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Osteoporosis in Women: A Scientometric Assessment of Indian Publications during 2000-2019

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Abstract

The study presents a quantitative and qualitative profile of India's research on "Osteoporosis in Women", based on scientific publications indexed in Scopus database covering the 20-year period 2000 - 2019. India's publications constitute only 1.80% share of global output in this area during 2000 - 2019, registered 21.98% growth per annum and averaged 14.14 citations per paper. The qualitative indicators used include relative citation index, citations per paper and highly cited papers. In addition, the study examine the various aspects of India's top 15 organizations and authors in the field, most favored subjects in the field, significant media of communication and characteristics of highly-cited publications. Central Drug Research Institute, Lucknow (82 papers), All India Institute of Medical Sciences, New Delhi (53 papers), Postgraduate Institute of Medical Education and Research, Chandigarh (29 papers) were the productive Indian organizations. Indraprastha Apollo Hospital (87.45 and 6.18), Indian Institute of Science, Bangalore (32.0 and 2.26), Central Drug Research Institute, Lucknow (19.94 and 1.41) were the most impactful organizations in terms of citation per paper and relative citation index. R. Trivedi (34 papers), R. Maurya (29 papers) and N. Chattopadhyay (28 papers) were the most productive authors. A. Mithal (79.40 and 5.62), K. Sharan (31.67 and 2.24) and A. Kumar (27.82 and 1.97) were the most impactful authors in terms of citation per paper and relative citation index. *Journal of Clinical and Diagnostic Research* (49 papers), *International Journal of Pharmaceutical Research* (20 papers) and *Indian Journal of Medical Research* (15 papers) were the leading journals contributing to this field.

Keywords: *Osteoporosis; Women; India; Publications; Scientometrics; Bibliometrics*

Introduction

Osteoporosis afflicts human bones, debilitates them and causes severe joint pain. The cross sectional microscopic architecture of bone would reveal a honeycomb structure. A patient suffering from osteoporosis has bigger holes and spaces in the honeycomb as compared to healthy bones owing to the loss of density in the bones. Even minor injuries can cause fractures in person having osteoporosis. Experts call it a silent disease, and predict that by 2025 osteoporosis alone will be responsible for approximately three million fractures every year [1].

Osteoporosis is a metabolic disease of the bone which leads to a reduction in the bone density. The density of the affected bones become lower and the bones become more fragile and are therefore more likely to break resulting in fractures. During the life process, bones change in size, shape and structural density. In general, bone mass is most rapidly built during childhood and adolescence and reaches its

peak in the mid-30s. After that, the optimal bone mass is maintained during young adulthood. From around age 40, the loss of bone mass becomes obvious, with a period of more rapid loss in women approaching menopause due to estrogen withdrawal [1].

Estrogen hormone is produced by ovaries in the female. It is responsible for maintaining bone health as it metabolizes calcium. By the time women reach menopause, production of estrogen is diminished which reduces bone density. Therefore, women tend to lose bone mass at a faster rate after 50 years of age. Reduced estrogen is also possible in women who get their ovaries removed and are at risk of developing osteoporosis at a younger age than men [3].

When loss of bone mass is faster than it should be, the chance of having osteoporosis and bone fracture will occur much earlier. Bones that commonly break include the vertebrae in the spine, the bones of the forearm, and the hip [1].

Osteoporosis is estimated to affect 200 million women worldwide - approximately one-tenth of women aged 60, one-fifth of women aged 70, two-fifths of women aged 80 and two-thirds of women aged 90. Osteoporosis affects an estimated 75 million people in Europe, USA and Japan (1). For the year 2000, there were an estimated 9 million new osteoporotic fractures, of which 1.6 million were at the hip, 1.7 million were at the forearm and 1.4 million were clinical vertebral fractures. Europe and the Americas accounted for 51% of all these fractures, while most of the remainder occurred in the Western Pacific region and Southeast Asia [3].

