A Bibliometric Assessment of Global Ice Bucket Challenge (Amyotrophic Lateral Sclerosis) Research

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Key Words

Amyotrophic lateral sclerosis · Ice bucket challenge · Bibliometric analysis

Abstract

Background: This study is a quantitative and qualitative assessment of the global research trends on amyotrophic lateral sclerosis (ALS) (popularly known as Ice Bucket Challenge), through related literatures retrieved from SCOPUS multidisciplinary database for the period 1974–2013. **Purpose:** This study is aimed at analyzing the literature on ALS in terms of document type, language, annual growth, productive country, journal, authors, subject, and most cited articles. **Methods:** The bibliographic data for this study was retrieved from the SCOPUS database using keywords ‘amyotrophic lateral sclerosis’, ‘motor neurone disease’, ‘Charcot disease’, ‘Lou Gehrig’s disease’, ‘Ice Bucket Challenge’ available in title, abstract, and keyword fields of Scopus database from 1974 to 2013. **Results:** The literature analysis included 21,750 articles during the period from 1974 to 2013 in different areas of ALS. USA was the most productive country in terms of literature produced, while *Neurology* was the most productive journal. **Conclusion:** An intensive awareness created by ‘Ice Bucket Challenge’ has attracted masses, and an

intensive growth of literature is pertinent on ALS. The results of this study are expressed in terms of growth of literature, output of individual countries, and authors, and will be helpful in collaborative research in future.

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Introduction

The evidence of literature on amyotrophic lateral sclerosis (ALS) can be traced back to 1881, when an article on ALS was published in *The Lancet* journal [1]. Since then, there has been tremendous growth of literature on ALS, discussing the various aspects of the disease. The popularity of ALS became viral over the internet after the launch of ‘Ice Bucket Challenge’ in August 2014, by eminent people and celebrities from the global world for raising funds for ALS research [2–4]. ALS is a motor neuron disorder, characterized by muscle spasticity, atrophy, dysarthria (difficulty in speaking), dysphagia (difficulty in swallowing), and dyspnea (difficulty in breathing). Because of muscular atrophy, an individual with ALS loses control over self-initiated movement. Stephen Hawking, a famous personality, was a victim of the ALS disorder. It is also named as motor neurone disorder or Lou Gehrig’s disorder.

der, because of its neurodegenerative characteristics. Some reports reveal that in an individual suffering from ALS, dementia, degenerative muscle disorder, and degenerative bone disorder coexist [5]. However, the individual may maintain his/her sensory function such as hearing, sight, touch, smell, and taste as the sensory nerves and the autonomic nervous system remain unaffected [6].

There has been an increasing interest in bibliometric research, especially in medical sciences, for quantitative analysis of literature published in a specific time period. A study on rheumatological research in the European Union reported that the 'statistical measurements of published literature help in understanding the advancement of knowledge over a period of time on a given subject [7]'. This paper is an effort to measure the research advancements in the area of ALS as it has become one of the most sought after disorder subsequent to the launch of 'Ice Bucket Challenge'. This study will help in understanding the trends of research over a period in terms of literature growth on ALS, publication counts of countries, authors, and journals, types of publication; citation patterns; subject coverage; and highly cited articles.

Literature Review

Bibliometric studies carried out in recent years provide a precise objective for measuring the contribution of an individual and an organization to the advancement of knowledge in a particular field. There are several bibliometric studies on neural research that present trends on literature growth and interpret the results statistically. These studies appear in different journals, dedicated to publish research related to neurology. In recent years, various researches on neurological disorder have been analyzed using the bibliometric methods, such as the publication output on Parkinson's disease [8–10], Alzheimer's disease [11–14], and Guillain-Barre syndrome [15]. Some other bibliometric studies related to these diseases are specialty focused on the contribution by specific countries [16, 17]. These literature reviews do not produce any evidence on the involvement of research output concerned with ALS. Thus, the objective of this study was to analyze the research trends on literature published on ALS during the period from 1974 to 2013.

Objectives

The objectives of this study are:

- (i) To find the growth of literature on ALS during 1974–2013;
- (ii) To assess document types and language of publication;

- (iii) To adjudge most productive countries, authors, and journals;
- (iv) To assess the shift in research trends in various subjects;
- (v) To trace the status of highly cited papers.

