

Science growth in Iran over the past 35 years

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Background: This study was carried out to evaluate activities in different branches of science in Iran compared to other countries over the past 35 years. **Materials and Methods:** Essential Science Indicators (ESI) and Web of Science from (Thomson Reuters ISI) and SCImago Journal & Country Rank (SJR) were searched for scientometrics data. ESI indicated place of Iran among other countries in all 22 scientific categories based on the publication and citation rates. SJR parameters, such as publication rate, citable publications, citation rate, citations per publication and the H-index were used to record the rank of Iran among the world's countries. **Results:** A progressive quantitative and qualitative growth of Iranian publications was evident. The field of chemistry in Iran was the most prolific in terms of the number of publications (16982) whereas economics and business was the least prolific (156). A growth in the quality of works of Iranian authors was evident by gaining higher H-index in the recent years. **Conclusions:** If this scientific growth of Iran continues, it would not be surprising to see Iran as one of the most powerful countries in the field of science in the World.

Key words: Iran, science growth, ranking in the world

INTRODUCTION

Progress in science and technology is a key driver of social development all over the world. Investing in research and development is a top priority for most developed and developing countries. As recently reviewed, Iran allocates around 0.5% of its gross domestic product (GDP) to research and development, which is of course less than that of some industrialized countries on average of 1.4%.^[1]

Though scientometric indicators, such as publication and citation rates, are not specific enough, these are increasingly used for analyzing scientific activities and their relationship with economics and social development. Research output measures such as publication and citation rates differ between various fields of science, universities and nations. The quantity and quality of articles indexed by sound databases are important for a country's contribution to science and its status in international academic rankings.

To ascertain place of Iran and its growth trend in science, scientometric analysis of relevant databases was conducted.

METHODS

We used the term "Iran" to search through online databases. Web of Science (ISI) was searched over the period of 1975-2010.^[2] Information on top

authors, institutions, subject areas, and journals was extracted from ISI, as well as publication number, citations, citation per paper, and H-index for Iran year by year. Parameters of a total of 233 countries were analyzed based on the SCImago Journal & Country Rank (SJR)^[3] for number of publications, citable publications, citations, self-citations, citation per publication, and the H-index for all 233 countries. By use of Essential Science Indicators (ESI), 10 years activities of the world top countries in 22 subject categories were specified.^[4] These included chemistry, engineering, clinical medicine, physics, plant and animal sciences, materials science, mathematics, biology/biochemistry, pharmacology/ toxicology, agricultural sciences, computer science, geoscience, environmental/ecology, social sciences/general, neuroscience/behavior, molecular biology/genetics, microbiology, immunology, psychiatry/ psychology, multidisciplinary, space science, and economics/business.

Results

Given the ISI data, it was apparent that scientific productivity in Iran has substantially improved over the past decade, with a record of 20610 publications indexed in 2010. The same trend of growth was obvious in number of citations, and H-index (Table 1).

As shown in table 2, Tehran University with a total of 12462 published articles tops the list of Iranian academic institutions, followed by Sharif University of

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Technology (8047 articles). Table 3 lists top 15 journals indexed by ISI where most Iranian papers were published. Asian journal of chemistry with 850 published papers was on the top followed by other international journals. Table 4 presents SJR country ranking taking into account cumulative data over the period of 1996-2010. Iran with a total of 118396 papers, 115044 citable

publications, 434990 citations, 7.20 citations per paper, and the H-index of 101 took the 31st place among 233 countries. According to ESI (Table 5), chemistry was the most productive field of science in Iran with 16982 papers listed in ISI, followed by engineering (12145) and clinical medicine (9740). Economics and business was the least productive field with only 156 papers.

