Bibliometric analysis of manuscript characteristics that influence citations: A comparison of four major neurology journals

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Abstract

Objective: To inspect 28 data characteristics among the top neurology journals with the highest impact factor and their influence on citation rate. *Methods:* Consecutive articles from January 2004 to June 2004 were collected from four major neurology journals with the highest impact factor: The Lancet Neurology (impact factor, 11.964), Acta Neuropathologica (7.589), Brain (5.858) and Annals of Neurology (5.706). Web of Science was used to extract the citation count for these articles, and 28 article characteristics were tabulated manually. Univariate analysis and a multiple regression model were performed to predict citation number from the collected variables. *Results:* A total of 288 manuscripts i.e. 24 in The Lancet Neurology, 70 in Acta Neuropathologica, 117 in Brain and 77 in Annals of Neurology. Univariate analysis revealed the following variables to have a significant positive correlation with increased citations: journal (1; p<0.0001), country of origin (15; p<0.0001), number of tables (28; p=0.0007), words per title (7; p=0.0006), design of study (17; p=0.001), open access (22; p<0.0001), total words (24; p<0.0001), total references (25; p<0.0001) and total number of pages (26; p<0.0001). In a multivariate regression model the following variables predicted increased citation count (p < 0.0001, R2 = 0.4377): number of pages, open access status, multicenter studies and journal origin.
Conclusion: The results of our bibliometric study may be used by authors while compiling their manuscript to increase recognition and improve the impact of their articles over what they would normally experience.

Keywords: Bibliometrics; citation rate; citation; manuscript, neurology

INTRODUCTION

Bibliometric analysis is a statistical tool that analyses published literature of a specialty quantitatively and its international scientific influence qualitatively[1], using parameters such as citation count and impact factor.[2] For better career advancements, current researchers aim to publish articles which attract more citations and qualifies as a high impact article.[3] In recent studies, the title characteristic of an article has been recognized as an independent variable in attracting citations.[4]

There has been a growing trend of bibliometric analysis in the fields of Neurology but to our knowledge, no other research has investigated the role of manuscript characteristics that influences Neurology literature. The purpose of our study was to analyze 28 data characteristics among the top Neurology journals with the highest impact factors. We hope that our study will enable future researchers to help maximize citation rates when assembling a manuscript.

METHODS

The data used for this retrospective study are publically available hence this study was exempt

from Institutional Review Board approval. No human or animal data were used. We used the SCImago Journal & Country Rank which uses Scopus® as its database to select the four journals with the highest impact factors in the category of neurology. We chose high-impact-factor journals which have the most visibility and citations to obtain an analysis with the greatest power. The four journals included were only centrally related to Neurology: The Lancet Neurology (impact factor, 11.964), Acta Neuropathologica (7.589), Brain (5.858) and Annals of Neurology (5.706).

We compiled a list of all original research and review articles published in these journals from January 1, 2004, through June 30, 2004. Editorials, case reports, letters to the editor, and commentaries were excluded. However, The Lancet Neurology includes data from review articles only for the January-June 2004 issues since original articles were not available. We gathered data from 2004 to ensure that the articles have had sufficient time to circulate and to give meaningful citation reports but are also relevant to current practice. We compared 28 characteristics among the four Neurology journals with the highest impact factors. We used Web of Science (Clarivate Analytics) to tabulate the citation count for each article. The country of origin of the article was organized into continents. The study characteristics and their definitions are shown in Table 1.

RESULTS

Between January 2004 and June 2004, a total of 288 articles were identified and included in our analysis. Of these articles, 24 were published in The Lancet Neurology, 70 in Acta Neuropathologica, 117 in Brain and 77 in Annals of Neurology. Approximately two-thirds (64%) of the studies were multi-institutional while one-third (36%) were single-center investigations, indicating the highly collaborative nature of Neurology research. 24% of the studies were conducted in the United States. Approximately half (52%) of the studies were prospective and approximately one third (29%) were retrospective in nature. 11% of the studies were reviews.

