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Original article

## Citation Analysis and Visualization of Iranian Urology and Nephrology Scientific Publications

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### Abstract

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**Introduction:** Urology and nephrology are the main sub-categories of internal medicine, and relevant research had been grown in recent years. The present study aimed to analyze the Iranian scientific publications in urology and nephrology indexed in the Science Citation Index Expanded (SCIE) from 1900 to 2020.

**Methods:** This cross-sectional and scientometric study was conducted in 2021. The urology and nephrology records were extracted from the Web of Science Core Collection (WSCC) with a time limitation from 1900 to 2020. Data analysis was performed in the Excel software in terms of descriptive statistics, and the scientific maps were visualized in VOSviewer.

**Results:** Until 2020, 3439 urology and nephrology scientific publications by Iranian researchers were indexed in the SCIE. These articles had received 25393 citations in total, with an h-index of 55. More than half of the articles (56.12%) were original, and the majority were published in 2012 (345; 10.03%). Tehran University of Medical Sciences was the most productive and top-cited organization on urology and nephrology, with 914 (26.57%) documents and total citations of 7741. Kajbafzadeh (140; 4.07%) and Basiri (133; 3.86%) were the most productive authors. The most productive journals were the Iranian Journal of Kidney Disease (650; 18.90%) and the Urology Journal (386; 11.22%).

**Conclusion:** The results demonstrated increasing of Iranian scientific publications, citations, co-authorship, and international collaboration. While the authors published their articles in higher ranking journals, more significant research budgets and open scientific diplomacy are necessary to promote visibility and motivate international collaboration among Iranian researchers.

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## Introduction

Urology is a surgical profession for studying, diagnosing, and treating the urinary system in both genders and the male reproductive organ. The common conditions include urinary blockage, urinary incontinence, urinary tract infections, and neoplasms (1). Nephrology became an independent specialty in the mid-1950s when famous physician Jean

Hamburger proposed this term for a branch of internal medicine that studies kidney diseases (2). Renal and reproductive diseases are prevalent conditions impacting patients of all ages and populations (3). Chronic kidney disease has become a global health challenge (4) and affects up to 10% of the total population (5). Based on predictions, its prevalence



is still high (6). Renal diseases have significantly and indirectly affected the global mortality rate. They can also progress to end-stage renal disease (7), reduce the quality of life (8), and incur heavy healthcare costs (9). Renal diseases also increase the risk of at least five other diseases, including cardiovascular diseases, diabetes, hypertension, HIV infection, and malaria (10). Based on the study of the global burden of this disease in 2015, it is estimated that 1.2 million deaths, 19 million disability-adjusted life years (DALYs), and 18 million years of lost life due to cardiovascular diseases are directly correlated with a reduced glomerular filtration rate (11). In 2015, an estimated 1.2 million people died due to renal failure, a value that has increased by 32% compared to 2005 (10). A 2010 estimation also shows that 2.3 to 7.1 million people with kidney disease died without dialysis access (12). Believably, about 1.7 million people die as a result of acute kidney disease annually (10, 12).

On the other hand, social health development depends on several factors, including scientific research. Scientific publications play an undeniable role in modern societies' cultural, political, social, and economic development and independence (13). One way to assess a country's scientific progress is through research collaboration in scientific productions (14). Scientific articles and journals are a significant indicator of a country's progress (15). Since the 1960s and 1970s, when bibliometric indices were defined for research evaluation, scientometric studies have been increasingly popular (16). Scientometrics is a valuable method for assessing scientific activities at the individual, department, university, and country level, performed mainly by evaluating the statistics of journals indexed in databases (15-17). Meanwhile, citation analysis and visualization are the main scientometric methods (18). Citation analysis ranks articles and journals based on their number of citations and can be used to assess a study's performance and calculate a journal's impact factor (19). Although citation is not a definitive indicator of the quality of research, its advocates believe that this method is the most objective for assessing the importance of a scientific article (20). Scientific mapping is a method for visualization of scientific research in a specific field that displays information to clarify the relationships among documents and facilitate the understanding of these relationships, thereby leading to discoveries (21).

In recent years, Iran has promoted its international position by increasing the quantity and quality of

medical research in international journals (PubMed, Web of Science Core Collection, and Scopus) (22, 23). However, there are limited studies regarding Iranian researchers' collaboration on urology and nephrology (22). In this regard, Einollahi (24), Rashidi (25), and Einollahi et al. (22) investigated Iranian urology and nephrology publications by scientometric method without visualization techniques and in different databases like PubMed. Researchers from other countries, such as Majzoub et al. (26), Velmurugan and Radhakrishnan (27), O'Connor et al. (28), and Velmurugan (29) studied urology and nephrology by scientometrics, but only Velmurugan has visualized the scientific publications. Regarding above mentioned and limited scientometric research on urology and nephrology, the present study aimed to visualize the Iranian urology and nephrology scientific publications in the Web of Science Core Collection (WSCC), which is one of the first research with these features in recent years. This study's results can help identify the most productive and cited researchers, organizations, journals, and level of scientific collaboration of Iranian researchers in the field of urology and nephrology. By identifying the most frequent keywords in these researches, the gap in these studies can be identified and applied by research managers and policymakers for human and financial research planning.

## Methods

The present cross-sectional and scientometric study adopted visualization techniques for scientific publications on urology and nephrology. The present study selected the Web of Science Core Collection (WSCC), a commonly used citation database for scientometric studies. The WSCC is the oldest and most widely used citation database with 22 subject categories, especially internal medicine, and one of its sub-categories is urology and nephrology. This database is a tool for retrieving citation information and analyzing scientific journals and publications (25).