Table 1. A trend of growth in Iran based on the Institute for Scientific Information (ISI)

Year	No. of Articles	No. of Citations	Citation per paper	H-index
1975	372	2587	6.95	26
1976	460	3618	7.87	28
1977	583	3286	5.64	27
1978	670	4309	6.43	28
1979	499	3902	7.82	28
1980	343	2683	7.82	24
1981	266	1986	7.47	22
1982	163	1211	7.43	20
1983	151	1053	6.97	16
1984	142	918	6.46	16
1985	138	867	6.28	16
1986	184	1114	6.05	16
1987	165	1074	6.51	18
1988	165	1030	6.24	17
1989	154	1491	9.68	21
1990	190	1305	6.87	18
1991	235	2325	9.89	26
1992	260	2426	9.33	26
1993	416	3996	9.61	29
1994	488	3878	7.95	29
1995	603	5333	8.84	33
1996	718	6214	8.65	34
1997	980	8350	8.52	40
1998	1231	11086	9.01	47
1999	1310	15436	11.78	52
2000	1749	16088	9.20	47
2001	2088	19276	9.23	50
2002	2845	23960	8.42	52
2003	3922	32965	8.41	59
2004	5142	35978	7.00	54
2005	6868	42550	6.20	59
2006	9221	50389	5.46	61
2007	13377	*	*	*
2008	17256	*	*	*
2009	19823	*	*	*
2010	20610	*	*	*

Data were obtained from <http://apps.webofscience.com> accessed 25 September 2011.

*Data could not be obtained because number of publications were more than the limitation of ISI (10000).

Table 2. Top 15 Iranian Universities based on scientific productivity according to the Institute for Scientific Information (ISI)

Grade	University	Number of Publication
1	University of Tehran	12462
2	Sharif University of Technology	8047
3	Islamic Azad University	7448
4	Tehran University of Medical Sciences	7074
5	Shiraz University	5239
6	Tarbiat Modarres University	4613
7	Iran University of Science and Technology	4229
8	Amirkabir University of Technology	4220
9	Isfahan University of Technology	3514
10	Shiraz University of Medical Sciences	2666
11	Ferdowsi University Mashhad	2451
12	Tabriz University	2054
13	Khajeh Nasir Toosi University of Technology	1843
14	Shahid Beheshti University	1614
15	Shahid Beheshti University of Medical Sciences	1579

Data were obtained from <http://apps.webofknowledge.com> accessed 03 August 2011.

Table 3. Journals where most Iranian papers were published according to the Institute for Scientific Information (ISI)

Grade	Journal's title	Number of published articles
1	Asian Journal of Chemistry	850
2	Applied Mathematics and Computation	653
3	Phosphorus Sulfur and Silicon and the Related Elements	623
4	Acta Crystallographica Section E-Structure Reports Online	613
5	Synthetic Communications	562
6	Lecture Notes in Computer Science	547
7	Iranian Polymer Journal	542
8	Journal of Applied Polymer Science	521
9	International Journal of Psychology	447
10	Iranian Journal of Science and Technology	422
11	Iranian Journal of Chemistry and Chemical Engineering-International English Edition	416
12	Acta Horticulturae	408
13	Transplantation Proceedings	400
14	Archives of Iranian Medicine	394
15	Journal of Chemical Research-S	392

Data were obtained from <http://apps.webofknowledge.com> accessed 03 August 2011.

Table 4. The rank of Iran among 233 countries of the world sorted by H-index based on Scientific Journal Rankings (SJR)

Rank	Country	Total number of publications	Citable publications	Total citations	Self-citations	Citations per publication	H-index
1	United States	5285514	4934052	94410591	43892266	19.11	1190
2	China	1837943	1819917	6549901	3472378	5.27	300
3	United Kingdom	1522264	1382080	22915219	5557332	16.48	721
12	Russian Federation	479095	474317	2288869	693521	4.87	274
21	Turkey	229932	217509	1257466	353989	7.06	167
31	Iran	118396	115044	434990	179227	7.20	101
32	Singapore	108522	104747	988263	146276	11.02	209
40	Egypt	64153	62827	333781	72862	6.30	110
50	Saudi Arabia	36466	34751	182765	25934	5.98	101

Data were obtained from <http://www.scimagojr.com> accessed 03 August 2011.

