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CITATIONS AND PUBLICATIONS ON YOGA RESEARCH DURING 2008-2021: A SCIENTOMETRIC STUDY

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ABSTRACT

This study aims to analyze the yoga research publications from the Scopus database between 2008 - 2021 with 9723 research publications and 149619 citations. From the study, it is identified that a maximum of 1324(13.62%) research publications are contributed in the year 2021. The average research publication per year is 694.5. The authors a maximum of 101(13.48%) research publications are contributed by Cramer, H. The United States. The relative growth rate is 0.74 in the year 2009 and 0.15 in the year 2021. This study confirmed that the relative growth rate is decreasing trend. At the same time doubling time was found that 0.94 in the year 2009 and 4.75 in the year 2021 and it is confirmed that doubling time is an increasing trend. The subject a maximum of 849(31.11%) research publications that are contributed by Arts and Humanities, the authorship pattern of 2323 research publications is contributed by single authors, and the average degree of collaboration is 0.76. The collaboration coefficient average is 0.52, the collaboration Index average is 3.18 and the modified collaboration coefficient average is 3.19. The document types are a maximum of 6019(61.90%) research publications are contributed by articles, the journal of a maximum of 230(17.10%) research publications are contributed by the Journal of Alternative and Complementary Medicine, the Institute of a maximum of 193(13.39%) contributions are Harvard Medical School, the country a maximum of 3696(41.07%) research publications are contributed by the United States, the highly cited paper of 1435 citations are received for the publication of Diamond, A., Lee, K. (2011) Interventions shown to aid executive function development in children 4 to 12 years old, Science, 333(6045), 959-964.

KEYWORDS

Scientometrics, Relative citation index, Relative growth rate, Doubling time, Degree of collaboration, Collaborative coefficient, Collaborative index, Modified collaborative co-efficient, Time series and Co-authorship index.

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INTRODUCTION

Yoga originated in India thousands of years ago as a philosophical or spiritual discipline to deliver practitioners from suffering, or dis-ease (dukkha). Yoga is a really successful system of theory and practice; it's a combination of breathing practices, poses, and meditation practiced for over 5,000 years.

Yoga has been used to reduce tension, and improve activity work, the ability to think carefully and view physical, mental, emotional, and spiritual. To minimize the adverse effects of medication, new therapeutic approaches are being recommended, such as Complementary and Alternative Medicine (CAM). According to the World Health Organization (2013), research based on an integrative approach in primary health care suggests that General Practitioners (GPs) should be more involved in delivering, referring, or supervising CAM treatments. Yoga, an example of CAM, is a worldwide practice, recognized as a method to promote health and wellbeing. World Health Organization (WHO) observed International Yoga Day on June, 21st of every year¹.

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 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 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.

LITERATURE REVIEW

Poornima A and Surulinathi M (2019)⁷ A Scientometric Study on Yoga Research during 1989-

2018. This study has highlighted quantitatively the contributions made by the researchers during 1989-2018 as reflected in the Web of Science database. Around 30 years 4090 articles were published. In the year 2017, 603 articles (14.76%) were published. Followed by 2016, around 529 articles were published and every year the number of articles is increasing. The study found that 73 papers received 100 and above citations. The range of Citation is 1-1134. The study also identified that the average citation per paper is 11.32. The study found that 1181 papers are published in open access journals. Author contributions have to be encouraged and this certainly will help more publications. Global level Universities and technical Institution researchers should be encouraged.

BM Gupta *et al* (2018)⁸ analyses Yoga Research a Scientometric Assessment of Global Publications Output during 2007-16. The paper examines 3966 global publications on yoga research, as covered in the Scopus database during 2007-16. The global output of yoga research output registered 7.79% growth, The top 10 most productive countries in yoga research individually contributed a global share from 1.31% to 38.35%, with the largest global publication share coming from the USA (38.35%), the 10 most productive countries accounted for 83.74% and 96.67% global publication and global citation share during 2007-16. Medicine, among subjects, contributed the largest publication share (78.67%), and authors together contributed 21.63% and 16.84% respectively as their global publication share and 35.37% and 25.10% respectively as their global citation share during 2007-16. Among the total journal output of 3719 papers, the top 15 journals contributed 21.22% share to the global journal output during 2007-16. These 44 highly cited papers were published in 35 journals, 5 papers were published in Cochrane database of systematic reviews.

