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A Scientometric Study on Yoga Research during 1989-2018

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Abstract **- Yoga is a mind-body exercise. Yogic breathing is a unique method for balancing the autonomic nervous system and influencing psychological and stress-related disorders. Yoga breathing (pranayama) can rapidly bring the mind to the present moment and reduce stress. This article presents the highly cited papers from yoga research output using different scientometric approach both quantitative and qualitative methods. Scientometric data for the study has been collected from Web of Science online database. A search was conducted with the phrase 'yoga' in the address field. An analysis of 4090 publications published by scientists during 1989 to 2018 and indexed by Web of Science online Database indicates that the publication output. Most of the prolific authors are from the highly productive institutions. This work is to provide a profile of Research Publication at global level. This includes tracking the number of papers, scatter of papers over journals, and its effect on publication output, authors' institutional affiliations and authorship patterns.**
Keywords: **Scientometrics; Yoga; Web of Science**

I. INTRODUCTION

Yoga Originated in India thousands of years ago as a philosophical or spiritual discipline to deliver practitioners from suffering, or dis-ease (duhkha). Yoga is 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, ability to think carefully, view-physical, mental, emotional and spiritual .To minimizes the adverse effects of medication, new therapy 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 year.

II. LITERATURE REVIEW

Health is the axis around which all the activities of life are based. Unfortunately in the present age health is passing through a transitional period. The health of most of the people is poor and is in a deplorable condition. The number of patients is increasing day by day. The situation is menacing and posing a great challenge to the medical science. In such a gloomy situation Yoga brings to the suffering humanity a ray of hope. The various Yoga and breathing exercises mentioned in Yoga philosophy regular practice and exercises helps in solving the problems related to health (Amarjeet, Y. & Sohan, R. T. (2011).Health is the most valuable possessing of man. Stress and tension are responsible for the various mental problems such as anxiety, depression, negative thinking, and illusion (Amarjeet, Y. & Sohan, R. T. (2011). Stress causes the depression. To overcome by this stress we have to practice Yoga regularly. By doing regular practice of Yoga one can make their life really meaningful and useful.

Bibliometric methods have been used for providing quantitative analysis of written publications. Bibliometrics is closely related to the broader term "infometrics" (Eggheand Rousseau 1990; Wolfram 2003) and the narrower term "scientometrics" (Bar-Ilan2008, 2010). Research by Ole, E. & Johan, A.W. (2015), the main investigation is based on the primary literature, mostly scholarly articles, indexed in the major bibliographic databases. Only literature about natural sciences, technical sciences, health sciences including medicine and yoga is considered in the present study. The scientific processes, as well as the methods for dissemination of information, are very similar within these fields. The humanities and social sciences have, to a large degree, other types of publication channels and are not included. The database chosen is WoS which has the oldest and most comprehensive records of citation indexes and includes a useful analysis tool.

III. OBJECTIVES OF THE STUDY

The main objective of this study was to use Scientometrics to analyze the Yoga Research Output covered in Web of Science database during 1989 - 2018:

1. To identify and analyze the growth rate of world research in yoga research output publications and doubling time by year-wise distribution;
2. To know the global research output of document wise distribution of publications;
3. To analyze the authorship pattern, prolific authors and examine the extent of research collaboration.
4. To assess the institution wise research concentration;
5. To examine the country-wise distribution of publications;

6. To analyze the Funding Agencies supported for Yoga research;

IV. METHODOLOGY

The study retrieved and downloaded 30 years publications data of the global output in yoga research output from the Web of Science online database covering the period of 1989 - 2018. The present study aims at analyze the research output of Researchers in the field of Yoga Research Output. The growth rates of output in terms of research productivity is analyze 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 extracted and tabulated in the form of tables and figures and it is also analytical in nature from strengthening the empirical validity due to application of suitable statistical tools.

