

Original Article:**Scientometric analysis of Radiology, Nuclear Medicine and Medical Imaging publications of Iran in the Web of Science and Scopus Databases****Mohammad Esmailpour-Bandboni¹, Iman Alizadeh², Mohammad Hossein YektaKooshali^{3,4,*}, Aboozar Ramezani⁵**¹Department of Nursing, School of Nursing, Midwifery and Paramedicine, Guilan University of Medical Sciences, Rasht, Iran²Department of English Language Teaching, School of Nursing, Midwifery and Paramedicine, Guilan University of Medical Sciences, Rasht, Iran³Young Researchers and Elite Club, Rasht Branch, Islamic Azad University, Rasht, Iran.⁴Student Research Committee, School of Nursing, Midwifery and Paramedicine, Guilan University of Medical Sciences, Rasht, Iran⁵Department of Medical Library and Information Sciences, Virtual School, Tehran University of Medical Sciences, Tehran, Iran*Corresponding Author: email address: Yektakooshali.mh@gums.ac.ir (M. H. YektaKooshali)**ABSTRACT**

Scientometric analysis should be given great heed in university and research centers for various research and educational reasons. This study aimed to carry out a scientometric analysis of Radiology, Nuclear Medicine and Medical Imaging articles authored by Iranian researchers and published in journals indexed in the Web of Science and Scopus databases from 2001 to 2016. This is a cross-sectional descriptive study in which as many as 3335 documents authored by Iranian researchers were identified on the two citation databases using field-specific keywords. HistCite™, MS Excel and VOSviewer™ were used to analyze the data. The study discovered that in terms of publications in both citation databases, Iran is almost among the top 30 countries in quantitative and qualitative studies. Iran's contribution was, however, very low in both web of Science (0.32%) and Scopus (0.52%). It was found that "Iranian Journal of Radiation Research" and "Iranian Journal of Radiology" are indexed in both databases; Tehran University of Medical Sciences and University of Tehran are also the most contributing institutions in the databases. According to the findings of the study, it is recommended that Iranian researchers increase their scientific cooperation with researchers from other leading countries in these fields including the United States, Japan and Germany to gain a better quantity and quality of publications.

Keywords: Bibliometrics; Radiology; Iran; Web of Science; Scopus**INTRODUCTION**

Scientometric analysis in research centres and universities should be considered for different reasons. The main purpose of scientometric studies is to become aware of existing situation, to compare the different subject areas and universities and to improve the academic ranking of universities and institutions [1]. Identifying top scientists, institutions, universities and other factors related to publications can be helpful in making better academic communications and cooperations possible. Since the scientific

communication acts as a key role in achieving the new insights, measurement and valuation of scientific publications have always attracted the attention of scientometric experts [2, 3]. Scientometric is a quantitative statistical analysis of scientific documents based on four main variables: authors, citations, references and publications [4]. Scientometrics is the interdisciplinary knowledge which reviews the wide-scope of fields in multi-dimensional quantitative research [2, 5]. Quantitative evaluation of scientific activities is an important factor for development and can help policy

makers to provide more solutions to research problems [3, 4, 6]. Web of Science (WOS) and Scopus are two citation databases produced by Thomson Reuters and Elsevier in order to have international overall reviews of research products. The Scopus database covers more than 21,500 journals. And 7.2 million Conference Paper from 83,000 International scientific conferences are indexed in it. In addition, more than 530 series of books are included in the database. Moreover, WOS database includes more than 12,000 qualified scientific journals, including open access journals, and more than 160 proceeding books in over 250 subject areas from the year 1900 till now [7]. "Vafayan" et al. (2012) show that in subjects of "art, humanity and social sciences" in some indicators such as "authors' reputation" and "management", the quality of journals in WOS is better than Scopus, but in the other indicators they are similar. On the other hand, in the fields of "medicine, engineering, agriculture and basic sciences", in some indicators the quality of journals in WOS is higher than Scopus; in some other indicators such as "aim, content and scope" and "citation quality", the quality of the journals indexed in Scopus and WOS are the same [8]. Radiology, nuclear medicine and medical imaging is a specialized field of medicine which uses x-ray and other types of waves and rays for the diagnosis or treatment of diseases. The field of radiology includes three branches, namely Ionization Radiation (Radiology, Fluoroscopy, Mammography, Angiography, and CT SCAN), Non Ionizing Radiation (MRI, fMRI, OCT) and Nuclear Methods (PET SCAN, SPECT) [9-15]. Radiology experts in their academic performance have research activities to improve their profession and to increase their university ranking. Their academic documents and publications are indexed and recorded in the two databases of WOS and Scopus. This study aimed to carry out a scientometric analysis of Radiology, Nuclear Medicine and Medical Imaging articles authored by Iranian researchers, published in journals indexed in the Web of Science and Scopus databases from 2001 to 2016.

