

Thyroid Research in India: A Scientometric Assessment of Publications Output during 2007-16

B.M.Gupta¹, K K Mueen Ahmed² and Ritu Gupta³

ABSTRACT

The paper examines 2483 global publications on thyroid research in India, as covered in Scopus database during 2007-16, experiencing an annual average growth rate of 10.76% and qualitative citation impact averaged to 4.75 citations per paper. India's share of internationally collaborative papers (ICP) was 8.82% during 2007-16, which increased from 8.19% to 9.21% from 2007-11 to 2012-16. The top 10 most productive countries individually contributed global share from 3.67% to 25.88%, with largest global publication share coming from USA (25.88%), followed by Italy (8.15%), etc. Together, the 10 most productive countries accounted for 73.75% share of global publication output during 2007-16. Medicine accounts for the largest share (77.57%) in Indian thyroid research, followed by biochemistry, genetics & molecular biology (23.60%), pharmacology, toxicology & pharmaceuticals (8.46%), agricultural & biological sciences (3.34%) and neurosciences (2.54%) during 2007-16. The top 15 most productive research organizations and the authors collectively contributed 31.70% and 11.24% respectively as their global publication share and 34.72% and 17.58% respectively as their global citation share during 2007-16. The journals accounted 23.23% share of total journal publication output during 2007-16, increasing from 19.62% to 25.66% between 2007-11 and 2012-16. Of the total thyroid research output from India, the top 13 highly cited publications registered citations from 83 to 422 and they together received 2023 citations, with 155.61 citations per paper. These 13 highly cited papers were published in 11 journals, of which 2 papers were published in American Journal of Transplantation and 1 paper each in 10 other journals.

Key words: Thyroid research, Indian publications, Scientometrics, Bibliometrics.

INTRODUCTION

Thyroid disorders are conditions that affect the thyroid gland, a butterfly-shaped gland in the front of the neck. The thyroid has important roles to regulate numerous metabolic processes throughout the body. Different types of thyroid disorders affect either its structure or function. The thyroid gland is located below the Adam's apple wrapped around the trachea (windpipe). A thin area of tissue in the gland's middle, known as the isthmus, joins the two thyroid lobes on each side. The thyroid uses iodine to produce vital hormones. Thyroxine, also known as T₄, is the primary hormone produced by the gland. After delivery via the bloodstream to the body's tissues, a small portion of the T₄ released from the gland is converted to triiodothyronine (T₃), which is the most active hormone. The function of the thyroid gland is regulated by a feedback mechanism involving the brain. When thyroid hormone levels are low, the hypothalamus in the brain produces a hormone known as thyrotropin releasing hormone (TRH) that causes the pituitary gland (located at the base of the brain) to release thyroid stimulating hormone (TSH). TSH stimulates the thyroid gland to release more T₄. Since the thyroid gland is controlled by the pituitary gland and hypo-

thalamus, disorders of these tissues can also affect thyroid function and cause thyroid problems.¹

Thyroid diseases are among the commonest endocrine disorders worldwide. In India it has been estimated that about 42 million people suffer from thyroid disorders, majorly because the entire population, and not just the Himalayan belt, is prone to iodine deficiency disorders (IDD) due to deficiency of iodine in the soil of the subcontinent. The overall prevalence of IDD is above 10% in India. IDD in pregnancy can lead to spontaneous abortions and stillbirths. It can have profound effects on the growing fetus and lead to congenital goiter and cretinism in the newborn. However, the effects can be observed during childhood when it can affect the growth and development of children, as also during adulthood when it can affect the productivity. Hypothyroidism and Autoimmune thyroiditis are common disorders in India, and over the years its incidences seem to be on the rise.² Thyroid diseases are different from other diseases in terms of their ease of diagnosis, accessibility of medical treatment, and the relative visibility that even a small swelling of the thyroid offers to the

B.M.Gupta¹, K K Mueen Ahmed² and Ritu Gupta³

¹1173 Sector 15, Panchkula 134 113, Haryana, INDIA.

²Phcog.Net and SciBioMed.Org, Bengaluru, Karnataka, INDIA.

