

Contribution of Iranian scholars to medical sciences: A holistic overview of 140-years publication

Shahram Sedghi^{1,2}, Maryam Razmgir^{*2} , Mina Moradzadeh^{*2,3} 

Received: 15 Apr 2019

Published: 23 Nov 2020

Abstract

Background: This study investigated the trends in the scientific output of Iran published in PubMed indexed journals. To the best of our knowledge, there was no previous study to examine the Iranian scientific output in all fields of health and biomedical sciences.

Methods: Using a bibliometric approach, we tracked 140 years (between 1877 and 2016) of Iranian scientific productions in PubMed. The journals which papers widely published over them were analyzed. The metadata of journals was extracted from Web of Science (WoS), Scopus, and Scimago Journal & Country Rank. The Gross Domestic Product (GDP) data was elaborated from the World Bank to evaluate the relationship with research output. We used Pearson's correlation coefficient at $p < 0.01$ significance level and reported the data in a scatterplot.

Results: We identified 106 226 documents produced by Iranian authors in journals indexed in PubMed since 1877. The number of papers climbed dramatically in 2000 and afterward, and this was consistent with the country's GDP. Although the scientific contribution of Iranian researchers is remarkable, 67% of papers (26 978 out of 106 226) were published in local Journals categorized into quartile 3 and 4 of WoS and Scopus. The study shows that GDP growth has had a positive influence on publication output ($r = 0.738$, $p < 0.001$).

Conclusion: This is the first study with a panorama view of Iran's contribution to biomedical literature. Based on the results of our survey, although the number of Iranian publications rose over time but they are mostly published in low ranked journals. Health policy-makers advise reconsidering the criteria for measuring research activities. Improving policies will help researchers to publish in higher ranked journals.

Keywords: Publications, Publishing trend, Scientific production, Iran, PubMed, Gross domestic product, GDP

Conflicts of Interest: None declared

Funding: None

***This work has been published under CC BY-NC-SA 1.0 license.**

Copyright© Iran University of Medical Sciences

Cite this article as: Sedghi Sh, Razmgir M, Moradzadeh M. Contribution of Iranian scholars to medical sciences: A holistic overview of 140-years publication. *Med J Islam Repub Iran*. 2020 (23 Nov);34:158. <https://doi.org/10.47176/mjiri.34.158>

Introduction

Publishing via scientific journals is the main channel to disseminate research results. After publication, results are used by other researchers in related studies, the article receives citations, and this process is continuing (1). The number of citations received by an article is a dominant measure of authors' and journals' performance and quality

(2). Accordingly, researchers consider metrics including impact factor (IF) to select journals not only for publishing their articles but also for reading and citing documents (3). Moreover, measurements and evaluations are required to analyze the quality of publications and to improve scientific productivity at the international level (4).

Corresponding author: Maryam Razmgir, razmgir.m@iums.ac.ir
Mina Moradzadeh, moradzadeh.mina@iums.ac.ir

¹ Health Management and Economics Research Center, Iran University of Medical Sciences, Tehran, Iran

² Department of Medical Librarianship and Information Sciences, School of Health Management and Information Sciences, Iran University of Medical Sciences, Tehran, Iran

³ Health Services Management Research Center, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran

↑What is "already known" in this topic:

There are many studies reported the biomedical research outputs of Iran over a limited range of years; however, there is no big picture for the country's publishing trend.

→What this article adds:

This study has a panorama view of the biomedical production trend in Iran. The findings show the increasing rate in the number of publications. However, the Iranian authors mostly tend to publish in low ranked Middle Eastern journals, typically local ones.

Publishing in prestigious journals indexed in sound databases such as Web of Science (WoS), Scopus, and PubMed represents the quality of articles. Moreover, the literature suggests that the papers published via high ranked journals receive more citations compared to others (5-7). Accordingly, analyzing the scientific productivity of scientists at the national level makes it possible not only to evaluate publication activity, but also to predict further methods for the development of science and technology.

Gul et al. investigated the scientific productivity of Middle Eastern countries. They retrieved 1 187 872 papers published by Middle Eastern scientists in journals indexed by Science Citation Index (SCI) in the WoS platform between 1945 and 2014. The authors reported that Israel had the highest number of papers followed by Turkey and Iran (8, 9).

With a rapid growth rate of publication, Iran leaves other fast-developing countries in the dust. For instance, Kharabaf and Abdollahi reviewed scientific output in Iran and reported that Iran accounted for 20 610 publications indexed ISI journals in Thomson Reuters in 2010 (10). While, according to Osareh and Wilson, only a single Iranian paper was published in SCI-indexed journals in 1972, whereas; the number of papers produced by the Iranian authors reached to 610 by the end of 1978 (11). Iranian authors tripled their scientific output from 501 articles in 1996 to 1 830 in 2002 (12). Naghizadeh and Naghizadeh examined the scientific contribution of Iranian authors. Their findings indicated that Iran acquired 17th world-wide ranking with 51 187 items in 2016 and achieved 18th international ranking in the number of citations (28 965) received based on the Scopus database (13). Saboury studied Iranian publications in WoS from 1993 to 2002 and compared the production status of Iran with selected countries. He concluded that the share of Iran's scientific outputs had been increased from 0.015 in 1993 to 0.217 in 2002 (14).

Moein et al. evaluated the scientific output of Iran from 1967 to 2003 and compared with other 15 countries; they showed the relative share of Iran in the scientific output increased from 0.0003% in 1970 to 0.29% in 2003 in the world and it stands on the 13th place among the selected countries (15). As evidence shows, despite there were an increasing rate in Iranian publications; however, citations did not seem to correspond to the growth rate (16).

Sadeh et al. reported the scientific output of Iran from 1997 to 2018 in Scopus. They reported that Iran stands in the twenty-first place in the global scientific publication ranking. Although 22% of papers were published in the health and biomedical field, the average ranks of source journals showed a significant and consistent drop (17).

To sum up, the scientific productivity of Iran increased significantly over time; however, to the best of our knowledge, there have been no big picture for Iranian biomedical publication.

