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RESEARCH ARTICLE

SCIENTOMETRIC ANALYSIS OF RESEARCH ON NEUROPHYSIOLOGY

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ABSTRACT

This paper discuss on Scientometric analysis of research on neurophysiology, the study aims to analysis, to find out year wise publications on neurophysiology research, to examine authorship pattern, to find out twenty authors contributed on neurophysiology research. The data have accessed from the Scopus database; the keyword was used in search documents 'Neurophysiology'. A total of 1366 records were retrieved the Scopus database, the year wise analysis shows on neurophysiology research publications an increasing and decreasing trend. The document type wise research publications on neurophysiology, article has first position with 506 publications, among the top twenty authors, De Paola, L. have first place with 1.61 per cent contributions on neurophysiology research, collaborative contributions are more, single authors' contributions are very least. Out of 1366 publications, Harvard Medical School occupies the first position with 32 contributions, UCL Queen Square Institute of Neurology, Sapienza Universit   di Roma has a second and third place with 22 contributions respectively.

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INTRODUCTION

Neurophysiology is a subdiscipline of the scientific disciplines (Luhmann H.J. 2013). Neurophysiology is the study of the functional properties of neurons, glia, and networks (T.J. Teyler 2001). Neurophysiology is concerned with the investigation of function in the central and peripheral nervous system (NHS Constitution). Neurophysiology also plays a role in monitoring people who have disorders affecting the brain including viral encephalitis, meningitis, strokes or are suffering with dementia (NHS Constitution). Neurological disorders included in the analysis were tetanus, meningitis, encephalitis, stroke, brain and other nervous system cancers, traumatic brain injury, spinal cord injury, Alzheimer's disease and other dementias, Parkinson's disease, multiple sclerosis, motor neuron disease, idiopathic epilepsy, migraine, tension-type headache, and a residual category of other less common neurological disorders (Valery L. Feigina and Theo Vosm 2019). Up to 1 billion people, nearly one in six of the world's population, suffer from neurological disorders, from Alzheimer and Parkinson disease, strokes, multiple sclerosis and epilepsy to migraine, brain injuries and neuroinfections, with some 6.8 million dying of the maladies each year (World Health Organization 2007), Neurophysiology offers the surgeon immediate identification of structures as functional nervous tissue, and their distinction from other tissue also in the sacral segments; and, furthermore, continuous monitoring of function of the relevant somatic nervous structures (David B. Vodušek, Vedran Deletis, 2020).

METHODOLOGY

In the present study, the data have accessed from the Scopus database; the keyword was used in search documents 'Neurophysiology' selected the search within field 'article title', and the time span field has been selected published from 2006 to 2020. A total of 1366 records were retrieved, the data downloaded and analyzed using MS office-Excel as per objectives of the present study.

Relative Growth Rate (RGT) and Doubling Time (DT): The relative growth rate is the increase in the number of publications/pages per unit of time. Here, 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 specific 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 of publications per unit of time (year)

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

Doubling Time (DT): A direct equivalence exists between the relative growth rate and doubling time. If the number of publications/pages of a subject doubles during a given period, then the difference between the logarithms of the numbers at the beginning and at the end of the period must be the logarithms of the number 2. This difference has a value of 0.693. Thus, the corresponding doubling time for publication and pages can be calculated by 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 are framed for the present study;

- To find out year wise publications on neurophysiology research
- To identify document types wise on neurophysiology
- To examine authorship pattern on neurophysiology research
- To find out twenty authors contributed on neurophysiology research
- To find out top twenty institutions contributed on neurophysiology
- To find top twenty sources contributions on neurophysiology research
- To identify top twenty countries contributed on neurophysiology research

ANALYSIS AND INTERPRETATION

Table 1. Year wise publications on neurophysiology research

Sl. No.	Document types	No. of Records	Percentages
1	2006	90	6.59
2	2007	82	6.00
3	2008	91	6.66
4	2009	112	8.20
5	2010	94	6.88
6	2011	84	6.15
7	2012	98	7.17
8	2013	69	5.05
9	2014	74	5.42
10	2015	95	6.95
11	2016	103	7.54
12	2017	84	6.15
13	2018	87	6.37
14	2019	103	7.54
15	2020	100	7.32
	Total	1366	100.00