³1K/A Arjun Nagar, Safdarjang Enclave, New Delhi 110029, INDIA.

Correspondence

Ritu Gupta

1K/A Arjun Nagar, Safdarjang Enclave, New Delhi 110029, INDIA.

Mobile no: 9711563995

Email: ritu7648@gmail.com

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treating physician. Early diagnosis and treatment remains the cornerstone of management.³

Literature Review

Only one study is available by Bhutani, Verma and Kalra [4], which quantitatively analyze 210 publications (appearing in 23 main issues and 1 special issue) of the journal entitled "Thyroid Research & Practice" during 2006-13. The articles covered in this journal are classified by type of articles, authorship pattern and by sub-specialties, origin of authors from India and abroad and contribution by academic and non-academic institutions.

OBJECTIVES

The main objectives of this study are to study the performance of Indian thyroid 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 research output, contribution of top 10 most productive countries, Indian research output and its citation impact; (ii) To study the share of international collaboration papers in India's overall research output and contribution of important international collaborative partner countries; (iii) To study the Indian research output by broad subject areas, by sub-fields and the trends of research by identifying important keywords; (iv) To study the publication productivity and citation impact of top 15 most productive organizations and authors; (vi) To study the modes of communication in research and identification of core journals and (vii) to study the characteristics of top 13 highly cited papers.

METHODOLOGY

The study retrieved and downloaded 10-year publication data of the world output in thyroid research from the Scopus database (<http://www.scopus.com>) covering the period 2007-16. Keywords, such as "thyroid" was incorporated in the search string and qualified these keyword with "keyword tag", "Article Title tag" and "Source Title tag", and in addition incorporated in this search string the period '2007-16' within "date range tag". Finally this search string was applied for searching global publication data on thyroid research. The search string was subsequently refined by "subject area tag", "country tag", "source title tag", "journal title name" and "affiliation tag", to get data/information on the distribution of publications output by subject, collaborating countries, author-wise, organization-wise and journal-wise, etc. For citation data, citations to publications were also collected from date of publication till 6 February 2017.

(KEY(thyroid) OR TITLE(thyroid) OR SRCTITLE(thyroid)) AND PUBYEAR > 2006 AND PUBYEAR < 2017

(KEY(thyroid) OR TITLE(thyroid)OR SRCTITLE(thyroid)) AND PUBYEAR > 2006 AND PUBYEAR < 2017 AND (LIMIT-TO (AFFILCOUNTRY,"India"))

ANALYSIS

The total global and Indian research output in field of thyroid research cumulated to 64992 and 2483 publications in 10 years during 2007-16. The annual output of the world and India in thyroid research research increased from 5489 and 140 in the year 2007 to 5560 and 323 publications in the year 2016, registering 0.67% and 10.96% growth per annum. The cumulative world and Indian output in thyroid research in 5 years 2007-11 increased from 30010 and 952 to 34982 and 1531 publications during succeeding 5-year period 2012-16, registering 16.17% and 60.82% quinquennial growth. India's share in global output on thyroid research was 8.82%, which increased from 8.19% to 9.21% from 2007-11

to 2012-16. Of the total global publications output in thyroid research, 76.72% (1905) was published as articles, 9.63% (239) as letters, 8.26% (205) as reviews, 1.77% (44) as conference papers, 1.25% (31) as notes, 1.055(26) as editorials and the rest as book chapters, articles in press and short surveys. The citation impact of Indian publications on thyroid research averaged to 4.75 citations per publication (CPP) during 2007-16; five-yearly impact averaged to 8.93 CPP for the period 2007-11 which declined to 2.15 CPP in the succeeding five-year 2012-16 (Table 1).

International Collaboration

India's share of internationally collaborative papers (ICP) was 8.82% during 2007-16, which increased from 8.19% to 9.21% from 2007-11 to 2012-16. Among the leading countries contributing to internationally collaborative papers, USA topped the list with 49.32% share, followed by Italy and U.K. (10.50% share each), Germany (7.76% share), France, Japan and Netherlands (6.85% share each), Australia (6.39% share), China (5.94% share) and Saudi Arabia (5.02% share) during 2007-16. The international collaborative publications share increased by 14.87% by USA, 3.82% by Saudi Arabia, 32.37% by Italy, 2.10% by Germany and 0.68% by Netherlands, as against decrease by 7.58% in U.K., 6.00% by Australia, 5.29% by France, 2.73% by China and 1.31% by Japan from 2007-11 to 2012-16 (Table 1-2).

