



# ANALYSIS OF REHABILITATION IN MULTIPLE SCLEROSIS WITH SCIENTIFIC MAPPING METHOD

Multiple skleroz'da rehabilitasyonun bilimsel haritalama yöntemiyle analizi

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## Abstract

This study is about scientific analysis of Multiple sclerosis rehabilitation. For this purpose, scientific mapping method was used in the analysis of publications. Scientific studies published in the Web of Science (WoS) database on rehabilitation in patients with multiple sclerosis between 1986-2021 were analyzed by bibliometric analysis method. VOSviewer package program was used to analyze the data. The data were analyzed in terms of variables such as the author of the publications, countries, active journal, citations, institutions, keywords. As a result of the study, regarding the publications on multiple sclerosis and its rehabilitation; the highest number of studies were published between 2018-2021, with the USA in the first place in this regard; Researchers affiliated with the University of Alabama Birmingham have the most publications on this subject; most publications were published in the journal Disability and Rehabilitation; the researcher who contributed the most to the subject is Robert W. Motl; It was seen that the most cited publication on multiple sclerosis belongs to Kurtzke JF. From Turkey, Idiman E. is at the forefront of the names that contribute to this field. As a result of the findings, it has been observed that the publications on multiple sclerosis and its rehabilitation have increased in recent years. This study can provide researchers with useful information about research directions and limitations, and coauthorship of publications. Focus on research base and collaborations should be increased for high quality multiple sclerosis rehabilitation studies.

**Keywords:** Multiple sclerosis, rehabilitation, Bibliometric analysis, VOSviewer

## Özet

Bu çalışma Multiple skleroz (MS) rehabilitasyonunun bilimsel analizi ile ilgilidir. Bu amaçla yayınların analizinde bilimsel haritalama yöntemi kullanılmıştır. 1986-2021 yılları arasında multiple skleroz hastalarında rehabilitasyon ile ilgili Web of Science (WoS) veri tabanında yayınlanan bilimsel çalışmalar bibliyometrik analiz yöntemi ile incelenmiştir. Verilerin analizi yapmak için VOSviewer paket programı kullanılmıştır. Veriler, yayınların yazarı, ülkeler, etkin dergi, yapılan atıflar, kurumlar, anahtar kelimeler gibi değişkenler bakımından analiz edilmiştir. Çalışma sonucunda multiple skleroz ve rehabilitasyonuna ilişkin yayınlarla ilgili olarak; en fazla çalışmanın 2018-2021 yılları arasında yayınlandığı, ABD'nin bu konuda ilk sıralarda yer aldığı; Alabama Birmingham Üniversitesi'ne bağlı araştırmacıların bu konuda en fazla yayın yaptığı; en fazla yayının Disability and Rehabilitation dergisinde yayınlandığı; konuya en fazla katkı yapan araştırmacının Robert W. Motl olduğu; multiple skleroz konusunda en fazla atıf alan yayının Kurtzke JF'e ait olduğu görülmüştür. Türkiye'den ise İdiman E. bu alana katkı yapan isimlerin ön sıralarında gelmektedir. Son yıllarda multiple skleroz ve rehabilitasyonuna ilişkin yayınların arttığı gözlenmiştir. Bu çalışma araştırmacılara araştırma yönelimleri ve sınırları, yayınlarda ortak yazarlıklar hakkında faydalı bilgiler sağlayabilir. Üst nitelikli multiple skleroz rehabilitasyon çalışmaları için araştırma dayanağı ve iş birliklerine odaklanma artırılmalıdır.

**Anahtar kelimeler:** Multiple Skleroz, rehabilitasyon, Bibliyometrik analiz, VOSviewer

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## Introduction

Multiple sclerosis (MS) is a progressive demyelinating disease of substantia alba in the central nervous system. It is one of the most common neurological diseases with a prevalence of 110/100,000. Because of the diffuse features of the lesions, the clinical symptoms of MS are common and relatively different to the individual. The disease usually occurs between the ages of 20-40, and the female-male ratio is approximately 1:2 when looking at the sex ratios (1). Commonly associated with MS are general fatigue, muscle weakness, spasticity, ataxia, sensory disturbances, and cognitive and autonomic dysfunctions (2,3). Impairment of ambulation, especially in affecting motor function, limits MS patients in their daily activities and social life (4). Since the time of Uhthoff, who described worsening of visual function due to increased body temperature, the heat sensitivity of MS patients also advises MS patients to avoid excessive physical activity. Therefore, most MS patients have very low levels of daily physical activity (2).