PubMed is the largest open-access database for biomedical literature that comprises more than 28 million citations from Medline, life science journals, and online books. It is worth noting that major medical journals are indexed in PubMed and more than 2 billion searches are performed each year via PubMed. Thus, it is an essential database for

researchers dealing with health-related subjects.

To sum up, the scientific productivity of Iran increased significantly over time; however, to the best of our knowledge, there have been no reports of Iranians publication trends in PubMed. Therefore, we investigated the country affiliated publication in PubMed to draw the overall picture of Iranian medical scientists' publications. Moreover, we studied the number of publications, the status of journals in citation databases, and the association between Gross Domestic Product (GDP) and research output.

Methods

This study conducted to investigate the scientific productivity of Iranian scholars in PubMed and examine the status of journals that the Iranian papers mostly published over them. Thus, the search was carried out using "Iran" OR "Persia" (the former and ancient name for Iran before the 20th century) syntax in the PubMed affiliation field from inception to December 2016. The data were collected in Jan 2018. All of PubMed publication types were included except book and book chapters (18, 19). In total, 106 226 publications were retrieved and included in the analysis, among which 2 582 were "in press".

Noteworthy, in 6 out of 106 226 papers, the country name in affiliations was "Persia" and for the remaining papers (106 220) authors used "Iran". We exported the data of all articles from PubMed into XML file format and converted to Microsoft Excel to perform the analysis.

We extracted the title of source journals and counted the number of articles for each journal to identify the top 100 journals with the highest number of articles (Appendix 1).

The details of top 100 source journals, which have published the most Iranian papers, including full name, ISSN, country of publisher, category (we mentioned the 1st category of Scopus), CiteScore, Percentile, Quartile (Q) and IF were obtained from the NLM catalog, Scopus, WoS, and Scimago Journal & Country Rank databases. We found that 8 out of the top 100 source journals were Iranian based on the publishers; however, published in a different country, 7 journals published in Netherlands and 1 journal in the UK; we considered them as Iranian journals.

Since the GDP is the key indicator for the economic strength of a country and it is related to the amount spent on research and development and effects on the scientific growth (20), we extracted the GDP data from the World Bank. We used Pearson's correlation coefficient at $p < 0.01$ significance level to evaluate the correlation of GDP and the publication productivity. The data was analyzed by SPSS 22.0 and the results reported with a scatterplot.

Results

1. Overview of Iranian Scholars Publication and GDP

In total, 106 226 papers were identified in PubMed published by Iran until the end of 2016. The first paper was authored by Dr. Lucas in 1877 and published in "The Indian Medical Gazette" journal entitled "Case of Scleroderma" who used the "Her Majesty's Bombay Army, Civil Surgeon, Bushire, Persia" as affiliation (21). Iranian authors published 6 papers until 1922. These papers used Persia as the affiliation. No article was found in PubMed authored by

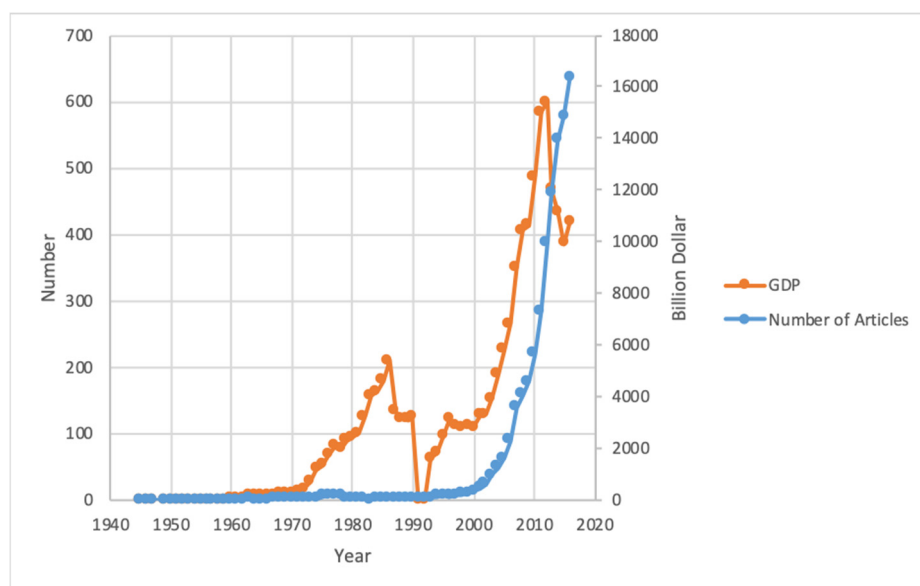


Fig. 1. Comparison of Iranian articles in PubMed with GDP trend 1945-2016

Iranian between 1922 and 1944, and after 22 years, only one paper was published in 1945. The first paper that mentioned “Iran” as affiliation was written in 1954 by M. Baltazard and M. Ghodssi from “Institut Pasteur of Iran” entitled “Prevention of Human Rabies; Treatment of Persons Bitten by Rabid Wolves in Iran”, published in “Bulletin of the World Health Organization” journal (22). The number of publications had increased dramatically after 2000 (Fig. 1).

We obtained the GDP data from the World Bank (23) to examine whether there was any association between the country research productivity and its GDP. Figure 1 presents an overview of Iranian publications and GDP trends during the investigated period. Likewise, the number of publications and the overall GDP rate increased throughout the years.

Although, there was a fall in the mid 1980s since the oil price dropped drastically, and this impressed the GDP in Iran and other oil-producing countries.

2. Analysis of Top 100 Contributing Journals to the Iranian Papers

This is worth mentioning that Iranian papers were published in 5 625 journals indexed in PubMed. The top 100 source journals were selected based on the number of papers published. We found that 38% of papers (40 160 out of 106 226) had been published in these 100 journals.

Analysis of the regional distribution for source journals showed that 61 journals from 100 titles are based in Middle Eastern countries, 23 journals in European Union, 7 journals in Northern America, and 9 in other countries (Fig. 2). Fifty-nine of these 100 journals were published in Iran while 41 were published in other countries (Fig. 3).

