Multiple Sclerosis and Related Disorders 54 (2021) 103112

Contents lists available at ScienceDirect

Multiple Sclerosis and Related Disorders

journal homepage: www.elsevier.com/locate/msard

Performance of highly cited multiple sclerosis publications in the Science Citation Index expanded: A scientometric analysis

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A R T I C L E I N F O

Keywords:
Scientometrics
Highly cited articles
Multiple sclerosis
Web of science core collection
Front page
Y-index

A B S T R A C T

Background: The present study aims to identify and analyze the characteristics of highly cited publications on Multiple sclerosis in the Science Citation Index Expanded.
Methods: Documents that had 100 citations or more were considered as the highly cited documents. Highly cited publications were analyzed in the distribution of document types, languages, publication years, Web of Science categories, and journals as well as publication performance of countries, institutions, and authors. The six and five publication indicators were applied to compare publications of the countries and the institutes respectively. Highly cited authors were analyzed by Y-index.
Results: In general, articles spent about 12 years to be highly cited articles. The USA dominated the production by the six publication indicators. Harvard University was the most active in research on multiple sclerosis while the University of California, Los Angeles in the USA shows the most independent research. M. Filippi was recognized as the most productive author who had the most articles as the corresponding author.
Conclusion: The findings may be of interest to multiple sclerosis researchers and policymakers all around the world.

1. Introduction

Scientific outputs indicate research activities and the rate of scientific development and progress in various areas (Jalal, 2013), and their evaluation is essential for scientific policymakers of countries and universities (Hood and Wilson, 2001). Scientometric studies are used to evaluate the quantity and quality of research outputs of researchers, institutions, countries, journals, and various fields (Bornmann and Leydesdorff, 2014; Hood and Wilson, 2001). It seems that R & D investments can lead to more scientific publications. Different countries tend to use policy levers in this area. The field of scientometrics can provide a quantitative solution to how research policy is made and how articles relate to research funding (Shelton, 2020). With an in-depth and comprehensive view of the current state of scientific publications, scientometric plays a crucial role in the proper direction of financial and human capital in scientific centers, making researchers aware of the current situation in the field and strive to achieve the desired situation.

Citation is the basis of scientometric indicators and reflects the academic impact of a document. Highly cited articles are recognized as indicators of scientific evaluation and comparison of different countries, authors, and institutions and a criterion for identifying high- quality research (The Europe 2020 competitiveness report: building a more competitive Europe, 2012).

Multiple Sclerosis (MS) is an autoimmune disease of the central nervous system that causes to damage the myelin sheaths of cells in the brain and spinal cord (Goldenberg, 2012). The disease causes disability in people and imposes a high cost on medical systems and patients (Kobelt et al., 2017). The number of people with MS is steadily increasing from 2.1 million to 2.3 million from 2008 to 2013 (Browne et al., 2014). Accordingly, this has led to much research in this area around the world, and their results are published in the form of scientific papers. However, only a few paper may be considered by the scientific community as highly cited publications.

So far, no global research has reviewed the highly cited articles in MS, and only one article has examined publications in this field in Southeast Asian countries (Espiritu et al., 2020). However, highly cited articles in various areas, including various medical fields, have always been the subject of some scientometrics papers (Haseli-Mofrad et al., 2019; Hsu and Ho, 2014; Miró et al., 2015; Pagni et al., 2014; Ram and Nisha, 2020). Therefore, the current study aims to identify the highly

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https://doi.org/10.1016/j.msard.2021.103112
Received 10 May 2021; Received in revised form 15 June 2021; Accepted 22 June 2021
Available online 30 June 2021

cited articles in MS and analyze their features, such as authors, countries, institutions, and journals that publish these articles from 1900 to 2019. Besides, the authors of highly cited MS articles are evaluated based on their writing characteristics using the *Y*-index.