Worldwide, 1 in 3 women over age 50 will experience osteoporotic fractures, as will 1 in 5 men aged over 50 (2,3,4). 80%, 75%, 70% and 58% of forearm, humerus, hip and spine fractures, respectively, occur in women. Overall, 61% of osteoporotic fractures occur in women, with a female-to-male ratio of 1.6 (214). Nearly 75% of hip, spine and distal forearm fractures occur among patients 65 years old or over (5). A 10% loss of bone mass in the vertebrae can double the risk of vertebral fractures, and similarly, a 10% loss of bone mass in the hip can result in a 2.5 times greater risk of hip fracture [3].

About 230 million Indians are over the age of 50 years in 2015, 20%, i.e. ~46 million, are women with osteoporosis. Thus, osteoporosis is a major public health problem in Indian women. Low calcium intakes with extensive prevalence of vitamin D deficiency, increasing longevity, sex inequality, early menopause, genetic predisposition, lack of diagnostic facilities, and poor knowledge of bone health have contributed toward the high prevalence of osteoporosis. Prevalence of osteoporosis ranging from 8% to 62% in Indian women of different age groups has been reported by several studies [4].

Fractures following "minimal trauma", especially of the vertebra, are the most common and earliest manifestations of osteoporosis. Fractures are also an important cause of morbidity and mortality in Indian osteoporotic patients and have been reported to occur much earlier in Indians compared to people in the West [4].

Diagnosis of osteoporosis is done with Dual energy X-ray Absorptiometry (DXA) scans to measure Bone Mineral Density (BMD). The World Health Organization Fracture Risk Assessment (FRAX) score is used to identify patients who are at risk of fractures [5].

Pharmacological treatment for Indian women is recommended who obtain a risk score sufficient enough to warrant treatment. The treatment of osteoporosis includes calcium and vitamin D replacement, bisphosphonates, denosumab, teriparatide and hormone replacement therapy in women. Potential therapies that are currently undergoing clinical trials include Abaloparatide and Romosozumab [5].

Literature Review

There are only few studies on assessment of India's research output on osteoporosis. Among such studies, Gupta and Ahmed Mueen [6] and Bharadwaj and Ram [7] examined Indian research output in osteoporosis during 2007-16 and 1973 - 2012 periods, using Scopus database, using almost similar bibliometric indicators. There were only few studies related to osteoporosis in women. Yuanyu Qiu., *et al*. [8] assessed the scientific activity in Postmenopausal osteoporosis (11142 papers) during 2008-18, using WoS database The quantity of

papers, number of citations, citation frequency per year, and H-index were assessed and compared among different countries, institutes, and researchers. Zhou, Tao, Zhu and Tao [9] identified that a total of 5,247 publications related to postmenopausal osteoporosis (2013 to 2017). Osteoporosis International was the leading journal in the field of postmenopausal osteoporosis research, both in terms of impact factor score (3.82) and H-index value (157). The United States has retained a top position and has exerted a pivotal influence in this field. The University of California, San Francisco was identified as a leading institution for research collaboration, and Professors Reginster and Kanis have made great achievements in this area.

Objectives of the Study

The study aims to examine the India's research output on "Osteoporosis in Women", based on scientific publications covered indexed in Scopus database during 2000 - 2019. The study focuses on the following aspects: (i) global publications - the contribution of top 10 most productive countries and growth rate; (ii) India's publication s- growth rate, global share, distribution by type and source of publications, share of international collaborative publications, impact of research, distribution of publications by broad subjects, identification of significant keywords, profile of top 15 organizations and authors, identification of important media of research communications and characteristic of highly- cited papers.

Methodology

The India's publications on "Osteoporosis in Women" were retrieved from the Scopus database (http://www.scopus.com) for the present study. Keywords for search included two combinations: "osteoporosis" and (women or female). These keywords were suffixed to "Keyword" and "Article Title" tags and the search output refined by period '2000-2019' using "date range tag". This main search strategy yielded a global output of 46135 records. The search string (shown below) focusing on India yielded 831 records and these records, which were further analyzed by broad subjects, collaborating countries, author-wise, organization-wise and journal-wise, etc. by using analytical provisions of Scopus database from date of their publication till 12 March 2020. A number of bibliometric indicators have been used to understand the various aspects of India's research on "Osteoporosis in Women".

