JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Zika Virus in Global Level Research Output: A Scientometric Analysis.

***S. Ravichandran, ** Dr.P. Rajendran, ***S. Vivekanandhan**

*Library Assistant, SRM Institute of Science and Technology, Kattankulathur, Chengalpattu, Tamilnadu, India. Pin- 603203,

**University Librarian, SRM Institute of Science and Technology, Kattankulathur, Chengalpattu, Tamilnadu, India

**Deputy Librarian, SRM Institute of Science and Technology, Kattankulathur, Chengalpattu, Tamilnadu, India. Pin: 603203,

Corresponding author: S. Ravichandran

Abstract

The present study has analyzed nearly 12294 publications in the field of zika virus during the study period of 2013 to 2022. The highest number of articles 12038(16.58%) was published in the year 2017. Followed by the second-highest number of articles in 2022(16.45%) were contributed in the year 2016. These two years are considered as most productive years. The author the maximum Wiwanitkit, V. has contributed the highest number of articles 213(24.23%) research publications in the United States. The subjects in Biochemistry, Genetics, and Molecular Biology have contributed the highest number of with 2451(54.75%) research publications. The United States contributed the highest number of articles which amounts to more than 4893(39.92%) of the total publication. The authorship pattern is 1496 research publications are contributed by single authors and the average degree of collaboration is 0.88. The average CC is 0.67, the average CI is 4.45, and the average MCC is 4.60. The Institutions of with Fundacao Oswaldo Cruz research institute alone published 695(22.51%) research publications. The journals of Viruses are at the top of the list with 429(20.88) research publications. The large majority of the research output is available in the form of Article 7608(61.88%) research publications. The time series analysis statistical application will be expected in the zika virus research publications in the year 2025 is around equal to 2749 in the year 2030 is around equal to 3104. So that time serious analysis confirmed that the publications on zika virus research are increasing trend. The highest number of citations with 5801 Wu, F., et.al (2020) a new coronavirus associated with human respiratory disease in China, Nature, 579(7798):265-269.

Keywords: Scientometric analysis, Bibliometric, Authorship pattern, Collaborative measure, Degree of collaboration, Time series analysis, Highly cited paper.

Introduction:

Zika virus is a mosquito-borne flavivirus that was first identified in Uganda in 1947 in monkeys. It was later identified in humans in 1952 in Uganda and the United Republic of Tanzania. Outbreaks of Zika virus disease have been recorded in Africa, the Americas, Asia, and the Pacific. From the 1960s to 1980s, rare sporadic cases of human infections were found across Africa and Asia, typically accompanied by mild illness. The first recorded outbreak of Zika virus disease was reported from the Island of Yap (Federated States of Micronesia) in 2007. This was followed

by a large outbreak of Zika virus infection in French Polynesia in 2013 and in other countries and territories in the Pacific. In March 2015, Brazil reported a large outbreak of rash illness, soon identified as Zika virus infection, and in July 2015, found to be associated with Guillain-Barré syndrome. In October 2015, Brazil reported an association between Zika virus infection and microcephaly. Outbreaks and evidence of transmission soon appeared throughout the Americas, Africa, and other regions of the world. To date, a total of 89 countries and territories have reported evidence of mosquito-transmitted Zika infection.

Protection against mosquito bites during the day and early evening is a key measure to prevent Zika virus infection. Special attention should be given to the prevention of mosquito bites among pregnant women, women of reproductive age, and young children. Personal protection measures include wearing clothing (preferably light-colored) that covers as much of the body as possible; using physical barriers such as window screens and closed doors and windows; and applying insect repellent to skin or clothing that contains DEET, IR3535, or icaridin according to the product label instructions. Young children and pregnant women should sleep under mosquito nets if sleeping during the day or early evening. Travelers and those living in affected areas should take the same basic precautions described above to protect themselves from mosquito bites. *Aedes* mosquitoes breed in small collections of water around homes, schools, and work sites. It is important to eliminate these mosquito breeding sites, including covering water storage containers, removing standing water in flower pots, and cleaning up trash and used tires. Community initiatives are essential to support local government and public health programs to reduce mosquito breeding sites. Health authorities may also advise the use of larvicides and insecticides to reduce mosquito populations and disease spread.[1]

Scientometrics Study:

Scientometrics is one of the truly interdisciplinary research fields to extend almost all scientific fields. In addition, many extensive bibliometric studies of important science fields appeared during the last two decades. At present, the connotation of bibliometric turns out to be the science of measurement relating to documents. The word measurement means the application of mathematical and statistical techniques to find out the growth of documents, scattering, or literature in various types of documents, publication of documents by an author, impact of document, and so on. **Cole and Eales (1917**)[2] in their publication on the history of comparative anatomy, applied statistical methods for analyzing the literature called statistical analysis. The most important contribution was made by **Hulme (1923)**[3] when he published the book statistical bibliography, this term continued to be used for statistical measures till the end of the 1960s. **Ranganathan (1948**)[4] coined the term librametry to denote the measurement of various library activities and services using mathematical and statistical techniques. **Alan Prichard** (1969)[5] coined the term bibliometric to denote the Application of mathematical and statistical methods to books and other media, the process of written communication, and of the nature and course of a discipline. **Van Raan (1997)**[6] According to scientometric research is devoted to Quantitative studies of science and technology.

Review of Literature

Manikandan M. Amsaveni N. (2015)[7] A Scientometric Measures In Cloud Computing: A Special Reference to Authors' Productivity. The computer science department developing and uprising as thrill grips the world about connecting Networks and communications from different places of the world. In this study, we have made an attempt to measure the research output through a Scientometric analysis of Cloud computing to understand the trends of research in terms of H-Index, Collaborative patterns, and Citations. The author of Buyya R. has 40 research publications, and total citations are is294, total global citations are 912, H- index is 12. The contribution of multiple authors is dominating with a major contribution of double and three authors, and the degree of collaboration is 0.86. The institutions of NASA have 304(5.5%) research publications, a total of citations 497, and a total of global citations are 12396.

