Arch Iranian Med 2007; 10 (2): 182 – 189

Original Article

The Impact Factor-Based Quality Assessment of Biomedical Research Institutes in Iran: Effect of Impact Factor Normalization by Subject

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Background: **The journal impact factor is increasingly employed to evaluate the quality of scientific research. This is in contrary to its critical limitations, e.g., its marked variation across scientific disciplines. This study was conducted to describe, in both quantitative and qualitative terms, the contribution of Iranian universities and research institutes to biomedical publications in 2004 and to examine the possible effect of impact factor normalization by subject on their rankings.**

Methods: **The Iranian biomedical articles were recruited from Thomson Science Citation Index Expanded and PubMed databases according to Thomson Scientific subject categorization of journals. Three subject-normalized impact factors were employed: rank-normalized impact factor, journal to field impact score, and standardized impact factor.**

Results: **Tehran and Shiraz Universities of Medical Sciences and University of Tehran were the top three institutes regarding the sum of impact factor in 2004. On the basis of the mean crude impact factor, Sharif University of Technology, University of Shiraz, and Baqiyatollah University were ranked as the first to third. However, the subject normalization of impact factor made some considerable changes in impact factor-based rankings of research institutes.**

Conclusion: **The Iranian scientific community and science development policy makers are recommended to employ subject-normalized impact factor, rather than crude impact factor, in quality assessment of biomedical research held in various academic and research institutes.**

Archives of Iranian Medicine, Volume 10, Number 2, 2007: 182 – 189.

Keywords: Biomedical research • Iranian universities • journal impact factor • quality assessment • subject normalization

Introduction

The quality assessment of the academic and research institutes are increasingly recognized as critical components of development programs.[1] Evaluation of quality in scientific research is a complex problem. Frequently, systematic review of research outputs by experts in the field is considered as an ideal solution of this problem.[2] The use of more objective scientometric indices in research evaluation emerged in the 1960s and 1970s.[3 – 5] These scientometric indicators, among which the most common one is probably the journal impact factor (IF), are increasingly employed to evaluate the quality of scientific research performed by individual scientists, research groups, or institutes.[6 – 8] The journal IF, first introduced by Garfield in 1960s, is a measure of the frequency with which the average article in a journal has been cited in a particular year.[4] This indicator, calculated annually by the Thomson Scientific (formerly Thompson ISI), is derived by dividing the number of citations in year 3 to any items published in the journal in years 1 and 2 by the number of substantive articles published in that journal in years 1 and 2.[4] In Iran, the use of journal IF has recently been advocated to evaluate the quality of research held in universities and research institutes.[9]

In spite of its obvious advantages including conceptual simplicity, and the fact that it provides a convenient method to assess the impact of

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Accepted for publication: 28 February 2007

journals and articles more immediately than citation itself, the employment of journal IF to evaluate the quality of research has been widely criticized.[2, 10 – 12] Some of these criticisms, however, are more related to the ISI policy in calculation of IF (e.g., its 2-year citation window) than the overall concept of IF. Among the most critical shortcomings of journal IF is that it strongly varies across different scientific disciplines.[2, 5] Several factors have been found to contribute to such differences among fields of research: variations in the intrinsic citation pattern, the dynamic or stable state of the field, etc.[13] For example, biochemistry and molecular biology articles are cited about five times as often as pharmacy articles.[14] Several methods have been proposed to normalize journal IFs by their subject,[15 – 20] among them the rank-normalized journal IFs and "journal to field impact score" (JFIS) are two examples.[15 – 16]

In recent years, Iran has substantially increased its presence in world science.[21, 22] This growing trend is evident in the annual number of scientific articles published by Iranian researchers in international journals.[21, 23 – 25] It has been reported that Iran experienced the most prominent rise in the number of scientific publications among the Middle East countries.[23] Especially, this upward trend has been observed in biomedical publications.[24 – 25]

The universities and research institutes of Iran seem to contribute unevenly in science production process. In the present study, the contribution of Iranian universities and research institutes to international biomedical publications in 2004 is described, in both quantitative and qualitative terms. Specifically, the aim of this study is to investigate how the normalization of journal IF by subject may affect the IF-based ranking of Iranian institutes active in biomedical research.