V. DATA ANALYSIS AND INTERPRETATIONS

To analyze the year wise publication of research on yoga research output, the data has been presented in Table I. From the below table, we could clearly see that during the period 1989 - 2018 a total of 4090 publications were published. In the present study the research output on Yoga Research Output publication is taken as a tool to evaluate the performance at various levels. The highest publication is 603 in 2017 with 458 Global Citation Scores followed by 529 papers in 2016 with 1324 Global Citation Score and 457 papers in 2015 with 1953 Global Citation Scores. It shows that even minimum numbers of records were scored higher global citations. The study also reveals all these 4090 publications have 46383 cited references it shows that there is a healthy trend in citing reference is found in yoga research output.

TABLE I SHOWS RELATIVE GROWTH RATE OF PUBLICATIONS & DOUBLING TIME

S. No	Year	No. of Publications	Cumulative Total	LogeW1	LogeW2	RGR	DT	TLCS	TGCS
1	1989	10	10			2.3		17	32
2	1990	10	20	2.3	2.99	0.69	1	57	103
3	1991	16	36	2.99	3.58	0.58	1.19	66	286
4	1992	10	46	3.58	3.82	0.24	2.88	53	144
5	1993	18	64	3.82	4.15	0.33	2.1	130	212
6	1994	17	81	4.15	4.39	0.23	2.88	141	348
7	1995	15	96	4.39	4.56	0.17	4.07	9	102
8	1996	10	106	4.56	4.66	0.09	7.7	46	85
9	1997	22	128	4.66	4.85	0.18	3.85	124	256
10	1998	27	155	4.85	5.04	0.19	3.64	197	485
11	1999	36	191	5.04	5.25	0.20	3.46	73	447
12	2000	40	231	5.25	5.44	0.19	3.64	329	805
13	2001	34	265	5.44	5.58	0.13	5.33	158	712
14	2002	48	313	5.58	5.74	0.16	4.33	316	1442
15	2003	56	369	5.74	5.91	0.16	4.33	185	967
16	2004	91	460	5.91	6.13	0.22	3.15	1123	2655
17	2005	87	547	6.13	6.3	0.17	4.07	1430	3303
18	2006	84	631	6.3	6.44	0.14	4.95	420	1740
19	2007	123	754	6.44	6.62	0.17	4.07	1377	4843
20	2008	122	876	6.62	6.77	0.15	4.62	823	2851
21	2009	144	1020	6.77	6.92	0.15	4.62	1301	3065
22	2010	161	1181	6.92	7.07	0.14	4.95	983	2943
23	2011	228	1409	7.07	7.25	0.17	4.07	1042	3763
24	2012	249	1658	7.25	7.41	0.16	4.33	1341	3850
25	2013	332	1990	7.41	7.59	0.18	3.85	1237	4062
26	2014	363	2353	7.59	7.76	0.16	4.33	890	3130
27	2015	457	2810	7.76	7.94	0.17	4.07	558	1953
28	2016	529	3339	7.94	8.11	0.17	4.07	415	1324
29	2017	603	3942	8.11	8.27	0.16	4.33	106	458
30	2018	143	4085	8.27	8.31	0.36	1.92	11	17
	Total	4085	29166	168.84	174.85	8.51	111.8	14958	46383

The study reveals that the major source of publications covered by Web of Science on Yoga Research Output in journal articles (58.09%), while meeting abstract comprises (13.6%), review comprises (12.7%), book review comprises (6.6%), editorial material comprises (3.5%), letter comprises (1.9%), article and proceedings paper comprises (1.7%), news item comprises (0.4%), correction comprises (0.1%), and poetry comprises (0.1%), article. The other forms of publications are displayed in the below table II.

TABLE II SHOWS DOCUMENT WISE DISTRIBUTION OF PUBLICATIONS

S. No	Document Type	Records	Percent	TGCS
1	Article	2376	58.09	32172
2	Meeting Abstract	558	13.6	114
3	Review	522	12.7	11486
4	Book Review	268	6.6	10
5	Editorial Material	146	3.5	335
6	Letter	81	1.9	220
7	Article; Proceedings Paper	70	1.7	2003
8	Others	69	1.9	43
	Total	4090	100.00	

Table III indicates ranking of authors by number of publications. Author "Telles" published highest number of articles for the study period with 76 records and received 987 citations, next author "Cramer .H" published with 66 records. "Carlson L.E." having highest Global Citation Scores of 1330 with just 20 publications followed by "Phillips R.S." is having Global Citation Score of 1329 with just 16 publications. Thus the most-cited authors are distinguished from the most-published ones.