Top 10 Most Productive Countries in Thyroid Research

The global research output in the field of thyroid research had originated from as many as 152 countries in the world during 2007-16. Top 10 most productive countries in thyroid research had contributed 2383 to 16823 publications each during 2007-16 (Table 3). Of the 152 countries, 102 contributed 1-10 papers each, 47 countries 11-50 papers each, 28 countries 51-100 papers each and 1 country 159 papers each. Top 10 most productive countries in thyroid research accounted for 73.75% global publication share during 2007-16. Their five-yearly output accounted for 71.88% global publication share during 2007-11 which increased to 75.36% during succeeding 5-year period 2012-16. Each of top 10 countries accounted for 3.67% to 25.88% global publication share during 2007-16, with USA accounting for the highest publication share (25.88%), followed by Italy (8.15%), China (7.70%), U.K., Germany and Japan (from 5.41% to 5.54%), South Korea (4.29%), France, Turkey and India (from 3.67% to 3.82%) during 2007-16. The global publication

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

Year	World		India				
	TP	TP	TC	CPP	%TP	ICP	%ICP
2007	5489	140	1216	8.69	2.55	8	5.71
2008	5615	138	1886	13.67	2.46	9	6.52
2009	5869	175	1473	8.42	2.98	15	8.57
2010	6324	221	1989	9.00	3.49	21	9.50
2011	6713	278	1940	6.98	4.14	25	8.99
2012	6971	264	1225	4.64	3.79	32	12.12
2013	7355	261	849	3.25	3.55	33	12.64
2014	7680	358	737	2.06	4.66	37	10.34
2015	7416	325	423	1.30	4.38	25	7.69
2016	5560	323	51	0.16	5.81	14	4.33
2007-11	30010	952	8504	8.93	3.17	78	8.19
2012-16	34982	1531	3285	2.15	4.38	141	9.21
2007-16	64992	2483	11789	4.75	3.82	219	8.82

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

share in five years increased by 5.67% by China, followed by 2.38% by South Korea, 0.92% by India and 0.40% by Turkey as against decrease by 2.28% by USA, 1.12% by U.K., 1.0% by Germany, 0.79% by France, 0.62% by Japan and 0.06% by Italy from 2007-11 to 2012-16.

Subject-Wise Distribution of Research Output

The Indian thyroid research output published during 2007-16 is distributed across five sub-fields (as identified in Scopus database classification), with medicine accounting for the highest publications share (77.57%), followed by biochemistry, genetics & molecular biology (23.60%), pharmacology, toxicology & pharmaceuticals (8.46%), agricultural & biological sciences (3.34%) and neurosciences (2.54%) 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 biochemistry, genetics & molecular biology (from 89.46 to 106.55%) and pharmacology, toxicology & pharmaceuticals (from 88.18 to 107.35), as against decline of research activity in medicine (from 101.70 to 98.94), agricultural & biological sciences (from 135.12 to 78.16) and neurosciences (from 124.20 to 84.95)

from 2007-11 to 2012-16. Agricultural & biological sciences registered the highest citation impact per paper of 7.22, followed by neurosciences (6.24), biochemistry, genetics & molecular biology (6.12), pharmacology, toxicology & pharmaceuticals (5.85) and medicine (4.65) during 2006-15 (Table 4).

Sub-Field Wise Classification of Thyroid Research

In terms of sub-specialties, clinical thyroidology received the largest share (65.85%) of papers, followed by thyroid Interface with non-endocrine systems (23.28%), investigational thyroidology (11.50%) and thyroid interface with endocrine systems (5.80%) during 2007-16. Within clinical thyroidology, the major share (32.46%) was contributed by oncology thyroidology, followed by medical thyroidology (19.73%), surgical thyroidology (10.78%), etc [Table 5].

