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What Insights Can We Gain from the Scientometric Analysis of Scientific Publications Related to Multiple Sclerosis?

Mohammad Ahmadian [1], Heidar Mokhtari [2], Fahime Mohammadi [3], Mohammad Karim Saberi [4,*] and Naseh Yousefi [5]

[1] Student Research Committee, School of Paramedicine, Tehran University of Medical Sciences, Tehran, Iran
[2] Department of Library and Information Science, Payame Noor University, Tehran, Iran
[3] Department of Medical Library and Information Sciences, School of Paramedicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[4] Department of Nursing, Shirvan Faculty of Nursing, North Khorasan University of Medical Sciences, Bojnurd, Iran
[5] Neuromusculoskeletal Research Center, Department of Physical Medicine and Rehabilitation, Iran University of Medical Sciences, Tehran, Iran

[*] *Corresponding author*: Associate Professor, Department of Nursing, Shirvan Faculty of Nursing, North Khorasan University of Medical Sciences, Bojnurd, Iran. Email: mohamadsaberi@gmail.com

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Abstract

Background: Bibliometrics is one of the credible methods of evaluating scientific publications and research output. This is the first study in the multiple sclerosis (MS) field that can guide researchers and policy-makers in contributing more to MS.
Objectives: The main purpose of this study is to conduct a bibliometric analysis and visualization of MS scientific products of the 17 Middle East (ME) countries during 1900 - 2020.
Methods: Data from January 1, 1900, to December 31, 2020, were searched in the Web of Science (WoS) database. Research productivity was evaluated by considering the country, year, number of publications, and time trend of these publications. Co-word and co-authorship analyses were done, and top authors, journals, institutions, and country contributions to MS research were identified.
Results: Middle Eastern countries produced 5.5% of the total number of MS research worldwide. Turkey (29.18%), Iran (23.54%), and Egypt (13.066%) had the top positions. King Saud University as a research center, Baser, Kemal Husnu Can as an author, and the Multiple Sclerosis Journal as a scientific journal, respectively, with a total of 1,582 (4.26%), 360 (0.97%) and 1,172 (3.15%) publications had the highest research productivities.
Conclusions: Accurate policy-making in research centers, prioritizing research topics, promoting journals, and making more international collaboration can decrease the gap in research on MS and increase its quality and quantity. Despite rising trends in research results, more strategic planning and cooperation between researchers are needed for regional advancement in the field.

Keywords: Multiple Sclerosis, MS, Middle East, Scientometrics, Bibliometrics, Visualization, Web of Science

1. Background

Nowadays, the power of nations and countries is evaluated based on their scientific research and knowledge (1). Scientific research is conducted for development in all life aspects and is published mainly in scientific journals as the main knowledge exchange contexts (2). Scientific development is conceived as one of the main indicators of the socio-economic development of countries (3).

The quantity and quality of publications indexed in international databases is the main factor representing the share of each country in producing scientific knowledge (4, 5). In addition, the scientific output in various scientific fields represents the research activities and scientific development in different countries and fields (6). Scientific collaboration is usually used by low- and middle-income countries as an effective way to access the knowledge and technologies of developed countries. Some issues, such as size, political and economic problems, mobility, and migration, affect scientific collaboration (7, 8).

Considering the importance of developing research in forming knowledge-based communities, the regular identification and evaluation of the research is highly preferred among academics and policy-makers (9-11). The research evaluation in each field, country, and region is

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not easy due to the variety of indexing databases and approaches (12-16).

Bibliometrics, with its various indicators, is one of the credible tools of scientific evaluation and is used for identifying, explaining, and predicting the researcher's and scientific institutions' research states from different national and international perspectives. It is effective and helpful in monitoring and ranking researchers, scientific centers, journals, and collaborating countries and regions (17-19). It provides a comprehensive and deep consideration of the current status and future growth in the world's scientific development and consequent logical assessment and evaluation of scientific performance and human and financial resources in research (20, 21). Bibliometrics has become one of the inseparable tools of research evaluation, resulting in awareness of the research situation and tracing back its optimal state (22), and is helpful in determining research lines and frontiers (23, 24). Bibliometrics is important as a tool for informing researchers and the scientific community of research findings and impact (25).