2.1 Web of Science analysis: Findings revealed that 71 of the top 100 source journals were indexed in WoS; however, only 51 of the journals had an IF based on Journal Citation Report (JCR 2016). The IF of 32 journals (out of 51) were higher than 1.00 according to data obtained from the WoS

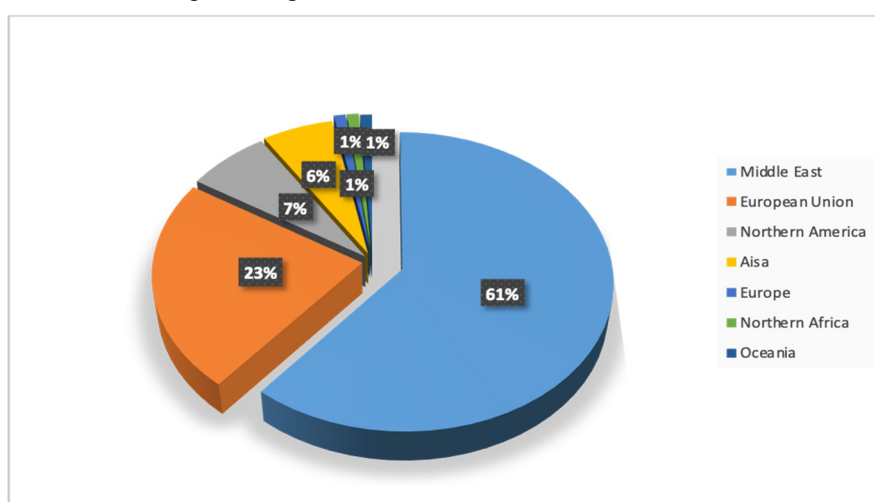


Fig. 2. Regional distribution of top 100 source journals Iranian researchers tend to publish

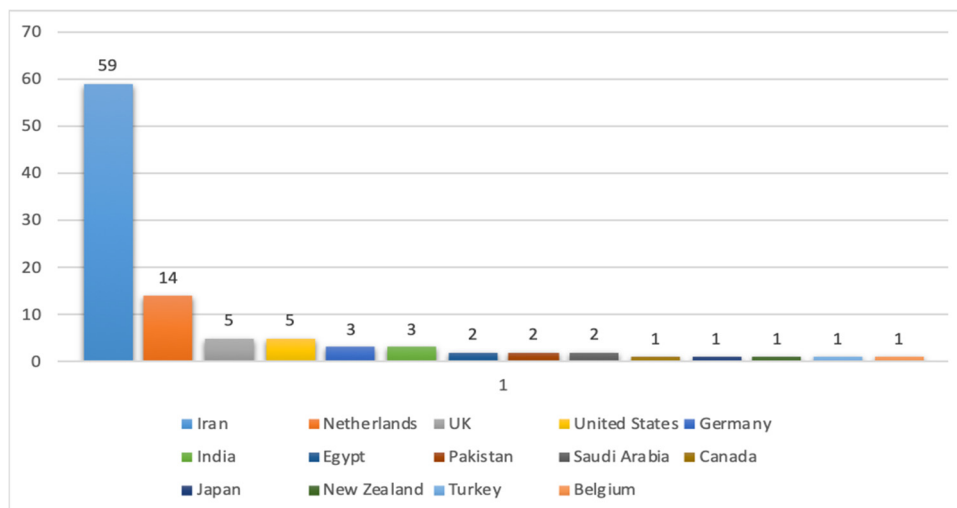


Fig. 3. Country distribution of top 100 source journals

Platform. The highest IF belonged to the journal of “Biosensors & Bioelectronics” (IF=7.78) from Elsevier and 0.004% of the papers (175 out of 106 226) were published in it. The average IF of the top 100 source journals was 2.1. Sixty-one journals (61%) were ranked in quartile 3 (Q3) and quartile 4 (Q4) in WoS.

2.2 Scopus analysis: Eighty-seven of the top 100 source journals were indexed in Scopus. As demonstrated in Figure 4, category of “General Medicine” with 25% has the highest contribution, “Public Health” (4%), and “Analytical Chemistry” (2%) respectively. The CiteScore of 53 journals (out of 87) which indexed in Scopus were higher than 1.00 and “Biosensors & Bioelectronics” journal obtained the highest CiteScore (7.22). The average CiteScore of journals was 1.75.

Twenty-two percent of journals indexed in Scopus were

ranked in Q1 based on CiteScore Percentile. The CiteScore Percentile of two journals; “Journal of Hazardous Materials” and “Biosensors & Bioelectronics”, were 99%; which means that they are in top one percent in their fields, however only 0.01% of total papers (568 of 106 226) were published in these two journals.

The H-index of top 100 source journals ranged between 0 and 218. The highest H-index (218) belonged to “PLOS One” published by Elsevier and the lowest (0) was for “Iranian Journal of Neurology” published by “Tehran University of Medical Sciences”. The average H-index was 46.2.

2.3 Status of Iranian journals among top 100 source journals: Fifty-nine titles of the source journals were published in Iran, which included 67% of total published articles (26 978 of 106 226) in PubMed. In other word, Iranian scholars

