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Four decades of hand microsurgery in Iran: A bibliographic analysis

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Abstract:

BACKGROUND: The aim of this study was to perform a bibliometric analysis to assess the number of articles published by Iranian researchers in the field of hand and microsurgery over the last four decades.

MATERIALS AND METHODS: An online search was conducted using 685 keywords in the abstract/title sections of articles, including carpal tunnel syndrome, wrist fractures, nerve injury and repair, skin flap and graft in the hand, congenital disorders in the hand and forearm, tumor in the hand and wrist, and infection in the hand and wrist. From February 1976 to May 2021, EndNote software version 8.1 was used to search articles in PubMed and Scopus databases. Articles in which at least one of the authors was affiliated with Iran were chosen. The name of the original institution, field of study, total number of publications, type of study, collaboration rate of Iranian hand surgeons for each year, and annual sharing of Iranian articles in journals with the highest cite scores in the field of hand and microsurgery were all examined in the present study.

RESULTS: The total number of publications in the field of hand and microsurgery was 632 (an average of 11 papers per year). Most of the Iranian hand and microsurgery papers were from the capital city, Tehran (38.09%). There was an increasing trend in the number of publications over the years, most which were about carpal tunnel syndrome (21.5%), tendon (9.8%), and nerve (9.6%). In total, 59.6% were descriptive articles, whereas the proportion of clinical trials was relatively small (22.3%).

CONCLUSIONS: Iranian hand microsurgeons have continued to increase their scientific output in hand microsurgery and related fields over the last 40 years. The quality of Iranian hand microsurgeons' scientific output, both within and outside their discipline, has greatly improved; however, they still have a long way to go before becoming a hub of science.

LEVEL OF EVIDENCE: IV, retrospective study without control group.

Keywords:

Bibliographic analysis, carpal tunnel syndrome, hand surgery, microsurgery

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Introduction

Community health development is dependent on a variety of elements, with scientific and medical studies playing an essential role.^[1] Over the last two decades, Iran has had a significant increase in the number of trained experts in medical fields, as well as advancements in medical science.^[2] As a result, Iran's health policy has changed via increasing the number of

clinical research institutes, medical students, and research budgets at medical universities in the last two decades to provide a favorable environment for scientists and researchers in order to increase science production. Iranian researchers have been successful in their efforts to raise their country's international presence in biomedical sciences by steadily increasing the number and quality of articles published in peer-reviewed biomedical journals indexed in PubMed, Scopus, and other databases. In Iran, hand surgery is a

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branch of the department of orthopedics, which is one of the country's oldest healthcare services. However, there is little knowledge about Iranian medical researchers and their expertise in hand and microsurgery so far. In this regard, bibliometric analysis is a valuable method for assessing scientific contributions across a wide range of areas of knowledge.^[3] It can also bring the focus of research on important unanswered questions, resulting in more useful government investment policies.^[4,5] The present research aims to review Iran's scientific progress and impact on global science production by estimating various quantitative and qualitative aspects of published articles in the field of hand and microsurgery. The findings of the present study would also serve as a baseline for future research. Furthermore, a thorough examination of overall research productivity at the regional and international levels is provided. Iran's data on the advancement of hand microsurgery is limited and unclear. Conducting a bibliometric analysis concentrating on this region will help identify the current situation of each country in detail, as well as existing knowledge gaps, so that efforts can be oriented toward important unresolved issues; thus, financial investments should be prioritized. Given this, the goal of this study was to provide an overview of Iran's scientific production in the field of hand microsurgery indexed in PubMed and Scopus from 1976 to 2021.

Materials and Methods

Study design and setting

A bibliometric analysis of documents published in Scopus and PubMed-indexed journals between 1976 and 2021 was performed. Medical Subject Headings (MeSH) terms for "hand microsurgery" and related terms found in previous literature were included in the search strategy. An online search was performed in the abstract/title sections of articles using 603 keywords (available in supplementary section), including carpal tunnel syndrome (CTS), wrist bones, fracture in hand and fingers, nerve transfer, nerve repair, infection in hand and wrist, scaphoid, lunate, Kienböck's disease, and several others.

