Correlation of publication frequency with impact factors in 1058 medical journals in SCI-expanded database

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ABSTRACT

We collected the impact factor (IF) and 5-year impact factor (5-IF) of 1058 medical journals in SCI-expanded database, and explore their changes with the increase of publication frequency (PF). Our studies shows that there are positive correlation of PF with IF (r=0.313, P=0.000) and 5-IF (r=0.298, P=0.000). According to the levels of journals' PF, the journals were divided into four groups. The journals with PF from 1 to 5 were divided into group I，that from 6 to 11, 12 to 23, 24 to 58 were divided into group II, group III and group IV, respectively. The IF of the journals in group I were 1.94±1.71，2.16±4.30 in group II, 3.17±2.93 in group III, and 8.00±9.68 in group IV, respectively. The 5-IF of the journals in group I were 2.080±1.668，2.194±3.046 in group II, 3.253±3.045 in group III, and 8.00±10.015 in group IV, respectively. With comparison of mean ranks of IF and 5-IF among four groups with different PF, we had found that the higher the PF the higher the IF (H=114.075, P=0.000) and 5-IF (H=102.796, P=0.000). From 2006 to 2008, PF increased at various degrees in 22 journals, of which the total citation increased too, and just 18 journals of which IF increased. After PF increased in 22 journals, IF and 5-year IF were obviously higher than those before PF increased (Z=2.386, P=0.017; Z=4.015, P=0.000). We concluded that the IF and 5-IF are increased with the increasing of journals' PF. The mechanism of the positive correlation between IF and PF are discussed.

Keywords: Publication frequency; 2-year impact factor; 5-year impact factor; Medical journals; SCI-expanded database

INTRODUCTION

The idea of impact factor (IF) was first mentioned in 1955 (Garfield 1955; Garfield 1999). In the early 1960s, Garfield and Sher (1963) created the journal IF to help select journals for the *Science Citation Index* (SCI). Through some decades development, the IF has gradually become the yardstick by which the academic community has come to assess its scientific efforts for some years in countries such as German and Japan (Firsching 2003), China (Su

2001), and it has gradually evolved, especially in Europe (Kirchhof et al. 2007). The IF was designed to assess journals, but there are frequent mentions in the literature of IFs being used as an indicator of the eventual impact of a scholar's work (Holden et al. 2006). Universities in Germany, for instance, regularly used the IF of journals in which scientists publish into formulae to help them determine departmental funding (Adam 2002). The Italian Association for Cancer Research requires grant applicants to complete worksheets calculating the average impact factor of the journals in which their publications appear (Adam 2002). In Finland, government funding for university hospitals was partly based on publications points, with a sliding scale corresponding to the IF of the journals in which researchers publish their work (Adam 2002). China's "SCI Phenomenon" (Su 2001) and India's "Impact Factor Syndrome" (Bachhawat 2002; Lakhotia 2010) has developed the IF that was used in academic evaluation. Therefore, many science journals hope to raise their IF.

Journal publication frequency (PF) is the number of journal published annually, while publication circle is the time circle of each number. Both indicators can indicate the time interval between each two consecutive numbers. If the PF is 12, the publication circle is monthly. Liu et al (2007) had investigated the correlation between publication circle and IF of 380 medical journals indexed in *Statistics of China Published Papers in Science & Technology* in 2005, and found that journal IF obviously increased with the shortening of PF. SCI is the popular scientific evaluation system, and there were 7347 journals indexed in *Science Citation Index Expanded* (SCIE) in 2009. To further explore this relationship between PF and IF of medical journals we have compared the 2-year IF and 5-year IF of 1058 medical journals indexed in SCIE in 2009. The aim of this study is to find out an effective method in publication element that helps improve the journals' impact factors.

MATERIALS AND METHOD

We chose the medical journals indexed in SCIE in 2009, including disciplines such as *Clinical Neurology*, *Dentistry*, *Oral Surgery and Medicine*, *Dermatology*, *Emergency Medicine*, *Endocrinology and Metabolism*, *Gastroenterology and Hepatology*, *Hematology*, *General and Internal Medicine*, *Nursing*, *Obstetrics and Gynecology*, *Oncology*, *Ophthalmology*, *Otorhinolaryngology*, *Pediatrics*, *Rheumatology*, *Surgery*, *Transplantation*, *Urology* and *Nephrology et al*. Two-year IF and 5-IF, total citation and PF were imputed into a spreadsheet application. After excluding some journals (journals which were found more than one time in different disciplines), there were 1058 medical journals.

