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SCIENTOMETRIC ANALYSIS OF BRAIN MAPPING RESEARCH PUBLICATIONS: A GLOBAL PROSPECTIVE

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Abstract

This paper discuss on Scientometric analysis of brain mapping research publications during 2002 to 2016, the present study reveals that totally 1486 papers published in brain mapping research during the study period. It could be noted that the brain mapping research publications is shows an increasing from 48 to 143 publications. Moreover, ten document types were contributed in this research among those more than 60 percent papers are in article types, language wise analysis found that majority of the paper were published in English, collaborative contributions are more comparative with single author papers, countries were contributed in this research during the study period United States of America occupies first place with 37.89 percent of papers contributed, sources wise revels that 'Neuroimage' has occupies first position with 108 papers in this research, institutions wise indicates that more than 161 institutions were contributing in this research, among those 'French National Institute of Health and Medical Research (Inserm)' has occupies first place with 55 papers contributed, remaining 160 institutions were contributed less than 50 contributions in this research during the study period.

Keywords: Brain mapping, Alzheimer's disease, Brain-imaging techniques, Scientometric.

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Introduction

Neuroimaging and brain mapping techniques offer extraordinary power to understand Alzheimer's disease (AD) providing spatially detailed information on the extent and trajectory of the disease as it spreads in the living brain. Computational anatomy techniques, applied to large databases of brain MRI scans, reveal the dynamic sequence of cortical and hippocampal changes with disease progression and how these relate to cognitive decline and future clinical outcomes. Applications to AD and other dementias are discussed, with a brief review of related findings in other neurological and neuropsychiatric illnesses, including epilepsy, HIV/AIDS, schizophrenia, and disorders of brain development (Liana G.Apostolova, Paul M.Thompson 2007). Human functional brain mapping as presently know it began when the experimental strategies of cognitive psychology were combined with modern brain-imaging techniques to examine how brain function supports mental activities (Marcus E.Raichle 2009).

Brain mapping and DBS surgery techniques have evolved over time. Together, they provide a unique opportunity to improve clinical care and shape our understanding of brain activity in health and disease (Zrinzo.L, 2015). Thus several brain mapping methods that have been developed for neuroscientific brain mapping efforts have been adapted to serve neurosurgical considerations. There are fundamental differences in how these methods are applied to neurosurgical patients and problems (Hussein Kekhia et al., 2011). The brain processes information and generates behavior by employing a wide array of different cell types. Ye Emily Wu et al. (2017) report a novel method that enables the efficient identification of molecularly defined cells that participate in a specific brain function.

Scientometrics

Scientometrics term introduced by Nalimov and Mulchenko (1969) is the application of these quantitative methods which are dealing with the analysis of science viewed as an information process". Scientometrics is a discipline which analyses scientific publications and citations appended to the papers to gain an understanding of the structure of science, growth of science at global level, performance of a country in a particular domain, performance of institutions, departments/divisions, and scientific eminence of an individual scientist. (Sagar et al., 2009).

Materials and Methods

The data have been collected from the Scopus database; the study period is during (2002-2016). The search string was used 'brain mapping' in the Title search box, field were used, the time span field were select from 2002 to 2016. A total of 1486 records were retrieved, the data downloaded and analyzed using MS office -Excel as per objectives of the present study. The present study helps to find in brain mapping research publications a global prospective.

Relative Growth Rate (RGT) and Doubling Time

The Relative Growth Rate is the number of publications/pages per unit of time. Hence, one year is taken as the unit of time. The mean relative growth rate R (1-2) over a specified period of interval can be calculated from the following equation suggested by Mahapatra (1985).

$$R(1-2) = \frac{W2 - W1}{T2 - T1}$$

Where,

R = Mean relative growth rate over the specify period of interval

W1 = log W1 (Natural log of initial number of publications/ pages)

W2 = log W2 (Natural log of initial number of publications/ pages)

T2-T1 = Unit difference between the initial time and final time.