Study participants and sampling

Two faculty members (two hand surgeons) of Iran University of Medical Sciences assisted us in locating all relevant keywords in the field of hand surgery and microsurgery. PubMed and Scopus databases were searched with the keywords for the period of February 1976 to May 2021. All articles in which at least one of the authors was affiliated with Iran were selected. Following the removal of duplicate records, two reviewers evaluated the titles and abstracts of the identified articles, and excluded any article that was not related to hand and microsurgery. If there was a disagreement among

the reviewers about whether or not to include or exclude an article, it was referred to a professor of hand surgery to make the final decision. Also, an offline database of 632 relevant articles was compiled for further analysis.

Data collection tool and technique

EndNote software version 8.1 was used to manage and handle the included articles. SPSS software version 16.0 was used to analyze the data (PASW, SPSS Inc., IMB Corporation, and Chicago, Illinois, USA). The mean and standard deviation of continuous variables were also calculated. In addition, percentages were used to express various variables. Regarding normality, one-way ANOVA was used to compare categorized values obtained in each year; otherwise, the Kruskal–Wallis H test was used. A statistically significant P value of 0.05 was also applied. Tables and graphs of frequency and percentages were used to present the findings. In the next step, VOSviewer version 1.6.6 was used to construct the collaboration network visualization maps (Leiden University, Leiden, The Netherlands). VOSviewer software is a free and open-source, bibliometric, mapping tool that can be downloaded from <http://www.vosviewer.com>. Countries and keywords based on co-authorship and co-occurrence networks extracted from Scopus were included in maps using network data. VOSviewer categorized the network nodes into clusters, which are groups of nodes that are related in some ways. The size of the nodes, the thickness of the edges, and the distance between the components were all factors in graphical interpretation (countries or keywords).^[6]

Results

In total, our search yielded 13,050 articles. After removing duplicate records, 5,203 papers were left. The titles and abstracts of 632 articles were found as relevant by the reviewers. From February 1976 to May 2021, the number of publications increased; also, slightly more than 65% of the articles were published between 2013 and 2021. The number of papers published each year is depicted in Figure 1a. Results of comparing 1976–2004 with 2005–2010, and with 2010–2020 show a significant increase in scientific production of up to five times than that started from 2005 ($P = 0.001$). Also, the trend of citation was analyzed for each article through years which is demonstrated in Figure 1b.

The leading Scopus indexed journals in which Iranian papers are published in the field of hand and microsurgery were *Journal of Hand Surgery* (45 documents, 11.5%), *Archives of Iranian Medicine* (21 documents, 5.7%), and *Archive of Bone and Joint Surgery* (19 documents, 4.8%). In total, 85 Iranian articles (21.73%) were published in the three abovementioned journals. Iranian journals were among 62.2% of all published papers, while non-Iranian

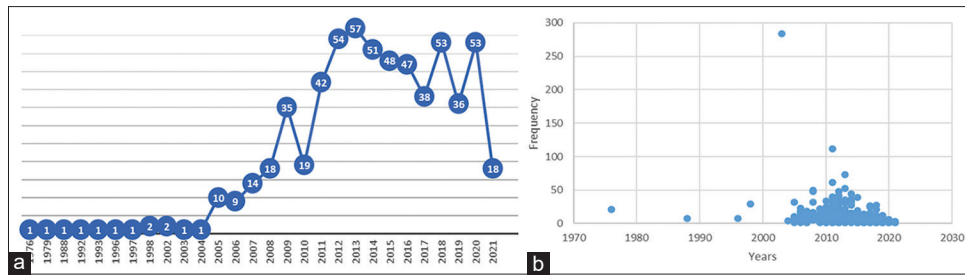


Figure 1: a) The annual number of Iranian articles in the field of hand and microsurgery in past four decades until mid-2021; b) The frequency of citation score of the articles during recent 40 years

journals were among 37.8% of published papers. Table 1 shows the top ten journals in this regard.