Profile of Top 15 Most Productive Global Organizations

The productivity of 15 most productive global organizations in Indian thyroid research varied from 24 to 159 publications and together they

Table 2: Share of Leading Foreign Countries in India's Collaborative Research Output in Thyroid 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	31	77	108	39.74	54.61	49.32
Italy	7	16	23	8.97	11.35	10.50
U.K.	12	11	23	15.38	7.80	10.50
Germany	5	12	17	6.41	8.51	7.76
France	8	7	15	10.26	4.96	6.85
Japan	6	9	15	7.69	6.38	6.85
Netherlands	5	10	15	6.41	7.09	6.85
Australia	8	6	14	10.26	4.26	6.39
China	6	7	13	7.69	4.96	5.94
Saudi Arabia	2	9	11	2.56	6.38	5.02
Indian Total	78	141	219	100.00	100.00	100.00

Table 3: Global Publication Share of Top 10 Most Productive Countries in Thyroid 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	8137	8686	16823	27.11	24.83	25.88
Italy	2457	2843	5300	8.19	8.13	8.15
China	1393	3609	5002	4.64	10.32	7.70
U.K.	1842	1756	3598	6.14	5.02	5.54
Germany	1810	1759	3569	6.03	5.03	5.49
Japan	1725	1793	3518	5.75	5.13	5.41
South Korea	903	1884	2787	3.01	5.39	4.29
France	1274	1207	2481	4.25	3.45	3.82
Turkey	1077	1394	2471	3.59	3.98	3.80
India	952	1431	2383	3.17	4.09	3.67
Total	21570	26362	47932	71.88	75.36	73.75
World	30010	34982	64992	100.00	100.00	100.00
Share of 10 Countries in World Total	71.88	75.36	73.75			

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

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
Medicine	751	1175	1926	101.70	98.94	8955	4.65	77.57
Biochemistry, Genetics & Molecular Biology	201	385	586	89.46	106.55	3584	6.12	23.60
Pharmacology, Toxicology & Pharmaceutics	71	139	210	88.18	107.35	1229	5.85	8.46
Agricultural & Biological Sciences	43	40	83	135.12	78.16	599	7.22	3.34
Neurosciences	30	33	63	124.20	84.95	393	6.24	2.54
Total Indian Output	952	1531	2483	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: Sub-Speciality Distribution of Papers in Indian Thyroid Research during 2007-16

Sub-Speciality	Number of Papers			Share of Papers			TC	CPP
	2007-11	2012-16	2007-16	2007-11	2012-16	2007-16		
Clinical Thyroidology	643	992	1635	67.54	64.79	65.85	8568	5.24
Medical Thyroidology	106	302	408	11.13	19.73	16.43	1554	3.81
Pediatric Thyroidology	22	49	71	2.31	3.20	2.86	316	4.45
Obstetric Thyroidology	6	19	25	0.63	1.24	1.01	161	6.44
Surgical Thyroidology	101	165	266	10.61	10.78	10.71	863	3.24
Autoimmunity Thyroidology	15	27	42	1.58	1.76	1.69	358	8.52
Oncology Thyroidology	331	497	828	34.77	32.46	33.35	4242	5.12
Investigational Thyroidology	75	176	251	7.88	11.50	10.11	994	3.96
Biochemistry/Essay	24	47	71	2.52	3.07	2.86	284	4.00
Pathology	48	119	167	5.04	7.77	6.73	673	4.03
Nuclear Medicine	2	5	7	0.21	0.33	0.28	33	4.71
Radiology	1	5	6	0.11	0.33	0.24	4	0.67
Thyroid Interface with Endocrine Systems	56	88	144	5.88	5.75	5.80	1297	9.01
Vitamin D and Musculoskeletal	11	21	32	1.16	1.37	1.29	201	6.28
Obesity/Metabolic Syndrome/Cardiovascular Systems	7	15	22	0.74	0.98	0.89	321	14.59
Pancreas	21	33	54	2.21	2.16	2.17	619	11.46
Pituitary	17	19	36	1.79	1.24	1.45	156	4.33
Thyroid Interface with Non-Endocrine Systems	260	318	578	27.31	20.77	23.28	3746	6.48
Nervous System	17	21	38	1.79	1.37	1.53	533	14.03
Eye	14	23	37	1.47	1.50	1.49	164	4.43
Skin	47	67	114	4.94	4.38	4.59	696	6.11
Hematology	2	4	6	0.21	0.26	0.24	1	0.17
Liver	94	103	197	9.87	6.73	7.93	1873	9.51
Dental	1	3	4	0.11	0.20	0.16	229	57.25
Kidney	85	97	182	8.93	6.34	7.33	250	1.37
Total of India	952	1531	2483	100.00	100.00	100.00		