2. Material and methods

The data required for the present study was obtained through searching SCI-EXPANDED on the Web of Science core collection database (updated on July 29, 2020). The basic search section can be used to search for MS articles. By searching for "multiple sclerosis", "multiple scleroses", "multiple sclerosia", "multiple sclerotic", and "disseminated sclerosis" in the basic search of topic including document title, abstract, author keywords, and *KeyWords Plus,* 994,112 records, including 64,920 articles were retrieved. However, since *KeyWords Plus* contains keywords that are selected based on the title of the articles mentioned in the references and footnotes (Garfield, 1990), searching through it may include articles that have little relevance to the topic (Fu and Ho, 2015). these articles may be suitable as readable sources but not for scientometrics analyzes (Ho, 2018),therefore, it is always necessary to have a bibliometric treatment when using the SCI-EXPANDED database and to solve the bias, retrieval from the advanced search section through searching the 'front page', including (title, author keywords, and abstract), has been suggested by the Ho's group (Fu et al., 2012). It should be noted that using this search method compared to the 'topic' has a big difference in the results (Ho, 2019a).

By using advanced search with TI (title), AB (abstract), and AK (author keywords) as 'front page', 90,548 documents (80% of the 112,994 documents) including 47,923 articles (74% of the 64,920 articles) were defined as multiple sclerosis research articles. These records were downloaded into spreadsheet software, and additional coding was manually performed using Microsoft Excel software 2016 for calculation. TC_{year} is the total citation number of a document from Web of Science Core Collection since its publication year to the end of the most recent year (Ho, 2012). In Ho's article, $TC_{year} \geq 100$ was used to retrieve highly cited articles (Ho, 2014). This study selected articles with $TC_{2019} \geq 100$ as highly cited articles.

In the SCI-EXPANDED database, the corresponding-author is marked as the reprinted author, but we use the term corresponding-author. In a single institutional article, the institution is classified as the first- and the corresponding-author institution (Ho, 2014). In multiple corresponding-author articles, only the last corresponding-author, institute, and country are considered (Ho, 2019b). In single-author articles that do not specify the authorship, the single-author is both the first-author and the corresponding-author (Ho, 2014). In articles with multiple first-authors, only the first-author, research institute, and country are considered. The affiliation of England, Scotland, Northern Ireland, Wales and Anguilla was reclassified as the United Kingdom (UK) (Chiu and Ho, 2005). Similarly, the affiliation with the Fed Rep Ger (Federal Republic of Germany) is also included in Germany (Ho, 2012).

3. Results and discussion

3.1. Document type and language of publication

A total of 4147 highly cited publications (8.7% of 47,923 multiple sclerosis publications) with a TC_{2019} of 100 or more were found within 11 document types indexed in the Web of Science. In order to have scientific results, which can be repeated and checked, Ho's group proposed citation indicators TC_{year} and citations per publication ($CPP_{year} = TC_{year}/TP$) (Ho and Fu, 2016).

Table 1 shows the characteristics of the 11 document types with the total number of publications (*TP*), the number of authors per publication (*APP*), and citations per publication (CPP_{2019}). The article document type was the most popular with 3232 articles (78% of 4147 documents) and an *APP* of 8.4. The news items document type had the highest CPP_{2019} of 429 which can be attributed to the only news item titled "Multiple sclerosis: a two-stage disease" by Steinman from Stanford University School of Medicine in the USA with a TC_{2019} of 429 (Steinman, 2001). This news item correctly shows two different faces but is related to each other in MS. The disease's inflammatory face, which is seen especially in its early stages, and the neurodegenerative face of the disease, although pathologically occurring from the very beginning of the disease, usually manifests itself clinically after a while. Attention to these two phases of the disease forms the basis of treatment. Particular attention is paid to the neurodegeneration process, which is the Achilles heel of MS and for which no cure has yet been discovered, is, therefore the reason of great interest to this news.

Table 1
Citations and authors according to document type.

Document type	*TP*	%	*AU*	*APP*	TC_{2019}	CPP_{2019}
Article	3232	78	27,172	8.4	706,542	219
Review	861	21	3176	3.7	208,916	243
Proceedings paper	136	3.3	626	4.6	26,941	198
Note	25	0.60	106	4.2	4688	188
Editorial material	14	0.34	30	2.1	5689	406
Book chapter	13	0.31	34	2.6	4812	370
Letter	10	0.24	115	12	2668	267
Meeting abstract	3	0.072	8	2.7	626	209
Retracted publication	2	0.048	13	6.5	271	136
News item	1	0.024	1	1.0	429	429
Reprint	1	0.024	15	15	132	132

TP: number of publications; *AU*: number of authors; *APP*: number of authors per publication (*AU*/*TP*); TC_{2019}: total citations from Web of Science Core Collection since publication to the end of 2019; CPP_{2019} citations per paper (TC_{2019}/TP).