(KEY (osteoporosis and (women OR female)) OR TITLE (osteoporosis AND (women OR female))) AND PUBYEAR > 1999 AND PUBYEAR < 2020 AND (LIMIT-TO (AFFILCOUNTRY, "India")).

Analysis and Results

The global and India's research on "Osteoporosis in Women" resulted in 46135 and 831 publications in 20 years (2000-19) as covered in Scopus database. The global annual output on "Osteoporosis in Women" registered 2.17% average growth rate, up from 1592 publications in the year 2000 to 2316 publications in the year 2019. Its ten-year cumulative publications output registered 19.43% absolute growth, up from 21025 publications during 2000-09 to 25110 publications during 2010-19. India's annual publications on "Osteoporosis in Women" registered 21.98% average growth, up from 5 in the year 2000 to 89 in the year 2019. India's ten-year cumulative publications registered 303.64% absolute growth, up from 165 during 2000-09 to 666 during 2010-19. India's global publication was 1.80% during 2000-19, which increased from 0.78% during 2000-09 to 2.65 during 2010-19. India's publications on "Osteoporosis in Women" averaged to 14.14 citations per paper (CPP) during 2000-19, which decreased from 34.96 CPP during 2000-09 to 8.98 CPP during to 2010-19 [1]. Of the total India's publications, 84.60% (703) publications appeared as articles, followed by reviews (63 and 7.58%), letters (30 and 3.61%), notes (15, 1.81%), conference papers (12 and 1.44%), editorials (7 and 0.84%) and short survey (1 and 0.12%).

The share of international collaborative papers (113) in India's publication output (831) was 13.60% during 2000-19, which decreased from 15.76% during 2000-09 to 13.06% during 2010-19. India's 113 ICP together received 5507 citations, with an average citation impact per paper of 48.73. USA contributed the largest number (51) of International collaborative papers in India's output, followed by U.K. (28 papers), Canada (14), Australia (12), Italy (11), Switzerland (10), Germany and Japan (8 each), France and South Korea (7), etc.

Publication Year	World	India					
	TP	TP	TC	CPP	ICP	%ICP	%TP
2000	1592	5	27	5.40	0	0.00	0.31
2001	1676	11	177	16.09	0	0.00	0.66
2002	1960	10	316	31.60	2	20.00	0.51
2003	2095	21	439	20.90	5	23.81	1.00
2004	2266	17	217	12.76	2	11.76	0.75
2005	2402	16	526	32.88	3	18.75	0.67
2006	2317	19	340	17.89	3	15.79	0.82
2007	2193	13	143	11.00	1	7.69	0.59
2008	2225	23	2085	90.65	5	21.74	1.03
2009	2299	30	1498	49.93	5	16.67	1.30
2010	2319	42	1038	24.71	10	23.81	1.81
2011	2553	50	1063	21.26	9	18.00	1.96
2012	2566	66	904	13.70	6	9.09	2.57
2013	2605	75	749	9.99	6	8.00	2.88
2014	2533	59	488	8.27	10	16.95	2.33
2015	2574	63	811	12.87	8	12.70	2.45
2016	2529	66	359	5.44	6	9.09	2.61
2017	2509	78	306	3.92	14	17.95	3.11
2018	2606	78	239	3.06	10	12.82	2.99
2019	2316	89	25	0.28	8	8.99	3.84
2000-09	21025	165	5768	34.96	26	15.76	0.78
2010-19	25110	666	5982	8.98	87	13.06	2.65
2000-19	46135	831	11750	14.14	113	13.60	1.80

