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Mapping of Indian Biomedicine Research: A Scientometric Analysis of Research Output During 2012 - 2016

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Abstract - This study analyzes the research activities of India in biomedicine during 2012–2016, based on the total publication output, its growth rate, quality of papers published and rank of India in the global context. Patterns of international collaborative research output and the major partner institutions of India are also discussed. This study also evaluates the research performance of different types of Indian biomedical and research foundations and the characteristics of published literature in Indian and foreign journals. It also analyzes the medical research output by disease and organs. Materials and Methods: The publication data on biomedicine has been retrieved by using Web of Science (WoS) database. Results: total number of 2712 publications as indexed in web of science database during 2012-2016. The results show that there insignificant growth in Biomedicine literature published from India. It may be researcher, institutions or India's collaboration with other countries, in all aspects considerable growth can be observed Conclusion: High quality research in India is grossly inadequate and requires strategic planning, investment and resource support. There is also a need to improve the existing biomedical education system, which should foster research culture.

Keywords: India, biomedical research, publication output, Scientometrics

I. INTRODUCTION

Biomedicine is a branch of medical science that applies biological and physiological principles to clinical practice. The branch especially applies to biology and physiology. Biomedicine also can relate to many other categories in health and biological related fields. It has been the dominant health system for more than a century. Molecular biology is the process of synthesis and regulation of a cell's DNA, RNA, and protein. Molecular biology consists of different techniques including Polymerase chain reaction, Gel electrophoresis, and macromolecule blotting to manipulate DNA. Polymerase chain reaction is done by placing a mixture of the desired DNA, DNA polymerase, primers, and nucleotide bases into a machine. The machine heats up and cools down at various temperatures to break the hydrogen bonds binding the DNA and allows the nucleotide bases to be added onto the two DNA templates after it has been separated. Gel electrophoresis is a technique used to identify similar DNA between two unknown samples of DNA. This process is done by first preparing an agarose gel. This jelly-like sheet will have wells for DNA to be poured into. An electric current is applied so that the DNA, which is negatively charged due to its phosphate groups is attracted to the positive electrode. Different rows of DNA will move at different speeds because some DNA pieces are larger than others. Thus if two DNA samples show a similar pattern on the gel electrophoresis, one can tell that these DNA samples match. Macromolecule blotting is a process performed after gel electrophoresis. An alkaline solution is prepared in a container. A sponge is placed into the solution and an agaros gel is placed on top of the sponge. Next, nitrocellulose paper is placed on top of the agarose gel and a paper towels are added on top of the nitrocellulose paper to apply pressure. The alkaline solution is drawn upwards towards the paper towel. During this process, the DNA denatures in the alkaline solution and is carried upwards to the nitrocellulose paper. The paper is then placed into a plastic bag and filled with a solution full of the DNA fragments, called the probe, found in the desired sample of DNA. The probes anneal to the complementary DNA of the bands already found on the nitrocellulose sample. Afterwards, probes are washed off and the only ones present are the ones that have annealed to complementary DNA on the paper. Next the paper is stuck onto an x ray film. The radioactivity of the probes creates black bands on the film, called an autoradiograph. As a result, only similar patterns of DNA to that of the probe are present on the film. This allows us the compare similar DNA sequences of multiple DNA samples. The overall process results in a precise reading of similarities in both similar and different DNA sample.(1)

II. REVIEW OF LITERATURE

Few quantitative studies have been carried in the past analyzing Indian overall medical or biomedical research. (Satyanarayana ,1983, [2]) examined Indian contribution in biomedical research (3605 papers in 1990 and 3241 papers in 1994) as indexed in three databases, such as Index Medicus, Excerpta Medica and Tropical Disease Bulletin. (Arunachalam, 1995,[3]) examined the relevance of Indian medical research during 1981–1985 using Science Citation Index database and concluded that Indian global share of research in medical sciences is very small compared to our contribution in other Science and Technology fields. (Gupta & Bala, 2011[4]) Conducted a scientometric study on asthma research in India during 1999 - 2008 using Scopus database. The study compared Indian position is 15th among the