The statistical population comprised all the scientific publications by Iranian researchers on urology and nephrology indexed in the WSCC (with at least one author affiliated with an Iranian university/research institute,  $n = 3439$  documents). The data were extracted from the Science Citation Index Expanded (SCIE) by searching Iran in the CU field and time limitation 1900-2020 in the advanced search. The scientific publications were limited to urology and nephrology



in the WoS Categories. The retrieved records were extracted from the WSCC Export section as Other File Format, saved as txt {Tab-delimited (Win)}, and Excel files. The txt files were then uploaded to VOSviewer, and scientific maps were visualized. The citation analysis was performed in Excel in descriptive statistics (frequency and percent), and the scientific maps were visualized by VOSviewer version 1.6.13. The citation analysis section identified top-cited articles, the most productive and top-cited authors and organizations, and core journals. In addition, the visualization of co-authorship, co-occurrence, and co-citation analyses was conducted. Co-authorship maps mainly highlight authors and their organizational affiliations to discover collaboration networks. A co-occurrence map considers the most important keywords used in the documents to visualize the map. In this way, it conceptually structures the subject

matter and helps detect basic patterns in published documents. Finally, a co-citation map considers the possible thematic similarity of the documents (30).

## Results

The citation analysis showed that up to 2020, Iranian researchers' 3439 scientific publications on urology and nephrology were indexed in the SCIE, the oldest of which dates back to 1973 (1 document). These articles received 25393 citations in total (7.38 citations per article on average), with an h-index of 55. The majority of them were original articles (n = 1930; 56.12%), followed by Meeting Abstract (n = 937; 27.24%), Letter (n = 201; 5.84%), respectively. There was one article in French and one in Spanish; the rest were in English.

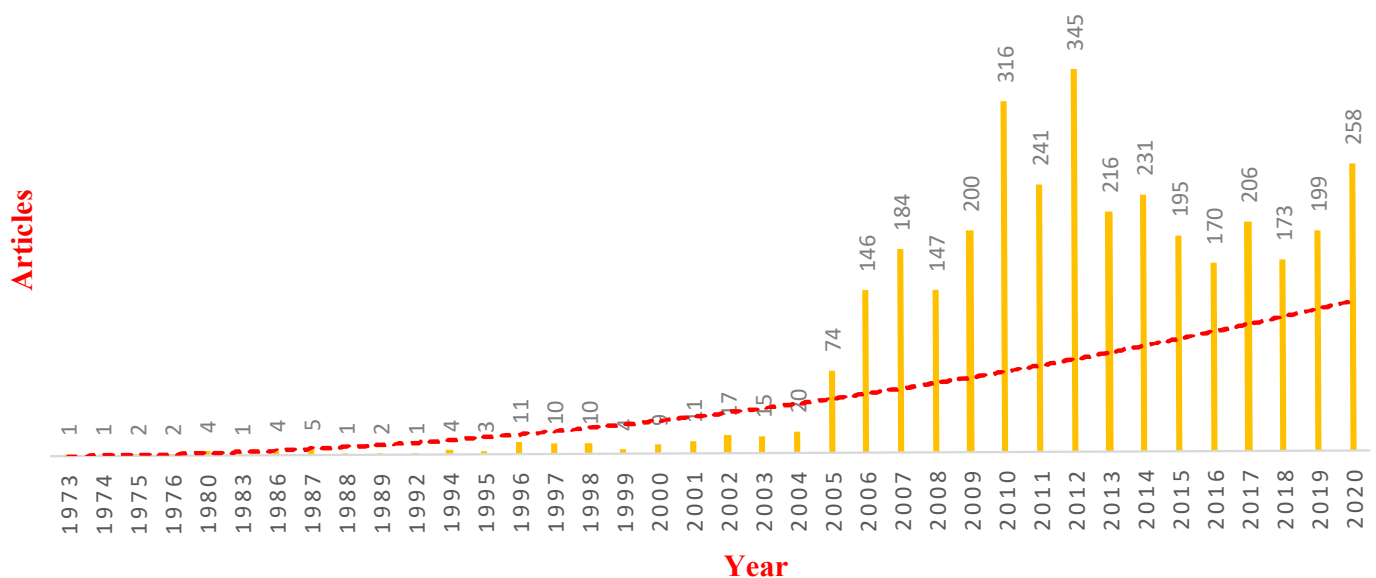


Figure 1. The trend of Iranian urology and nephrology studies in the SCIE 1900 to 2020

Most articles were published in 2012 (n = 345; 10.03%), 2010 (n = 316; 9.18%), and 2020 (n = 258; 7.50%), respectively (Figure 1). Table 1 shows the

frequency of ten productive Iranian organizations in the field of urology and nephrology in the SCIE.