Table 1*: Indian publication output and citations count in "osteoporosis in women" research, 2000-2019. TP: Total Papers; TC: Total Citations; CPP: Citations Per Paper.*

Top 10 most productive countries

The 77.45% of the global research output share come from top 10 countries. USA leads the ranking with global publication share of 26.60% share, followed far behind by U.K. and China (8.65% and 8.31%), Japan (6.16%), Germany, Italy and Canada (5.65%, 5.46% and 5.05%), France, Australia and Spain (3.95%, 3.86% and 2.76%) during 2000-19. The global publication increased in 7 countries namely China, Spain, Australia, Italy, Canada and Japan. (from 0.24% to 6.71%), as against decrease in 4 other countries, namely Germany, France, U.K. and USA (from 0.03% to 5.60%) during 2000-09 to 2010-19 (Table 2).

Subject-wise distribution of research output

Medicine contributed the largest publication share (66.19%) to India's publications on "Osteoporosis in Women", followed distantly by biochemistry, genetics and molecular biology (27.20%), pharmacology, toxicology and pharmaceutics (19.98%), etc. Based on the activity index, it was observed that the research activities have decreased in medicine (from 152.76 to 95.74) and neuroscience (from 271.19

S. No	Name of the Country	Number of Papers			Share of Papers		
		2000-09	2010-19	2000-19	2000-09	2010-19	2000-19
1	USA	6233	6039	12272	29.65	24.05	26.60
2	U.K.	1995	1996	3991	9.49	7.95	8.65
3	China	979	2853	3832	4.66	11.36	8.31
4	Japan	1267	1574	2841	6.03	6.27	6.16
5	Germany	1191	1414	2605	5.66	5.63	5.65
6	Italy	1077	1440	2517	5.12	5.73	5.46
7	Canada	1034	1299	2333	4.92	5.17	5.06
8	France	933	891	1824	4.44	3.55	3.95
9	Australia	740	1041	1781	3.52	4.15	3.86
10	Spain	683	1051	1734	3.25	4.19	3.76
	Total of 10 countries	16132	19598	35730	76.73	78.05	77.45
	World	21025	25110	46135	100.00	100.00	100.00

Table 2: *Global publication output and share of top 10 most productive countries in "osteoporosis in women" research, 2000-19.*

and 81.10), as against increase in biochemistry, genetics and molecular biology from all three subjects, namely psychology (from 95.34 to 102.59), health profession (62.89 to 120.62) and agricultural and biological Sciences (83.07 to 107.11), pharmacology, toxicology and pharmaceutics (from 89.30 to 105.980, dentistry (from 71.95 to 109.18) and immunology and microbiology (from 41.97 to 115.18) during 2000-09 to 2010-19. Immunology and microbiology registered the highest citation impact per paper of 18.38) and dentistry the least (8.17) (Table 3).

S. No	Subject*	Number of Papers (TP)			Activity Index		TC	CPP	%TP
		2000-09	2010-19	2000-19	2000-09	2010-19	2000-19		
1	Medicine	128	422	550	152.76	95.74	9140	16.62	66.19
2	Biochemistry, Genetics and Molecular Biology	32	194	226	83.07	107.11	2953	13.07	27.20
3	Pharmacology, Toxicology and Pharmaceutics	25	141	166	89.30	105.98	1385	8.34	19.98
4	Dentistry	3	21	24	71.95	109.18	196	8.17	2.89
5	Neuroscience	7	13	20	271.19	81.10	247	12.35	2.41
6	Immunology and Microbiology	1	12	13	41.97	115.18	239	18.38	1.56
	India's Output	165	666	831					

Table 3: *Subject-wise breakup of Indian publications in "osteoporosis in women" research during 2000-19.*

Significant keywords

75 keywords (assumed to be significant) have been identified from the literature on India's research on "Osteoporosis in Women", which through light on the research trends and factors involved in this area. These keywords are listed in table 4 in the decreasing order of the frequency of their occurrence in the literature during 2000-19. Most of the keywords are related to the bone, except few general keywords like biological marker, *in vitro* study, risk assessment, prevalence, body weights, drug safety, drug effect, *in vivo* study, etc.