The most common topics of papers were carpal tunnel syndrome (CTS) constituting 21.5% of the papers, tendon (repair, transfer) constituting 9.8%, nerve (repair, transfer, graft) 9.6%, fracture (distal radius, metacarpus, finger) 8.4%, congenital disorder (syndactyly, polydactyly, Madelung) 6.9%, and tumor (wrist and hand) 6.6%. Figure 2 also shows the top Iranian authors who have published the most papers in the field of hand and microsurgery over the last four decades, and Figure 3 shows their collaboration network in Iran. As it can be seen, Dr Ahmadreza Afshar from Urmia University of Medical Sciences ranked at the top in publishing articles in the field of hand microsurgery in Iran. Top collaborations rate also belonged to Afshar-Tabrizi and Najd-Jafari.

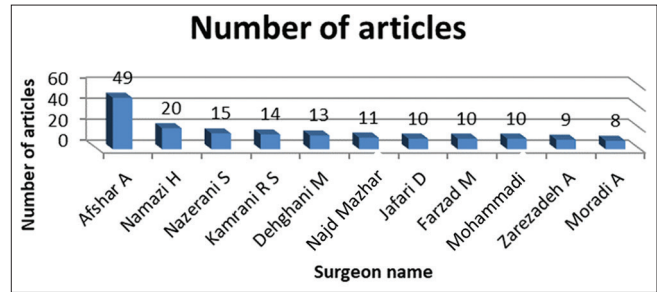


Figure 2: Iranian authors with the most published papers in the past four decades in the field of hand and microsurgery

The top productive institutions were mainly located in Tehran, the capital city of Iran, with 38.09% of publications. Tehran University of Medical Sciences (TUMS) was the most productive among the medical universities, accounting for 12.6% of all articles with 80 documents, while Iran University of Medical Sciences (IUMS), Shiraz and Shahid Beheshti Universities of Medical Sciences ranked second, third, and fourth, with 12.3%, 10.4%, and 10.3% of articles, respectively [Figure 4].

In terms of study design, 42.6% of all papers were case-control studies, 22.3% were clinical trials (experimental-interventional and case report), 16.9% were case reports, and 0.95% were systematic reviews [Figure 5]. A total of 91 keywords were found in 642 documents, with a minimum of 30 occurrences in each. The saurus-based methods were used to organize them and were presented in groups based on the number of occurrences. Cluster 1 (type of disease) was the most common ($n = 41$; 34.4%), with terms like “carpal tunnel syndrome” and “median nerve” being prominent. The main terms in cluster 2 were “controlled studies” and “clinical article”. Figure 5 depicts all of the clusters determined with various colors. Table 2 shows the top terms of this network and their values.

Figure 6 depicts the international collaboration networks in which 30 countries co-authored Scopus publications with Iran. United States ($n = 38$), Canada ($n = 10$), and United Kingdom ($n = 7$) had the highest number of collaborative networks.

Initially, all terms were divided into 11 groups in order to categorize the major reasons for hand microsurgeries. In the next step, the articles associated with each group were identified. Findings revealed that the majority of the surgeries performed were due to hand nerve diseases, including carpal tunnel syndrome (CTS) with 43 articles, and other types of nerve diseases with 137 articles. Other strategies were hand trauma conditions, hand small bone fractures, tendons, and congenital hand issues. Figure 7 presents all categories with identified subgroups, as well as the number of articles for each one.

Discussion

Professor Jamal Gousheh (1930–2016) and Dr Shoja-ad-Din Sheikholeslamzadeh (1931–2014) were the pioneers of hand surgery who established modern hand surgery in the country. Professor Gousheh founded the hand and microsurgery ward in 1980 at Shahid Beheshti University of Medical Sciences. Also, in 1971, Dr Sheikholeslamzadeh who was an orthopedic surgeon established a hospital to treat patients with disabilities. A separate ward in that hospital was dedicated to hand and upper-limb surgeries. The Iranian Society for Hand Surgery (ISSH) was a subgroup of the Iranian Orthopedic Association

