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A Scientometric Assessment of Obesity Research Publications from India during 2007-16

B M Gupta¹, K K Mueen Ahmed², Ritu Gupta³

ABSTRACT

The paper examines 3960 Indian publications on obesity, as covered in Scopus database during 2007-16, registering an annual average growth rate of 10.28% and qualitative impact averaged to 12.50 citations per paper. The top 15 most productive countries in global obesity research individually contributed global share from 2.02% to 48.90%, with USA accounting for the highest publication share (48.90%), followed by U.K. (11.37%), Germany and Italy (6.52% and 6.26%), Canada, Australia, Spain and France (from 5.18% to 5.89%), etc. during 2007-16 etc. Together, the 15 most productive countries accounted for more than 100% of global publications share during 2007-16. The share of India's internationally collaborative papers (ICP) in obesity research was 20.25% during 2007-16, which increased from 17.92% during 2007-11 to 21.44% during 2012-16. Medicine, among subjects, accounted for the highest publications share (89.22%) in India's obesity research, followed by biochemistry, genetics & molecular biology (34.24%), pharmacology, toxicology & pharmaceuticals (20.53%), nursing (8.33%), agricultural & biological sciences (5.96%), chemistry (2.02%), neurosciences (1.92%) and immunology and microbiology (1.67%) during 2007-16. The top 25 and 20 most productive Indian organizations and authors together contributed 43.64% and 21.67% respectively as their share of Indian publication output and 82.03% and 80.61% respectively as their share of Indian citation output during 2007-16. Among the total journal output of 4503 papers, the top 15 journals contributed 19.94% share to the Indian journal output during 2007-16, which increased from 19.16% to 20.27% from 2007-11 to 2012-16. Of the total 3960 research papers in obesity research from India, the top 114 highly cited publications registered citations from 100 to 1805 and they together received 28158 citations, with 247.0 citations per paper. These 114 highly cited papers were published in 69 journals, of which 11 papers were published in *The Lancet*, followed by *International Journal of Obesity* and *Diabetes Research & Clinical Practice* (6 papers each), *Nutrition* (5 papers), *Diabetes Care* and *Diabetologia* (4 papers each), etc.

Key words: Obesity research, India, Publications, Scientometrics, Bibliometrics.

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INTRODUCTION

The term overweight refers to excess body weight for a particular height whereas the term obesity is used to define excess body fat. Overweight and obesity primarily happen either due to excess calorie intake or insufficient physical activity or both. Furthermore, various genetic, behavioural, and environmental factors play a role in its pathogenesis.^[1]

Obesity is known to affect the overall health of a population. According to the World Health Organization (WHO), overweight and obesity are the fifth leading risk for global deaths. Obesity is also found to be associated with a number of non-communicable diseases (NCDs), such as cardiovascular diseases, diabetes, musculoskeletal disorders and some forms of cancers. Statistics indicate that 44% of the diabetes burden, 23% of the heart disease burden and between 7% and 41% of certain cancer burdens can be attributed to overweight and obesity.^[2]

Worldwide, the number of obese people rose to 641 million in 2014 from 105 million in 1975, according

to a study published in the British medical journal, the Lancet. The study, comparing body-mass index from 1975 to 2014 from adults in 186 countries showed middle- and poorer-income countries like China, India and Brazil jumped in rankings when it came to obesity although India and China also have the most underweight citizens in the world.^[3] This study demonstrated that India has raced to third place, after the United States of America and China in the highest number of obese people worldwide; the United States of America accounting for 13% of obese people globally and India together with China accounting for 15% of the world's obese.^[4] Recent studies using Indian specific criteria for overweight (BMI \geq 23), obesity (BMI \geq 25) and abdominal obesity (WC \geq 90 cm in men and \geq 80 cm in women) have found the prevalence rates among Indians exceeding those in the US population.^[5]

Global obesity rates almost tripled for men to 11% of the total from 3.2% in 1975, while among women

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it nearly doubled to 15% from 6.4% in 1975. China had the most obese men and women in the world in 2014. Still, India saw a more significant rise in obesity from its 19th position for both men and women in 1975 to rankings 5th and 3rd respectively in 2014, reflecting increasing obesity rates among women worldwide.^[3]

India's women are more likely to be obese than their male counterparts. There were 20 million obese women in India in 2014 compared with 9.8 million obese men. Severe obesity was observed in an additional 4 million Indian women. There were less than 800,000 obese women in India in 1975 compared with 400,000 obese men.^[3]

India, known for its malnourished population, now has more and more overweight and obese people having high risk of adverse consequences. Obesity in India is different from the rest of the world; the "Thin-Fat Indian Phenotype"^[6] in that the proportion of body fat, abdominal obesity, subcutaneous fat, intra-abdominal fat and ectopic deposition of fat is more in Indian overweight and obese population. This, along with the genetic predisposition of Indians for high lipoprotein (a) levels, predisposes Indians at high risk of developing diabetes mellitus, cardiovascular diseases and death, particularly at younger age than the rest of the world. When India is still fighting against rural under-nutrition, the rising threat of urban obesity makes the problem double sided.

