impact of different countries, institutions, authors and journals research publications. The scientific impact of leading countries was examined by using two relative indicators, namely citations per paper (CPP) and relative citations index (RCI). Citations per paper (CPP) are a relative indicator computed as the average number of citation per paper. To measure the both influence and visibility of a country research, the following formula has been used by **Bharvi Dutt and Khaiser Nikam (2016).**[17]

$$RCI = \frac{\text{A Country share of the World Citations}}{\text{A Country share of the World Publications}}$$

RCI = 1 indicate that a country's citation rate is equal to the world citation rate

RCI > 1 indicate that a country's citation rate is greater than the world citation rate

RCI < 1 indicate that a country's citation rate is lower than the world citation rate

H-Index

Hirsch (2005)[18] proposed the h-index is one of the alternatives to the standard bibliometric indicators for single scientists, it is defined below the table,

A scientist has index h if h of his or her Np papers have at least h citations each and other papers (Np – h) have ≤ citations each.

Ye (2009)[19] found that the **Glanzel-Schubert (2007)**[20] model was better than the **Hirsch and Egghe-Rousseau (2006)**[21] model to estimate the *h*-index of countries and other units. **Gupta and Bala (2013)**[21] discussed the *h*-index in the various acts of Epilepsy research in India. Differences among the various models of the *h*-index are

Various methods of *h*-index

Model	Equation	Description
Hirsch	$h = \sqrt{(C / a)}$	C = Total Citations; a = Constant
Egghe-Rousseau	$h = P^{1/\infty}$	P = Total Publications; a > 1 is Lotka's Exponential
Glanzel-Schubert	$h = c\,P^{1/3}$ $(CPP)^{2/3}$	c is a Constant; P = Total Publications CPP = Citations Per Publications

Year Wise Growth of Leukemia Research Outputs Publications

Table 1: Year Wise Growth of Leukemia Research Outputs Publications.

S.No	year	Publications	%	Citations	%	Cited	%	Uncited	%	CPP	RCI
1	2011	410	7.49	9086	10.46	356	8.42	54	4.33	22.16	1.40
2	2012	477	8.71	8382	9.65	411	9.72	66	5.30	17.57	1.11
3	2013	497	9.08	8196	9.43	453	10.71	44	3.53	16.49	1.04
4	2014	562	10.27	7043	8.11	463	10.95	99	7.95	12.53	0.79
5	2015	552	10.08	26325	30.30	468	11.07	84	6.74	47.69	3.01
6	2016	600	10.96	5730	6.60	497	11.75	103	8.27	9.55	0.60
7	2017	533	9.74	12682	14.60	424	10.03	109	8.75	23.79	1.50
8	2018	576	10.52	5044	5.81	440	10.41	136	10.91	8.76	0.55
9	2019	575	10.50	2683	3.09	385	9.11	190	15.25	4.67	0.29
10	2020	692	12.64	1698	1.95	331	7.83	361	28.97	2.45	0.15
	Total	5474	100.00	86869	100.00	4228	100.00	1246	100.00		
	CAGR	5.37									

The year –wise growth of leukemia research publications during the 10 years study period in the table-1 between 2011 and 2020 with 5,474 research publications and 86,869 citations. The study from the maximum of 692 (12.64%) research publications are contributed in the year 2020, followed by 600 (10.96%) publications in the year 2016, and 575 (10.50%) publications in the year 2019. The average research publication per year is 547.4.

During the ten-year study that a total number of 5,474 publications are received 86,869 citations. Out of that maximum of 26,325 (30.30%), citations are received 552 publications in the year 2015. Followed by 12,682 (14.60%) citations are received 533 publications in the year 2017. From the study, out of 5,474 publications, 4,228 (100%) research publications are cited publications, and 1,246 (100%) research publications are uncited publications. The maximum of citation per paper is 47.69 in the year 2015, followed by CPP is 23.79 in the year 2017, and by CPP is 22.16 in the year 2011 and the average citation per paper is 1.66. The maximum of RCI is 3.01 in the year 2015, followed by 1.50 in the year 2017, by 1.40 in the year 2011 and the average RCI is 1.04.