A total of 861 highly cited reviews were published in 339 journals mainly in *Lancet Neurology* (50 reviews; 5.8% of 861 reviews) with a CPP_{2019} of 264. The top three most frequently cited reviews were published by Compston and Coles (2008) with a CPP_{2019} of 2509, Noseworthy et al. (2000) with a CPP_{2019} of 2421, and Heinrich et al. (2003) with a CPP_{2019} of 2011. It should be noticed that documents could be classified into two document types in Web of Science, for example, 136 highly cited documents were classified in both document types of proceedings papers and articles, thus the sum of percentages was higher than 100%.

Only the article document type were used for subsequent analysis because they contain complete research ideas and results (Zhang et al., 2010). All 3232 highly cited articles were published in English.

3.2. Trends over time of multiple sclerosis publications

To understand the highly cited articles and citation development trend, a relationship between the total number of highly cited articles in a year (*TP*) and their citations per publication ($CPP_{year} = TC_{year}/TP$) by the years (Yeung and Ho, 2019) and decades (Hsu and Ho, 2014) in medical-related topics were proposed. Altogether, 3232 highly cited multiple sclerosis articles were published between 1926 and 2018 with an average of TC_{2019} being 219 and the maximum value of TC_{2019} being 9215 (Fig. 1).

Fig. 1 shows in the 1920s, one highly cited article was published in 1926. Two highly cited articles were published in the 1930s and one in the 1940s. A significant increase was found between 1981 (seven articles) to 2007 (180 articles), reaching its peak. Afterward, the number of articles began to decline to three articles in 2018. Time is necessary to accumulate the number of citations to be 100 citations as highly cited articles. It took roughly 12 years to reach its maximum number of highly cited articles. On the contrary, dental articles took about 14 years to reach its peak (Yeung and Ho, 2019). The year 1983 had 14 articles with the highest citations per publication with a CPP_{2019} of 1328 which can be attributed to tow classic articles with a CPP_{2019} of 1000 or more (Long et al., 2014) titled "Rating neurologic impairment in multiple sclerosis: An expanded disability status scale (EDSS)" by Kurtzke (1983)

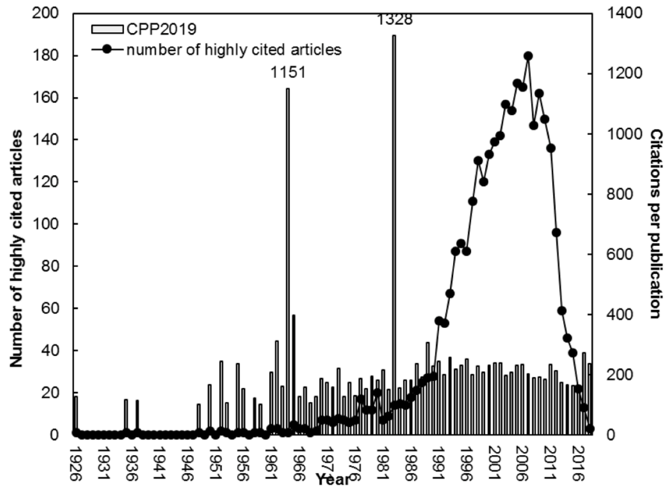

Fig. 1. Number of highly cited articles and citations per publication by year.

with a TC_{2019} of 9215 (rank 1st) and "New diagnostic criteria for multiple sclerosis: Guidelines for research protocols" by Poser et al. (1983) with a TC_{2019} of 6670 (rank 2nd). Similarly, the year 1964 had one classic article titled "Preliminary trial of carisoprodol in multiple sclerosis" by Ashworth (1964) with a higher CPP_{2019} of 1151.