Obesity is usually reported in terms of body mass index (BMI) and waist circumference (WC) but the cutoff points differ by ethnicity. Earlier studies for assessment of obesity in India used the standard criteria (developed for and by Caucasians/Europids) that have significantly underestimated the prevalence of obesity and metabolic syndrome in India.^[7,8]

Literature Review

Few bibliometric studies have been carried out in the past in the past on global assessment of obesity research publications. Among country studies, one study focuses on Canada. Among such studies, Khan, Choudhury, Uddin and Baur^[9] made an attempt to study was to understand research trends among 117,340 research articles, their collaboration patterns together with scholarly impact within the domain of global obesity research during 1993-2012, using Scopus database. The authors found steady growth and an exponential increase of publication numbers. The authors also identified around 42 broad disciplines from authors' affiliation data, and these showed strong collaboration between them. Vioque, Ramos, Navarrete-Muñoz and García-de-la-Hera^[10] described a bibliometric review of the publications (58325) on obesity research in PubMed over the last 20 years from 1988 to 2007. The growth in the number of publications showed an exponential increase. The references were published in 3613 different journals, with 20 journals contributing 25% of obesity literature. The US was the predominant country in number of publications, followed by the United Kingdom, Japan and Italy. The ranking of production changed when the number of publications was normalized by population, gross domestic product and obesity prevalence by countries. Sokar and Sharma^[11] identified research published on obesity in Canada and explored the range of areas studied and identified gaps and areas that merit future research attention. A total of 1186 relevant articles were identified, of which 816 were considered original studies and accepted for this analysis. Twelve research areas were identified: basic science involving animal experiments (29%), human experiments (16%), populations surveys (14%), obesity-related comorbidities (13%), diagnostic/surgical issues (11%), non-pharmacological approaches (7%), drug-related issues (4%), anthropometrics (2%), impact of weight loss (2%), cost/healthcare use (1%), attitudes/perceptions (0.9%), and models/procedures (0.5%). Two-thirds of all research was conducted in Quebec (34%) and Ontario (33%). Canadian obesity research covers a broad range of areas with a predominance of basic science but

lesser emphasis on community and primary care studies. Since no bibliometric study was available on India in the past and as a result we decided to undertake the present study.

OBJECTIVES

The main objectives of this study are to study the performance of Indian obesity research during 2007-16, based on publications output covered in Scopus database. In particular, the study focuses on the following objectives: (i) To study the growth of world and Indian research output in obesity research and the citation impact of India's research; (ii) To study the international collaboration share of top 10 most productive countries in India's output; (iii) To study the Indian research output by broad subject areas and the dynamics of its growth and decline; (iv) To study the trends in Indian obesity research by identifying significant keywords; (v) To study the publication productivity and citation impact of top 25 and 20 most productive Indian productive organizations and authors; (vi) To study the modes of communication in research and identification of most productive journals and (vii) to study the characteristics of top 114 Indian highly cited papers.

METHODOLOGY

The publication data on obesity research in India was retrieved and downloaded from the Scopus database (<http://www.scopus.com>) covering the 10 years period 2007-16. Scopus is an online bibliographical multidisciplinary publication and citation database prepared by Elsevier and covers nearly 22,000 titles in the science, technology, medical, social sciences and humanities. The search strategy in the present paper was based on the search for obesity research publications in which keywords such as "obesity" had appeared in either "Keyword tag" or "Article Title tag" or "Source Title tag". The time was set from 2007 to 2016. Using analytical commands or tags, such as "year", "document type", "source type", "language", "subject area", "keyword", "author name", "affiliation", "country/territory" and "source type" available in Scopus database, the authors were able to analyze publication distribution by year-wise, document type, source type, language-wise, subject-wise, keywords, source title and identify important authors and organizations and distribution of international collaborative publications and also leading collaborative countries. The publications receiving 100 or more citations from the date of publications till 21 June 2017 was designated here as high cited papers. A number of raw and relative bibliographical indicators were used to assess and understand the growth and dynamics of Indian obesity research. The raw bibliographical indicators used were: growth rate number of publications and international collaborative publications, citation per paper, h-index, etc. Among relative bibliographical indicators, we have used activity index and relative citation index.