Table 1. The top 10 productive Iranian organizations on urology and nephrology in the SCIE

Organizations Name	Documents (N = 3439)		Citation (rank)	Citation/Document (rank)	h-index (rank)
	N	%			
Tehran University of Medical Sciences	914	26.57	7741 (1)	8.47 (3)	37 (1)
Shahid Beheshti University of Medical Sciences	669	19.45	5819 (2)	8.70 (2)	34 (2)
Shiraz University of Medical Sciences	317	9.21	2483 (3)	7.83 (5)	26 (3)
Iran University of Medical Sciences	262	7.61	1821 (4)	6.95 (6)	21 (5)
Tabriz University of Medical Sciences	225	6.54	1247 (6)	5.54 (7)	19 (6)
Mashhad University of Medical Sciences	222	6.45	1030 (7)	4.64 (10)	17 (7)
Isfahan University of Medical Sciences	197	5.72	1669 (5)	8.47 (3)	23 (4)
Baqiyatallah University of Medical Sciences	109	3.16	888 (9)	8.15 (4)	17 (7)

In this regard, Tehran, Shahid Beheshti, and Shiraz Universities of Medical Sciences were the most productive and top-cited organizations in urology and nephrology, with 914 (26.57%), 669 (19.45%), and 317 (9.21%) documents, and the total citations of 7741, 5819, and 2483, respectively. However, in terms of “citations per article,”

Shahid Beheshti University (9.26), Shahid Beheshti University of Medical Sciences (8.70), and Tehran University of Medical Sciences (8.47) ranked first to third, respectively. Of these institutes, seven are located in Tehran (Table 1). Table 2 revealed the SCIE’s most productive Iranian researchers on urology and nephrology.

Table 2. The top ten productive Iranian researchers in the field of urology and nephrology in the SCIE

Author’s Name	No. of Articles	Citations (rank)	Citation/Document (rank)	h-index (rank)	Affiliation	WSCC Researcher ID
Kajbafzadeh, AM	140	1038 (3)	7.41 (5)	17 (3)	Tehran University of Medical Sciences, Tehran, Iran	W-9882-2019
Basiri, A	133	1407	10.58 (2)	22 (2)	Shahid Beheshti University of Medical Sciences, Tehran, Iran	-----
Safarinejad, MR	99	2260 (1)	22.83 (1)	30 (1)	Clin Ctr Urol Dis Diag, Tehran, Iran	T-3486-2019
Simforoosh, N	88	902 (4)	10.25 (3)	16 (4)	Shahid Beheshti University of Medical Sciences, Tehran, Iran	-----
Aminsharifi, A	76	408 (7)	5.37 (9)	12 (7)	Cleveland Clinic Foundation, Cleveland, OH, USA	-----
Pourmand, G	75	496 (6)	6.61 (7)	14 (6)	Tehran University of Medical Sciences, Tehran, Iran	-----
Hooman, N	70	266 (10)	3.80 (10)	10 (8)	Iran University of Medical Sciences, Tehran, Iran	A-1916-2012
Falahatkar, S	63	558 (5)	8.86 (4)	15 (5)	Tehran University of Medical Sciences, Tehran, Iran	Q-3039-2018
Mehrsai, A	57	368 (8)	7.28 (6)	12 (7)	Tehran University of Medical Sciences, Tehran, Iran	-----
Einollahi, B	53	386 (8)	7.28 (6)	12 (7)	Baqiyata wllah University of Medical Sciences, Tehran, Iran	Y-9387-2019

Table 2 shows that Kajbafzadeh (n = 140; 4.07%), Basiri (n = 133; 3.86%), and Safarinejad (n = 99; 2.87%) were the most productive authors, respectively. Safarinejad, Basiri, and Kajbafzadeh (2260, 1407, 1038 citations; 22.83, 10.58, 7.41 citations per article

on average), were the top-cited Iranian researchers in the field of urology and nephrology in the SCIE, respectively (Table 2). Table 3 presents the top journals that published most of the Iranian articles in the field of urology and nephrology.

Table 3. The top 10 Journals Publishing Iranian Scientific publications on urology and nephrology in the SCIE

Journal's Name	Documents (N = 3439)		Total Citation (rank)	Citation/ Document (rank)	Impact Factor 2019 (rank)	h-index 2019 (rank)	SJR 2019	Quartile
	N	%						
Iranian Journal of Kidney Diseases	650	18.90	4082 (1)	6.28 (3)	1.033 (10)	29 (9)	0.34	Q <sub>4</sub>
Urology Journal	386	11.22	2158 (2)	5.59 (7)	1.378 (9)	28 (10)	0.51	Q <sub>4</sub>
Journal of Endourology	283	8.22	1683 (4)	5.95 (6)	2.328 (6)	88 (6)	1.10	Q <sub>2</sub>
Nephrology Dialysis Transplantation	249	7.24	724 (8)	2.91 (9)	4.531 (2)	163 (3)	1.86	Q <sub>1</sub>
Pediatric Nephrology 220	220	6.39	702 (9)	3.19 (8)	2.676 (5)	102 (5)	0.81	Q <sub>2</sub>
Urology	168	4.88	1039 (6)	6.18 (4)	1.924 (7)	172 (2)	0.85	Q <sub>3</sub>
Journal of Sexual Medicine	156	4.53	954 (7)	6.12 (5)	3.293 (4)	108 (4)	1.32	Q <sub>2</sub>
International Urology and Nephrology	114	3.31	1099 (5)	9.64 (2)	1.843 (8)	50 (7)	0.60	Q <sub>3</sub>
European Urology Supplements	98	2.84	12 (10)	0.12 (10)	3.613 (3)	30 (8)	0.34	Q <sub>1</sub>
Journal of Urology	97	2.82	2031 (3)	20.94 (1)	5.925 (1)	249 (1)	2.19	Q <sub>1</sub>

The most productive were the Iranian Journal of Kidney Diseases (n = 650; 18.90%), Urology Journal (n = 386; 11.22%), and the Journal of Endourology (n = 283; 8.22%), respectively. Of these, the top-cited journals were the Iranian Journal of Kidney disease (4082 citations, mean: 6.28 per article), Urology Journal (2158 citations, mean: 5.59 per article), and the Journal of Urology (2031 citations, mean: 20.94 per article), respectively. Based on the citation per

article index, the Journal of Urology (index: 20.94) ranked first (surpassing the second journal by 11.30). Of the 2421 published articles (70.39%) in these ten core journals, 1036 (30.12%) were published in Q4 and 444 (12.91%) in Q1 journals (Table 3).