Manimuthu A. (2015)[8] scientometric analysis of cloud computing literature The Popularity and rapid development of cloud computing in recent years have led to a huge amount of publications containing the achieved knowledge of this area of research. While evaluating science has a long tradition in many fields, we identify a lack of comprehensive scientometric study in the area of cloud computing. The authors Buyya Raj Kumar, the University of Melbourne,

Australia is 29.360. The Scopus database 2008-2013 total number of 15376. Based on the large book reference(bibliographic) database this study applies scientometric means to empirically study the evolution and state of cloud computing research with a view from above the clouds by this, we provide extensive insights into publication patterns, research facts, and research productivity. The result of this study provides a better understanding of patterns, trends, and important factors as a basis for directing research activities.

Ravichandran S and Vivekanandhan S. (2021)[9] analyzed the wireless sensor network research output in India from 2010 to 2019 from the Scopus database with 11775. This study identified that a maximum number of 2058(17.48%) publications are contributed in the year 2019 and the compound annual growth rate was 5.44. This study identified that the relative growth rate was decreasing trend and doubling time was increasing trend. The average degree of collaboration was 0.96 and CAI for single and two authorship contributions are increasing trend from 1st block year to 2nd block year. At the same time, the CAI was decreasing trend for more than three authors from 1st block year (106.71) to 2nd block year (97.39). The highly cited publications are 391 with Ojha, T., et.al. (2015)Wireless sensor networks for agriculture: The state-of-the-art in practice and future challenges, Computers, and Electronics in Agriculture,118,66-84.

Praveena K. et al (2021)[10] examined the Mapping of Artificial Intelligence Research Output: A Scientometric Study. The present study analyses the research in progress regarding the subject of artificial intelligence. The data are collected from the Web of Science at the end of November 2020. The period considered for the study is from 1999 to 2019. It is found that a total of 21643 papers are published on the subject of Artificial Intelligence during this period. The collection is exported to HistCite to obtain a large list of 20743 articles and 341247 times cited references along with their local and global citation scores (LCS and GCS). It is found that the Degree of Collaboration is 0.83.

Ravichandran S and Vivekanandhan S. (2021)[11] examine the Scientometric analysis of wastewater management research publications from 2010 to 2019 from the Scopus database. The study identified that a 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 the average degree of collaboration was 0.97. A maximum of 2102(10.58%) research publications are contributed in Bioresource technology, ministry of education, china with 863(22.32%) research publications, and China has contributed the maximum of 5919(29.80%) research publications.

Need for the study

An attempt has been made to analyze the research trend and their characteristics in the field of the Zika virus literature published in the Scopus online database from 2013 to 2022 by using bibliometric techniques.

Objectives of the study

The main objective of the study is to analyze the growth pattern of the Zika virus literature over the study period, the specific objectives of the study are as follows.

- To examine the publication and growth rate of literature over the study period in the field of the Zika virus.
- To examine the RGR and doubling time of the publications over the study period.
- To study the authorship pattern and degree of collaboration of publications.
- To find out the most prolific authors and most prolific institutions in the field of zika virus.
- To study the distribution of publications country-wise.
- To identify the form-wise distribution of articles in the field of the Zika virus.
- To study the time series analysis and highly cited paper on the Zika virus.

Methodology

The researcher has collected the required research data from the online version of the Scopus database on the Zika virus from 2013 to 2022 and it is used as the main source of data for the present study. The researcher has used the zika virus for searching the records on a given field, an overall of 81102 records was retrieved as a result of a search

made in the database. (TITLE-ABS-KEY ("Zika virus") AND PUBYEAR > 2012 AND PUBYEAR < 2023 AND PUBYEAR > 2012 AND PUBYEAR < 2023). The data was collected on 03.11.2022 for the Scopus database in the Micro soft Excel sheet.

Data Analysis and Interpretation

The bibliographical data so collected from the online version of the Scopus database on the zika virus from 2013 to 2022. As many as more than 12294 publications are considered the main source of data for the present study. The collected data was entered into an excel sheet and analyzed and tabulated with the help of frequency, and percentage, drawing meaningful conclusions.

Citations per Publication (CPP)

CPP has been broadly used in the scientometric assessment to stabilize the variation in volumes of literature published by different institutions/countries etc., **Bharvi and Khaiser (2016)[12]** and **Sandhya (2016)[13].** From this study, CPP has been used to assess the impact of research publications for the years, countries, institutes, and authors for the below-mentioned formula,

$$\text{CPP} = \frac{\text{Total Citations of a Country or Institution}}{\text{Total of Publications}}$$

4.4.16 *h*-Index

Hirsch (2005)[14] proposed the h-index is one of the alternatives to the standard bibliometric indicators for single scientists, it is defined in 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)[15] found that the **Glanzel-Schubert (2007)[16]** model was better than the Hirsch **and Egghe-Rousseau (2006)[17]** model to estimate the *h*-index of countries and other units. **Gupta and Bala (2013)[18]** discussed the *h*-index in various activities 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

4.4.17 Relative Citation Index (RCI)

The relative citation index (RCI) was developed by the Institute of Scientific Information (now Thomson Reuters, USA) and examines the impact of different countries and institutions in the field of Pollution Control 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) is a relative indicator computed as the average number of citations per paper. It has been broadly used in bibliometric studies as it normalizes a large difference in the volumes of publications among the most productive countries, institutions, and authors.