Bibliometric analysis is a systematic method that not only reveals the quantitative information of publications, but also evaluates co-author studies and current analyzes (5). In bibliometric analysis, two methods have been developed as performance analysis and scientific mapping. In the performance analysis, depending on the publication result, citations to the publication, authors, countries are used to evaluate the research performance. In the scientific mapping method, network analyzes such as author, country and institution collaborations are examined (6). It is clear that the increase in the number of research documents makes it difficult to carry out

analyzes on a particular subject effectively and efficiently. Therefore, it will be useful and necessary to resort to intelligent methods to facilitate the analysis of a research area by automatically classifying research results according to different themes and topics. Therefore, scientific mapping tools play an important role in bibliometric analysis. Different tools can be used to perform scientific mapping analysis. Bibexcel, CiteSpace II, CoPalRed, IN- SPIRE, VOSViewer are some of these tools (7).

Shafin et al. (2022) used "multiple sclerosis" as a keyword in their bibliometric analysis on Scopus. Words such as "covid-19", "teriflunomide", "clinical experiment" were found extensively on the maps (8).

Taslim et al. (2022) found that keywords such as pattern analysis, magnetic resonance imaging, optical coherence tomography, extended disability status, demyelination, and epidemiology were the main themes of MS research in Arab countries (9).

Benavent et al. (2014) similarly used the keyword "multiple sclerosis" in their study. The country with the most studies was the USA and most of the articles were found to be published in the Multiple Sclerosis Journal (10).

In this study, the areas where multiple sclerosis focuses specifically on rehabilitation, the distribution of publications, and the status of the publications in our country have been a matter of curiosity. For this purpose, the trends of the publications on MS in recent years were revealed by scanning the indexed publications on MS between the years 1986-2021.

## Material and Method

This study has an exploratory character and was carried out according to the bibliometric method. WoS database is preferred because it is supported by many

analyze bibliometric mapping. VOSviewer offers a view that allows bibliometric maps to be viewed in full detail (11).

It is aimed to determine the

distribution of the publications in the database determined by the bibliometric analysis method, according to the countries, the distribution of the publications according to the institutions, the distribution of the keywords used in the publications, and the authors who are pioneers in the subject of MS. It is thought that this study will serve as a guide for researchers who will carry out studies specific to the subject, by revealing the developments related to MS.

### Article Selection

Article search in WoS was made on May 22, 2022. Rehabilitation and exercise studies within the scope of SCI- EXPANDED, SSCI, ESCI, CPCI-S, BKCI-S, CPCI-SSH, BKCI-SSH indices in

the MS field in WoS were included in the study. The search was made with the keywords "multiple sclerosis and rehabilitation and exercise". The studies carried out in the 1986-2021 time period were included. Since the data found were downloaded from public databases and there was no ethical problem with the data found, no application was made for ethical approval.

### Inclusion and Exclusion Criteria

(1) Research articles published in 1986- 2021 on MS rehabilitation and physiotherapy, other

rehabilitation methods, and clinical treatment and exercises of MS.

(2) Types of articles, including original research, papers, notes, letters, discussions, and book chapters, are excluded.

(3) Turkish and English are included as languages.

As a result of these applied criteria, 1097 articles were published.

