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Bibliometric Analysis of Manuscript Title Characteristics Associated With Higher Citation Numbers: A Comparison of Three Major Radiology Journals, AJNR, AJR, and Radiology☆

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Our purpose was to determine if associations exist between titles characteristics and citation numbers in Radiology, American Journal of Roentgenology (AJR), and American Journal of Neuroradiology (AJNR). This retrospective study is Institutional Review Board exempt. We searched Web of Science for all original research and review articles in Radiology, AJR, and AJNR between 2006 and 2012 and tabulated number of words in the title, presence of a colon symbol, and presence of an acronym. We used a Poisson regression model to evaluate the association between number of citations and title characteristics. We then used the Wald test to detect pairwise differences in the effect of title characteristics on number of citations among the 3 journals. Between 2006 and 2012, Radiology published 2662, AJR 3998, and AJNR 2581 original research and review articles. There was a citation number increase per title word increase of 1.6% for AJNR and 2.6% for AJR and decrease of 0.8% for Radiology. For all, $P < 0.001$. A title colon was associated with citation increases for AJNR (16%), Radiology (14%), and AJR (7.4%). Title acronym was associated with citation increases for AJNR (10%), Radiology (14%), and AJR (13.3%). All $P < 0.001$. AJR had greatest effect for number of words in title vs Radiology and AJNR ($P < 0.001$), AJNR for presence of colon vs Radiology ($P < 0.001$), and AJR for presence of acronym vs AJNR ($P = 0.028$). Title characteristics investigated here showed a strong association with higher citation numbers in Radiology, AJR, and AJNR.

Introduction

Numbers of citations and impact factors are important to authors, journal editors, and journal publishers as they correlate with higher amount subscriptions and these in turn with higher advertisements.[1] Faculty hiring and promotion processes are also intimately linked to the effect of an author's work today measured at least partly by citation metrics like the H-index.[2-4] Several bibliometric analyses ranging from specialty journals with highly cited articles to assessing the effect of articles focusing on specific disease states or therapies are found in the literature.[5-14]

However, there has been little attention on the effect of manuscript title characteristics and their association with citations. What few studies have been published show highly variable associations between title characteristics, especially title length, and citation numbers. Recent studies by Jamali and Nikzad[13] and Letchford et al[14] have found that shorter titles are associated with higher citation counts. However, in 2010, Jacques and Sebire published such an analysis and they found that 3 distinct title characteristics were highly associated with high citation numbers in the journals Lancet, British Medical Journal, and Journal of Clinical Pathology.[15] These were (1) total number of words in the title, (2) presence of a colon symbol (:), and (3) presence of an acronym (eg, such as in a clinical trial).

An evaluation of title characteristics in the radiology and imaging literature has yet to be performed. The purpose of this study is to determine if similar associations are found in the 2 most important radiology journals and the radiology subspecialty journal with the highest impact factor—Radiology, American Journal of Roentgenology (AJR), and American Journal of Neuroradiology (AJNR), respectively. We hypothesize that the number of citations increases with total number of title words, with presence of a colon, and in the presence of a title acronym.

Materials and Methods

Data Query

This is an Institutional Review Board exempt retrospective study. We queried Web of Science (Thompson Reuters) for all original research and review articles published in Radiology, AJR,

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and AJNR between Jan 1, 2006 and Dec 31, 2012. The article titles characteristics, (1) total number of words in the title, (2) the presence of a colon symbol (:), and (3) the presence of an acronym were tabulated for all three journals. Only original research and review articles were included in the search to minimize confounding by other types of publication, such as case reports, editorials, and letters to the editor, etc.

Statistical Analysis

Comparisons Between Different Journals

We calculated and tabulated the (1) mean number of words, (2) frequency of titles that have a colon, and (3) the frequency of titles with at least 1 acronym across the 3 journals over different publication years.