To measure the both influence and visibility of the country research the global wise, the following formula has been used by **Bharvi Dutt and Khaiser Nikam (2016)**[19]

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

RCI = 1 indicates that a country's citation rate is equal to the world citation rate
RCI > 1 indicates that a country's citation rate is greater than the world citation rate
RCI < 1 indicates that a country's citation rate is lower than the world citation rate

Year-Wise Growth Zika Virus Research Publication

Table 1 Year-Wise Growth Zika Virus Research Publication

S.No	Year	Publications	%	Cum	%	Citations	%	H-Index	CPP	RCI
1	2013	3	0.02	3	0.01	748	0.28	3.00	249.33	11.43
2	2014	24	0.20	27	0.05	6208	2.32	20	258.67	11.86
3	2015	53	0.43	80	0.15	7084	2.64	31	133.66	6.13
4	2016	2022	16.45	2102	3.97	93217	34.77	150	46.10	2.11
5	2017	2038	16.58	4140	7.83	59527	22.20	103	29.21	1.34
6	2018	1876	15.26	6016	11.38	41406	15.44	81	22.07	1.01
7	2019	1627	13.23	7643	14.45	26146	9.75	59	16.07	0.74
8	2020	1735	14.11	9378	17.73	24525	9.15	48	14.14	0.65
9	2021	1826	14.85	11204	21.18	8252	3.08	31	4.52	0.21
10	2022	1090	8.87	12294	23.25	988	0.37	11	0.91	0.04
	Total	12294	100.00	52887	100.00	268101	100.00			

Table 1 reveals the growth of research publications published during the study period from 2013 to 2022 with a sample of 12294 articles published in the field of zika virus. The highest number of articles i.e. 12038(16.58%) was published in the year 2017. Followed by the second-highest number of articles in 2022(16.45%) were contributed in the year 2016. These two years are considered as most productive years. The productivity of the publications in these two years increased to 33.02%. However, the minimum number of articles 03(0.02%) were published in the year 2013.

The high citations are with 93217(34.77%) research publications, the h-index is 150, the CPP is 46.10, and RCI is 2.11. The lowest citations are with 748(0.28%) research publications, the h-index is 03, the CPP is 249.33, and the RCI is 11.43. During the ten-year study period with 12294(100%) research publications.

Relative growth rate (RGR) and doubling time (Dt)

The relative growth of publications was analyzed by using the two parameters namely relative growth rate and doubling time originated by **Mahapatra (1985)**[20] RGR is a measure to study the increases in the number of articles over a period of time. It is calculated as

$$\text{R(a)} = \frac{(\text{W2}-\text{W1})}{(\text{T2}-\text{T1})}$$

Whereas

R (a) = RGR = the mean relative growth rate over the specific period of interval
W_1 = the logarithm of the beginning number of publications/pages

W_2= the logarithm of the 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.

Doubling 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. Thus the corresponding doubling time can be calculated by the following formula,

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

RGR and Doubling time in the field of Zika Virus Research Publication

Table 2 RGR and Doubling time in the field of Zika Virus Research Publication

S.No	Year	Publications	Cumulative	W1	W2	RGR	Dt
1	2013	3	3		1.10		
2	2014	24	27	1.10	3.30	2.20	0.32
3	2015	53	80	3.30	4.38	1.09	0.64
4	2016	2022	2102	4.38	7.65	3.27	0.21
5	2017	2038	4140	7.65	8.33	0.68	1.03
6	2018	1876	6016	8.33	8.70	0.37	1.86
7	2019	1627	7643	8.70	8.94	0.24	2.91
8	2020	1735	9378	8.94	9.15	0.20	3.40
9	2021	1826	11204	9.15	9.32	0.18	3.91
10	2022	1090	12294	9.32	9.42	0.09	7.50
11	Total	12294	52887	9.42	10.88	1.46	0.48

Table 2 clearly shows the mean relative growth rate and doubling time of the publications in the area of the zika virus for the study period. It is noticed that the RGR of an article has gradually increased from 2.20 in the year 2014 to 0.09 in the year 2022 for the given study period. The doubling time of the publication of articles gradually increases from 0.32 in the year 2014 to 7.50 in the year 2022. It can be summarized from the above discussion that the RGR of the article gradually decreased. And on the other hand, the doubling time of the articles gradually increased.

Most Prolific Authors in the Field of Zika Virus Research Publication

Table 3 Most Prolific Authors in the Field of Zika Virus Research Publication

S.No	Authors	Country	Publications	%	Citations	%	H-Index	CPP	RCI
1	Wiwanitkit, V.	United States	213	24.23	390	0.87	7	1.83	0.04
2	Joob, B.	Brazil	90	10.24	141	0.31	6	1.57	0.03
3	Shi, P.Y.	China	90	10.24	5519	12.29	34	61.32	1.20
4	Brasil, P.	United Kingdom	75	8.53	4612	10.27	27	61.49	1.20
5	Weaver, S.C.	France	75	8.53	4680	10.42	34	62.40	1.22
6	Musso, D.	India	74	8.42	9507	21.16	30	128.47	2.51
7	Benelli, G.	Germany	70	7.96	3789	8.43	32	54.13	1.06
8	Diamond, M.S.	Canada	70	7.96	7619	16.96	42	108.84	2.13
9	Honein, M.A.	Italy	63	7.17	5104	11.36	31	81.02	1.59

10	Qin, C.F.	Australia	59	6.71	3563	7.93	32	60.39	1.18
	Total		879	100.00	44924	100.00			

Table -3 shows the contribution of the most prolific authors in the field of zika virus, it is observed that Wiwanitkit, V. has contributed the highest number of articles i.e. 213(24.23%) research publications in the United States, followed by Joob, B. 90(10.24%) research publications Brazil, and Shi, P.Y.. 90(10.24%) research publications in china. The highest number of citations is 9507(21.16%) research publications, and H-index is 30, the CPP is 128.47, and the RCI is 2.51. Followed by 7619(16.69%) research publications, the H-index is 42, the CPP is 108.84, and the RCI is 2.13. The lowest number of citations is 141(0.31%) research publications, the H-index is 6, the CPP is 1.57, and the RCI is 0.03.