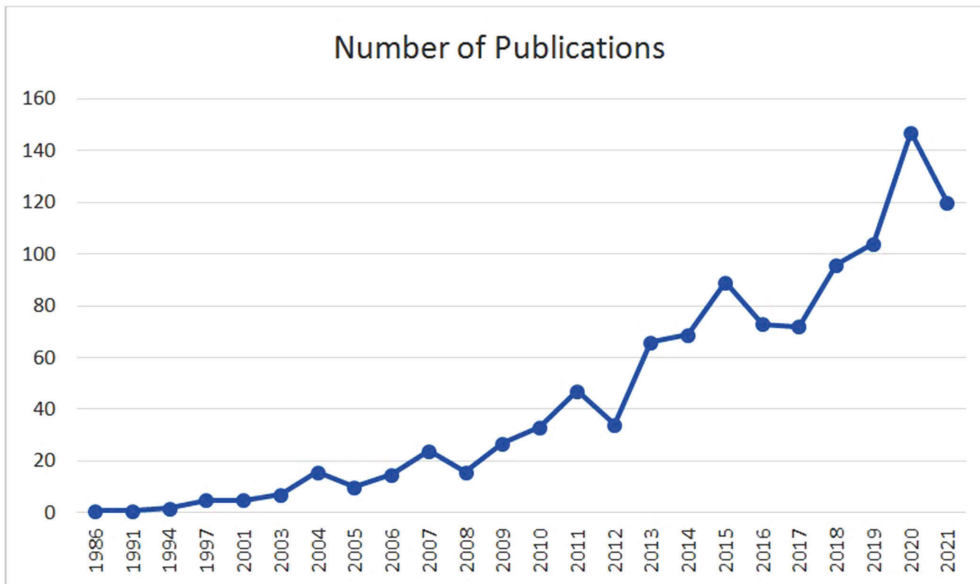
### Data Analysis

The included articles were analyzed using the WoS and Visualization of Similarities (VOSviewer) viewer 1.6.18. Vosviewer is a new method for visualizing and mapping similarities between objects (11). The data exported from the WoS database was imported into VOSviewer to discover if the keywords used by the authors in their articles coexist. The publication trends of MS-related research were obtained from WoS, including the distribution of countries/regions, institutions, authors, citations received and the distribution of the top 20 most cited articles over the last four decades. As a result of VOSviewer analysis, outputs in different colors, shapes and sizes were obtained. Label size and the circle of an item were determined by the weight of the item. The larger an item's weight, the larger the item's label and circle.

## Results

According to the search results made in the WoS database, a total of 1097 publications were made in the world between the years 1986-2021. The data obtained by examining the distribution of these publications by years are shown below

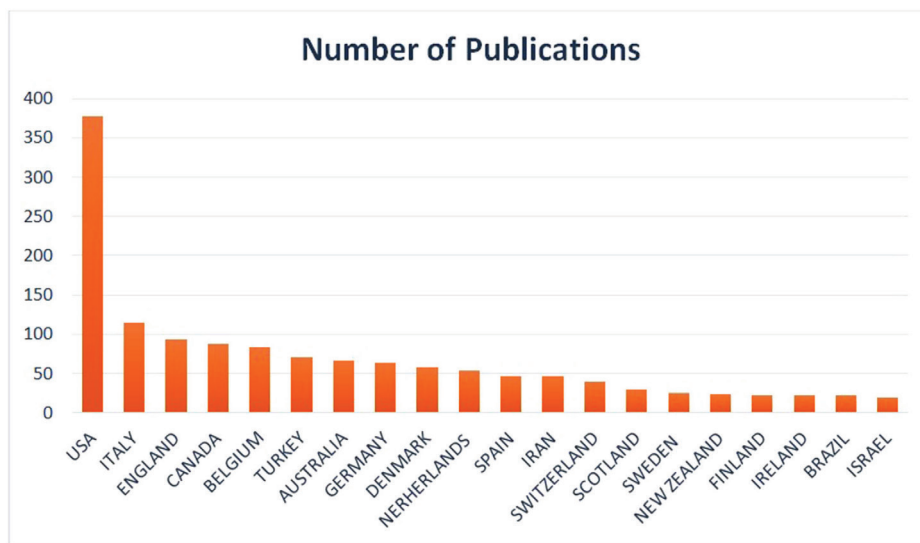
(Graph 1). There is a steady increase in studies on MS rehabilitation and exercise between 2010-2021. The most publications on the subject were made between 2010-2021. The highest number of publications was 147 in 2020 (Graph 1).