Materials and Methods

Subject categorization of journals

The subject categories of journals provided by Thomson Scientific were employed. The journals are classified into various subject categories on the basis of an indicator called relatedness index. This index is calculated for each pair of journals on the basis of the amount of citations between them. According to the subject categorization of journals done by Thomson Scientific, some journals may be assigned to more than one subject categories.[26 – 27]

Normalization of journal IFs by subject

To factor out the inherent variation of journal IF among different disciplines,[13] three normalized indicators were calculated:

1) Rank-normalized IF (rnIF): Each journal was assigned its rnIF after calculation of its fractional rank (in increasing order) within its related subject category. So, rnIF varies between 0 and 1 and journals with the highest IF within their related categories were described by rnIF equal to 1.[15]

2) JFIS: The journal IFs were divided by the aggregate IFs calculated for their related subject categories.[16] The aggregate IFs, provided as part of the Journal Citation Report (JCR), reflects how many times the average article of the field is cited.

3) Standardized IF (SIF): A novel method was also employed to normalize journal IFs by their subjects. Since the journal IFs were found to obey, globally and within the subject categories, a log-normal distribution, the following transformations were made to fit the observed IF distribution across subject categories: First, the journal IFs were logarithmically transformed and a new normally-distributed variable was obtained. Second, using the mean and standard deviation of this new variable, the standardization process was made and identical standard normal distributions were reached for SIFs for all subject categories. This normalized indicator could so reflect the relative position of each journal in its own related category, hence, making it possible to compare journals from various categories.

Recruitment and classification of Iranian biomedical articles

The articles from Iranian researchers published during 2004 in biomedical research fields were recruited from the Science Citation Index Expanded (SCI-Expanded) database of Thomson ISI Web of Science, through limiting the search to biomedical subject categories. The joint publications with researchers from other countries were also included in this study. To avoid any missing of the Iranian articles due to possible errors in ISI indexing, the PubMed database was also searched for Iranian articles. In PubMed, articles were considered to be from Iran only if "Iran" was mentioned in the affiliation address of the first author. The published Iranian articles were then assigned to diverse scientific subfields, according to the subject category of the publishing journal. If the journal had been assigned to more than one category, the category with most

relevance to the specialty of the first author was chosen. In case of any doubt, the category with the highest normalized IF for that journal was selected. The quality of articles published by the country was then evaluated in terms of crude IFs and the three above-mentioned normalized IFs.

IF-based ranking of Iranian academic/research institutes and statistical analysis

The Iranian biomedical articles published in 2004, recruited from either ISI SCI-Expanded or PubMed databases and categorized by their subjects were attributed to various universities and research institutes on the basis of the affiliation address of the author. The universities and research institutes were then ranked on the basis of the mean crude or subject-normalized IF of journals publishing their articles. The rankings of Iranian research institutes on the basis of crude and normalized IFs were finally compared through calculating the Pearson's and Spearman's correlation coefficients between them.

Results

The total number of biomedical journals studied was 3,842, attributed to 69 different subject categories. The SIF of these journals, calculated as described earlier, exhibited an excellent correlation with their rnIFs, with Pearson's and Spearman's correlation coefficients being 0.946 and 0.992, respectively. The correlation of SIF with JFIS was also strong, although it was relatively weaker than rnIF (Pearson's and Spearman's coefficients were 0.745 and 0.955, respectively). The observed correlations were strong enough to justify the employment of SIF in parallel to rnIF and JFIS in the present study.

The total number of Iranian biomedical articles published in 2004 was 1,172 from which 876 articles were published in journals with a calculated IF. Table 1 presents the descriptive statistics of crude and normalized IFs related to journals publishing Iranian biomedical articles in 2004. The maximum crude IF belonged to an article by A. Gharehbaghian of the Iranian Blood Transfusion Center, published in *The Lancet* with an IF of 21.713. This article was a joint publication with the Transplantation Sciences group of the University of Bristol. The rnIF of this journal was 0.98 and its JFIS and SIF values were 5.078 and 2.599, respectively. The second and third high-impact articles were published in *Neuron* and *EMBO J*, with crude IFs of 14.439 and 10.492, respectively. The mean and median crude IF of journals publishing Iranian articles in 2004 were 1.663 and 1.392, respectively. The journal IFs showed a significant positive skewness and kurtosis. The journal IF distribution could be satisfactorily described by a log-normal distribution (Figure 1), with scale and shape parameters of 1.322 and 0.701, respectively.

The mean ± SD rnIF for journals publishing Iranian biomedical articles in 2004 was 0.471 ± 0.252 (Table 1). The mean ± SD JFIS was 0.670 ± 0.446 and the corresponding value of SIF was (-0.108 ± 0.771). In agreement with each other, these three indicators reveal that Iranian articles were published in 2004 in those journals slightly weaker than the average journal of the field.