Coined by Pritchard, bibliometrics is the application of statistics and mathematics for communication media and evaluates publications by using quantitative approaches (26, 27). In recent years, this scientific field has expanded as scientometrics (1969), informetrics (1979), webometrics (1997), and so on (28). It includes some techniques such as co-word, co-authorship, and co-citation analyses (29) and scientific mapping and visualization (30).

Focusing on the bibliometric analyses of scientific production in medical fields indexed in prestigious databases is a credible tool for measuring the processes and progressions in the field (20, 31). One of these databases is the Web of Science (WoS), a dynamic indexing/abstracting database for making bibliometric analysis and visualization (32).

Multiple sclerosis (MS) is a chronic disease characterized by the inappropriate invasion of lymphocytes and monocytes into the CNS, where they orchestrate the demyelination of axons, leading to physical and cognitive disability (33) and resulting in serious problems in the patient's family life, personal activity and socio-economic situations (34). Multiple sclerosis continues to be a challenging and disabling condition, predominantly affecting individuals in their early life, and has an impact functionally, financially, and on quality of life (35).

Many bibliometric studies and scientific visualization analyses related to medical fields have been conducted worldwide. Some of them, such as endocrinology and metabolism (36), adrenal gland diseases (18), hepatitis (37), obesity/overweight (38), diabetes (18), and cardiovascular disease (39) in the Middle East, have practical importance. They help identify dominant research areas and leading contributors, aiding resource allocation and collaborative opportunities for addressing health concerns effectively. For instance, research in endocrinology pinpointed Diabetes Mellitus as a focal point. Adrenal gland disease studies emphasize international collaboration and priority areas such as congenital hyperplasia. Hepatitis research highlights the need for enhanced efforts and quality journals. Obesity and overweight analyses show significant growth, informing health policies. Diabetes research quantifies contributions, particularly Iran's, guiding resource allocation and regional collaboration. Cardiovascular disease studies reveal the region's lag and the need for increased research and resource allocation, especially among the Gulf countries.

2. Objectives

As there is not any bibliometric visualization of MS publications in the Middle East, this study aimed to conduct a bibliometric study and visualization of the research made by the countries in the region on MS using WoS during 1900 - 2020. By this, a comprehensive depiction of trends and topics and top researchers, authors, and journals can be found, and better communication with those in the research on the field can be obtained.

3. Methods

3.1. Study Design and Data Source

This study was a cross-sectional bibliometric analysis based on the WoS, which is one of the most important databases for indexing scientific papers. As PubMed does not allow for citation review, WoS is favored over it. In the same way, WoS is favored over Scopus because it contains the most respected and prominent journals in all medical fields (14). The study population was selected using the indexed scientific results of MS in the WoS during 1900 - 2020. It was assumed that this 120-year period would project a better picture of the pattern of publications.

3.2. Time Span and Language

To analyze data, the time span was limited to the period 1 January 1900 to 31 December 2020. Our last search was performed on February 16, 2021, and no language and document type limitation was imposed on data.

3.3. Search Strategy

Initially, the keyword "Multiple Sclerosis" was searched in the controlled vocabulary database, Mesh (Medical Subject Headings), and all entry terms that were near the descriptor and referral keywords were selected for searching. Data collection was performed by searching the advanced search section of WoS. The keywords entered into WoS in order to accomplish the objectives of this study were "MS", "Multiple Sclerosis", "Sclerosis, Multiple", "Sclerosis, disseminated", "Disseminated Sclerosis," and "Multiple Sclerosis, Acute Fulminating" as article topics (TS). This field tag allowed searching for the topic within titles, abstracts, and keywords. Then, all 17 countries in the Middle East were entered as country/region (CU) (including Turkey, Egypt, Iran, Iraq, Saudi Arabia, Yemen, Syrian Arab Republic, Jordan, United Arab Emirates, Israel, Cyprus, Lebanon, Oman, Palestine, Kuwait, Qatar and Bahrain). The resulting search in WoS was as follows:

You searched for TS = (MS OR Multiple Sclerosis OR Sclerosis, Multiple OR Sclerosis, Disseminated OR Disseminated Sclerosis OR Multiple Sclerosis, Acute Fulminating) AND CU = (Turkey OR Egypt OR Iran OR Iraq OR Saudi Arabia OR Yemen OR Syrian Arab Republic OR Jordan OR United Arab Emirates OR Israel OR Cyprus OR Lebanon OR Oman OR Palestine OR Kuwait OR Qatar OR Bahrain). Timespan: 1900 - 2020. Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC.

3.4. Statistical and Visualization Analysis

Using the WoS tools, all collected data were analyzed on the basis of the following parameters: country, year, number of publications, and time trend of these publications, authors, journals, co-word and co-authorship analysis, and top active institutions. The data retrieved was downloaded as files containing 500 documents in plain text format, and all were merged for use in Excel and VOSviewer software. VOSviewer is a powerful software tool developed by van Eck, NJ, and Waltman, L, which simplifies the process of generating and visualizing bibliometric networks. These networks can involve various entities such as journals, researchers, or individual publications and can be constructed based on different types of relationships such as citation, bibliographic coupling, co-citation, or co-authorship. Additionally, the tool offers text mining capabilities that allow the creation and visualization of co-occurrence networks, which highlight significant terms extracted from a collection of scientific literature (40-44).

4. Results

Total publications on MS worldwide from 1900 - 2020 amounted to 669,842. The Middle Eastern countries contributed to publishing 37,101 (5.5%) documents in the field. The first published documents in the world and the Middle East belonged to the years 1921 and 1973, respectively.

Figure 1 shows the number of publications in MS during the study time span. Blue and orange graphs depict the World and the Middle East, respectively. As can be seen, the growth in publication has had an ascending trend, with the highest growth rate in 2020.

Table 1 shows the yearly frequencies and percentages of publications on MS in the World and the Middle East. The highest frequency was 2020, with 7.09% and 12.2% of all publications in the World and Middle East, respectively. 5.5% of all world publications belonged to Middle Eastern countries.

In total, 761 Middle Eastern researchers contributed to MS research during the study time span. Table 2 shows the top ten highly productive authors. Baser, Kemal Husnu Can from Turley, with 360 papers (0.97% of all publications in the region), ranked first. Most highly productive authors were from Turkey and Iran.

Figure 2 depicts the co-authorship map of researchers, including 31 clusters. Each cluster includes co-authors. Highly productive authors were highlighted with highlighted letters and greater circles. The most highly productive authors were Baser, Kemal Husnu Can from Turkey, Achiron, Anat from Israel, and Sahraian Mohammad Ali from Iran, respectively.

Of a total of 1000 publishing research institutes in the Middle East, 10 top ones are shown in Table 3. The first to third ranks belonged to King Saud University from Saudi Arabia, with 1582 publications; Islamic Azad University from Iran, with 1488 publications; and Tehran University of Medical Sciences from Iran, with 1379, respectively.

Researchers from the Middle East collaborated with authors from 104 countries worldwide. As Table 4 shows, with 11,657 documents, Turkey was at the top of the highly productive collaborating countries and produced 29.18% and 1.74% of MS documents in the region and the world, respectively. It mostly collaborated with the USA (611 documents), Italy (379 documents), and Germany (354 documents). The second rank belonged to Iran, with 9,404 documents, which contributed to 23.54% and 1.41% of publications in the region and the world, respectively. It mostly collaborated with the USA (411 documents), Canada (218 documents), and UK (182 documents). Egypt, with 5,219 documents, had the third rank in this regard, contributing to 13.066% and 0.78% of publications in the region and the