Most Prolific Subjects in the Field of Zika Virus Research Publication

Table 3 Most Prolific Subjects in the Field of Zika Virus Research Publication

S.No	Subjects	No. of articles	%
1	Agricultural and Biological Sciences	755	16.86
2	Arts and Humanities	43	0.96
3	Biochemistry, Genetics and Molecular Biology	2451	54.75
4	Business, Management and Accounting	38	0.85
5	Chemical Engineering	265	5.92
6	Chemistry	567	12.66
7	Computer Science	272	6.08
8	Decision Sciences	24	0.54
9	Dentistry	38	0.85
10	Earth and Planetary Sciences	24	0.54
	total	4477	100.00

Table -3 shows the contribution of the most prolific subjects in the field of zika virus, it is observed that Biochemistry, Genetics, and Molecular Biology have contributed the highest number of with 2451(54.75%) research publications, followed by Agricultural and Biological Sciences with 755(16.86%) research publications, and Chemistry with 567112.66%) research publications. The lowest subject was Decision Sciences and Dentistry with 24(0.54%). During ten years of the study period the subject with 4477(100.00).

Country-wise Distribution of Zika Virus Research Publication

Table 4 Country-wise Distribution of Zika Virus Research Publication

S.No	Country	No.of articles	%	Citations	%	H-Index	CPP	RCI
1	United States	4893	39.92	140293	41.77	160	28.67	1.05
2	Brazil	2167	17.68	52576	15.66	102	24.26	0.89
3	China	1121	9.15	25716	7.66	67	22.94	0.84
4	United Kingdom	968	7.90	28496	8.49	80	29.44	1.07
5	France	717	5.85	26049	7.76	73	36.33	1.33
6	India	622	5.07	8556	2.55	48	13.76	0.50
7	Germany	486	3.96	13276	3.95	57	27.32	1.00
8	Canada	458	3.74	13021	3.88	54	28.43	1.04
9	Italy	427	3.48	13313	3.96	59	31.18	1.14
10	Australia	399	3.26	14538	4.33	44	36.44	1.33
	Total	12258	100.00	335834	100.00			

Table 4 depicts the geographical wise distribution of publications, out of 12294 articles, the United States contributed the highest number of articles which amounts to more than 4893(39.92%) of the total publication then followed by Brazil 2167(17.68%) and, the china 1121(9.15%), these three countries together contributed more than 66.74% of the world publications in the field of zika virus. Further, it is observed that the United Kingdom 968(7.90%), France 717(5.58%), India 622(5.07%), Germany 486(3.96%), Canada 458(3.74%), Italy 427(3.48%), Australia 399(3.26%),

The highest number of citations is 140293(41.77%) research publications, and H-index is 160, the CPP is 28.67, and the RCI is 1.05. Followed by 52576(15.66%) research publications, the H-index is 102, the CPP is 24.26, and the RCI is 0.89. The lowest number of citations is 13021(3.84%) research publications, the H-index is 54, the CPP is 28.43, and the RCI is 1.04. However, Germany and other countries have made less contribution to the field. So it can be concluded that the USA, Brazil, and China are more emerging countries in the field of the zika virus at the global level.

Authorship pattern in Zika Virus Research Publication

Table 5 Authorship pattern in Zika Virus Research Publication

Years	1	2	3	4	5	>5	total
2013	0	0	1	0	1	1	3
2014	3	0	4	0	3	14	24
2015	14	8	6	6	2	17	53
2016	655	326	196	150	120	575	2022
2017	289	328	214	183	183	841	2038
2018	179	249	191	190	170	897	1876
2019	116	176	166	154	141	874	1627
2020	102	178	186	151	163	955	1735
2021	96	216	192	194	181	947	1826
2022	42	88	120	107	93	640	1090
total	1496	1569	1276	1135	1057	5761	12294

Table 5 identified the year-wise authorship pattern in the field of zika virus research during the ten-year study period. From the study, it is identified that, out of 12294 research publications, 1496 research publications are contributed by single authors, and the remaining 10798 research publications are multi-author contributions of the multi-author publications, a maximum of 1569 research publications are contributed by two authors, followed by 1276 publications contributed by three authors, 1135 publications are four authors, and 1057 publications are five authors. During the ten-year study period, more than five authors contributed 5761 publications.

Degree of collaboration

The degree of collaboration is the relationship between single-author and multi-author contributions. The degree of collaboration is calculated by the **Subramanian (1983)**[21] formula and used by **Ravichandran (2021)**[22] **Sivasamy (2020).**[23]

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

Where DC = Degree of Collaboration

N_m = Number of Multi-authored publications

N_s = Number of single-authored publications

In the present study, Nm = 10798, Ns= 1496

So that the degree of collaboration is =10798/ (1496+10798) = 0.88

Degree of collaboration in Zika Virus Research Publication

Table 6 Degree of collaboration in Zika Virus Research Publication

Years	Singel	Multi	total	DC
2013	0	3	3	1.00
2014	3	21	24	0.88
2015	14	39	53	0.74
2016	655	1367	2022	0.68
2017	289	1749	2038	0.86
2018	179	1697	1876	0.90
2019	116	1511	1627	0.93
2020	102	1633	1735	0.94
2021	96	1730	1826	0.95
2022	42	1048	1090	0.96
total	1496	10798	12294	

Table 6 shows the degree of collaboration in zika virus research publications for the ten-year study period. From this study, it is identified that the degree of collaboration is between 1.00 in the year 2013 and 0.96 in the year 2022. The average degree of collaboration is 0.88. From this study, it is identified that the majority of the zika virus research publications are contributed by collaborative authors.

Collaborative Co-efficient (CC)

The pattern of co-authorship collaboration among the authors can be measured with the following formula suggested by **Ajiferuke, et al. (1988)**[24]

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

Whereas,

Fj = Number of publications with j author papers

N = Total number of research publications and

k = the greatest number of authors/papers in the given field

Collaboration Index (CI)

The simple indicator is presently employed in the publications to the collaboration index among the co-authors, which is to be understood nearly as the mean number of authors per paper are suggested by **Ajiferuke, et al.(1988)**[24]

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

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 the same time field.