Table 2 demonstrates the top 20 Iranian universities according to the sum of their IFs in 2004. This criterion represents simultaneously both the quantitative and qualitative aspects of biomedical publications. Obviously, Tehran University of Medical Sciences with the sum of IF of 313.9 is far higher than other Iranian universities. This is almost 22% of the total IF the Iranian biomedical articles achieved in this year. Regarding this criterion, Shiraz University of Medical Sciences and University of Tehran had the second and third ranks.

To evaluate the quality of research, the Iranian universities and research institutes were separately ranked on the basis of their mean crude IF in 2004 (Table 3). Sharif University of Technology, University of Shiraz, and Baqiyatollah University were the top three universities, in respect with the

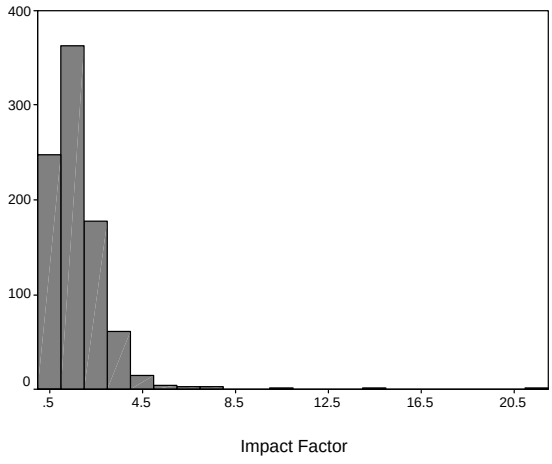

Figure 1. The distribution of impact factor of journals publishing Iranian biomedical articles in 2004.

Table 1. The crude and subject-normalized impact factors of journals publishing 1,172 Iranian biomedical articles in 2004.

	Impact factor	rnIF	JFIS	SIF
Articles with calculated index	876	768	768	768
Mean (CI95%)	1.663 (1.575 – 1.752)	0.471 (0.453 – 0.489)	0.670 (0.639 – 0.702)	-0.108 [(-0.162) - (-0.053)]
Median	1.392	0.465	0.592	-0.048
Interquartile range	1.230	0.422	0.487	1.008
Minimum	0.096	0.018	0.027	-2.841
Maximum	21.713	1.000	5.078	2.599
Variance	1.789	0.063	0.199	0.595
Skewness (SE)	5.753 (0.083)	0.085 (0.088)	2.570 (0.088)	-0.322 (0.088)
Kurtosis (SE)	68.929 (0.165)	-1.076 (0.176)	17.279 (0.176)	0.4 (0.176)

mean crude IF. Among the research institutes, the Institute for Advanced Studies in Basic Sciences (IASBS, Zanjan), Institute for Theoretical Physics and Mathematics (IPM) and National Research Institute for Tuberculosis, affiliated to Shaheed Beheshti University of Medical Sciences, were respectively located in first to third positions.

To take into account the marked variation of journal IFs in different disciplines, the subject-normalized IFs (rnIF, JFIS, and SIF) were calculated as described earlier and the universities and research institutes were again separately ranked according to these normalized variables. Tables 4 to 6 demonstrate the ranking of institutions on the basis of rnIF, JFIS and SIF, respectively.

The rankings changed considerably when the journal IFs were normalized by their subjects and University of Tabriz, Islamic Azad University, and University of Ferdowsi, Mashhad, were recognized as the top three universities. Among the research institutes, Digestive Disease Research Center, Tehran University of Medical Sciences (DDRC, TUMS), National Research Center for Genetic Engineering and Biotechnology (NRCGEB), and Iran Polymer and Petrochemical Institute were moved to top ranks after IF normalization by subject.

To compare the rankings of Iranian universities according to the crude and subject-normalized IFs, the Pearson's and Spearman's correlation coefficients between them were calculated (Table 7). The Pearson's correlation coefficients between the crude IF and rnIF, JFIS, or SIF were 0.577, 0.657, and 0.640, respectively. The corresponding Spearman's coefficients were 0.694, 0.716, and 0.734, respectively.

Discussion

The quality of biomedical research held in

Table 2. The Iranian universities, ranked according to sum of the impact factor of their publications in 2004.