S. No	Name of the Keyword	Frequency	S. No	Name of the Keyword	Frequency	S. No	Name of the Keyword	Frequency
1	Osteoporosis	731	26	Estrogen	60	51	Biological Marker	39
2	Bone Density	387	27	Menopause	60	52	Alendronk Acid	39
3	Calcium	195	28	Ossification	58	53	Hypertension	39
4	Osteopenia	174	29	Pathophysiology	58	54	Osteolysis	39
5	Post- menopause Osteoporosis	167	30	Metallic Bone Disease	58	55	Estradiol	39
6	Osteolysis	136	31	Risk Assessment	58	56	*In Vitro* Study	38
7	Alkaline Phosphatase	135	32	Ossification	58	57	Zoledronik Acid	37
8	Ovariectomy	122	33	Osteocalcin	57	58	Drug Safety	36
9	Post-menopause	108	34	Pathology	57	59	Enzyme Activity	36
10	Prevalence	102	35	Estradiol	56	60	Bone Remodeling	34
11	Bone Mineral Density	101	36	Femur Neck	56	61	Genetics	33
12	Femur	98	37	Body Weight	55	62	Osteoclast	33
13	Vitamin D	96	38	Phosphorous	54	63	Estrogen Deficiency	24
14	Bone Mass	90	39	Plant Extracts	54	64	Diphosphonates	23
15	Body Mass	80	40	Hip Fracture	50	65	Raloxifene	22
16	Lumber Spine	78	41	Osteogenesis	46	66	Bisphosphonates	18
17	Metabolism	76	42	Physiology	46	67	Ibandronic Acide	18
18	Parathyroid Hormone	76	43	Clinical Trials	54	68	Estrogen Therapy	18
19	Bone Strength	75	44	Bisphosphonic Acid Derivatives	44	69	Estrogen Receptor Modulator	18
20	Calcium Blood Level	73	45	Spine Fracture	43	70	Harmone Substitution	18
21	Drug Effect	72	46	Bone Mineralization	42	71	Osteopenia	16
22	Osteoblast		47	*In Vivo* Study	41	72	Risedronic Acid	15
23	Drug Efficacy	69	48	Relaxofene	41	73	Imidazoles	14
24	Trabecular Bone	69	49	*In Vivo* Study	41	74	Estrogen Replacement Therapy	9
25	Bone Minerals	61	50	Biomechanics	40	75	Breast Cancer	8

Table 4: *Significant Keywords Appeared in India's Publications in "Osteoporosis in Women" during 2000-19.*

Top 15 most productive Indian organizations

A total of 237 organizations unevenly participated in India's research on "Osteoporosis in Women" during 2000 - 2019: 190 organizations published 1 - 5 papers each, 31 organizations 6 - 10 papers each, 10 organizations 11 - 20 papers each, 4 organizations 21 - 50

papers each and 2 organizations 51 - 82 papers each during 2000-19.

The productivity of top 15 most productive organizations varied from 11 to 82 publications; together they contributed 44.04% (366) India's publications and fetched 42.68% (5015) of India's citations during 2000-19. Their scientometric profile is presented in table 5:

- Four organizations registered their publication output above the group average (24.4) of all organizations: Central Drug Research Institute, Lucknow (82 papers), All India Institute of Medical Sciences, New Delhi (53 papers), Postgraduate Institute of Medical Education and Research, Chandigarh and Christian Medical College, Vellore (29 papers each);
- Four organizations registered their citation per paper and relative citation index above the group average (13.70 and 0.97) of all organizations: Indraprastha Apollo Hospital (87.45 and 6.18), Indian Institute of Science, Bangalore (32.0 and 2.26), Central Drug Research Institute, Lucknow (19.94 and 1.41) and Kasturba Medical College, Manipal (16.89 and 1.19).