MATERIALS AND METHODS

This is a cross-sectional descriptive research using scientometric approach. All scientific

documents of Iranian researchers in the field of radiology indexed in both citation databases of Scopus and WOS from 2001 to 2016 were selected. The advanced search option was used to collect relevant data. The procedure was as follows: Scientific documents were searched in the WOS databases through using "Radiology, Nuclear Medicine & Medical Imaging" as a word category and were limited to Iran: Search keywords: WC=Radiology, Nuclear Medicine & Medical Imaging AND CU=Iran. Furthermore, the documents were searched in the Scopus database by using "radiology OR "Nuclear Medicine" OR "Medical Imaging"" as keywords; the search was limited to Iran: Search keywords: TITLE-ABS-KEY ((radiology OR "Nuclear Medicine" OR "Medical Imaging")) AND (LIMIT-TO (AFFILCOUNTRY, "Iran")). HistCite™ (version 12.03.17) and MS Excel™ 2003 Software were used to analyse the data from both databases. The number of articles and the mean of h-index were set in both databases. Some scientometric indicators such as documents' type, top 10 collaborated researches with other countries, researchers, journals, institutions and universities, and yearly output were compared within the two selected databases. Moreover, VOSViewer™ (version 1.6.4) software was used to depict scientific maps of the discipline of Radiology in these two databases.

RESULTS

The searches showed that 670057 documents have been indexed in WOS in the field of radiology till 2016; Iran's contribution was 2182 (0.32%). Iranian scientific documents in the WOS database were calculated as twenty-six in the world. The h-index of Iranian scientific documents ranked twenty-eighth and 99.8% of the documents were published in English language. It was also discovered that 221032 documents were indexed in Scopus in the field of radiology till 2016, where Iran's contribution was 1153 (0.52%). The ranking of Iranian scientific documents in the Scopus database was thirty-one in the world. The h-index of Iranian scientific documents were calculated as "thirty" and 96.7% of the documents were published in English language. In addition, 28 articles (2.4%) were published in 11 Iranian Scopus Journals in this area. It was also revealed that among 11

Iranian Scopus journals, only five journals exclusively publish articles on radiology [1].

Three of the journals are indexed in the WOS databases of which two of them enjoy an impact factor.

Table1. Iranian Indexed journals in WOS and SCOPUS

#	Journals	Publisher	Impact Factor 2016	H-Index 2016	Indexed Year
1	International Journal of Radiation Research	Novin Medical Radiation Institute	0.250	12	2004
2	Iranian Journal of Nuclear Medicine	Teheran University of Medical Sciences	-	9	2006
3	Iranian Journal of Radiology	Teheran University of Medical Sciences	0.554	9	2008
4	Iranian Journal of Medical Physics	Mashhad University of Medical Sciences	-	4	2012
5	Iranian Journal of Nuclear Medicine	Shiraz University of Medical Sciences		4	2015

More than 65% of Iranian scientific documents on radiology were original

articles in these two citation databases (Table2).

Table2. types of documents

#	WOS	Records	Percent	Scopus	Records	Percent
1	Original Article	1446	66.3	Original Article	751	65.1
2	Meeting Abstract	339	15.5	Conference Paper	332	28.8
3	Proceedings Paper	200	9.2	Review	42	3.6
4	Letter	78	3.6	Letter	10	0.9
5	Editorial Material	44	2.0	Editorial	5	0.4
6	Review	38	1.7	Article in Press	4	0.3
7	Article; Proceedings Paper	26	1.2	Unknown	4	0.3
8	Correction	7	0.3	Erratum	2	0.2
9	Note	4	0.2	Note	2	0.2
10	---	----	-----	Short Survey	1	0.1
Total		2182	100		1153	100