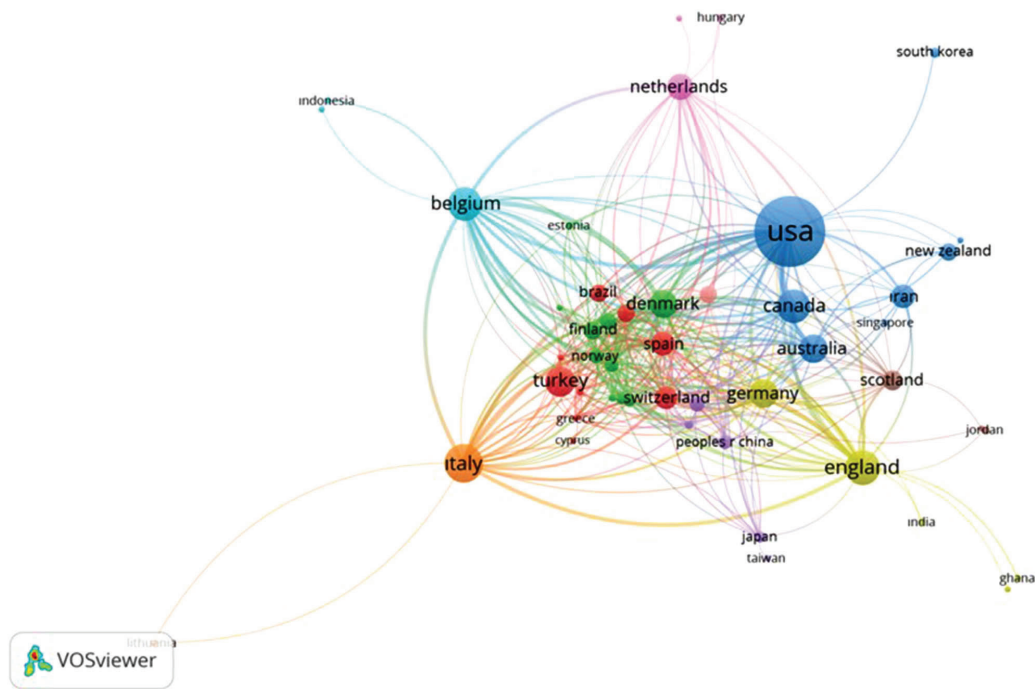
**Graph 1:** Analysis of publications by years.

In the last thirty-five decades, articles on MS rehabilitation and exercise have been published in fifty-four countries. The number of articles from fifty-four countries that have published studies on this subject is shown in

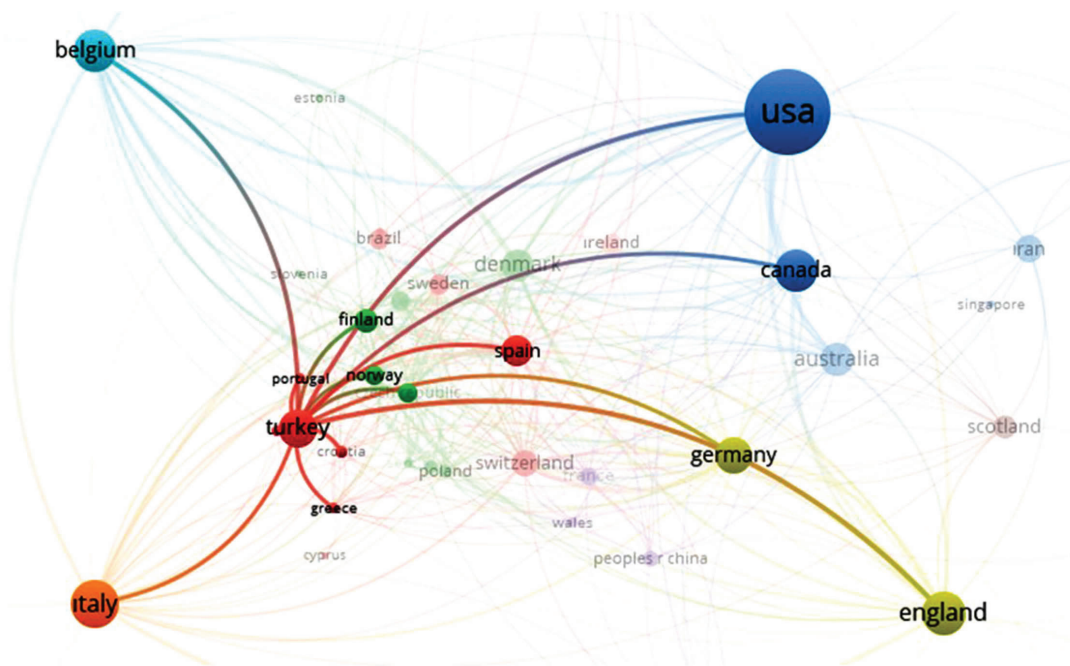
Figure 1. Countries publishing the study appear to be in collaboration with other countries and are shown in these figures. Turkey has an important place in this list (Fig.2).



**Graph 2:** Analysis of publications by top twenty countries.



**Figure 1:** Bibliometric analysis of publications by countries and collaborating countries



**Figure 2:** Bibliometric analysis of publications for Turkey and collaborating countries

Considering the number of publications in MS rehabilitation and exercises, the United States (377) ranks first with the highest number of articles, followed by Italy (115) and England (94). Turkey ranks sixth with 70 publications and 986 citations. Network visualization of co-authoring relationship between countries was analyzed using VOSviewer software. Countries with at least 3 citations and 3 articles were

included and 54 countries met the threshold.