Ravichandran Sand Vivekanandhan S. Siva N (2022)⁹ examine the present study of scientometric analysis of Leukemia research output 2011-2020 from 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. A maximum of 692 (12.64%) research publications are contributed in the year 2020. and the CAGR is 5.37. Authorship pattern more than five authorship modes 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 is 4.30, and the average value is 4.3. A 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 of 266(24.14%) research publications are contributed by the Indian Journal of Hematology and Blood Transfusion. Collaborator country a maximum of 462(37.90%) research publications are collaborated by the United States of America. The highly cited paper of 18098 citations is received by Ferlay, J (2015) Cancer incidence and mortality worldwide. Surulinathi M (2020)¹⁰ analyzed the Research output on Covid-19/Coronavirus Vaccine: A Scientometric Study, This article presents a Scientometric analysis of Covid-19 Vaccine research Literature indexed by Web of Science. Assessing research activity is important for planning future protective and adaptive policies. The objective of the current study was to assess research activity on Covid-19 Vaccine literature. A Scientometric method was applied using Scopus, Documents on "Covid-19 literature". The study period was from 1971 to 2020. The search query found 7181 documents in Coronavirus Vaccine literature. The growth of publications showed 4402 in 2020. Documents published in Vaccine journal received the highest number of publications (203) followed by Journal of Virology with 104 Publications, and Nature with 96 Publications. The most productive countries are i.e. the United States with 2178 (H-Index-114), China with 1068 (H-Index-75, India with 678 (H-Index-26), and the United Kingdom with 614 (H-Index-53). Ravichandran S. Siva N (2022)¹¹ examines the Infertility research publications contributed from the Scopus database during the study period of 2012-2021 with a total number of 3701 publications in India. The year-wise research publications contributed to Infertility research, a maximum of

462(15.04%) research publications are contributed in the year 2021. The United States is the most contributing top-ranking collaborator country with 184(32.03%) Infertility research publications. The time series analysis on Infertility research is an increasing trend. A maximum number of 43(13.15%) research publications are contributed by Kamath, M.S, and India with top-ranking authors. The authorship pattern is a maximum number of 786(25.59%) research publications contributed by more than five authors, and the average degree of collaboration is 0.92. The average collaborative coefficient is 0.66, the average collaborative index is 3.86, and the average modified collaboration coefficient is 3.87. The study most contributed top-ranking All India Institute of Medical Sciences, New Delhi with 203(25.38%) research publications. Top-ranking Journal of Human Reproductive Sciences with 250(34.06%) research publications

Objectives the study

The main objective of this study was to use Scientometrics to analyze the Yoga Research Output covered in the Scopus database during 2008 - 2021:

- To identify and analyze the growth rate of world research in yoga research output publications
- To analyze the author's, relative growth rate and doubling time research output publications
- To analyze the subject and authorship pattern of research output publications
- To identify the degree of collaboration and collaborative index (CC, CI, MCC)
- To analyze co-authorship index and time series research output publications
- To know the global research output of document-wise distribution of publications
- To assess the institution-wise and journals research concentration;
- To examine the country-wise distribution of publications;
- To analyze the Funding Agencies supported Yoga research
- To analyze highly cited papers of research publications

METHODOLOGY

The study retrieved and downloaded 14 years of publications data on the global output in yoga research output from the Scopus database covering the period of 2008-2021. The present study aims to analyze the research output of Researchers in the field of Yoga Research Output. The growth rates of output in terms of research productivity were analyzed during the study period. The authorship pattern and author productivity are examined to identify the pattern of research contribution in the field of Yoga Research Output. The data have been extracted and tabulated in the form of tables and figures and it is also analytical in nature strengthening the empirical validity due to the application of suitable statistical tools. The data was collected on 18.04.2022 and the Micro Soft excel format was downloaded.

Data Analysis and Interpretations

Relative Citation Index (RCI)

The relative citation index (RCI) was developed by the institute of scientific information and examined 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) is a relative indicator computed as the average number of citations per paper. To measure both influence and visibility of country research, the following formula has been used by Bharvi Dutt and Khaiser Nikam (2016)¹²

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

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.

Table No.1 shows the year-wise growth of Yoga research publications during the 14- year study period between 2008 and 2021 with 9723 research publications and 149619 citations. From the study, it is identified that a maximum of 1324(13.62%) research publications are contributed in the year

2021, followed by 1170(12.03%) publications in the year 2020, and 934(9.61%) publications in the year 2019. The average research publication per year is 694.5

During the 14 - year study it is identified that a total number of 9723 publications received 149619 citations. Out of that maximum of 16067 citations received 615 publications in the year 2013. Followed by 14718 citations received 523 publications in the year 2012. From the study, out of 9723 publications, 5090(100%) research publications are cited publications. The maximum citation per paper is 0.54 in the year 2021, followed by CPP is 0.20 in the year 2020, and by CPP is 0.14 in the year 2019 and the average citation per paper is 0.10. The maximum RCI is 2.41 in the year 2008 and the minimum RCI is 0.12 in the year 2021.

Table No.2 identified the top 14-author contributions for the research publications on Yoga research from the Scopus database. From the study, it is identified that the maximum of 101(13.48%) research publications are contributed by Cramer, H. The United States, followed by Telles, S. India with 93(12.42%) research publications, Nagendra, H.R., United kingdom with 79(10.55%) research publications. The highest citations of were 3615(16.81%) Cramer, H. In the United States and the lowest number of citations is 602(2.80%) Balkrishna, A. China. The highest CPP is 57.96, the H-index is 33 and RCI is 2.02. The lowest CPP is 3.36, the H-index is 06 and RCI is 0.12. From this study, it is identified that 749(100%) research publications are contributed by the top 14 authors from 14 different countries.