Only one-third (36%) of the studies reported the study design in their titles while two-thirds (74%) of articles had the study findings in their title. 41% of the articles reviewed were open access and 80% of the studies were supported through funding. The median number of authors and references was 6 (IQR 4-9) and 44 (IQR 33-60) respectively.

Citation analysis

The median number of citations received per article was 66 (IQR 30-128). The total original research and review articles published between January 2004 and June 2004 for The Lancet Neurology, Acta Neuropathologica, Brain and Annals of Neurology were 24 (8%), 70 (24%), 117 (41%) and 77 (27%) respectively.

The remainder of the study characteristics are summarized in Figure 1 and Table 2.

Univariate analysis (summarized in Table 3) revealed an association between the number of citations and journal (1; p<0.0001), country of origin (15; p<0.0001), number of tables (28; p=0.0007), words per title (7; p=0.0006), design of study (17; p=0.001), open access (22; p<0.0001), total words (24; p<0.0001), total references (25; p<0.0001) and total number of pages (26; p<0.0001). A borderline association was found with objective sub-specialty16; p=0.043). No significant correlation was found with study design in the title, study findings in the title, punctuation in title, number of authors, having all neurology authors, sample size, abstract word or character count, or funding.

Stepwise backward regression analysis was performed to create a multivariate model based on four major independent characteristics as independent predictors of citations: number of pages (p=0.0001), open access (p<0.0001), country of origin (p=0.042 for multi-institutional studies) and journal (p<0.0001 for both the Lancet Neurology and Annals of Neurology). These variables were found to predict the number of citations statistically significantly with $F_{(11, 276)} = 21.31$, p<0.0001, $r^2 = 0.4377$.

DISCUSSION

To our knowledge, bibliometric article characteristics in the field of neurology have not yet been evaluated for the purpose of establishing a correlation with overall citation count. Our analysis predicts that a neurology article with a greater number of pages, conducted as a multicenter study and published as open access in a higher impact journal such as *The Lancet Neurology* or *Annals of Neurology* had the greatest positive correlation with overall citation count.

A recent study of bibliometric characteristics of radiology journals[4] also suggests that open access article status correlates positively with citation count. Open access articles may reach more readers than subscription access publishing as