More than 95% of authors in the discipline of radiology co-authored the publications. USA, Canada and Switzerland are the three first countries that have the top scientific collaboration with Iranian researchers in both citation databases. “Beiki D” with 91 articles, “Eftekhari M” with 88 articles and “Fallahi B” with 84 articles were the most prominent Iranian researchers in this field in the WOS database; “Soltanian-Zadeh H” with 64 articles, “Ay MR” with 34 articles and “Sadeghi R” with 25 articles were the most productive authors in the Scopus database respectively (Table 3). It was also indicated that “Iranian Journal of Radiology” has

published the highest number of articles in these two citation databases. In addition, Iranian researchers in the discipline of radiology selected 9 journals as a target journal to publish their papers. “Iranian Journal of Radiation Research” and “Journal of Applied Radiation and Isotopes” are two journals which are indexed in both citation databases and are targeted by Iranian researchers. “Tehran University of Medical Sciences” with 576 documents in the WOS and 266 in the Scopus and “University of Tehran” with 150 documents in the WOS and 119 documents in the Scopus are the two prominent Iranian institutions in the discipline of radiology in terms of publications (Table 3)

Table 3. Comparison of top 10 countries, authors, journals and institutions in the WOS and Scopus databases

Subject	#	WOS			Scopus		
			Records	Percent		Records	Percent
collaborated countries	1	Iran	2118	97.5	Iran	1100	95.4
	2	USA	182	8.4	USA	104	9.0
	3	Unknown	47	2.2	Unknown	41	3.6
	4	Switzerland	41	1.9	Canada	29	2.5
	5	Canada	36	1.7	Switzerland	24	2.1
	6	UK	36	1.7	UK	22	1.9
	7	Netherlands	30	1.4	Japan	11	1.0
	8	Germany	23	1.1	Australia	10	0.9
	9	Austria	20	0.9	Germany	7	0.6
	10	Italy	20	0.9	South Korea	7	0.6
Authors	1	Beiki D.	91	4.2	Soltanian-Zadeh H	64	5.6
	2	Eftekhari M.	88	4	Ay MR.	34	2.9
	3	Fallahi B.	84	3.9	Sadeghi R.	25	2.2
	4	Assadi M.	78	3.6	Ghanaati H.	24	2.1
	5	Saghari M.	73	3.4	Rajabi H.	21	1.8
	6	Soltanian-Zadeh H.	72	3.3	Firouznia K.	20	1.7
	7	Fard-Esfahani A.	67	3.1	Ahmadian A.	18	1.6
	8	Sadeghi R.	61	2.8	Zaidi H.	18	1.6
	9	Ay Mr.	60	2.7	Sadeghi M.	17	1.5
	10	Javadi H.	49	2.3	Shakiba M.	17	1.5
Journals	1	Iranian Journal Of Radiology	263	12.1	Iranian Journal Of Radiology	31	2.7
	2	European Journal Of Nuclear Medicine And Molecular Imaging	252	11.6	Iranian Journal Of Nuclear Medicine	19	1.6
	3	Applied Radiation And Isotopes	139	6.4	Iranian Journal Of Radiation Research	18	1.6
	4	Iranian Journal Of Radiation Research	129	5.9	Imaging Science In Dentistry	15	1.3
	5	Radiation Protection Dosimetry	114	5.2	Annals Of Nuclear Medicine	14	1.2
	6	Medical Physics	63	2.9	Dentomaxillofacial Radiology	11	1.0
	7	International Journal Of Radiation Research	61	2.8	Ifmbe Proceedings	10	0.9
	8	Hellenic Journal Of Nuclear Medicine	37	1.7	Journal Of Nuclear Medicine Technology	9	0.8
	9	Nuclear Medicine Communications	37	1.7	Applied Radiation And Isotopes	7	0.6
	10	Ultrasonics	37	1.7	Computerized Medical Imaging And Graphics	7	0.6
Institutions	1	Tehran University of Medical Sciences	576	26.5	Tehran University of Medical Sciences	266	23
	2	Tehran University	150	6.9	University of Tehran	119	10
	3	Islamic Azad University	147	6.8	Amirkabir University of Technology	80	06
	4	Mashhad University of Medical Sciences	145	6.7	Islamic Azad University	72	06
	5	Shahid Beheshti University of Medical Sciences	140	6.4	Shahid Beheshti University of Medical Sciences	71	06
	6	Tarbiat Modares University	138	6.4	Tarbiat Modares University	70	06
	7	Nuclear Science & Technology Res Institution	96	4.4	Mashhad University of Medical Sciences	65	05
	8	Tabriz University of Medical Sciences	91	4.2	Sharif University of Technology	60	05
	9	Iran Atomic Energy Organization	84	3.9	Islamic Azad University, Science and Research Branch	54	04
	10	Shiraz University of Medical Sciences	84	3.9	Shiraz University of Medical Sciences	53	04

The analysis of the density and network visualizations (Map 1) of both databases showed that algorithm, diagnosis, phantom, radiation, dosimetry, Monte, irradiation, brachytherapy, myocardial perfusion and interaction modelling were the most frequent words and subject areas included in title and abstract of the documents indexed in the WOS database, whereas controlled study, human, medical imaging, image analysis, computer simulation, Monte Carlo method, MRI, biomedical engineering, radiation exposure and quality control were the most frequent words and subject areas in the Scopus database.