Relative Growth Rate of Publications

The relative growth of publications was analyzed by using the two parameters namely relative growth rate and doubling time originated by Mahapatra (1985)¹³. RGR is a measure to study the increases in the number of articles over a period of time. It is calculated as

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

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,

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

The relative growth rate and the doubling time (Dt) were calculated and the results are presented in Table No.3. From the study, it is identified that the relative growth rate is 0.74 in the year 2009 and 0.15 in the year 2021. This study confirmed that the relative growth rate is decreasing trend. At the same time doubling time was found that 0.94 in the year 2009 and 4.75 in the year 2021 and it is confirmed that doubling time is an increasing trend.

Table No.4 identified the top ten subject contributions for the research publications of Yoga research from the Scopus database. From the study it is identified that a maximum of 849(31.11%) research publications are contributed by Arts and Humanities, followed by Biochemistry, Genetics and Molecular Biology with 719(26.35%) research publications, computer science with 269(9.86%) research publications. The lowest subject is Dentistry with 23(0.84%). Research publications.

Table No.5 identified the year-wise authorship pattern in the field of Yoga research during the 14-year study period. From the study, it is identified that, out of 9723 research publications, 2323 research publications are contributed by single authors and the remaining 7400 research publications are multi-author contributions. Of the multi-author publications, a maximum of 1641 research publications are contributed by two authors, followed by 1469 publications contributed by three authors and 1272 publications are four authors. And

11016 publications are contributed by five authors. During the 14- year study period more than five authors contributed to 2002 publications.

The degree of collaboration is the relationship between single author and multi-author contributions. The degree of collaboration is calculated by the Subramanian (1983)¹⁴ formula and used by Ravichandran (2021)¹⁵ Sivasamy (2020)¹⁶.

$$DC = \frac{N_m}{(N_m + N_s)}$$

Where DC = Degree of Collaboration

N_m = Number of Multi- authored publications

N_s = Number of single-authored publications

In the present study, $N_m = 7400$, $N_s = 2323$

So that the degree of collaboration is $=7400/(2323+9723) = 0.76$

Table 6 shows the degree of collaboration in Yoga research publications for the 14- year studies period. From this study, it is identified that the degree of collaboration is between 0.65 in the year 2008 and 0.84 in the year 2021. The average degree of collaboration is 0.76. From this study, it is identified that the majority of Yoga research publications are contributed by collaborative authors.

Collaborative of 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)¹⁷.

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

Whereas,

F_j = 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)¹⁷.

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

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)¹⁸.

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.....

F_j = 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

It is observed from Table No.7, the collaborative coefficient is calculated and presented during the 14-year study period for Yoga research publications. It is observed from the table-14 highest collaboration co-efficient is 0.61 in the year 2021 and lowest CC is 0.43 in the year 2010, and the average CC is 0.52. The collaboration index observed in Table No.7 the maximum collaboration Index is 3.81 in the year 2021, a minimum of 2.70 in the year 2008 and an average CI is 3.18. The Modified collaboration coefficient observed in table 8 is a maximum of is 3.81 in the year 2021, a minimum of 2.71 in the year 2008 and an average MCC is 3.19.

Co-Authorship Index

Co-authorship Index (CAI) is obtained by calculating proportionately the publications by single, two, and multi-authored papers Garg and Padhi, (1999)¹⁹.

$$CAI = \frac{N_{ij}/N_{io}}{N_{oj}/N_{oo}} \times 100$$

Where,

N_{ij} = Number of papers having authors in block i

N_{io} = Total output of block i

N_{oj} = Number of papers having j authors for all blocks.

N_{oo} = 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 corresponds 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.2008-2014 and 2015-2021) Vs. Single, Two, Three authors, and More than three authors.

Table No.9 shows that Co-Authorship Index values are calculated by block year period for Yoga research publications for the selected 14- year study period. From the study, it is identified that CAI for single, two, and three authorship contributions are decreasing trend from 1st block year to 2nd block year. At the same time, CAI is increasing trend for more than three authors from 1st block year (84.66) to 2nd year block year (107.36).

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)²⁰ Ravichandran (2020)²¹.

Table No.10 shows that the time series analysis formula has been predicted for yoga research publications for the years 2025 and 2030

The straight Line Equation is

$$Y = a + bx$$

Here,

$$\sum Y = 9723, \sum X^2 = 280, \sum XY = 18267$$

$$a = \frac{\sum Y}{N} = \frac{9723}{14} = 694.5 = 695$$

$$b = \frac{\sum XY}{\sum X^2} = \frac{18267}{280} = 65.24 = 65$$

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

$$Y = a + bx$$

$$= 695 + (65 \times 10) = 695 + 650 = 1345$$

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

$$Y = a + bx$$

$$= 695 + (65 \times 15) = 695 + 975 = 1670$$

The estimated growth based on a time series analysis statistical application will be expected in the Yoga research publications in the year 2025 is around equal to 1345 and the year 2030 is around equal to 1670. So that time serious analysis confirmed that the publications on Yoga research are increasing trend.