According to PF, all journals were divided into four groups, group I (205 journals) with PF from 1 to 5, group II (441 journals) with PF form 6 to 11, group III (375 journals) with PF from 12 to 23 and group IV (37 journals) with PF from 24 to 58. The total publication number was 9 526, and the average PF was 9.01. We statistically analyzed the correlation of PF with 2-year IF and 5-year IF, and compared the IF and 5-IF in each group.

Correlation of PF with IF and 5-IF were analyzed with Spearman non-parametric test; comparison of IF and 5-IF among groups was tested using Kruskal-Wallis *H* test; multi-comparison between each two groups were tested using Nemenyi rank test; and comparison of IF and 5-IF before and after the increase of PF used the Wilcoxon *W* test for two related samples.

RESULTS

Publication Frequency (PF) of 1058 Medical Journals

The PF of 1058 medical journals sampled in this study are shown in Table 1.

Table 1: Publication Frequency of 1058 Medical Journals

PF	Number	PF	Number	PF	Number	PF	Number
1	3	8	64	15	6	36	1
2	2	9	16	16	5	40	2
3	7	10	43	18	3	48	1
4	185	11	5	20	1	50	1
5	8	12	351	22	1	52	3
6	309	13	3	24	26	58	1
7	4	14	5	28	2		

Note: The average value of 1058 medical journals was 9.00±5.58.

Correlation of PF with 2-year IF and 5-year IF

The correlation between PF and 2-year IF of 1058 medical journals collected from SCIE in 2009 was determined by Spearman non-parametric test (r=0.313, *P*=0.000), and the scattergram is shown in Figure 1. The correlation between PF and 5-year IF was also determined by Spearman non-parametric test (r=0.298, *P*=0.000), and the scattergram is shown in Figure 2. We found that there were positive correlations of PF with both year-window frames. About 31.3% increase of 2-year IF was determined by PF, and 29.8% increase of 5-IF was determined by PF.

Total levels of IF and 5-IF of Journals in Four Groups

Total levels of 2-year IF and 5-IF of journals in the four groups is shown in Table 2. Statistical analysis of mean ranks of 2-year IF and 5-IF are shown in Table 3. Multi-comparison of 2-year IF and 5-year IF among groups are shown in Table 4. We find the average values of 2-year IF and 5-year IF increasing with the raise of PF in all groups in Table 2. The mean ranks of 2-year IF and 5-year IF gradually increase with the raise of PF, and there are statistical differences (all *P*=0.000). Table 4 shows the differences of 2-year IF and 5-year IF among groups.