Relative Growth Rate (RGR)

The most important feature of science and technology in recent years has been calculated by the rate of growth. Scientific growth has been involved not only increase in manpower and financial investment. The relative growth rate is identified by the increase in number of publications per unit of time. The mean relative growth rate over the particular period of interval can be calculated in the following formula developed by **Mahapatra (1985).[23]**

$$R(a) = \frac{(W_2 - W_1)}{(T_2 - T_1)}$$

Where,

R (a) = RGR = the mean relative growth rate over the specific period of interval

W_1 = the logarithm of beginning number of publications/pages

W_2= the logarithm of ending number of publications/pages after a specific period of interval

$T_2 - T_1$ = the unit difference between the beginning time and the ending time.

The doubling time is the time taken for the doubling of the number of records actually published within a stipulated period. The doubling time is calculated from the relative growth rate and the natural logarithm number is used, the difference has a value of 0.693. The corresponding doubling time can be calculated by the following formula,

$$Dt = \frac{0.693}{R(a)}$$

Relative Growth Rate and Doubling Time in Leukemia Research Outputs

Table 3: Relative Growth Rate and Doubling Time in Leukemia Research Outputs.

S.No	Years	Publications	Cum	W1	W2	RGR=(W2-W1)	Dt=(0.693/RGR
1	**2011**	**410**	**410**		6.02		
2	2012	477	887	6.02	6.79	0.77	0.90
3	2013	497	1384	6.79	7.23	0.44	1.56
4	2014	562	1946	7.23	7.57	0.34	2.03
5	2015	552	2498	7.57	7.82	0.25	2.78
6	2016	600	3098	7.82	8.04	0.22	3.22
7	2017	533	3631	8.04	8.20	0.16	4.37
8	2018	576	4207	8.20	8.34	0.15	4.71
9	2019	575	4782	8.34	8.47	0.13	5.41
10	2020	692	5474	8.47	8.61	0.14	5.13
	Total	5474					

The leukemia research output in India in the relative growth rate and the doubling time (Dt) the result are presented the calculate in table-3 from the study it is identified that, the relative growth rate is 0.77 in the year 2012 and 0.14 in the year 2019. This study confirmed that, relative growth rate is decreasing trend from 2012 to 2020. At the same time, doubling time is found that 0.90 in the year 2012 and 5.13 in the year 2020. It is conformed that doubling time is increasing trend during the study period.

Authorship Pattern in Leukemia Research Outputs

Table 4: Authorship Pattern in Leukemia Research Outputs.

	Authorship Pattern						
year	1	2	3	4	5	>5	Total
2011	18	70	70	91	48	113	410
2012	16	70	73	101	61	157	478
2013	18	63	75	102	77	162	497
2014	25	66	91	128	70	181	561
2015	18	77	79	108	76	195	553
2016	26	63	107	119	74	211	600
2017	11	60	82	107	74	199	533
2018	7	69	89	106	93	212	576
2019	15	89	85	99	80	207	575
2020	26	69	134	103	86	273	691
Total	180	696	885	1,064	739	1,910	5,474
%	3.29	12.71	16.17	19.44	13.50	34.89	100.00

From the study it is identified the authorship pattern table-4 in the field of leukemia research output in India, The majority of the authors in the field are preferred to publish their research works in more than five authorship mode with 1,910 (34.89%) publications. Followed by four authorship mode with 1,064 (19.44%) publications, three authorship mode with 885 (16.17%) publications. During the study period five authors are contributed with 739(13.50%) publications, two authors are contributed only 696 (12.71%) publications. single author are contributed only 180(3.29%) publications. This study confirmed that more than 97% of publications are contributed in multiple authors.