3.3. Web of science categories and journals

A total of 3232 multiple sclerosis highly cited articles were published in 422 journals which are classified among the 78 Web of Science categories in SCI-EXPANDED. Altogether, 175 articles were published in 39 journals, which were not in SCI-EXPANDED in 2019. Twelve categories (15% of 78 categories) published only one highly cited article. Out of the 3232 articles, 1827 articles (57% of 3232 articles) were published in journals classified under clinical neurology with 1487 articles (46%) and neurosciences with 1141 articles (35%). Followed distantly by immunology with 474 articles (15%), research and experimental medicine with 223 articles (6.9%), and multidisciplinary sciences with 213 articles (6.6%). It has been noticed that journals could be classified into two or more categories in Web of Science. For instance, *Brain* with 263 articles was classified in the categories of clinical neurology and neurosciences thus the sum of percentages was higher than 100% .

The top ten most productive journals are listed in Table 2 with journal impact factor (IF_{2019}), number of authors per publication (*APP*), number of citations per publication (CPP_{2019}), and Web of Science category. Six of the top 10 productive journals are classified under the category of clinical neurology. *Neurology* published the most articles (292 articles; 9.0% of 3232 articles) followed by *Brain* with 263 articles (8.1%), and *Annals of Neurology* with 227 articles (7.0%). The top three journals in the category of general and internal medicine include *New England Journal of Medicine* ($IF_{2019} = 74.699$) with 57 articles, *Lancet* ($IF_{2019} = 60.392$) with 59 articles, and *JAMA-Journal of the American Medical Association* ($IF_{2019} = 45.540$) with eight articles. Table 2 shows that articles published in *Neurology* had the highest *APP* of 12. Articles published in the *Multiple Sclerosis Journal* had the highest CPP_{2019} of 1994 while articles published in the *Journal of Experimental Medicine* had a CPP_{2019} of 1262.

3.4. Countries, institutions, and authors

There were 3174 highly cited articles (98% of 3232 highly cited articles) with author affiliation information in SCI-EXPANDED from 80 countries. Altogether, 2135 (67% of 3174 articles) were single country articles from 35 different countries and 1039 (33%) were internationally collaborative articles from 80 countries. The six publication indicators (Ho and Kahn, 2014) listed below were applied to compare the top ten productive countries: total articles (*TP*), country independent articles (*IP*), internationally collaborative articles (*CP*), first-author articles (*FP*), corresponding-author articles (*RP*), and single-author articles (*SP*). Eight European countries and two American countries were ranked in the top 10 publications (Table 3).

Japan with 96 articles ranked 14th was the most productive Asian country. The USA dominated in the six publication indicators with *TP* of 1679 highly cited articles (53% of 3174 highly cited articles), *IP* of 1034

Table 2
The ten most productive journals.

Journal	*TP* (%)	IF_{2019}	*APP*	CPP_{2019}	Web of Science category
Neurology	292 (9.0)	8.770	12	1559	clinical neurology
Brain	263 (8.1)	11.337	7.5	1447	clinical neurology neurosciences
Annals of Neurology	227 (7.0)	9.037	8.1	1345	clinical neurology neurosciences
Journal of Immunology	147 (4.5)	4.886	6.8	1755	Immunology
Archives of Neurology	115 (3.6)	N/A	6.5	1918	clinical neurology
Proceedings of the National Academy of Sciences of the United States of America	110 (3.4)	9.412	8.6	1449	multidisciplinary sciences
Journal of Neuroimmunology	105 (3.2)	3.125	5.9	1830	immunology neurosciences
Journal of Neurology Neurosurgery and Psychiatry	90 (2.8)	8.234	6.9	1934	clinical neurology psychiatry surgery
Multiple Sclerosis Journal	82 (2.5)	5.412	8.0	1994	clinical neurology neurosciences
Journal of Experimental Medicine	75 (2.3)	11.743	8.1	1262	immunology research and experimental medicine

TP: total number of highly cited articles; IF_{2019}: journal impact factor for 2019; *APP*: number of authors per article; CPP_{2019} citations per paper (TC_{2019}/TP), N/A: not available in 2019.

Table 3
Top 10 most productive countries.