Modified Collaboration Coefficient

The modified collaboration coefficient (MCC) counted by the formula which is suggested by **Savanur and Srikanth, (2010)**[25]

Which is given below:

Where,

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

j = the number of 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 article

CC, CI, MCC in Zika Virus Research Publication

Table-7 CC, CI, MCC in Zika Virus Research Publication

Years	1	2	3	4	5	>5	CC	CI	MCC	total
2013	0	0	1	0	1	1	0.77	4.67	7	3
2014	3	0	4	0	3	14	0.70	4.75	4.96	24
2015	14	8	6	6	2	17	0.53	3.47	3.54	53
2016	655	326	196	150	120	575	0.49	3.24	3.24	2022
2017	289	328	214	183	183	841	0.63	4.06	4.06	2038
2018	179	249	191	190	170	897	0.68	4.39	4.40	1876
2019	116	176	166	154	141	874	0.71	4.63	4.63	1627
2020	102	178	186	151	163	955	0.72	4.71	4.71	1735
2021	96	216	192	194	181	947	0.72	4.64	4.64	1826
2022	42	88	120	107	93	640	0.74	4.87	4.88	1090
total	1496	1569	1276	1135	1057	5761				12294

It is observed in Table 7, the collaborative coefficient is calculated and presented during the ten-year study period for zika virus research publications. It is observed from the table the highest collaboration coefficient is 0.77 in the year 2013 and lowest CC is 0.49 in the year 2016, and the average CC is 0.67. The collaboration index observed in table 7 the maximum collaboration Index is 4.87 in the year 2022, a minimum of 3.24 in the year 2016, and the average CI is 4.45. The Modified collaboration coefficient observed in table 7 a maximum is 4.96 in the year 2014, a minimum of 3.24 in the year 2016, and an average MCC is 4.60.

Co-Authorship Index

Co-authorship Index (CAI) is obtained by calculating proportionately the publications by single, two, and multi-authored papers **(Garg & Padhi, 1999).**[26]

$$CAI = \frac{N_{ij}/N_{io}}{N_{oj}/N_{oo}} X100$$

Where,

Nij = Number of papers having authors in block i
Nio = Total output of block i
Noj = Number of papers having j authors for all blocks.
Noo = Total number of papers for all authors and all blocks

CAI=100 indicates that a country's co-authorship effort for a particular type of Authorship correspondents to the world average.
CAI>100 reflects a higher than average co-authorship effort and

CAI<100 shows lower than average Co-authorship effort for a given type of authorship pattern.

For calculating the co-authorship index for authors, years have been replaced with block years. For this study, the authors have been classified into two blocks (ie.2013-2017 and 2018-2022) Vs**.** Single, Two, Three authors, and More than 3 authors.

Co-Authorship Index in Zika Virus Research Publication

Table-8 Co-Authorship Index in Zika Virus Research Publication

5 year Block	Single	CAI	Two	CAI	Three	CAI	More than three	CAI	Total
2013-2017	961	190.76	662	125.29	421	97.98	2096	78.26	4140
2018-2022	535	53.92	907	87.16	855	101.03	5857	111.04	8154
Total	1496		1569		1276		7953		12294

Table 8 shows that Co-Authorship Index values are calculated by block year period for zika virus research publications for the selected ten-year 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 and more than three authors from 1st block year (78.26) to 2nd year block year (111.04).

Top ten Research Institutions in the field of Zika Virus Research Publication

Table 9 top ten Research Institutions in the field of Zika Virus Research Publication

S.No	Institutions	No. of articles	%	Citations	%	H-Index	CPP	RCI
1	Fundacao Oswaldo Cruz	695	22.51	23839	21.87	70.00	34.30	0.97
2	Centers for Disease Control and Prevention	407	13.18	15429	14.15	59	37.91	1.07
3	Universidade de São Paulo	381	12.34	11760	10.79	47	30.87	0.87
4	Inserm	259	8.39	8173	7.50	49	31.56	0.89
5	Universidade Federal do Rio de Janeiro	253	8.20	6557	6.01	37	25.92	0.73
6	UT Medical Branch at Galveston	246	7.97	12664	11.62	58	51.48	1.46
7	Chinese Academy of Sciences	218	7.06	5966	5.47	38	27.37	0.77
8	London School of Hygiene & Tropical Medicine	213	6.90	6185	5.67	37	29.04	0.82
9	National Institutes of Health NIH	208	6.74	7467	6.85	39	35.90	1.02
10	CNRS Centre National de la Recherche Scientifique	207	6.71	10983	10.07	47	53.06	1.50
	Total	3087	100.00	109023	100.00			

Table -9 gives the account of research publications by the top ten research institutions at the global level in the area of zika virus all together they published 3087 publications sharing nearly more than 22.51% of the world publications during the study period. Which, Fundacao Oswaldo Cruz research institute alone published 695(22.51%) articles and then followed by the Centers for Disease Control and Prevention contributed nearly 407(13.18%) articles, Universidade de São Paulo 381(12.34%)), Inserm 259(8.39%), Universidade Federal do Rio de Janeiro 253(8.20%), UT Medical Branch at Galveston 246(7.97%) respectively.

The highest is 23839(21.87%) research publications, the H-index is 70, the CPP is 34.30, and the RCI is 0.97. Followed by 15429(14.15%) research publications, the H-index is 59, the CPP is 37.91, and the RCI is 1.07. The

lowest number of citations is 5969(5.47%) research publications, the H-index is 38, the CPP is 27.37, and the RCI is 0.77.