Methods

The data was collected from the SCOPUS multidisciplinary bibliographic database. The keywords 'amyotrophic lateral sclerosis', 'motor neurone disease', 'Charcot disease', 'Lou Gehrig's disease', 'Ice Bucket Challenge' available in the title, abstract, and keyword fields of SCOPUS database were used to extract bibliographic information for the period from 1974 to 2013. The articles published from England, Scotland, Northern Ireland, and Wales were considered as being published from the United Kingdom. The performance of the individual author and institution was determined based on the number of articles written by the author and his/her affiliation address. The citation count was taken as the number of citations scored by each title since its publication till December 2013. The journal impact factor was obtained from the 2013 edition of Journal Citation Report, published by ISI Web of Knowledge. The *h*-index [18], defined as 'the number of papers with citation number greater than or equal to *h*', was taken from the SCOPUS database.

Results

Document Type and Language of Publication

The 21,750 publications on ALS disorder were distributed in 11 document types, as indexed in the SCOPUS database. These include 13,206 articles as the most popular document type, which comprises 60.72% of the total production, followed distantly by reviews (4,421; 20.33%), conference papers (1,224; 5.63%), letters (877; 4.03%), editorials (598; 2.75%), notes (487; 2.24%), and short surveys (416; 1.91%). Other document types with less than 1% contribution were book chapters (156; 0.72%), errata (71; 0.33%), books (11; 0.05%), and conference reviews (4; 0.02%). There were 372 articles which were not classified in any group. As journal articles represented the majority of document types, 13,206 articles (60.72%) were further analyzed for interpreting various results. The 21,750 articles were published in 28 different languages; of which, 19,261 articles (88.56%) were published in English.

Characteristics of Publication

The characteristics of ALS publication outputs during the period of 40 years from 1974 to 2013 are presented in table 1.

Table 1. Characteristics of ALS publications analyzed in a 5 years block period

Year range	TP	GR	AGR	AU	AU/TP	TC	ACPP
1974–1978	507	–16.24	3.25	1,245	0.41	2,307	4.55
1979–1983	574	24.75	4.95	1,618	0.35	4,406	7.68
1984–1988	788	28.13	5.63	2,521	0.31	11,268	14.30
1989–1993	1,199	55.88	11.18	4,526	0.26	35,769	29.83
1994–1998	2,282	34.32	6.86	9,182	0.25	112,158	49.15
1999–2003	3,186	21.68	4.34	13,210	0.24	139,502	43.79
2004–2008	5,078	44.05	8.81	22,779	0.22	180,844	35.61
2009–2013	8,136	45.02	9.00	43,930	0.19	113,579	13.96
Global total	21,750	1,543.59	38.59	99,011		599,833	
Average					0.22		27.58

TP = Total publications; AU = total authors; TC = total citations; GR = growth rate; AGR = annual growth rate; ACPP = average citation per paper.

Fig. 1. Cumulative number of publications analyzed in terms of annual growth.

The trends of publication are analyzed in a period of 5 years duration in terms of total number of articles, growth rate (GR), annual GR (AGR), total number of authors, average number of authors, total citations, and average citation per paper (ACPP). It was found that the publication on ALS-related research obtained an overall GR of 1,543.59 (AGR of 39.59%) with 507 articles in the period 1974–1978 to 8136 in 2009–2013. A total of 99,011 authors, either singly or in joint collaboration published 21,750 articles. On an average, 0.41 authors per ALS publication published articles during the peri-

od 1974–1978, while the number steadily decreased to 0.19 in 2009–2013. The 21,750 articles have accumulated 5,99,833 citations with an ACPP of 27.58 citations. The articles which were published during the period 1994–1998 have the highest ACPP, though the total number of citations of articles published during the period 2004–2008 was the highest (180,844 citations; table 1).