Model

We fit a Poisson regression model to investigate the association between the number of citations (y) and the title characteristics including the number of words (x_1), the presence of a colon symbol (x_2), and the presence of an acronym (x_3). We also adjusted for the potential confounders year (x_4). Specifically, we used the following model.

$$y \sim \text{Poisson}(\mu), \log(\mu) = \beta_0 = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4.$$

Effects on Citations

We analyzed the data for the 3 journals—Radiology, AJR, and AJNR. We then computed the estimates of regression coefficients, standard errors and assessed the coefficient significance using the Wald test. We used the statistical software R (Vienna, Austria) to perform all the analyses.[16]

We used the Wald test to detect the pairwise difference in the effect of the title characteristics on the number of citations among the 3 journals—Radiology, AJR, and AJNR. Namely, we compared Radiology vs AJR, Radiology vs AJNR, and AJR vs AJNR. For all analyses, a $P = 0.05$ or less was considered statistically significant.

Results

Comparisons Between Different Journals

From 2006-2012, published original research and review articles counts were as follows: AJR 3998, AJNR 2581, and Radiology 2662. In this period, the mean number of words in titles (Fig 1) ranged from (1) 13.88-15.13 for AJNR, (2) 12.06-13.30 for Radiology, and (3) 13.13-14.94 for AJR. The frequency of titles that have a colon (Fig 2) ranged from (1) 0.63-0.80 for AJNR, (2) 0.45-0.57 for Radiology, and (3) 0.35-0.47 for AJR. Lastly, the frequency of titles with at least 1 acronym (Fig 3) ranged from (1) 0.098-0.144 for AJNR, (2) 0.316-0.392 for Radiology, and (3) 0.051-0.100 for AJR.

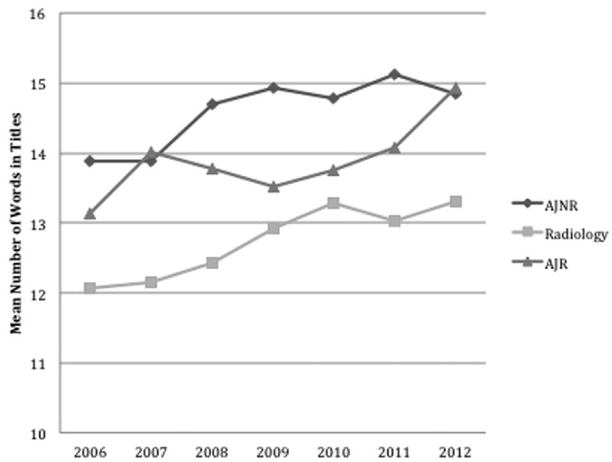

Fig. 1. Mean number of words in titles, per year.

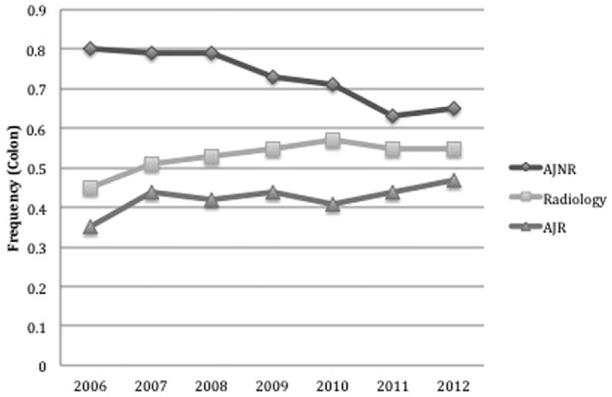

Fig. 2. Frequency of titles that have a colon, per year.

Effects on Citations

For AJNR, if one word increases in title, citation numbers tended to increase (1.6%) (Fig 4). The presence of a colon in AJNR titles was associated with a 14.8% increase in citations. The presence of an acronym in a title was associated with a 9.8% increase in citations.