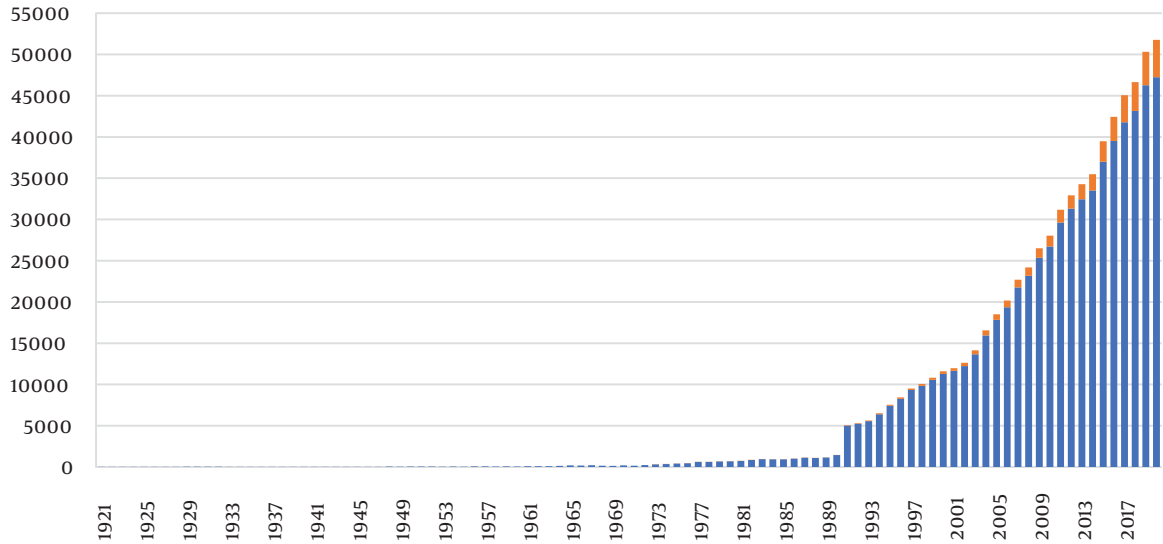

Figure 1. The frequency distribution of multiple sclerosis publications in the world (in blue) and Middle East (in orange)

Table 1. The Yearly Frequencies and Percentages of Publications on Multiple Sclerosis in the World and the Middle East

Year	World Pub. No.	% of Total Contribution (1900 - 2020)	Year	Middle East Pub. No.	% of Total Publications (1900 - 2020)
2020	47249	7.09	2020	4512	12.2
2019	46259	6.94	2019	4068	11.0
2018	43155	6.48	2018	3487	9.4
2017	41787	6.27	2017	3271	8.8
2016	39517	5.93	2016	2910	7.8
2015	36988	5.55	2015	2488	6.7
2014	33528	5.03	2014	1962	5.3
2013	32456	4.87	2013	1812	4.9
2012	31305	4.70	2012	1616	4.4
2011	29628	4.45	2011	1549	4.2
2010	26730	4.01	2010	1312	3.5
2009	25366	3.81	2009	1139	3.1
2008	23182	3.48	2008	1005	2.7
2007	21761	3.27	2007	926	2.5
2006	19353	2.91	2006	817	2.2
2005	17829	2.68	2005	675	1.8
2004	15952	2.39	2004	615	1.7
2003	13657	2.05	2003	489	1.3
2002	12222	1.83	2002	409	1.1
2001	11646	1.75	2001	324	0.9
2000	11281	1.69	2000	309	0.8
1900 - 1999	85304	12.81	1900 - 1999	1406	3.8
Total	666155	100.00	Total	37101	100.0

Table 2. Top Ten Highly-Productive Middle Eastern Authors in Multiple Sclerosis Research

Author Name	Pub. No.	% of Total Pub.	Country
Baser, Kemal Husnu Can	360	0.97	Turkey
Achiron, Anat	326	0.87	Israel
Sahraian, Mohammad Ali	293	0.78	Iran
Demirci, Betul	256	0.69	Turkey
Alroughani, Raed	219	0.59	Kuwait
Ozakbas, Serkan	200	0.53	Turkey
Etemadifar, Masoud	193	0.52	Iran
Shaygannejad, Vahid	168	0.45	Iran
Miller, Ariel	143	0.38	Israel

