

Anemia Research Output from India: A Scientometric Assessment of Publications during 2008-2017

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ABSTRACT

The paper examines India's research output on anemia research on a series of bibliometric indicators. India published a total of 5723 publications in anemia research in 10 years during 2008-2017 registering an average annual growth rate of 11.65%, citation impact of 8.68 citations per paper, global publication share of 5.44% and international collaborative publication share of 12.60%. The paper profiles global publication output and output of 10 most productive countries in anemia research, 15 most productive Indian organizations and 15 most productive authors on a series of indicators including publications output, number of citations, the relative citation index, citations per paper, h-index and share of international collaborative papers during 2008-2017. Suggest the need for countries to develop specific plans of action and their strategic implementation at national level and prioritize national goals for anemia research.

Keywords: Anemia research, Indian publications, Scientometrics, Bibliometrics

INTRODUCTION

Among the nutritional deficiency disorders of the world, anemia (measured in terms of hemoglobin concentration) is the most common public health problem that affects low, middle and high-income countries and has significant adverse health consequences, as well as adverse impact on social and economic development [1]. Here, the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiologic needs, which vary by age, sex, altitude, smoking and pregnancy status. The hemoglobin content of anemic blood is lower than normal as a result of deficiency of one or more essential nutrients. Iron deficiency is the most significant cause of anemia (contributing to 50% of the cases). Micronutrient deficiencies (e.g. foliate, riboflavin, vitamins A and B12), acute and chronic infections (e.g. malaria, cancer, tuberculosis and HIV), helminthic and parasitic infections and inherited or acquired disorders that affect hemoglobin synthesis, red blood cell production or red blood cell survival (e.g. Hemoglobinopathies) are the other causes of anemia [1]. Anemia leads to fatigue, weakness, dizziness and drowsiness in its severe form and can lead to several issues, ranging from fatigue to bone diseases, or even cancer.

The prevalence of anemia, although, decreased between 1990 and 2010 (from 40.2% to 32.9%), it still remained a

significant burden on society, with an increase in global YLDs (Years lived with disability) from 65.5 million to 68.4 million over the 20 years period [2].

Nearly 2.3 billion people are currently suffering from anemia globally and of which an estimated 50% are due to iron deficiency anemia. The highest prevalence regions of anemia (Southeast Asia and Africa) accounted for 85% of the burden affecting mainly women and children. Anemic prevalence becomes more serious in reproductive age of women (between 15-49 ages). Nearly 202 million and 100 million affected women with anemia were in Southeast Asia and Western Pacific regions of the world. Globally, 41.8% of pregnant women and 600 million pre-school and school-age children are anemic. Alone 60% of pregnant and around half of children cases are attributable to iron deficiency.

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South Asia has some of the highest rates of anemia worldwide [3]. Anemia prevalence is higher in India as compared to other developing countries in all groups. Anemia affects an estimated 50% of the total population in India. Anemia disproportionately affects women: Eastern region population affected have a significantly higher prevalence (72%) of anemia than the Western states (45%) of India. 20-40 percent of maternal estimated deaths in India are due to anemia. Aggregated data from the National Nutrition Monitoring Bureau and Indian Council of Medical Research shows that 80-90% of pre-school children, pregnant and lactating women and adolescent girls have anemia. All adolescents, male or female, are more susceptible to anemia during this stage of their lives due to the increase in muscle mass and blood volume as a function of growth and development. Deficiencies in women can start with low birth weight infant females and worsen during adolescence with the onset of menstruation. Pregnancy further worsens and taxes an already anemic body [4,5].

Indian Government although launched a number of programs from time to time, the latest being launched in December 2015 which aimed to cut down on anemia levels among the large Indian adolescent population. Nearly 56% of girls and 30% of boys (in the age group of 15-19 years) in India are anemic, with a large percentage suffering from moderate to severe anemia according to Government data. The latest 'Weekly Iron and Folic Acid Supplementation' (WIFS) program of Indian Government was focused on adolescent children (in government or aided school children's), where a tablet of Iron and folic Acid is administered once a week for 13 months. Proper information campaign and counseling were also conducted to ensure timely implementation of the program [6].

