Investigation of the Iranian Scientific Products in the Field of Pharmacology based on Their Citation Value and Using In-text Citation Frequency and Potential in the Web of Science Database

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Abstract

Introduction:

Science production is not the only valuable index to reflect a country's growth and progress, nor can the citation alone represent the validity of a work. Hence, to assess the validity of the scientific articles produced, it is necessary to use other metrics and indicators such as in-text citation frequency and text citation potential.The present study aimed at determining the validity of the Iranian articles in the field of pharmacology based on their citation value in the Web of Science database using the in-text frequency and text citation potential.

Methods:

This survey was conducted based on the scientometrics and text citation analysis approach. The research population consisted of Iranian articles in the field of pharmacology published in the 2012 in Web of Science database. The sample consisted of 382 articles cited in the field of pharmacology. They were randomly retrieved and selected among 1698 Iranian articles.The data were analyzed using Excel and Endnote software and Statistics Package for Social Sciences. Data analysis was performed using descriptive and inferential statistics. Frequency and percentage were used to assess the text citation potential. The mean was used to determine the top Iranian authors and articles based on the text citation potential and in-text frequency. To analyze the collected data, the values of each indicator were calculated and Spearman correlation coefficient was used to assess the relationship between the rate of the citation to articles, the text citation potential and the text citation.

Results:

The reviewed articles received 1841 citations. The mean text citation potential was 1.09%, the mean in-text frequency was 1.31% and the mean self-citation in the articles was 0.46. The findings showed that there was a direct and significant relationship between the citation frequency and the in-text frequency as well as between the text frequency and the text citation potential and self-citation, but there was no significant relationship between the citation frequency and the text citation potential. Based on the findings, most of the articles in the field of pharmacology had the lowest citation value.

Conclusions:

Due to different and unequal value of the citations, it is necessary to use qualitative evaluation methods obtained from the evaluated indicators in Iran's research evaluation system to improve the accuracy in evaluation of the articles. Accordingly, the use of measures such as text citation frequency, text citation potential and the placement of citation is crucial for researchers' scientific evaluation.

Keywords: scientific productions, citation value, in-text citation frequency, citation potential, text citation potential, Web of Science database, Iran's Pharmacology.

Introduction

In the age of communication, each country's progress and development is assessed by the production of knowledge. Moreover, development and prosperity contribute to the creation of knowledge and science in various aspects. Scientometrics experts use the two absolute indicators- the number of the productions and the number of the citations- for measuring science. In recent years, the index of Iran's articles in the valid citation indexes has achieved significant successes, but it does not reflect the quality and effectiveness of the articles (1).Thompson Reuters institution uses the indicators such as number of citations, impact factor, and percentage of the cited documents to show different aspects of the validity of the scientific articles. The citation rate has been introduced as the basic indicator, and the effectiveness of the article is assessed through this indicator. However, the number of the citations cannot be used absolutely to assess the validity of the works since different motivations are involved in citing or not citing an article(1).The criteria that can be helpful in determining the value of the citations and thus in determining the validity of the citing articles are: the type of citation, the placement of a citation in the citing article, and the in-text citation frequency (2,3). Moreover, since the use of these criteria helps identify the similar articles in terms of subject, they can be used to retrieve information. Although the use of these criteria reduces the retrieval of articles, it increases the accuracy of searching and retrieving more relevant articles (4).

However, since the use of the methods such as evaluation by the reviewers is less objective and relies more on the subjective aspects and because it is also a long-term and costly process, the scientometrics experts decided to overcome the shortcomings of the existing quantitative metrics to achieve more qualitative metrics (5).One of the characteristics that can be used in evaluating the qualitative level of the citations is the in-text citation frequency. The text citation frequency can represent the extent of using a work in the citing document and reflect another aspect of the citation value. It is obvious that the articles that have an equal text citation frequency are not comparable, since they may be cited in articles with a different size, subject, and type, and all of these factors affect the citation potential of the citing article (6,7). Therefore, it is necessary to standardize the text citation frequency based on the article reference potential. The text citation potential variable is used to calculate this indicator. The text citation potential is the ratio of the total in-text references of the article to the total references of the citing article.

