A Bibliometric Analysis of Toxicology Publications of Iran and Turkey in ISI Web of Science

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Received: 30.9.2012 *Accepted: 20.10.2012*

ABSTRACT

Background: Web of Science (WoS) is an online academic citation index provided by Thomson Reuters which supplies valuable bibliometric information for comparing impact of specific author, organization, or country in science production. The aim of this study was to compare toxicology publications of Iran and Turkey indexed in WoS from bibliometric point of view.

Methods: The WoS database was queried based on keywords "Iran" and "Turkey" separately in the "Address" field and refined by "Toxicology" as a category. All records were transferred to Microsoft Excel® application. The dataset were analyzed from different perspectives, such as publication years, number of references and citations, authorship pattern, publications types, affiliated organizations, core subject areas and journals.

Results: There were 1178 and 2240 publications that met the criteria during 1993-2011 for Iran and Turkey, respectively. Less than 2% of authors had published more than 25% of all toxicology papers in both countries. The average number of citation per article was about 3.48 for Iranian and 6.73 for Turkish papers. By the time of the analysis, 54.3% of Iranian and 31.6% of Turkish articles had not received any citation.

Conclusion: This analysis reveals that top Iranian toxicologists had a better performance than their Turkish counterparts but overall authorship pattern was well-distributed among Turkish researchers and organizations. If Iranian authors desire to achieve first rank of toxicology articles in the Middle East region by 2025, they must try to increase the quantity and quality of their international publications.

Keywords: Bibliometric Analysis, Iran, Toxicology, Turkey.

IJT 2013; 735-745

INTRODUCTION

Scientific progress is one of the most important indicators for the social and economic development of different countries. Evaluation of scientific activities of a country in global science production often depends on its domestic and international publications. There are some well-known databases such as PubMed (1), Scopus (2), Google Scholar (3), and Thomson Reuters Institute for Scientific Information (ISI) (4) for indexing international publications in biomedical sciences. ISI has various databases among which "Web of Science" (WoS) offers web access to the citation indexes, containing multidisciplinary, high quality research information from the world's leading science, social sciences and arts and humanities journals (5,6). WoS is a bibliographic database and nowadays most high quality bibliometric studies on the

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basis of citation analysis are done by using this database (6).

Iran is one of the most rapidly developing countries and its scientific output has grown 11 times faster than the world average, faster than any other country. A survey of the number of scientific publications listed in the WoS database shows that growth in the Middle East – mostly in Turkey and Iran – is nearly four times faster than the world average (7,8). According to the future outlook document of the country, Iran must be the leading country in economy, science, and technology in the region by 2025, inspiring the region and the world with its constructive and effective interactions in international relationships (9,10). Determining the current status of science production in various scientific fields and comparing the results with other major Middles East countries are necessary for achieving the above-mentioned strategic goals. In this study, we carried out a comparative evaluation of Iranian and Turkish scientific activities based on their publications in "Toxicology" category indexed in WoS from 1993 to 2011.

MATERIALS AND METHODS

The ISI "WoS" database was queried based on the terms "Iran" and "Turkey" separately in the "Address" field and refined by "Toxicology" as a category on 31 Dec. 2011. All founded records were transferred to Microsoft Excel® application. By using "Analyze Results" option of WoS and also using some tools of MS-Excel, the two datasets were examined from different perspectives including publication years, number of references, the most productive authors, authorship pattern, collaboration with other countries, publications types and languages, affiliated organizations, and core subject areas and journals.

To calculate the number of author(s) for each record, the semicolon (;) character in author (AU) filed of each record of dataset was counted using a computer program called "CounString module" (11) and the result was added by 1. The accuracy of calculation was checked by comparing the sum of the result with total numbers of authors reported by WoS. The dataset had a NR field in which the numbers of references for each article were recorded. Average number of references for each country was calculated using these data.

Analysis of citations to publications of each country was performed by using "Create Citation Report" of WoS and also by additional functions of MS-Excel on 1 September 2012. Citations in 2012 were not calculated at the subsequent analyses.

RESULTS

From the beginning of 1993 until the end of 2011, there were 1178 and 2240 toxicology articles indexed in WoS from Iranian and Turkish authors, respectively. Almost 1.02% of all Iranian and about 0.94% of all Turkish publications were related to toxicology category and its related subject areas. Table 1 shows the trend of toxicological publications' growth of Iran and Turkey indexed in WoS. Accordingly, the number of published articles of Iran has increased significantly during recent years.