Document types identified during the 14- year study period on Yoga research publications are shown in Table No.11. From the study, it is identified that a maximum of 6019(61.90%) research publications are contributed by articles, followed by 1788(18.39%) research publications are review and third placed in the book chapter with 514(5.29%) research publications. The lowest document type of data paper 1(0.01%) research publications. This study confirmed that more than 61% of research publications are contributed by articles. Remaining nearby 39% of research publications are identified in the other form documents.

Table No.12 shows the top 14 journals' contributions in the field of Yoga research. From the study, it is identified that the maximum of 230(17.10%) research publications are contributed by the Journal of Alternative and Complementary Medicine, followed by Complementary Therapies in Medicine with 177(13.16%) research publications, third-placed in the International Journal of Yoga Therapy with 144(10.71%) research publications. During 14-the year study period the highest citations were 5028(20.07%) from the Journal of Alternative and Complementary Medicine, the CPP is 21.86, the H-Index is 37 and RCI is 1.17. The Lowest citations of 478(1.19) Indian Journal of Physiology and Pharmacology, the CPP is 9.02, the H-Index is 13 and the RCI is 0.48 During the 14- year study period top 14 journals are contributed by 1345(100.%) research publications.

During the 14-year study period, the top 14institutions' contributions are identified in Table No.13, from the study the maximum of 193(13.39%) contributions are Harvard Medical School, followed by University Duisburg-Essen contributed with 113(7.84%) research publications, National Institute of Mental Health and Neuro Sciences contributed

with 110(7.63%) research publications. The highest citations were 5811 (13.74%) from the Harvard Medical School and the CPP is 30.11. The H- Index is 43, and RCI is 1.03. The lowest citations of 1405(3.32%) All India Institute of Medical Sciences, New Delhi and the CPP is 14.64, H-Index is 17 and RCI is 0.50. During 14- the year study period Top 14 institutions are contributed by 1441(100%) research publications.

Table No.14 shows the top 14 countries' research publications for Yoga research during the study period from 2008-2021. From this study, it is identified that a maximum of 3696(41.07%) research publications are contributed by the United States, followed by India with 1902(21.13%) research publications and third place is the united kingdom with 664(7.38%) research publications. During ten year study period the highest number of citations was 79695(48.30%) in the United States, the CPP is 21.56, the H-index is 112 and RCI is 1.18. The lowest citations of were 1526 (0.92%) in Japan and Iran. The CPP is 12.02, the H-index is 24 and RCI is 0.66. The top 14 countries contributed 9000(100.%) research publications.

Table No.15 shows the top 14 funding agencies' research publications for Yoga research during the study period from 2008-2021. From this study, it is identified that a maximum of 437(27.42%) research publications are contributed by the National Institutes of Health, followed by National Center for Complementary and Integrative Health with 298(18.70%) research publications, and third place is the U.S. Department of Health and Human Serviceswith 121(7.59%) research publications. During the top 14 funding agency contributed 1594(100%) research publications.

Table No.16 the highly cited top 14 Yoga research publications during the selected 14- year study period. From the study, it is identified that a maximum of 1435 citations are received for the publication of Diamond A, Lee K. (2011). Interventions shown to aid executive function development in children 4 to 12 years old, Science, 333(6045), 959-964. Followed by 1083 citations by Qaseem, A, et al (2017) Noninvasive treatments for acute, subacute, and chronic low back pain: A

clinical practice guideline from the American College of Physicians, *Annals of Internal Medicine*, 166(7), 514-530. And 994 Carmody, J, Baer, R.A. (2008). Relationships between mindfulness practice and levels of mindfulness, medical and psychological symptoms and well-being in a mindfulness-based stress reduction program, *Journal of Behavioural Medicine*, 31(1), 23-33. The top 14 highly cited publications are covered by 07 articles and 07 review.

Major Finding

During the 14- year study period year-wise growth of Yoga research publications between 2008 and 2021 with 9723 research publications and 149619 citations. From the study, it is identified that a maximum of 1324(13.62%) research publications are contributed in the year 2021, followed by 1170(12.03%) publications in the year 2020 and 934(9.61%) publications in the year 2019. The average research publication per year is 694.5.

During the authorship a maximum of 101(13.48%) research publications are contributed by Cramer, H. the United States. The relative growth rate is 0.74 in the year 2009 and 0.15 in the year 2021. This study confirmed that the relative growth rate is decreasing trend. At the same time doubling time was found that 0.94 in the year 2009 and 4.75 in the year 2021 and it is confirmed that doubling time is an increasing trend.

During the subject a maximum of 849(31.11%) research publications are contributed by Arts and Humanities, during the authorship pattern, 2323 research publications are contributed by single authors, and the average degree of collaboration is 0.76. The collaboration coefficient of the average is 0.52. The collaboration Index average is 3.18. The Modified collaboration coefficient of the average is 3.19.

During the study period CAI for single, two, and three authorship contributions are decreasing trend from 1st block year to 2nd block year. At the same time, CAI is increasing trend for more than three authors from 1st block year (84.66) to 2nd year block year (107.36).

The time series analysis statistical application will be expected in the Yoga research publications in the

year 2025 is around equal to 1345 and the year 2030 is around equal to 1670. So that time serious analysis confirmed that the publications on Yoga research are increasing trend.