S. No	Name of the Organization	TP	TC	CPP	HI	ICP	ICP (%)	RCI
1	Central Drug Research Institute, Lucknow	82	1635	19.94	23	7	8.54	1.41
2	All India Institute of Medical Sciences, New Delhi	53	646	12.19	13	7	13.21	0.86
3	Postgraduate Institute of Medical Education and Research, Chandigarh	29	198	6.83	9	1	3.45	0.48
4	Christian Medical College, Vellore	29	150	5.17	6	2	6.90	0.37
5	Sanjay Gandhi Postgraduate Institute of Medical Education and Research, Lucknow	24	285	11.88	10	4	16.67	0.84
6	Chettinad Academy of Research and Education, Chennai	22	1	0.05	1	1	4.55	0.00
7	Manipal Academy of Higher Education	21	144	6.86	8	7	33.33	0.48
8	Kasturba Medical College, Manipal	18	304	16.89	9	5	27.78	1.19
9	King George's Medical University, Lucknow	18	86	4.78	5	0	0.00	0.34
10	SRM Institute of Science and Technology, Chennai	14	50	3.57	8	2	14.29	0.25
11	Indian Institute of Science, Bangalore	12	384	32.00	8	2	16.67	2.26
12	Jawaharlal Institute of Postgraduate Medical Education and Research, Pondicherry	11	41	3.73	3	0	0.00	0.26
13	Maulana Acad Medical College, Delhi	11	74	6.73	3	3	27.27	0.48
14	Kasturba Medical College, Mangalore	11	55	5.00	4	2	18.18	0.35
15	Indraprastha Apollo Hospital	11	962	87.45	4	2	18.18	6.18
	Total	366	5015	13.70	7.6	45	12.30	0.97
	India's Total	831	11750	14.14				
	Share of top 15 in India's total	44.04	42.68					

Table 5: *Top 10 most productive organizations in India's research on "osteoporosis in women" during 2000-19.*

Top 15 most productive authors

A total of 357 authors unevenly participated in India's research on "Osteoporosis in Women" during 2000-2019: 305 authors published 1-5 papers each, 38 authors 6-10 papers each, 10 authors 11-20 papers each and 4 authors 21-34 papers each during 2000-19. The research productivity of top 15 most productive authors varied from 10 to 34 publications per author. Together they contributed 32.01% (266) India's publications share and 52.14% (6127) India's citations share during 2000-19. Most (12) of the top 15 authors contributing

the India's Osteoporosis research in women were from the single research organization (CDRI). Their detailed scientometric profile is presented in table 6:

- Six authors registered their publications output above the group average of 17.73: R. Trivedi (34 papers), R. Maurya (29 papers), N. Chattopadhyay (28 papers), D. Singh (26 papers), P. Kushwaha (20 papers) and V. Khedgikar (18 papers);
- Six authors registered their citation per paper and relative citation index above the group average (23.03 and 1.63) of all authors: A. Mithal (79.40 and 5.62), K. Sharan (31.67 and 2.24), A. Kumar (27.82 and 1.97), J. Gautam (26.67 and 1.89), N. Chattopadhyay (25.50 and 1.80) and G.K. Nagar (24.23 and 1.71).