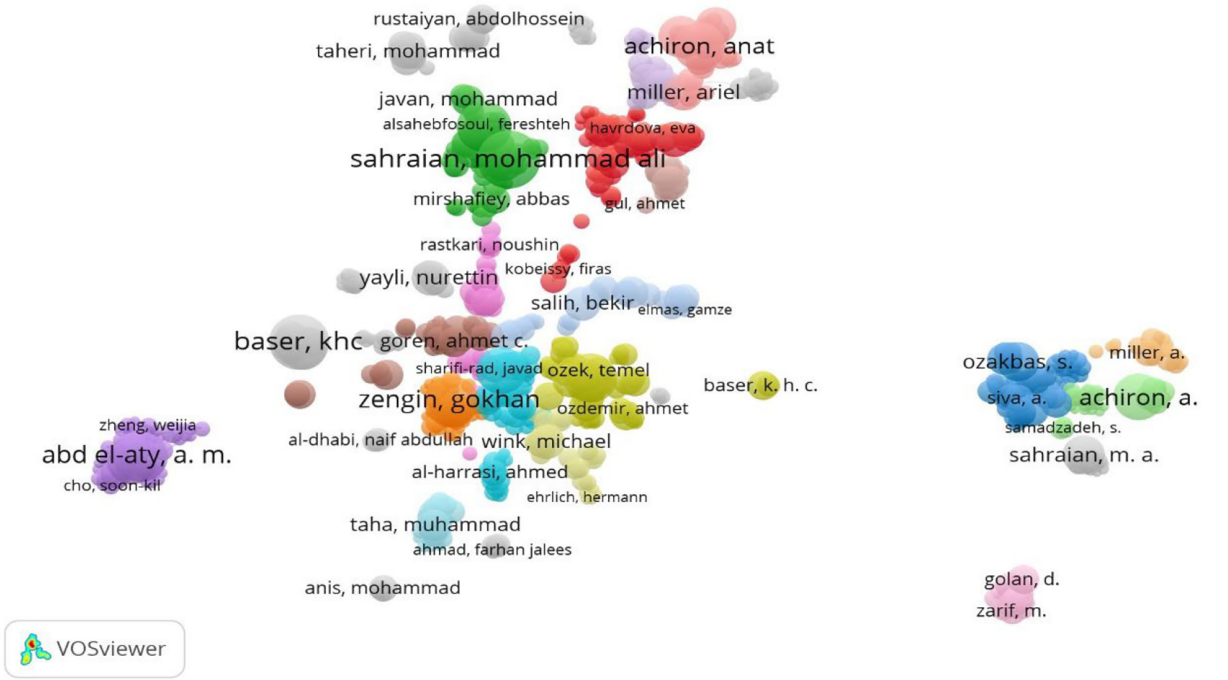

Figure 2. Co-authorship map of multiple sclerosis researchers from the Middle East

World, respectively. This country mostly collaborated with Saudi Arabia (1,091 documents), the USA (486 documents), and Germany (441 documents). Syrian Arab Republic was the least productive, with only 13 published documents on MS.

Some highly productive journals publishing Middle Eastern researchers' documents on MS during the study time span were Multiple Sclerosis Journal, with 1,172 papers on the field. The journal is in English, and its impact factor for the year 2020 is 5.412. Table 5 shows the status of the top 10 publishing journals. These are all relatively prestigious ones indexed in WoS.

Figure 3 shows the word co-occurrence map of terms used by Middle Eastern authors in the research on MS during the study time span. The first and second ranks belonged to the phrases "multiple sclerosis," with 2,909 frequencies, and "essential oil," with 1,766 frequencies, respectively. The map consisted of 6 main subject clusters (Table 6).