Table 4 presents ten top-cited urology and nephrology articles by Iranian researchers in the SCIE, each with at least 98 citations.



Table 4. The top-cited urology and nephrology articles by Iranian researchers in the SCIE

Title	Author	Year	Source Title	Document Type	Cited by	Quartile
Female sexual dysfunction in a population-based study in Iran: Prevalence and associated risk factors	Safarinejad, M.R.	2006	International journal of impotence research	Article	192	Q <sub>4</sub>
Lupus nephritis - Discussion	Berden, JHM; et al.	1997	Kidney International	Editorial Material	170	Q <sub>1</sub>
Iranian model of paid and regulated living-unrelated kidney donation	Ghods, Ahad J. & Savaj, Shekoufeh.	2006	Clinical journal of the American society of nephrology	Article	166	Q <sub>1</sub>
Comparison of laparoscopic and open donor nephrectomy: A randomized controlled trial	Simforoosh, N; et al.	2005	BJU International	Article	153	Q <sub>1</sub>
Penile fracture in Kermanshah, Iran: Report of 172 cases	Zargooshi, J.	2000	Journal of Urology	Article	132	Q <sub>1</sub>
Quality of life of Iranian kidney “donors”	Zargooshi, J.	2001	Journal of Urology	Article	125	Q <sub>1</sub>
Efficacy of selenium and/or N-Acetyl-Cysteine for improving semen parameters in infertile men: A double-blind, placebo-controlled, randomized study	Safarinejad, M.R; et al.	2009	Journal of Urology	Article	114	Q <sub>1</sub>
Penile fractures: Evaluation, therapeutic approaches, and long-term results	Asgari, MA; et al.	1996	Journal of Urology	Article	106	Q <sub>1</sub>
Oral supplementation of turmeric attenuates proteinuria, transforming growth factor-beta and interleukin-8 levels in patients with overt type 2 diabetic nephropathy: A randomized, double-blind, and placebo-controlled study	Khajehdehi, Parviz; et al.	2011	Scandinavian journal of urology and nephrology	Article	100	Q <sub>3</sub>
A systematic review and meta-analysis of tobacco use and prostate cancer mortality and incidence in prospective cohort studies	Islami, Farhad; et al.	2014	European Urology	Review	98	Q <sub>1</sub>

Based on Table 4, there is one review (with 98 citations) and an editorial material (with 170 citations) on this list. The top-cited article was published in a Q4 journal. Moreover, four top-cited articles were published in the Journal of Urology (40%), a Q1 journal with an IF of

5.925 (2019 IF = 5.925). Of the 3439 articles by Iranian researchers, 2100 documents (61.06%) received at least one citation. The majority of articles were on pediatrics (n = 276; 8.02%), transplantation (n = 254; 7.38%), and endocrinology metabolism (n = 40; 1.16%).

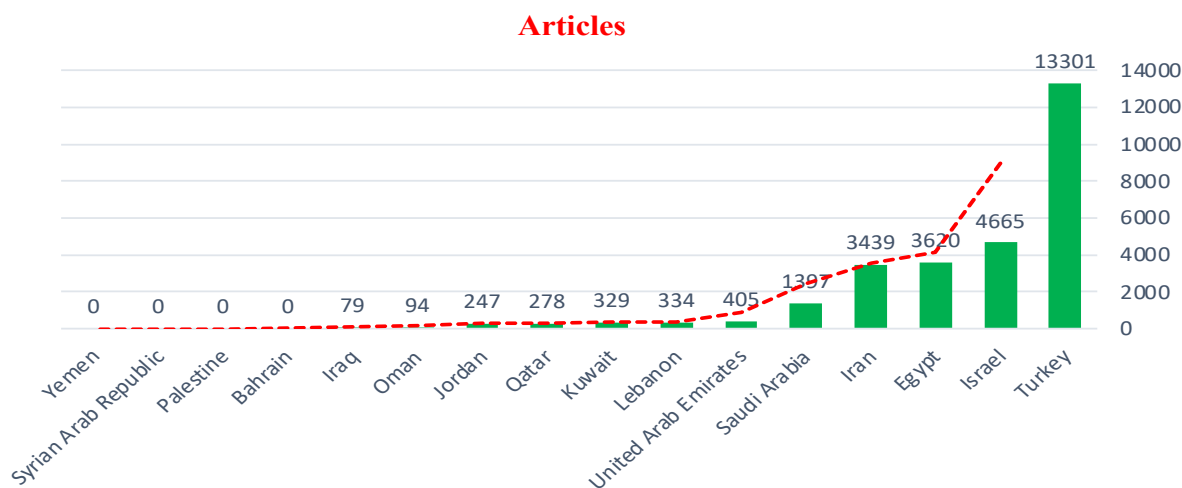


Figure 2. Middle East countries' share of urology and nephrology publications in SCIE

Based on Figure 2, Middle Eastern countries' share of the scientific urology and nephrology publications indexed in the SCIE was 4.61% (28346 articles out of the total 613900 articles). Turkey (n = 13301; 47.18%), Israel (n = 4665; 16.54%), Egypt (n = 3620; 12.84%), Iran (n = 3439; 12.20%), and Saudi

Arabia (n = 1397; 4.95%) ranked first to fifth in the Middle East, respectively. Nearly half of the Middle Eastern publications on this topic in WSCC belonged to Turkey (47.18%). Bahrain, Palestine, Syria, and Yemen had no publications on this topic in the SCIE.