Most Productive Journals in the field of Zika Virus Research Publication

Table 10 Most Productive Journals in the field Zika Virus Research Publication

S.No	Journal	No. of articles	%	Citations	%	H-Index	CPP	RCI
1	Viruses	429	20.88	4310	9.00	31	10.05	0.43
2	Plos Neglected Tropical Diseases	369	17.96	11084	23.14	51	30.04	1.29
3	Scientific Reports	236	11.48	5752	12.01	39	24.37	1.05
4	Emerging Infectious Diseases	189	9.20	8911	18.60	45	47.15	2.02
5	Plos One	184	8.95	2763	5.77	29	15.02	0.64
6	Journal Of Virology	147	7.15	4278	8.93	33	29.10	1.25
7	Frontiers In Microbiology	143	6.96	2582	5.39	28	18.06	0.77
8	Frontiers In Immunology	132	6.42	1987	4.15	24	15.05	0.65
9	American Journal Of Tropical Medicine And Hygiene	113	5.50	2285	4.77	22	20.22	0.87
10	Antiviral Research	113	5.50	3949	8.24	34	34.95	1.50
	Total	2055	100.00	47901	100.00			

Table -10 shows the top ten most productive journals in the area of the zika virus. It found that Viruses is on the top of the list with the publication of 429(20.88) publications securing the first rank. Accordingly, Plos Neglected Tropical Diseases occupied the second rank with a publication of 369(17.96%) Scientific Reports 236(11.48%) secured the third rank. These three journals appear to be the most productive journals in the field of the zika virus. The remaining productivity journals are also listed in the above table. The lowest journal American Journal of Tropical Medicine and Hygiene and Antiviral Research 113(5.50%) research publications.

The highest is 11084(23.14%) research publications, the H-index is 51, the CPP is 30.04, and the RCI is 1.29. Followed by 8911(18.60%) research publications, the H-index is 45, the CPP is 47.15, and the RCI is 2.02. The lowest number of citations is 1987(4.15%) research publications, the H-index is 24, the CPP is 15.05, and the RCI is 0.65.

Type of Document wise distribution in Zika Virus Research Publication

Table-11 Type of Document wise distribution in Zika Virus Research Publication

S.No	Document type	No. of articles	%	Cumulative	%
1	Article	7608	61.88	7608	4.76
2	Review	2020	16.43	Table 11	6.02
3	Letter	820	6.67	10448	6.53
4	Note	627	5.10	11075	6.92
5	Editorial	441	3.59	11516	7.20
6	Book Chapter	300	2.44	11816	7.39
7	Short Survey	181	1.47	11997	7.50
8	Conference Paper	153	1.24	12150	7.60
9	Erratum	111	0.90	12261	7.67
10	Book	18	0.15	12279	7.68
11	Data Paper	5	0.04	12284	7.68
12	Conference Review	4	0.03	12288	7.68
13	Retracted	3	0.02	12291	7.68
14	Undefined	3	0.02	12294	7.69
	total	12294	100.00	159935	100.00

It is evident from table 11 showing the bibliographical form-wise distribution of documents, that the large majority of the research output is available in the form of Article 7608(61.88%), and a considerable amount of publications are also published in the form of research Review 2020(16.43%). A Significant amount of publications were brought in the form of Letter and Note respectively 820(6.67%), and 627(5.10%). However, very few publications are also published in the form of Editorial 441(3.59%), Book Chapter 300(2.44%), Short Survey 181(1.47%), Conference Paper 153(1.24%), and Erratum 111(0.90%). Book, Data Paper, Conference Review, Retracted, Undefined respectively 18(0.15%), 5(0.04%), 4(0.03%), 30.02%), and 3(0.02) It can be concluded from the above discussion that the majority of the publications are published in the form of Article and Review of research publications.

The keywords of the Zika Virus Research Publication

Table 12 Keywords of the Zika Virus Research Publication

S.No	Keyword	No. of articles	%
1	Zika Virus	9681	15.33
2	Human	9146	14.48
3	Humans	7563	11.97
4	Zika Fever	7364	11.66
5	Zika Virus Infection	6455	10.22
6	Nonhuman	5763	9.12
7	Article	5249	8.31
8	Virology	4039	6.39
9	Female	4020	6.36
10	Animals	3887	6.15
	Total	63167	100.00

Table -3 shows the contribution of the most prolific subjects in the field of zika virus, it is observed that Zika Virus has contributed the highest number of Zika Virus with 9681(15.33%) research publications, followed by Human with 9146(14.48%) research publications, and Humans with 7563(11.97%) research publications. The lowest keyword was Animals with 14(0.02%) research publications.

Time Series Analysis

Time series analysis reveals the estimated growth values are identified based on previous data. A straight–line equation is adapted to measure the future values based on previous data. Time series analysis used by **Jeyshankar and Ramesh babu (2013)**[27] **Ravichandran.S &.Vivekanandhan.S (2021)**[28]

Time Series Analysis Zika Virus Research Publication

Table 13 Time Series Analysis Zika Virus Research Publication

Sl. No	Year	Count (Y)	X	X^2	XY
1	2013	3	-5	25	-15
2	2014	24	-4	16	-96
3	2015	53	-3	9	-159
4	2016	2022	-2	4	-4044
5	2017	2038	-1	1	-2038
6	2018	1876	1	1	1876
7	2019	1627	2	4	3254

8	2020	1735	3	9	5205
9	2021	1826	4	16	7304
10	2022	1090	5	25	5450
	Total	12294		110	16737

Table 13 shows that the time series analysis formula has been predicted for the zika virus research publications for the years 2025 and 2030

The straight Line Equation is

$Y = a + bx$

Here,

$\sum Y = 12294, \sum X^2 = 110, \sum XY = 16737$

$a = \sum Y/N = 12294/10 = 1229.4 = 1229$

$b = \sum XY/ \sum X^2 = 16737/110 = 152.15 = 152$

Estimated publications in the year 2025 are when X=2025-2015=10

$Y = a + bx$

$= 1229 + (152*10) = 1229+1520 = 2749$

The Estimated literature in 2030 is when X=2030-2015=15

$Y = a + bx$

$= 1229 + (152*15) = 1229 + 1875 = 3104$

The estimated growth based on a time series analysis statistical application will be expected in the zika virus research publications in the year 2025 is around equal to 2749nd in the year 2030 is around equal to 3104. So that time serious analysis confirmed that the publications on the zika virus research are increasing trend.