top 23 countries in asthma research, with its global publication share of 1.27(862papers), registering an average citation per paper of 3.43 and achieved an h index of 33 during 1999-2008. (Jain, N.C. 2008[5]) examined the visibility and extent of coverage of Indian biomedical and life sciences journals in global alerting services. (Diwakar, 2008,[6]) provided a comparative analysis of Indian biomedical papers (4732 in 1999 and 6088 in 2007), using SCI database. (Costas et al, 2011[7]) Data were obtained from a survey of researchers ascribed to the 'Biology and Biomedicine' area of the Spanish Council for Scientific Research, as well as from their curricula vitae. One quarter of the scientists work as members of teams in the process of consolidation. Our findings illustrate the importance, for the development and consolidation of research teams, of the availability of a minimum number of researchers with a permanent position and of a minimum number of support staff and non-staff personnel (mainly post-doctoral fellows). (Gupta and Bala, 2011[8]) studied the research activities of India in medical during 1999-2008, based on the total publication output its growth rate, quality of papers published and rank of India in the global context. (Mahmudi et al, 2015[9]) conducted a comprehensive bibliometrics analysis to calculate the H, G, M, A and R indicators for all Iranian biomedical research centers (IBRCs) from the output of ISI Web of Science (WoS) and Scopus between 1991 and 2010. We compared the research performance of the research centers according to these indicators

III. OBJECTIVES

The main objective of the study is to analyze the research performance of India in medicine in national and global context, as reflected in its publication output during 3007-2016. In particular, the study focuses on the following objectives:

1. Year wise growth and distribution of publications
2. Document type wise distributions
3. Research areas wise contribution of publications
4. The publications productivity and impact of leading institutions of India.
5. The patterns of research communication in most productive journals.
6. The characteristics of most prolific authors

IV. MATERIALS AND METHODS

This study based on Indian publication data in biomedicine, retrieved from the Clarivate analytics Web of Science (WoS), Science citation database for the 10 years (2007-2016). Search string used for the data retrieval is SU=(Biomedicine) Refined by Countries/Territories: India AND Timespan=2007-2016. Databases=SCI-EXPANDED, this search criteria yielded 2,712 records. The citations received by papers are considered. The institutional performance was measured on the number of quantitative and qualitative indicators, such as the number of papers, average citation per paper (ACPP), h-index (HI) and share of international collaborative papers (ICP) and share of high cited papers (HCP). It is based on the highest number of papers included that have had at least the same number of citations e.g. a scholar having h-index means has published h number of papers each of which has been cited by others at least h times.(Bala and Gupta, 2010, [10]).

V. RESULTS AND DISCUSSION

TABLE 1 INDIA'S BIOMEDICINE PUBLICATIONS OUTPUT FROM 2012 TO 2016

Publication Years	Records	% of 2712
2012	533	19.653
2013	580	21.386
2014	522	19.248
2015	549	20.243
2016	528	19.469

Table 1 Show that India has contributed total number of 2712 publications on Biomedicine as per Web of Science database (WoS) during 2012 – 2016. Highest publications (580) were published in 2013 and lowest publications (528) were published in the year 2016.

TABLE 2 DOCUMENT TYPE WISE DISTRIBUTION OF PUBLICATIONS

Type of publications	Records	% of 2712
Article	2308	85.103
Meeting abstract	175	6.453
Review	158	5.826
Editorial material	50	1.844
Proceedings paper	28	1.032
Correction	11	0.406
Letter	10	0.369
Book chapter	5	0.184

TABLE 3 RESEARCH AREA WISE DISTRIBUTIONS OF PUBLICATIONS

RESEARCH AREAS	RECORDS	% of 2712
Life sciences biomedicine other topics	2712	100
Mathematical computational biology	285	10.509
Biochemistry molecular biology	250	9.218
Cell biology	200	7.375
Physiology	157	5.789
Computer science	152	5.605
Engineering	88	3.245
Biophysics	76	2.802
Radiology nuclear medicine medical imaging	70	2.581
Agriculture	60	2.212
Environmental sciences ecology	57	2.102
Anthropology	51	1.881
Zoology	45	1.659
Nuclear science technology	42	1.549
Veterinary sciences	40	1.475
Microscopy	31	1.143
Anatomy morphology	31	1.143
Public environmental occupational health	30	1.106
Electrochemistry	26	0.959
Evolutionary biology	25	0.922