S. No	Name of the Author	Affiliation of the Author	TP	TC	CPP	HI	ICP	ICP (%)	RCI
1	R. Trivedi	CDRI-Lucknow	34	660	19.41	16	4	11.76	1.37
2	R. Maurya	CDRI-Lucknow	29	621	21.41	16	2	6.90	1.51
3	N. Chattopadhyay	CDRI-Lucknow	28	714	25.50	18	3	10.71	1.80
4	D. Singh	CDRI-Lucknow	26	513	19.73	13	0	0.00	1.40
5	P. Kushwaha	CDRI-Lucknow	20	343	17.15	10	1	5.00	1.21
6	V. Khedgikar	CDRI-Lucknow	18	362	20.11	10	1	5.56	1.42
7	A. Mithal	Medanta, Gurgaon	15	1191	79.40	9	9	60.00	5.62
8	N. Ahmad	CDRI-Lucknow	14	74	5.29	6	3	21.43	0.37
9	M. Anburajan	SRM institute of Science and Technology	13	84	6.46	5	0	0.00	0.46
10	G.K. Nagar	CDRI-Lucknow	13	315	24.23	11	0	0.00	1.71
11	J. Gautam	CDRI-Lucknow	12	320	26.67	10	0	0.00	1.89
12	K. Sharan	CDRI-Lucknow	12	380	31.67	11	2	16.67	2.24
13	Kumar	CDRI-Lucknow	11	306	27.82	9	1	9.09	1.97
14	T.V. Paul	Christian Medical College, Vellore	11	55	5.00	3	0	0.00	0.35
15	P.R. Mishra	CDRI-Lucknow	10	189	18.90	6	0	0.00	1.34
			266	6127	23.03	10.2	26	9.77	1.63
			831	11750	14.14				
			32.01	52.14					

Table 6: *Top 10 most productive authors in India's research on "osteoporosis in women" during 2000-19.*

Medium of research communication

Of the total India's research output on "Osteoporosis in Women", 99.04% (823) appeared in journals, 0.60% (5) in conference proceedings, 0.12% (1) as book series and 0.24% (2) as undefined.

Of the 188 journals which reporting 823 articles, 156 published 1 - 5 papers each, 24 published 6 - 10 papers each, 7 published 11 - 20 papers each and 1 published 49 papers during 2000-19. The top 15 most productive journals published 9 to 49 papers and together accounted for 25.64% share of total India's research output on "Osteoporosis in Women" that appeared in journal medium during 2000-19, which increased from 12.27% to 28.98% between 2000-09 and 2010-2019. The top 5 most productive journals were *Journal of Clinical and Diagnostic Research* (49 papers), *International Journal of Pharmaceutical Research* (20 papers), *Indian Journal of Medical Research* (15 papers), *Archives of Osteoporosis* (13 papers) and *Osteoporosis International* (13 papers). The top 5 most impactful journals were: *Osteoporosis International* (89.54), *Menopause* (21.36), *Indian Journal of Clinical Biochemistry* (10.89), *Archives of Osteoporosis* (7.46) and

Journal of Association of Physicians of India (7.44), Almost 50% of top 15 journals were either started or indexed in Scopus database after 2009 (Table 7).

S. No	Name of the Journal	Number of Papers			TC	CPP
		2000-09	2010-19	2000-19	2000-19	
1	*Journal of Clinical and Diagnostic Research*	1	48	49	247	5.04
2	*International Journal of Pharmaceutical Research*	0	20	20	0	0.00
3	*Indian Journal of Medical Research*	2	13	15	55	3.67
4	*Archives of Osteoporosis*	1	12	13	97	7.46
5	*Osteoporosis International*	4	9	13	1164	89.54
6	*BMJ Case Reports*	0	12	12	23	1.92
7	*Journal of Clinical Orthopedics and Trauma*	0	12	12	38	3.17
8	*Menopause*	1	10	11	235	21.36
9	*Bone*	0	10	10	56	5.60
10	*Indian Journal of Endocrinology and Metabolism*	0	10	10	61	6.10
11	*Indian Journal of Rheumatology*	0	10	10	16	1.60
12	*Asian Journal of Pharmaceutical and Clinical Research*	0	9	9	14	1.56
13	*Indian Journal of Clinical Biochemistry*	4	5	9	98	10.89
14	*Journal of Association of Physicians of India*	7	2	9	67	7.44
15	*Journal of Clinical Densitometry*	0	9	9	29	3.22
	Total of 15 journals	20	191	211	2200	
	India's total in journals	163	659	823		
	Share of top 15 journals in India's journal output	12.27	28.98	25.64		

Table 7: *Top 15 journals publishing India's research on "osteoporosis in women" during 2000-19.*

Highly-cited papers

Of the 831 India's publications in research on "Osteoporosis in Women" during 200019, only 13 (1.56% share) publications registered 100 to 1658 citations per paper (assumed here highly- cited) and they together received a total 4476 citations, since their publication, averaging to 344.31 citations per paper.