Highly cited paper in Zika Virus Research Publication

Table 14 highly cited paper in Zika Virus Research Publication

S.No	Titles	Citations	Document Type
1	Wu, F., et.al (2020) A new coronavirus associated with human respiratory disease in China, Nature, 579(7798):265-269.	5801	Article
2	Mlakar, J., et.al (2016) Zika virus associated with microcephaly, New England Journal of Medicine, 374(10):951-958.	1812	Article
3	Cao-Lormeau, V.-M., et.al (2013) Guillain-Barré Syndrome outbreak associated with Zika virus infection in French Polynesia: A case-control study, The Lancet, 387(10027):1531-1539.	1590	Article

4	Gootenberg, J.S., et.al (2017) Nucleic acid detection with CRISPR-Cas13a/C2c2, Science, 356(6336):438-442.	1326	Article
5	Rasmussen, S.A., et.al (2016) Zika virus and birth defects - Reviewing the evidence for causality, New England Journal of Medicine, 374(20):1981-1987.	1316	Article
6	Brasil, P., et.al (2016) Zika virus infection in pregnant women in rio de janeiro, New England Journal of Medicine, 375(24):231-2334.	1261	Article
7	Qian, X., et.al (2016) Brain-Region-Specific Organoids Using Mini-bioreactors for Modeling ZIKV Exposure, Cell, 165(5): 1238-1254.	1179	Article
8	Gootenberg, J.S., et.al (2018) Multiplexed and portable nucleic acid detection platform with Cas13, Cas12a and Csm6, Science, 360(6387):439-444.	957	Article
9	Musso, D., and Gubler, D.J. (2016) Zika virus, Clinical Microbiology Reviews, 29(3):487-524.	922	Article
10	Tang, H., et.al (2016) Zika virus infects human cortical neural progenitors and attenuates their growth, Cell Stem Cell, 18(5):587-590.	900	Article

Table 14 the highly cited paper is Wu, F., et.al (2020) a new coronavirus associated with human respiratory disease in China, Nature, 579(7798):265-269. Citations are 5801 and the document type of the article. Followed by Mlakar, J., et.al (2016) Zika virus associated with microcephaly, New England Journal of Medicine, 374(10):951-958. Citations are 1812 and document-type of Article. Cao-Lormeau, V.-M., et.al (2013) Guillain-Barré Syndrome outbreak associated with Zika virus infection in French Polynesia: A case-control study, The Lancet, 387(10027):1531-1539. Citations are 1590 and the document type of the article. Among the top 10, highly cited papers are 10 articles.

Major Findings of the Study

- The present study has analyzed nearly 12294 publications in the field of the zika virus during the study period of 2013 to 2022. The highest number of articles i.e. 12038(16.58%) was published in the year 2017. Followed by the second-highest number of articles in 2022(16.45%) were contributed in the year 2016. These two years are considered as most productive years.
- The relative growth rate of an article has gradually increased from 2.20 in the year 2014 to 0.09 in the year 2022 for the given study period. The doubling time of the publication of articles gradually increases from 0.32 in the year 2014 to 7.50 in the year 2022.
- During the author the maximum Wiwanitkit, V. has contributed the highest number of articles i.e. 213(24.23%) research publications in the United States, followed by Joob, B. 90(10.24%) research publications in Brazil, and Shi, P.Y.. 90(10.24%) research publications in china.
- During the subjects in the field of the zika virus, it is observed that Biochemistry, Genetics, and Molecular Biology have contributed the highest number of with 2451(54.75%) research publications, followed by Agricultural and Biological Sciences with 755(16.86%) research publications, and Chemistry with 567112.66%) research publications.
- During the United States contributed the highest number of articles which amounts to more than 4893(39.92%) of the total publication then followed by Brazil 2167(17.68%) research publications and china 1121(9.15%) research publications.
- The study, authorship pattern is 1496 research publications are contributed by single authors, and the remaining 10798 research publications are multi-author contributions of the multi-author publications.

- During the degree of collaboration is between 1.00 in the year 2013 and 0.96 in the year 2022. The average degree of collaboration is 0.88. From this study, it is identified that the majority of zika virus research publications are contributed by collaborative authors.
- During the collaborative measure the highest collaboration coefficient is 0.77 in the year 2013 and lowest CC is 0.49 in the year 2016, and the average CC is 0.67. The collaboration index observed the maximum collaboration Index is 4.87 in the year 2022, a minimum of 3.24 in the year 2016, and the average CI is 4.45. The Modified collaboration coefficient was observed at a maximum is 4.96 in the year 2014, a minimum of 3.24 in the year 2016, and an average CI is 4.60.
- During the CAI single, two authorship contributions are decreasing trend from 1st block year to 2nd block year. At the same time, CAI is increasing trend for three and more than three authors from 1st block year (78.26) to 2nd year block year (111.04
- The Institutions of with Fundacao Oswaldo Cruz research institute alone published 695(22.51%) research publications and then followed by the Centers for Disease Control and Prevention contributed nearly 407(13.18%) research publications. Universidade de São Paulo 381(12.34%)) research publications.
- During the journals of Viruses is at the top of the list with the publication of 429(20.88) publications. Plos Neglected Tropical Diseases occupied the second rank with a publication of 369(17.96%) Scientific Reports 236(11.48%) secured the third rank. These three journals appear to be the most productive journals in the field of the zika virus.
- The large majority of the research output is available in the form of Article 7608(61.88%) research publications, and a considerable amount of publications are also published in the form of research Review 2020(16.43%) research publications.
- During the highest number of keywords of the Zika Virus with 9681(15.33%) research publications, followed by Human with 9146(14.48%) research publications, and Humans with 7563(11.97%) research publications. The lowest keyword was Animals with 14(0.02%) research publications.
- The time series analysis statistical application will be expected in the zika virus research publications in the year 2025 is around equal to 2749 in the year 2030 is around equal to 3104. So that time serious analysis confirmed that the publications on zika virus research are increasing trend.
- During the highest number of citations 5801 with Wu, F., et.al (2020) a new coronavirus associated with human respiratory disease in China, Nature, 579(7798):265-269.