Despite the extensive uses of the citation and the indicators obtained from it, there are some criticisms of this (6,7). For example, equating all citations makes it impossible to recognize the range of the use of cited work, since each work is observed only once in the list of the references of a document, that is, its citation in the citing work will always be equal to one. However, articles that have been cited several times in a text are more valuable to the citing author (2,5,8). One of the indicators that can correct this defect is the in-text citation frequency or frequency of citing a work in the text of citing author.

The review and search of the texts related to the research subject, including printed and electronic, showed that only one article examined the value of the citations to Iranian articles (1). Hence, the present study was conducted to use the indicators of in-text citation frequency and valuing citations rather than merely counting the citations, to assess the validity and the value of the scientific articles in the most productive and most cited field in medical sciences. This field, based on the researcher's search in Web of Science, was pharmacology. Hence the purpose of this study was to determine the validity of Iranian articles in the field of pharmacology based on the citation value and their in-text frequency and potential in the citation database of Web of Science in 2012.

Methods

The present study was a survey with the scientometrics approach and using the citation analysis. The population of this research included Iranian articles in the field of pharmacology published in 2012. The reason for choosing the year 2012 was to give the citing articles at least three years opportunity to cite. Accordingly, citations to Iranian articles were examined up to the end of 2015. The research population consisted of 1698 pharmacological articles produced by Iranian authors, indexed in the Web of Science citation database in 2012 and received 6820 citations. The sample size included 382 Iranian articles whose citation value was examined in this study. Iranian articles and articles citing them were collected using Thompson-Reuters' Science Citation Index. The data were collected using the Advanced Search System in the Web of Science database. The Excel software and the Statistical Package for Social Sciences were used to record the data extracted from the databases. The Endnote software was also used for managing the resources, grouping them and getting the full text of articles. In order to identify the Iranian scientific productions in the field of pharmacology, a search strategy formulated as Cu=Iran was performed using the advanced search service of Web of Science. Next, "document type" menu was used to filter results by journal articles, and "publication year" menu was used to filter results by the year of 2012 to the end of 2015. The retrieved results were 1698 Iranian articles in the field of pharmacology receiving 1927 citations. Then, through the menu of "save to other file formats" a notepad file of all Iranian Pharmaceutical articles was created. After that, a copy of this file was made and imported into an Excel file.

In the Excel file, the columns AU, TC, NR, CR, SO were selected and the other columns were deleted. In the next step, the TCs that were zero in the Excel file were deleted from this file. It resulted in retrieving 1698 Iranian pharmaceutical articles that received 1927 citations. After that, the articles were extracted from the database by the name of "responsible author" of which 113 articles whose responsible authors were not Iranian were excluded. In the next step, the articles were sorted by the publications of universities and from the articles within each, in accordance to the volume of the publications of each university, 382 articles were randomly selected as the sample size. The selected articles were searched in Web of Science and imported into the Endnote software. Then for obtaining the full text of articles we searched the databases from within endnote. By completing the full text of the articles in Endnote, we provided the conditions to examine the relationship between the rate of the citation and in-text frequency as well as text citation potential.

Spearman correlation coefficient was used to assess the relationship between the rate of citation to the articles and the in-text frequency of their citations and the text citation potential and also the relationship between each of them with self-citation(1). Frequency and percentage were used to assess the text citation potential. The mean was used to determine the top Iranian authors and articles based on the text citation potential and in-text frequency. To analyze the collected data, the values of each indicator were calculated.To obtain the in-text citation frequency, we had to count manually all of the in-text citations of the citing articles (formula 1). In this research, to calculate the text citation potential of Iranian articles, the articles' text citation potential was first obtained. The text citation potential was obtained by dividing the total number of text references of the citing article by total references of the citing article as appearing in the list of references (formula 2). It indicates that how many times the articles have been cited on average in the text. Then, by dividing the frequency of the in-text citation to Iranian articles by the citation potential of the citing article, the potential of each Iranian article from the text potential was calculated(1).