The first cluster (in red) with 350 topical terms relates to MS, disease, expression, risk, and prevalence, directing to the mechanisms that damage the central nervous system, resulting in MS and its prevalence and risks. Consisting of 228 terms, the second cluster (in

Table 3. Top Ten Research Centers from the Middle Eastern Countries in Multiple Sclerosis Research

Research Center	Pub. No.	% of Total Pub.	Affiliated Country
King Saud University	1582	4.26	Saudi Arabia
Islamic Azad University	1488	4.010	Iran
University Tehran Medical Science	1379	3.71	Iran
Tel Aviv University	1302	3.50	Israel
Cairo University	1127	3.03	Egypt
Hebrew University Jerusalem	957	2.57	Israel
Istanbul University	907	2.44	Turkey
Hacettepe University	883	2.379	Turkey
National Research Center	804	2.167	Egypt
University Tehran	763	2.056	Iran

Table 4. Top-Ranked Middle Eastern Countries Collaborating in Research on Multiple Sclerosis

Country	Pub No.	% Among ME Countries	% In the World	Top Collaborating Countries (Pub No.)
Turkey	11657	29.18	1.74	USA (611), Italy (379), Germany (354)
Iran	9404	23.54	1.41	USA (411), Canada (218), UK (182)
Egypt	5219	13.066	0.78	Saudi Arabia (1091), USA (486), Germany (441)
Israel	5197	13.011	0.78	USA (1180), Germany (526), Italy (301)
Saudi Arabia	4347	10.88	0.65	Egypt (961), India (440), USA (415)
Lebanon	643	1.60	0.09	France (229), USA (105), Italy (91)
Kuwait	556	1.39	0.08	Australia (114), Span (105), Italy (105)
Jordan	482	1.2	0.072	Germany (94), Saudi Arabia (84), USA (67)
Palestine	479	1.199	0.071	Morocco (19), Saudi Arabia (17), Jordan (10)
Cyprus	478	1.196	0.071	Greece (130), Turkey (62), USA (58)
Iraq	467	1.169	0.07	Malaysia (80), UK (41), USA (39)
Qatar	346	0.86	0.051	USA (63), UK (52), Saudi Arabia (28)
Oman	282	0.70	0.042	Pakistan (52), India (31), Saudi Arabia (30)
Yemen	140	0.35	0.021	Saudi Arabia (37), Egypt (26), USA (25)
United Arab Emirates	140	0.35	0.021	Saudi Arabia (44), Egypt (43), Jordan (33)
Bahrain	92	0.23	0.013	Saudi Arabia (24), Kuwait (18), United Arab Emirates (16)
Syrian Arab Republic	13	0.032	0.001	Saudi Arabia (7), Lebanon (6), Jordan (5)

green) considers derivatives, acid, and degradation. The third cluster (in blue) with 182 terms orients toward mechanisms and techniques of mass spectrophotometry, liquid-chromatography, and solid-phase extraction, focusing on the identification of antioxidant and antimicrobial nature of some chemical components. The fourth cluster (in orange) consists of 166 terms focusing on essential oils. The fifth cluster (in purple) with 65 terms concentrates on biosynthesis and regeneration and laboratory culture and growth aspects. With its 9 terms, the six cluster (in indigo) considers bacteria, maldi-tof ms, genes, flight mass-spectrometry, desorption ionization-time, and strains.

5. Discussion

Bibliometric indicators have gained significant importance as tools for analyzing scientific endeavors and their correlation with economic and social progress. These metrics allow for the evaluation of the performance and advancement of a country's science and technology.