The document types a maximum of 6019(61.90%) research publications are contributed by articles, during the journal of the maximum of 230(17.10%) research publications are contributed by the *Journal of Alternative and Complementary Medicine*.

During the Institute a maximum of 193(13.39%) contributions are Harvard Medical School, During the country, a maximum of 3696(41.07%) research publications are contributed by the United States, and the funding agency is a maximum of 437(27.42%) research publications contributed by the National Institutes of Health.

During the maximum of 1435 citations are received for the publication of Diamond, A., Lee, K. (2011) Interventions shown to aid executive function development in children 4 to 12 years old, *Science*, 333(6045), 959-964.

Year-wise growth of publications

Table No.1: Year-wise growth of publications and Citations

S.No	Years	Publications	%	Citations	%	H-Index	Cited	%	Uncited	%	CPP	RCI
1	2008	271	2.79	10058	6.72	53	206	4.05	65	1.40	0.03	2.41
2	2009	297	3.05	9670	6.46	54	178	3.50	119	2.57	0.03	2.12
3	2010	361	3.71	9721	6.50	52	223	4.38	138	2.98	0.04	1.75
4	2011	461	4.74	13283	8.88	57	302	5.93	159	3.43	0.03	1.87
5	2012	523	5.38	14718	9.84	62	423	8.31	100	2.16	0.04	1.83
6	2013	615	6.33	16067	10.74	66	609	11.96	6	0.13	0.04	1.70
7	2014	623	6.41	13219	8.84	55	558	10.96	65	1.40	0.05	1.38
8	2015	707	7.27	13152	8.79	53	535	10.51	172	3.71	0.05	1.21
9	2016	777	7.99	12261	8.19	49	515	10.12	262	5.66	0.06	1.03
10	2017	842	8.66	12769	8.53	44	433	8.51	409	8.83	0.07	0.99
11	2018	818	8.41	9797	6.55	43	378	7.43	440	9.50	0.08	0.78
12	2019	934	9.61	6453	4.31	32	271	5.32	663	14.31	0.14	0.45
13	2020	1170	12.03	5978	4.00	29	237	4.66	933	20.14	0.20	0.33
14	2021	1324	13.62	2473	1.65	17	222	4.36	1102	23.79	0.54	0.12
	Total	9723	100.00	149619	100.00		5090	100.00	4633	100.00		

Top 14 A Authors' contributions to yoga research publications

Table No.2: Top 14 Author's contributions to yoga research publications

S.No	Author	Country	Publications	%	TC	%	CPP	H-Index	RCI
1	Cramer, H.	United States	101	13.48	3615	16.81	35.79	33	1.25
2	Telles, S.	India	93	12.42	1597	7.42	17.17	22	0.60
3	Nagendra, H.R.	United Kingdom	79	10.55	1805	8.39	22.85	20	0.80
4	Dobos, G.	Australia	58	7.74	3039	14.13	52.40	32	1.82
5	Gangadhar, B.N.	Canada	55	7.34	1103	5.13	20.05	20	0.70
6	Lauche, R.	Germany	49	6.54	2840	13.20	57.96	31	2.02
7	Balkrishna, A.	China	47	6.28	602	2.80	12.81	14	0.45
8	Nagarathna, R.	Italy	42	5.61	1245	5.79	29.64	19	1.03
9	Varambally, S.	Brazil	41	5.47	1049	4.88	25.59	19	0.89
10	Khalsa, S.B.S.	Japan	40	5.34	1327	6.17	33.18	21	1.16
11	Langhorst, J.	South Korea	39	5.21	1713	7.96	43.92	25	1.53
12	Bhargav, H.	Spain	39	5.21	131	0.61	3.36	6	0.12
13	Raghuram, N.	Sweden	34	4.54	599	2.78	17.62	11	0.61
14	Schmid, A.A.	Iran	32	4.27	844	3.92	26.38	16	0.92
	Total		749	100.00	21509	100.00			

Relative growth rate and doubling time of yoga research publications

Table No.3: Relative growth rate and doubling time of yoga research publications

S.No	Year	Publications	Cumulative	W1	W2	RGR	Dt = (0.693/RGR)
1	2008	271	271		5.60		
2	2009	297	568	5.60	6.34	0.74	0.94
3	2010	361	929	6.34	6.83	0.49	1.41
4	2011	461	1390	6.83	7.24	0.40	1.73
5	2012	523	1913	7.24	7.56	0.32	2.18
6	2013	615	2528	7.56	7.84	0.28	2.50
7	2014	623	3151	7.84	8.06	0.22	3.16
8	2015	707	3858	8.06	8.26	0.20	3.44
9	2016	777	4635	8.26	8.44	0.18	3.79
10	2017	842	5477	8.44	8.61	0.17	4.17
11	2018	818	6295	8.61	8.75	0.14	5.00
12	2019	934	7229	8.75	8.89	0.14	5.03
13	2020	1170	8399	8.89	9.04	0.15	4.64
14	2021	1324	9723	9.04	9.18	0.15	4.75
15	Total	9723					