(KEY(obesity) OR TITLE(obesity)OR SRCTITLE(obesity)) AND PUBYEAR > 1996 AND PUBYEAR < 2017 AND (LIMIT-TO (AFFILCOUNTRY;"India"))

ANALYSIS

The total global and Indian research output in field of obesity research cumulated to 195661 and 3960 publications in 10 years during 2007-16. The annual output of the world and India in obesity research increased from 14485 and 206 in the year 2007 to 17817 and 416 publications in the year 2016, registering 3.03% and 10.28% growth per annum. The cumulative world and India's output in obesity research in 5 years 2007-11 increased from 83995 and 1334 to 111666 and 2626 publications during succeeding 5-year period 2012-16, registering 32.94% and 96.85% quinquennial growth. India's share in global output in obesity research was 2.02%, which increased from 1.59% to 2.35% from 2007-11 to 2012-16.

Of the total global publications output in obesity research, 69.05% (3150) was published as articles, 17.36% (792) as reviews, 6.25% (285) as letters, 2.74% (125) as editorials, 1.51% (69) as conference papers, 1.47 (67) as notes and the rest as book chapters (35), short surveys (22), articles in press (10), erratum (6) and book (1). The citation impact of global publications on obesity research averaged to 12.50 citations per publication (CPP) during 2007-16; five-yearly impact averaged to 23.02 CPP for the period 2007-11 which declined to 7.16 CPP in the succeeding five-year 2012-16 (Table 1).

International Collaboration

India's share of internationally collaborative papers (ICP) in obesity research was 20.25% during 2007-16, which increased from 17.92% to 21.44% from 2007-11 to 2012-16. Among the leading countries contributing to India's internationally collaborative papers, USA topped the list with 59.48% share, followed by U.K. (34.41%), Canada (14.21%), Australia (13.59%), China (9.85%), Japan (8.73%), Brazil (6.98%), etc. India's international collaborative publications share increased by 9.62% in USA, 8.92% in Canada, 8.66% in China, 7.90% in U.K., 6.84% in Australia, 4.95% in South Africa, 4.37% in Singapore, 4.09% in Japan, 3.99% in Brazil, 3% in Taiwan, 2.62% in Italy, 1.66% in Germany, 0.78%

Table 1: World and Indian Publication Output in Obesity Research, 2007-16

Publication Year	World			India			
	TP	TP	TC	CPP	%TP	ICP	%ICP
2007	14485	206	5707	27.70	1.42	32	15.53
2008	15399	194	5928	30.56	1.26	38	19.59
2009	16487	212	5898	27.82	1.29	38	17.92
2010	18308	319	6942	21.76	1.74	59	18.50
2011	19316	403	6238	15.48	2.09	72	17.87
2012	21477	528	5878	11.13	2.46	102	19.32
2013	23682	537	5052	9.41	2.27	102	18.99
2014	24431	566	4976	8.79	2.32	133	23.50
2015	24259	579	1686	2.91	2.39	121	20.90
2016	17817	416	1207	2.90	2.33	105	25.24
2007-11	83995	1334	30713	23.02	1.59	239	17.92
2012-16	111666	2626	18799	7.16	2.35	563	21.44
2007-16	195661	3960	49512	12.50	2.02	802	20.25

TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper

Table 2: Share of Leading Foreign Countries in India's Collaborative Research Output in Obesity Research during 2007-16

Collaborative Country	Number of Papers			Share of Papers		
	2007-11	2012-16	2007-16	2007-11	2012-16	2007-16
USA	126	351	477	52.72	62.34	59.48
U.K.	69	207	276	28.87	36.77	34.41
Canada	19	95	114	7.95	16.87	14.21
Australia	21	88	109	8.79	15.63	13.59
China	9	70	79	3.77	12.43	9.85
Japan	14	56	70	5.86	9.95	8.73
Brazil	10	46	56	4.18	8.17	6.98
Italy	12	43	55	5.02	7.64	6.86
France	18	35	53	7.53	6.22	6.61
Germany	13	40	53	5.44	7.10	6.61
Switzerland	14	35	49	5.86	6.22	6.11
South Africa	6	42	48	2.51	7.46	5.99
Denmark	13	35	48	5.44	6.22	5.99
Singapore	4	34	38	1.67	6.04	4.74
Taiwan	6	31	37	2.51	5.51	4.61
India	239	563	802	100.00	100.00	100.00

Table 3: Global Publication Share of Top 15 Most Productive Countries in Obesity Research during 2007-16

Name of the Country	Number of Papers			Share of Papers		
	2007-11	2012-16	2007-16	2007-11	2012-16	2007-16
USA	30949	64737	95686	36.85	57.97	48.90
U.K.	7293	14956	22249	8.68	13.39	11.37
Germany	4153	8600	12753	4.94	7.70	6.52
Italy	3865	8391	12256	4.60	7.51	6.26
Canada	3681	7837	11518	4.38	7.02	5.89
Australia	3724	7691	11415	4.43	6.89	5.83
France	3411	7412	10823	4.06	6.64	5.53
Spain	3370	6766	10136	4.01	6.06	5.18
Japan	2954	6463	9417	3.52	5.79	4.81
China	2035	6069	8104	2.42	5.43	4.14
Brazil	2244	4913	7157	2.67	4.40	3.66
Netherlands	2185	4691	6876	2.60	4.20	3.51
Sweden	1930	4267	6197	2.30	3.82	3.17
South Korea	1459	3585	5044	1.74	3.21	2.58
India	1334	2626	3960	1.59	2.35	2.02
Total	74587	159004	233591	88.80	142.39	119.39
World	83995	111666	195661	100.00	100.00	100.00
Share of 15 Countries in World Total	88.80	142.39	119.39			

in Denmark and 0.36% in Switzerland as against decrease by 1.31% in France from 2007-11 to 2012-16 (Table 2).