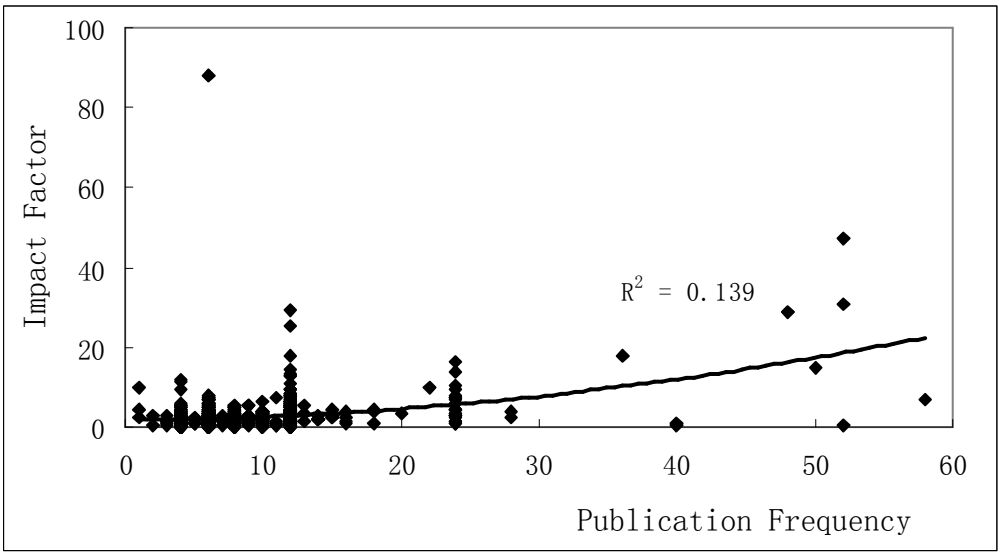

Figure 1: Correlation between 2-Year Impact Factors and Publication Frequencies

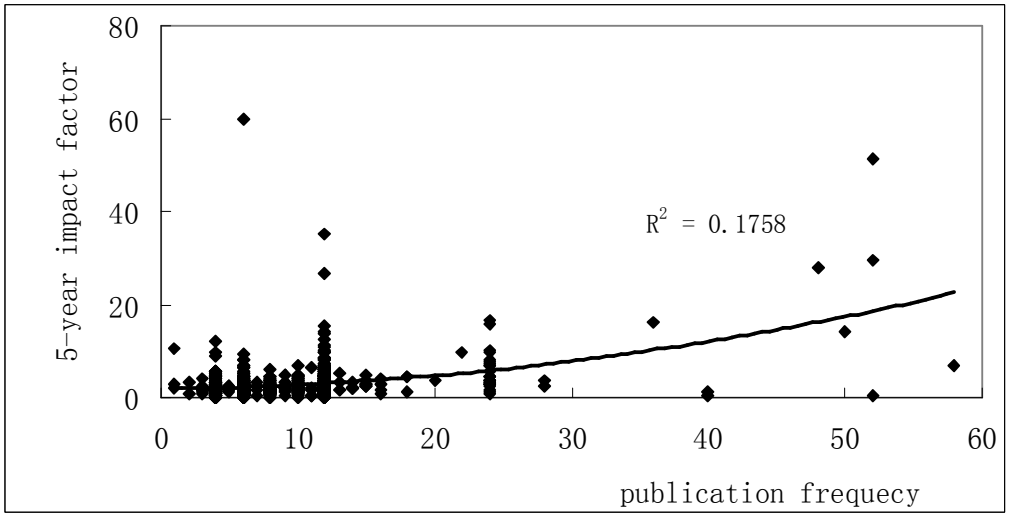

Figure 2: Correlation between 5-Year Impact Factors and Publication Frequencies

Table 2: Total Levels of 2-year IF and 5-year IF of Journals in Four Groups

Groups	Numbers	IF_{max}	IF_{min}	IF_{mean}	IF_{SD}	5-IF_{max}	5-IF_{min}	5-IF_{mean}	5-IF_{SD}
Group I	205	12.05	0.08	1.94	1.71	12.039	0.091	2.080	1.668
Group II	441	97.93	0.07	2.16	4.30	60.000	0.069	2.194	3.046
Group III	375	29.54	0.12	3.17	2.93	34.983	0.125	3.253	3.045
Group IV	37	47.05	0.42	8.00	9.68	51.410	0.410	8.000	10.015

Table 3: Comparison of Mean Ranks of 2-year IF and 5-year IF of Journals in Four Groups

Group	Numbers	IF mean rank	5-IF mean rank
Group I	205	435.44	439.29
Group II	441	462.32	459.15
Group III	375	632.43	620.79
Group IV	37	808.22	791.85
H		114.075	102.796
P		0.000	0.000

Table 4: Multi-comparison of Difference of 2-year IF and 5-year IF of Journals in Four Groups

（*P* value）

Group	Group Ⅱ		Group Ⅲ		Group Ⅳ	
	2-year IF	5-year IF	2-year IF	5-year IF	2-year IF	5-year IF
Group Ⅰ	0.781	0.900	0.000	0.000	0.000	0.000
Group Ⅱ			0.000	0.000	0.000	0.000
Group Ⅲ					0.011	0.0100

Changes of 2-year IF Before and After Increasing of PF

PF of 22 journals increased at various degrees from 2005 to 2008 out of which, IF of 18 journals raised and of 4 journals decreased. The Wilcoxon *W* test shows there was statistical difference with the increase of IF before and after increase of PF (*Z*=2.386, *P*=0.017). Total citation of the 22 journals increased, and there was statistical difference (*Z*=2.386, *P*=0.017).

After the increase of PF, the calculation of increase and decrease of IF for 2006 is as below:

$$\frac{(\text{Journal IF in } 2007 + \text{Journal IF in } 2008)}{2} - \text{Journal IF in } 2006;$$

that for 2007, its calculation is:

$$\frac{(\text{Journal IF in } 2008 + \text{Journal IF in } 2009)}{2} - \text{Journal IF in } 2007;$$

that for 2008, its calculation is:

$$\text{Journal IF in } 2009 - \text{Journal IF in } 2008$$

The increase and decrease of total citation is calculated as the total citation at the increasing year minus the total citation at the last year. Changes of IF and total citation of 22 journals after PF increased are shown in Table 5.