The data were further analyzed, and it was found that a significant correlation exists between the annual cumulative number of publications and the period of study

Table 2. Most productive countries in ALS research

Country	TP	%TP	IP	%IP	CP	%CP
United States	7,475	34.37	2,538	33.95	4,937	66.05
Japan	2,375	10.92	527	22.19	1,848	77.81
Italy	1,727	7.94	903	52.29	824	47.71
United Kingdom	1,677	7.71	1,326	79.07	351	20.93
Germany	1,454	6.69	1,062	73.04	392	26.96
Canada	1,172	5.39	848	72.35	324	27.65
France	1,085	4.99	714	65.81	371	34.19
Netherlands	504	2.32	491	97.42	13	2.58
Spain	499	2.29	298	59.72	201	40.28
Australia	483	2.22	297	61.49	186	38.51

TP = Total publications; IP = independent publications; CP = collaborated publications.

from 1974 to 2013 (fig. 1). A cumulative progression, in terms of number of publications, was drawn and tested with an exponential model, which can be expressed as follows:

$$y = 280.61e^{0.1142x}$$

Due to the high coefficients of determination ($r^2 = 0.9707$), the rate of increase in global publication on ALS is expected to continue. Li et al. [8] reported an increasing trend of publications, which deals with neurological disorders such as Alzheimer's disease, multiple sclerosis, Huntington's disease, and Friedreich's ataxia.

Productive Countries

The publications share of the 10 most productive countries in ALS is given in table 2. The publication research ranges from 2.22 to 34.37% during 1974–2013. USA ranks first in the list, with a publications share of 34.37% during 1974–2013. Japan ranks second, followed by Italy, United Kingdom, and Germany (their global publications share ranging from 10.92 to 6.69%). Canada, France, Netherlands, Spain, and Australia rank at 6th–10th positions and their global publications share ranges from 5.39 to 2.22%. Among these top 10 productive countries in ALS research, Netherlands has 97.42% papers produced from Netherlands only, while Japan has least papers (22.19%). The United Kingdom has 79.07% articles, while Germany has 73.04%. Most of the papers published from Japan are published in collaboration with other countries, followed by USA (66.05%) and Italy (47.71%).

Table 3. Productive journals publishing ALS research, 1974–2013

Journals	TP	%TP	IF (2013)
Neurology	847	3.89	8.303
Journal of Neurological Sciences	650	2.99	2.262
Amyotrophic Lateral Sclerosis, now Amyotrophic Lateral Sclerosis and Frontotemporal Degeneration	598	2.75	2.591
Muscle and Nerve	466	2.14	2.311
Clinical Neurology	353	1.62	N/A
Acta Neuropathologica	336	1.54	9.777
Annals of Neurology	324	1.49	11.91
Amyotrophic Lateral Sclerosis and Other Motor Neuron Disorders – Continued as Amyotrophic Lateral Sclerosis now	293	1.35	2.591
Journal of Neurology Neurosurgery and Psychiatry	274	1.26	5.58
Archives of Neurology	261	1.20	7.008
Journal of Neurochemistry	235	1.08	4.244
Plos One	224	1.03	3.534
Journal of Neurology	213	0.98	3.841
Proceedings of the National Academy of Sciences of the United States of America	199	0.91	9.809
Neuroscience Letters	191	0.88	2.055
Acta Neurologica Scandinavica	187	0.86	2.537
Experimental Neurology	176	0.81	4.617
Brain Research	175	0.80	2.828
Neurobiology of Aging	174	0.80	4.853
Revue Neurologique	166	0.76	0.601

TP = Total publication; IF = impact factor.

Productive Journals

Table 3 presents the status of 20 most productive journals, which publishes about 29.16% global literature on ALS. A total of 21,750 articles were published in a wide range of journals, conferences, and books. The journal