Therefore,

R (a) = relative growth rate per unit per of publication per unit of time (year)

R (p) = relative growth rate per unit per of pages per unit of time (year

The corresponding Doubling Time for publications and pages can be calculated by using the following formula:

$$\text{Doubling time (Dt)} \frac{0.693}{R}$$

Therefore,

$$\text{Doubling time for publications Dt (a)} \frac{0.693}{R(a)}$$

Objectives

The following objectives of the present study are:

- To find brain mapping research publications during 2002 - 2016
- To find authorship pattern in brain mapping research publications
- To find out top ten authors contributed in brain mapping research publications
- To identify the top ten countries contributed in brain mapping research
- top ten sources published in brain mapping research papers
- To find out top ten institutions contributed in brain mapping research
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ANALYSIS AND INTERPRETATION

Table 1 year wise research performance in brain mapping

Sl. No	Year	No. of records	Percentages
1	2002	48	3.23
2	2003	74	4.98
3	2004	66	4.44
4	2005	86	5.79
5	2006	81	5.45
6	2007	92	6.19
7	2008	80	5.38
8	2009	80	5.38
9	2010	96	6.46
10	2011	109	7.34
11	2012	115	7.74
12	2013	137	9.22
13	2014	139	9.35
14	2015	140	9.42
15	2016	143	9.62
	Total	1486	100.00

Table 1 shows that year wise research performance in brain mapping during the period 2002 to 2016; totally 1486 papers were published during the research period, among the fifteen years 2016 has occupies first place with 143 papers, 2015 has occupies second place with 140 papers, 2014 has third place with 139 papers, followed by 2013 has 137 papers, 2012 has 115 papers, 2011 has 109 papers, 2010 has 96 papers, 2007 has 92 papers, 2005 has 86 papers, 2006 has 81 papers, 2008 and 2009 has 80 papers respectively, 2003 has 74 papers, 2004 has 66 papers, during the study period of starting years 2002 has occupies last position with 48 papers.

Table 2 Relative Growth Rate and Doubling Time of brain mapping research publications

Sl. No	Year	No. of records	Cumulate	W1	W2	R(a)	Mean (a) 1-2	Doubling Time	Mean Dt (a) 1-2
1	2002	48			3.87				
2	2003	74	122	3.87	4.3	0.43		1.61	
3	2004	66	188	4.3	4.18	0.12		5.77	
4	2005	86	274	4.18	4.45	0.27		2.57	
5	2006	81	355	4.45	4.39	0.06		11.55	
6	2007	92	447	4.39	4.52	0.13		5.33	
7	2008	80	527	4.52	4.38	0.14		4.95	
8	2009	80	607	4.38	4.38	0.00	0.07	0.00	1.82
9	2010	96	703	4.38	4.56	0.18		3.85	
10	2011	109	812	4.56	4.69	0.13		5.33	
11	2012	115	927	4.69	4.74	0.05		13.86	
12	2013	137	1064	4.74	4.91	0.17		4.08	
13	2014	139	1203	4.91	4.93	0.02		34.65	
14	2015	140	1343	4.93	4.94	0.01		69.30	
15	2016	143	1486	4.94	4.96	0.02	0.08	34.65	23.67
	Total	1486					0.075		12.74

Table 2 shows that, Relative Growth Rate and Doubling Time of brain mapping research publications, during the study period publications of Doubling Time mean value are 12.74. In 2002, the brain mapping research publication was 48; gradually the research publications were rise to 143 in the year 2016, the relative growth rate mean is 0.075. Conclude for this table its

evidence that Growth Rate of publications is raise from 48 to 143 publications in brain mapping research during the study period.

Table 3 document types in brain mapping research

Sl. No	Document types	No. of records	Percentages
1	Article	996	67.03
2	Conference Paper	217	14.60
3	Review	140	9.42
4	Book Chapter	40	2.69
5	Note	36	2.42
6	Editorial	22	1.48
7	Erratum	16	1.08
8	Letter	8	0.54
9	Short Survey	7	0.47
10	Book	4	0.27
	Total	1486	100.00

Table 3 indicated that document types in brain mapping research during 2002 to 2016, among the 1486 papers, Article has first position with 996 documents, Conference Paper has second place with 217, Review type has third place with 140 documents, followed by Book Chapter has 40 documents, Note has 36 documents, Editorial has 22 documents, Erratum has 16 documents, Letter has 8 documents, Short Survey has 7 documents, Book has 4 documents.