Table 1 show that the year wise publications on neurophysiology research publications, during the study period, in the year 2009 has more publication with 8.20 per cent, 2016 and 2019 has published 7.54 per cent papers respectively, followed by in year 2010 has 7.32 per cent paper published, 2012 have published 7.17 per cent papers, 2015 have published 6.95 per cent papers, in the year 2010 have published 6.88 per cent papers, 2008 have published 6.66 per cent papers, 2006 have published 6.59 per cent papers, 2018 have published 6.37 per cent papers, 2011 and 2017 have published 6.15 per cent papers respectively, 2007 have published 6.00 per cent papers, 201 have published 5.42 per cent papers, and the year 2013 have least publication with 5.05 per cent papers in this research.

It found that, the year wise analysis shows on neurophysiology research publications an increasing and decreasing trend.

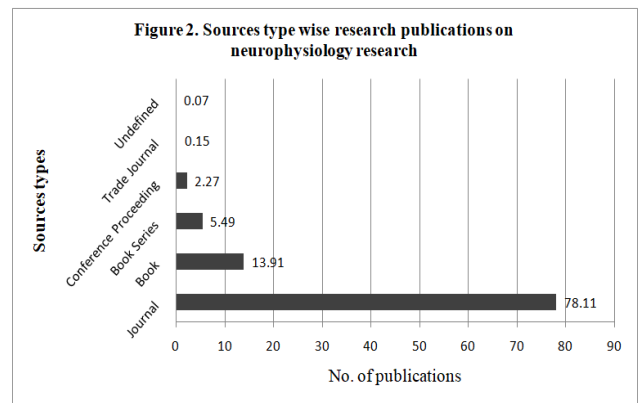
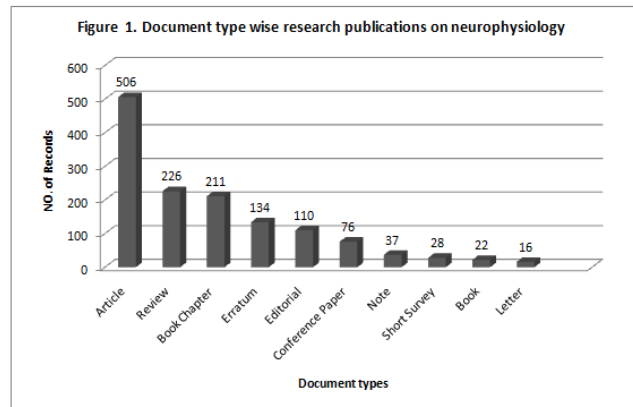


Table 2 shows that Relative Growth Rate and Doubling Time of neurophysiology research, the publications Doubling Time mean value is 1.11. In 2006, the neurophysiology research publications were 90; gradually the research publications were raised to 100 in the year 2020, the relative growth rate mean value is 0.007. The neurophysiology research publications are increasing more than three times from starting year to end of the study period year. Figure 1 show that the document type wise research publications on neurophysiology, totally ten document type are contributed on this research, article has first position with 506 publications, review has second place with 226 papers, book chapter has third place with 211 publications, erratum has fourth place with 134 publications, followed by editorial have published 110 publications, conference paper have published 76 publications, note have published 37 publications, short survey have published 28 publications, book have published 22 publications, letter have published 16 publications. Figure 2 shows that the sources type wise research publications on neurophysiology research, among the six sources, journal has more contribution with 78.11 per cent publications, followed by book has 13.91 per cent contributions, book series has 5.49 per cent contributions, conference proceeding have published 2.27 per cent publications, trade journal have published 0.5 per cent publications, and undefined sources were contributed 0.07 per cent publications. Table 3 shows that the top twenty authors contributed on neurophysiology research publications, among the twenty authors, De Paola, L. has occupies first place with 1.61 per cent contributions on neurophysiology research, Tsuchida, T.N. has second place with 1.02 per cent, Drislane, F.W. and Sala, F. A. they have third and fourth place respectively, Deletis, V. has fifth place with 0.73 per cent, Halford, J.J, Sinha, S.R. Stecker, M.M. A. they have sixth, seventh and eighth place with 0.59 per cent contributions respectively, Hallett, M., Rothwell, J.C. A. they have ninth and tenth place with 0.51 per cent contributions respectively, Acharya, J.N., Burke, D., Cheek, J. Micoulaud-Franchi, J.A., Sabau, D., Tatum, W.O. and Ziemann, U. A. they have eleventh, twelfth, thirteenth, fourteenth, fifteenth, sixteenth, seventeenth place with 0.44 per cent contributions respectively, Berlucchi, G., Cendes, F., Grippo, A. they have eighteenth nineteenth, and twentieth place with 0.37 per cent contributions respectively.