Degree of Collaboration

The degree of collaboration is relationship between the single author and multi author's contributions. The degree of collaboration is calculated by the **Subramanian formula (1983)[24], used by Vivekanandhan (2016),[25] Sivasamy (2020).[26] Ravichandran (2021)[27]**

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

N_m = Number of multi authored publications

N_s = Number of single authored publications

The present study of number of multi- authors = 5294, number of single author = 180

The degree of collaboration is =5294/ (180+5294) = 0.97

Degree of Collaboration in Leukemia research publications

Table 5: Degree of Collaboration in Leukemia research publications.

year	Single Author Publications NS	Multi Author Publications NM	Total Author Publications NS+NM	Degree of collaboration DC = Ns/ (Ns+Nm)
2011	18	392	410	0.96
2012	16	462	478	0.97
2013	18	479	497	0.96
2014	25	536	561	0.96
2015	18	535	553	0.97
2016	26	574	600	0.96
2017	11	522	533	0.98
2018	7	569	576	0.99
2019	15	560	575	0.97
2020	26	665	691	0.96
Total	180	5,294	5,474	0.97

The leukemia research publications in India table -5 shows that the degree of collaboration ten years study period to selected. The degree of collaboration from the study it is identified that is between 0.96 in the year 2011 and 0.96 in the year 2020. The degree of collaboration average is 0.97. The majority from this study it is identified that, the leukemia research publications are contributed by collaborated authors.

Collaborative Coefficient (CC)

The pattern of co-authorship collaboration among the authors can be measured with the following formula suggested by **Ajiferuke, et al. (1988).**[28]

$$CC = 1 - \left[\sum_{j=0}^{k} \left(\frac{1}{j} \right) \times Fj/N \right]$$

Whereas,

Fj = Number of publications with j author papers

N = Total number of the research publications and

k = the greatest number of authors/ paper in the given field.

Collaboration Index (CI)

The simple indicator are presently employed in the publications to the collaboration index, which is to be understand nearly as the mean number of authors per paper are suggested by **Ajiferuke, et al.(1988)**[28]

$$CI = \frac{\sum_{j=1}^{k} jf_j}{N}$$

Here

J - The number of co-authored papers appearing in a discipline

N - The total number of publications in the field over the same time period of interval and

k - The highest number of authors per paper in a same time field.

Modified Collaboration Coefficient

The modified collaboration coefficient (MCC) counted by the formula which is suggested by **Savanur and Srikanth, (2010)[29]**

Which is given below:

Where,

$$MCC = \frac{N}{N-1} \left[1 - \frac{\sum_{j=1}^{k} jf_j}{N} \right]$$

j = the number authors in an article i.e. 1, 2, 3......

Fj = the number of j authored articles

N = the total number of articles published in a year, and

A = the total number of authors per articles

Collaborative Measure in Leukemia Research Publications

Table 6: Collaborative Measures in Leukemia Research Publications.

year	1	2	3	4	5	>5	CC	CI	MCC
2011	18	70	70	91	48	113	0.69	4.02	4.03
2012	16	70	73	101	61	157	0.71	4.24	4.25
2013	18	63	75	102	77	162	0.71	4.29	4.30
2014	25	66	91	128	70	181	0.71	4.24	4.25
2015	18	77	79	108	76	195	0.72	4.32	4.33
2016	26	63	107	119	74	211	0.71	4.31	4.32
2017	11	60	82	107	74	199	0.73	4.44	4.45
2018	7	69	89	106	93	212	0.74	4.47	4.47
2019	15	89	85	99	80	207	0.72	4.32	4.33
2020	26	69	134	103	86	273	0.72	4.41	4.41
Total	180	696	885	1,064	739	1,910			

Caption above the table: **Authorship Pattern** (spanning columns 1, 2, 3, 4, 5, >5)

The collaborative index measure of leukemia of research publications in India table -6 the selected ten year study period from 2011 to 2020. The study period it is identified from the table-6 the maximum of CC value is 0.74 in the year 2018, and minimum of CC value is 0.69

in the year 2011. The average CC value is 0.76. The CI values are identified from the table-6, the maximum of CC value is 4.44 in the year 2017 and a minimum of CI value is 4.02 in the year 2011.The average CI value 4.30. The maximum of MCC value is 4.47, and a minimum of MCC value is 4.03. The average MCC value is 4.32.