The distribution of 13 highly-cited papers is highly skewed: 5 papers each registered citations in the range 100-199, 6 papers in citation range 200-299 and 2 papers in citation range 884-1658. Among 13000 highly cited papers, USA contributed the highest number of papers (8), followed by U.K. and Switzerland (3 papers each), Argentina, Australia, Belgium, Canada, Norway and Spain (2 papers each) and Brazil, Chile, Croatia, France, Lebanon, Germany, Italy, Mexico, Netherland and South Africa (1 paper each). The 13 highly-cited papers (9 articles and 4 reviews) involve 108 authors and 71 organizations. Of the 13 high cited papers, 2 are zero-collaborative, 1 national collaborative and 10 international collaborative.

16 Indian organizations participated in these highly-cited papers: Central Drug Research Institute, Lucknow (2 papers), All India Institute of Medical Sciences, ICMR Centre for Advanced Research in Newborn Health, New Delhi, Clinical Endocrinology, Education and Research, Chennai, Dr. ALMPGIBMS, University of Madras, Army Hospital, Joint Replacement Centre, New Delhi, Centre for Diabetes and Endocrine Care, Karnataka, Centre for Health Research and Development, Society for Applied Studies, New Delhi, College of Pharmaceu-

tical Sciences, Manipal, Kasturba Medical College, Manipal, Dr. D.Y. Patil Medical College for Women, Pimpri, Pune, Indraprastha Apollo Hospitals, Sarita Vihar, New Delhi, Jaslok Hospital, Sir Hurkisondas Hospital, Mumbai, Novartis Healthcare Private, Ltd., Hyderabad and Sitaram Bhartia Institute of Science and Research, New Delhi (1 paper each).

The top 13 highly-cited papers were published in 12 journals, with 2 papers in *Clinica Chimica Acta* and 1 paper each in *Acta Paediatrica, International Journal of Paediatrics, Climacteric, Journal of Bone and Mineral Research, Journal of Bone and Joint Surgery - Series A, Journal of Ethnopharmacology, Journal of Clinical Endocrinology and Metabolism, The Lancet, Molecular and Cellular Endocrinology, Nature Medicine, New England Journal of Medicine* and *Osteoporosis International*

Summary and Conclusion

The India's research on "Osteoporosis in Women" resulted in 831 publications 2000-19. The annual and ten-year cumulative global output on "Osteoporosis in Women" registered 21.98% and 303.64% growth respectively during the last 20 years. The share of India in global publication output was 1.80% during 2000-19, which increased from 0.78% during 2000-09 to 2.65% during 2010-19. India's publications averaged to 14.14 citations per paper (CPP) during 2000-19, which decreased from 34.96 CPP and 8.98 CPP from 2000-09 to 2010-19. India's share of international collaborative papers (ICP) in its national publication output 13.60%, which decreased from 15.76% to 13.06%, during 2000-09 to 2010-19.

In total 237 organizations and 357 authors participated in India's research on "Osteoporosis in Women" during 2000-19, of which the top 15 global organizations and authors contributed 44.04% and 32.01% to national publication share respectively and 42.68% and 52.14% national citation share respectively during 2000-19. The journals medium accounted for 99.04% share of India's output on "Osteoporosis in Women" during 2000-19, of which the top 15 most productive journals (of 188 participating) accounted for 25.64% of total India's output in journals during 2000-19.

Meagerly, 13 (1.56% share) publications out of 831 India's publications on "Osteoporosis in Women" during 2000-19 received 100 to 1658 citations per paper. They together received a total of 4476 citations, averaging to 344.31 citations per paper.

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