Rank	Academic or research institute	No. of publications	Mean IF	SD of IF	Sum of IF
1	Tehran Univ Med Sci	194	1.618	1.338	313.9
2	Shiraz Univ Med Sci	68	1.668	1.144	113.4
3	Univ Tehran	55	1.753	0.932	96.4
4	Sh Beheshti Univ Med Sci	65	1.431	0.882	93.0
5	Tarbiat Modarress Univ	44	1.785	1.080	78.5
6	Iran Univ Med Sci	33	1.368	0.821	45.2
7	Univ Shiraz	19	2.224	1.242	42.2
8	Isfahan Univ Med Sci	37	1.126	0.480	41.7
9	Tabriz Univ Med Sci	19	1.916	1.339	36.4
10	Baquiatollah Univ	16	2.118	1.077	33.9
11	Mashhad Univ Med Sci	25	1.280	0.659	32.0
12	Sharif Univ Technol	14	2.241	1.017	31.4
13	Univ Isfahan	13	1.802	0.674	23.4
14	Amir Kabir Univ Technol	9	1.735	0.924	15.6
15	Univ Ferdowsi, Mashhad	10	1.464	0.727	14.6
16	Univ Tabriz	9	1.598	0.945	14.4
17	Islamic Azad Univ	7	1.965	0.759	13.8
18	Kermanshah Univ Med Sci	7	1.717	1.531	12.0
19	Bu-Ali Sina Univ, Hamedan	6	1.815	0.955	10.9
20	Jondishapour Univ Med Sci, Ahvaz	6	1.697	1.508	10.2

Table 3. The top 15 Iranian universities and 10 research centers active in biomedical research, ranked according to the mean of their crude IFs in 2004.

Rank	Universities†	Mean IF	Research centers†	No. of publications	Mean IF
1	Sharif Univ Technol	2.241	IASBS*	8	3.657
2	Univ Shiraz	2.224	IPM*	9	3.183
3	Baqiyatollah Univ	2.118	NRIT*, SBUMS*	4	2.907
4	Islamic Azad Univ	1.965	DDRC*, TUMS*	13	2.897
5	Tabriz Univ Med Sci	1.916	NRCGEB*	17	2.320
6	Bu-Ali Sina Univ, Hamedan	1.815	IBB*, UT*	22	2.041
7	Univ Isfahan	1.802	NRC*, SBUMS*	8	2.033
8	Tarbiat Modarress Univ	1.785	Inst Pasteur	18	1.962
9	Univ Tehran	1.753	Ministry of Health	6	1.850
10	Amir Kabir Univ Technol	1.735	IAARI*, TUMS	4	1.722
11	Kermanshah Univ Med Sci	1.717	—	—	—
12	Jondishapour Univ Med Sci	1697	—	—	—
13	Shiraz Univ Med Sci	1.668	—	—	—
14	Tehran Univ Med Sci	1.618	—	—	—
15	Univ Tabriz	1.598	—	—	—

†Only universities and research centers with respectively at least 5 and 4 biomedical publications in 2004 were considered for this ranking; *IASBS = Institute for Advanced Studies in Basic Sciences, Zanjan; IPM = Institute for Theoretical Physics and Mathematics, Tehran; NRIT = National Research Institute for Tuberculosis; SBUMS = Shaheed Beheshti University of Medical Sciences; DDRC = Digestive Disease Research Center; TUMS = Tehran University of Medical Sciences; NRCGEB = National Research Center for Genetic Engineering and Biotechnology; IBB = Institute of Biochemistry and Biophysics; UT = University of Tehran; NRC = Neuroscience Research Center; IAARI = Immunology, Asthma, and Allergy Research Institute.

Iranian academic and research institutes in 2004 was evaluated in terms of the crude and subject-normalized IF of journals publishing their articles. It was shown that the subject normalization of IF influences the IF-based ranking of Iranian research institutes.

Various methods of IF normalization by subject have been proposed in recent years.[15 – 20] For example, the journal IFs may be normalized through dividing the IF by the maximum IF in the field or the average IF of highest-rank journals, the aggregate IF, the mean IF, the median IF, or any other point indicator of IF distribution in the field.[16-18] Alternatively, the subject normalization of journal IFs may be performed after the IF-based ranking of journals in their related subject categories.[15] Needless to say, all these methods disregard the variation of journal IF distribution in

Table 4. The top 15 Iranian universities and 10 research centers active in biomedical research, ranked according to mean of their rank-normalized IF (rnIF) in 2004.