LITERATURE REVIEW

Few scientometric studies are available on anemia research. Ramalingam and Chamy [7] studied Indian anemia research output (5085) during 1993-2013, with a focus on authorship pattern, degree of collaboration, most productive authors, subject pattern, major collaborative partners in India, most productive journals, active institutions and highly cited papers. Bansal et al. [8] examined Indian iron deficiency research output (717) using Scopus database during 2006-2015 on selective aspects: publication growth, citation impact, share of international collaborative papers and identification of major international collaborative partners, global rank and share of India amongst the top countries, leading Indian institutes and authors productivity and citation impact, medium of communication in most productive journals. Mesquita et al. [9] analyzed and assessed national and international scientific publication output of anemia in chronic kidney disease, using Scopus database.

OBJECTIVE

The present study is aimed at making a scientometric assessment of India's publications in anemia research, indexed in Scopus database during 2008-2017. The specific objectives are to study:

- The growth and distribution of world and top 10 countries literature and Indian literature on anemia research, its publication output, its global publication share and citation impact;
- International collaboration and identification of major collaborators with India;
- The distribution of India's publication output by broad subject areas and by type of anemia research;
- The scientometric profile of 10 most productive countries, 15 most productive Indian organizations and 15 productive Indian authors;
- The leading medium of communication in India and the bibliographic characteristics of highly cited publications by India on anemia research.

METHODOLOGY

The global publications and of top 10 countries in anemia research were sourced from Scopus international database (<http://www.scopus.com>) using a keyword "anemia" for the years 2008 to 2017. The "Article title" or "Keyword" (as shown in the search string below) tags were searched for the keyword restricting the hit to the period 2008-2017 in "date range tag". This statement became the main search string. The main search string was further restricted to 10 countries one by one in "country tag" for obtaining publication information of these countries (as shown below for India). On further restricting India's main search string (as provided in analytical functions of Scopus database) by "subject area tag", "country tag", "source title tag", "journal title name" and "affiliation tag", statistics on distribution of publications by subject, collaborating countries, author-wise, organization-wise and journal-wise were obtained. Separate search strategies were also developed to get information on different type of anemia research (**Table 1**). Citations data was obtained from the date from date of publication till 19 April 2018.

ANALYSIS

Anemia research consisting of 105145 global and 5723 Indian publications were derived from Scopus database and studied during 10 years (2008-2017). The annual and cumulative publication output of India and world over increased from 8986 and 269 in the year 2008 to 10780 and 675 publications in the year 2017, averaging 2.11% and 11.65% annual growth rate, respectively. The global and Indian cumulative output (computed in 5 years) in anemia research increased from 49880 and 2177 (during 2008-2012)

to 55265 and 3546 (during 2013-2017), registering 10.80% and 62.88% growth rates, respectively. India's global share

Table 1. Search strategies to get information on different type of anemia research.

(KEY(Anemia) OR TITLE(Anemia)) AND PUBYEAR>2007 AND PUBYEAR<2018
(KEY(Anemia) OR TITLE(Anemia)) AND PUBYEAR>2007 AND PUBYEAR<2018 AND (LIMIT-TO (AFFILCOUNTRY, "India"))
(KEY (Iron AND deficiency AND anemia) OR TITLE (Iron AND deficiency AND anemia)) AND PUBYEAR>2007 AND PUBYEAR<2018 AND (LIMIT-TO (AFFILCOUNTRY, "India"))

in anemia research averaged to 5.44% during 2008-2017, which increased from 4.36% during 2008-2012 to 6.42% during 2013-2017. The citation impact of Indian publications on anemia research averaged to 8.68 citations per publication (CPP) during 2008-2017; which declined from 13.20 CPP during 2008-2012 to 5.90 CPP during 2013-2017. On measuring impact of publications in terms of citations per paper, it was observed Indian publications on

anemia research averaged to 8.68 citations per publication (CPP) during 2008-2017, which decreased from 13.20 CPP during 2008-2012 to 5.90 CPP during 2013-2017 (**Table 2**). Of the total Indian publications output, 75.64% (4329) was published articles, 9.80% (561) as reviews, 8.96% (513) as letters, 2.25% (129) as notes, 1.43% (82) as conference papers, 1.0% (57) as editorials and the rest as short surveys (28), book chapters (18), articles in press (4) and book (2).