Table 2 gives an idea about publications which published in different type of documents during 2012-2016. Articles has highest share with 2308 (85.103%) publications fol lowed by Meeting Abstracts 175 (6.453%) while reviews are having 158 (5.826%) whereas Editorial Materials 50 (1.844%), Proceedings papers 28 (1.032%),

Table 3 show research area wise distributions of publications on Biomedicine published during 2012-2016 according to web of science citation database. As already discussed Biomedicine is palsying significant role in many other domains like Life Science Biomedicine other topics top list 2712 publications.

TABLE 4 TOP SCIENTISTS / RESEARCHERS CONTRIBUTIONS

Authors	Records	% of 2712
KUMAR A	63	2.323
KUMAR S	53	1.954
KUMAR V	42	1.549
SINGH S	36	1.327
KUMAR P	30	1.106
SINGH R	29	1.069
KUMAR R	29	1.069
SINGH A	28	1.032
PANDEY A	25	0.922
KUMAR D	24	0.885
SHARMA S	20	0.737
SHARMA VK	19	0.701
SHARMA A	19	0.701
SHARMA R	18	0.664
SINGH M	16	0.59
SINGH D	16	0.59
SHARMA V	16	0.59
KUMAR M	16	0.59

Table 4 show highly productive scientists/ researchers of India in the field of Biomedicine. After analyzing the data it is found that Kumar, A has highest publications to his credit 63 (2.323%) followed by Kumar, S. 53 publications (1.954%), whereas Kumar V 49 publications (1.549%).

TABLE 5 INSTITUTIONAL WISE DISTRIBUTIONS OF PUBLICATIONS

Organizations	Records	% of 2712
Banaras hindu university	87	3.208
Indian inst technol	78	2.876
University of delhi	74	2.729
Indian inst science	69	2.544
Csir	53	1.954
Jawaharlal nehru university	50	1.844
University of calcutta	49	1.807
Vit university	45	1.659
King saud university	43	1.586
Indian agr res institute	41	1.512
All india inst med science	38	1.401
Tata inst fundamental research	37	1.364
Bhabha atom res ctr	34	1.254
Anna university	32	1.18
University lucknow	30	1.106
Jawaharlal nehru ctr adv sci re-search	30	1.106
Indian statical institute	29	1.069
Indian inst sci educ research	27	0.996
Panjab university	26	0.959

Table 5 brings out the top institutions wise distribution of publications in the journal during 2012 -2016. These top institutions have contributed total 2712 publications. Banaras Hindu University India top the list with 87 (3.208%) , followed by Indian Institute of Technology 78 (2.876%),

TABLE 6 SOURCE WISE (JOURNAL WISE) DISTRIBUTION OF PUBLICATIONS

Source titles	Records	% of 2712
Indian journal of experimental biology	510	18.805
Journal of biosciences	229	8.444
Faseb journal	197	7.264
Proceedings of the national academy of sciences India section b biological sciences	138	5.088
Brazilian archives of biology and technology	107	3.945
Biological rhythm research	98	3.614
Biologia	97	3.577
Saudi journal of biological sciences	92	3.392
Computers in biology and medicine	88	3.245
Journal of theoretical biology	78	2.876
Excli journal	69	2.544
Computational biology and chemistry	64	2.36
Turkish journal of biology	54	1.991
Life science journal acta zhengzhou university Overseas edition	46	1.696
International journal of radiation biology	42	1.549
Journal of thermal biology	41	1.512
Journal of animal and plant sciences	40	1.475
Mathematical biosciences	39	1.438
Elife	38	1.401
Microscopy research and technique	31	1.143

Journals are main source for publishing research work. Table 6 shows top 20 journals which published papers on Biomedicine during 2012 -2017 as per Web of Science Science citation database (WoS). Some Journals are Indian Journal of Experimental Biology 510 (18.805%) publications followed by Journal of Biosciences 229 (8.444%), FASEB Journal 197 (7.264%) Publication.