For AJR, if one word increases in title, then the citations tended to increase (2.6%) (Fig 5). Presence of a colon in a title was associated with a 7.1% increase in citations. Presence of an acronym in a title was associated with a 12.5% increase in citations.

For Radiology, if one word increases in title, citations numbers tended to decrease (0.8%) (Fig 6). Presence of a colon in a title was associated with a 14% significant increase in citations. Presence of an acronym in a title was associated with a 12.8% increase in citations. Table 1 outlines the preceding results.

When we evaluated the differences in the 3 characteristics between the 3 journals, the number of title words in AJR had the strongest effect on higher citation numbers. Next, AJNR was stronger than Radiology. All differences were significant ($P < 0.001$). For the presence of a colon, Radiology had the strongest and AJNR the next strongest associations with higher citation numbers compared to AJR ($P < 0.001$), however, statistical significance was not reached when comparing the effects of Radiology vs AJNR ($P = 0.321$). Finally, if a title had an acronym,

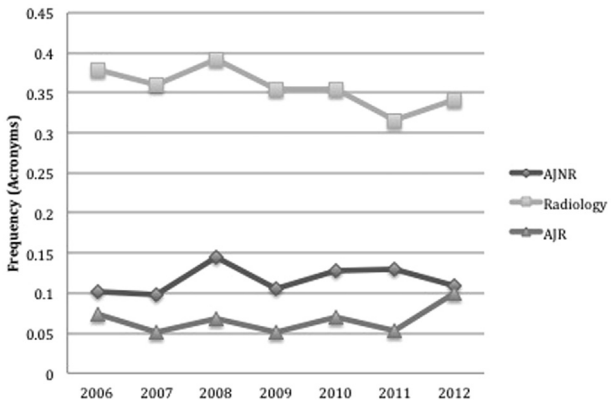

Fig. 3. Frequency of titles with acronyms, per year.

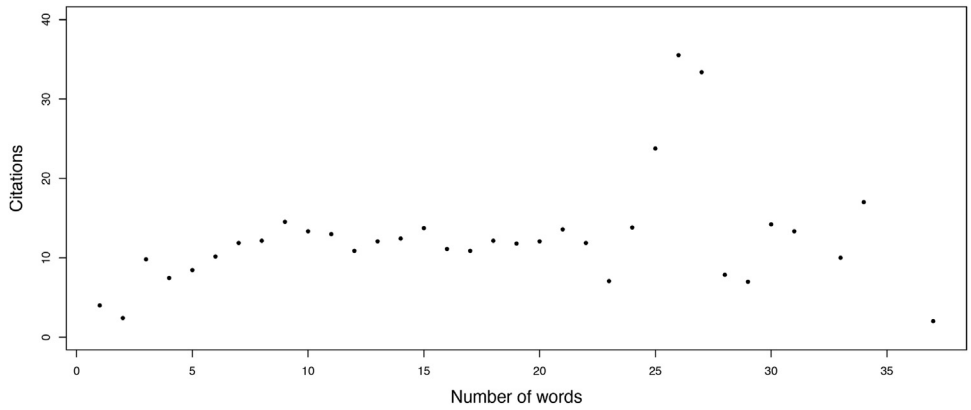

Fig. 4. Association of number of word and citations for AJNR.

AJR had a stronger effect on higher citation numbers than AJNR ($P = 0.028$), but there were no significant differences between Radiology and AJNR ($P = 0.169$) and as well as Radiology and AJR ($P = 0.442$). Please see Table 2 for further details.

Discussion

We have confirmed our hypothesis by evaluating 3 title characteristics in the 2 major specialty journals in radiology (AJR and Radiology) and a high impact factor subspecialty journal, AJNR. Our results mimic those of Jacques and Sebire,[15] however, contradict the results found by Jamali and Nikzad[13] and Letchford et al[14] In our study the number of title words, the presence of a colon symbol, and the presence of an acronym are all significantly associated with higher number of citations in all 3 journals.