contributed 31.70% (787) publication share and 34.72% (4093) citation share to its cumulative publications output during 2007-16. The scientometric profile of these 20 organizations is presented in Table 6. Four of these organizations registered publications output greater than the group average of 52.47: AIIMS - New Delhi (159 papers), PGIMER-Chandigarh and TMH-Mumbai (94 papers each) and SGPGIMS-Lucknow (92 papers) during 2007-16. Four organizations registered impact above the group average of 5.20 citations per publication during 2007-16: INMAS-Delhi (11.26), AIIMS-New Delhi (7.70), BARC-Mumbai (6.71) and SGPGIMS-Lucknow (5.82) during 2007-16. Six organizations registered h-index above the group average of 7.93: AIIMS-New Delhi (16), INMAS-Delhi and SGPGIMS-Lucknow (13 each), TMH-Mumbai (11), PGIMER-Chandigarh (8) and JIPMER- Pondicherry (8) during 2007-16. Seven organizations contributed international collaborative publications share above the group average of 5.59%: University of Calcutta, Kolkata and MAMC-Delhi (14.29% each), KMC-Manipal (11.54%), TMH-Mumbai (8.51%), SIKIMS-Srinagar (7.69%), BARC-Mumbai (6.45%) and AIIMS-New Delhi (5.66%) during 2007-16. Four organizations registered the relative citation index above the group average (1.09) of all organizations: INMAS-Delhi (2.37), AIIMS-New Delhi (1.62), BARC-Mumbai (1.41) and SGPGIMS- Lucknow (1.22) during 2007-16.

Profile of Top 15 Most Productive Authors

The research productivity of top 15 most productive authors in Indian thyroid research varied from 12 to 34 publications. Together they contributed 11.24% (279) Indian publication share and 17.58% (2072) cita-

tion share during 2007-16. The scientometric profile of these 15 authors is presented in Table 7. Four authors registered publications output above the group average of 18.60: S. Basu (34 papers), A. Agarwal (27 papers), C. Bal (31 papers) and R.K. Marwaha (19 papers) during 2007-16. Six authors registered impact above the group average of 7.43 citations per publication: A.Kar (24.41), R.K.Marwaha (16.26), G. Mughesh (12.29), N. Tandon (11.94), G.Agarwal (11.38) ANDA.Bhansali (8.58) during 2007-16. Six authors registered h-index above the group average of 6.27 of all authors: A.Kar (11), R.K.Marwaha (10), N.Tandon and C.Bal (8 each), G.Mughesh and G.Agarwal (7 each) during 2007-16. Four authors contributed international collaborative publications share above the group average of 6.09% of all authors: S.Basu (20.59%), C.Bal (12.90%), G.Mughesh (11.76%) and B.R.Mittal (6.67%) during 2007-16. Six authors registered the relative citation index above the group average (1.56) of all authors: A.Kar (5.14), R.K.Marwaha (3.42), G.Mughesh (2.59), N.Tandon and G.Agarwal (2.39 each) and A.Bhansali (1.81) during 2007-16.