Table 4 source type in brain mapping research publications

Sl. No	Source type	No. of records	Percentages
1	Journals	1244	83.71
2	Conference Proceedings	151	10.16

3	Books	44	2.96
4	Book Series	43	2.89
5	Trade Publications	4	0.27
	Total	1486	100.00

Table 4 source that type in brain mapping research publications, totally five sources were contributed in this research during the study period, 1486 papers were published Journals has predominate place with 1244 papers, followed by cconference proceedings has 151 papers, books ahs 44 papers, book series has 43 papers, Trade Publications has 4 papers with last position.

Table 5 language wise brain mapping research publications

Sl. No	Language	No. of records	Percentages
1	English	1428	96.10
2	Japanese	20	1.35
3	Chinese	14	0.94
4	French	4	0.27
5	Spanish	4	0.27
6	German	3	0.20
7	Portuguese	3	0.20
8	Russian	3	0.20
9	Bulgarian	2	0.13
10	Polish	2	0.13
11	Italian	1	0.07
12	Swedish	1	0.07
13	Turkish	1	0.07
	Total	1486	100.00

Table 5 shows that language wise brain mapping research publications, 1486 papers were contributed in thirteen languages, among the thirteen languages1428 papers were published in English, 20 papers were published in Japanese, 14 papers in Chinese, in French and Spanish

languages were published 4 papers respectively, in German, Portuguese and Russian were contributed 3 papers respectively, in Bulgarian and Polish were contributed 2 papers respectively, in Italian , Swedish and Turkish contributed brain mapping research at 1 papers respectively.

Table 6 authorship pattern in brain mapping research publications

Sl. No.	Authorship pattern	No. of records	Percentages
1	Single	125	8.41
2	Double	215	14.47
3	Three	171	11.51
4	Four	191	12.85
5	Five	152	10.23
6	Six and above	632	42.53
	Total	1486	100.00

Table 6 indicates that, authorship pattern in brain mapping research publications from 2002 to 2016, 1486 papers were contributed by 2743 authors, among the 1486 papers six and above authors collaborative contributions are high, followed double authors collaborative contributions are 215 papers, four authors collaborative contribution are 191, three authors collaborative papers are 171, five author collaborative papers are 152, single author's papers are 125. It reveals that, 91.59 per cent papers were contributes collaborative authors, only 8.41 percent of papers were contributed single authored papers.

Table 7 top ten authors contributed in brain mapping research from 2002 to 2016

Sl. No	Author name	No. of records	% of 1486
1	Thompson, P.M.	36	2.42
2	Duffau, H.	26	1.75
3	Toga, A.W.	23	1.55
4	Wang, Y.	20	1.35

5	Chan, T.F.	14	0.94
6	Gu, X.	10	0.67
7	Yau, S.T.	9	0.61
8	Culver, J.P.	8	0.54
9	Haacke, E.M.	8	0.54
10	Miller, M.I.	8	0.54

Table 7 shows that top ten authors contributed in brain mapping research from 2002 to 2016, totally 2743 authors were contributed in this research, among the authors Thompson, P.M. has contributed 36 papers with first place, Duffau, H. has second place with 26 papers contributed, Toga, A.W. has third place with 23 papers contributed, Wang, Y. has fourth place with 20 papers contributed, Chan, T.F. has fifth place with 14 papers contributed, Gu, X. has sixth place with 10 papers contributed, Yau, S.T. has seventh place with 9 papers contributed, Culver, J.P., Haacke, E.M. and Miller, M.I. has eighth, ninth and tenth place with 8 papers contributed respectively.

Table 8 top ten countries contributed in brain mapping research

Sl. No	Country	No. of records	% of 1486
1	United States America	563	37.89
2	Germany	140	9.42
3	United Kingdom	123	8.28
4	France	120	8.08
5	Japan	100	6.73
6	Italy	99	6.66
7	China	95	6.39
8	Canada	77	5.18
9	Spain	43	2.89
10	Switzerland	43	2.89

Table 8 indicates that top ten countries contributed in brain mapping research, totally 62 countries were contributed in this research during the study period. Among the 62 countries top ten countries are listed in this table, among ten countries United States of America occupies first place with 37.89 percent of papers contributed, Germany has occupies second place with 9.42 per cent of papers, United Kingdom has third place with 8.28 percent of papers, France has fourth place with 8.08 percent of papers, Japan has fifth place with 6.73 percent of papers, Italy has sixth place with 6.66 percent of papers, China has seventh place with 6.39 percent of papers, Canada has eight place with 5.18 papers, Spain and Switzerland has ninth and tenth position with 2.89 percent of papers in this research, moreover the remaining 52 countries were contributed below 43 papers in this research.