Table 1: Study characteristic and definitions

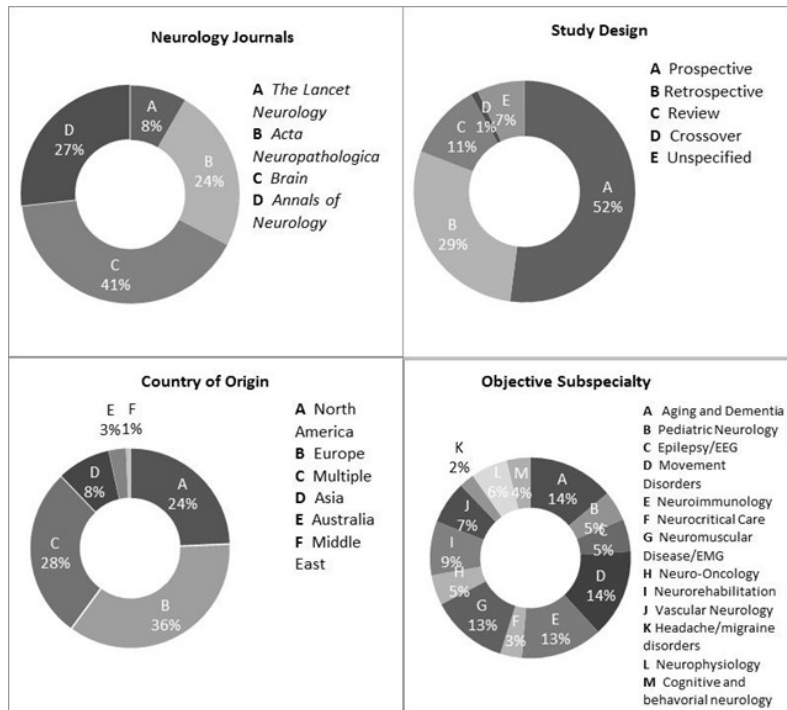|	Study Characteristics	Characteristic Definition
1	Neurology journals	Top four major neurology journals with the highest impact factor
2	Journal impact factor	The journal's impact factor according to SCOPUS
3	Journal 5-Year impact factor	The journal's 5-year impact factor according to SCOPUS
4	Journal origin	The continent the journal originated from
5	WOS citation number	No. of citations per article according to the WOS
6	Year of publication	Year the article was published in the journal
7	Words per title	No. of words present in the article title
8	Characters per title	No. of characters in the article title
9	Study Design in title	Study design reported in the title of the article
10	Study Findings in title	Study findings reported in the title of the article
11	Punctuation in title	Punctuation is present in the title (none, question mark, semi-colon, colon)
12	Number of authors	No. of authors in the article
13	Neurology authors	Are all authors from a neurology background?
14	Multi-institutional	Is the article a multi-institutional study?
15	Country of origin	The country that the article originated from, defined as the location of the institution of the first author
16	Objective subspecialty	The objective sub-specialties included: Neurodegenerative disease, Pediatric Neurology, Epilepsy/EEG, Movement Disorders, Neuroimmunology/Multiple Sclerosis, Emergency Neurology, Neuromuscular Disease/EMG, Neuro-Oncology, Neuropsychiatry, Neurorehabilitation, Vascular Neurology, Headache/migraine disorders, Neurophysiology, Cognitive and behavioral neurology
17	Design of study	Is the study design prospective, retrospective, review or crossover?
18	Sample size	Sample size (no.) included in the article
19	Abstract word count	Word count of the abstract
20	Abstract character count	Character count of the abstract
21	Structured abstract	Is the abstract one large paragraph or is the abstract divided into sections (i.e., Objective, Materials and Methods, Results and Conclusion)?
22	Open access	Is the article open access?
23	Funding	Was there any funding for the study?
24	Total words	Total no. of words in the article
25	No. of references	Total no. of references in the article
26	No. of pages	Total no. of pages in the article
27	No. of figures	Total no. of figures in the article
28	No. of tables	Total no. of tables in the article

Figure 1. Characteristics of 288 articles published in four Neurology journals during the 6-month period in 2004 that we evaluated. Some percentages do not total 100 because of rounding.

they are more readily searchable and identifiable. The more widely accessible open access journals can effectively be reached by a broader audience leading to a higher citation count.[5] A study has shown that, for the same author, publications in open access journals have a higher rate of citation than publications in traditional, non- open access journals in some medical fields, such as cytopathology.[6] However other authors have not necessarily found this to be the case in other fields.[5] The citation advantage associated with open access may be explained by an artifact of other causes such as self-selection.[7]

An experiment controlled for self-selection showed that open access increases the readership of articles but has no effect on the number of citations in the first year after publication compared to subscription-access control articles within 3 years.[5] In contrast to our findings, open access articles have not received significantly more citations than non-open access articles in dentistry and ophthalmology.[8,9] Journal impact also varies in between subspecialty which provides limitations to open access status.

While the overall length of an article was also found to correlate positively with citation count,

Table 2: Variables with associated mean and standard deviations

Variable	Mean	SD
No. of words per title	12	4
No. of characters per title	81	26
No. of authors per article	6	4
Abstract word count	231	72
Abstract character count	1377	734
Total no. of words	5555	2134
No. of figures	4	2
No. of tables	2	2