Co-authorship Index (CAI)

To study how the pattern of co-authorship and the use of co-authorship index suggested by **Garg and Padhi (2001)[30]** has been explained the under mentioned formula. To evaluate the co-authorship index (CAI) is the whole set of data is divided into 2 block years.

$$CAI = \left[\frac{(Nij/Nio)}{(Noj/Noo)}\right] \times 100$$

Whereas,

Nij - Number of publications having j authors in i block

Nio - Total publications of i block

Noj - Number of publications having j authors for all blocks

Noo-: Total number of publications for all authors and the all blocks

Here CAI=100 implies that a country's co-authorship effort for a particular authorship correspond to the world average

CAI > 100 reflects higher than average co-authorship effort

CAI < 100 reflects lower than average co-authorship effort by the given type of authorship pattern.

For calculating the co-authorship index for authors, years have been replaced into block years. For this study, the authors have been classified into two blocks (ie.2010-2014 and 2015-2019) Vs**.** Single, Two, Three authors and More than 3 authors.

Co- Authorship Index (CAI) in Leukemia research publications

Table 7: Co- Authorship Index) in Leukemia research publications.

5 year Block	Single	CAI	Two	CAI	Three	CAI	More than three	CAI	Total
2011-2015	95	115.61	346	108.89	388	96.03	1670	98.52	2499
2016-2020	85	86.89	350	92.53	497	103.33	2043	101.24	2975
Total	180		696		885		3713		5474

The Co- authorship index values are calculated by the block year period for table-7, for leukemia research publications in India for selected ten years study period. From the study it is identified that, CAI for single and two authorship contributions are decreasing trend from

1st block year to 2nd block year. At the same time CAI is increasing trend for three authors and more than three authors from 1st block year to 2nd block years (98.52) to (101.24).

Top 10 Authors Contribution in Leukemia Research Publications in India

Table 8: Top 10 Authors Contribution in Leukemia Research Publications in India.

S.No	Author	Country	Publications	%	Citations	%	CPP	H-Index	RCI
1	Malhotra, P.	India	128	17.16	499	8.96	3.90	10	0.52
2	Varma, N.	United States	111	14.88	614	11.03	5.53	12	0.74
3	Bakhshi, S.	United Kingdom	91	12.20	521	9.36	5.73	12	0.77
4	Varma, S.	Canada	72	9.65	318	5.71	4.42	8	0.59
5	Kumar, L.	Saudi Arabia	66	8.85	667	11.98	10.11	12	1.35
6	George, B.	Germany	59	7.91	725	13.02	12.29	16	1.65
7	Prakash, G.	Australia	57	7.64	193	3.47	3.39	8	0.45
8	Mathews, V.	Italy	56	7.51	864	15.52	15.43	16	2.07
9	Bansal, D.	France	55	7.37	455	8.17	8.27	11	1.11
10	Khadwal, A.	Japan	51	6.84	712	12.79	13.96	7	1.87
	Total		746	100.00	5,568	100.00	7.46		

Top 10 author's contribution in leukemia research publications in India from the 10 year selected study period from the study it is identified that, the maximum of 128(17.16%) research publications are contributed by Malhotra, P. India and his publications are received 499(8.96%) citations, CPP is 3.90, h-index is 10 and RCI value is 0.52. Followed by Varma, N. from Varma, N. the United States with 111(14.88%) research publications and it is received by 614(11.03%) citations, CPP is 35.53, h-index is 12 and RCI value is 0.74. Third ranking author is Bakhshi, S. from United Kingdom with 91(12.20%) research publications, 521(9.36%) citations, CPP is 5.73, h-index is 12 and RCI value is 0.77.