Country	*TP*	*TPR* (%)	*IPR* (%)	*CPR* (%)	*FPR* (%)	*RPR* (%)	*SPR* (%)
USA	1679	1 (53)	1 (48)	1 (62)	1 (43)	1 (42)	1 (51)
UK	644	2 (20)	2 (13)	2 (35)	2 (13)	2 (13)	2 (16)
Germany	410	3 (13)	5 (4.8)	3 (30)	4 (6.5)	3 (6.8)	5 (3.0)
Canada	378	4 (12)	4 (5.6)	4 (25)	3 (6.5)	5 (6.2)	3 (6.1)
Italy	323	5 (10)	3 (6.4)	5 (18)	5 (6.3)	4 (6.7)	9 (1.5)
Netherlands	242	6 (7.6)	6 (3.3)	6 (16)	6 (3.8)	6 (3.9)	3 (6.1)
France	200	7 (6.3)	8 (2.2)	7 (15)	7 (2.9)	7 (3.0)	7 (2.3)
Switzerland	172	8 (5.4)	14 (0.89)	8 (15)	9 (1.8)	9 (1.9)	9 (1.5)
Austria	151	9 (4.8)	15 (0.7)	9 (13)	12 (1.7)	11 (1.8)	9 (1.5)
Sweden	145	10 (4.6)	7 (2.6)	10 (8.6)	8 (2.3)	8 (2.2)	7 (2.3)

TP: total articles, *TPR* (%): total number of articles and the percentage of total articles, *IPR* (%): rank and percentage of single country articles, *CPR* (%): rank and percentage of internationally collaborative articles, *FPR* (%), rank and the percentage of first author articles, *RPR* (%), rank and the percentage of the corresponding authored articles. *SPR* (%): rank and the percentage of the single-author articles.

articles (48% of 2135 independent articles), *CP* of 645 articles (62% of 1039 internationally collaborative articles), *FP* of 1356 articles (43% of 3174 first-author articles), *RP* of 1236 articles (42% of 2914 corresponding-author articles), and *SP* of 67 articles (51% of 132 single-author articles).

In total, 863 highly cited articles (27% of 3174 highly cited articles) were institute independent articles and 2311 (73%) were inter-institutionally collaborative articles. A total of 103 institutes from 14 countries published 20 highly cited articles or more. The 50 of 103 institutes located in the USA. The top 10 productive institutions were listed in Table 4. The five publication indicators (Ho et al., 2016) such as total articles (*TP*), institutional independent articles (*IP*), inter-institutionally collaborative articles (*CP*), first-author articles (*FP*), and corresponding-author articles (*RP*) were applied to compare the top 10 institutions in Table 4. It shows five of the top ten productive institutes located in the USA, three in the UK, and two in Canada. Harvard University in the USA dominated in the four publication indicators with *TP* of 207 highly cited articles (6.5% of 3174 highly cited articles), *CP* with 188 articles (8.1% of 2311 internationally collaborative articles), *FP* of 81 articles (2.6% of 3174 first-author articles), and *RP* of 71 articles (2.4% of 2914 corresponding-author articles). University of California Los Angeles in the USA published 68 highly cited articles ranked 12th. However, articles published by the university had the highest *IP* with 20 articles (2.3% of 863 institutional independent articles).

D.H. Miller from the University College London in the UK published the most 105 highly cited multiple sclerosis articles including 11 first-author articles and 27 corresponding-author articles. M. Filippi from Italy published the most first (17) and corresponding-author (36) articles, respectively. J.F. Kurtzke from Veterans Administration Medical Center in the USA published the most single-author articles (8).

In recent years, Ho (2012, 2014) proposed an indicator, the *Y*-index is related to the number of first-author publications (*FP*) and corresponding-author publications (*RP*). The *Y*-index combines two parameters (*j, h*), to assess both the publication potential and characteristics of the contribution as a single index. This indicator has also been applied to compare highly cited authors in the highly cited articles in the health care sciences and services field (Hsu and Ho, 2014) and the highly cited dental articles(Yeung and Ho, 2019). The *Y*-index is defined as:

$$j = FP + RP \tag{1}$$

$$h = \tan^{-1}\left(\frac{RP}{FP}\right) \tag{2}$$

Where j is the publication potential, a constant related to publication quantity; and h is publication characteristics that can describe the proportion of *RP* to *FP*. The greater the value of j, the more the contribution of the first-author and corresponding-author articles. Different values of h represent different proportions of corresponding author articles from first author articles.