Top 10 Most Productive Countries in Obesity Research

The global research output in the field of obesity research had originated in more than 100 countries in the world during 2007-16. Top 15 most productive countries in obesity had contributed 23359 publications, which account for more than 100% of global publications during 2007-16. Each of top 15 countries accounted for 2.02% to 48.90% global publication share during 2007-16, with USA accounting for the highest publication share (48.90%), followed by U.K. (11.37%), Germany and Italy (6.52% and 6.26%), Canada, Australia, Spain and France (from 5.18% to 5.89%), Japan and China (4.14% and 4.81%), Brazil, Netherlands and Sweden (from 3.17% to 3.66%), South Korea and India (2.02% and 2.58%) during 2007-16. The global publication share in five years increased by 21.12% by USA, followed by U.K. and China (4.71% and 3.01%), Italy, Germany, Canada, France, Australia, Japan and Spain (from 2.05% to 2.91%), Brazil, Netherlands, Sweden and South Korea (1.47% to 1.73%) and India (0.76%) from 2007-11 to 2012-16 (Table 3).

Subject-Wise Distribution of Research Output

The Indian obesity research output published during 2007-16 is distributed across eight sub-fields (as identified in Scopus database classification), with medicine accounting for the highest publications share (89.22%), followed by biochemistry, genetics & molecular biology (34.24%), pharmacology, toxicology & pharmaceuticals (20.53%), nursing (8.33%), agricultural & biological sciences (5.96%), chemistry (2.02%), neurosciences (1.92%) and immunology and microbiology (1.67%) during 2007-16. The activity index, which computes change in research activity in a

discipline over time 2007-11 to 2012-16 (world average activity index of a given subject is taken as 100), witnessed increase in all subjects from 2007-11 to 2012-16. Nursing registered the highest citation impact per paper of 21.22, followed by agricultural & biological sciences (19.27), neurosciences (17.95), biochemistry, genetics & molecular biology (16.39), chemistry (16.30), medicine (12.54), immunology and microbiology (10.53) and pharmacology, toxicology & pharmaceuticals (8.80) during 2006-15 (Table 4).

Profile of Top 25 Most Productive Indian Organizations

The productivity of 25 most productive global organizations in Indian obesity research varied from 33 to 350 publications and together they contributed 43.64% (1728) publication share and 82.03% (40616) citation share to its cumulative publications output during 2007-16. The scientometric profile of these 25 organizations is presented in Table 5. Six of these organizations registered publications output greater than the group average of 69.12: All India Institute of Medical Sciences (AIIMS), New Delhi (350 papers), Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh (125 papers), Madras Diabetes Research Foundation (114 papers), National Institute of Nutrition, Hyderabad (104 papers), Fortis Healthcare (90 papers) and King Edward Memorial Hospital, Mumbai (84 papers) during 2007-16. Six organizations registered impact above the group average of 23.5 citations per publication during 2007-16: King Edward Memorial Hospital, Mumbai (67.42), Fortis Healthcare (57.09), Diabetes Research Center, Chennai (52.27), National Institute of Pharmaceutical Education & Research, Mohali (51.74), Madras Diabetes Research Foundation 114 (33.04) and All India Institute of Medical Sciences, New Delhi (27.31) during 2007-16. Eight organizations registered h-index above the group average

Table 4: Subject-Wise Breakup of Publications in Obesity Research in India during 2007-16

S.No	Subject*	Number of Papers (TP)			Activity Index		TC	CPP	%TP
		2007-11	2012-16	2007-16	2007-11	2012-16	2007-16	2007-16	2007-16
1	Medicine	1036	2497	3533	87.05	106.58	44312	12.54	89.22
2	Biochemistry, Genetics & Molecular Biology	370	986	1356	81.00	109.65	22222	16.39	34.24
3	Pharmacology, Toxicology & Pharmaceutics	227	586	813	82.88	108.69	7156	8.80	20.53
4	Nursing	107	223	330	96.25	101.90	7002	21.22	8.33
5	Agricultural & Biological Sciences	62	174	236	77.99	111.18	4547	19.27	5.96
6	Chemistry	24	56	80	89.06	105.56	1304	16.30	2.02
7	Neurosciences	16	60	76	62.50	119.05	1364	17.95	1.92
8	Immunology & microbiology	14	52	66	62.97	118.81	695	10.53	1.67
	Total Indian Output	1334	2626	3960	100.00	100.00			