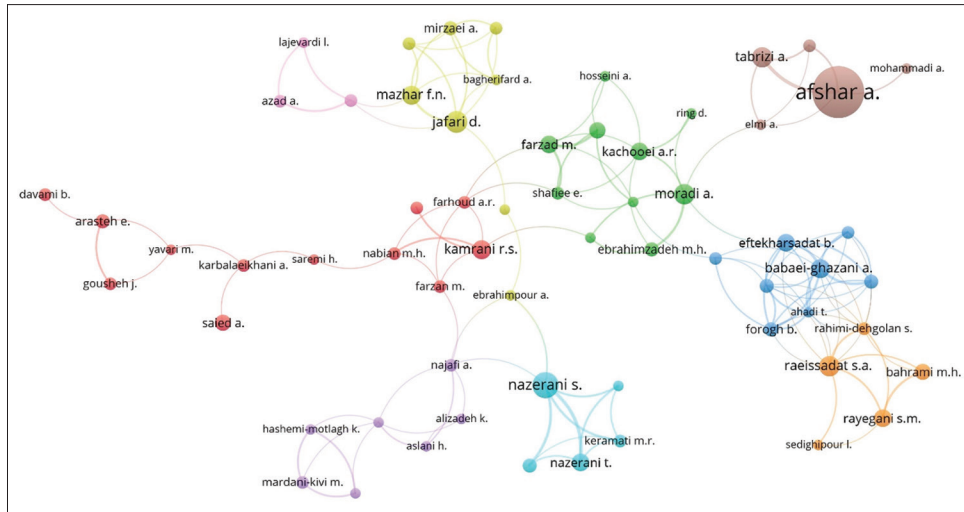


Figure 3: Collaboration network of hand microsurgery researchers with other researchers. The size of the circles demonstrates the numbers of publications in the field. The edges show co-authorships among them. Authors with more collaborations have been grouped together and color-coded. (Minimum number of documents of an author = 4, Minimum number of citations of an author = 0, Min. strength = 0)

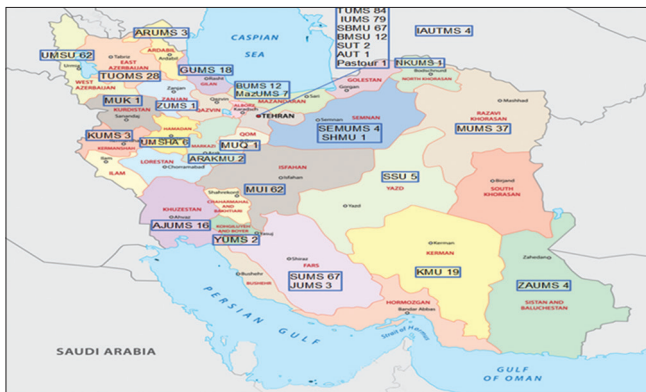


Figure 4: The map of Iran indicating the number of articles published by each university. UMS: University of Medical Sciences

from 1984 to 2007, before becoming an independent society in 2007.^[7]

Iran’s scientific production of hand microsurgery has increased significantly in recent years; however, the progress is lower than that reported globally. As shown in Figure 1, the number of indexed Iranian publications in PubMed and Scopus has increased significantly since 2005, with the number of publications increasing from one in 2003 and 2004 to more than ten in 2005. This significant increase could be attributed to the presidential election in 2005, as well as changes in the Iranian government’s clinical research funding policies. Since then, Iranian researchers have spotted a significant increase in scientific output. Other reasons for the rising trend in the quantity of published papers in this field could be an increase in the number of specialized institutions, researchers, and experts, as well as an increase in the number of domestic journals.^[3] Nonetheless, the number of publications derived from Scopus- and MEDLINE-indexed journals

Table 1: Top 10 journals who have published Iranian papers in the field of hand and microsurgery indexed in Scopus