Documents Types

Table 2 shows the type of documents of Iranian and Turkish toxicologists. The average numbers of references for publications were 20.13 and 27.18 for Iranian and Turkish articles, respectively.

Authorship Pattern

Pattern of authorship within publications of Iranian and Turkish toxicologists is shown in Figure 1. The average number of authors per paper was 4.08 (SD=2.25, Min=1, Max=23) for Iran and 4.39 (SD=2.26, Min=1, Max=38) for Turkey. About 94.6% of Iranian and 95.6% of Turkish papers were written in multiple-author status.

Table 1. Frequency of Iranian and Turkish toxicology articles in WoS

Publication Year	IRAN		TURKEY	
	No of article	%	No of article	%
1993	1	0.09	11	0.49
1994	3	0.25	20	0.89
1995	6	0.51	16	0.71
1996	8	0.68	16	0.72
1997	10	0.85	31	1.38
1998	14	1.19	36	1.61
1999	7	0.6	61	2.72
2000	15	1.27	47	2.1
2001	36	3.06	78	3.48
2002	17	1.44	93	4.15
2003	30	2.55	89	3.97
2004	99	8.4	175	7.81
2005	66	5.6	187	8.35
2006	58	4.92	190	8.48
2007	104	8.83	227	10.13
2008	180	15.28	236	10.54
2009	167	14.18	212	9.47
2010	144	12.22	193	8.62
2011	213	18.08	322	14.38
Sum	**1178**	**100**	**2240**	**100**

Table 2. Document types of Iranian and Turkish toxicology publications in WoS from 1993-2011

Type of Publication	Iran		Turkey	
	N	%	N	%
Article	659	55.94	1782	79.55
Meeting abstract	466	39.56	332	14.82
Review	25	2.12	19	0.85
Letter	10	0.85	26	1.16
Editorial material	4	0.34	6	0.27
Correction	3	0.25	7	0.31
Book chapter	0	0	3	0.13
Note	1	0.08	3	0.13
Biographical-Item	0	0	1	0.04
Sum	**1178**	**100**	**2240**	**100**

As shown in Figure 2, less than 2% of authors in both countries wrote about one fourth of all toxicology publications and less than 10% of the authors wrote 50% of all articles while more than 75% of all projects were done by less than 30% of the authors.

Further analysis of papers showed that Iranian and Turkish authors collaborated with other countries researchers in 14.1% (166 articles) and 14.5% (325 articles) of their publications, respectively.

The collected data allowed authors' productivity to be measured on the basis of the number of articles published. The results are shown in the Table 3. Top 10 most prolific authors in Iran wrote 27.59% of the articles, whereas, in Turkey, 16.83% of papers had been written by the most productive authors. Overall, H-index in toxicology category was calculated until the end of 2011 for each author.

Table 4 presents the subject areas of published papers by Iranian and Turkish authors.

Table 5 shows 10 top journals in which toxicology articles of Iranian and Turkish authors were published.