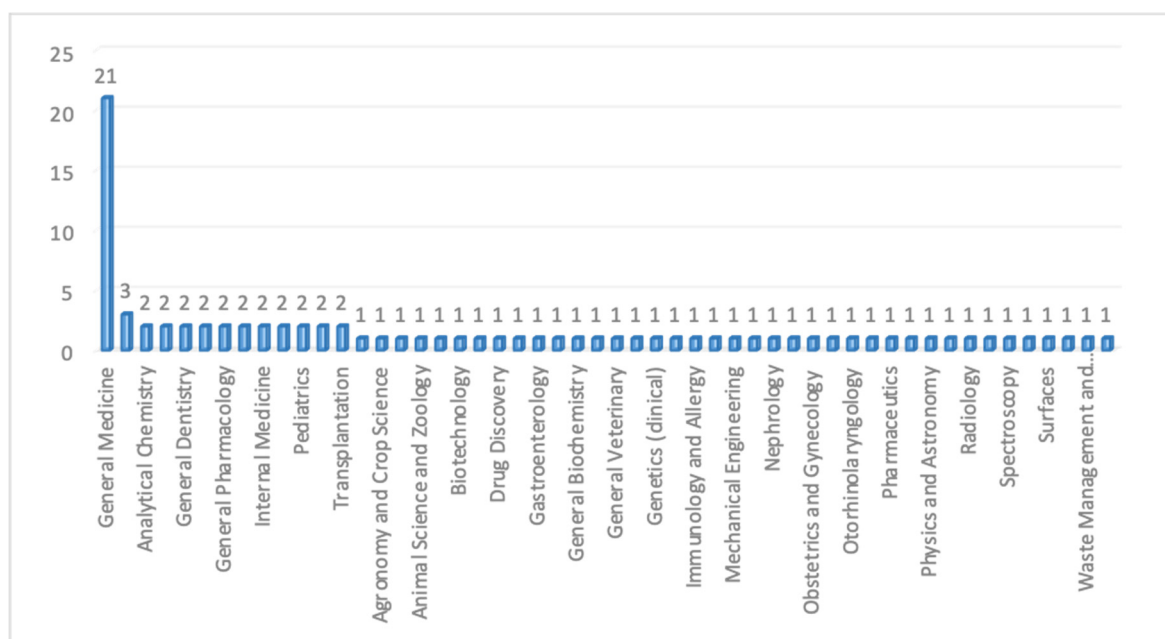


Fig. 4. Category distribution of top 100 source journals

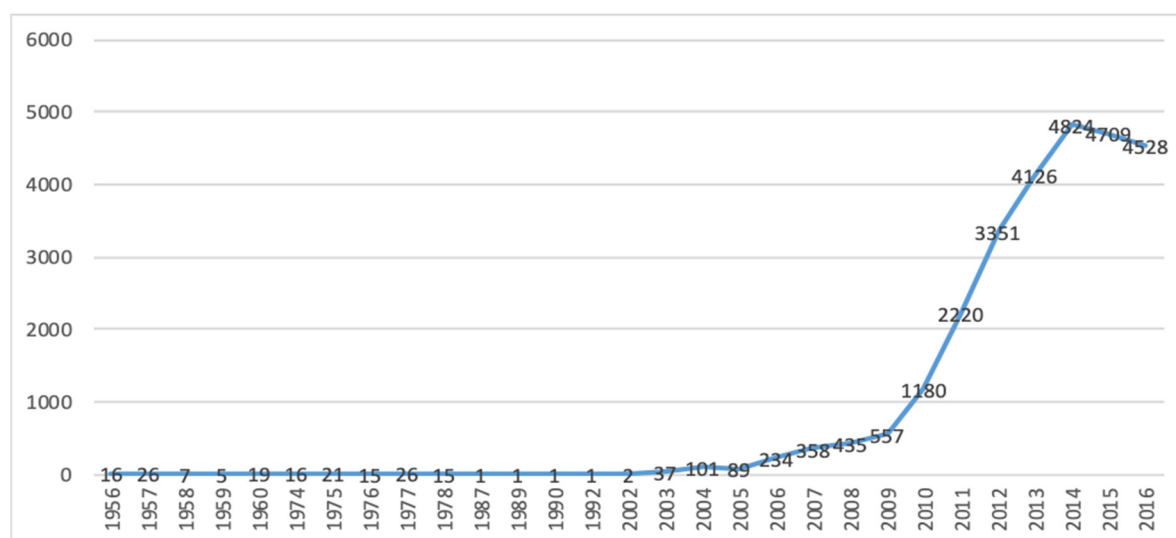


Fig. 5. The trend of Iranian publications in local journals from 1956 to 2016

often tend to publish their papers in local journals rather than other countries. As illustrated in Figure 5, Iranian scholars started to publish in local journals from 1956 in the *Acta Medica Iranica* which is the oldest scientific medical journal of the country in English language (24). Evidence showed the growing tendency to publish in local journals which tripled in 2003 and doubled between 2009 and 2010.

Despite 63% (37 of 59) of Iranian journals were indexed in WoS, only 26 journals (38%) had IF. The highest IF was 2.5 related to “Asian Pacific Journal of Cancer Prevention: APJCP” and the average IF was 1.1. All of the 59 journals were in Q3 and Q4 of WoS ranking.

Eighty percent (47 of 59) of Iranian journals were indexed in Scopus. The highest CiteScore was 2.1 and obtained by “Advanced Pharmaceutical Bulletin” journal. The average CiteScore was 1.1 and the H-index ranged between 0 and 55 (Average=14.4). Sixty-seven percent of 59 journals were ranked in Q3 and Q4 of Scopus and only 3 journals (6%) were in Q1.

2.4. Top prolific journals: 10.92% of papers published in the top 10 journals (Table 1) and all of them published in the Middle Eastern and Asia countries. Eight out of 10 were Iranian local journals and two of them belonged to India

and Pakistan. The most of papers (approximately 1.5 %) were published via “Archives of Iranian Medicine”.

3. Influence of GDP on the scientific productivity

Iran is the second largest economy in the Middle East and North Africa (MENA) after Kingdom of Saudi Arabia, this is evidenced by Iran’s GDP which is US\$ 418.977 billion in 2016 (23) and is estimated to reach US\$ 451 billion in 2020 (25). We found a positive and strong correlation between the GDP and number of publications ($r = .738$, $p < 0.001$) using a Pearson’s correlation coefficient test, it presented in a scatterplot (Fig. 6).

Discussion

Most of the previous studies have been conducted in a specific subject, domain, or in the limited time frame. Therefore, in this scientometric study, the quantity and quality characteristics of Iran affiliated documents indexed in PubMed were examined and we visualized a big picture of medical publishing of the country over nearly a century and a half.