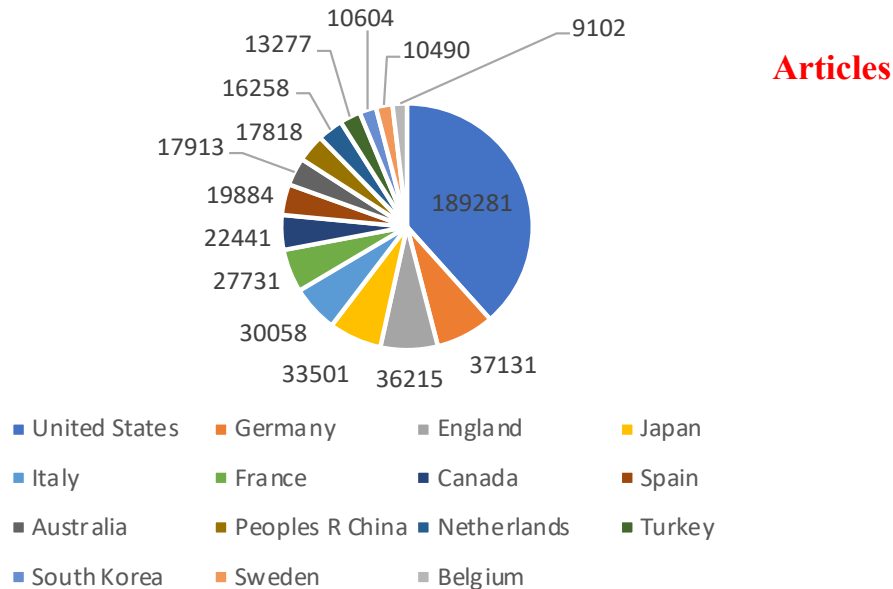


Figure 3. World countries' share of urology and nephrology publications in the SCIE

Overall, 613900 urology and nephrology articles were published in the SCIE from 1900 to 2020. Figure 3 displays the top 15 productive countries. The US (n = 189281; 30.83%), Germany (n = 37131; 6.04%), the UK (n = 36215; 5.89%), Japan (n = 33501; 5.45%),

and Italy (n = 30058; 4.89%) ranked first to fifth in the world, respectively. Of the 15 top countries, only one country belongs to the Middle East (Turkey, with a global rank of 12) (n = 13301; 2.16%), and Iran has a global rank of 28 (n = 3439; 0.56%) (Figure 3).

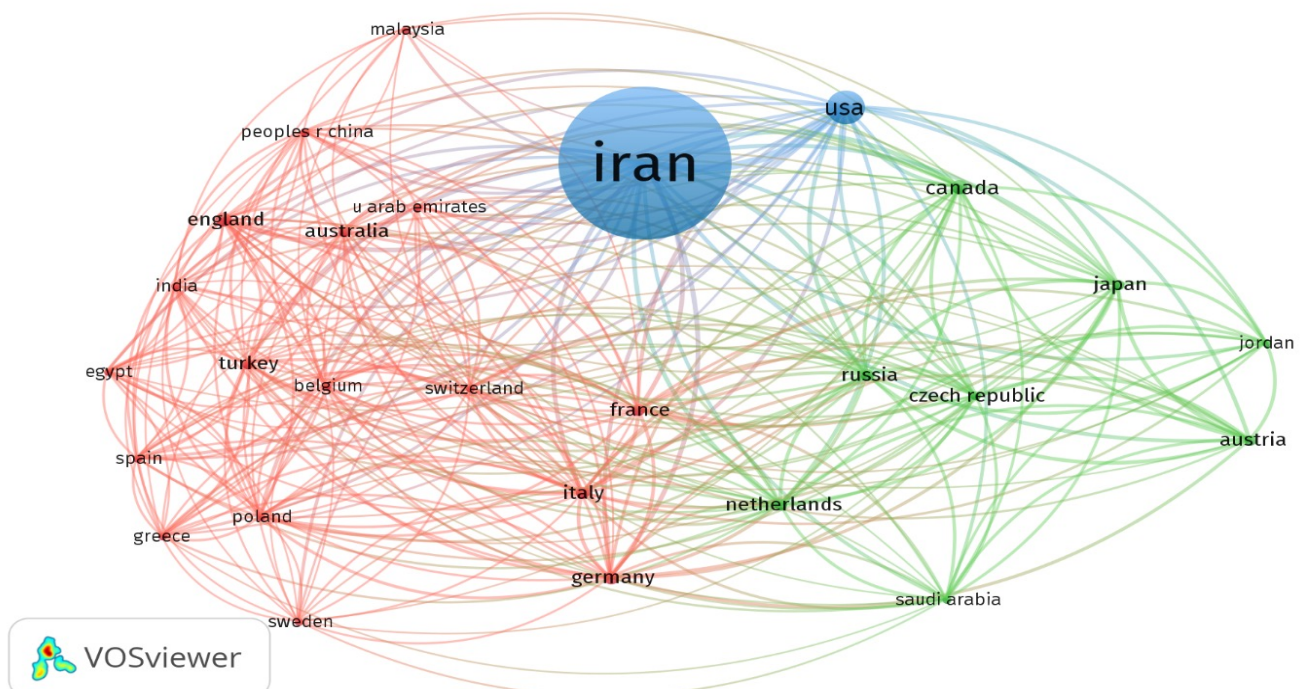


Figure 4. Co-authorship map of countries that co-authored with Iran on urology and nephrology



Iranian researchers collaborated and co-authored papers with 82 countries. Twenty-six countries collaborated with Iranian researchers on at least ten articles used to visualize the scientific map. Based on the co-authorship map, Iranian researchers mostly

collaborated with researchers from the US ( $n = 222$ ; 6.50%), Canada ( $n = 53$ ; 1.55%), the UK ( $n = 47$ ; 1.37%), Germany ( $n = 41$ ; 1.20%), and Russia and Italy (both  $n = 35$ ; 1.02%) (Figure 4).