DISCUSSION

Based on Iran 1404 vision, a focus on scientometric indicators and taking measures based on these indicators can help the country to achieve a high scientific ranking in the Middle East and in the world. Research policymakers, through selection and prioritization of effective domains can make maximum use of resources. The present study shows a rise in the number of publications in radiology in both WOS and Scopus databases. Besides, Iran has witnessed progress in other areas in the past ten years [1, 16, 17]. Iranian quantitative and qualitative scientific products indexed in both WOS and Scopus databases is ranked thirteenth in the world. H-index indicator is one of the indexes that estimates applicability of survey and is supposed to be higher in general fields, while a decline in specialty and sub-specialty fields is expected [18]. In order to calculate h-index in different studies, the same techniques should be used. [19, 20]. The average of h-index of Iranian articles in the field of radiology in Scopus and WOS citation databases represents the quality of the publications. Directing researchers toward practical research priorities can be one of the constructive strategies to improve this index. In addition, registering internal journals in international citation databases such as WOS and Scopus will definitely help promote the visibility of articles published by Iranian authors as they can publish in these journals more easily. Various studies have shown that indexing articles and journals in the Scopus database is easier than the WOS database; subsequently, the database puts

under its coverage more journals [8, 20-22]. This is consistent with the findings of the present study. Therefore, the journals should try more to get indexed in more citation databases including WOS. According to the released findings of the WOS and Scopus databases, majority of journals use English as the dominant writing language [3, 16].

Hence, it can be claimed that writing scientific articles in English language is one of the solutions to quantitatively-qualitatively raise the scientific outputs in the radiology field in terms of two citation databases- WOS and Scopus. Empowering faculty members, creating suitable infrastructures and providing research teams in which individuals are fluent in English, especially in Research centres, can help the growth of scientific productions in Iran.

The visualization of Scopus and WOS outputs is dense, showing that the keywords are the same in both databases. The presence of the similar keywords in both visualizations may be due to the fact that some documents are indexed in both databases simultaneously. Focusing on hot research topics, that is the dense ones in the world can be an efficient measure to improve the content as well as quality of the studies [23, 24].

Types of documents indicated that about two third of the released outputs of the databases were original articles. There are two possible reasons for this. Firstly, researchers prefer to publish their academic activities in original articles than in other formats. Another reason is that researchers are recruited at universities and need to carry out research to promote their scientific rank. The findings also reveal that there is a propensity among Iranian researchers to publish original papers, while other formats such as review articles and letters are also indexed in the databases, can be published more easily and can help a better visibility.

Most of Iranian researchers in the field of radiology have preferred to select other Iranian researchers as co-authors. According to the result of this study, researchers affiliated with Tehran University of Medical Sciences have the greatest publications in this field that corresponds to the results of a study by Zera'atkar [5]. It is also discovered that Iranian researchers in this study

have little cooperation to publish articles which is in line with the findings of the study by Zera'atkar [5]. On the other hand, cooperation and collaboration with other Middle Eastern countries can help increase the quantity and quality of scientific products [5, 13, 16]. Having specific categories as the keywords may have caused an incomplete search in the two databases which can be regarded as a limitation of the study. The other limitation is the strategy used in the search in WOS which was limited to the journals falling under the category of Radiology as some researchers in this field may have published their articles in other journals. Along the same line of discussion, "Eun Joo Yu" et al. [25] state that researchers in the field of radiology may have published their academic papers somewhere out of the respective field.

CONCLUSION

From the findings of the study, it can be concluded that it is essential that Iranian researchers in the field of radiology increase the quantity and quality of their scientific papers and try to cooperate and collaborate with foreign researchers in this field as co-authors. It is also highly recommended that Iranian researchers in the field of radiology publish their research papers in field-specific journals. Moreover, continuous assessment of the trend of scientific products [16, 22, 26, 27] for the journals [28, 29] and authors [30-33] in the field of radiology is recommended and according to our findings, short, medium and long-term policy making should be regulated to improve the quality and quantity of research in this field.

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