Journal Name	Number of articles	Cite Score	H-index
Journal of Hand Surgery	45	3.00	115
Archives of Iranian Medicine	21	2.29	47
The Archives of Bone and Joint Surgery	19	2.1	19
Journal of Isfahan Medical School	18	0.3	10
Journal of Research in Medical Sciences	17	3.3	39
Trauma Monthly	17	0.7	16
Journal of Hand Surgery: European Volume	14	2.8	79
Journal of Hand and Microsurgery	13	-	-
Medical Journal of the Islamic Republic of Iran	13	1.5	22
Advanced Biomedical Research	12	-	-

Table 2: The top ten terms of occurrences network with the highest total link strength

keywords	Total link strength	Occurrence	Link
Carpal tunnel syndrome	427	103	71
Controlled study	600	94	87
Median nerve	289	54	64
Wrist	230	47	
Case report	181	46	57
Randomized controlled trial	258	35	64
Range of motion	180	36	57
Hand	128	35	79
Forearm	117	26	
Prospective studies	149	32	63

cannot be a good representation of all Iranian scientific publications on hand and microsurgery; this statistic merely reflects an overview of the reality. Also, this should be kept in mind that while the number of

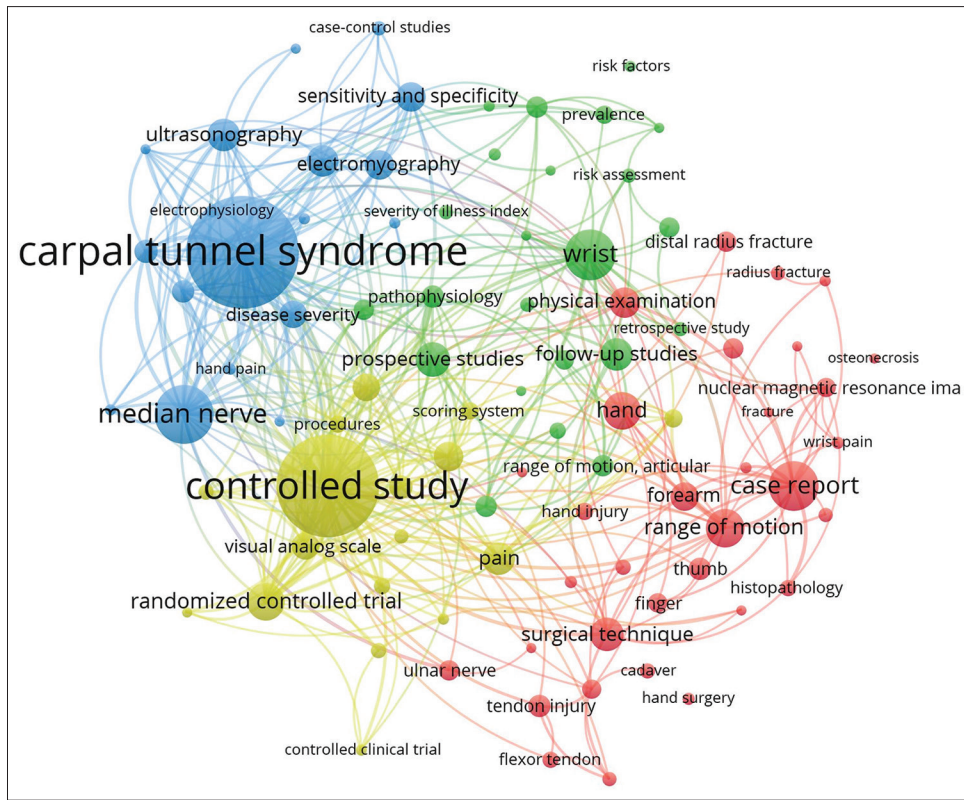


Figure 5: Network of occurrences of the hand microsurgery keyword map. The size of the circles is scaled according to the number of total occurrences of each term. (Minimum number of co-occurrences of a keyword = 2, Min. strength = 4)