The socio-cultural factors in 19th century contributed in emergence of the first Iranian PubMed-indexed paper in

Table 1. The 10 top journals which Iranian authors tend to publish in

	Journal Name	No of Article	Country	Scopus	CiteScore 2016	Q in Scopus	WoS	JCR 2016	IF	Q in WoS
1	Archives of Iranian medicine	1546	Iran	Yes	1.26	Q2	Yes	Yes	1.200	Q3
2	Iranian Red Crescent medical journal	1425	Iran	Yes	1.10	Q2*	Yes	Yes	0.865	Q3*
3	Iranian journal of public health	1401	Iran	Yes	0.85	Q3	Yes	Yes	0.768	Q4
4	Acta medica Iranica	1242	Iran	Yes	0.72	Q2*	No	No	-	-
5	Pakistan journal of biological sciences	1197	Pakistan	Yes	0.77	Q3	No	No	-	-
6	Journal of research in medical sciences	1168	Iran	Yes	1.47	Q2	Yes	Yes	1.237	Q3
7	Iranian journal of pharmaceutical research	1013	Iran	Yes	1.70	Q1*	Yes	Yes	1.507	Q4
8	Asian Pacific journal of cancer prevention	991	Iran	Yes	1.87	Q2	Yes	Yes	2.514	Q3
9	Advanced biomedical research	823	India	No	-	-	No	No	-	-
10	Iranian journal of basic medical sciences	799	Iran	Yes	1.63	Q3 †	Yes	Yes	1.424	Q3*

Note: Authors double checked the quartiles of the journals after the whole data analysis based on latest Scimago and JCR data, some ranks is changed as specified.

*The quartile fell down one class.

† The quartile improved one class.

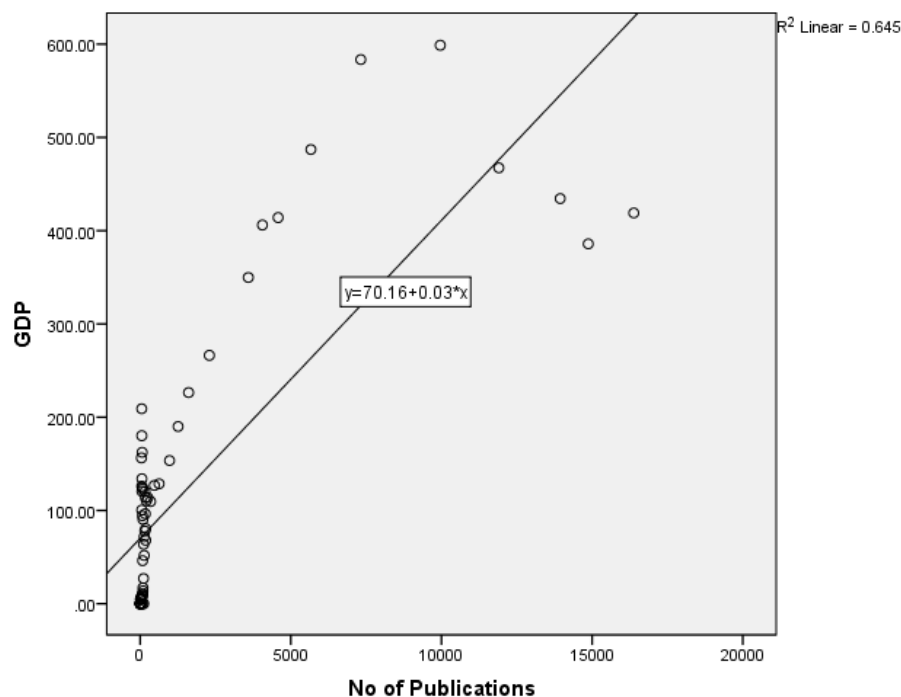


Fig. 6. Correlation between the GDP of Iran and Iranian publications from 1960 to 2016

1877. In this period, relations between Iran and Europe expanded (26) and movement toward modernity was started (27). The long-term publication output trends indicate that contribution to global knowledge production had slow growing rate until 1922 since only six papers published in PubMed by Iran from 1877 to 1922. It is noteworthy the authors of all six papers was foreigner who worked as researcher in Iran.

From 1922 to 1945 there was a stagnation period in the academic publication. World War I and II and regime changes from Qajar to Pahlavi dynasty occurred between 1914 and 1945 (28, 29), could be the main reasons for publication stagnation for 23 years in Iran.

From 1945, the Iranian scholars restarted academic publishing with slow rate until 2000. During this period, country experienced unstable political relationship due to Islamic revolution occurred in 1979 and Iran-Iraq war (1980-1988). Therefore, the growth was interrupted and according to Habibi et al report, the number of publications authored or coauthored by Iranian researchers decreased clearly during and consequent upon the long-lasting war (30). The Joint Comprehensive Plan of Action (JCPOA) in July 2015 by Iran and a group of six other countries, with the aim of lifting sanctions against Iran, fueled the hopes for improvement and progress in the scientific and research productions in Iran (31).

As the past studies reported, despite the sanctions against Islamic Republic of Iran, there is increasing rate in number of publications from 2000 to 2016 (343 to 16 382 paper) (32). The number of governmental universities, non-governmental institutions (eg, Islamic Azad University), and students, developed in this period (33); thus the number of scientific publication increased, subsequently.

Regardless of the growing number of publications, the

Iranian scholars tend to publish their works in local journals which categorized in Q3 and Q4 of Scopus and WoS rank, thus the quality is questionable. This finding is consistent with Mansoori and Sadeh et al. results that Iranian researchers have high contribution in the journals with low IF (17, 34).