Medium of Communication

Of the total Indian output in thyroid research, 98.35% (2343) appeared in journals. The top 15 most productive journals accounted for 22 to 95 papers each in thyroid research and together accounted for 23.23% share (544 papers) of total journal publication output during 2007-16. The publication share of these top 15 most productive journals increased from 19.62% to 25.66% between 2007-11 and 2012-16. The top most productive journal (with 95 papers) was *Journal of Clinical & Diagnostic Research*, followed by *Indian Journal of Nuclear Medicine* (51 papers),

Table 6: Scientometric Profile of Top 15 Most Productive Organizations in Thyroid Research in India during 2007-16

Name of the Organization	TP	TC	CPP	HI	ICP	%ICP	RCI
All India Institute of Medical Sciences (AIIMS), New Delhi	159	1225	7.70	16	9	5.66	1.62
Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh	94	367	3.90	10	2	2.13	0.82
Tata Memorial Hospital (TMH), Mumbai	94	369	3.93	11	8	8.51	0.83
Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS), Lucknow	92	535	5.82	13	5	5.43	1.22
Christian Medical College (CMC), Vellore	45	84	1.87	5	2	4.44	0.39
Institute of Nuclear Medicine & Allied Sciences (INMAS), Delhi	43	484	11.26	13	1	2.33	2.37
Jawaharlal Institute of Postgraduate Medical Education & Research (JIPMER), Pondicherry	39	192	4.92	8	0	0.00	1.04
PBDS Postgraduate Institute of Medical Sciences (PBDS PGIMS), Rohtak	33	128	3.88	6	1	3.03	0.82
Bhabha Atomic Research Center (BARC), Mumbai	31	208	6.71	7	2	6.45	1.41
Maulana Azad Medical College (MAMC), Delhi	28	53	1.89	4	4	14.29	0.40
University of Calcutta, Kolkata	28	94	3.36	6	4	14.29	0.71
Sher-I-Kashmir Institute of Medical Sciences (SIKIMS), Srinagar	26	129	4.96	6	2	7.69	1.04
Kasturba Medical College (KMC), Manipal	26	38	1.46	3	3	11.54	0.31
Lady Harding Medical College (LHMC), New Delhi	25	114	4.56	6	0	0.00	0.96
Medical College & Hospital (MCH), Kolkata	24	73	3.04	5	1	4.17	0.64
Total of 15 organizations	787	4093	5.20	7.93	44	5.59	1.09
Total of India	2483	11789	4.75				
Share of top 15 organizations in India total output	31.70	34.72					

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

Table 7: Scientometric Profile of Top 15 Most Productive Authors in Thyroid Research in India during 2007-16

Name of the Author	Affiliation of the Author	TP	TC	CPP	HI	ICP	%ICP	RCI
S.Basu	TMH-Mumbai	34	96	2.82	6	7	20.59	0.59
A.Agarwal	SGPIMS-Lucknow	27	76	2.81	6	1	3.70	0.59
C.Bal	AIIMS-New Delhi	31	169	5.45	8	4	12.90	1.15
R.K.Marwaha	INMAS-Delhi	19	309	16.26	10	0	0.00	3.42
A.Mishra	SGPIMS-Lucknow	18	71	3.94	6	1	5.56	0.83
N.Tandon	AIIMS-New Delhi	18	215	11.94	8	0	0.00	2.51
A.Kar	Devi Ahila University, Indore	17	415	24.41	11	1	5.88	5.14
G.Mugesh	IISc-Bangalore	17	209	12.29	7	2	11.76	2.59
G.Agarwal	SGPIMS-Lucknow	16	182	11.38	7	0	0.00	2.39
B.R.Mittal	PGIMER-Chandigarh	15	44	2.93	4	1	6.67	0.62
P.V.Pradeep	SGPIMS-Lucknow	15	56	3.73	4	0	0.00	0.79
A.Bhattacharya	PGIMER-Chandigarh	14	27	1.93	4	0	0.00	0.41
S.K.Mishra	SGPIMS-Lucknow	14	84	6.00	6	0	0.00	1.26
A.Abhyankar	TMH-Mumbai	12	16	1.33	2	0	0.00	0.28
A.Bhansali	PGIMER-Chandigarh	12	103	8.58	5	0	0.00	1.81
Total of 15 authors		279	2072	7.43	6.27	17	6.09	1.56
Total of India		2483	11789	4.75				
Share of top 15 authors in Indian total output		11.24	17.58					