Table 2. Annual Publications output by India and World on Anemia Research during 2008-2017.

Period	World	India					
	TP	TP	TC	CPP	%TP	ICP	%ICP
2008	8986	269	3922	14.58	2.99	34	12.64
2009	9470	357	4081	11.43	3.77	43	12.04
2010	9996	393	6682	17.00	3.93	52	13.23
2011	10372	526	4745	9.02	5.07	60	11.41
2012	11056	632	9314	14.74	5.72	65	10.28
2013	11357	678	6829	10.07	5.97	85	12.54
2014	10847	743	5154	6.94	6.85	97	13.06
2015	11094	703	5791	8.24	6.34	88	12.52
2016	11187	747	2521	3.37	6.68	93	12.45
2017	10780	675	616	0.91	6.26	104	15.41
2008-2012	49880	2177	28744	13.20	4.36	254	11.67
2013-2017	55265	3546	20911	5.90	6.42	467	13.17
2008-2017	105145	5723	49655	8.68	5.44	721	12.60

TP: Total Papers; TC: Total Citations; CPP: Citations Per Paper; ICP: International Collaborative Papers

International collaboration

12.60% of the total research output by India in anemia research was published as international collaborative papers during 2008-2017. India's collaborative output increased from 11.67% during 2008-2012 to 13.17% during 2013-

2017. The leading foreign countries that collaborated with India in anemia research were: USA (53.12% publication share), followed by U.K. (24.13%), Australia (12.21%), France and Germany (11.93% each), Canada and Italy (11.23% each), Switzerland (9.43%), Spain (9.15%) and Netherland (7.35%) during 2008-2017. India's international

collaborative publications share showed increase in all 10 countries (as indicated in the **Table 3**) ranging from 1.19% during 2008-2012 to 8.84% during 2013-2017 (**Table 3**).

Table 3. Publication share of leading foreign countries in India's collaborative papers (ICP) output in anemia research during 2008-2017.

S. No.	Collaborative Country	Number of ICP			Share of ICP		
		2008-2012	2013-2017	2008-2017	2008-2012	2013-2017	2008-2017
1	USA	131	252	383	51.57	53.96	53.12
2	UK	48	126	174	18.90	26.98	24.13
3	Australia	25	63	88	9.84	13.49	12.21
4	France	19	67	86	7.48	14.35	11.93
5	Germany	22	64	86	8.66	13.70	11.93
6	Canada	14	67	81	5.51	14.35	11.23
7	Italy	21	60	81	8.27	12.85	11.23
8	Switzerland	22	46	68	8.66	9.85	9.43
9	Spain	16	50	66	6.30	10.71	9.15
10	Netherlands	11	42	53	4.33	8.99	7.35
	Indian Total	254	467	721			

ICP: International Collaborative Papers

Most productive countries contribution in global anemia research

The global anemia research witnessed the participation of 180 countries during 2008-2017. However, the top 10 countries together alone accounted for 82.99% global publication share during 2008-2017, which showed increase from 80.07% during 2008-2013 to 85.63% during 2013-2017. Individually, the top 10 countries publications ranged from 3879 to 33410 and accounted for 3.69% to 31.78% of global publication share during 2008-2017. USA, among top countries, accounted for the largest publication share (31.78%), followed by UK (8.25%), Italy and Japan (6.97% and 6.44%), France, Germany, India and China (from 5.02% to 5.65%), Spain and Canada (4.20% and 3.69%) during 2008-2017. Seven countries which showed increase in their global publication share in five years were: Italy, Japan, France, India, China, Spain and Canada, as against only three countries, namely USA, UK and Germany, showing

decrease in their global publication from 2008-2012 to 2013-2017 (**Table 4**).