Figure 1. *Authorship pattern of Iranian and Turkish toxicologists*

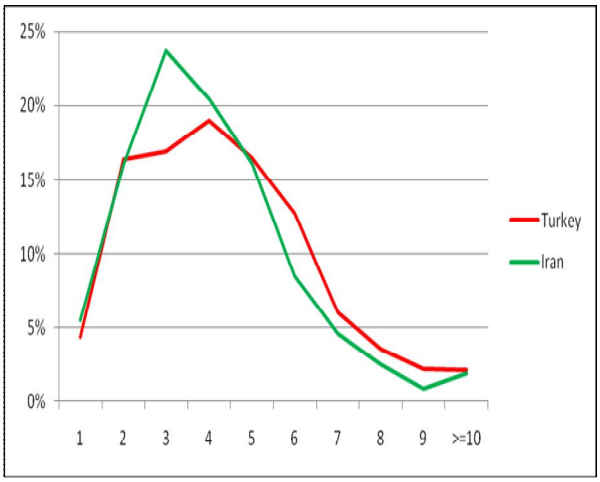

Figure 2. *Percentage of authors' contribution to the percentage of articles*

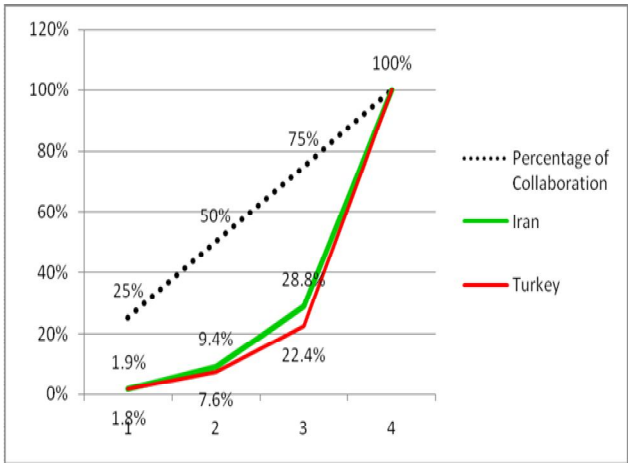

Table 3. Ten most prolific Iranian and Turkish toxicology authors

Iran					Turkey				
Authors	**Publication**		**WoS H-Index at 2012-09-08**		**Authors**	**Publication**		**WoS H-Index at 2012-09-08**	
	No	**%**	**Overall**	**Toxicology**		**No**	**%**	**Overall**	**Toxicology**
Abdollahi M.	107	9.08	32	20	Karakaya AE	49	2.19	19	16
Ghazi-Khansari M.	34	2.89	11	8	Aydin A.	44	1.96	40	5
Shadnia S.	33	2.80	11	11	Tuncok Y.	42	1.88	9	7
Ghanei M.	27	2.29	12	9	Burgaz S.	39	1.74	17	14
Azizi E.	24	2.04	19	5	Basaran N.	38	1.70	19	11
Ghazanfari T.	22	1.87	9	6	Sardas S.	35	1.56	15	13
Dehpour AR	21	1.78	22	7	Karakaya A.	33	1.47	11	9
Zarrindast MR	20	1.70	27	7	Soylemezoglu T.	33	1.47	6	1
Hassan ZM	19	1.61	14	6	Undeger U.	33	1.47	15	10
Ostad SN	18	1.53	13	5	Soylak M.	31	1.38	46	13
Sum	**325**	**27.59**	**170**	**84**		**377**	**16.82**	**197**	**99**

Table 4. Cross-pollination of Iranian and Turkish toxicology papers in different specialties

Interdisciplinary association for Iran	**Frequency**	**%**	**Interdisciplinary association for Turkey**	**Frequency**	**%**
Pharmacology Pharmacy	335	28.44	Environmental Sciences Ecology	442	19.73
Environmental Sciences	133	11.29	Pharmacology Pharmacy	413	18.43
Public Environmental Occupational Health	79	6.71	Food Science Technology	253	11.30
Food Science Technology	68	5.77	Public Environmental Occupational Health	221	9.87
Immunology	42	3.56	Chemistry	171	7.63
Biochemistry Molecular Biology	31	2.63	Genetics Heredity	155	6.92
Zoology	23	1.95	Biotechnology Applied Microbiology	102	4.55
Genetics Heredity	21	1.78	Biochemistry Molecular Biology	72	3.21
Chemistry Applied	20	1.70	Pathology	58	2.59
Ophthalmology	17	1.44	Ophthalmology	45	2.01

Table 5. Top journals which published Iranian and Turkish toxicology papers

IRAN			TURKEY		
Journal Title	**Frequency**	**H- Index**	**Journal Title**	**Frequency**	**H- Index**
Toxicology Letters	281	88	Toxicology Letters	233	88
Toxicology and Applied Pharmacology	72	115	Bulletin of Environmental Contamination and Toxicology	180	42
Human Experimental Toxicology	61	47	Human Experimental Toxicology	145	47
Basic Clinical Pharmacology Toxicology	57	39	Food and Chemical Toxicology	139	86
Toxicology	56	91	Toxicology and Industrial Health	111	42
Clinical Toxicology	52	23	Archiv Fur Lebensmittelhygiene	76	13
Food and Chemical Toxicology	48	86	Toxicology	67	91
Immunopharmacology and Immunotoxicology	37	28	Basic Clinical Pharmacology Toxicology	66	39
Bulletin of Environmental Contamination and Toxicology	34	42	Mutation Research Genetic Toxicology and Environmental Mutagenesis	66	68
Toxicology Mechanisms and Methods	30	16	Environmental Toxicology and Pharmacology	51	37
Sum	**728**	**575**	**Sum**	**1134**	**553**

Most cited articles

The objective of the following analysis is to identify and list articles that had mostly influenced others as measured by citations count. An understanding of which research is viewed by the research community is highly valuable because it may provide proper insight into what might research or even researcher focus on now and in the future. Citation data available for articles indexed in WoS showed that 1178 and 2240 published articles by Iranian and Turkish toxicologists received 4096 and 15068 citations, respectively. In other words, the average number of citations per article was about 3.48 for Iranian and 6.73 for Turkish papers, respectively. However, 54.3% of Iranian papers and 31.6% of Turkish articles had not received any citations by the time of analysis (31 December 2011). Table 6 presents a list of 10 most cited articles in for Iran and Table 7 presents such a list for Turkey. Further analysis revealed the H-Index of 27 for Iranian and 44 for Turkish toxicology papers until 31 December 2011.