Table 7 depicts highly cited from India in Biomedicine published in various journals during 2012 -2016. Most frequently cites one “Vesiclepedia: A Compendium for Extracellular Vesicles with Continuous Community Annotation” with 236 citations written by Kalra, H *et al*. which published in PLOS BIOLOGY (2012). Most of all publications are more than two authors except one publication (DNA damage by reactive species: Mechanisms, mutation and repair, (2012).

VI. FINDINGS

The findings of the present lead to the following concluding remarks. The finding of growth of publication of Biomedicine research output brings out the research paper published trend in increasing trend. The overall study period the highest percentage publication published in 2013.

TABLE 7 HIGHLY CITED PAPERS FROM INDIA IN BIOMEDICINE

Rank	Citations	Title	Author	Sources	Vol.	Issue	Year
1	236	Vesiclepedia: A Compendium for Extracellular Vesi-cles with Continu-ous Community Annotation	Kalra, H *et al.*	PLOS BIOLOGY	10	12	2012
2	128	The Vascular Endothelium and Human Diseases	Rajendran, P *et al.*	NTERNATIONAL JOURNAL OF BIOLOGICAL SCIENCES	9	10	2013
3	77	Harvesting the Promising Fruits of Genomics: Applying Genome Sequencing Technologies to Crop Breeding	Varshney, RK *et al.*	PLOS BIOLOGY	12	6	2014
4	66	DNA damage by reactive species: Mechanisms, mutation and repair	Jena, NR (Jena, N. R.)	JOURNAL OF BIOSCIENCES	37	3	2012
5	60	Empirical mode decomposition based ECG enhancement and QRS detection	Pal, S *et al.*	COMPUTERS IN BIOLOGY AND MEDICINE	42	1	2012
6	56	Chou's pseudo amino acid composition improves sequencebased antifreeze protein prediction	Mondal, S *et al.*	JOURNAL OF THEORETICAL BIOLOGY	356		2014
7	55	Prediction of betalactamase and its class by Chou's pseudoamino acid composition and support vector machine	Kumar, R *et al.*	JOURNAL OF THEORETICAL BIOLOGY	365		2015
8	54	Pyrroloquinolinequi none and its versatile roles in biological processes	Misra, HS *et al.*	JOURNAL OF BIOSCIENCES	37	2	2012
9	53	Metaanalysis of tRNA derived RNA fragments reveals that they are evolutionarily conserved and associate with AGO proteins to recognize specific RNA	Kumar, P *et al.*	BMC BIOLOGY	12	78	2014
10	53	Finding Our Way through Phenotypes	Deans, AR *et al.*	PLOS BIOLOGY	13	1	2015

VII. CONCLUSION

Scientometric is an emerging thrust area of research in the field of Library and Information Science. Scientometric studies are used to identify quantitative aspects. Research is the most remarkable phenomena of development in any subject. It is the most important tool for the advancement of knowledge, scientific discoveries, technological achievement and scholarly publications. It is carried out to develop new concepts and theories and to contribute towards new knowledge, in any discipline in general and in the discipline, "Library and Information Science" in particular. Findings from the present study provide data on issues like, determining research capacity in LIS, In conclusion it may be said that, this study provided new and foundational data to characterize and measure the research activity of a group of Library Information Science Professionals. (Govindaraju, 2017, [11]).

Biomedicine plays a revolutionary part in Medical, present study is an overview of Biomedicine research in India during 2012-2016. For analyzing gathered data many scientometric techniques has been used. Assessment of research activity is very important get knowledge of present situation in that particular field. After analyzing total number of 2712 publications as indexed in web of science database during 2012-2016. The results show that there insignificant growth in Biomedicine literature published from India. It may be researcher, institutions or India's collaboration with other countries, in all aspects considerable growth can be observed

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