Table 3: Study characteristic and results of univariate analysis

	Study Characteristics	Statistical significance
1	Neurology journals	p<0.0001; The Lancet Neurology > Brain (5.858) > Annals of Neurology (5.706) > Acta Neuropathologica
2	Words per title	p=0.0006
3	Study Design in title	NS
4	Study Findings in title	NS
5	Punctuation in title	NS
6	Number of authors	NS
7	Neurology authors	NS
8	Country of origin	p<0.0001
9	Objective subspecialty	p=0.043
10	Design of study	p=0.001
11	Sample size	NS
12	Abstract word count	NS
13	Abstract character count	NS
14	Open access	p<0.0001
15	Funding	NS
16	Total words	p<0.0001
17	No. of references	p<0.0001
18	No. of pages	p<0.0001
19	No. of figures	p=0.0007
20	No. of tables	p=0.0007

this was also consistently true for the length of sections of the article, for example total words, number of references and number of tables. These findings are consistent with bibliometric journal analysis in psychiatry.[10] Falagas et al. reported a positive association between the length of the article and the citation count, even after adjusting for several potentially confounding variables, such as the study design, prospective or retrospective nature of the study, abstract and title word count, number of author–affiliated institutions and number of bibliographic references. Falagas also reported a positive correlation between the number of pages and citation count, specifically an increase by an average of 0.079 in the logarithm of citations per article for each additional page.[3] Longer articles could indicate an advanced methodological quality of a study and more scientific complexity, as well as contain more information. This increases the chances of part of it being appropriate for citation for points being made by other researchers. Our findings are consistent with those of Falagas et al.[3]

The converse was true for correlation with title word (and character count) – shorter titles were found to correlate with increased citation count. This is in keeping with bibliometric journal analyses in other specialties.[4] An analysis of 140,000 papers by Letchford et al. provided evidence that journals which publish papers with shorter titles receive more citations per paper.[11] Conciseness can improve the chances of a paper being discovered, make it easier to understand and encourage readers not to pass it over.

We observed that the top neurology journals with impact factor ranking first and second, The Lancet Neurology and Acta Neuropathologica allow up to 300 words in the abstract compared to the 400 and 500 word limit in the third and fourth ranking journals. Letchford et al. found that journals which publish papers whose abstracts are shorter and contain more frequently used words receive slightly more citations per paper.[12] Shorter abstracts with more commonly used words may be easier to read and hence attract more citations. Editors of neurology journals may perhaps update

their guidelines for authors by limiting the length of an abstract.

Our current study demonstrated that a multi-institutional study increased the odds of a published article's being cited more frequently than the mean citation rate. Other studies have shown similar results.[13] Multicenter collaboration can result in higher rates of patient enrolment than single-center trials, clearer results which are more convincing and more readily accepted, as the patient sample of multicenter trials is considered to be representative. The involvement of investigators from a variety of institutions also gives the opportunity for a wider range of clinical judgments concerning the subject under investigation.[13]

The study design was not significantly associated with citation rates, which was similarly reported in a bibliometric analysis of radiology journals.[4] Again, the reason for this is unclear, as one might expect review articles, prospective trials, and large meta-analyses to be more commonly cited than case reports and technical notes. Review articles are valuable clinical references, however they are not based on primary data, hence they may not be cited as often as expected. On the other hand case reports and technical notes, in spite of having lower levels of evidence, may be one of the few reports on a particular topic and thus are more likely to be cited in subsequent papers in that area.

The current study also demonstrated that publication journal was an independent predictor

of increased odds for a published article to be cited more frequently than the mean citation rate, particularly for *the Lancet Neurology* and *Annals of Neurology*. This finding is not surprising, as article citation rate is a major determinant of journal impact factor and coincides with previous literature of citation rates in other specialties.[14-16] High-impact factor journals are more likely to attract submissions based on higher-quality research. Finally, the increased citation rates in studies from higher–impact factor journals may be due to the rigorous standards set by the journal editorial boards, which result in higher-quality studies being accepted.

This study has some limitations. The journals studied in our study are only from high impact journals hence the results are liable to a selection bias. Our findings may not be applicable to all published articles and all journals in neurology or other fields. The results may also be influenced by the fact that each journal that was selected also has its individual criteria for manuscript correlation.

