Original Article

Journal Impact Factors for Predicting Future Citation Rate of an Article in Medical Journals: A Retrospective Cohort Study into a Medical School Article Collection

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Objective: To examine the correlation between The Journal Impact Factors (JIFs), Journal Impact Factor Quartiles (JIFQs), and future citation frequency in the three years following publications of a medical school article collection.

Materials and Methods: The present sample was the collection of articles published by the academics of Chiang Mai University Faculty of Medicine in 2014. The authors searched the Scopus to collect the citation frequencies of each article between 2014 and 2017. The authors constructed two regression models to determine whether JIFs and JIFQs of the journals publishing articles could predict citation frequencies during the three years after publication.

Results: The present study included 336 scientific articles. The Spearman's rank correlation tests revealed that citation frequencies showed a significant correlation with JIFs (rho=0.572, p<0.001) and JIFQs (rho=–0.505, p<0.001). Two ordinal logistic regression analyses revealed that JIFs and JIFQs were significant predictors of citation frequency (β=0.734, p<0.001 and β=–0.696, p<0.001, respectively).

Conclusion: For a medical institution, there appears to be a correlation between JIFs, and JIFQs, and future citation of the articles published by its academics. Further studies in this area are warranted.

Keywords: Bibliometrics, Citation analysis, Journal impact factor, Medical institution, Regression analysis

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Citation is a metric reflecting the quality of most research studies and articles. The accrual of an academic's citations may also indicate his/her research performance. Consequently, the citation rate per academic member or per paper is an index included in many university ranking systems, e.g., QS World University Ranking, Times Higher Education World University Rankings. Many institutions now prefer their academics to publish articles that are likely to accrue high citations. While researchers and leadership teams wish to know the future citation rate of an article soon after its publication, it may take years to collect citations.

Journal Impact Factors (JIFs) and Journal Impact Factor Quartiles (JIFQs) have been used as metrics of journal quality. In any given year, the JIF of a journal is the number of citations received in that year by articles published in the two preceding years, divided by the total number of articles published in that journal during the two preceding years. The JIFQ of a journal is the quotient of a journal's rank in category (X), and the total number of journals in the category (Y), so that (X/Y) = percentile rank Z. A journal can have only one JIF but may have several JIFQs, depending on the number of fields relevant to that journal. The use of JIFs and JIFQs have been extended to estimate the quality of research projects, including the publication of scientific articles[(1)].

Although a JIF of a scientific journal is based on previous citation counts, it may also show a correlation with the future citation rate of an article published in

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that journal. In a study of duplicate papers, articles published in journals with high JIFs were likely to received larger numbers of citations than those published in journals with low JIFs[2]. In the fields of internal medicine and emergency medicine, JIFs of the original publishing journals were the predictor of future citation[3]. Such predictability appeared to be prominent in clinical medicine articles[4]. Similarly, there were strong negative correlations between non-cited articles and JIFs for immunology (rho=–0.854) and surgery journals (rho=–0.924)[5]. These findings suggest that an article published in a high-impact journal would have a higher citation rate in the future.

Contrary to the above-mentioned findings, growing evidence suggests that there is no relationship between JIFs and future citation in many fields, e.g., chemistry, management, and orthopedic medicine[6,7]. Highly cited articles appeared to be published more often in low-impact journals[8]. Thus, the relation between JIFs and future citation has been weakening[9]. The JIFs of open access journals did not show a strong correlation with future citation[10]. These findings suggest some level of unpredictability of JIFs regarding the future citation rate of a scientific article.

The correlation between a JIF and future citation of a scientific article remains controversial. In addition, no study has been carried out into the correlation of these metrics specific to an article collection of a single medical institution. Therefore, the authors proposed to determine whether JIFs and JIFQs could predict the future citation frequency of those articles during the three years after their publication.

Materials and Methods

The present sample was the collection of articles published by the academics of Chiang Mai University Faculty of Medicine in 2014. This institution was established in 1959 to educate medical students, train medical specialists, provide tertiary care services, and conduct medical research. Its research topics cover all areas of medicine, including biomedical sciences, clinical medicine, and health sciences. Based on the Scopus, Web of Science, and PubMed searches, the 440 full-time academic members published 404 medical articles in 2014. Published conference abstracts may duplicate the publications of a research project, so 67 conference abstracts were excluded from the study. A further article that reported on the withdrawal of a Cochrane review was also excluded. The present study did not involve human subjects.