Table 4. Publication output and global publication share (%) of top 10 most productive countries in anemia research during 2008-2017.

S. No.	Name of the Country	Number of Papers			Share of Papers		
		2008-2012	2013-2017	2008-2017	2008-2012	2013-2017	2008-2017
1	USA	16025	17385	33410	32.13	31.46	31.78
2	UK	4174	4496	8670	8.37	8.14	8.25
3	Italy	3469	3863	7332	6.95	6.99	6.97
4	Japan	2997	3779	6776	6.01	6.84	6.44
5	France	2783	3154	5937	5.58	5.71	5.65
6	Germany	2878	2959	5837	5.77	5.35	5.55
7	India	2177	3546	5723	4.36	6.42	5.44
8	China	1645	3635	5280	3.30	6.58	5.02
9	Spain	2086	2331	4417	4.18	4.22	4.20
10	Canada	1706	2173	3879	3.42	3.93	3.69
	Total	39940	47321	87261	80.07	85.63	82.99
	World Total	49880	55265	105145			
	Share of 10 Countries in World Total	80.07	85.63	82.99			

Subject-wise distribution of Indian research papers

Anemia research output from India published during 2008-2017 was classified under five broad subjects (as defined by Scopus database) during 2008-2017. Medicine accounted for the largest publication share (80.83%) and agricultural and biological sciences 92.71%) for the least. The activity index showed increase in publication activity in biochemistry, genetics and molecular biology and pharmacology, toxicology and pharmaceuticals, as against decline in medicine, immunology and microbiology and agricultural and biological sciences from 2008-2012 to 2013-2017. The average value of activity index is 100. Immunology and microbiology registered the highest citation of 9.31 per

paper and pharmacology, toxicology and pharmaceuticals registered the least citation impact (6.13 per paper) during 2008-2017 (**Table 5**).

Table 5. Subject-wise breakup of India's publications on anemia research during 2008-2017.

S. No.	Subject*	Number of Papers (TP)			Activity Index		TC	CPP	%TP
		2008-2012	2013-2017	2008-2012	2008-2012	2013-2017	2008-2017	2008-2017	2008-2017
1	Medicine	1804	2822	4626	102.52	98.45	42354	9.16	80.83
2	Biochemistry, Genetics and Molecular Biology	331	769	1100	79.10	112.83	10139	9.22	19.22
3	Pharmacology, Toxicology and Pharmaceutics	217	367	584	97.68	101.42	3581	6.13	10.20
4	Immunology and Microbiology	91	147	238	100.51	99.68	2216	9.31	4.16
5	Agricultural and Biological Sciences	63	92	155	106.85	95.79	1209	7.80	2.71
		2177	3546	5723					

There is overlapping of literature covered under various subjects

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

Distribution of Indian papers by types of anemia research

Iron deficiency anemia, among its various types of anemia, registered the largest publication share (16.69%) in Indian output compared to other types of anemia research: anemia of chronic diseases (7.97%), sickle cell anemia (6.06%), aplastic anemia (5.22%), autoimmune hemolytic anemia

(2.64%) and pernicious anemia (0.65%) during 2008-2017. In contrast, anemia of chronic diseases registered the highest citation impact (31.48 per paper); compared to much lower citation impact of sickle cell anemia, iron deficiency anemia, aplastic anemia, autoimmune hemolytic anemia and pernicious anemia (from 2.05 to 13.04 per paper) during 2008-2017 (**Table 6**).

Table 6. Distribution of India's publications by type of anemia research during 2008-2017.