Table 2. Relative Growth Rate and Doubling Time of neurophysiology research

Sl. No.	Publication Years	No. of Records	Cumulative	W1	W2	W2 - W1(Ra)	Mean (Ra) W2-W1	Doubling Time	Mean Dt (a)
1	2006	90	90		4.5				
2	2007	82	172	4.5	4.4	-0.1	0.01	-6.93	-0.31
3	2008	91	263	4.4	4.51	0.11		6.30	
4	2009	112	375	4.51	4.71	0.2		3.47	
5	2010	94	469	4.71	4.54	-0.17		-4.08	
6	2011	84	553	4.54	4.43	-0.11	0.002	-6.30	1.8
7	2012	98	651	4.43	4.58	0.15		4.62	
8	2013	69	720	4.58	4.23	-0.35		-1.98	
9	2014	74	794	4.23	4.3	0.07		9.90	
10	2015	95	889	4.3	4.55	0.25		2.77	
11	2016	103	992	4.55	4.63	0.08	0.01	8.66	1.85
12	2017	84	1076	4.63	4.43	-0.2		-3.47	
13	2018	87	1163	4.43	4.46	0.03		23.10	
14	2019	103	1266	4.46	4.63	0.17		4.08	
15	2020	100	1366	4.63	4.6	-0.03		-23.10	
	Total	1366					0.007		1.11

Table 3. Top twenty authors contributed on neurophysiology research

Sl. No.	Author name	No. of Records	% of 1366
1	De Paola, L.	22	1.61
2	Tsuchida, T.N.	14	1.02
3	Drislane, F.W.	12	0.88
4	Sala, F.	12	0.88
5	Deletis, V.	10	0.73
6	Halford, J.J.	8	0.59
7	Sinha, S.R.	8	0.59
8	Stecker, M.M.	8	0.59
9	Hallett, M.	7	0.51
10	Rothwell, J.C.	7	0.51
11	Acharya, J.N.	6	0.44
12	Burke, D.	6	0.44
13	Cheek, J.	6	0.44
14	Micoulaud-Franchi, J.A.	6	0.44
15	Sabau, D.	6	0.44
16	Tatum, W.O.	6	0.44
17	Ziemann, U.	6	0.44
18	Berlucchi, G.	5	0.37
19	Cendes, F.	5	0.37
20	Grippio, A.	5	0.37

Table 4. Language wise research performance on neurophysiology

Sl. No.	Languages	No. of Records	% of 1366
1	English	1189	87.04
2	German	52	3.81
3	Portuguese	36	2.64
4	French	26	1.90
5	Spanish	18	1.32
6	Japanese	12	0.88
7	Russian	10	0.73
8	Polish	7	0.51
9	Chinese	6	0.44
10	Italian	5	0.37
11	Slovenian	2	0.15
12	Bulgarian	1	0.07
13	Czech	1	0.07
14	Hungarian	1	0.07
	Total	1366	100.00