Document Type Contributions in Leukemia research output in India

Table 9: Document Type Contributions in Leukemia research output in India.

S.No	Document Type	Publications	%
1	Article	3837	70.09
2	Review	683	12.48
3	Letter	471	8.60
4	Conference Paper	210	3.84
5	Note	119	2.17
6	Book Chapter	61	1.11
7	Editorial	51	0.93
8	Short Survey	26	0.47
9	Erratum	8	0.15
10	Book	4	0.07

11	Data Paper	1	0.02
12	Retracted	1	0.02
13	Undefined	2	0.04
	Total	5,474	100.00

Document types are identified during the ten-year study period on leukemia research publications are shown in table 9. From the study, it is identified that a maximum of 3837(70.09%) research publications are contributed by Article, followed by 683(12.48%) research publications are Review and third-placed in Letter with 471(8.60%) research publications. This study confirmed that more than 91% of research publications are contributed by article, review, and letter. The remaining nearby 9% of research publications are identified in the other form documents.

Top 10 Institutions Contributions in Leukemia research output in India

Table 10: Top 10 Institutions Contributions in Leukemia research output in India.

S.No	Organization	Publications	%	Citations	%	CPP	H-Index	RCI
1	All India Institute of Medical Sciences, New Delhi	404	23.82	10,390	14.88	25.72	21	0.62
2	Postgraduate Institute of Medical Education & Research, Chandigarh	365	21.52	11,159	15.98	30.57	25	0.74
3	Tata Memorial Hospital	201	11.85	20,854	29.86	103.75	21	2.52
4	Institute Rotary Cancer Hospital India	159	9.38	1026	1.47	6.45	14	0.16
5	Christian Medical College, Vellore	125	7.37	7860	11.25	62.88	23	1.53
6	Indian Institute of Integrative Medicine, Srinagar	114	6.72	2,582	3.70	22.65	28	0.55
7	Manipal Academy of Higher Education	86	5.07	651	0.93	7.57	13	0.18
8	Council of Scientific and Industrial Research India	86	5.07	7,808	11.18	90.79	29	2.20
9	Cancer Institute India	78	4.60	343	0.49	4.40	10	0.11
10	University of Delhi	78	4.60	7,164	10.26	91.85	22	2.23
	Total	1,696	100.00	69,837	100.00			

Top 10 Institutions from the table-10 are contributed a total number of 1,696 publications and it is received 69,837 citations for the selected ten year study period in Leukemia research output in India. From the study it is identified that, maximum number of 404(23.82%) publications are contributed by All India Institute of Medical Sciences, New Delhi and it is received 10,390(14.88%) citations, CPP is 25.72, h-index is 21 and RCI value is 0.62. Followed by Postgraduate Institute of Medical Education & Research, Chandigarh

contributed with 365(21.52%) research publications, 11,159(15.98%) citations, CPP is 30.57, h-index is 25 and RCI value is 0.74. Third rank institution is Tata Memorial Hospital with 201(11.85%) research publications, 20,854(29.86%) citations, CPP is 103.75, h-index is 21 and RCI value is 2.52.

Top 10 Journals Contributions in Leukemia Research Output in India

Table 11 top 10 Journals Contributions in Leukemia Research Output in India.