Table 5: Changes of IF and Total Citation of 22 Journals after PF Increased

Journals	Increased number (Year)	TC1	TC2	IF1	IF2
Curr med Res Opin	4 (2006)	1801	2444↑	3.062	2.547↓
Horm Metab Res	6 (2006)	2917	3019↑	1.977	2.701↑
Int J Neuropsychoph	2 (2006)	1079	1496↑	5.184	4.626↓
Otol Neurotol	2 (2006)	998	1330↑	1.339	1.423↑
Pediatr Hemat oncol	2 (2006)	646	693↑	0.529	0.846↑
Skin Pharmacol Phys	2 (2006)	703	804↑	1.48	2.253↑
Am J Chinese med	3 (2007)	776	904↑	0.71	1.240↑
Ann Med	2 (2007)	2943	3143↑	4.594	4.841↑
Injury	2 (2007)	3197	3673↑	1.067	2.165↑
J Neurosurg-Spine	6 (2007)	418	848↑	1.478	1.508↑
J Surg Oncol	4 (2007)	3543	3954↑	2.183	2.490↑
J Viral Hepatitis	6 (2007)	1909	2154↑	3.29	3.337↑
Neoplasia	6 (2007)	2301	3201↑	4.913	5.108↑
BJOG-Int J Obstet Gy	1 (2008)	9572	10915↑	3.101	3.437↑
Blood	27 (2008)	116789	122032↑	10.432	10.555↑
Epilepsy Behav	6 (2008)	1937	2699↑	2.302	2.610↑
Int J Gynecol Cancer	3 (2008)	2265	3344↑	1.932	2.179↑
Int J Hyperther	2 (2008)	1349	1386↑	2.339	2.412↑
J Clin Neurosci	6 (2008)	1252	1771↑	1.19	1.170↓
J Pediatr Orthoped	2 (2008)	3478	4429↑	1.569	1.226↓
Surg Radiol Anat	2 (2008)	841	1177↑	0.782	0.926↑
Western J Nurs Res	2 (2008)	795	856↑	0.989	1.090↑
Statistical analysis		TC1 *vs* TC2: Z=4.015, P=0.000		IF1 *vs* IF2: Z=2.386, P=0.017	

Note: TC1: Total citation before PF increasing; TC2: Total citation after PF increasing; IF1: IF before PF increasing; IF2: IF after PF increasing; ↑means increasing; ↓means decreasing.

PF of Medical Journals with 2-year IF or 5-year IF more than 10

PF of medical journals with 2-year IF or 5-year IF more than 10 in 2009 are shown in Table 6. The average PF of journals was 22.1 and 21.8 with 2-year IF more than 10 and 5-year IF more than 10, respectively, which were significantly higher than 9.0 of 1058 medical journals (both P=0.000).

Table 6: PF of Medical Journals with 2-year IF or 5-year IF more than 10 in 2009

Journal	PF	2-year IF	Journals	PF	5-year IF
CA-Cancer J Clin	6	87.925	CA-Cancer J Clin	6	60
New Engl J Med	52	47.05	New Engl J Med	52	51.41
Lancet	52	30.758	Nat Rev Cancer	12	34.983
Nat Rev Cancer	12	29.538	Lancet	52	29.443
JAMA-J Am Med Assoc	48	28.899	JAMA-J Am Med Assoc	48	27.753
Cancer Cell	12	25.288	Cancer Cell	12	26.636
Lancet Neurol	12	18.126	Ann Intern Med	24	16.552
J Clin Oncol	36	17.793	J Clin Oncol	36	15.969
Ann Intern Med	24	16.225	J Natl Cancer I	24	15.62
Circulation	50	14.816	Lancet Neurol	12	15.46
Lancet Oncol	12	14.47	Circulation	50	14.049
J Natl Cancer I	24	14.069	PLoS Med	12	14.023
Brit Med J	12	13.66	Lancet Oncol	12	13.673
PLoS Med	12	13.05	Gastroenterology	12	12.432
Gastroenterology	12	12.899	Front Neuroendocrin	4	12.039
Front Neuroendocrin	4	12.048	Brit Med J	12	11.284
BBA-Rev Cancer	4	11.685	Hepatology	12	10.912
Hepatology	12	10.84	Ann Rev Med	1	10.609
Blood	24	10.555			
Average	22.1			21.8	

Note: There were 9 526 numbers of 1058 medical journals in 2009. The average PF was 9.0 obviously lower than PF of journals with 2-year IF or 5-IF more than 10 with Mann-Whiteney (U=4.281, P=0.000; U=3.907, P=0.000).