Table 4. Productive authors in ALS research, 1974–2013

Author	Institute	TP	TC	ACPP	<i>h</i> -Index
Albert Christian Ludolph	Department of Neurology, Universitat Ulm, Germany	217	4,715	21.73	40
Peter Nigel Leigh	Trafford Centre for Medical Research, University of Sussex, UK	186	10,863	58.40	60
Vincent Meininger	ALS Community Network, Hopital Pitie Salpetriere, Paris, France	177	6,765	38.22	43
Hiroshi Mitsumoto	Department of Neurology, Columbia University Medical Center, New York, USA	156	5,863	37.58	43
Adriano Chiò	Rita Levi Montalcini Department of Neuroscience, Università degli Studi di Torino, Torino, Italy	141	4,409	31.27	43
Leonard Hendrik Van Den Berg	Department of Neurology, University Medical Center Utrecht, Netherlands	137	3,541	25.85	42
Pamela Jean Shaw	Department of Neuroscience, University of Sheffield, UK	136	6,362	46.78	49
Stanley H. Appel	Department of Neurology, Methodist Hospital Houston, USA	136	7,398	54.40	53
Wim Robberecht	Department of Neurology, University Hospital Leuven, Belgium	129	6,414	49.72	50
Michael R.W. Swash	Departments of Neurology and Neuroscience, Queen Mary, University of London, UK	127	3,701	29.14	31
Ammar Al Chalabi	Department of Basic and Clinical Neuroscience, King's College London, UK	125	6,084	48.67	44
Orla M. Hardiman	Quantitative Neuroimaging Group, Trinity College Dublin, Ireland	119	4,513	37.92	44
Christopher E.D. Shaw	Department of Basic and Clinical Neuroscience, King's College London, UK	115	6,367	55.37	46
Don W.W. Cleveland	Department of Cellular and Molecular Medicine, University of California, San Diego, USA	109	14,928	136.95	62
V. Silani	Department of Neurology, Università degli Studi di Milano, Italy	104	2,498	24.02	32
		2,114	94,421	44.66	
TP = Total publication; TC = total citation; ACPP = average citation per paper.					

Neurology (IF2013 = 8.303) was ranked first with 847 articles, which was 3.89% of the total publication on ALS. *Journal of Neurological Sciences* (IF = 2.262) was ranked second with 650 (2.99%) articles, followed by *Amyotrophic Lateral Sclerosis* now *Amyotrophic Lateral Sclerosis and Frontotemporal Degeneration* (IF = 2.591) with 598 articles (2.75%), and *Muscle and Nerve* (466; 2.14%). *Clinical Neurology* with 353 articles did not have much impact. Additionally, in the list of most productive journals, the *Annals of Neurology* had the highest impact factor (11.91).

Most Productive Authors on 'ALS' Research

The analysis of author's contribution to ALS research was carried out based on the most number of articles published during the period of study. It helps to identify

those researchers who have made important contributions in ALS research. A total of 99,011 authors either singly or in joint collaboration published 21,750 articles. Of these authors, it was found that 15 authors have made the highest contribution (table 4). Of these, 'Albert Christian Ludolph' had published the most number of articles on ALS (217 papers) and is the most productive author without author information (116 articles, 2.3% of 5,109 articles) followed by 'Peter Nigel Leigh' (186 papers) and 'Vincent Meininger' (177 papers). In terms of citation count, 'Don W.W. Cleveland' had scored the most number of citations for 109 papers with an ACPP of 136.95 followed by 'Peter Nigel Leigh' (10,836 citations; ACPP 58.4), and Stanley H. Appel (7,398 citations; ACPP 54.4). The research impact of these authors was found in

Table 5. Distribution of ALS literature in different subject categories

Subject area	TP	%Share
Medicine	13,464	61.90
Neuroscience	9,870	45.38
Biochemistry, Genetics and Molecular Biology	5,526	25.41
Pharmacology, Toxicology and Pharmaceutics	1,638	7.53
Psychology	604	2.78
Agricultural and Biological Sciences	463	2.13
Immunology and Microbiology	419	1.93
Health Professions	376	1.73
Multidisciplinary	365	1.68
Engineering	300	1.38
Nursing	290	1.33
Arts and Humanities	258	1.19
Chemistry	244	1.12
Computer Science	200	0.92
Social Sciences	159	0.73
Environmental Science	143	0.66
Chemical Engineering	140	0.64
Mathematics	78	0.36
Physics and Astronomy	63	0.29
Materials Science	39	0.18
Decision Sciences	32	0.15
Dentistry	24	0.11
Veterinary	14	0.06
Energy	9	0.04
Earth and Planetary Sciences	7	0.03
Business, Management and Accounting	6	0.03
Economics, Econometrics and Finance	6	0.03

TP = Total publication.

terms of *h*-Index. ‘Don W.W. Cleveland’ had the highest *h*-Index value of 62, followed by ‘Peter Nigel Leigh’ (*h*-Index 60), and ‘Stanley H. Appel’ (*h*-Index 53; table 4).