Similarly, the reports show that although the titles of Iranian medical journals approved by Commission for Accreditation and Improvement of Iranian Medical Journals (CAIMJ) increased over the past 10 years (from 113 journals in 2007 to 212 in 2011, and 415 titles in 2018), the quality improvement of journals is slow, whereas only 2% of Iranian medical journals were indexed in WoS and Scopus in 2007. The rate increased to 12% (26 of 212) for journals indexed in WoS and 39% (82 of 212) for Scopus in 2011. Even though the quantity is doubled in 2018, the number of journals indexed in WoS increased only 5% (from 12% in 2011 to 17% in 2018) and the percentage of Iranian Scopus journals dropped from 39% in 2011 to 25% in 2018 (35, 36). Davarpanah also reported the low visibility of the local journals. Consequently, the number of citations can affect and falls under the visibility limitation (37). An increasing tendency to publish in local journals with less credibility is the dark side of scientific production in Iran.

Further studies should be conducted to investigate the cause and effect of publishing in low ranked local journals. Nevertheless, in most of Iranian universities, quantitative criteria, e.g. number of documents published in prestigious databases such as PubMed, WoS, or Scopus, are the mere tools to evaluate the research performance of researchers (38). Consequently Iranian researchers tend to publish in journals with high acceptance rate (34). Other studies suggest that Iranian scholars are the main contributors to the

predatory journals (39) and the country seemed to be the origin of a relatively large number of papers and authors in predatory journals according to Research Papers in Economics (RePEc) archives published in 2015 (40).

Further evaluation revealed that there is a strong effect of GDP on scientific output in Iran. This resembles the findings reported in the past literature (41-45).

The time for scientific flourishing in Iran was shortened since the United States left the Iran nuclear deal and re-imposed sanctions against Iran in 2018. Based on previous studies, sanctions have had negative impact on the quantity and quality of publications in Iran because of accessibility to the scholarly works as well as limitations in the scientific collaboration between Iran and international researchers (46), purchasing laboratory materials and equipment (47) and the other economic problems caused by sanctions.

Overall, while the quantity of Iranian medical papers is remarkably significant, based on the country's publishing pattern, quality-related issues need to be investigated further to improve.

Limitations: The study had two limitations. First, since the GDP data was introduced from 1945, we selected the mirror publication data for correlation test and the data before 1945 were excluded in the related analysis. The second limitation originate from the PubMed indexing method which some of the papers may appear later. Although research data were extracted in January 2018 it is likely to say that some data were missed in current study.

Conclusion

This is the first study with panorama view of the medical publishing in Iran, one of the largest economies in the world in terms of natural oil and gas reserves. We discussed that a significant positive trend exists for PubMed indexed documents in Iran and the GDP growth has had positive influence on quantity of publications. However, more than half of journals which Iranian scholars tend to publish, were categorized into Q3 and Q4 rank of WoS and Scopus. The Iranian medical research policy-makers are encouraged to support revising the tenure and promotion criteria of faculty members and researchers as a result the Iranian scholars will concentrate quality of their publications rather than quantity.

Conflict of Interests

The authors declare that they have no competing interests.

References

- Durieux V, Gevenois PA. Bibliometric indicators: quality measurements of scientific publication. *Radiology*. 2010;255(2):342-51.
- Judge TA, Cable DM, Colbert AE, Rynes SL. What causes a management article to be cited—article, author, or journal? *Acad Manage J*. 2007;50(3):491-506.
- Brembs B, Button K, Munafò M. Deep impact: unintended consequences of journal rank. *Front Hum Neurosci*. 2013;7:291.
- Kharabaf S, Abdollahi M. Science growth in Iran over the past 35 years. *J Res Med Sci*. 2012;17(3):275.
- Valderas JM. Why Do Team-Authored Papers Get Cited More? *Science*. 2007;317(5844):1496-8.
- van Raan A, Visser M, Van Leeuwen T, van Wijk E. Bibliometric analysis of psychotherapy research: performance assessment and position in the journal landscape. *Psychother Res*. 2003;13(4):511-28.
- Bormann L, Schier H, Marx W, Daniel HD. What factors determine citation counts of publications in chemistry besides their quality? *J Informetr*. 2012;6(1):11-8.
- Gul S, Nisa NT, Shah TA, Gupta S, Jan A, Ahmad S. Middle East: research productivity and performance across nations. *Scientometrics*. 2015;105(2):1157-66.
- Akyüz ZC, Correia RA. A Bibliometric Analysis of High Impact Research in the Middle East Using Champion Works. *Int Inform Lib Rev*. 2017;49(1):11-8.
- Kharabaf S, Abdollahi M. Science growth in Iran over the past 35 years. *J Res Med Sci*. 2012;17(3):275-9.
- Osareh F, Wilson CS. Collaboration in Iranian scientific publications. *Libri*. 2007;52(2):88-98.
- Atta Ur R, Nasim A. Time for 'enlightened moderation'. *Nature*. 2004;432(7015):273-4.
- Naghizadeh M, Naghizadeh R. Growth of scientific publications in Iran: Reasons, impacts, and trends. *The Development of Science and Technology in Iran*: Springer; 2017. p. 75-86.
- Saboury A. Research report status of Iran in 2002. *Rahyaf*. 2003;28:87-95.
- Moin M, Mahmoudi M, Rezaei N. Scientific output of Iran at the threshold of the 21st century. *Scientometrics*. 2005;62(2):239-48.
- Malekzadeh R, Azarakhsh Mokri M, Azarmina P. Medical science and research in Iran. *Arch Iran Med*. 2001;4(1):28.
- Sadeh S, Mirramezani M, Mesgaran MB, Feizpour A, Azadi P. (2019). The Scientific Output of Iran: Quantity, Quality and Corruption. Working Paper 7, Stanford Iran 2040 Project, Stanford University.
- Publication Characteristics (Publication Types) with Scope Notes; 2018 MeSH Pubtypes: U.S. National Library of Medicine; [Dec 2018]. Available from: <https://www.nlm.nih.gov/mesh/pubtypes.html>.
- Baker RL, editor *Persia Becomes Iran*. Current History and Forum; 1935: CH publishing corporation, etc.
- Farnen RF. Political culture, socialization, democracy and education: interdisciplinary and cross-national perspectives for a new century (Vol. 7). Peter Lang Publishing. 2008.
- Lucas. Case of scleroderma. *Ind Med Gaz*. 1877;12(8):211.
- Baltazard M, Ghodssi M. Prevention of human rabies; treatment of persons bitten by rabid wolves in Iran. *Bull World Health Organ*. 1954;10(5):797-803.
- GDP of Iran, Islamic Rep. : The World Bank Group; 2018 [Dec 2018]. Available from: <https://tradingeconomics.com/iran/forecast>.
- Acta Medica Iranica: Tehran University of Medical Sciences; [May 2020]. Available from: <http://acta.tums.ac.ir/index.php/acta>.
- Economic Forecasts for Iran: Trading Economics; 2018 [Dec 2018]. Available from: <https://tradingeconomics.com/iran/forecast>.
- de Bruijn JTP. Persian literature 2015 June 19, 2018. Available from: <https://www.britannica.com/art/Persian-literature/Classical-prose>.
- Roshanfekr Joursharia M, Roshanfekr Jourshari S, Najafgholi Pour Kalantari N. Studying the effects of modernity on development of Iranian architecture in the Qajar Era. *International Comprehensive Competition Conference on Engineering Science In Iran*; Anzali, Iran: University of Guilan; 2016.
- Keegan J. The first world war 2014 June 19, 2018 Dec 2018]. Available from: http://www.firstworldwar.com/features/germany_duringww1.htm.
- Gilbert M, Mayes B. The second world war: A complete history: H. Holt; 1989.
- Habibi G, Rashidi A, Feldman MD. Emerging concerns about Iran's scientific and medical future. *Lancet*. 2006;9540(368):985.
- Mozafari M. Iran and science publishing in the post-sanctions era. *Lancet*. 2016;387(10029):1721-2.
- Lankarani KB, Haghdoust A, Smith P. Embargo on publication of scientific papers by Iranian authors. *Lancet*. 2012;380(9842):648-9.
- Bazargan A. Internal evaluation as an approach to revitalize university systems: the case of the Islamic Republic of Iran. *High Educ Pol*. 2000;13(2):173-80.
- Mansoori P. 50 years of Iranian clinical, biomedical, and public health research: a bibliometric analysis of the Web of Science Core Collection (1965-2014). *J Glob Health*. 2018;8(2):020701.
- Rezaeian M, Hadavi M, Bakhtar M, Davvodi Salestani A, Karimeian M. Evaluation the quality of english and persian journals approved by commission for accreditation and improvement of Iranian medical journals (CAIMJ) in 2011: Successes and challenges. *J Rafsanjan Univ*