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

Table 8: Top 15 Most Productive Journals in Thyroid 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	83	95
Indian Journal of Nuclear Medicine	17	34	51
BMJ Case Reports	2	42	44
Indian Journal of Pathology & Microbiology	25	15	40
Indian Journal of Endocrinology & Metabolism	0	36	36
Journal of Association of Physicians of India	22	11	33
Journal of Cytology	13	20	33
Journal of Cancer Research & Therapy	10	22	32
International Journal of Pharma & Bio Sciences	3	27	30
Clinical Nuclear Medicine	15	13	28
Indian Journal of Cancer	13	14	27
Indian Journal of Surgical Oncology	17	10	27
World Journal of Surgery	13	11	24
Indian Journal of Dermatology	12	10	22
Indian Journal of Pediatrics	11	11	22
Total of 15 journals	185	359	544
Total India journal output	943	1399	2342
Share of top 15 journals in Indian journal output	19.62	25.66	23.23

Table 9: List of Significant Keywords in Literature on Thyroid Research in India during 2007-16

Keyword	Frequency	S.No	Keyword	Frequency
Thyroxine	477	23	Thyroid Papillary Carcinoma	122
Thyrotropin	436	24	Immunochemistry	115
Hypothyroidism	429	25	Thyroid Tumor	113
Thyroid Hormone	356	26	Blood	109
Thyroid Gland	339	27	Metabolism	108
Liothyronine	336	28	Levothyroxine	105
Thyroidectomy	312	29	Aspiration Cytology	87
Thyroid Function Test	301	30	Pregnancy	87
Thyroid Disease	297	31	Protein Expression	87
Thyroid Neoplasm	264	32	Thorax Radiography	86
Echography	217	33	Thyroglobulin	85
Throtopin Blood Level	210	34	Thyroid Medullary Carcinoma	82
Thyroid	190	35	Lymph Node Metastasis	80
Throxine Blood	176	36	Breast Cancer	79
Thyroid Cancer	173	37	Thyroid Scintiscanning	77
Hyperthyroidism	172	38	Hypertension	73
Goiter	168	39	Thyrotoxicosis	72
Thyroid Carcinoma	161	40	Thyroid Follicular Carcinoma	71
Pathology	156	41	Diabetes Mellitus	69
NML Resonance Imaging	140	42	Pathophysiology	69
Thyroid Nodule	135	43	Hydrocortisone	67
Iodine131	126			

BMJ Case Reports (44 papers), Indian Journal of Pathology & Microbiology (40 papers), etc. during 2007-16 (Table 8).

Significant Keywords

Around 43 significant keywords have been identified from the literature, which point to possible trends in mobile cloud computing research. These keywords are listed in Table 9 in the decreasing order of the frequency of occurrence during 2007-16.

Highly Cited Papers

A total of 13 highly cited papers were identified which received citations from 83 to 422 (5 papers in citation range 83-97, 5 papers in citation range 108-139 and 3 papers in citation range 218-422) during 2007-16. These 13 papers together received 2023 citations, which averaged to 155.61 citations per paper. Of the 13 highly cited papers, 2 resulted from the participation of single organization (non-collaborative) and 11 involved the participation of two or more organizations (2 national collaborative and 9 international collaborative). Among international collaborative papers, the largest participation was from USA (6 papers), followed by France, Argentina and Netherlands (3 papers each), U.K., Belgium, Mexico, Switzerland, Germany, Japan, China and Australia (2 papers each) and 1 paper each by 22 countries. There were 17 Indian organizations involved in these high cited papers. Of the 13 highly cited papers, 8 were published as articles, 3 as review papers and 2 as conference paper. These 13 highly cited papers were published in 11 journals, of which 2 papers were published in *American Journal of Transplantation* and 1 paper each in 10 other journals, namely *Archives of Medical Science*, *BJOG: An International Journal of Obstetrics & Gynaecology*, *Fitoterapia*, *International Journal of Epidemiology*, *Journal of Allergy &*

Clinical Immunology, *Journal of Gastroenterology & Hepatology*, *The Lancet*, *Pharmacognosy Review*, *Silence*, *World Journal of Surgery* and *World Psychiatry*.