The research on MS in the Middle East had an increasing trend in the studied years. This finding accords with those on endocrinology, diabetes, and hepatitis

Table 5. Top Ten Highly-Productive Journals Publishing Middle Eastern Researchers' Papers on Multiple Sclerosis

Journal	Pub. No.	%	Country	IF
Multiple sclerosis journal	1172	3.15	UK	5.412
Journal of Essential Oil-Bearing Plants	623	1.67	India	0.824
Journal of Essential oil research	420	1.13	USA	1.148
Natural product research	335	0.90	Uk	2.158
Multiple sclerosis	312	0.84	UK	4.230
Multiple sclerosis and related disorders	259	0.69	UK	2.889
Food chemistry	251	0.67	UK	6.306
European journal of neurology	249	0.67	UK	4.516
Journal of the neurological sciences	244	0.65	Netherlands	3.115
Molecules	241	0.64	Switzerland	3.06

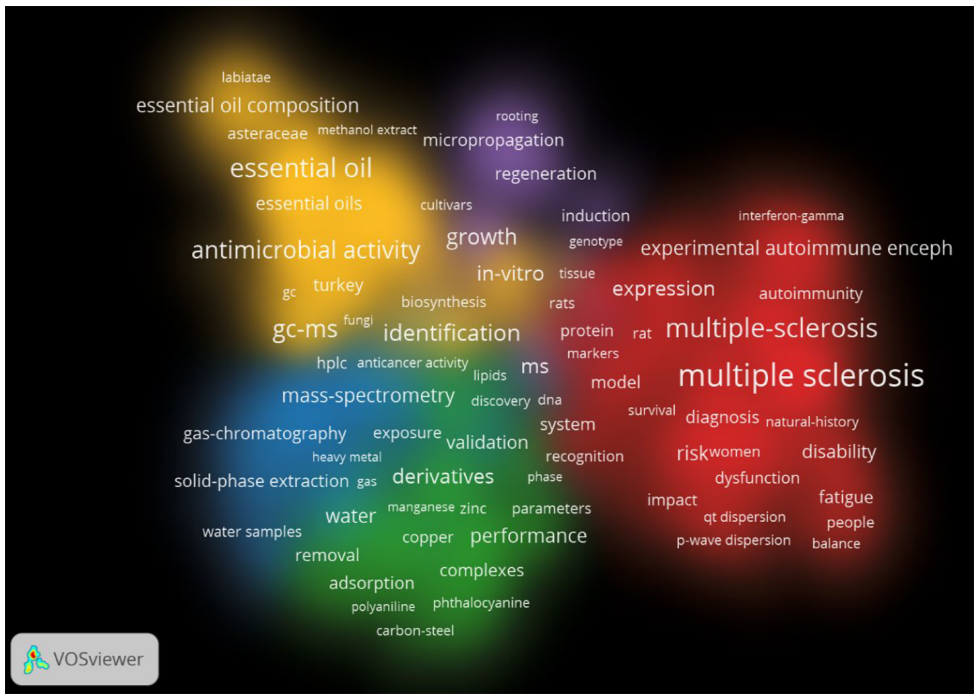

Figure 3. Word co-occurrence map of terms used by Middle Eastern authors in the research on multiple sclerosis

(7, 18, 36, 37). A study related to research in the field of obesity in the MENA (Middle East/North Africa) region also mentioned an upward trend in scientific output (45). Furthermore, the participation of Middle Eastern countries in publications in the Journal of Arthroplasty as a Q1 journal in the field of Orthopedics and Sports Medicine has been reported to increase (46). Alongside the increase in publication share, which is not unaffected by advancements in technology and communications, facilitating international collaborations and providing researchers with easier access to journals and submission systems (47), the lack of collaboration among Middle Eastern countries is also an important issue that should not be overlooked.

The top ten highly productive researchers produced 5.5% of documents in this field in the Middle East. These authors were from highly productive countries in the region. Researchers in other countries can develop the field by collaborating with these countries and coauthoring their top authors.