- Med Sci. 2014;13(2):163-74.
36. CAIMJ. About the Commission Tehran, Iran: Commission for Accreditation and Improvement of Iranian Medical Journals 2018 [Dec 2018]. Available from: <https://journals.research.ac.ir/page/11/%D8%AF%D8%B1%D8%A8%D8%A7%D8%B1%D9%87-%DA%A9%D9%85%DB%8C%D8%B3%DB%8C%D9%88%D9%86>.
 7. Davarpana MR, Behrouzfar H. International visibility of Iranian ISI journals: A citation study. *Aslib Proc.* 2009;61(4):407-19.
 38. Beall J. Essential information about predatory publishers and journals. *Int High Educ.* 2016(86):2-3.
 39. Shen C, Björk BC. 'Predatory' open access: a longitudinal study of article volumes and market characteristics. *BMC Med.* 2015;13(1):230.
 40. Wallace FH, Perri TJ. Economists behaving badly: publications in predatory journals. *Scientometrics.* 2018;115(2):749-66.
 41. Oelrich B, Peters R, Jung K. A Bibliometric Evaluation of Publications in Urological Journals among European Union Countries between 2000-2005. *Eur Urol.* 2007;52(4):1238-48.
 42. Fan G, Han R, Zhang H, He S, Chen Z. Worldwide Research Productivity in the Field of Minimally Invasive Spine Surgery: A 20-year Survey of Publication Activities. *Spine.* 2017;42(22):1717-22.
 43. Wiysonge CS, Uthman OA, Ndumbe PM, Hussey GD. A bibliometric analysis of childhood immunization research productivity in Africa since the onset of the Expanded Program on Immunization in 1974. *BMC Med.* 2013;11:66.
 44. Niu B, Hong S, Yuan J, Peng S, Wang Z, Zhang X. Global trends in sediment-related research in earth science during 1992–2011: a bibliometric analysis. *Scientometrics.* 2014;98(1):511-29.
 45. Şenel E, Demir E. A global productivity and bibliometric analysis of telemedicine and teledermatology publication trends during 1980–2013. *Dermato Sin.* 2015;33(1):16-20.
 46. Adab P, Mavaddat N, Lee C, Foroughi M, Lilford RJ. Post-sanctions era in Iran: opportunity for science and publication. *Lancet.* 2016;388(10039):28-9.
 47. Zahediasl S. Iran and science publishing: an open letter. *Lancet.* 2013;382(9892):596.

Appendix 1. Top 100 source journals' data published the most Iranian papers in PubMed