Rank	Universities†	Mean rnIF	Research centers†	No. of publications	Mean rnIF
1	Univ Tabriz	0.703	DDRC*, TUMS*	13	0.642
2	Islamic Azad Univ	0.680	IPPI	4	0.596
3	Univ Ferdowsi, Mashhad	0.623	NRCGEB*	9	0.535
4	Amir Kabir Univ Technol	0.593	Inst Pasteur	18	0.522
5	Sharif Univ Technol	0.586	NRC*, SBUMS*	8	0.522
6	Univ Isfahan	0.583	Ministry of Health	6	0.501
7	Baqiyatollah Univ	0.570	IBB*, UT*	22	0.485
8	Univ Shiraz	0.559	IAARI*, TUMS*	4	0.477
9	Tabriz Univ Med Sci	0.530	IPM*	8	0.435
10	Kermanshah Univ Med Sci	0.513	Cardiovasc Res Center, Isfahan Univ Med Sci	5	0.387
11	Univ Tehran	0.512	—	—	—
12	Tarbiat Modarress Univ	0.512	—	—	—
13	Jondishapour Univ Med Sci	0.509	—	—	—
14	Mazandaran Univ Med Sci	0.504	—	—	—
15	Shiraz Univ Med Sci	0.479	—	—	—

†Only universities and research centers with respectively at least 5 and 4 biomedical publications in 2004 were considered for this ranking; *DDRC = Digestive Disease Research Center; TUMS = Tehran University of Medical Sciences; IPPI = Iran Polymer and Petrochemical Institute; NRCGEB = National Research Center for Genetic Engineering and Biotechnology; NRC = Neuroscience Research Center; SBUMS = Shaheed Beheshti University of Medical Sciences; IBB = Institute of Biochemistry and Biophysics; UT = University of Tehran; IAARI = Immunology, Asthma, and Allergy Research Institute; IPM = Institute for Theoretical Physics and Mathematics.

Table 5. The top 15 Iranian universities and 10 research centers active in biomedical research, ranked according to mean of their journal to field impact score (JFIS) in 2004.

Rank	Universities†	Mean JFIS	Research centers†	No. of publications	Mean JFIS
1	Univ Ferdowsi, Mashhad	1.141	IPM*	8	0.943
2	Univ Tabriz	1.015	DDRC*, TUMS*	13	0.867
3	Islamic Azad Univ	0.979	NRCGEB*	9	0.749
4	Tabriz Univ Med Sci	0.863	Inst Pasteur	18	0.725
5	Baqiyatollah Univ	0.855	Ministry of Health	6	0.717
6	Sharif Univ Technol	0.838	NRC*, SBUMS*	8	0.697
7	Amir Kabir Univ Technol	0.773	MPRI*, SBUMS*	4	0.675
8	Kermanshah Univ Med Sci	0.761	IPPI*	4	0.633
9	Univ Isfahan	0.757	IBB*, UT*	22	0.602
10	Jondishapour Univ Med Sci	0.751	PPDRI*	4	0.573
11	Tarbiat Modarress Univ	0.714	—	—	—
12	Mazandaran Univ Med Sci	0.705	—	—	—
13	Univ Shiraz	0.685	—	—	—
14	Tehran Univ Med Sci	0.675	—	—	—
15	Sh Bahonar Univ, Kerman	0.673	—	—	—

†Only universities and research centers with respectively at least 5 and 4 biomedical publications in 2004 were considered for this ranking; *IPM = Institute for Theoretical Physics and Mathematics; DDRC = Digestive Disease Research Center; TUMS = Tehran University of Medical Sciences; NRCGEB = National Research Center for Genetic Engineering and Biotechnology; NRC = Neuroscience Research Center; SBUMS = Shaheed Beheshti University of Medical Sciences; MPRI = Medicinal Plants Research Institute; IPPI = Iran Polymer and Petrochemical Institute; IBB = Institute of Biochemistry and Biophysics; UT = University of Tehran; PPDRI = Plant Pests and Diseases Research Institute.

different subject categories, hence, they cannot reflect the real position of journals within their categories. On the contrary, the SIF seems to represent well the situation of each journal within their subject categories. Using this subject-normalized IF, the inter-category comparison of journal IFs becomes possible.

After calculating the mean of crude and subject-normalized IFs for each Iranian research institute in 2004, these institutes were ranked according to each of these four indicators. Obviously, the rankings changed considerably when the journal IFs were normalized by their subjects. While Sharif University of Technology, University of Shiraz, and Baqiyatollah University were the top three universities in respect to the mean crude IF, after subject normalization of journal IFs, University of Tabriz, Islamic Azad University, and University of Ferdowsi, Mashhad, were recognized as the top three universities. Similarly among the research institutes, the DDRC, NRCGEB, and Iran Polymer and Petrochemical Institute were moved

Table 6. The top 15 Iranian universities and 10 research centers active in biomedical research, ranked according to mean of their standardized IF (SIF) in 2004.