Conclusion:

This research study was carried out from a quantitative perspective to understand the pattern of research trends and development in the field of zika virus indexed in the Scopus database from 2013 to 2022 worldwide. Bibliometric indicators are used to evaluate scientific productivity and quantification. As we know that the zika virus is one of the emerging and promising areas in the field of medicine. The United States contributed the highest number of articles which amounts to more than 4893(39.92%) of the total publication. The average degree of collaboration is 0.88. The Institutions of with Fundacao Oswaldo Cruz research institute alone published 695(22.51%) research publications. The journals of Viruses are at the top of the list with 429(20.88) research publications in the field of the zika virus diseases. The recent outbreaks of ZIKV infection in the Americas have brought this emerging arbovirus disease into the limelight as a cause of congenital anomaly (microcephaly) in infants born to infected mothers. The rapid spread of ZIKV is an international cause of concern with the virus reaching Asian countries, including the neighboring countries of India. The other issue of epidemic control in the future to be addressed is the spreading menace of mosquito-borne diseases due to the inadequate control of the breeding of this vector. Furthermore, there is a need for large-scale animal and human studies from various corners of the globe so that clear management guidelines can be developed against ZIKV. Furthermore, efforts to control the emerging menace due to obscure and new viruses should be given prime importance.

References.

1. https://www.who.int/news-room/fact-sheets/detail/zika-virus. (Accessed online on 01.12.2022)

2. **Cole E J and Eales, NB, (1917)** the history of comparative anatomy: A statistical analysis of the literature, *Science Progress*, 11(44): 578-963.

3. **Hulme EW, (1923)** Statistical bibliography in relation to the growth of modern civilization, London: *Grafton*, 44(6):1859-1951.

4. **Ranganathan S R (1995**) Library and its scope Bangalore DRTC Seventh seminar volume paper DA, *International journal of scientometrics and info metrics*, 1(1): 15-21.

5. **Prichard A, (1969)** Statistical Bibliography of Bibliographies, *journal of documentation*, 25(4): 348-349.

6. **Van Raan A F J, (1997)** Scientometrics state- of The Art, *Scientometrics*, 38(1): 205-218.

7. Manikandan M. Amsaveni N. (2015) A Scientometric Measures In Cloud Computing: A Special Reference to Authors' Productivity, *International Journal of Library and Information Studies*, 5(2):1-7.

8. **A.Manimuthu (2015)** scientometric analysis of cloud computing literature, *International Journal of Emerging Technology in Computer Science & Electronics*, 18(1): 1-6.

9. Ravichandran S and Vivekandhan S (2021). Wireless sensor network research output in India research publications from SCOPUS database during 2010-2019. *Library Philosophy and Practice (e-journal)*, 5509, 1-12.

10. K. Praveena et al (2021) Mapping of Artificial Intelligence Research Output: A Scientometric Study, *Library Philosophy and Practice (e-journal)*, 4925, 1-18.

11. Ravichandran S and Vivekandhan S (2021). Scientometric analysis of wastewater management research publications from the SCOPUS database from 2010 to 2019. *Library Philosophy and Practice (e-journal)*, 5139, 1-18.

12. Bharvi, D. and Khaiser, N. (2016). Scientometric analysis of global solar cell research. *Annals of Library and Information Studies*, 63, 31-41.

13. Sandhya, D. (2016). Global allergy research during 1994-2013: a scientometric study. *Annals of Library and Information Studies*, 63, 16-23.

14. Hirsch, J.E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences*, 102(46), 16569-16572.

15. **Ye, F.Y. (2009).** An investigation on mathematical models of the h-index. *Scientometrics*, 81(2), 493-98.

16. **Schubert, A. and Glanzel, W. (2007).** A systematic analysis of Hirsch-type indices for journals. *Journal of Informetrics*, 1(2), 179-184.

17. **Egghe, L. and Rousseau, R. (2006).** An informetric model for the Hirsch-index. *Scientometrics*, 69(1), 121-129.

18. **Gupta, B.M. and Bala, A. (2013).** Epilepsy Research in India: A Scientometric Analysis of Publications Output during 2002-11. *Annals of Neurosciences*, 20(2), 71-78.

19. Bharvi, D. and Khaiser, N. (2016). Scientometric analysis of global solar cell research. *Annals of Library and Information Studies,* 63, 31-41.

20. **Mahapatra, M, (1985)** on the validity of the theory of exponential growth of scientific literature. *Proceedings of the 15th IASLIC Conference, Bangalore,* 61-70.

21**. Subramanyam K, (1983)** Bibliometric Studies of research collaboration: A review, *Journal of Information Science,* 6(1): 33-38.

22. **Ravichandran S and Vivekandhan S (2021).** Wireless sensor network research output in India research publications from the Scopus database during 2010-2019. *Library Philosophy and Practice (e-journal),* 5509, 1-12.

23. **Sivasamy. K et.al, (2020)** Scientometrics Analysis of Leprosy Research Publications. *International Journal of Library and Information Studies*, 10 (3): 2231-4911.

24. **Ajiferuke, I., Burrel, Q., and Tauge J, (1988)** Collaborative Co-efficient: A single measure of the degree of collaboration in research. *Scientometrics,* 14, 421-433

.

25. **Kiran Savanur and Srikanth. (2010)** Modified Collaborative Coefficient: a new measure for quantifying the degree of research collaboration. *Scientometrics,* 84(2):365-371.

26. **Garg, K.C and Padhi. P, (1999)** Scientometrics of laser research literature as viewed through the Journal of Current Laser Abstracts. *Scientometrics,* 45 (2): 251-268.

27. **Jeyashankar R, Ramesh Babu B, (2013)** Scientometric Analysis of Leukemia Research output 1960-2011: An Indian perspective, *Asia Pacific Journal of Library and information science,* 3(2): 1-15.

28. **Ravichandran.S &.Vivekanandhan.S (2021)** Scientometric analysis of wastewater management research publications from Scopus database during 2010-2019, *Library Philosophy and Practice (e-journal),* 5139:1-18.