- There is overlapping of literature covered under various subjects
TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper

Table 5: Scientometric Profile of Top 25 Most Productive Organizations in Obesity Research in India during 2007-16

S.No	Name of the Organization	TP	TC	CPP	HI	ICP	%ICP	RCI
1	All India Institute of Medical Sciences (AIIMS), New Delhi	350	9559	27.31	51	70	20.00	2.18
2	Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh	125	2349	18.79	21	22	17.60	1.50
3	Madras Diabetes Research Foundation	114	3767	33.04	30	42	36.84	2.64
4	National Institute of Nutrition, Hyderabad	104	2001	19.24	22	29	27.88	1.54
5	Fortis Healthcare	90	5138	57.09	28	32	35.56	4.57
6	King Edward Memorial Hospital, Mumbai	84	5663	67.42	32	40	47.62	5.39
7	Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS), Lucknow	68	722	10.62	15	6	8.82	0.85
8	Manipal University	65	202	3.11	8	11	16.92	0.25
9	CSM Medical University, Lucknow	65	583	8.97	11	7	10.77	0.72
10	Maulana Azad Medical College, Delhi	58	1301	22.43	12	15	25.86	1.79
11	Banaras Hindu University, Varanasi	57	292	5.12	10	9	15.79	0.41
12	University of Delhi	54	491	9.09	11	6	11.11	0.73
13	Jawaharlal Institute of Postgraduate Medical Education & Research (JIPMER), Pondicherry	53	632	11.92	11	4	7.55	0.95
14	Christian Medical College, Vellore	45	632	14.04	9	17	37.78	1.12
15	National Institute of Pharmaceutical Education & Research, Mohali	39	2018	51.74	19	3	7.69	4.14
16	University of Calcutta	38	368	9.68	11	2	5.26	0.77
17	Indian Statistical Institute, Kolkata	38	455	11.97	13	7	18.42	0.96
18	Kasturba Medical College, Mangalore	37	134	3.62	6	2	5.41	0.29
19	Visva Bharti University	37	568	15.35	11	2	5.41	1.23
20	Kasturba Medical College, Manipal	35	115	3.29	6	4	11.43	0.26
21	University College of Medical Sciences, Delhi	35	664	18.97	13	3	8.57	1.52
22	National Institute of Mental Health & Allied Sciences, Bangalore	35	277	7.91	9	6	17.14	0.63
23	Panjab University, Chandigarh	35	444	12.69	13	6	17.14	1.01
24	Sir Ganga Ram Hospital, New Delhi	34	516	15.18	9	4	11.76	1.21
25	Diabetes Research Center, Chennai	33	1725	52.27	18	10	30.30	4.18
	Total of 25 organizations	1728	40616	23.50	15.96	359	20.78	1.88
	Total of India	3960	49512	12.50				
	Share of top 25 organizations in India total output	43.64	82.03					

TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper; HI=h-index; ICP=International Collaborative Papers; RCI=Relative Citation Index

Table 6: Scientometric Profile of Top 20 Most Productive Authors in Obesity Research in India during 2007-16

S.No	Name of the Author	Affiliation of the Author	TP	TC	CPP	HI	ICP	%ICP	RCI
1	Anoop Misra	Diabetes Foundation, New Delhi	123	5709	46.41	40	34	27.64	3.71
2	V.Mohan	Madras Diabetes Research Foundation	99	3451	34.86	29	32	32.32	2.79
3	N.K.Vikram	AIIMS-New Delhi	58	2930	50.52	26	13	22.41	4.04
4	R.M.Pandey	AIIMS-New Delhi	54	2110	39.07	24	14	25.93	3.13
5	D.Prabhakaran	AIIMS-New Delhi	49	3661	74.71	20	37	75.51	5.98
6	C.S.Yajnik	King Edward Memorial Hospital, Mumbai	54	4476	82.89	26	33	61.11	6.63
7	R.Gupta	Monilok Hospital & Research Center, Jaipur	45	3624	80.53	22	14	31.11	6.44
8	A.Ramchandran	MV Hospital For Diabetes, Chennai	45	2561	56.91	45	18	40.00	4.55
9	A.Ghosh	University of Calcutta	41	424	10.34	13	2	4.88	0.83
10	K.S.Reddy	AIIMS-New Delhi	41	2717	66.27	21	30	73.17	5.30
11	N.Tandon	AIIMS-New Delhi	36	540	15.00	15	11	30.56	1.20
12	C.Snehalatha	MV Hospital For Diabetes, Chennai	34	1775	52.21	20	11	32.35	4.18
13	R.M.Anjana	Madras Diabetes Research Foundation	31	848	27.35	15	13	41.94	2.19
14	R.B.Singh	Heart Research Laboratory, Moradabad	30	830	27.67	18	23	76.67	2.21
15	R.Deepa	Madras Diabetes Research Foundation	28	1624	58.00	19	8	28.57	4.64
16	A.V.Kurpad	St John's Research Institute, Bangalore	27	780	28.89	16	26	96.30	2.31
17	G.V.Krishnaveni	Holdsworth Memorial Hospital, Mysore	16	518	32.38	7	16	100.00	2.59
18	S.V.Madhu	University College of Medical Science, Delhi	16	562	35.13	11	1	6.25	2.81
19	R.K.Marwaha	INMAS-Delhi	16	196	12.25	9	1	6.25	0.98
20	G.R.Chandok	CCMB-Hyderabad	15	577	38.47	11	12	80.00	3.08
		Total of 15 authors	858	39913	46.52	20.35	349	40.68	3.72
		Total of India	3960	49512	12.50				
		Share of top 15 authors in Indian total output	21.67	80.61					