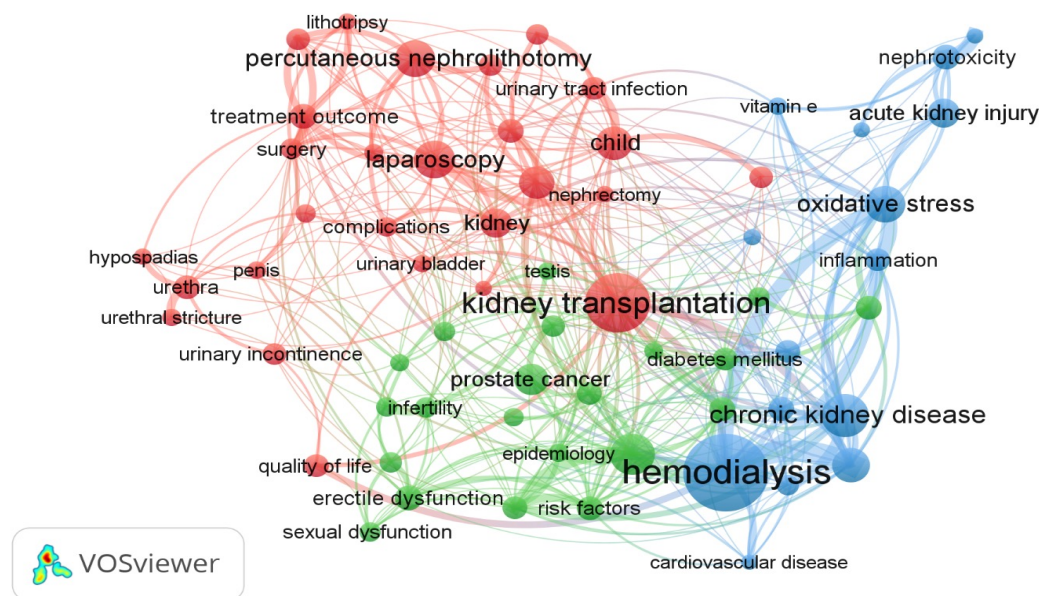


Figure 5. Keyword co-occurrence map of Iranian researchers' papers on urology and nephrology

Iranian researchers used 3821 keywords in their articles, of which 63 were used at least 15 times and are displayed in the keyword co-occurrence map (Figure 5). The greatest keyword co-occurrence belonged to hemodialysis, kidney transplantation, and chronic kidney disease (186, 121, and 75 times),

respectively. The most frequently used keywords were classified into three main clusters. The first (red), second (green), and third (blue) clusters (with 27, 21, and 15 keywords, respectively) focused on treatment and surgery, epidemiological aspects, and kidney diseases, respectively (Figure 5).

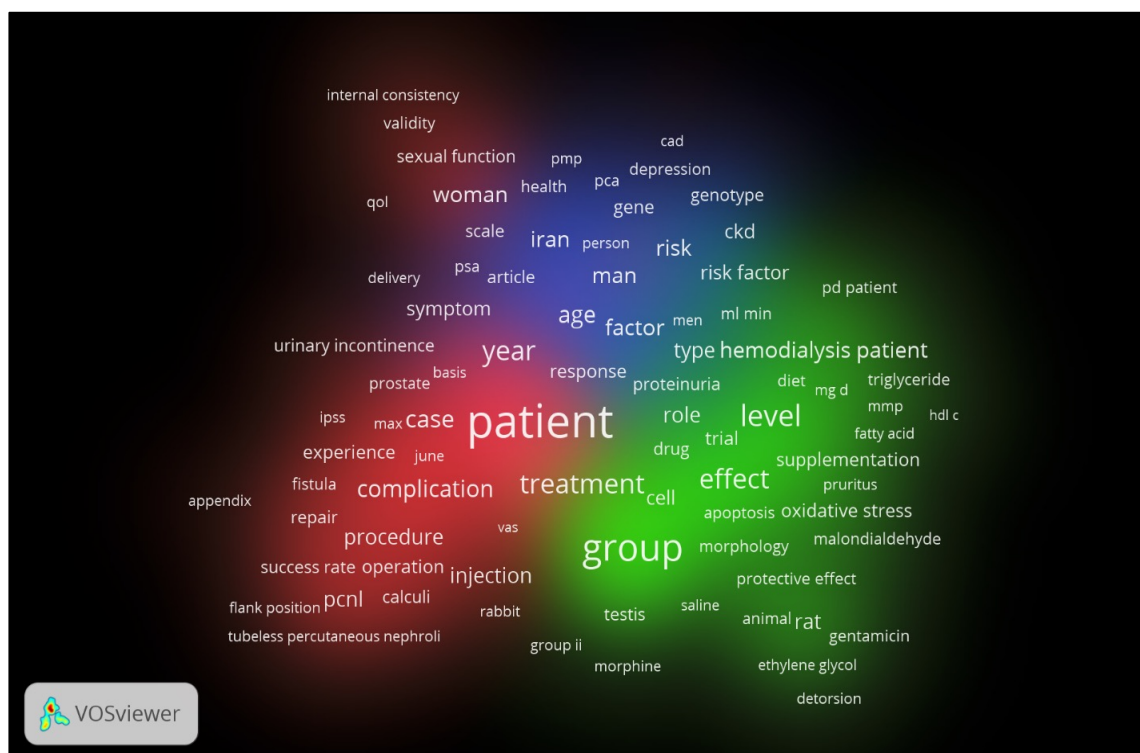


Figure 6. Title/Abstract term co-occurrence map of Iranian researchers' papers on urology and nephrology