DISCUSSIONS AND CONCLUSIONS

The 1058 international medical journals indexed in SCIE database were investigated in this study. There were 205 (19.38%) journals with PF≤5, and 37 (3.05%) journals with PF≥24 and the average PF was 9.01. Liu et al. (2007) had investigated 380 Chinese medical journals, including 50 (13.16%) quarterly, 200 (52.63%) bimonthly, 118 (31.05%) monthly and 12 (3.16%) semimonthly. The average PF was 8.17 slightly lower than that of medical journals collected by SCIE, but equaled to average PF of all scientific and technological journals indexed in SCIE. Another investigation showed that PF of Chinese medical journals (9.20±5.70) was higher than (8.45±5.74) of medical journals of the world, but no difference was found (Liu, Sheng and Qin 2010). Therefore, average PF of Chinese medical journals was equaled to that of foreign medical journals on the whole, and PF should not be called the bottleneck of development of Chinese scientific and technological journals. Although foreign scientific and technological journals are trying to increase their PF (Anon. 2010; Oliver 2008; Suzuki 2000; Waring 2006), Chinese scientific and technological journals have more chance to increase their PF. So PF of Chinese Scientific and technological journals will

be higher than that of foreign scientific and technological journals in the future.

We had determined the correlation of PF with 2-year IF and 5-year IF from 3 different aspects, all of which demonstrated that 2-year IF and 5-IF increased with the rise of PF. With Spearman non-spearman test, Kruskal-Wallis *H* test and Wilcoxon *W* test, we obtained the same conclusion. On the other hand, we found that the average PF were 22.1 and 21.8 for 19 medical journals with 2-year IF more than 10 and 18 medical journals with 5-IF more than 10 (13 journals were reduplicates), which were greatly higher than that of 1058 medical journals. From Table 4, we could know that there was no difference of 2-year IF and 5-year IF between group I and group II (P=0.781, P=0.900), which implied no difference between PF from 1 to 5 and PF from 6 to 11. But differences were found when compared with the group with PF more than 12 and PF of more than 24. 2-year IF and 5-year IF were the highest in group IV. For Chinese medical journals, IF was the highest in monthly journals, followed by those published semi-monthly, however no difference was found. This indicates that some Chinese medical journals have a healthy state of manuscript submission that can cope with semi-monthly publication. Foreign-based medical journals with high PF tend to increase their PF when they have increased number of manuscripts. This situation may imply that high academic level and increased PF have improved the 2-year and 5-year IF of journals.

There have been many studies that dealt with the 2-year impact factor issues (Bouyssoua and Marchantc 2011; Campanario and Coslado 2011; Egghe et al. 2009; Egghe 2011; Garfield 2006) and 5-year impact factor (Della Sala and Grafman 2009; van Nierop 2010; STIMULATE 9 Group 2009), but we had not found any article that studied the possible correlation of PF with IF in the Web of Science, ScienceDirect, SpringerLink, EBSCOhost, Academic Search Premier, CNKI and Wanfang Database. The reasons for positive correlation between PF and IF was not clear. We therefore speculated that, first, journals with high PF could effectively control publication delays, improve the timeliness of journals, shorten manuscripts publication lag (Liu 2003), and increase the possibility of manuscripts being published. Ren et al. (2000) opined that the journal with shorter publication circle could achieve more cited frequencies. That is to say, journals with higher PF can have higher 2-year and 5-year IFs on the basis of having enough high quality manuscripts – journals such as *Nature*, *Science*, *New EngL J Med*, *JAMA*, *Lance*, *Circulation,* and many others. Second, journals with high PF, which have made progressed through tough times due to insufficient manuscripts, are definitely of higher academic level and achieving greater 2-year and 5-year IFs. Thirdly, journal with high quality, high impact, low publication circle and strong timeliness has more advantage to attract higher quality manuscripts, and would continue to achieve high 2-year and 5-Ifs. More studies are needed to confirm the notion that positive correlation exists between PF and IF.

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