In January 2018, the authors searched Scopus to collect the citation frequencies of each article between 2014 and 2017. The 2013 lists of JIFs and JIFQs were obtained from the Web of Science. For a journal with two JIFQs or more, the authors chose the highest value. For the journal having no JIF or JIFQs, the authors gave the values of 0 and 5, respectively. This decision was made because the quality of journals without a JIF or JIFQ are likely to be lower than those having one.

Two factors affecting citation frequencies were also considered. Previous findings showed that author numbers showed a positive correlation with citation frequencies[11]. The presence of authors working in high-citation countries might also directly increase the citation frequencies. The high-citation countries in the present study were the top 10 in the field of medicine listed in the 2013 SCImago. These included United States, United Kingdom, Germany, Japan, China, France, Italy, Canada, Spain, and Australia.

As already mentioned, the data of citation frequencies, JIFs, JIFQs, and author numbers are likely to be skewed. Therefore, the authors used the Shapiro-Wilk tests to examine the data distribution. For data with a non-normal distribution, the authors applied non-parametric tests to determine their correlation with citation frequency. Two regression models were constructed to determine whether the JIFs and JIFQs of the journals publishing articles could predict citation frequencies during the three years after publication. All statistical analyses were carried out using Microsoft R Open 3.4.3 (Microsoft, Redmond, WA, USA; R Foundation for Statistical Computing, Vienna, Austria), the Rcmdr 2.4 to 1 for descriptive, univariate, and multivariate analyses. The pscl 1.5.2 was used to calculate the McFadden R^2. Two-sided, p-values lower than 0.05 were considered statistically significant.

Results

The present study included 336 scientific articles. The results from the Shapiro-Wilk test revealed the highly skewed data of citation frequencies, JIFs, JIFQs, and author numbers ($p<0.001$). Means, medians (first and third quartile rank) of the variables were 11.54, 4 (1, 9) for citation frequencies, 2.82, 2.10 (0.85, 3.23) for JIFs, 2.76, 3 (1, 4) for JIFQs, and 13.15, 6 (4, 9) for author numbers. Out of 336 articles, 127 (37.80%) had at least one author working in a high-citation country. The mean citation frequencies of articles authored by those working in high-citation countries and not working in high-citation countries (first and third quartile ran) were 22.079 (3, 17) and 5.143 (1, 6), respectively.

Table 1. Ordinal logistic regression analysis for determining whether JIFs or JIFQs could predict four-quartile citations

Independent variables	Coefficient (95% CI)	Adjusted OR (95% CI)	Coefficient (95% CI)	Adjusted OR (95% CI)
JIFs	0.734 (0.567 to 0.902)*	2.084 (1.771 to 2.475)		
JIFQs	N/A	N/A	–0.696 (–0.868 to –0.524)*	0.500 (0.419 to 0.591)
Author numbers	0.000 (–0.006 to 0.007)	1.000 (0.995 to 1.009)	0.004 (–0.002 to 0.011)	1.004 (0.999 to 1.013)
High-citation countries	0.316 (–0.132 to 0.764)	1.371 (0.876 to 2.149)	0.429 (–0.016 to 0.874)	1.536 (0.984 to 2.399)
	McFadden R^2=0.154		McFadden R^2=0.107	

CI=confidence interval; JIFs=Journal Impact Factors; JIFQs=Journal Impact Factor Quartiles; N/A=not available

* p<0.001

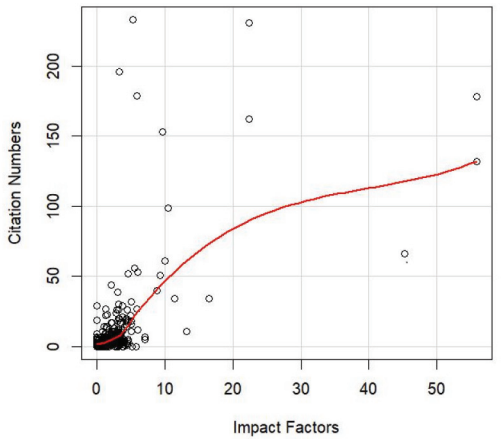

Figure 1. Scatterplot of the correlation between impact factors and citation numbers.

Spearman's rank correlation (rho)=0.572 (p<0.001)

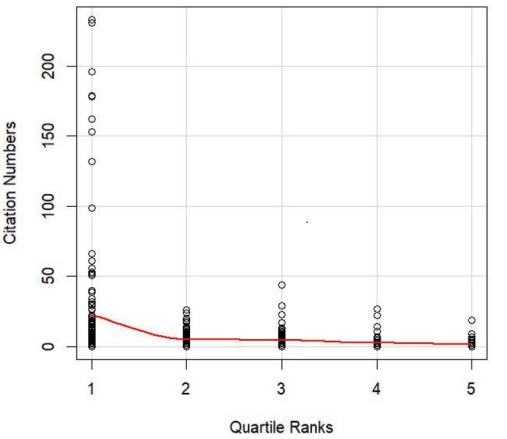

Figure 2. Scatterplot of the correlation between quartile ranks and citation numbers.