The study found from the table IV that the total research output of the Yoga Research Output for the study period (1989 – 2018) published in 1394 journals. The journal "Journal of Alternative and Complementary Medicine" topped with 162 publications with the Global Citation Score of 3203; next "Library Journal" has 105 publications with the Global Citation Score of 3 and "Medicine and Science in Sports and Exercise" with 88 publications with the Global Citation Score of 257.

"Journal of Alternative and Complementary Medicine" has scored the highest Global Citation Score of 3203 with 162 publications.

TABLE III SHOWS RANKING OF AUTHORS (TOP 10)

S. No	Author	Records	Percent	TLCS	TGCS	TLCR
1	Telles S	76	3.4	575	987	337
2	Cramer H	66	2.9	477	926	1293
3	Nagendra HR	52	2.3	904	1261	201
4	Dobos G	51	2.28	443	877	1072
5	Lauche R	46	2.06	409	718	1067
6	Gangadhar BN	38	1.7	428	659	213
7	Nagarathna R	37	1.66	610	898	182
8	Langhorst J	36	1.6	332	629	538
9	Khalsa SBS	28	1.25	273	423	287
10	Varambally S	28	1.25	241	300	170

TABLE IV SHOWS DISTRIBUTION OF YOGA RESEARCH OUTPUT IN JOURNAL PUBLICATIONS

S. No	Journal	Records	Percent	TGCS	TLCR
1	Journal of Alternative and Complementary Medicine	162	6.85	3203	935
2	Library Journal	105	4.44	3	0
3	Medicine and Science in Sports and Exercise	88	3.72	257	28
4	Evidence-Based Complementary and Alternative Medicine	86	3.63	1116	827
5	Complementary Therapies in Medicine	75	3.17	988	782
6	Alternative Therapies in Health and Medicine	50	2.11	1861	253
7	Annals of Behavioral Medicine	50	2.11	351	30
8	BMC Complementary and Alternative Medicine	46	1.94	535	481
9	Cochrane Database of Systematic Reviews	44	1.86	945	409
10	Complementary Therapies in Clinical Practice	43	1.81	201	376

The below table V analysis indicates Institution-wise research productivity. It is noted that 3305 institutions were contributed 4090 of the total research productivity. The publications from Harvard University contributed the highest number of research publications with (90) at the same time it ranks first in terms of Global Citation Score

3107 followed by University Duisburg Essen with 71 Publications and received 991 citations.

TABLE V SHOWS INSTITUTION WISE DISTRIBUTION OF PUBLICATIONS (TOP 10)

S. No	Institution	Records	Percent	TLCS	TGCS
1	Harvard University	90	2.86	1008	3107
2	University Duisburg Essen	71	2.26	493	991
3	UniversityCalif. Los Angeles	62	1.97	489	1163
4	University Washington	60	1.91	379	1262
5	Natl. Inst Mental Hlth. &Neurosci.	49	1.56	443	683
6	University Penn	48	1.52	505	1098
7	Boston University	47	1.49	616	1178
8	UniversityCalif. San Diego	47	1.49	143	615
9	UniversityCalif. San Francisco	44	1.4	395	1016
10	University Calgary	40	1.27	211	1440

Table VI shows that global distribution of yoga research output covered by the study tops United States of America with 1710(36.55%) publications, India ranked second with 583(12.46%), 266 publications (5.68%) paper each was contributed by the authors from UK and ranked third, Canada with 231(4.93%) and Australia with 220(4.7%) research publications respectively. First place goes to United States of America having total Global Citation Score of 22672 with 1710 publications. India secured second rank in terms of GCS with 4719 but with only 583 publications and also collaboration with more than 80 Countries.