A total of 37348 terms were extracted from the SCIE's titles and abstracts of Iranian urology and nephrology articles. Based on Figure 6, the terms' co-occurrence was visualized with the threshold of 20 in three clusters. The most frequently used terms in the first cluster in red (entitled "kidney pathology") include patient, symptom, complication, internal consistency, urinary incontinence, kidney stone, and success rate

operation. The most frequently used terms in the second cluster in green (entitled "treatment of kidney diseases") include treatment, group, hemodialysis patient, effect, morphine, drug protective effect, and level. The most frequently used terms in the third cluster in blue (entitled "epidemiology of kidney disease") include age, risk, risk factor, health, Iran, person, and response.

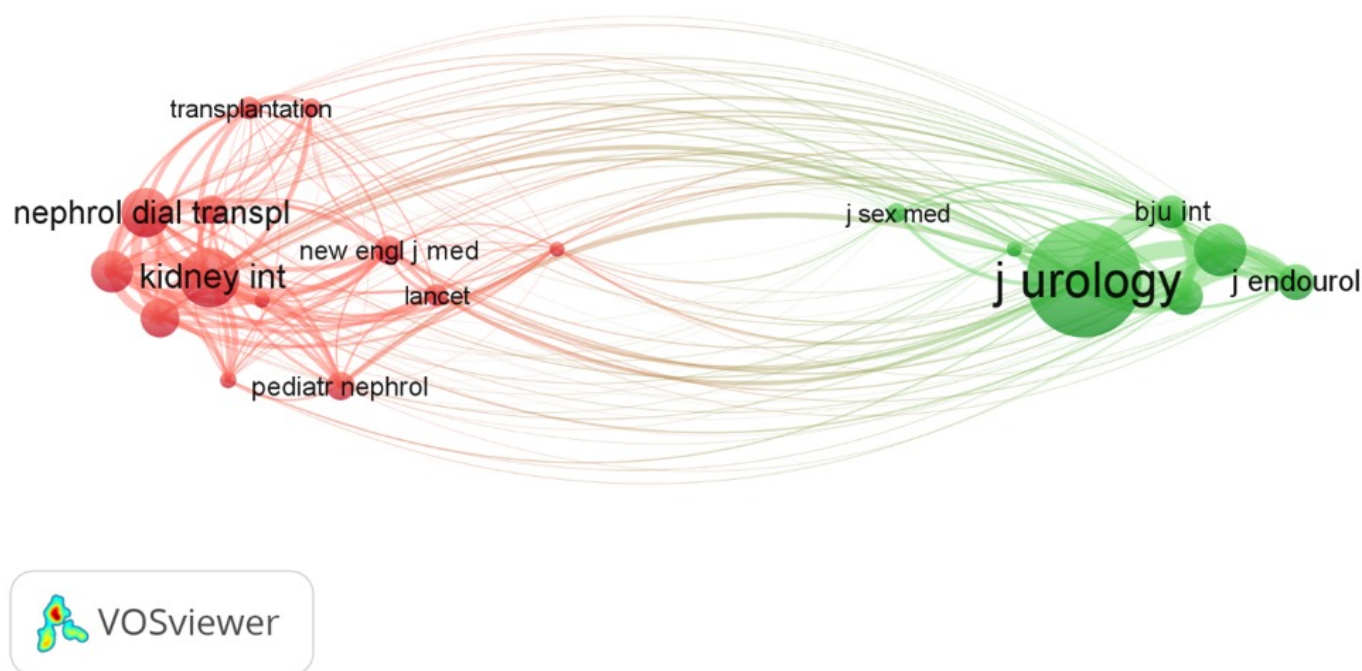


Figure 7. Co-citation map of sources cited by Iranian researchers in their papers on urology and nephrology

Based on Figure 7, a total of 7701 documents (journals and books) have been cited in the articles authored by Iranian researchers on urology and nephrology indexed in the SCIE from 1900 to 2020. The Twenty journals received at least 300 citations from these articles. Based on the co-citation map, the greatest citations belonged to the Journal of Urology ( $n = 3855$ ; 50.05%), Kidney International ( $n = 1739$ ; 22.58%), and Urology ( $n = 1455$ ; 18.89%), respectively.