Table 6. Main Subject Clusters and Terms Used by Middle Eastern Authors in the Research on Multiple Sclerosis

Cluster	No. of Included Terms	Main Topics	Label	Color
1	350	Multiple sclerosis, disease, expression, risk, prevalence	Multiple sclerosis,	Red
2	228	Derivatives, acid, performance, water, degradation, nanoparticles, optimization	Derivatives,	Green
3	182	Ms (mass spectrophotometry), extraction, validation, liquid-chromatography, solid-phase extraction	Mass spectrophotometry	Blue
4	166	Essential oil, antimicrobial activity, antioxidant, identification, chemical-composition	Essential oil	Orange
5	65	Growth, micropropagation, regeneration, induction, stress	Growth	Purple
6	9	Bacteria, maldi-tof ms, genes, flight mass-spectrometry, desorption ionization-time, strains	Bacteria	Indigo

Research institutes from Saudi Arabia and Iran were highly productive in this regard. The presence of Iranian research institutes was considerable in some other medical fields, too (7, 18, 36).

The top highly productive countries were Turkey, Iran, and Egypt, respectively. In some other medical fields, including, among others, endocrinology, diabetes, obesity, hepatitis, and oral and maxillofacial surgery, Turkey, Iran, and Israel were highly productive (7, 18, 36, 37, 45, 48). In terms of the number of scientific publications in the Khalifa et al.'s study (46), these four countries were also among the most prolific nations. Iran is consistently reported as one of the most productive countries in all related studies. In recent years, we have witnessed remarkable successes in the field of medical sciences in Iran. In 2015, this country ranked first among Middle Eastern countries and all Islamic countries in terms of the number of scientific publications and received citations (49). In general, the recent increase in research productivity can be attributed to the attention given to research by country policy-makers up to the highest level of leadership. This has led to a strong national commitment to research policies, facilities, and resources (50, 51).

In terms of the total number of scientific collaborations, Turkey, Iran, and Egypt ranked first to third, respectively. The USA had the highest statistics of cooperation with Middle Eastern countries, with 1180 documented collaborations between Israel and the USA in this domain. The highest level of cooperation among Middle Eastern countries was observed between Egypt and Saudi Arabia, with 1091 documented collaborations. These findings align with the research conducted by Valizadeh et al. (45). Palestine had the least number of scientific collaborations among the countries studied.

The researchers published their papers in various journals in the field. The first-ranked journal in this regard, the Multiple Sclerosis Journal, is indexed in the UK and has a high impact factor (5.412 in 2020). As the top highly-productive journals are non-Middle Eastern, it is necessary that related journals in this region should be highlighted and indexed in international indexing/abstracting databases.

The results of word co-occurrence showed that the highly frequent terms relatively cover the issues considered in MS. In other words, the Middle Eastern researchers involved in research on MS considered most issues of the disease.

Research production on MS in Middle Eastern countries has an acceptable growth rate. However, there is a significant gap between the leading countries in the region and those in the World. Insufficient research support, inadequate research infrastructures, limited communications, insufficient collaborations, flawed documentation systems, lack of registered data, and political and military conflicts are among the factors that have contributed to significant disparities in the number of publications between Middle Eastern countries and other nations. Furthermore, it is worth noting that the acceptance rate of submitted articles can be influenced by the nationality of the authors or the affiliations associated with them.

Accurate policy-making in research centers, prioritizing research topics, continuous assessment of research activity progress, promoting journals in the region, and making more international collaboration can decrease the distance and increase the quality and quantity of the research on MS. Additionally, establishing a scientific network within the region can be beneficial in achieving these goals.

5.1. Conclusions

In summary, the increase in multi-disciplinary faculties, research centers, specialists, students, research projects, and dissertations undoubtedly contributes to the growth in the number of papers and citations in this field. The study conducted by Keshtkar et al. (52), aiming to examine the role of Health Research Networks

(HRN) in facilitating and expediting the achievement of health research objectives based on Iran's vision until 2025, confirms our findings. It is suggested that more studies be conducted to investigate the possible reasons for the lack of participation and possible solutions for improvement and cooperation between the authors of the Middle Eastern countries.

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Footnotes

Authors' Contribution: Study concept and design: All authors; analysis and interpretation of data: Ahmadian, M., and Saberi, M. K.; drafting of the manuscript: All authors; critical revision of the manuscript for important intellectual content: Ahmadian, M., and Saberi, M. K.; statistical analysis: Ahmadian, M., Mokhtari, H., and Yousefi, N.

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