We realize that other confounding factors are likely involved in determining or at least are associated with variations in citation numbers. These factors include the actual content of the study and its level of evidence base medicine (eg, case series vs randomized controlled trial) and tendency for certain topics to be highly covered and coveted (eg, cancer vs esoteric diseases). Nonetheless, as Jacques and Sebire[15] discussed in their article, a vast majority of literature searches are carried out using PubMed and Google Scholar (and nowadays just Google), so a longer, more comprehensive title may help in such searches to increase the chances of finding the study that is relevant to their research. This observation is important as Smith et al[17] suggested that many manuscript

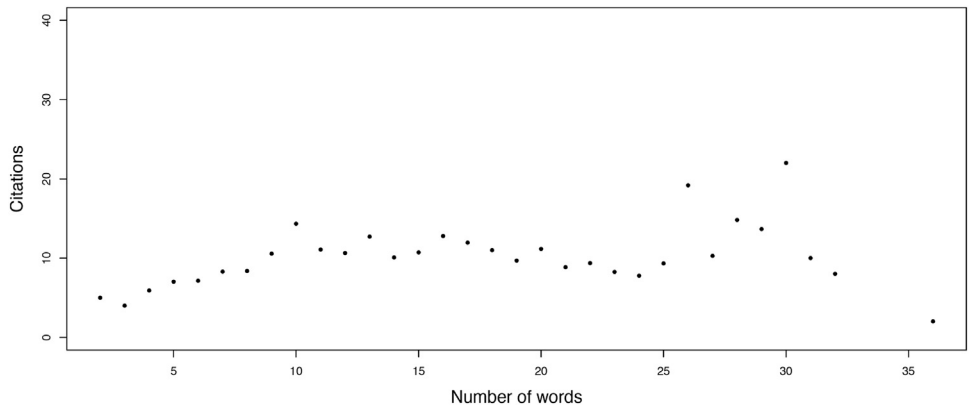

Fig. 5. Association of number of word and citations for AJR.

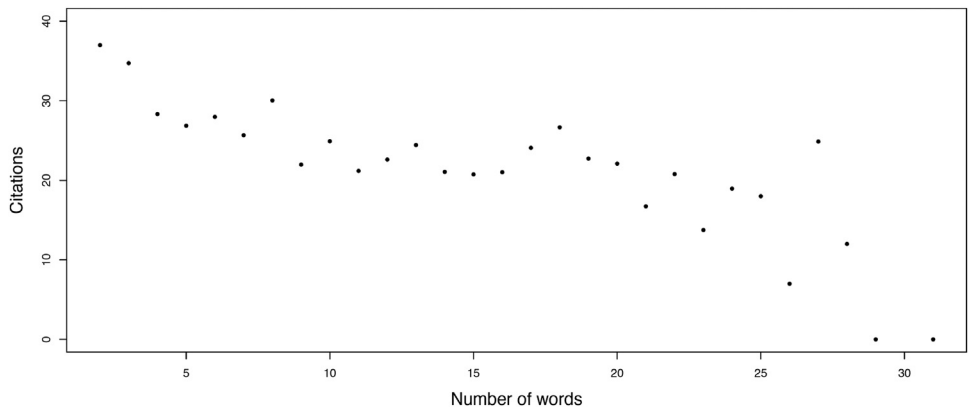

Fig. 6. Association of number of word and citations for Radiology.

titles might be misleading or inaccurate and lead to inadequate search results.

In our study, an interesting finding was that citation numbers actually decreased by 0.8% per additional title word in the journal Radiology. This was unexpected and is difficult to explain. One hypothesis is that manuscripts published in Radiology may have more specific topic focus, thereby leading to titles that are highly specific for the content of the study being published and thus appear less often in searches which in turn leads to them not been cited.