$h = \pi/2$, j is the number of corresponding-author articles;

$\pi/2 > h > 0.7854$ indicates more corresponding-author articles;

$h = 0.7854$ indicates the same number of first- and corresponding-author articles;

$0.7854 > h > 0$ indicates more first-author articles;

$h = 0$, j is the number of first-author articles.

In total, 2862 (89% of 3232 articles) highly cited multiple sclerosis articles in the SCI-EXPANDED with both first- and corresponding-author information were selected to calculate *Y*-index for the highly cited authors. A total of 2862 highly cited articles were contributed by 13,903 authors. Specifically, 11,422 (82% of 13,903 authors) authors had no first- and corresponding-author articles with *Y*-index = (0, 0); 466 (3.4%) authors published only corresponding-author articles with $h = \pi/2$; 174 (1.3%) authors published more corresponding-author articles with $\pi/2 > h > 0.7854$; 899 (6.5%) authors published the same number of first- or corresponding-author articles with $h = 0.7854$; 74 (0.53%) authors published more first-author articles with $0.7854 > h > 0$; and 888 (6.4%) authors published only first-author articles with $h = 0$.

Fig. 2 shows the distribution of the *Y*-index (*j, h*) of the top 22 highly cited authors with $j \geq 15$. Each dot represents one value that could be one author or many authors, for example, C.S. Raine and L.B. Krupp with *Y*-index (15, 0.852) and P.A. Calabresi and M. Rodriguez with *Y*-index (17, 1.176). M. Filippi had the highest j of 50, published 67 highly cited articles, including 14 first-author and 36 corresponding-author articles with *Y*-index = (50, 1.200). H. Lassmann and L. Kappos had the same publication potential with the same j of 39. It is clear that the authors are

Table 4
Top 10 most productive institutions.

Institute	*TP*	*TPR* (%)	*IPR* (%)	*CPR* (%)	*FPR* (%)	*RPR* (%)
Harvard University, USA	207	1 (6.5)	2 (2.2)	1 (8.1)	1 (2.6)	1 (2.4)
University of California San Francisco, USA	148	2 (4.7)	39 (0.58)	2 (6.2)	2 (1.7)	2 (1.6)
McGill University, Canada	114	3 (3.6)	6 (1.5)	3 (4.4)	9 (1.1)	6 (1.1)
Brigham And Women's Hospital, USA	91	4 (2.9)	133 (0.12)	4 (3.9)	6 (1.2)	10 (1.0)
Cleveland Clinic Foundation, USA	90	5 (2.8)	3 (1.7)	8 (3.2)	3 (1.6)	2 (1.6)
University of British Columbia, Canada	89	6 (2.8)	8 (1.4)	7 (3.3)	17 (0.72)	20 (0.69)
University of Oxford, UK	89	6 (2.8)	30 (0.7)	5 (3.6)	6 (1.2)	8 (1.0)
Stanford University, USA	86	8 (2.7)	21 (0.93)	6 (3.4)	10 (1.0)	11 (0.93)
University College London (UCL), UK	85	9 (2.7)	12 (1.3)	9 (3.2)	4 (1.4)	4 (1.4)
University of Cambridge, UK	84	10 (2.6)	8 (1.4)	10 (3.1)	5 (1.3)	5 (1.2)

TP: total highly cited articles, TPR (%): total number of articles and the percentage of total articles, IPR (%): rank and percentage of single institute articles, IPR (%): rank and percentage of inter-institutionally collaborative articles, FPR (%): rank and the percentage of first author articles, *RPR* (%): rank and the percentage of the corresponding authored articles.