TP=Total Papers; TC=Total Citations; CPP=Citations Per Paper; HI=h-index; ICP=International Collaborative Papers; RCI=Relative Citation Index

of 15.96: All India Institute of Medical Sciences, New Delhi (51), King Edward Memorial Hospital, Mumbai (32), Madras Diabetes Research Foundation (30), Fortis Healthcare (28), National Institute of Nutrition, Hyderabad (22), Postgraduate Institute of Medical Education & Research, Chandigarh (21), National Institute of Pharmaceutical Education & Research, Mohali (19) and Diabetes Research Center, Chennai (18) during 2007-16. Seven organizations contributed international collaborative publications share above the group average of 20.78%: King Edward Memorial Hospital, Mumbai (47.62%), Christian Medical College, Vellore (37.78%), Madras Diabetes Research Foundation (36.84%), Fortis Healthcare (35.56%), Diabetes Research Center, Chennai (30.3%), National Institute of Nutrition, Hyderabad (27.88%) and Maulana Azad Medical College, Delhi (25.86%) during 2007-16. Six organizations registered the relative citation index above the group average (1.88) of all organizations: King Edward Memorial Hospital, Mumbai (5.39), Fortis Healthcare (4.57), Diabetes Research Center, Chennai (4.18), National Institute of Pharmaceutical Education & Research, Mohali (4.14), Madras Diabetes Research Foundation (2.64) and All India Institute of Medical Sciences, New Delhi (2.18) during 2007-16.

Profile of Top 20 Most Productive Indian Authors

The research productivity of top 20 most productive authors in Indian obesity research varied from 15 to 123 publications. Together they contributed 21.67% (858) global publication share and 80.61% (39913) citation share during 2007-16. The scientometric profile of these 20 authors is

presented in Table 6. Eight authors registered publications output above the group average of 42.9: Anoop Misra (123 papers), V. Mohan (99 papers), N.K.Vikram (58 papers), R.M. Pandey and C.S.Yajnik (54 papers each) D. Prabhakaran (49 papers), R. Gupta and A. Ramchandran (45 papers each) during 2007-16. Eight authors registered impact above the group average of 46.52 citations per publication: C.S.Yajnik (82.89), R. Gupta (80.53), D. Prabhakaran (74.71), K.S. Reddy (66.27), R. Deepa (58.0), A. Ramchandran (56.91), C. Snehalatha (52.21) and N.K. Vikram (50.52) during 2007-16. Eight authors registered h-index above the group average of 20.35 of all authors: A. Ramchandran (45), Anoop Misra (40) V. Mohan (29), C.S. Yajnik and N.K. Vikram (26 each), R.M. Pandey (24), R. Gupta (22) K.S. Reddy (21) and D. Prabhakaran(20) during 2007-16. Eight authors contributed international collaborative publications share above the group average of 40.68% of all authors: G. V. Krishnaveni(Holdsworth Memorial Hospital, Mysore(100.0%),A.V.Kurpad(96.3%),G.R.Chandok (80.0%), R.B. Singh (76.67%), D. Prabhakaran (75.51%), K.S. Reddy (73.17%), C.S. Yajnik (61.11%) and R.M. Anjana (41.94%) during 2007-16. Eight authors registered the relative citation index above the group average (3.72) of all authors: C.S. Yajnik (6.63), R. Gupta (6.44), D. Prabhakaran (5.98), K.S. Reddy (5.30), R. Deepa (4.64), A. Ramchandran (4.55), C. Snehalatha (4.18) and N.K. Vikram (4.04) during 2007-16.