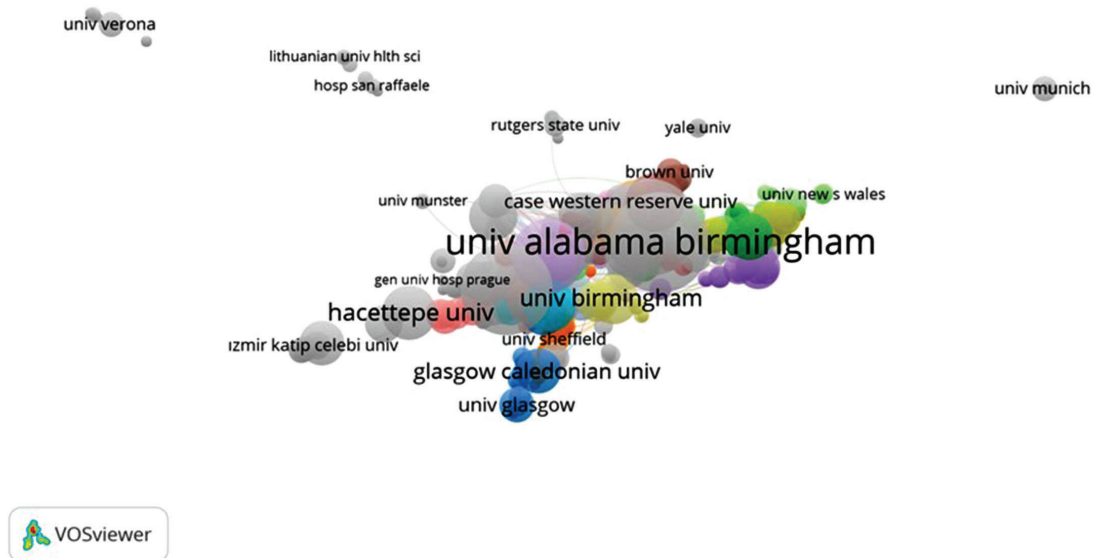
As in Figure 1, the United States is at the center of research on MS rehabilitation. It has close relations with Italy, England and Canada. There are also important research relations between other countries such as Turkey, USA, Italy and England.

#### **Analysis of Publications by Institutions**

According to the distribution of

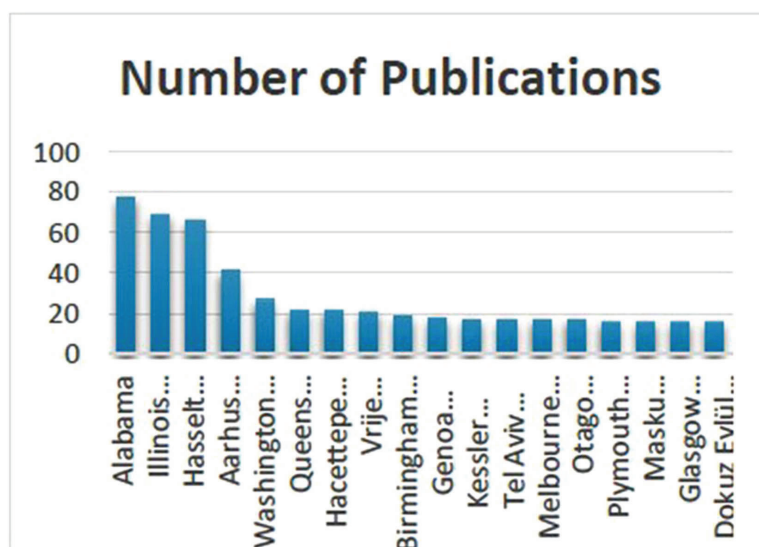
of institutions, a total of 1179 institutions or organizations published articles between 1986 and 2021, and institutions, mostly from the United States, actively participated in MS-related research. The top 18 institutions and organizations are listed in Table 1. Among them, 4 institutions from the United States and 3 institutions from the UK, 2 from Turkey. There is 1 institution from Australia, Belgium, Denmark, Finland, Netherlands, Italy, Israel, Canada and New Zealand. The University of Alabama Birmingham

contributed the most with 77 articles, followed by the University of Illinois (69 articles) and Hasselt University (66 articles). (Table 1). Regarding citations, the University of Illinois ranks first with 1906 citations. Hacettepe University ranks 7th with 22 articles. Dokuz Eylül University is in the 17th place with 16 articles. In the analysis, the thickness of the cross-country line shows the intensity of co-authorship cooperation between institutions or organizations (Fig.3).