Also, as we hypothesized, the presence of a colon and acronyms were associated with increased citation numbers. These title additions may be making searching for a paper easier by joining topics such as that of a trial (eg, ACRIN) with specific imaging sequence (eg, IDEAL or SPACE) as the acronym. This may indicate that a title that contains more information is likely to appear more often in searches and be cited more.

We also showed that there are effects of the journal on the association of title characteristics and citation numbers. The total number of title words seems to have the greatest effect in AJR compared to AJNR and Radiology. For the presence of a colon, Radiology and AJNR had stronger associations with higher citation numbers compared to AJR. Finally, if a title had an acronym, AJR had a stronger effect on higher citation numbers than AJNR, however, no significant differences were seen between Radiology and AJNR and as well as Radiology and AJR.

Likely, there is no single reason for such observations of journal and title effects. One reason may be the variation in audiences each journal attracts. Radiology and AJR are both the 2 major specialty journals, however, Radiology may attract more articles and readers in academics who conduct research using trials and more fundamental and transitional research, compared to AJR which has been traditionally regarded as a more clinically oriented journal and thus geared toward individuals in clinical practice. Thus, AJR may attract articles and readers interested in other topics outside of traditional imaging science or translational research, such as health policy and health services research. AJNR is a subspecialty journal with content directed at neuroradiologists and other neuroscientists and manuscript content varies from translational studies, to retrospective cohort studies, to clinical trials, and practice perspectives.

We hypothesize that the difference in our results compared to Jamali and Nikzad[13] may be because of the significantly different journal types studied. The PLoS family of journals studied by Jamali and Nikzad[13] is for a highly variable author and readership audience than radiology journals. Accordingly, Letchford et al[14] examined 20,000 articles from *Scopus* published between 2007 and 2013. They found that shorter titles were associated with higher citations. Differences between their results and ours may stem from the significant difference in breadth of disciplines they included compared to the relatively narrow scope of radiology journals we used. This difference may translate to as yet unidentified discipline-specific biases toward certain title characteristics, such as longer or shorter titles.

Table 1
Title characteristics associated with higher citation numbers

Journal	Characteristics	Estimate	Standard Error	*P* Value
AJNR	Number of words	0.016	0.001	< 0.001
	Presence of colon	0.148	0.012	< 0.001
	Presence of acronym	0.098	0.022	< 0.001
Radiology	Number of words	−0.008	0.001	< 0.001
	Presence of colon	0.14	0.01	< 0.001
	Presence of acronym	0.128	0.012	< 0.001
AJR	Number of words	0.026	0.001	< 0.001
	Presence of colon	0.071	0.01	< 0.001
	Presence of acronym	0.125	0.01	< 0.001

Table 2
Effect of journal on association between title characteristics and citation numbers

Characteristics	AJNR vs Radiology		Radiology vs AJR		AJR vs AJNR	
	Z	*P* Value	*Z*	*P* Value	*Z*	*P* Value
Number of words	15.079	< 0.001	−23.896	< 0.001	6.436	< 0.001
Presence of colon	0.465	0.321	4.744	< 0.001	−5.412	< 0.001
Presence of acronym	−0.959	0.169	0.146	0.442	1.91	0.028

Our study has the strength of large sample sizes and focused statistical evaluation of the variables stated in the methods section, however, we have identified some limitations. We acknowledge that we did not evaluate original research and review articles separately, rather than in bulk as we think that this better reflects the overall content of a journal. We did not review the contents of all the articles in the analysis but rather focused on 3 title characteristics and their citation numbers. Additionally, we did not assess the effect of time after publication on citation numbers but we presume that there is a relationship between a longer time after publication and accumulating citations. Finally, we realize that the association between these title characteristics and citation numbers is correlative and not causative.

Conclusions

In summary, the title characteristics of number of words, presence of a colon symbol, and presence of an acronym are associated with higher citation numbers in AJNR, AJR, and Radiology. Authors and editors may wish to consider title formulation and its possible effects with increasing scrutiny to potentially maximize their articles' citations.

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