S. No.	Type of Anemia	Global	India				
		GTP	TP	TC	CPP	%GTP	%TP
1	Iron Deficiency Anemia	11954	955	11021	11.54	7.99	16.69
2	Pernicious Anemia	1034	37	76	2.05	3.58	0.65
3	Aplastic Anemia	4932	299	3032	10.14	6.06	5.22
4	Autoimmune Hemolytic Anemia	3091	151	597	3.95	4.89	2.64
5	Sickle Cell Anemia	9903	347	4526	13.04	3.50	6.06
6	Anemia of Chronic Diseases	12533	456	14354	31.48	3.64	7.97
	Total of India	105145	5723	49655	8.68		

GTP: Global Total Papers; TP: Total Papers; TC: Total Citations; CPP: Citations Per Paper; ICP: International Collaborative Papers

Top 15 most productive Indian organizations contribution and impact

The 15 most productive organizations together contributed 1965 publications (34.34% share) and 34488 citations (69.46% share) in India's output during 2008-2017. Individually the top 15 organizations contribution varied from 75 to 365 in 10 years. Only three organizations registered productivity rate above the group average of 131 per organization: AIIMS, New Delhi (365 papers), PGIMER, Chandigarh (356 papers) and SGPIMS, Lucknow (134 papers). Only six organizations registered citation

impact and relative citation index above the group average of 17.55 citations per publication and 2.02: CSMMU, Lucknow (37.01 and 4.26), SGPIMS, Lucknow (35.26 and 4.06), AIIMS, New Delhi (28.6 and 3.29), CMC, Vellore (27.53 and 3.17), BHU, Varanasi (23.65 and 2.72) and PGIMER, Chandigarh (19.9 and 2.29). Six organizations registered international collaborative publications above the group average of 11.50%: CMC, Vellore (29.41%), TMH, Mumbai (21.57%), KEMH, Mumbai (19.48%), BHU, Varanasi (15.29%), SGPIMS, Lucknow (11.94%) and AIIMS, New Delhi (11.51%) during 2008-2017 (**Table 7**).

Table 7. Scientometric profile of top 15 most Indian productive organizations on anemia research during 2008-2017.

S. No.	Name of the Organization	TP	TC	CPP	HI	ICP	%ICP	RCI
1	All India Institute of Medical Sciences (AIIMS), New Delhi	365	10439	28.60	24	42	11.51	3.29
2	Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh	356	7086	19.90	20	31	8.71	2.29
3	Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPIMS), Lucknow	134	4725	35.26	17	16	11.94	4.06
4	Lady Harding Medical College (LHMC), New Delhi	118	465	3.94	12	5	4.24	0.45
5	Kasturba Medical College (KMC), Manipal	117	392	3.35	11	13	11.11	0.39
6	Christian Medical College (CMC), Vellore	102	2808	27.53	19	30	29.41	3.17
7	Tata Memorial Hospital (TMH), Mumbai	102	1245	12.21	16	22	21.57	1.41
8	Manipal Academy of Higher Education (MAHE), Manipal	97	284	2.93	10	9	9.28	0.34
9	Maulana Azad Medical College (MAMC), Delhi	89	580	6.52	13	7	7.87	0.75
10	Medical College and Hospital (MCH), Kolkata	85	269	3.16	8	3	3.53	0.36
11	Banaras Hindu University (BHU), Varanasi	85	2010	23.65	15	13	15.29	2.72
12	Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Pondicherry	84	322	3.83	8	4	4.76	0.44
13	CSM Medical University (CSMMU), Lucknow	79	2924	37.01	11	8	10.13	4.26
14	King Edward Memorial Hospital (KEMH), Mumbai	77	480	6.23	12	15	19.48	0.72
15	Institute of Immunohaematology (II) i, Mumbai	75	459	6.12	13	8	10.67	0.71
	Total of 15 organizations	1965	34488	17.55	13.93	226	11.50	2.02
	Total of India	5723	49655	8.68				
	Share of top 15 organizations in India total output	34.34	69.46					