Table 6 shows that the authorship pattern on neurophysiology research publications, out of 1366 publications on neurophysiology research, Six and above authors' contributions are 36.68 per cent, followed by five authors contributions are 22.11 per cent, four authors contributions are 19.11 per cent, three authors are 10.76 per cent contributions, double authors' contributions are 7.03 per cent, single authors' contributions are very least at 4.32 per cent. Table 4 shows that the language-wise research publications on neurophysiology, 1366 records were published in fourteen languages, out of 1366 papers, 87.04 percent of papers have been published in English, in German 3.81 per cent of papers have been published, in Portuguese 2.64 per cent of papers have been published, in French 1.90 per cent of papers have been published, in Spanish 1.32 per cent of papers have been published, in Japanese 0.88 per cent of papers have been

published in Russian 0.73 per cent of papers have been published in Polish 0.53 per cent of papers have been published, in Chinese 0.44 per cent of papers have been published followed by in Italian 0.37 per cent paper, in Slovenian 0.15 per cent paper, in Bulgarian, Czech, and Hungarian 0.07 per cent papers published respectively. Table 5 shows that top twenty institutions contributed on neurophysiology research, out of 1366 publications, Harvard Medical School occupies the first position with 32 contributions, UCL Queen Square Institute of Neurology, Sapienza Università di Roma has a second and third place with 22 contributions respectively, followed by CNRS Centre National de la Recherche Scientifique has fourth place with 21 contribution, University of California,

Table 5. Top twenty institutions contributed on neurophysiology research

Sl. No.	Institutions (Affiliations)	No. of Records	% of 1366
1	Harvard Medical School	32	2.34
2	UCL Queen Square Institute of Neurology	22	1.61
3	Sapienza Università di Roma	22	1.61
4	CNRS Centre National de la Recherche Scientifique	21	1.54
5	University of California, San Francisco	20	1.46
6	University of Toronto	18	1.32
7	Inserm	17	1.24
8	University College London	17	1.24
9	Beth Israel Deaconess Medical Center	17	1.24
10	Ludwig-Maximilians-Universität München	15	1.10
11	University of Pittsburgh	14	1.02
12	University of Oxford	14	1.02
13	Université McGill	13	0.95
14	University of California, Los Angeles	13	0.95
15	Azienda Ospedaliera Universitaria Integrata Verona	13	0.95
16	University of Zurich	12	0.88
17	University of Washington	12	0.88
18	Medical University of South Carolina	12	0.88
19	The George Washington University School of Medicine and Health Sciences	12	0.88
20	Fondazione Don Carlo Gnocchi	12	0.88

Table 6. Authorship pattern on neurophysiology research

Sl. No.	Authorship pattern	No. of papers	Percentages
1	Single	59	4.32
2	Double	96	7.03
3	Three	147	10.76
4	Four	261	19.11
5	Five	302	22.11
6	Six and Above	501	36.68
	Total	1366	100.00

Table 6. Top twenty sources contributed on neurophysiology

Sl. No.	Source titles	No. of Records	% of 1366
1	Journal of Neurophysiology	105	7.69
2	Clinical Neurophysiology	69	5.05
3	Journal of Clinical Neurophysiology	34	2.49
4	Handbook of Clinical Neurology	32	2.34
5	Journal of Epilepsy and Clinical Neurophysiology	31	2.27
6	Klinische Neurophysiologie	21	1.54
7	Neurophysiologie Clinique	18	1.32
8	Neurophysiology	16	1.17
9	Childs Nervous System	12	0.88
10	Current Biology	10	0.73
11	Encyclopedia of Neuroscience	10	0.73
12	Journal of Undergraduate Neuroscience Education	10	0.73
13	Neurodiagnostic Journal	9	0.66
14	Neurophysiologie Labor	9	0.66
15	Frontiers in Neuroscience	8	0.59
16	Neuroimage	8	0.59
17	Neurology	8	0.59
18	Neuroscience and Biobehavioral Reviews	8	0.59
19	Journal of Neuroscience	7	0.51
20	Journal of Neuroscience Methods	7	0.51

Table 7. Top twenty countries contributed on neurophysiology research

Sl. No.	Countries	No. of Records	% of 1366
1	United States of America	469	34.33
2	United Kingdom	150	10.98
3	Italy	131	9.59
4	Germany	116	8.49
5	Canada	80	5.86
6	France	75	5.49
7	Australia	50	3.66
8	Switzerland	46	3.37
9	Japan	43	3.15
10	Netherlands	37	2.71
11	Belgium	36	2.64
12	Denmark	27	1.98
13	China	22	1.61
14	Spain	21	1.54
15	Brazil	17	1.24
16	Mexico	17	1.24
17	Finland	16	1.17
18	Russian Federation	16	1.17
19	Austria	15	1.10
20	India	15	1.10