Subject wise of yoga research publications

Table No.4: Subject wise of yoga research publications

S.No	Subject	Publications	%	Cumulative	%
1	Agricultural and Biological Sciences	103	3.77	103	0.38
2	Arts and Humanities	849	31.11	952	3.48
3	Biochemistry, Genetics and Molecular Biology	719	26.35	1671	6.11
4	Business, Management and Accounting	189	6.93	1860	6.80
5	Chemical Engineering	35	1.28	1895	6.93
6	Chemistry	26	0.95	1921	7.02
7	Computer Science	269	9.86	2190	8.00
8	Decision Sciences	33	1.21	2223	8.13
9	Dentistry	23	0.84	2246	8.21
10	Earth and Planetary Sciences	25	0.92	2271	8.30
11	Economics, Econometrics and Finance	60	2.20	2331	8.52
12	Energy	32	1.17	2363	8.64
13	Engineering	240	8.79	2603	9.51
14	Environmental Science	126	4.62	2729	9.98
15	Total	2729	100.00	27358	100.00

Authorship pattern in yoga research publications

Table No.5: Authorship pattern in yoga research publications

S.No	Authorship Pattern							Total
	Year	1	2	3	4	5	>5	
1	2008	96	52	43	30	16	34	271
2	2009	99	59	48	22	32	37	297
3	2010	134	60	57	32	19	59	361
4	2011	149	83	79	58	38	54	461
5	2012	152	87	82	66	49	87	523
6	2013	158	101	85	74	70	127	615
7	2014	144	123	83	80	78	115	623
8	2015	208	115	96	88	85	115	707
9	2016	193	156	107	105	73	143	777
10	2017	204	142	143	106	85	162	842
11	2018	172	125	123	108	94	196	818
12	2019	172	170	146	145	88	213	934
13	2020	228	190	185	172	117	278	1170
14	2021	214	178	192	186	172	382	1324
15	Total	2323	1641	1469	1272	1016	2002	9723

Degree of collaboration in yoga research publications

Table No.6: Degree of collaboration in yoga research publications

S.No	Year	Single author publications	Multi-author publications	Total author publications	DC = Degree of collaboration
1	2008	96	175	271	0.65
2	2009	99	198	297	0.67
3	2010	134	227	361	0.63
4	2011	149	312	461	0.68
5	2012	152	371	523	0.71
6	2013	158	457	615	0.74
7	2014	144	479	623	0.77
8	2015	208	499	707	0.71
9	2016	193	584	777	0.75
10	2017	204	638	842	0.76
11	2018	172	646	818	0.79
12	2019	172	762	934	0.82
13	2020	228	942	1170	0.81
14	2021	214	1110	1324	0.84
15	Total	2323	7400	9723	

Collaboration index and collaborative co-efficient of yoga research

Table No.7: Collaboration index and collaborative co-efficient of yoga research

S.No	Authorship Pattern										
	Year	1	2	3	4	5	6	CC	CI	MCC	Total
1	2008	96	52	43	30	16	34	0.44	2.70	2.71	271
2	2009	99	59	48	22	32	37	0.45	2.80	2.81	297
3	2010	134	60	57	32	19	59	0.43	2.78	2.78	361
4	2011	149	83	79	58	38	54	0.46	2.82	2.82	461
5	2012	152	87	82	66	49	87	0.50	3.07	3.07	523
6	2013	158	101	85	74	70	127	0.53	3.29	3.29	615
7	2014	144	123	83	80	78	115	0.54	3.27	3.28	623
8	2015	208	115	96	88	85	115	0.50	3.10	3.11	707
9	2016	193	156	107	105	73	143	0.52	3.18	3.18	777
10	2017	204	142	143	106	85	162	0.53	3.25	3.26	842
11	2018	172	125	123	108	94	196	0.57	3.51	3.51	818
12	2019	172	170	146	145	88	213	0.58	3.48	3.48	934
13	2020	228	190	185	172	117	278	0.57	3.51	3.51	1170
14	2021	214	178	192	186	172	382	0.61	3.81	3.81	1324
15	Total	2323	1641	1469	1272	1016	2002				9723

Co- Authorship Index (CAI) in yoga research publications

Table No.8: Co- Authorship Index (CAI) in yoga research publications

S.No	Block Years	Single author publications	CAI	Two author publications	CAI	Three author publications	CAI	Morethan three author publications	CAI	Total
1	2008-2014	932	123.80	565	106.24	477	100.20	1177	84.66	3151
2	2015-2021	1391	88.59	1076	97.01	992	99.91	3113	107.36	6572
3	Total	2323		1641		1469		4290		9723

Time Series Analysis of Yoga research

Table No.9: Time series analysis of yoga research

S.No	Year	Count(y)	X	X ²	XY
1	2008	271	-7	49	-1897
2	2009	297	-6	36	-1782
3	2010	361	-5	25	-1805
4	2011	461	-4	16	-1844
5	2012	523	-3	9	-1569
6	2013	615	-2	4	-1230
7	2014	623	-1	1	-623
8	2015	707	1	1	707
9	2016	777	2	4	1554
10	2017	842	3	9	2526
11	2018	818	4	16	3272
12	2019	934	5	25	4670
13	2020	1170	6	36	7020
14	2021	1324	7	49	9268
15	Total	9723		280	18267