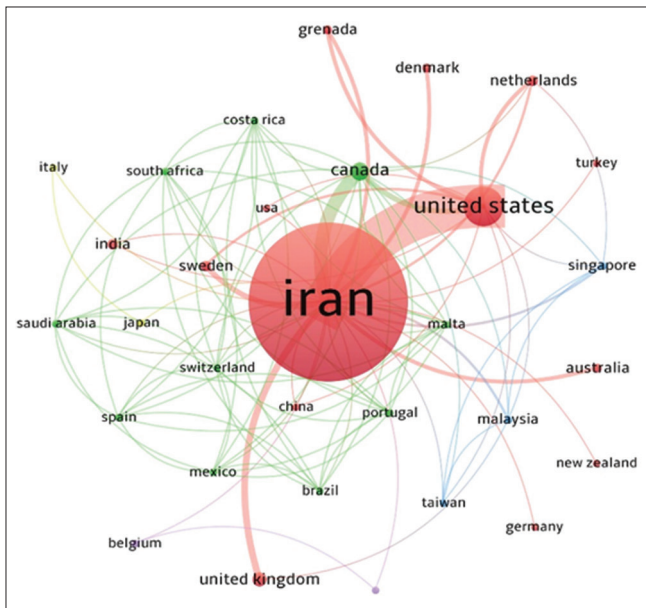


Figure 6: Co-authorship network of countries. The size of the circles and the width of the edges show the number of publications and co-authorships. (Minimum number of documents of a country = 1, Minimum number of citations of a country = 0, Min. strength = 0)

were in 2010, and published articles after 2010 did not have a high citation frequency, which could be attributed to the general unwillingness of most high-impact journals to publish Iranian authors due to political and financial issues. In this regard, Iranian researchers also have to improve the quality of their research methods and evaluations in order to have higher impact outputs. Overall, Iran and Tehran Universities of Medical Sciences accounted for nearly half of Iranian production in hand microsurgery. This is not surprising given that these two medical universities have established themselves as leaders in biomedical and public health research in Iran.

Due to the wide variety of hand microsurgery types, there are undoubtedly many complex issues in these areas that need to be investigated further. It has been found that the subject of CTS has received the most attention in recent years, and most paper topics in the present study were about median nerve release (21.5%). According to the findings of this study, Fajardo *et al.*^[8] investigated the descriptive statistics of CTR surgery trends from 1996 to 2006, in ambulatory facilities in the United States. Their findings revealed that the estimated number of CTR surgeries performed in the ambulatory setting increased by 38%, indicating that this is the most commonly performed surgery in the United States. To be more specific, all the reasons for hand surgery performed in Iran were divided into subgroups in order to show

publications and the citations of earlier articles in this field has increased over the last few decades, the citation scores of the recently published articles were not particularly high. Figure 1b shows that the majority of the citations



Figure 7: Results of the causes of referral for hand microsurgery types in a hierarchical model. In the first level, all terms were divided into 11 categories. The number of articles for each term is demonstrated

the most common types of hand surgeries [Figure 7]. Findings revealed that the most frequently used keyword in relation to performed surgeries was repair of nerve issues (with 180 articles), specifically carpal tunnel syndrome. This also highlights how developments in microsurgery have enhanced peripheral nerve surgery, and extended the types of nerve repair that can be performed in Iran. It is important to remember that nerve repair is the most commonly reported type of hand surgery in Iran that might not be the most commonly performed type of hand surgery. In addition, any studies have shown that simple decompressive surgery for hand neuropathies benefits from local anesthesia and microsurgical epineurolysis^[9]; these types of surgeries are also common in Iran. The second frequent term was anesthesia, which referred to hand local anesthesia treatment methods. This could imply that the use of pure local anesthesia for hand surgery has increased dramatically in Iran over the last few decades, and is also expected to continue, owing to new techniques for reducing the pain of local anesthesia injections, and the significant cost savings of tourniquet-free, pure, local anesthesia.^[10,11]