Subject Coverage of ALS Papers Published from India

The ALS documents appeared in 27 different subject categories (SCOPUS Journal Subject classification). The highest publications were related to the subject category Medicine (13,464 publications, 61.90% share). The other subject categories were Neuroscience (9,870 publications, 45.38% share), Biochemistry, Genetics and Molecular Biology (5,526 publications, 25.41% share), and Pharmacology, Toxicology and Pharmaceutics (1,638 publications, 7.53% share). These 4 subjects’ have contributed 1,000 and more documents on ALS, and the majority of documents fall into these 4 categories. Being a multidisciplinary area, the subjects have been put into more than one category. The other prominent subject classification of ALS research is given in table 5.

Institutes’ Research Performances

The contribution of top 10 most productive institutes is given in table 6. Massachusetts General Hospital, USA is the most productive institute with 383 publications, which is 1.76% of the total global output. King’s College London was ranked second (351; 1.61% share) and VA Medical Center, USA (322; 1.48%) third. In terms of citation count, Massachusetts General Hospital, USA ranked one (29,327 citations), followed by Kings College London (16,928 citations), and Johns Hopkins University, USA (16,636 citations). Impact in terms of ACP, Johns Hopkins University, USA topped the rank (84.02 citations per paper), followed by Massachusetts General Hospital, USA (76.57 citations per paper), and Johns Hopkins School of Medicine, USA (71.61 citations per paper).

Most Frequently Cited Paper

The research impact of any work published in the form of an article is assessed in terms of citation scored by the article since its publication. Marx and Cardona [19] dis-

Table 6. Most productive institutions on ALS research

Institutes	TP	%Share	TC	ACPP
Massachusetts General Hospital, USA	383	1.76	29,327	76.57
King's College London, UK	351	1.61	16,928	48.23
VA Medical Center, USA	322	1.48	10,763	33.43
Hopital Pitie Salpetriere, France	248	1.14	6,297	25.39
The University of British Columbia, Canada	247	1.14	12,290	49.76
The Johns Hopkins School of Medicine, USA	225	1.03	16,113	71.61
Universitat Ulm, Germany	222	1.02	4,153	18.71
University Medical Center Utrecht, Netherlands	199	0.91	4,245	21.33
Johns Hopkins University, USA	198	0.91	16,636	84.02
University of California, San Francisco, USA	192	0.88	10,519	54.79

TP = Total publications; TC = total citations.

Table 7. Characteristics of most frequently cited articles on ALS

Year	Article title	SCOPUS citation	Google citation	Web of Science
1996	Beckman JS, Koppenol, WH: Nitric oxide, superoxide, and peroxynitrite: the good, the bad, and the ugly. <i>Am J Physiol</i> 271:3660–4772	3,660	4,722	3,451
1993	Rosen DR, Siddique T, Patterson D, et al: Mutations in Cu/Zn superoxide dismutase gene are associated with familial amyotrophic lateral sclerosis. <i>Nature</i> 362:3326–4725	3,326	4,725	3,693
2002	Wolpaw JR, Birbaumer N, McFarland DJ, et al: Brain–computer interfaces for communication and control. <i>Clin Neurophysiol</i> 113:2505–3760	2,505	3,760	1,866
1994	Gurney ME, Pu H, Chiu AY, et al: Motor neuron degeneration in mice that express a human Cu/Zn superoxide dismutase mutation. <i>Science</i> 264:2208–2779	2,208	2,779	2,255
2006	Neumann M, Sampathu DM, Kwong LK, et al: Ubiquitinated TDP-43 in frontotemporal lobar degeneration and amyotrophic lateral sclerosis. <i>Science</i> 314:1657–2011	1,657	2,011	1,560
1995	Bonfoco E, Krainc D, Ankarcrona M, et al: Apoptosis and necrosis: two distinct events induced, respectively, by mild and intense insults with <i>N</i> -methyl-D-aspartate or nitric oxide/superoxide in cortical cell cultures. <i>PNAS U S A</i> 92:1558–1975	1,558	1,975	1,540
2000	Brooks BR, Miller RG, Swash M, Munsat TL: El Escorial revisited: revised criteria for the diagnosis of amyotrophic lateral sclerosis. <i>Amyotroph Lateral Scler</i> 1:293–299	1,646	2,025	
2006	Smith, et al: Tract-based spatial statistics: voxelwise analysis of multi-subject diffusion data. <i>NeuroImage</i> 31:1498–1904	1,498	1,904	1,399
1994	Brooks BR: El Escorial World Federation of Neurology criteria for the diagnosis of amyotrophic lateral sclerosis. <i>J Neurolo Sci</i> 124(suppl):96–107	1,481	1,269	1,478
2003	Turrens JF: Mitochondrial formation of reactive oxygen species. <i>J Physiol</i> 552:1417–2009	1,417	2,009	1,363