S.No	Journals	Publications	%	Citations	%	CPP	H-Index	RCI
1	Indian Journal Of Hematology And Blood Transfusion	266	24.14	64	1.97	0.24	10	0.08
2	Indian Journal Of Medical And Pediatric Oncology	184	16.70	541	16.69	2.94	11	1.00
3	Indian Journal Of Pathology And Microbiology	129	11.71	356	10.98	2.76	9	0.94
4	Indian Journal Of Cancer	102	9.26	289	8.91	2.83	9	0.96
5	Journal Of Clinical And Diagnostic Research	102	9.26	322	9.93	3.16	8	1.07
6	Journal Of Cancer Research And Therapeutics	68	6.17	591	18.23	8.69	8	2.95
7	Leukemia And Lymphoma	68	6.17	505	15.58	7.43	13	2.52
8	BMJ Case Reports	64	5.81	95	2.93	1.48	4	0.50
9	Indian Journal Of Pediatrics	60	5.44	256	7.90	4.27	9	1.45
10	Indian Pediatrics	59	5.35	223	6.88	3.78	8	1.28
	Total	1102	100.00	3,242	100.00			

Top 10 Journals contributions in the field of leukemia research publications in India the table-11. The study period from it is identified that, the maximum of 266(24.14%) research publications are contributed by Indian Journal of Hematology and Blood Transfusion and it is received by 64(1.97%) citations, CPP is 0.24, h-index is 10 and RCI value is 0.08. Followed by Indian Journal of Medical and Pediatric Oncology with 184(16.70%) research publications, 541(16.69%) citations, CPP is 2.94, h-index is 11 and RCI value is 1.00. Third placed contributing Indian Journal of Pathology and Microbiology research with 129(11.71%) publications, 356(10.98%) citations, CPP is 2.76, h-index is 9 and RCI value is 0.94.

Top 10: International Collaborated Countries in Leukemia Research Publications in India

Table- 12: Top 10 International Collaborated Countries in Leukemia Research Publications in India.

S.No	Country	Publications	%	Citations	%	CPP	H-Index	RCI
1	United States	462	37.90	21,867	13.76	47.33	56	0.36
2	United Kingdom	130	10.66	32,712	20.59	251.63	35	1.93
3	Canada	100	8.20	12,621	7.94	126.21	27	0.97
4	Saudi Arabia	94	7.71	10,435	6.57	111.01	23	0.85
5	Germany	93	7.63	13,500	8.50	145.16	30	1.11
6	Australia	72	5.91	12,466	7.85	173.14	28	1.33
7	Italy	71	5.82	12,110	7.62	170.56	30	1.31
8	France	69	5.66	31,357	19.74	454.45	30	3.49
9	Japan	67	5.50	11,803	7.43	176.16	25	1.35
10	China	61	5.00	1,5048	9.47	246.69	27	1.89
	Total	1,219	100.00	173,919	109.47			
	Others Country 120	1,260						

Top ten International collaborated countries of leukemia research publications in India. During the study period of 20110 to 2020in the table- 12. The maximum of 462(37.90%) research publications are collaborated by United States of America. Followed by United Kingdom with 130(10.66%) research publications, Canada with 100(8.20%) research publications. During the ten year study period total number of 1219 publications are collaborated by 120 countries 1260 publications in other Countries.

Time Series Analysis in Leukemia Research Publications in India

Table 13: Time Series Analysis in Leukemia Research Publications in India.

S.No	Years	Count(Y)	X	Y^2	XY
1	2011	410	-5	25	-2050
2	2012	477	-4	16	-1908
3	2013	497	-3	9	-1491
4	2014	562	-2	4	-1124
5	2015	552	-1	1	-552
6	2016	600	1	1	600
7	2017	533	2	4	1066
8	2018	576	3	9	1728
9	2019	575	4	16	2300
10	2020	692	5	25	3460
	Total	5474		110	2029

A straight – line equation is adapted to measure the future value based on previous data. The time series analysis study reveals that, the estimated growth values are identified based on previous data. Time series analysis used by **Jeyshankar and Ramesh babu (2013).**[31]

This study identified the future prediction of Leukemia research publications in India for the year 2025 and 2030.