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

Top 15 most productive Indian authors' contribution and impact

The top 15 most productive authors contributed 22 to 69 papers each and together they contributed 531 papers (9.28%) and received 2670 citations (5.38%) during 2008-2017. Nine authors registered publication productivity above the group average of 35.4: Ghosh (69 papers), Saxena (45 papers), Malhotra (39 papers), Das (38 papers), Chandra (37 papers), Mahapatra, Varma and Varma (37 papers each) and Prabhash (36 papers). Four authors registered impact and

relative citation index above the group average of 5.03 citations per publication and 0.58: Prabhash (17.14 and 1.97), Ghosh (6.09 and 0.70), Das (5.24 and 0.60) and Ahluwalia (5.18 and 0.60). Seven authors registered international collaborative publications (ICP) share more than the average ICP share (4.71%): Prabhash (13.89%), Varma (13.51%), Varma (8.11%), Bansal and Malhotra (7.69% each), Ghosh (5.80%) and Das (5.26%) during 2008-2017 (**Table 8**).

Table 8. Scientometric profile of top 15 most productive Indian authors in anemia research during 2008-2017.

S. No.	Name of the author	Affiliation of the author	TP	TC	CPP	HI	ICP	%ICP	RCI
1	Ghosh K	Institute of Immunohematology, Mumbai	69	420	6.09	12	4	5.80	0.70
2	Saxena R	All India Institute of Medical Sciences, New Delhi	45	215	4.78	8	0	0.00	0.55
3	Malhotra P	Postgraduate Institute of Medical Education and Research, Chandigarh	39	104	2.67	6	3	7.69	0.31
4	Das R	Postgraduate Institute of Medical Education and Research, Chandigarh	38	199	5.24	7	2	5.26	0.60
5	Chandra J	Lady Hardinge Medical College, New Delhi	37	157	4.24	7	0	0.00	0.49
6	Mahapatra M	All India Institute of Medical Sciences, New Delhi	37	113	3.05	6	0	0.00	0.35
7	Varma N	Postgraduate Institute of Medical Education and Research, Chandigarh	37	163	4.41	6	3	8.11	0.51
8	Varma S	Postgraduate Institute of Medical Education and Research, Chandigarh	37	135	3.65	6	5	13.51	0.42
9	Prabhash K	Tata Memorial Hospital, Mumbai	36	617	17.14	10	5	13.89	1.97
10	Seth T	All India Institute of Medical Sciences, New Delhi	34	91	2.68	6	0	0.00	0.31
11	Bansal D	Postgraduate Institute of	26	78	3.00	6	2	7.69	0.35

		Medical Education and Research, Chandigarh							
12	Noronha V	Tata Memorial Hospital, Mumbai	26	90	3.46	5	1	3.85	0.40
13	Joshi A	Tata Memorial Hospital, Mumbai	24	83	3.46	5	0	0.00	0.40
14	Mishra P	All India Institute of Medical Sciences, New Delhi	24	91	3.79	5	0	0.00	0.44
15	Ahluwalia J	Postgraduate Institute of Medical Education and Research, Chandigarh	22	114	5.18	7	0	0.00	0.60
		Total of 15 authors	531	2670	5.03	6.8	25	4.71	0.58
		Total of India	5723	49655	8.68				
		Share of 15 authors in India's total	9.28	5.38					

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

Distribution of publications by source and channel of communication

Of the 5723 publications by India in anemia research, 99.16% (5675) appeared in journals and the rest as books (0.31%), conference proceedings (0.30%) and book series (0.23%) during 2008-2017. The top 15 most productive journals (with contributions from 49 to 306 papers) together contributed 1550 publications (27.31% share of total journal output) during 2008-2017. The cumulative five year journal

publication output reported in 15 journals increased from 23.69% during 2008-2012 to 29.54% during 2013-2017. The leading journals contributing to Indian research in anemia research are listed in **Table 9**: Journal of Clinical and Diagnostic Research (306 publications), followed by Indian Journal of Pediatrics (186 publications), Indian Journal of Hematology and Blood Transfusion (160 publications), BMJ Case Reports (119 publications), etc. during 2008-2017 (**Table 9**).