Medium of Communication

Of the total Indian output in obesity research, 98.71% (4503) appeared in journals. The top 15 most productive journals accounted for 42 to 113 papers each in obesity research and together accounted for 19.94%

Table 7: Top 15 Most Productive Journals in Obesity Research in India during 2007-16

Name of the Journal	Number of Papers		
	2007-11	2012-16	2007-16
Journal of Clinical & Diagnostic Research	12	101	113
Indian Journal of Medical Research	42	54	96
Indian Pediatrics	25	55	80
Research Journal of Pharmaceutical Biology & Chemical Sciences	16	60	76
International Journal of Pharma & BioSciences	15	54	69
PLOS One	7	51	58
Diabetes & Metabolic Syndrome. Clinical Research & Development	36	21	57
Obesity Surgery	7	50	57
Indian Journal of Public Health Research & Development	15	41	56
Indian Heart Journal	10	44	54
Journal of Association of Physicians of India	21	31	52
Indian Journal of Pediatrics	15	35	50
Diabetic Obesity & Metabolism	13	36	49
Journal of Indian Medical Association	20	23	43
Indian Journal of Physiology & Pharmacology	18	24	42
Total	254	656	910
India's Total	1326	3237	4563
Share of 15 journals in India's total	19.16	20.27	19.94

share (910 papers) of total journal publication output during 2007-16. The publication share of these top 15 most productive journals increased from 19.16% to 20.27% between 2007-11 and 2012-16. The top most productive journal (with 113 papers) was *Journal of Clinical & Diagnostic Research*, followed by *Indian Journal of Medical Research* (96 papers), *Indian Pediatrics* (80 papers), *Research Journal of Pharmaceutical Biology & Chemical Sciences* (76 papers), etc. during 2007-16 (Table 7).

Significant Keywords

Around 44 significant keywords have been identified from the literature, which point to possible trends in Indian obesity research. These keywords are listed in Table 8 in the decreasing order of the frequency of occurrence during 2007-16 (Table 8).

Highly Cited Papers

A total of 114 highly cited papers were identified which received citations from 100 to 1805 during 2007-16. These 114 papers together received 28158 citations, which averaged to 247.0 citations per paper. Of the 114 highly cited papers, 32 resulted from the participation of single organization (non-collaborative) and 82 involved the participation of two or more organizations (25 national collaborative and 57 international collaborative). Among international collaborative papers, the largest participation was from USA (35 papers), followed by U.K. (29 papers), Australia (17 papers), Canada (13 papers), Japan and Germany (12 papers each), Switzerland and France (11 papers each), Italy, China, South Africa and Denmark (8 papers each), Brazil and Taiwan (6 papers each), etc., The leading Indian organizations involved in high cited papers were: All India Institute of Medical Sciences, New Delhi (27 papers), King Edward Memorial Hospital (14 papers), Madras Diabetes Research Foundation (10 papers), Fortis Healthcare (9 papers), Public Health Foundation of India, New Delhi (7 papers), Diabetes Research Center, Madras (5 papers), National Institute of Pharmaceutical Education and Research, Mohali,

Diabetes Foundation, Delhi (4 papers), Postgraduate Institute of Medical Education & Research, Chandigarh, South Asia Network for Chronic Diseases, Delhi, Sunder Lal Jain Hospital, Delhi, Healix-Sekharia Institute of Public Health, Mumbai (3 papers), National Institute of Nutrition, Hyderabad, Maulana Azad Medical College, Delhi and CSM Medical University, Lucknow, Medical College, Jaipur, Agharkar Research Institute, Pune, Sitaram Bhartia Institute of Science & Research, Delhi (2 papers each), etc. Of the 114 highly cited papers, 72 were published as articles, 38 as review papers and 4 as conference paper. These 114 highly cited papers were published in 69 journals, of which 11 papers were published in *The Lancet*, followed by *International Journal of Obesity* and *Diabetes Research & Clinical Practice* (6 papers each), *Nutrition* (5 papers), *Diabetes Care* and *Diabetologia* (4 papers each), *New England Journal of Medicine* (3 papers), *Nature Genetics*, *The Lancet Oncology*, *World Psychiatry*, *Journal of Clinical Endocrinology & Metabolism*, *Diabetes*, *Indian Journal of Medical Research*, *Journal of Association of Physicians of India*, *PLOS One*, *Journal of Gastroenterology & Hepatology (Australia)*, *Diabetic Medicine*, *PLOS Medicine* and *Proceedings of the Nutrition Society* (2 papers each), and 1 paper each by 50 other journals.