Document types of yoga research

Table No.10: Document type of yoga research

S.No	Document types	Publications	%	Cumulative	%
1	Article	6019	61.90	6019	5.16
2	Review	1788	18.39	7807	6.69
3	Book Chapter	514	5.29	8321	7.13
4	Note	366	3.76	8687	7.44
5	Conference Paper	324	3.33	9011	7.72
6	Editorial	250	2.57	9261	7.93
7	Letter	218	2.24	9479	8.12
8	Book	111	1.14	9590	8.22
9	Short Survey	83	0.85	9673	8.29
10	Erratum	30	0.31	9703	8.31
11	Conference Review	16	0.16	9719	8.33
12	Retracted	3	0.03	9722	8.33
13	Data Paper	1	0.01	9723	8.33
14	Total	9723	100.00	116715	100.00

Top 10 Journal's contributions to yoga research

Table No.11: Top 15 Journal's contributions to yoga research

S.No	Journals	Publications	%	TC	%	CPP	H-Index	RCI
1	Journal of Alternative and Complementary Medicine	230	17.10	5028	20.07	21.86	37	1.17
2	Complementary Therapies In Medicine	177	13.16	2801	11.18	15.82	28	0.85
3	International Journal of Yoga Therapy	144	10.71	807	3.22	5.60	17	0.30
4	Complementary Therapies In Clinical Practice	132	9.81	2103	8.40	15.93	24	0.86
5	Evidence Based Complementary And Alternative Medicine	106	7.88	3202	12.78	30.21	38	1.62
6	Cochrane Database of Systematic Reviews	81	6.02	3421	13.66	42.23	27	2.27
7	Journal of Ayurveda and Integrative Medicine	79	5.87	583	2.33	7.38	11	0.40
8	BMC Complementary and Alternative Medicine	75	5.58	2150	8.58	28.67	27	1.54
9	Journal of Clinical And Diagnostic Research	56	4.16	562	2.24	10.04	14	0.54
10	Plos One	55	4.09	1584	6.32	28.80	22	1.55
11	Integrative Cancer Therapies	54	4.01	1050	4.19	19.44	18	1.04
12	Indian Journal of Physiology and Pharmacology	53	3.94	478	1.91	9.02	13	0.48
13	Journal of Bodywork and Movement Therapies	53	3.94	700	2.79	13.21	14	0.71
14	Indian Journal of Psychiatry	50	3.72	578	2.31	11.56	9	0.62
	Total	1345	100.00	25047	100.00			

Top 10 Institution contributions to yoga research

Table No.12: Top 15 Institutions contributions to yoga research

S.No	Organizations	Publications	%	TC	%	CPP	H-Index	RCI
1	Harvard Medical School	193	13.39	5811	13.74	30.11	43	1.03
2	Universität Duisburg-Essen	113	7.84	3855	9.11	34.12	36	1.16
3	National Institute of Mental Health and Neuro Sciences	110	7.63	1466	3.47	13.33	22	0.45
4	University of Toronto	108	7.49	3518	8.32	32.57	29	1.11
5	University of Washington	103	7.15	3719	8.79	36.11	31	1.23
6	Brigham and Women's Hospital	99	6.87	3155	7.46	31.87	31	1.09
7	All India Institute of Medical Sciences, New Delhi	96	6.66	1405	3.32	14.64	17	0.50
8	University of California, San Diego	95	6.59	2427	5.74	25.55	28	0.87
9	Massachusetts General Hospital	94	6.52	2938	6.95	31.26	28	1.06
10	Kliniken Essen-Mitte	92	6.38	2189	5.18	23.79	28	0.81
11	University of California, Los Angeles	90	6.25	2633	6.23	29.26	28	1.00
12	University of California, San Francisco	85	5.90	3646	8.62	42.89	31	1.46
13	VA Medical Center	84	5.83	2408	5.69	28.67	24	0.98
14	The University of Sydney	79	5.48	3124	7.39	39.54	24	1.35
	Total	1441	100.00	42294	100.00			

Top 14-countries' contributions to yoga research

Table No.13: Country-wise contributions to yoga research

S.No	Country	Publications	%	TC	%	CPP	HI	RCI
1	United States	3696	41.07	79695	48.30	21.56	112	1.18
2	India	1902	21.13	15842	9.60	8.329	52	0.45
3	United Kingdom	664	7.38	14236	8.63	21.44	57	1.17
4	Australia	546	6.07	12041	7.30	22.05	51	1.2
5	Canada	503	5.59	15486	9.38	30.79	58	1.68
6	Germany	411	4.57	10368	6.28	25.23	54	1.38
7	China	285	3.17	3069	1.86	10.77	30	0.59
8	Italy	173	1.92	3109	1.88	17.97	32	0.98
9	Brazil	164	1.82	1990	1.21	12.13	27	0.66
10	Japan	137	1.52	1518	0.92	11.08	23	0.66
11	South Korea	136	1.51	1661	1.01	12.21	23	0.67
12	Spain	128	1.42	1940	1.18	15.16	24	0.83
13	Sweden	128	1.42	2534	1.54	19.8	30	1.08
14	Iran	127	1.41	1526	0.92	12.02	24	0.66
15	Total	9000	100.00	165015	100.00			