Table 5. Ranking of different subject categories in Iran based on Essential Science Indicators (ESI)

Field	Papers	Citations	Citations per publication
Chemistry	16982	103384	6.09
Engineering	12145	40236	3.31
Clinical Medicine	9740	35345	3.63
Physics	5385	23953	4.45
Materials Science	4828	16244	3.36
Plant & Animal Science	4354	9482	2.18
Mathematics	2628	5387	2.05
Agricultural Sciences	2378	7128	3.00
Biology & Biochemistry	2268	10616	4.68
Computer Science	1802	3624	2.01
Pharmacology & Toxicology	1778	9616	5.41
Geosciences	1414	5528	3.91
Environment/Ecology	1362	4849	3.56
Social Sciences, General	1267	2336	1.84
Neuroscience & Behavior	868	4947	5.70
Microbiology	755	2161	2.86
Molecular Biology & Genetics	691	4083	5.91
Immunology	414	2549	6.16
Space Science	362	1071	2.96
Psychiatry/Psychology	325	1817	5.59
Multidisciplinary	277	106	0.38
Economics & Business	156	273	1.75

Data were obtained from <http://esi.webofknowledge.com/home.cgi> accessed 31 July 2011.

DISCUSSION

Iran is a country with bright history of science and rich scientific culture.^[1] Over the past decades, despite numerous socioeconomic difficulties, most branches of Iranian science have flourished. Indeed, available scientometric evidences indicated growth in scientific production.^[5] Osareh and Marefat evaluated Iran's scientometrics in Medline between 1976-2003 and concluded a significant growth especially during 1990-2003.^[6] In another report, Iranian articles in three different fields of ISI was evaluated between 1993-2002, and a major growth was found.^[7] The same results was found in the field of medicine in another study.^[8] In a recent essay written by Abdollahi (2011), various reports of international scientometric societies were reviewed and a major record in the world science growth was found for Iran as 736 papers in 1996 reached 13238 papers in 2008.^[9] Iran with a rank of 31 in the world has the second rank after Turkey among its neighbors and the eight in whole Asia. Fortunately, the quality of Iranian publications have been also increased.

We authors of the present paper believe that scientific growth of Iran is mainly related to the thoughts of policy makers in paying more attention to science and technology and allocating more budget to developing

human resources and infrastructure. In the essay published in European Science editing in 2006,^[10] the author related the growth of science in Iran to several reasons such as larger allocation of budget to scientific research sector, increase in the number of graduates and assistant professors over the recent years, and the requirement of students to complete their study with publication or patenting or creating a product. Of course, in the last years, the subject of science editing has been dramatically improved. Most of Iranian journals are now managed by expert editors who know the procedures of improvement the quality of publications such as indexing, online journal management systems, peer review, etc. Now, many of Iranian journals are covered by Scopus, MedLine/PubMed, Web of Science. Meanwhile, the number of Iranian editors who have become member of the Committee on Publication Ethics (COPE), World Association of Medical Journal Editors (WAME), and European Association of Science Editors (EASE) has increased dramatically. In addition, some of them are managing the mentioned committees at higher stages.

Iranian scientists have been very productive in several experimental fields such as pharmacology/toxicology, chemistry, physic, computer, engineering, and clinical medicine. Iranian researchers have gained internation-

al reputations since the 1990s and some of them are listed among 1% top scientists of the world as reported by ESI. Highly expensive instruments especially for high technology researches have been provided in Iranian universities during the past two decades. In addition, many inventions have been registered in Iran in the last 5 years showing a dramatic increase in comparison with the past.^[11] Considering the growth rate of science in Iran, it would not be surprising to see Iran as one of the most powerful countries in the field of science in the world.

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