San Francisco has fifth place with 20 contributions, University of Toronto has sixth place with 18 contributions, Inserm, University College London, and Beth Israel Deaconess Medical Center has seventh, eighth and ninth place with 17 contributions respectively, Ludwig-Maximilians-Universität München has tenth place with 15 contribution, University of Pittsburgh, and University of Oxford has eleventh and twelfth place with 14 contributions respectively, Université McGill, University of California, Los Angeles, Azienda Ospedaliera Universitaria Integrata Verona, has thirteenth, fourteenth and fifteenth place with 13 contributions respectively, University of Zurich, University of Washington, Medical University of South Carolina, The George Washington University School of Medicine and Health Sciences and Fondazione Don Carlo Gnocchi has sixteenth, seventeenth, eighteenth, nineteenth and twentieth place with 12 contributions respectively. Table 6 shows that top twenty sources contributed on neurophysiology during the study period, out of 1366 publications, the Journal of Neurophysiology occupies the first position with 1.69 per cent of papers published, Clinical Neurophysiology has second place with 5.05 per cent publications, Journal of Clinical Neurophysiology has third place with 2.49 per cent publications, Handbook of Clinical Neurology has fourth place with 2.34 per cent publications, Journal of Epilepsy and Clinical Neurophysiology has fifth place with 2.27 per cent publications, followed by Klinische Neurophysiologie has sixth place, Neurophysiologie Clinique has seventh place, Neurophysiology has eighth place, Childs Nervous System has ninth place, Current Biology, Encyclopedia of Neuroscience, has tenth, eleventh and

twelfth place respectively, Neurodiagnostic Journal, Neurophysiologie Labor has thirteenth and fourteenth place respectively, Frontiers in Neuroscience, Neuroimage, Neuroscience and Biobehavioral Reviews, has fifteenth, sixteenth, seventeenth and eighteenth place respectively, Journal of Neuroscience and Journal of Neuroscience Methods has occupied nineteenth and twentieth place with 0.51 per cent papers respectively. Table 7 shows that top twenty countries contributed on neurophysiology research, out of 1366 neurophysiology research publications, the United States of America has occupied first place with 34.33 per cent contributions, United Kingdom has second place with 10.98 per cent contributions, Italy has third place with 9.59 per cent contributions, followed by Germany has fourth place, Canada has fifth place, France has sixth place, Australia has seventh place, Switzerland has eighth place, Japan has ninth place, Netherlands has tenth place, Belgium has eleventh place, Denmark has twelfth place, China has thirteenth place, Spain has fourteenth place, Brazil and Mexico has fifteenth and sixteenth place respectively, Finland, Russian Federation has seventeenth and eighteenth place respectively, Austria, India has nineteenth and twentieth place with 1.1 per cent contributions respectively.

CONCLUSION

Conclude from the study, the year wise analysis shows on neurophysiology research publications an increasing and decreasing trend. The neurophysiology research papers were published in ten document types, the article type has the first position with 506 publications, the review has second place with 226 papers, book chapter has third place with 211 publications. The sources type-wise research publications on neurophysiology research; the journal has more contribution with 78.11 per cent publications; other sources were contributed least percentages. It found, the authorship pattern on neurophysiology research publications, multiple authorship patterns were contributed more than 95 per cent of publications compare to single-author publications. The language-wise research publications on neurophysiology, 1366 records were published in fourteen languages, out of 1366 papers, 87.04 percent of papers have been published in English, in German 3.81 per cent of papers have been published. Out of 1366 publications, Harvard Medical School occupies the first position with 32 contributions on neurophysiology. Out of 1366 neurophysiology research publications, the United States of America has occupied first place with 34.33 per cent contributions, India has a twentieth place with 1.1 per cent contributions.

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