Straight Line Equation is

$$Y = a + bx$$

Here,

$\sum Y = 5474, \sum X^2 = 110, \sum XY = 2029$

a= $\sum Y/N$ = 5474/10 = 547.4 = 547

b= $\sum XY/ \sum X^2$ = 2029/110 = 18.4 = 18

The growth of estimate publications in the year 2025 is, when x = 2025-2015 = 10

$$Y = a + bx$$

= 547+ (110*10) = 547+1100 = 1647

The growth of estimate publications in the year 2030 is, when x = 2030-2015 = 15

$$Y = a + bx$$

$$= 547 + (110*15) = 547 + 1650 = 2197$$

The estimated growth based on a time series analysis statistical application will be expected in the Leukemia research publications in Indian in the year 2025 is around are equal to 1647 publications and the year 2030 is around are equal to 2197 publications. So that time serious analysis study conformed Leukemia research publications in India is increasing trend.

Top 10 Highly Cited Leukemia Research Publications in India

Table 14: Top 10 Highly Cited Leukemia Research Publications in India.

S.No	Titles	Citations	Document Type
1	Ferlay, J. 2015) Cancer incidence and mortality worldwide: Sources, methods and major patterns in GLOBOCAN 2012, International Journal of Cancer, 136(5): 359-386.	18098	Article
2	Vos T(2017) Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016, The Lancet, 390(10100):1211-1259.	2529	Article

3	Fitzmaurice, C., (2017) Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 32 cancer groups, 1990 to 2015: A Systematic Analysis for the Global Burden of Disease Study Global Burden of Disease Cancer Collaboration, JAMA Oncology, 3(4): 524-548.	2040	Review
4	Mehata, S. (2017) Global, regional, and national age-sex specifc mortality for 264 causes of death, 1980-2016: A systematic analysis for the Global Burden of Disease Study 2016, The Lancet, 390(10100):1151-1210.	2012	Article
5	Allemani C (2015) Global surveillance of cancer survival 1995-2009: Analysis of individual data for 25 676 887 patients from 279 population-based registries in 67 countries (CONCORD-2), The Lancet, 385(9972):977-1010.	1313	Article
6	Hay S.I (2017) Global, regional, and national disability-adjusted life-years (DALYs) for 333 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016, The Lancet, 390(10100): 1260-1344.	933	Article
7	Fitzmaurice, C. (2018) Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life-years for 29 cancer groups, 1990 to 2016 a systematic analysis for the global burden of disease study global burden of disease cancer collaboration, JAMA Oncology, 4(11): 1553-1568.	676	Article
8	Bulbake, U., (2017) Liposomal formulations in clinical use: An updated review, Pharmaceutics, 9(2): Article No. 12.	658	Review
9	Premanathan, M. (2011) Selective toxicity of ZnO nanoparticles toward Gram-positive bacteria and cancer cells by apoptosis through lipid peroxidation, Nanomedicine: Nanotechnology, Biology, and Medicine, 7(2): 184-192.	658	Article
10	Kantarjian, H.M., (2012) Dasatinib or imatinib in newly diagnosed chronic-phase chronic myeloid leukemia: 2-Year follow-up from a randomized phase 3 trial (DASISION), Blood, 119(5):1123-1129.	436	Article

Table 15 indicates the high cited top 10 Leukemia research publications in India for the selected ten year study period. From the study it is identified that, maximum number of 18098 citations are received by Ferlay, J.,(2015) Cancer incidence and mortality worldwide: Sources, methods and major patterns in GLOBOCAN 2012, International Journal of Cancer, 136(5): 359-386.

Followed by 2529 citations from Vos,.T(2017) Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016, The Lancet, 390(10100):1211-1259.

Third rank by 2040 citations from Fitzmaurice, C., (2017) Global, regional, and national cancer incidence, mortality, years of life lost, years lived with disability, and disability-

adjusted life-years for 32 cancer groups, 1990 to 2015: A Systematic Analysis for the Global Burden of Disease Study Global Burden of Disease Cancer Collaboration, JAMA Oncology, 3(4): 524-548. The top ten highly cited leukemia research publications in India are contributed 8 articles and 2 review papers.