**Figure 3:** Bibliometric network analysis of publications by institutions.

**Table 1:** Bibliometric network analysis of publications by institutions.



### Research Categories and Article Types

There are 83 journal categories for MS articles, including rehabilitation (522), clinical neurology (312), neuroscience (169), and sports science (157) (Fig.4).

Considering the increasing clinical applications, Science Citation Index Expanded (SCI-EXPANDED) (941), Social Sciences Citation Index (515), Emerging Sources Citation Index (87) are formed.

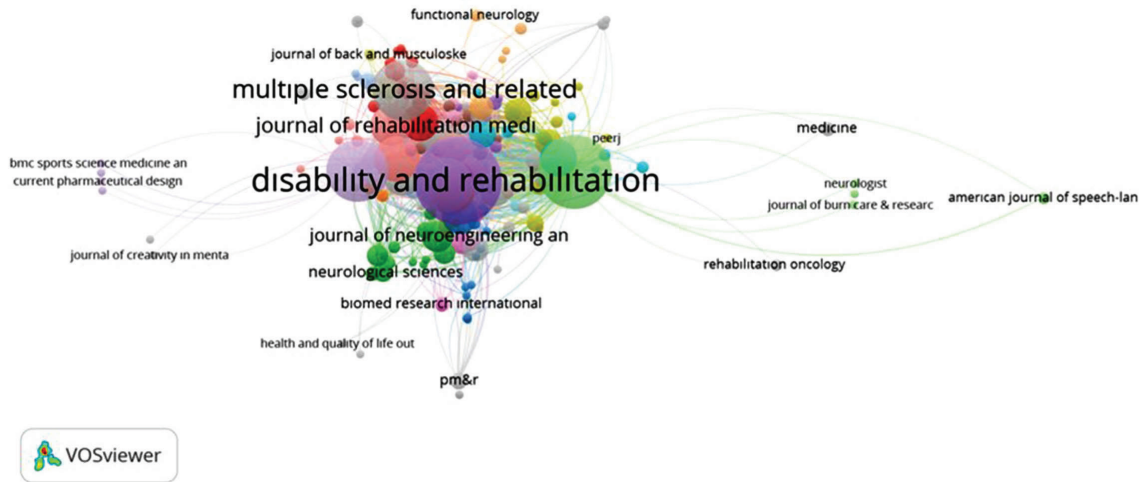


Figure 4: Distribution of publications by journals.

### Top 5 Active Authors and 10 Most Cited Articles

As seen in Figure 5, the most active authors in the field of MS were taken from the WoS database and analyzed. Robert W. Motl from the USA is the largest contributor among the authors, with 96 articles and 1178 citations (12). From Turkey, İdiman E. 10

articles with 14 citations (13), Kara B. 5 articles with 14 citations (14), Özakbaş S. 5 articles with 10 citations (15) contribute to this list (Fig.5). When the citation numbers of the publications were analyzed, Kurtzke J.F (16). He is the author with the highest number of publications with 283 citations (Fig.6).