Table 6. The 10 most cited toxicology articles of Iran in Web of Sciences

Authors	Title	Time cited	Year of publication
Galati, G; Sabzevari, O; Wilson, JX; O'Brien, PJ	Prooxidant activity and cellular effects of the phenoxyl radicals of dietary flavonoids and other polyphenolics	206	2002
Akhgari, M; Abdollahi, M; Kebryaeezadeh, A; Hosseini, R; Sabzevari, O	Biochemical evidence for free radical-induced lipid peroxidation as a mechanism for subchronic toxicity of malathion in blood and liver of rats	98	2003
Vessal, M; Hernmati, M; Vasei, M	Antidiabetic effects of quercetin in streptozocin-induced diabetic rats	86	2003
Ranjbar, A; Pasalar, P; Abdollahi, M	Induction of oxidative stress and acetylcholinesterase inhibition in organophosphorous pesticide manufacturing workers	76	2002
Abdollahi, M; Jalali, N; Sabzevari, O; Hoseini, R; Ghanea, T	A retrospective study of poisoning in Tehran	65	1997
Shadnia, S; Azizi, E; Hosseini, R; Khoei, S; Fouladdel, S; Pajoumand, A; Jalali, N; Abdollahi, M	Evaluation of oxidative stress and genotoxicity in organophosphorus insecticide formulators	59	2005
Abdollahi, M; Mostafalou, S; Pournourmohammadi, S; Shadnia, S	Oxidative stress and cholinesterase inhibition in saliva and plasma of rats following subchronic exposure to malathion	57	2004
Langaee, T; Ronaghi, M	Genetic variation analyses by Pyrosequencing	53	2005
Milani, E; Nikfar, S; Khorasani, R; Zamani, MJ; Abdollahi, M	Reduction of diabetes-induced oxidative stress by phosphodiesterase inhibitors in rats	52	2005
Sabzevari, O; Galati, G; Moridani, MY; Siraki, A; O'Brien, PJ	Molecular cytotoxic mechanisms of anticancer hydroxychalcones	50	2004

Table 7. The 10 most cited toxicology articles of Turkey in Web of Sciences

Authors	Title	time cited	year of publication
Gulcin, I	Antioxidant activity of caffeic acid (3,4-dihydroxycinnamic acid)	30	006
Gurer, H; Ozgunes, H; Neal, R; Spitz, DR; Ercal, N	Antioxidant effects of N-acetylcysteine and succimer in red blood cells from lead-exposed rats	18	998
Gultekin, F; Ozturk, M; Akdogan, M	The effect of organophosphate insecticide chlorpyrifos-ethyl on lipid peroxidation and antioxidant enzymes (in vitro)	02	000
Gultekin, F; Delibas, N; Yasar, S; Kilinc, I	In vivo changes in antioxidant systems and protective role of melatonin and a combination of vitamin C and vitamin E on oxidative damage in erythrocytes induced by chlorpyrifos-ethyl in rats	9	001
Giray, B; Gurbay, A; Hincal, F	Cypermethrin-induced oxidative stress in rat brain and liver is prevented by Vitamin E or allopurinol	1	001
Naziroglu, M; Karaoglu, A; Aksoy, AO	Selenium and high dose vitamin E administration protects cisplatin-induced oxidative damage to renal, liver and lens tissues in rats	0	004
Ak, Tuba; Gulcin, Ilhami	Antioxidant and radical scavenging properties of curcumin	4	008
Gurer-Orhan, H; Sabir, HU; Ozgunes, H	Correlation between clinical indicators of lead poisoning and oxidative stress parameters in controls and lead-exposed workers	9	004
Yildiz, D	Nicotine, its metabolism and an overview of its biological effects	8	004

Organizations

Table 8 lists the top 10 active organizations in Iran and Turkey in toxicological research. H-Index of organizations was taken from "Organization-Enhanced" option in WoS main search page. Date range was selected from 1993-01-01 until 2011-12-31. Note that in ISI database "UNIV TEHRAN MED SCI" is defined as affiliate of "UNIV TEHRAN" so when "UNIV TEHRAN" is searched in "Organization-Enhanced" option of WoS and then refined by "Toxicology" category, the total numbers of toxicology articles for both universities are shown.