Table 9 top ten sources published in brain mapping research papers

Sl. No	Source title	No. of Records	% of 1486
1	Neuroimage	108	7.27
2	Human Brain Mapping	32	2.15
3	Neurosurgery	31	2.09
4	Magnetic Resonance in Medicine	29	1.95
5	Plos One	29	1.95
6	Lecture Notes In Computer Science, Artificial Intelligence and Bioinformatics	24	1.62
7	Journal of Neuroscience Methods	20	1.35
8	Progress in Biomedical Optics and Imaging Proceedings of SPIE	17	1.14
9	Journal of Neurosurgery	15	1.01
10	Journal of Neuroscience	13	0.87

Table 9 shows that top ten sources published in brain mapping research papers, 1486 papers were published 657 sources. Among the 657 sources, only top ten sources listed in this table, 'Neuroimage' sources has occupies first position with 108 papers, 'Human Brain Mapping' has second place with 32 papers, 'Neurosurgery' has third place with 31 papers, 'Magnetic Resonance in Medicine' and , 'Plos One' has fourth and fifth place with 29 papers respectively,

'Lecture Notes In Computer Science, Artificial Intelligence and Bioinformatics' has sixth place with 24 papers, 'Journal of Neuroscience Methods' has seventh place with 20 papers, 'Progress in Biomedical Optics and Imaging Proceedings of SPIE' has eighth place with 17 papers, 'Journal of Neurosurgery' has ninth place with 15 papers, 'Journal of Neuroscience' has tenth place with 13 papers, moreover remaining 647 sources were published below 13 papers in this research during the study period.

Table 10 top ten institutions contributed in brain mapping research performance

Sl. No	Institutions name	No. of records	% of 1486
1	French National Institute of Health and Medical Research (Inserm)	55	3.70
2	David Geffen School of Medicine at UCLA	49	3.30
3	University of California, Los Angeles	45	3.03
4	CNRS Centre National de la Recherche Scientifique	26	1.75
5	UCL Institute of Neurology	25	1.68
6	Harvard Medical School	24	1.62
7	Johns Hopkins University	24	1.62
8	National Institutes of Health, Bethesda	24	1.62
9	University of California, San Francisco	23	1.55
10	University of Toronto	21	1.41

Table 10 shows that top ten institutions contributed in brain mapping research performance during 2002 to 2016, more than 161 institutions were contributing in this research, among those top ten institutions are 'French National Institute of Health and Medical Research (Inserm)' has occupies first place with 55 papers contributed, 'David Geffen School of Medicine at UCLA' has second place with 49 papers, 'University of California, Los Angeles' has third place with 45 papers, 'CNRS Centre National de la Recherche Scientifique' has fourth place with 26 papers, 'UCL Institute of Neurology', 'Johns Hopkins University' and 'National Institutes of Health, Bethesda' has sixth, seventh and eighth place with 24 papers respectively, 'University of California, San Francisco' has ninth place with 23 papers, and 'University of

Toronto' has contributed tenth place with 21 papers, moreover remaining instaurations were contributed published less than 21 papers in this research.

Conclusion

Conclude form the present study, the brain mapping research publications are showing increasing from 48 to 143 papers, moreover during the study period publications of Doubling Time mean value is 12.74 and the relative growth rate mean value is 0.075, the Growth of publications is raise during the study period. Among the 1486 papers, article has first position, Conference Paper has second place, Review type has third place, followed by Book Chapter, Note, Editorial, Erratum, Letter, Short Survey and Book last position. Totally 1486 papers were contributed in thirteen languages, among those languages1428 papers were published in English, 20 papers were published in Japanese and so on. It reveals that, 91.59 per cent papers were contributes collaborative authors, only 8.41 percent of papers were contributed single authored papers. Totally 2743 authors were contributed in this research, among the authors Thompson, P.M. has contributed 36 papers, remaining authors were contributed less number of papers, totally 62 countries were contributed in this research during the study period. Totally 657 sources were published 1486 papers the 'Neuroimage' sources has occupies first position the remaining sources are contributed less than 50 papers in this research during 2002 to 2017.

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