Rank	Universities†	Mean SIF	Research centers†	No. of publications	Mean SIF
1	Univ Tabriz	0.544	DDRC*, TUMS*	13	0.397
2	Islamic Azad Univ	0.442	Ministry of Health	6	0.130
3	Univ Ferdowsi, Mashhad	0.441	NRCGEB*	9	0.123
4	Sharif Univ Technol	0.247	IPM*	8	0.111
5	Amir Kabir Univ Technol	0.171	IPPI*	4	0.105
6	Univ Isfahan	0.148	Inst Pasteur	18	0.084
7	Baqiyatollah Univ	0.141	NRC*, SBUMS*	8	0.009
8	Univ Shiraz	0.105	IBB*, UT*	22	-0.087
9	Univ Tehran	0.039	IAARI*, TUMS*	4	-0.127
10	Jondishapour Univ Med Sci	0.033	NNFTRC*, SBUMS*	4	-0.153
11	Kermanshah Univ Med Sci	0.016	—	—	—
12	Mazandaran Univ Med Sci	-0.003	—	—	—
13	Tabriz Univ Med Sci	-0.016	—	—	—
14	Sh Bahonar Univ, Kerman	-0.032	—	—	—
15	Tarbiat Modarress Univ	-0.034	—	—	—

†Only universities and research centers with respectively at least 5 and 4 biomedical publications in 2004 were considered for this ranking; *DDRC = Digestive Disease Research Center; TUMS = Tehran University of Medical Sciences; NRCGEB = National Research Center for Genetic Engineering and Biotechnology; IPM = Institute for Theoretical Physics and Mathematics; IPPI = Iran Polymer and Petrochemical Institute; NRC = Neuroscience Research Center; SBUMS = Shaheed Beheshti University of Medical Sciences; IBB = Institute of Biochemistry and Biophysics; UT = University of Tehran; IAARI = Immunology, Asthma, and Allergy Research Institute; NNFTRC = National Nutrition and Food Technology Research Center.

Table 7. Pearson's and (Spearman's) correlation coefficients between various IF-based rankings of Iranian universities active in biomedical research.

IF	Crude IF	rnIF	JFIS	SIF
Crude IF	—	—	—	—
rnIF	0.577 (0.694)	—	—	—
JFIS	0.657 (0.716)	0.888 (0.862)	—	—
SIF	0.640 (0.734)	0.957 (0.918)	0.930 (0.897)	—

to top ranks after IF normalization by subject.

To quantify the correlation between various IF-based rankings of Iranian biomedical research institutes, Pearson's and Spearman's correlation coefficients between them were calculated. The Pearson's coefficients between the crude IF-based rankings and three subject-normalized IFs were lower than 0.66 and the Spearman's coefficients were below 0.74. The presently introduced indicator of SIF exhibited strong correlation with both JFIS and especially rnIF, which is known to behave superior to some of the other known indicators in terms of IF subject normalization[15]. The calculated correlation coefficients can be taken to suggest that the subject normalization of IF may considerably influence the ranking of Iranian universities.

In Iran, there is a growing tendency to use the journal IF to evaluate the quality of research performed by individual scientists or research institutes.[9] The increasing awareness of journal IF and its possible use in evaluation are now reshaping Iranian scientists' publication behavior towards publishing in journals with higher IFs, often at the expense of apparently low-impact specialist journals. However, the results of this study, along with several other studies,[2, 10 – 12] indicated that the straightforward use of the crude journal IFs in quality assessment of research may be quite misleading. Based on the obtained results, it is suggested that the Iranian scientific community and science development policy makers should be cautious in using the crude journal IFs in research quality assessment. Instead, employing a subject-normalized IF, which may provide a more realistic picture of research quality, is recommended.

It is noteworthy that only biomedical articles published in journals have been included in this study. So, institutes which often publish their articles in nonbiomedical journals should cautiously be judged according to the results of this study. Such institutes like IASBS (Zanjan), IPM, Sharif, or Amir Kabir University of Technology may have qualitatively dissimilar situations in fields other than biomedical area. Therefore, the results of this study should be regarded to reflect only the situation of biomedical research held in various institutes.

Acknowledgment

This study was supported by a grant from the Endocrine Research Center, Shaheed Beheshti University of Medical Sciences. The assistance of Dr. A. Etemadi and Mr. M. Khorsand is gratefully acknowledged.

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