Table 9. Top 15 most productive journals reporting output from Indian scholars in anemia research during 2008-2017.

S. No.	Name of the Journals	Number of Papers		
		2008-2012	2013-2017	2008-2017
1	Journal of Clinical and Diagnostic Research	47	259	306
2	Indian Journal of Pediatrics	93	93	186
3	Indian Journal of Hematology and Blood Transfusion	47	113	160
4	BMJ Case Reports	27	92	119
5	Indian Pediatrics	59	59	118
6	Indian Journal of Pathology and Microbiology	51	42	93
7	Indian Journal of Medical Research	41	42	83
8	Indian Journal of Public Health Research and Development	15	64	79
9	Research Journal of Pharmaceutical Biological and Chemical	15	64	79

	Sciences			
10	Indian Journal of Cancer	14	44	58
11	Journal of Obstetrics and Gynecology of India	19	37	56
12	International Journal of Pharma and Bio Sciences	17	38	55
13	Journal of Indian Medical Association	37	18	55
14	Indian Journal of Dermatology	19	5	54
15	Indian Journal of Nephrology	11	38	49
	Total of 15 journals	512	1038	1550
	Total India journal output	2161	3514	5675
	Share of top 15 journals in Indian journal output	23.69	29.54	27.31

Highly cited papers

Out of 5723 papers from Indian scholars published, there were 54 highly cited papers having received citations from 100 to 2790 citations per paper (20 in 100-200 citations range each, 16 in 200-399 citations range, 8 in 400-699 citations range, 6 in 700-100 citations range, and the remaining 5 papers in 1126-2790 citation range) during 2008-2017. Together these 54 papers accounted for 24764 citations, averaging 458.59 citations per paper. The 54 highly cited papers had participation from 83 countries: USA (36 papers), France (24), UK (23), Germany (22), Italy (21), Australia (18), Canada (14) and Spain (10), etc. The significant Indian organizations participating in these 54 highly cited papers include All India Institute of Medical Sciences, New Delhi (7 papers), Postgraduate Institute of Medical Education and Research, Chandigarh (6 papers), Christian Medical College, Vellore and Banaras Hindu University, Varanasi (4 papers each), Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow (3 papers), Tata Memorial Hospital, Mumbai and CSM Medical University, Lucknow (2 papers each). The 54 highly cited papers were published in 37 journals, including 15 papers in The Lancet, followed by New England Journal of Medicine and Journal of Clinical Oncology (5 papers each), The Lancet Oncology (4 papers), Indian Journal of Medical Research (2 papers) and 1 paper each in 23 other journals.

SUMMARY AND CONCLUSION

Summary

Anemia research, worldwide originated in 180 countries during 2008-2017. 82.99% of total global publication share, however, came from 10 most productive countries during 2008-2017, which showed increase from 80.07% during 2008-2012 to 85.63% during 2013-2017. USA, among top 10 countries, accounted for the highest publication share (31.78%), followed by UK (8.25%), Italy and Japan (6.97% and 6.44%), France, Germany, India and China (from 5.02%

to 5.65%), Spain and Canada (4.20% and 3.69%) during 2008-2017.

India had published 5723 publications in anemia research during 2008-17, which showed increase from 269 in the year 2008 to 675 in the year 2017, averaging 11.65% annual growth rate. India's share in the global publication output in anemia research was 5.44% during 2008-2017, which showed increase from 4.36% during 2008-2012 to 6.42% during 2013-2017. India's citation impact in anemia research averaged to 8.68 citations per publication during 2008-2017, which dropped from 13.20 during 2008-2012 to 5.90 during 2013-2017. The share of India's international collaborative papers share was 12.60% during 2008-2017, which showed increase from 11.67% during 2008-2012 to 13.17% during 2013-2017. Medicine registered the highest publications share (80.83%), followed by followed by biochemistry, genetics and molecular biology (19.22%) and pharmacology, toxicology and pharmaceuticals (10.20%), immunology and microbiology (4.16%) and agricultural and biological sciences (2.71%) during 2008-2017.