SUMMARY AND CONCLUSION

India published 3960 publications in obesity research in 10 years during 2007-16, as reflected in Scopus database. Its annual publications increased from 206 in the year 2007 to 416 publications in the year 2016, experiencing 10.28% growth per annum. India was ranked at 15th position in global obesity output and its global share was just 2.02%, which increased from 1.59% during 2007-11 to 2.35% during 2012-16. India's obesity research registered an average citation impact per publication of 12.50 citations per publication (CPP) during 2007-16, which decreased from 23.02 to 7.16 from 2007-11 to 2012-16. The share of India's internationally collaborative papers (ICP) in its obesity research output was 20.25% during 2007-16, which increased from 17.92% to 21.44% from

Table 8: List of Significant Keywords in Literature on Obesity Research in India during 2007-16

S.No	Keyword	Frequency	S.No	Keyword	Frequency
1	Obesity	3964	23	Smoking	348
2	Body Mass	1485	24	Weight Reduction	340
3	Hypertension	956	25	Triacylglycerol Blood Level	321
4	Diabetes Mellitus	931	26	Metabolism	315
5	Body Mass Index	792	27	Diet	292
6	Non-Insulin Dependent Diabetes Mellitus	782	28	Waist Hip Ratio	290
7	Insulin Resistance	711	29	Blood Pressure	287
8	Glucose	692	30	Low Density Lipoprotein Cholesterol	279
9	Glucose Blood Level	686	31	Diastolic Blood Pressure	217
10	Body Weight	627	32	Inflammation	217
11	Triacylglycerol	599	33	Blood	210
12	Disease Association	576	34	Abdominal Obesity	209
13	Insulin	564	35	Insulin Blood Level	207
14	Metabolic Syndrome	539	36	Coronary Artery Disease	205
15	Waist Circumference	453	37	Body Fat	201
16	Cardiovascular Disease	439	38	Hyperglycemia	198
17	Cholesterol Blood Level	409	39	Metformin	196
18	Cholesterol	404	40	Lipid Diet	176
19	Diabetes Mellitus Type 2	398	41	Body Composition	176
20	Cardiovascular Risk	389	42	Alcohol Consumption	170
21	High Density Lipoprotein Cholesterol	378	43	Hyperlipidemia	155
22	Dyslipidemia	369	44	Pregnancy	155

2007-11 to 2012-16. USA topped the list with 59.48% share in India's international collaborative papers, followed by U.K. (34.41%), Canada (14.21%), Australia (13.59%), China (9.85%), Japan (8.73%), Brazil (6.98%), etc.

Medicine accounted for highest publications share (89.22%) among various subjects contributing to India obesity research, followed by biochemistry, genetics & molecular biology (34.24%), pharmacology, toxicology & pharmaceuticals (20.53%), nursing (8.33%), agricultural & biological sciences (5.96%), chemistry (2.02%), neurosciences (1.92%) and immunology and microbiology (1.67%) during 2007-16. The top 25 and 20 most productive Indian organizations and authors together contributed 43.64% and 21.67% respectively as their share of Indian publication output and 82.03% and 80.61% respectively as their share of Indian citation output during 2007-16. Among the total journal output of 4503 papers, the top 15 journals contributed 19.94% share to the Indian journal output during 2007-16, which increased from 19.16% to 20.27% from 2007-11 to 2012-16.

Of the total Indian output in Indian obesity research, 114 papers are considered as highly cited papers, as they have received 100 to 1805 during 2007-16. These 114 papers together received 28158 citations, which averaged to 247.0 citations per paper. Of the 114 highly cited papers, 32 resulted from the participation of single organization (non-collaborative) and 82 involved the participation of two or more organizations (25 national collaborative and 57 international collaborative). Among international collaborative papers, the largest participation was from USA (35 papers), followed by U.K. (29 papers), Australia (17 papers), Canada (13 papers), Japan and Germany (12 papers each), etc. The leading Indian organizations involved in high cited papers were: All India Institute of Medical Sciences, New Delhi (27 papers), King Edward Memorial Hospital (14 papers),

Madras Diabetes Research Foundation (10 papers), Fortis Healthcare (9 papers), Public Health Foundation of India, New Delhi (7 papers), etc. These 114 highly cited papers were published in 69 journals, of which 11 papers were published in *The Lancet*, followed by *International Journal of Obesity* and *Diabetes Research & Clinical Practice* (6 papers each), *Nutrition* (5 papers), *Diabetes Care* and *Diabetologia* (4 papers each), *New England Journal of Medicine* (3 papers), etc.

Concludes that obesity significantly increases mortality and morbidity in both developed and developing country (including India), with substantial economic impact to the family and the country. In order to tackle this complex problem, education and awareness is the key. Indian Government and nongovernment organizations should develop an integrated, multi-sectoral, population-based approach, which includes environmental support for healthy diets and regular physical activity. Key elements include: (i) Creating supportive population-based environments through public policies that promote the availability and accessibility of a variety of low-fat, high-fibre foods, and that provide opportunities for physical activity; (ii) Promoting healthy behaviours to encourage, motivate and enable individuals to lose weight by: eating more fruit and vegetables, as well as nuts and whole grains; engaging in daily moderate physical activity for at least 30 minutes; - cutting the amount of fatty, sugary foods in the diet; moving from saturated animal-based fats to unsaturated vegetable-oil based fats, (iii) Mounting a clinical response to the existing burden of obesity and associated conditions through clinical programmes and staff training to ensure effective support for those affected to lose weight or avoid further weight gain

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