The time interval during which our data were extracted was approximately 6 months. Making use of a larger time frame and larger sample size can yield more powerful results. Another factor to be taken into account is our manual data extraction, which is prone to human error. Nevertheless, to the best of our knowledge, our study is the only study that has been done in neurology examining a large number of manuscript variables on citation count.
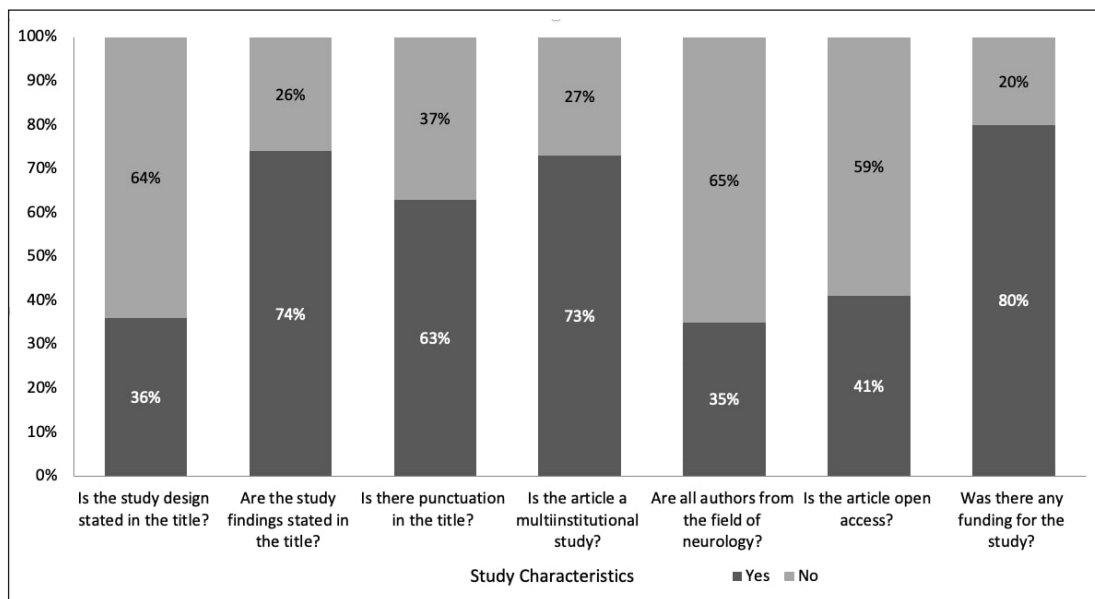

Figure 2. Study characteristics percent

Different databases like WOS, Scopus and Google scholar return vastly different results for citation count.[17,18] We chose WOS as our database because it offers the most reliable results and incorporates citation metrics from various sources within a single interface as well as providing a strict evaluation process.[20]

Since our data extraction points were measured after the articles were published, this provides another limitation to our study. It is plausible that the editor made modifications to the article, including the title, abstract and body.[19,20] It is important to note that having statistically significant data set does not necessarily signify correlation being representative of causation. Another potential source of bias of all retrospective bibliometric articles is that there is a relationship between manuscript correlation and citation number. In this era of digital research, it is worthwhile to note that bibliometrics characteristics should be taken into account when compiling a manuscript.[4]

The results of our bibliometric study may be used by authors while compiling their manuscript to increase recognition and improve the impact of their articles over what they would normally experience. Neurology authors may consider writing more comprehensive articles and including more references, using shorter titles with brief and concise abstracts, and choosing open access and/or high impact factor journals for publishing. Journals may also benefit by recommending authors to limit the title length and abstract count. Open access status, publication journal, country of origin and number of pages all showed a statistical significance in the multi- regression model. In this era of digital research and massive publication productions, bibliometric characteristics should be taken into account while editing and assembling a manuscript. In conclusion, we are not suggesting that the article assembly surpasses science, but rather the method of presentation can complement and supplement science and has the capacity to increase citation.

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