cussed the citation activity in terms of time dependency of an article and refer to it as ‘sales figure’ of the article. Table 2 presents the status of 10 articles on ALS, which are most frequently cited. The article ‘Nitric Oxide, Superoxide, and Peroxynitrite: The Good, the Bad, and the Ugly’ was the most frequently cited article on ALS, with an average citation of 203.33 citations per year since its publication in 1996. The citations slightly increased after

it was published and reached a maximum after 6 years. However, a decreasing trend can be seen after 6 years (i.e. 2002). This article basically deals with the effect of nitric oxide, superoxide, and peroxynitrite on internal messenger services. Furthermore, antibodies to nitrotyrosine have revealed nitration in human atherosclerosis, myocardial ischemia, septic and distressed lung, inflammatory bowel disease, and ALS [20]. Table 7 also gives the

Fig. 2. Characteristics of 5 most cited articles on ALS.

citation count by 3 different databases such as SCOPUS, Google Citation, and Web of Science. A significant difference can be observed in the number of citation data available through these 3 sources. These variations in terms of quantity and quality of citation through these sources have always been debatable and will be used as a measure of research impact [21].

The citation analysis of the top cited articles since their publication describes the research impact in that particular subject field. Several studies have assessed the impact based on the citation count. Aversa [22] reported 2 types of citation patterns: 'delayed rise – slow decline' and 'early rise – rapid decline'. Various other terminologies to such kinds of citation pattern, where 'delayed rise – slow decline' papers often turn out to be more valuable and influential. According to Stent [23], these are known as 'scientific prematurity', while Garfield [24] termed them as 'delayed recognition' and Van Raan [25] as 'sleeping beauties'. Fitting into these hypotheses, 2 papers on ALS – Rosen et al. (1993) (3,326 citations) and Gurney et al. (1994) (2,208 citations) – show 'slow rise – delayed decline' citation pattern and these articles are still being well

cited even after 20 years of their publication. One article by Danbolt N.C. (2001) scored 2,177 citations and shows an early rise in the citation but starts decline after 6 years of its publication. While the article by Wolpaw et al. (2002) with a citation of 2,505 is continuously increasing year after year (fig. 2).

Discussion

ALS is a neurodegenerative motor neuron disorder, characterized by muscle spasticity, atrophy, dysarthria, dysphagia, and dyspnea. Because of muscular atrophy, an individual with ALS loses control over self-initiated movement. The ALS gained publicity with the involvement of celebrities worldwide in a campaign known as 'Ice Bucket Challenge'. The SCOPUS database had indexed 21,750 articles during the period 1974–2013. There were 16 document types used in ALS research publications, where 60.72% documents were published as journal articles. Though journal articles were the most prominent mode of publication, there were also conference pa-

pers which have a fair amount of publication share. English was the most predominant language of communication. The articles on ALS research had an AGR of 39.59% per year during the period of study. All the papers were published by about 0.22 authors per paper. There was a high coefficient of determination, which illustrates a continued growth trend in future. USA was the most productive country with a share of 34.37% of global publication. Japan had more collaborative papers shared with other countries; 77.81% papers published from Japan were collaborated papers. Papers published from the Netherlands were least collaborated; 97.42% papers were published by authors from Netherlands only. The research in developing countries, such as India, does not show any progressive impact on research-related to ALS and ranked far behind in the list. ALS research was published in a wide range of journals, with the journal 'Neurology' being the most productive journal. 'Massachusetts General Hospital, USA' was the most productive in-

stitution in terms of the number of publications on ALS. There was a correlation between the *h*-Index and citations. The authors with highest citations have a higher *h*-Index value. However, the most productive author does not have a high *h*-Index value.