Spearman's rank correlation (rho)=–0.505 (p<0.001)

The Spearman's rank correlation tests revealed that citation frequencies showed a significant correlation with JIFs (rho=0.572, p<0.001) (Figure 1), JIFQs (rho=–0.505, p<0.001) (Figure 2), and author numbers (rho=0.224, p<0.001). Mean citation frequencies were also significantly different between articles with authors in high-citation countries and those without (Wilcoxon rank sum W=8,623, p<0.001).

Due to the highly skewed data of citation frequency, the authors transformed these continuous data set into four equal-count bins of ordinal data. The four ranges (n, %) were as follows, Q1 ranged 0 to 1 (n = 86, 25.60%), Q2 ranged 1 to 4 (n = 94, 27.98%), Q3 ranged 4 to 9 (n = 82, 24.40%), and Q4 ranged 9 to 233 (n = 74, 22.02%).

JIFs, author numbers, and the presence of authors in high-citation countries (dependent variable) were included in the first model of multivariate ordinal logistic regression analysis as independent predictors of 4-bin citation frequencies (dependent variable). Only the JIF was a significant predictor of citation frequency (β=0.734, p<0.001) (Table 1). JIFQs, author numbers, and the presence of an author in a high-citation country (dependent variable) were included in the second model of the multivariate ordinal logistic regression analysis as independent predictors of 4-bin citation frequency (dependent variable). Only the JIFQ was a significant predictor of citation frequency (β=–0.696, p<0.001) (Table 1). In both models, author numbers and the presence of an author in a high-citation country were not significant predictors of citation frequency.

Discussion

The present study examined about the articles published by the academics of the Faculty of Medicine, Chiang Mai University. The findings suggested that an article published in a journal with a high JIF or JIFQ was more likely to receive more citation counts than

that published in a journal with a lower JIF or JIFQ. The results were the same, even after the adjustment of author numbers and the presence of authors working in high-citation countries.

To the authors knowledge, this was the first study examining the correlation between JIFs, JIFQs, and citation frequencies in the sample of articles published by a specific medical institution's faculties. The present findings were in line with previous studies conducted into medical articles[2-5]. It is possible that the large proportion of social science articles included in the two previous studies played a role in causing the disparity between the present findings and the previous ones[9,11].

The present findings suggested that a JIF-guided policy for academic paper publication may be a strategy to raise the citation count of a medical institution. The JIF of a published article is an in-hand metric that can predict future citation of that article. Institutions wishing to increase their citation rate should encourage their academics to publish articles in high-impact journals. However, this strategy should be used with caution. The policy that is too harsh may be a cause of JIF abuse. In addition, a JIF is not related with the quality of individual research articles and, therefore, should not be used for assessing an individual scientist's contributions, or in hiring, promotion, or funding decisions[12].

The present study had some limitations. First, the sample size of 336 articles was relatively small. Non-significant correlations found in the present study might be caused by Type II errors derived from the small sample size. Second, we did not take into account several factors affecting citation counts of medical articles. Examples of those were the number of databases indexed, clinical relevance, number of pages, a structured abstract, and publication in an open access journal[10,13]. The low McFadden R^2's of 0.154 and 0.107 suggested that many factors affecting citation counts were not included in the two regression models. Finally, the institution used in the present study is relatively unique, any generalization of present findings, therefore, should be carried out with caution. The authors institution is a mid-size medical school in a country that is not recognized as having a high citation rate for articles. Moreover, each medical institution may have its own prominent areas of research.

Conclusion

For a medical institution, there might be a correlation between the JIF, JIFQs, and future citation rate of the articles published by its academics. Increased publication in high-impact journals should be a part of the strategy to increase the citation count. Further studies in this area are warranted.

What is already known on this topic?

JIFs and JIFQs have been used as metrics of journal quality. There is no relationship between JIFs and future citation in many fields, e.g., chemistry, management, and orthopedic medicine.

What this study adds?

An article published in a journal with a high JIF or JIFQ was more likely to receive more citation counts than that published in a journal with a lower JIF or JIFQ.

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Conflicts of interest

The authors declare no conflict of interest.

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