formula 1:(1)

$$\text{In} - \text{text citation frequency of cited article} = \frac{\text{frequency of in} - \text{text citations to cited article}}{\text{text citation potential of citing work}}$$

formula 2:(1)

$$\text{text citation potential} = \frac{\text{total text references of citing article}}{\text{total references of citing article}}$$

After calculating the text citation potential of the citing article to Iranian articles, text citation potential indicator was used to calculate the potential of each Iranian article from the potential of citing article. text citation potential is the ratio of the in-text citation frequency of the cited article to the text citation potential of the citing article.

Results

Investigating the in-text citation frequency of these articles showed that 382 citing articles in the field of pharmacology provided 1883 in-text citations to Iranian articles in this field. The mean text citation for Iranian articles was 1.31. The highest text citation (7.5 times) belonged to Nickbakht et al. The calculation of text citation potential for all Iranian articles revealed that the highest text citation potential was 3.14 and belonged to the article written by Zarrindast et al in the field of behavioral sciences, and the lowest in-text citation potential was zero and belonged to the article written by Ashkavand in the field of plant sciences. The mean citation potential was also 1.09. Spearman correlation test was used to determine the relationship between two variables of citation frequency and the in-text citation frequency to Iranian articles. The results of the Table 1 show that there is a direct and significant relationship between citation frequency and text citation frequency at the level of 0.85. The value of the correlation coefficient indicates a strong relationship between the citation frequency and in-text citation frequency. Accordingly, increase in the frequency of citations increases the in- text citation frequency.

Table 1: Results of testing the Spearman correlation between the citation frequency and in-text citation frequency

		in-text frequency / variable
0.85	**Correlation percent**	
0001/0P<	**Significance**	**Citation**
382	**Total number**	

Top articles in terms of in-text citation frequency

Table 2 presents the top ten articles in terms of in-text citation frequency. The first rank belonged to the article written by Nickbakht et al with 7.5 in-text citations. The second rank belonged to the article written by Zarrindast with 4.27 in-text citations. The articles that were ranked 3rd and 4th received 4 and 3 text citations, respectively. Each of the articles that were ranked 5th and 6th received 2.8 in-text citations. Each of the articles that were ranked 7th and 8th received 2.5 in-text citations, and each of the articles that were ranked 9th and 10th received 2.33in- text citations.

Table 2: Top ten articles in terms of the in-text citation frequency

In-text Frequency	Author	Title	Rank
7.5	Nikbakht et al	Comparison of Two Doses of Recombinant Human Chorionic Gonadotropin (rhCG) During Ovulation Induction in Intrauterine Insemination Cycles: A Prospective Randomized Clinical Trial	1
4.27	Zarrindast et al	Nitric oxide in the nucleus accumbens is involved in retrieval of inhibitory avoidance memory by nicotine	2
4	Khouri et al	Acute effects of simvastatin to terminate fast reentrant tachycardia through increasing wavelength of atrioventricular nodal reentrant tachycardia circuit	3
3	Google et al	Simvastatin as an adjuvant therapy to fluoxetine in patients with moderate to severe major depression: A double-blind placebo-controlled trial	4
2.8	Hasanadeh et al	Cannabinoid CB1 Receptors Mediate the Gastroprotective Effect of Neurotensin	5

2.8	Tamaddonfard et al	Effects of administration of histamine and its H-1, H-2, and H-3 receptor antagonists into the primary somatosensory cortex on inflammatory pain in rats	6
2.5	Mirakabadi et al	Induction of Apoptosis in Human Leukemia Cell Line ((HL60) by Animal's Venom Derived Peptides (ICD-85	7
2.5	Dadkha et al	The Chemopreventive Effect of Nigella Sativa on 1,2-dimethylhydrazine-induced Colon Tumor	8
2.33	Sadegh et al	Morphine deteriorates spatial memory in sodium salicylate treated rats	9
2.33	Darakhshan et al	The Effects of Tamoxifen in Combination with Tranilast on CXCL12-CXCR4 Axis and Invasion in Breast Cancer Cell Lines	10

Top ten authors in terms of the in-text citation frequency have been presented in Table 3. Two articles authored by Tamaddonfard et al were among the top 10 articles in terms of in-text citation frequency. They could receive 1.98 in-text citation frequency and to be in the forefront of the top ten authors.