In terms of the types of articles published in journals, findings of the present study were relatively similar to those of previous studies. The majority of these studies were retrospective, with a slight contribution to clinical trials; however, there are some disagreements. For example, according to Zhou *et al.*,^[12] case reports, randomized controlled trials, and clinical trial articles were the most widely published articles in the fields of

nephrology and urology over a 10-year period in China. These findings challenged those of the present research. According to the researchers of this study evaluating the records of patients in observational studies, it was found that scientific validity was less than analytic studies. Results of this study showed that case-control studies were the most frequent keywords among articles. A case-control study (also known as a case-referent study) is an observational study in which two selected groups with different outcomes are identified and compared based on certain putatively causal attributes. Case-control studies are widely used to determine factors that may contribute to a medical condition by comparing patients with that condition or disease (the “cases”) to patients who do not have that condition or disease, but are otherwise similar (the “controls”).^[13]

Academic medicine promotion has traditionally been linked to research productivity (publications, presentations, and grant funding). Over the last decade, there has been a growing emphasis on broadening the criteria for academic advancement, allowing individuals who have made significant contributions to clinical care, administrative or community service, or teaching, to use their accomplishments to advance their academic rank. Despite these well-documented shifts, academic surgeons’ productivity in research work remains a critical factor because simple metrics, such as the number of publications or the amount of grant funding have traditionally been used to assess success.^[14] For more documentation, Joseph Lopez *et al.* conducted a cross-sectional study of full-time academic hand surgeons in hand surgery fellowship programs approved by the Accreditation Council for Graduate Medical Education in the United States and Canada.^[14] The study variables were divided into bibliometric (h-index, I-10 index, total number of publications, total number of citations, and maximum number of citations for a single work), demographic (h-index, I-10 index, total number of publications, total number of citations, and maximum number of citations for a single work), and categories (gender and training factors). The outcome was a method for determining a scientist’s academic ranking, namely instructor, assistant professor, associate professor, professor, and endowed professor.^[10] Figure 2 shows the most productive corresponding authors who published more papers in the past four decades in hand and microsurgery in Iran. Not surprisingly, these authors are among the top hand microsurgions in Iran.^[15-17] The majority of Iranian scientific production on hand microsurgery are published by faculty members at TUMS and IUMS. This is not surprising given that these two have established themselves as leaders in biomedical and public health research in Iran.^[18] Iranian universities are highly competitive in terms of publishing research articles and, more importantly, promoting medical sciences to

international collaborations. Figure 6 shows a piece of evidence for international co-authorships in the field of hand microsurgery. The United States, Canada, and the United Kingdom are the countries with the most links to Iran in this regard. This could be due to a number of factors, including the fact that these three countries are regarded as world leaders in hand microsurgery, and are among the top countries in terms of the number of publications in this field, which is led by the United States; also, these countries have a policy regarding scientific collaborations with developing countries. Increased international research collaborations and positive movement in the Iranian research community, on the other hand, could be attributed to an improved encouragement for researchers, a well-developed research culture, fellowship training in hand and microsurgery, and the establishment of a research PhD degree.

Limitation and Recommendation

The present study has some limitations. First, data was extracted from only the Scopus and PubMed databases; as a result, some national and regional journals' articles may not have been included. It should be also mentioned that these two databases were chosen because they were the most relevant databases for the current research; also, they are the world's greatest peer-reviewed databases^[19] with a decent range of non-English-language journals.^[20] Moreover, while some of the top scientists and types of hand surgeries have been introduced in the present study, it is important to note that these results are based on the most published experiences of hand surgery in Iran, which may not reflect the entire reality because all experts may not publish their experiences.

Conclusion

Iranian researchers' publications in the field of hand and microsurgery have experienced a considerable and significant surge over the past 40 years. The increase in publication in the field of hand surgery in Iran, particularly after 2005, implies that more studies on this topic will be conducted in coming years. The quality of Iranian hand microsurgeons' scientific output, both within and outside their discipline, has also greatly improved; however, they still have a long way to go before becoming a hub of science in this field.

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Author contributions

HS proposed the study. MM, FS, and FNM gathered the data and evaluated the articles. FS and RS wrote the manuscript. AB and MB performed statistical analyses.

AB and RS designed the graphs and tables. MF and FNM clinically revised the manuscript. SJE edited the English language of the manuscript. All the authors reviewed and approved the final draft.

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Conflicts of interest

There are no conflicts of interest.

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