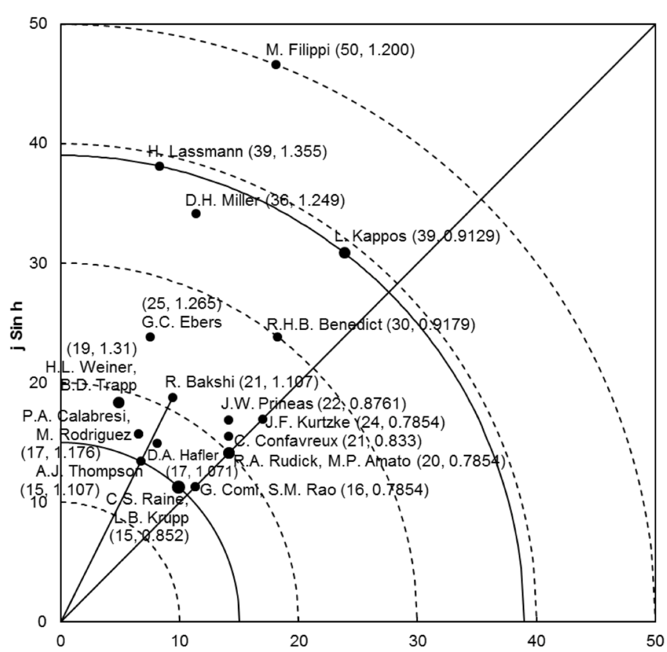

Fig. 2. Distribution of the top 22 highly cited authors with their Y-index values ($j \geq 15$).

located on the same curve ($j = 39$) in Fig. 2, but they have different publication characteristics. Lassmann with an h of 1.355 has a higher ratio of corresponding-author articles to first-author articles than Kappos with an h of 0.9129. These authors had the same potential to publish highly cited articles but different publication characteristics. Furthermore, R. Bakshi (21, 1.107) and D.A. Hafler (17, 1.071) are located on the same straight line, indicating that they have different publication potential but the same publication characteristics with the same h of 1.107. Similarly, J.F. Kurtzke (24, 0.7854), R.A. Rudick (20, 0.7854), M. P. Amato (20, 0.7854), G. Comi (16, 0.7854), and S.M. Rao (16, 0.7854) published the same number of first- and corresponding-author articles with an h of 0.7854. When different authors have the same name or an author uses different names in their articles (such as maiden surnames), potential biases may arise in authorship analysis (Zhang et al., 2010). When the author moves from one affiliation to another, another potential confounding factor will appear (Ho, 2007). For example, M. Filippi used 10 institutes in Italy as the corresponding-author affiliation and seven institutes in both Italy and the UK as the first-author affiliation.

4. Conclusions

A total of 4147 highly cited multiple sclerosis-documents in 11 document types were found in the Science Citation Index Expanded. A total of 3232 highly cited articles were published between 1926 and 2018, with most articles occurring in the 2000s. English was the only language used. The average citation of review articles was higher than the research articles. The highly cited articles published most in the Web of Science category of clinical neurology and neurosciences. *Neurology, Brain*, and *Annals of Neurology* with high impact factors published the most highly cited articles. However, articles in *Brain* had lower citations per publication. Most of the researches supported by the developed countries from America and Europe. The USA ranked top in the six publication indicators followed by the UK. Excepted for Japan, the G7 ranked in the top seven in total articles.

Multiple sclerosis research is widely concerned in American institutes. Harvard University ranked top in four of the publication indicators while the University of California, Los Angeles in the USA published the most institutional independent articles. Results from analysis of Y-index show that D.H. Miller published the highest articles while M. Filippi had the most publication potential incited multiple sclerosis research.

The findings show that the peak number of highly cited articles has been declining since 2006. Given that the time required to reach the maximum number of citations in the reviewed articles was 12 years, in the coming years, the number of highly cited articles after 2006 may increase. However, if this number does not increase, the definitive reason for the decrease in the number of highly cited articles after 2006 needs further investigation.

Analysis of MS highly cited articles is one method of assessing the drivers of progress in MS. Researchers want to know how they can increase the visibility of their articles internationally, just like highly cited articles. Findings of the present research may provide some insights that could help researchers in their ways. It can make researchers familiar with influential authors, papers, and their characteristics. It may also provide the ground for more scientific cooperation. The findings may also be useful for funding investment and the promotion of researchers within universities, and the reputation of universities in the international levels. Many countries tend to increase their scientific output in various fields and to this end they should be aware of the current situation. The current article can be helpful in this regard.

According to research findings and the spread of this disease throughout the world, it is recommended that research institutes and policymakers support international and inter-institutional research, and researchers with allocating sufficient funding for effective research.

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