Table 3: Top ten authors in terms of in-text citation frequency

In-text Frequency mean	Author	Rank
1.98	Tamaddonfard et al	1
1.80	Yazdi et al	2
1.66	Nabavi et al	3
1.51	Mansoori et al	4
1.15	Bahramikia et al	5
1.29	Soufi et al	6
1.25	Varshosaz et al	7
1.10	Hasanzadeh et al	8
1.08	Rezaei et al	9

Discussion and Conclusion

The results showed that 382 Iranian articles under review received 1875 citations and 4740 in-text citations. Spearman correlation test was used to evaluate the relationship between these two variables. The results indicated a significant and direct relationship between these two variables. These results are consistent with those of the research conducted by Ding et al in 2013. Using content analysis of the scientific-research articles in the field of informatics during 2000-2011, they found that there was a significant correlation between the citation frequency and the in-text citation frequency to their reviewed articles.

So, they considered the use of the in-text citation frequency indicator-which indicates the number of times a citation is repeated in the text and is somewhat more qualitative than citation - to be necessary for showing the quality of the impact via evaluating citations. Confirming the strong relationship between the citation frequency and in-text citation frequency, the results of this study showed that although the in-text citation frequency is an evaluated indicator indicating the scope of use, it is strongly correlated with the citation quantity. In the other words, the citing authors used mostly those works in their articles that received more citations(1). Accordingly, the citation frequency can predict the quality of the impact of the articles in the field of pharmacology in terms of the in-text citation frequency.

It is also possible to rank the author's articles by applying in-text frequency indicator that reflects the importance of the work to the citing author (5,6,8). For this purpose, articles with more in-text frequency can be ranked higher using this indicator. With this ranking, the cited author realizes that which of his or her articles are more important and influential to other authors. One of the things that distinguishes this indicator from citation index is the unequal value of the citations, so that the value of each citation

can be distinguished based on the rate of its use in the text. This issue increases the motivation for the authors to produce articles with higher quality. Another assumption in using the citations is that the author cites the articles that their subjects are related to his/her research topic, so we can identify the articles that have a greater impact on the author and have a higher importance and value for his/her research by using the text frequency index. It provides the conditions to access to a wide range of the related articles and helps the reader easily identify the most influential articles related to his/her subject.

Results of this study on classifying Iranian articles in the field of pharmacology in terms of the text citation potential and their frequency in each group indicated that most of these articles had the lowest text citation potential (0-0.08) and few of them achieved a high text citation potential. In their research, Bonitz et al concluded that a great number of the articles (or documents) had a lower citation. Dividing the world's countries into three groups of citation winners, citation losers, and middle group or countries with acceptable performance, they reported that a large number of the countries in the world were placed in the group of citation losers (1).

In this study, the articles that obtained the highest value in the examined indicators were identified as the top articles. Accordingly, the top ten articles in terms of the in-text citation frequency were identified in the field of pharmacology. Review of these articles showed that the articles with the same in-text citation frequency did not have the same text citation potential, because the articles with the same in-text citation frequency obtained different text citation potential among these articles. The reason for this difference in the text citation potential can be traced in the potential difference of the in-text references of the citing articles.

Recommendations
Given the importance of paying attention to the quality of science, it is recommended to hold workshops so that Iranian researchers gain more knowledge on the way of producing high-quality science and the factors affecting and underling it. It is also recommended to evaluate the relationship between these two indicators that have different self-citation rates in other fields, regardless of the effect of the self-citation.

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