DISCUSSION

Although ISI WoS has a major limitation in reflecting real schemas of research activities in non-English speaking countries, it is an important database in ranking of scientific activities of countries.

Based on the “SCImago Journal & Country Rank” which is a portal that includes the journals and countries scientific indicators developed from the information contained in the Scopus® database, Iran has the second place in the scientific production in “Toxicology” among Middle East countries by publishing 478 journal articles from 1996 to 2010 while Turkey published 1158 articles at the same time and ranked first in the Middle East (12). The results are similar to the findings of our study.

The results of the current survey revealed that Turkey has been more active than Iran in toxicology researches; however, Iranian toxicologists have published a great number of articles in recent years and overall publication growth

rate is in favor of Iran. In spite of this, a high percentage of Iranian publications was meeting abstracts which have usually no references and as a result the average number of Iranian articles' references was reported low.

Top 10 Iranian authors were more active than their Turkish counterparts, so that 27.59% of all Iranian and 16.82% of all Turkish publications were written by these authors, but authorship pattern and contribution of authors in articles production was more well-distributed in Turkey than Iran. Writers of both countries published their articles in almost comparable journals. Among top 10 journals which published Iranian and Turkish toxicology articles, 6 of them are similar. On the other hand, top 10 active organizations of Iran published more than 70% of toxicology publications while this percentage was about 56% for Turkey, so research activities are more well-distributed among Turkish organizations and universities than Iran.

Turkish articles were cited more, almost double, than Iranian articles. Self-citations were slightly common among Iranian toxicologists (12.8% vs. 9.6%) but the ratios of "citing articles without self-citation to all citing articles" were about 93% for both countries.

In 1995, there were 72 journals indexed under "toxicology," while in 2005 that category was comprised of 76 journal titles. This is in contrast to an increase of 32% in the number of journals indexed by the ISI Web of Science in the same period (13). In 2011, this number reached to 83 journal titles, but none of them belonged to Iran or Turkey. However, both countries have potentially some valuable peer-reviewed journals which could be submitted for indexing in ISI.

Table 8. The most productive organizations in Iran and Turkey in the field of toxicology

Iran				**Turkey**			
Organization	Article No	%	H-Index in Toxicology	Organization	Article No	%	H-Index in Toxicology
UNIV TEHRAN MED SCI	322	27.33	23	GAZI UNIV	229	10.22	23
UNIV TEHRAN	113	9.59	13	HACETTEPE UNIV	217	9.68	26
SHIRAZ UNIV MED SCI	77	6.54	5	ANKARA UNIV	211	9.42	20
TARBIAT MODARES UNIV	67	5.69	7	CUKUROVA UNIV	129	5.76	19
MASHHAD UNIV MED SCI	63	5.35	7	ERCIYES UNIV	109	4.86	16
ISLAMIC AZAD UNIV	61	5.18	6	SULEYMAN DEMIREL UNIV	104	4.64	20
SHAHEED BEHESHTI UNIV MED SCI	58	4.92	10	ATATURK UNIV	90	4.02	13
MAZANDARAN UNIV MED SCI	39	3.31	5	ISTANBUL UNIV	90	4.02	16
BAQIYATALLAH UNIV MED SCI	33	2.80	7	DOKUZ EYLUL UNIV	84	3.75	12
Sum	**833**	**70.71**			**1263**	**56.37**	

CONCLUSION

Achieving the first rank of science production between the Middle East countries is an important strategic goal which needs more efforts by Iranian scientists. In order to increase citations to Iranian toxicology articles, it is suggestible that :

a) Iranian toxicologists write more original “articles” and specially “review” articles instead of meeting abstracts,

b) Clinical field of toxicology is small in scope but the subject matter of toxicology is enormous, overlapping with many other scientific and medical specialties. This leads to toxicology manuscripts being published in many other journals that are not classified under “toxicology” category in WoS. Iranian toxicologists should engage other researchers to submit their manuscripts to peer-reviewed toxicology journals.

c) The absolute numbers of practitioners of medical or clinical toxicology is small, leading to relatively fewer researchers publishing their articles in peer-reviewed journals than other disciplines; thus, establishing more toxicology wards and research centers are mandatory for the country,

d) All authors desire to publish their results in journals with high impact factors since overall impact factors of toxicology journals are lower than other scientific journals (13). Hence, the publication of research findings in toxicology journals should be supported.

e) Decision makers must distribute funds between different institutions and universities well in order to allow smaller institutions to play a more effective role in toxicology research and article production, and

f) Iranian scientists should pay more attention to the quality of their publications than their quantity.

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