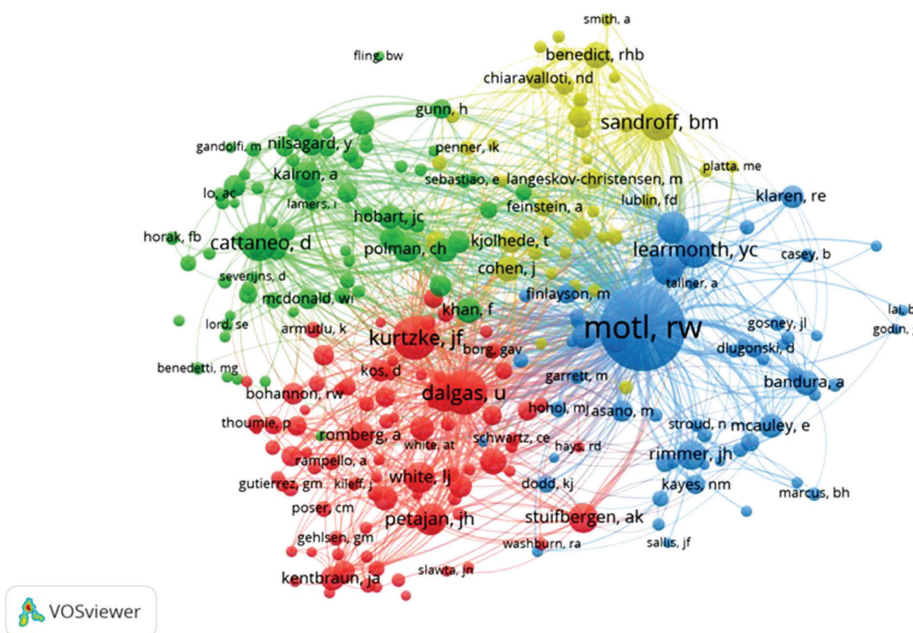
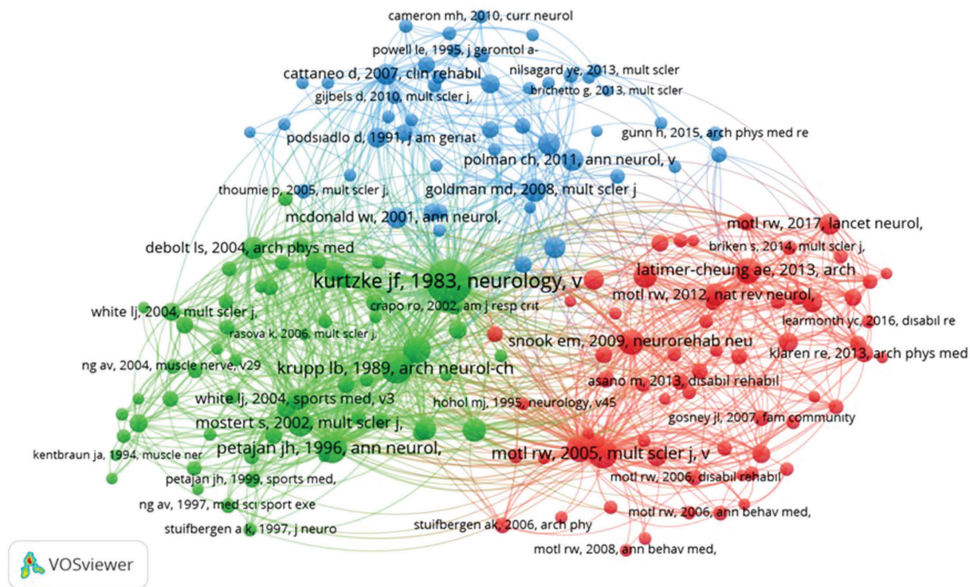


Figure 5: Network analysis of publications by researchers.

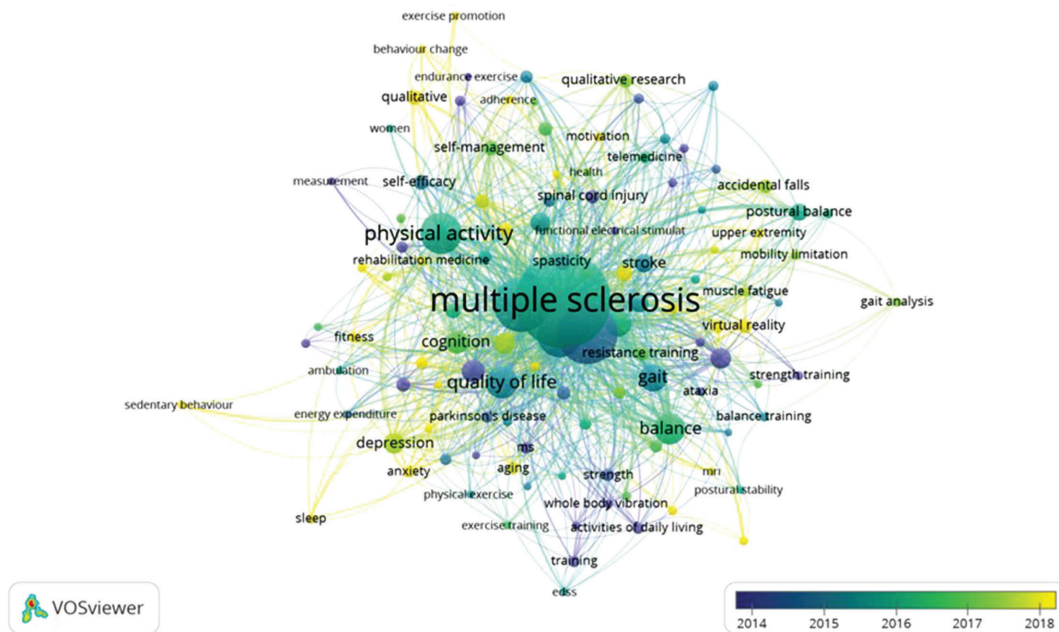


**Figure 6:** Network analysis by citation numbers of publications.

### Keyword Analysis

MS-related keywords in the literature were analyzed with the VOSviewer software. The results showed that "multiple sclerosis", "rehabilitation" and "exercise" were the most common keywords. A total of 115 keywords

were found as the most used keywords in 35 years. In order to better understand the change of research keywords over time, the change of the most frequently used keywords was observed each year (Fig.7).