	Journal Title	No of Articles	ISSN	Country
1	Archives of Iranian medicine	1546	1029-2977	Iran
2	Iranian red crescent Medical journal	1425	2074-1804	Iran
3	Iranian journal of public health	1401	0304-4556	Iran
4	Acta medica Iranica	1242	0044-6025	Iran
5	Pakistan journal of biological sciences	1197	1028-8880	Pakistan
6	Journal of research in medical sciences	1168	1735-1995	Iran
7	Iranian journal of pharmaceutical research	1013	1735-0328	Iran
8	Asian Pacific journal of cancer prevention	991	1513-7368	Iran
9	Advanced biomedical research	823	2277-9175	India
10	Iranian journal of basic medical sciences	799	2008-3866	Iran
11	International journal of preventive medicine	783	2008-7802	Iran
12	Iranian journal of pediatrics	751	2008-2142	Iran
13	Iranian journal of kidney diseases	732	1735-8582	Iran
14	Iranian journal of nursing and midwifery research	656	2228-5504	Iran
15	Spectrochimica acta. Part A, Molecular and biomolecular spectroscopy	624	1386-1425	UK
16	Iranian journal of allergy, asthma, and immunology	621	1735-1502	Iran
17	Iranian journal of medical sciences	567	0253-0716	Iran
18	Eastern Mediterranean health journal	563	1020-3397	Egypt
19	Talanta	562	0039-9140	Netherlands
20	Medical journal of the Islamic Republic of Iran	558	1016-1430	Iran
21	Global journal of health science	530	1916-9736	Canada
22	Iranian journal of parasitology	498	1735-7020	Iran
23	Iranian journal of reproductive medicine	471	1680-6433	Iran
24	Jundishapur journal of microbiology	467	2008-3645	Iran
25	Urology journal	467	1735-1308	Iran
26	Plose One	466	1932-6203	United States
27	Iranian endodontic journal	451	1735-7497	Iran
28	Transplantation proceedings	442	0041-1345	United States
29	Hepatitis monthly	413	1735-143X	Iran
30	Journal of hazardous materials	411	0304-3894	Netherlands
31	Journal of dentistry	396	1735-2150	Iran
32	Materials science & engineering. C, Materials for biological applications	396	0928-4931	Netherlands
33	International journal of biological macromolecules	389	0141-8130	Netherlands
34	Journal of ophthalmic & vision research	378	2008-2010	Iran
35	Dental research journal	373	1735-3327	Iran
36	Iranian journal of microbiology	363	2008-3289	Iran
37	Iranian journal of radiology	359	1735-1065	Iran
38	Electronic physician	350	2008-5842	Iran
39	Iranian biomedical journal	350	1028-852X	Iran
40	Saudi journal of kidney diseases and transplantation	349	1319-2442	Saudi Arabia
41	Environmental monitoring and assessment	337	0167-6369	Netherlands
42	Cell journal	330	2228-5806	Iran
43	Ultrasonics sonochemistry	328	1350-4177	Netherlands
44	Journal of education and health promotion	327	2319-6440	Iran
45	Iranian journal of immunology	322	1735-1383	Iran
46	Analytica chimica acta	317	0003-2670	Netherlands
47	Saudi medical journal	317	0379-5284	Saudi Arabia
48	ARYA atherosclerosis	308	1735-3955	Iran
49	Journal of dental research, dental clinics, dental prospects	308	2008-210X	Iran
50	Advanced pharmaceutical bulletin	291	2251-7308	Iran
51	Caspian journal of internal medicine	276	2008-6164	Iran
52	Daru : journal of faculty of pharmacy	266	1560-8115	Iran
53	Zootaxa	266	1175-5326	New Zealand
54	Anesthesiology and pain medicine	265	2228-7523	Netherlands
55	Iranian journal of otorhinolaryngology	262	2251-7251	Iran
56	European journal of pharmacology	259	0014-2999	Netherlands
57	Iranian journal of psychiatry	254	1735-4587	Iran
58	The journal of Tehran heart center	254	1735-8620	Iran
59	Physical review. E, Statistical, nonlinear, and soft matter physics	250	1539-3755	United States
60	Iranian journal of cancer prevention	246	2008-2398	Iran

Appendix 1. Ctd

	Journal Title	No of Articles	ISSN	Country
61	Journal of separation science	245	1615-9306	Germany
62	Veterinary research forum	245	2322-3618	Iran
63	Journal of research in health sciences	243	2228-7795	Iran
64	Iranian journal of neurology	241	2252-0058	Iran
65	Journal of chromatography. A	239	0021-9673	Netherlands
66	The scientific world journal	239	1537-744X	Egypt
67	Molecular biology reports	237	0301-4851	Netherlands
68	Gastroenterology and hepatology from bed to bench	232	2008-2258	Iran
69	International journal of fertility & sterility	230	2008-076X	Iran
70	Middle East journal of digestive diseases	220	2008-5230	Iran
71	Iranian journal of psychiatry and behavioral sciences	219	1735-8639	Iran
72	Research in pharmaceutical sciences	219	1735-5362	Iran
73	The Journal of the Pakistan medical association	218	0030-9982	Pakistan
74	Journal of clinical and diagnostic research	216	0973-709X	India
75	Trauma monthly	216	2251-7464	Iran
76	Journal of parasitic diseases : official organ of the Indian Society for Parasitology	212	0971-7196	India
77	Tanaffos	210	1735-0344	Iran
78	Iranian journal of child neurology	209	1735-4668	Iran
79	Journal of diabetes and metabolic disorders	201	2251-6581	Iran
80	Avicenna journal of phytomedicine	196	2228-7930	Iran
81	Journal of environmental health science & engineering	195	2052-336X	UK
82	Avicenna journal of medical biotechnology	194	2008-2835	Iran
83	Biological trace element research	191	0163-4984	United States
84	Journal of dentistry	188	2345-6485	Iran
85	Nephro-urology monthly	187	2251-7006	Netherlands
86	Food chemistry	184	0308-8146	Netherlands
87	Journal of colloid and interface science	181	0021-9797	United States
88	Carbohydrate polymers	180	0144-8617	UK
89	Experimental and clinical transplantation : official journal of the Middle East Society for Organ Transplantation	180	1304-0855	Turkey
90	Journal of cardiovascular and thoracic research	177	2008-5117	Iran
91	Biosensors & bioelectronics	175	0956-5663	UK
92	Journal of medical signals and sensors	174	2228-7477	Iran
93	Tumour biology: the journal of the international society for oncodevelopmental biology and medicine	171	1010-4283	Germany
94	Analytical sciences: the international journal of the Japan society for analytical chemistry	169	0910-6340	Japan
95	Communications in agricultural and applied biological sciences	169	1379-1176	Belgium
96	Colloids and surfaces. B, Bio interfaces	168	0927-7765	Netherlands
97	Natural product research	168	1478-6419	UK
98	Addiction & health	167	2008-4633	Iran
99	Parasitology research	167	0932-0113	Germany
100	Journal of caring sciences	164	2251-9920	Iran