There is a need to understand the importance of these diseases and the results reported in this study shall help the scientists and other stakeholders in collaboration for future research.

Author Contribution

All work on the manuscript was done by Shri Ram.

Disclosure Statements

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References

- 1 Ferrier D: National hospital for the paralysed and epileptic. Cases of amyotrophic lateral sclerosis. *Lancet* 1881;117:822–823.
- 2 INDEPENDENT: George Bush Delivers Possibly the Best ALS Ice Bucket Challenge Yet (retrieved August 20, 2014).
- 3 Metro: 10 of the Best Celebrity Ice Bucket Challenges (retrieved August 20, 2014).
- 4 Guardian: The 10 Best Celebrity Takes on the Ice Bucket Challenge (retrieved August 20, 2014).
- 5 Johnson JO, Mandrioli J, Benatar M, Abramzon Y, Van Deerlin VM, Trojanowski JQ, et al: Exome sequencing reveals VCP mutations as a cause of familial ALS. *Neuron* 2010;68:857–864.
- 6 NIH: Amyotrophic Lateral Sclerosis (ALS) Fact Sheet. http://www.ninds.nih.gov/disorders/amyotrophiclateralsclerosis/detail_als.htm.
- 7 Mela GS, Cimmino MA: An overview of rheumatological research in the European Union. *Ann Rheum Dis* 1998;57:643–647.
- 8 Li T, Ho YS, Li CY: Bibliometric analysis on global Parkinson's disease research trends during 1991–2006. *Neurosci Lett* 2008;441:248–252.
- 9 Ansari MA, Khan A: Parkinson's disease: a bibliometric profile. *Trend Inform Manag* 2008;3:58–68.
- 10 Ponce FA, Lozano AM: The most cited works in Parkinson's disease. *Mov Disord* 2011;26:380–390.
- 11 Ansari MA, Gul S, Yaseen M: Alzheimer's disease: a bibliometric study. *Trend Inform Manag* 2006;2:130–140.
- 12 Sorensen AA: Alzheimer's disease research: scientific productivity and impact of the top 100 investigators in the field. *J Alzheimers Dis* 2009;16:451–465.
- 13 Sorensen AA, Seary A, Riopelle K: Alzheimer's disease research: a COIN study using co-authorship network analytics. *Proced Soc Behav Sci* 2010;2:6582–6586.
- 14 Chen H, Wan Y, Jiang S, Cheng Y: Alzheimer's disease research in the future: bibliometric analysis of cholinesterase inhibitors from 1993 to 2012. *Scientometrics* 2014;98:1865–1877.
- 15 Ram S: India's contribution on 'Guillain-Barre syndrome': mapping of 40 years research. *Neurol India* 2013;61:375–382.
- 16 Gupta BM, Bala A: Alzheimer's disease research in India: a scientometric analysis of publications output during 2002–2011. *Res Neurol* 2013;11:204542.
- 17 Gupta BM, Bala A: Parkinson's disease in India: an analysis of publications output during 2002–2011. *Int J Nutr Pharmacol Neurol Dis* 2013;3:254–262.
- 18 Hirsch JE: An index to quantify an individual's scientific research output. *Proc Natl Acad Sci U S A* 2005;102:16569–16572.
- 19 Marx W, Cardona M: The impact of solid state communications in view of the ISI citation data, *Solid State Commun* 2003;127:323–336.
- 20 Beckman JS, Koppenol WH: Nitric oxide, superoxide, and peroxynitrite: the good, the bad, and ugly. *Am J Physiol* 1996;271(5 pt 1):C1424–C1437.
- 21 De Winter JCF, Zadpoor AA, Dodou D: The expansion of Google Scholar versus Web of Science: a longitudinal study. *Scientometrics* 2014;98:1547–1565.
- 22 Aversa ES: Citation patterns of highly cited papers and their relationship to literature aging: a study of the working literature. *Scientometrics* 1985;7:383–389.
- 23 Stent GS: Prematurity and uniqueness in scientific discovery. *Sci Am* 1972;227:84–93.
- 24 Garfield E: Premature discovery or delayed recognition – why. *Curr Contents* 1980;21:5–10.
- 25 Van Raan AFJ: Sleeping beauties in science. *Scientometrics* 2004;59:467–472.