**Figure 7:** Keywords used together with Multiple Sclerosis, rehabilitation and exercise.



## Discussion

The aim of this study is to make an evaluation by analyzing it with the scientific mapping method for MS rehabilitation. The biggest problem for researchers when starting a scientific study is how popular the research area is or what topics the researches focus on. To answer these questions, we conducted a worldwide bibliometric analysis of MS between 1986 and 2021. As a result of the analysis, it has been observed that the number of publications in the field of MS increases every year. Especially in the last 13 years (2009-2021), the number of publications has increased. Shafin et al. (2022) examined the articles published between 2012-2021 with the search title "multiple sclerosis" and found that the keyword 'covid-19' was frequently used (8). It is thought that the pandemic had an effect on the publication of the most articles between 2018-2021. This study will provide support to researchers in the choice of MS- related topics and will guide them in finding suitable teams and research platforms that can closely follow the international situation of MS.

When the publications are analyzed in terms of country distribution, it is clearly seen that the United States of America ranks first with the highest number of articles on MS. With a more detailed analysis of each country's annual publications, it is seen that the number of publications in Turkey is not to be underestimated. This result shows that studies on MS are in the focus of attention of Turkish researchers. Idiman E., Kara B., Ozakbas S. from Turkey contribute to this list.

However, no study was found in which Turkish researchers collaborated with authors from other countries in the field of MS. Generally, studies have been limited to

Turkey. From the network visualization of the co-authorship relationship between countries or organisations, it appears that US institutes are at the center of MS and are collaborating with institutes from Italy, England, Canada and Germany. Another remarkable issue is that the number of studies on MS from countries such as Mexico, Finland, India and Egypt is limited to one or two studies. Among the articles published in the journals in WoS, the most cited publications were examined and Oken's study named "Randomized controlled trial of yoga and exercise in multiple sclerosis" received three hundred and sixty-two citations (17). In the journal analysis, Disability and Rehabilitation is in the first place with 105 publications. The majority of these publications consist of research articles and systematic reviews. When the study is examined in terms of keywords, in the last 5 years, the keywords "telerehabilitation", "virtual reality", "neuroplasticity", "qualitative research" and "accidental falls" have been used more and more. This gives the impression that the symptoms of MS are increasing. In terms of research categories, MS is a multidisciplinary research area with internal medicine, occupational health and safety, engineering.

### Limitation

The findings of this study are limited to the WoS database only. To determine the research productivity of research in the field of MS, researchers can focus on examining research outputs in other databases.

Since the bibliometric analysis program used could not make any changes on the outputs, some typing differences had been emerged in some figures.

## Conclusions

This detailed bibliometric analysis in the MS field showed that scientific output has shown an increasing graph since 1986. In addition, it has been observed that Turkish

researchers have a significant number of studies on this subject and are increasing gradually. Although there are high-quality publications, there is a need to increase both

the quality and quantity of scientific articles in order to increase the high citation numbers and average citations. This study also recommends that Turkish researchers expand their research cooperation internationally in order to improve and develop their scientific results.

**Supporting Organization:** No support was received from any organization for this study.

**Conflict of Interest:** There was no conflict of interest among the authors in this study.

**Ethical Approval:** Ethics committee was not obtained for this study because the data were obtained from Web of Science, a

publicly available system.

**Note:** Because of the output style of software used in bibliometric analysis, the words that should start with a capital letter (upper case), appear in lower case and also there are some typing errors in labels in some of the figures. We could not make correction on figures about both of these problems.

**Author Contributions:** Concept- GD, FE, GY; Design- FE, GD; Supervision- FE,GY,GD; Sources- FE,GY,GD; Materials- GD; Data Collection and/or Processing- GD, FE, GY; Analysis and/or Interpretation- GD, FE; Literature Search- GD; Article Writing- GD; Critical Review; GD, FE, GY.

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