The 15 most leading organizations and authors together contributed 34.34% and 9.28% as their share of Indian publication output and 69.46% and 5.38% as their share of Indian citation output respectively during 2008-2017. Indian organizations, showing comparatively higher productivity in anemia research were: All India Institute of Medical Sciences, New Delhi (with 365 papers), Postgraduate Institute of Medical Education and Research, Chandigarh (356 papers) and Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow (134 papers) during 2008-2017. Similarly, Indian organizations showing comparatively higher citation impact per paper were: CSM Medical University, Lucknow (37.01), Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow (35.26), All India Institute of Medical Sciences, New Delhi (28.6), Christian Medical College, Vellore (27.53), Banaras Hindu University, Varanasi (23.65) and Postgraduate Institute of Medical Education and Research, Chandigarh (19.9) during 2008-2017.

Indian authors showing comparatively higher productivity in anemia research were: Ghosh (with 69 papers), Saxena (45 papers), Malhotra (39 papers), Das (38 papers), Chandra (37 papers), Mahapatra, Varma and Varma (37 papers each), Prabhash (36 papers), etc. during 2008-2017. Similarly, Indian authors showing with comparatively higher citation impact per paper were: Prabhash (17.14), Ghosh (6.09), Das (5.24) and Ahluwalia (5.18) during 2008-2017.

Of the 5723 Indian publications on anemia research, 5675 appeared in journals. The 15 most productive journals contributed 27.31% share to the Indian journal publication output during 2008-2017. The publication share in five years from top 15 journals increased from 23.69% during 2008-2012 to 29.54% during 2013-2017. The leading journals contributing to India's anemia research were: Journal of Clinical and Diagnostic Research (with 306 papers), followed by Indian Journal of Pediatrics (186 papers), Indian Journal of Hematology and Blood Transfusion (160 papers) and BMJ Case Reports (119 papers) during 2008-2017.

Only 54 highly cited papers, out of output of 5723 publications on anemia research from India, received from 100 to 2790 citations per paper during 2008-2017. These 54 highly cited papers together received 24764 citations, averaging to 458.59 citations per paper. The USA accounted for the highest number of papers (36) in the 54 highly cited papers, followed by France (24 papers), UK (23 papers), Germany (22 papers), Italy (21 papers), Australia (18 papers), Canada (14 papers), Spain (10 papers), etc. The 54 highly cited papers were published in 37 journals, including with 15 papers in The Lancet, followed by New England Journal of Medicine and Journal of Clinical Oncology (5 papers each), The Lancet Oncology (4 papers), etc.

Conclusion

India's anemic population (women and children in particular) face severe health problem, as against moderate health problem in some countries of South-East Asia region. Inflammation caused by infections and genetic partially cause anemia, as against widely caused by nutritional deficiencies. Till today, only select few countries have managed to significantly reduce the prevalence of anemia.

Many policy gaps and programmatic bottlenecks limit the effectiveness of anemia intervention programmes within countries, in spite of availability of informed global recommendations. The WHO consultation [10] indicates that there is an urgent need to develop national policies with regard to anemia and other micronutrient deficiencies. It advocates donors and other stakeholders to support national efforts in preventing anemia. Develop evidence informed strategies to address anemia using current evidence from a situational analysis. It is also suggested that each country should develop specific plans of action and their strategic implementation at national level and prioritize national goals for anemia: (i) for assessment, prevention and control, based

on resources available, from highest to lowest priority; women of reproductive age particularly pregnant women, lactating women, pre-pregnant women, adolescents, children aged 0-2 years, children aged 2-10 years, other groups; (ii) adopt national targets and timelines for anemia reduction based on current prevalence and determinants of anemia in the national setting; (iii) Implement a programme of action using WHO's evidence-informed guidance on preventing anemia to facilitate best practices on preventing iron deficiency and other causes of anemia using specific entry points in the life cycle and action sequences most appropriate to the country context.

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