Major Finding

❖ The year-wise growth of leukemia research publications during the 10-year study period between 2011 and 2020 with 5,474 research publications and 86,869 citations. From the study, it is identified that the maximum of 692 (12.64%) research publications are contributed in the year 2020, the average research publication per year is 547.4.

❖ From the study, out of 5,474 publications, 4,228 (100%) research publications are cited publications, and 1,246 (100%) research publications are uncited publications. The maximum of citation per paper is 47.69 in the year 2015

❖ The relative growth rate is 0.77 in the year 2012 and 0.14 in the year 2019. This study confirmed that, relative growth rate is decreasing trend from 2012 to 2020. At the same time, doubling time is found that 0.90 in the year 2012 and 5.13 in the year 2020. It is conformed that doubling time is increasing trend during the study period.

❖ The authorship pattern is more than five authorship mode with 1,910 (34.89%) publications, the average degree of collaboration is 0.97, and the majority of leukemia research publications are contributed by collaborative authors.

❖ During the maximum of CC value is 0.74 in the year 2018, and minimum of CC value is 0.69 in the year 2011. The average CC value is 0.76. The the maximum of CI value is 4.44 in the year 2017 and a minimum of CI value is 4.02 in the year 2011.The average CI value 4.30. The maximum of MCC value is 4.47, and a minimum of MCC value is 4.03. The average value is 4.32.

❖ CAI for single and two authorship contributions are decreasing trend from 1st block year to 2nd block year. At the same time CAI is increasing trend for three authors and more than three authors from 1st block year to 2nd block years (98.52) to (101.24).

❖ During the study a maximum of 128(17.16%) research publications are contributed by Malhotra, P. India and his publications are received 499(8.96%) citations, CPP is 3.90, h-index is 10 and RCI value is 0.52.

❖ The study document type of a maximum of 3837(70.09%) research publications are contributed by Article, followed by 683(12.48%) research publications are Review and third-placed in Letter with 471(8.60%) research publications

❖ During the maximum number of 404(23.82%) publications are contributed by All India Institute of Medical Sciences, New Delhi and it is received 10,390(14.88%) citations, CPP is 25.72, h-index is 21 and RCI value is 0.62..

❖ The study maximum of 266(24.14%) research publications are contributed by Indian Journal of Hematology and Blood Transfusion and it is received by 64(1.97%) citations, CPP is 0.24, h-index is 10 and RCI value is 0.08.

❖ Collaborator country the maximum of 462(37.90%) research publications are collaborated by United States of America. Followed by United Kingdom with 130(10.66%) research publications, Canada with 100(8.20%) research publications.

❖ The time series analysis statistical application will be expected in the Leukemia research publications in Indian in the year 2025 is around are equal to 1647 publications and the year 2030 is around are equal to 2197 publications. So that time serious analysis study conformed Leukemia research publications in India is increasing trend.

❖ The highly cited paper of 18098 citations are received by Ferlay, J (2015) Cancer incidence and mortality worldwide: Sources, methods and major patterns in GLOBOCAN 2012, International Journal of Cancer, 136(5): 359-386.

CONCLUSION

It is identified in the ten-year study that leukemia research publications. This analysis indicated pattern of different peripherals of the study such as future trend of literature, The collaborator country the maximum of 462(37.90%) research publications are collaborated by United States of America, the maximum of 266(24.14%) research publications are contributed by Indian journal of hematology and blood transfusion, and a maximum of 128(17.16%) research publications are contributed by Malhotra, P. India and his publications. The average degree of collaboration is 0.97, the maximum number of 404(23.82%) publications are contributed by all India institute of medical sciences, New Delhi. The Asian countries leukemia research particularly needed more research is evaluate. In this studies would be helpful any research area output. The collaborative projects will produce improved research output and exchange of information in any subject in national and international.

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