Top 14- Funding agency's contributions to yoga research

Table No.14: Funding agency's contributions to yoga research

S.No	Funding Agency	Publications	%
1	National Institutes of Health	437	27.42
2	National Center for Complementary and Integrative Health	298	18.70
3	U.S. Department of Health and Human Services	121	7.59
4	National Cancer Institute	118	7.40
5	National Center for Advancing Translational Sciences	102	6.40
6	National Institute on Aging	72	4.52
7	National Center for Research Resources	70	4.39
8	National Institute of Mental Health	68	4.27
9	National Center for Complementary and Alternative Medicine	62	3.89
10	Eunice Kennedy Shriver National Institute of Child Health and Human Development	54	3.39
11	National Natural Science Foundation of China	51	3.20
12	National Institute on Drug Abuse	50	3.14
13	National Institute for Health Research	46	2.89
14	Canadian Institutes of Health Research	45	2.82
	Total	1594	100.00

Highly cited paper top 14 yoga research publications

Table No.15: Highly cited paper top 14 yoga research publications

S.No	Titles	Citations	Document type
1	Diamond A, Lee K. Interventions shown to aid executive function development in children 4 to 12 years old, <i>Science</i> , 333(6045), 2011, 959-964.	1435	Review
2	Qaseem, A, et al. Non-invasive treatments for acute, subacute, and chronic low back pain: A clinical practice guideline from the American College of Physicians, <i>Annals of Internal Medicine</i> , 166(7), 2017, 514-530.	1083	Review
3	Carmody J, Baer R A. Relationships between mindfulness practice and levels of mindfulness, medical and psychological symptoms and well-being in a mindfulness-based stress reduction program, <i>Journal of Behavioral Medicine</i> , 31(1), 2008, 23-33.	994	Article
4	Barnes P M, et al. Complementary and alternative medicine use among adults and children: The United States, <i>National Health Statistics Reports</i> , 12(1), 2009, 1-23.	981	Article
5	Bushnell M C, et al. Cognitive and emotional control of pain and its disruption in chronic pain, <i>Nature Reviews Neuroscience</i> , 14(7), 2013, 502-511.	910	Review
6	Clarke, T C, et al. Trends in the use of complementary health approaches among adults: The United States, 2002–2012, <i>National Health Statistics Reports</i> , 79, 2015, Article 79.	850	Article
7	Barnes, P.M., et al. Complementary and alternative medicine use among adults and children: The United States, 2007, <i>National Health Statistics Reports</i> , 2008, 12.	805	Article
8	Foster, N E, et al. Prevention and treatment of low back pain: Evidence, challenges, and promising directions, <i>The Lancet</i> , 391(10137), 2018, 2368-2383.	730	Review

9	Haroon E, et al. Psychoneuroimmunology meets neuropsychopharmacology: Translational implications of the impact of inflammation on behavior, <i>Neuropsychopharmacology</i> , 37(1), 2012, 137-162.	591	Review
10	Mishra, S I, et al. Exercise interventions on health-related quality of life for people with cancer during active treatment, <i>Cochrane Database of Systematic Reviews</i> , 2012(8), 2012.	510	Review
11	Douglas G, et al. British guideline on the management of asthma: A national clinical guideline, <i>Thorax</i> , 63(4), 2008, 1-121.	448	Review
12	O'Donovan G, et al. The ABC of physical activity for health: A consensus statement from the British association of sport and exercise sciences, <i>Journal of Sports Sciences</i> , 28(6), 2010, 573-591.	422	Article
13	Diamond A and Ling D S. Conclusions about interventions, programs, and approaches for improving executive functions that appear justified and those that, despite much hype, do not, <i>Developmental Cognitive Neuroscience</i> , 18, 2016, 34-48.	411	Article
14	Brook R D, et al. Beyond medications and diet: Alternative approaches to lowering blood pressure: A scientific statement from the American heart association, <i>Hypertension</i> , 61(6), 2013, 1360-1383.	368	Article

CONCLUSION

The yoga research publications from the Scopus database between 2008 -2021. A scientometric study. The Practice of yoga can attain good health and not only provide relief from diseases but also provide health, happiness, and contentment which are the ultimate goals of a man's life. The authors a maximum of 101(13.48%) research publications are contributed by Cramer, H. In the United States, the authorship pattern of 2323 research publications is contributed by single authors and the average degree of collaboration is 0.76. Journal of a maximum of 230(17.10%) research publications is contributed by the Journal of Alternative and Complementary Medicine. Yoga gets scientific justification as a useful practice for maintaining health. Yoga has come full circle by providing the techniques for living a meaningful and purposeful life, which are improved both from a medical and spiritual point of view. There are other areas in Yoga that are important in terms of research interest. These results imputation that this research field is growing hastily and will excite more research in the future.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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