## Discussion

The present study aimed to analyze the Iranian urology and nephrology scientific publications indexed in the SCIE from 1900 to 2020. To this end, citation analysis was performed, and scientific maps were visualized by identifying the most productive researchers, journals, and organizations. Iranian researchers published 3439 scientific articles on urology and nephrology and received 25431 citations (7.39 citations per article) up to the end of 2020, contributing significantly to the scientific publications

in this field. Most productive and influential institutes, organizations, and researchers in urology and nephrology were from the capital of Iran (Tehran). As research in this field dramatically promotes the health of patients with renal and urinary system diseases, other universities and research centers in Iran should strive to promote the quantity and quality of their research. The comparison of these results with those of Einollahi (24) and Rashidi (25) reveals a significant rise in Iranian researchers' urology and nephrology studies in the WSCC up to 2020, demonstrating the significant contribution of such studies to health promotion. Similarly, according to Einollahi et al. (22), the volume of urology and nephrology studies markedly increased, and most of these studies were conducted in universities in Tehran, including the Tehran and Shahid Beheshti Universities of Medical Sciences. However, those studies selected a different period and used PubMed instead of WSCC. Similar to the study by Velmurugan (31), most urology and nephrology studies by Iranian researchers in the present study were original articles in English and published in 2012; however, Velmurugan examined

the "2011-2016" time, and the majority of articles were published in 2014. Velmurugan (31) also examined the articles' quality improvement trends based on the journals' IF, which differs from the present study. It is suggested that researchers will investigate various types of urology and nephrology studies published by Iranian researchers. Such studies' results can help to allocate the research budget and demonstrate the effectiveness of research findings on the community's health.

Most urology and nephrology articles by Iranian researchers were published in the *Urology Journal*, a Q4 journal (based on its IF in JCR). Researchers also published in Q1 and Q2 journals, but the considerable portion of studies in Q3 and Q4 journals necessitates the articles' quality enhancement for publication in high-IF journals. Although IF is not the only indicator of journal quality and reputability, it is still acceptable in scientific circles as an indicator of journal credibility. These articles cited famous medical journals, including the *Journal of Urology*, *Kidney International*, *Urology*, and *Nephrology Dialysis Transplantation*. Another study introduced the *British Journal of Urology International* as the most productive urology and nephrology journal (36). Based on the findings, Iranian researchers' most urology and nephrology articles received at least one citation. Several factors increase the number of citations, including the articles' increased visibility on social media. Medical library and information science experts should educate researchers to promote the visibility of their articles. Moreover, the articles primarily focused on transplantation, pediatrics, and endocrinology metabolism. As most Iranian researchers studied the epidemiological aspects of kidney diseases, their pathology, and treatment, future research should focus on practical aspects to promote the health of society. The keywords of kidney transplantation, hemodialysis, and chronic kidney disease had the greatest keyword co-occurrence, respectively. Einollahi (22) concluded that most urology and nephrology articles dealt with transplantation, nephrology, hemodialysis, and infertility. According to Nourbala et al. (32), after Turkey, Iran published the most articles on transplantation among Muslim countries during eight year (2000-2007), indicating Iranian urologists' interest in this field. Velmurugan (31) also showed that "Nephrology," "Kidney," "Patients," "Disease", and "Renal" had the highest frequency among urology and nephrology articles authored by Indian researchers.

Although Iranian researchers mostly collaborated

with US peers, they also tended to collaborate with authors across the European Union. Among Middle Eastern countries, nearly half of the publications on urology and nephrology (47.18%) belonged to Turkey. Iran ranks 3rd in the Middle East and 28th globally in scientific publications in this field. Due to the region's conditions, Middle Eastern countries had minimal participation in urology and nephrology publications in the WoS. Bahrain, Palestine, Syria, and Yemen had no scientific publications in this field, which could be due to their political conditions, civil wars, and economic crises. Increasing the international collaborations of all Iranian universities and research centers (not just those in Tehran) with top-ranked world universities will promote the quality and quantity of research and motivate more scientific collaboration. According to Velmurugan et al. (31), Indian urology and nephrology researchers mostly collaborated with researchers from the US, Italy, Canada, the UK, and Germany. The co-authorship map in the present study also demonstrated that Iranian researchers mostly collaborated with researchers from the US, Canada, the UK, Germany, Russia, and Italy. Sweileh et al. (16) concluded that Arab nephrology and urology researchers had the most significant collaboration with US researchers. Based on Eskrootchi and Sane (33), there are different indicators for ranking research units, such as countries, organizations, authors, and journals. Nevertheless, existing indicators cannot be perfect metrics for acceptable ranking of different aggregations. Therefore, citation analysis is not without problems, and it needs to use new and combined indicators to evaluate research performance in various scientific fields, including medical sciences. A limitation of the present study was that only the WSCC was used for data extraction, while the number of urology and nephrology studies by Iranian researchers could be more than the reported results. Future studies are recommended to apply Scopus, Google Scholar, PubMed, and the like to compare the scientific networks of research in these databases based on co-authorship, co-occurrence, and co-citation indices. Similar studies can also be conducted in other medical fields.

## Conclusion

The results demonstrated increasing of Iranian scientific publications, citations, co-authorship, and international collaboration. While the authors published their articles in higher prestigious journals, more significant research budgets and open scientific diplomacy are necessary to promote visibility and



motivate international collaboration among Iranian researchers. The Iranian Ministry of Health and Medical Education (MoHME) should also allocate more budget to other universities of medical sciences to enhance the quality and quantity of their urology and nephrology research. To increase researchers' visibility, medical library and information science experts can educate them on identifying valid scientific journals, scientometric indices, and the importance of organizational, national, and international collaborations.

## Declarations

### Acknowledgement

Not applicable.

### Conflicts of Interests

The authors declared no conflict of interest.

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## Ethical statement

This study is the result of a research project entitled “Longitudinal visualization of Iranian researchers’ scientific publications in the field of urology and nephrology in the Science Citation Index Expanded up to 2020” and Code of Ethics IR.IUMS.REC.1399.802 at Iran University of Medical Sciences, Tehran, Iran.

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## Authors’ contributions

The research ideation was done by all the authors. Data collection and analysis were performed by Chia Rostami and Mohammad Karim Saberi. The article was written and finalized by all the authors.





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