CONCLUSION

Using the Scopus database, this study provides a quantitative and qualitative description of the development of the research involving thyroid research over a period of 10 years. From 2007 to 2016 the scientific literature related to thyroid research registered a high growth of 10.76% per annum. However, qualitative performance of thyroid research measured in terms of citation impact is not as stunning. Compared to quantitative performance it averaged to mere 4.75 citations per paper in 10 years period. India's share in global output on thyroid research was 8.82%, which increased from 8.19% to 9.21% from 2007-11 to 2012-16. USA is the top most productive country in the world in thyroid research. The other Asian countries joining the top 10 most productive countries in 2007-16: China (ranked 3rd), Japan (6th), South Korea (7th) and India (10th). From the western world and North America, the USA ranked 1st, Italy (2nd rank), U.K. (4th rank), Germany (5th rank), France (8th rank) and Turkey (9th rank).

Medicine among subjects accounted for highest publication share of 77.57%, followed by biochemistry, genetics & molecular biology (23.60%), pharmacology, toxicology & pharmaceuticals (8.46%), agricultural & biological sciences (3.34%) and neurosciences (2.54%) during 2007-16. The research activity witnessed increase in by biochemistry, genetics & molecular biology and pharmacology, toxicology & pharmaceuticals, as against decline of research activity in medicine, agricultural & biological sciences and neurosciences from 2007-11 to 2012-16. Agri-

cultural & biological sciences registered the highest citation impact per paper of 7.22, followed by neurosciences (6.24), biochemistry, genetics & molecular biology (6.12), pharmacology, toxicology & pharmaceutics (5.85) and medicine (4.65) during 2006-15 .

In terms of sub-specialties, clinical thyroidology received the largest share (65.85%) of papers, followed by thyroid Interface with non-endocrine systems (23.28%), investigational thyroidology (11.50%) and thyroid interface with endocrine systems (5.80%) during 2007-16.

The top 15 most productive research organizations and the authors collectively contributed 31.70% and 11.24% respectively as their global publication share and 34.72% and 17.58% respectively as their global citation share during 2007-16.

The journals as a medium ranked 1st, accounting for 98.35% share of total Indian output on thyroid research during 2007-16. The 15 most productive journals involved in Indian thyroid research constituted 23.23% share of total journal publication output during 2007-16, increasing from 19.62% to 25.66% between 2007-11 and 2012-16. Journal of Clinical & Diagnostic Research accounted for largest number of papers (95), followed by Indian Journal of Nuclear Medicine (51 papers), BMJ Case Reports (44 papers), Indian Journal of Pathology & Microbiology (40 papers), etc. during 2007-16.

Of the total Indian output on thyroid research, only 13 publications registered high citations, in the range of 83 to 422 citations per paper, and collectively these 13 highly cited papers received a total of 2023 citations, averaging to 155.61 citations per paper. Among international collaborative papers, the largest participation was from USA (6 papers), followed by France, Argentina and Netherlands (3 papers each), U.K., Belgium, Mexico, Switzerland, Germany, Japan, China and Australia (2 papers each) and 1 paper each by 22 countries. There were 17 Indian organiza-

tions involved in these high cited papers. Of the 13 highly cited papers, 8 were published as articles, 3 as review papers and 2 as conference paper. These 13 highly cited papers were published in 11 journals, of which 2 papers were published in American Journal of Transplantation and 1 paper each in 10 other journals

Concludes that there is a high burden of thyroid diseases in India, which is under-addressed both within government programs, population level and the medical fraternity level too. Thyroid diseases are different from other diseases in terms of their diagnosis and medical treatment. Early diagnosis and treatment is the cornerstone of management of thyroid disorders, hence there is an urgent need to build capacity in this area as thyroid has become a serious health threat with exploding population. India needs to build capacity amongst primary care physicians to address management, counseling, referral and prevention of thyroid disorders. It will go a step further to tackle the rising prevalence thyroid disorders aimed to strengthen the capacity of doctors to deal with the enormous challenges it poses, with the ultimate aim of improving the health outcomes of people.

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