TABLE VI SHOWS COUNTRY WISE DISTRIBUTION OF PUBLICATIONS (TOP 10)

S. No	Country	Records	Percent	TLCS	TGCS
1	USA	1710	36.55	7702	22672
2	India	583	12.46	2632	4719
3	UK	266	5.68	1106	4034
4	Canada	231	4.93	753	4607
5	Australia	220	4.7	625	2675
6	Germany	193	4.12	954	2441
7	Peoples R China	86	1.83	159	467
8	Brazil	85	1.81	174	626
9	Italy	58	1.23	214	799
10	South Korea	56	1.19	145	342

From table VII various funding agencies are supported for Yoga research. Below mentioned agencies are supported. “NCCIH NIH HHS” has supported for Forty Two Publications and more articles followed by National Institutes of Health for 28 publications.

From table VIII the top 30 Global Citation Scores papers the most cited research papers span the period from 1989 to 2018 with one major network. There are only 34 links with GCS ranging between maximum 1134 and minimum 136.

TABLE VII SHOWS FUNDING AGENCY SUPPORT FOR THE RESEARCHERS

Funding Agencies	Records	% of 4090
NCCIH NIH HHS	42	1.018
National Institutes of Health	28	0.679
NIH	26	0.630
NCRR NIH HHS	23	0.557
NIA NIH HHS	19	0.460
National Center for Complementary and Alternative Medicine (NCCAM)	18	0.436
National Center for Complementary and Alternative Medicine	17	0.412
NIMH NIH HHS	16	0.388
NCI NIH HHS	15	0.364
RUT and KLAUS Bahlsen Foundation	13	0.315

TABLE VIII GLOBAL CITATION SCORES OF TOP 30

S. No	Node	Author / Year / Journal	LCS	GCS
1.	158	Garfinkel MS, 1998, JAMA-J AM MED ASSOC, V280, P1601	87	155
2.	162	Lou HC, 1999, HUM BRAIN MAPP, V7, P98	26	159
3.	201	Janakiramaiah N, 2000, J AFFECT DISORDERS, V57, P255	83	136
4.	270	Bernardi L, 2001, BRIT MED J, V323, P1446	44	163
5.	313	Kronenberg F, 2002, ANN INTERN MED, V137, P805	18	322
6.	317	Raub JA, 2002, J ALTERN COMPLEM MED, V8, P797	132	168
7.	335	Astin JA, 2003, J AM BOARD FAM PRACT, V16, P131	26	220
8.	354	Carlson LE, 2003, PSYCHOSOM MED, V65, P571	49	330

9.	398	Woolery A, 2004, ALTERN THER HEALTH M, V10, P60	126	149
10.	421	Carlson LE, 2004, PSYCHONEUROENDOCRINO, V29, P448	51	300
11.	423	Cohen L, 2004, CANCER, V100, P2253	112	205
12.	427	Oken BS, 2004, NEUROLOGY, V62, P2058	97	292
13.	475	Tindle HA, 2005, ALTERN THER HEALTH M, V11, P42	36	532
14.	479	Brown RP, 2005, J ALTERN COMPLEM MED, V11, P189	89	156
15.	541	Kirkwood G, 2005, BRIT J SPORT MED, V39, P884	125	154
16.	545	Pilkington K, 2005, J AFFECT DISORDERS, V89, P13	122	170
17.	552	Sherman KJ, 2005, ANN INTERN MED, V143, P849	140	225
18.	561	Oken BS, 2006, ALTERN THER HEALTH M, V12, P40	113	198
19.	626	Culos-Reed SN, 2006, PSYCHO-ONCOL, V15, P891	0	144
20.	728	Moadel AB, 2007, J CLIN ONCOL, V25, P4387	107	178
21.	729	Chou R, 2007, ANN INTERN MED, V147, P478	40	1134
22.	730	Chou R, 2007, ANN INTERN MED, V147, P492	29	385
23.	735	Carlson LE, 2007, BRAIN BEHAV IMMUN, V21, P1038	42	259
24.	781	Carmody J, 2008, J BEHAV MED, V31, P23	43	498
25.	1033	O'Donovan G, 2010, J SPORT SCI, V28, P573	0	253
26.	1042	Ross A, 2010, J ALTERN COMPLEM MED, V16, P3	135	168
27.	1353	Diamond A, 2011, SCIENCE, V333, P959	12	656
28.	1843	Brook RD, 2013, HYPERTENSION, V61, P1360	6	171
29.	1892	Bushnell MC, 2013, NAT REV NEUROSCI, V14, P502	4	297
30.	2259	Rosenbaum S, 2014, J CLIN PSYCHIAT, V75, P964	8	140

Highly Cited paper is identified through papers are arranged in descending order according to Citations in table IX.

TABLE IX SHOWS HIGHLY CITED PAPERS

S. No	Date / Author / Journal	LCS	GCS	LCR	CR
1	729Chou R, Qaseem A, Snow V, Casey D, Cross JT, et al. Diagnosis and treatment of lowbackpain: A jointclinicalpracticeguideline from the Americancollege of physicians and the Americanpainsociety, ANNALS OF INTERNAL MEDICINE. 2007 OCT 2; 147 (7): 478-491	40	1134	2	131
2	1353Diamond A, Lee K, Interventions Shown to AidExecutiveFunctionDevelopment in Children 4 to 12 YearsOld, SCIENCE. 2011 AUG 19; 333 (6045): 959-964	12	656	0	48
3	475Tindle HA, Davis RB, Phillips RS, Eisenberg DM Trends in use of complementary and alternativemedicine by us adults: 1997-2002 ALTERNATIVE THERAPIES IN HEALTH AND MEDICINE. 2005 JAN-FEB; 11 (1): 42-49	36	532	1	27
4	781Carmody J, Baer RA Relationships between mindfulnesspractice and levels of mindfulness, medical and psychologicalsymptoms and well-being in a mindfulness-basedstressreductionprogram JOURNAL OF BEHAVIORAL MEDICINE. 2008 FEB; 31 (1): 23-33	43	498	0	44
5	730Chou R, Huffman LH Non-pharmacologictherapies for acute and chroniclowbackpain: A review of the evidence for an AmericanpainSociety/Americancollege of physiciansclinicalpracticeguideline ANNALS OF INTERNAL MEDICINE. 2007 OCT 2; 147 (7): 492-504	29	385	3	185
6	354Carlson LE, Speca M, Patel KD, Goodey E Mindfulness-basedstressreduction in relation to quality of life, mood, symptoms of stress, and immuneparameters in breast and prostatecanceroutpatients PSYCHOSOMATIC MEDICINE. 2003 JUL-AUG; 65 (4): 571-581	49	330	0	73
7	313Kronenberg F, Fugh-Berman A Complementary and alternativemedicine for menopausalsymptoms: A review of randomized, controlledtrials, ANNALS OF INTERNAL MEDICINE. 2002 NOV 19; 137 (10): 805-813	18	322	0	58
8	421Carlson LE, Speca M, Patel KD, Goodey E Mindfulness-basedstressreduction in relation to quality of life, mood, symptoms of stress and levels of cortisol, dehydroepiandrosteronesulfate (DHEAS) and melatonin in breast and prostatecanceroutpatients, PSYCHONEUROENDOCRINOLOGY. 2004 MAY; 29 (4): 448-474	51	300	1	88
9	1892Bushnell MC, Ceko M, Low LA, Cognitive and emotionalcontrol of pain and its disruption in chronicpain, NATURE REVIEWS NEUROSCIENCE. 2013 JUL; 14 (7): 502-511	4	297	0	183
10	427Oken BS, Kishiyama S, Zajdel D, Bourdette D, Carlsen J, *et al.*, Randomizedcontrolledtrial of yoga and exercise in multiplesclerosis NEUROLOGY. 2004 JUN 8; 62 (11): 2058-2064	97	292	2	56

VI. FINDINGS AND CONCLUSION

1. This study has highlighted quantitatively the contributions made by the researchers during 1989-2018 as reflected in 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.
2. The study found that 73 papers are received 100 and above citations. The range of Citation is 1-1134.
3. The study also found that the overall h-index 90 and Citations are 46383.
4. Top 10 countries India secured second rank in terms of GCS with 4719 but with only 583 publications and also collaboration with more than 80 countries.
5. The study also identified that an average citation per paper is 11.32.
6. The study found that 1181 papers are published in open access journals.
7. Author contributions have to be encouraged and this certainly will help more publications. Global level Universities and technical Institution researchers should be encouraged.

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 man's life (Amarjeet, Y. & Sohan, R. T. (2011). 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 exciting more research in the future.

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