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## Bibliometric Analysis of Studies in The Field of Knee Osteoarthritis in Women

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#### ABSTRACT:

**Purpose:** Knee osteoarthritis is a degenerative disease characterized by joint pain, stiffness, and limited movement, accompanied by damage to the articular cartilage. Osteoarthritis (OA) is the most common type of arthritis, and the knee is the most frequently affected joint. Several risk factors, such as age, gender, and body mass index, contribute to the development of knee osteoarthritis. The incidence of osteoarthritis is twice as high in women as in men. Our study aims to analyze all the scientific articles related to knee osteoarthritis in women, indexed in the Scopus database, and the data were downloaded from the database on October 31, 2023.

**Material and Methods:** Bibliometric analysis is a type of content analysis conducted to obtain frequency and citation analysis of articles using various parameters such as topics, methods, and references. The data in this study were analyzed using the VoSviewer and Biblioshiny software programs.

**Results:** Our study included 4254 articles from the literature. The United States is the leading contributor in terms of the number of articles, and Germany is the country with which the United States has the most international collaboration. Notably, "Boston University" stands out as the institution with the most productive research output in this field. Felson DT. is the most prolific author with 118 publications. The most frequently used keywords include "women," "male," and "aged."

**Conclusion:** The findings of this study are valuable for anyone interested in gaining insights into potential future developments regarding knee osteoarthritis in women. Ultimately, this research provides a roadmap for future studies related to knee osteoarthritis in women.

Keywords: Osteoarthritis; knee; bibliometric; pain; women

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#### INTRODUCTION

Osteoarthritis (OA) is a degenerative disease characterized by progressive cartilage destruction, osteophyte formation, subchondral sclerosis, and a series of biochemical and morphological changes in the synovial membrane and joint capsule, especially in load-bearing joints under the influence of genetic, mechanical and biochemical factors (Li et al., 2019). The knee is the most commonly symptomatically involved joint in OA (Hedbom and Häuselmann, 2002). OA is the most common form of arthritis worldwide, often affecting the elderly population, leading to erosion of articular cartilage, osteophyte formation, and subchondral sclerosis (Bilge et al., 2018). In epidemiological studies conducted in various regions of the world, it has been reported that 10-30% of people over the age of 65 have symptomatic knee OA (Hedbom and Häuselmann, 2002). In adults over 55 years of age, the prevalence of symptomatic knee OA was found to be 13% (Magnusson et al., 2019). The Framingham OA study reports a prevalence of 11% in women and 7% in men. Interestingly, not everyone with radiographic signs of knee OA will be symptomatic. One study found that only 15% of patients with radiographic findings of knee OA were symptomatic. In a

prevalence study conducted in Türkiye, the prevalence of symptomatic knee OA in the population aged 50 years and older was 14.8%, reported as 22.5% in women and 8% in men (Magnusson et al., 2019).

There are many risk factors that cause QA. There are many risk factors that cause OA, including age, gender, muscle weakness, lack of physical activity, smoking and other diseases. OA is the most common chronic disease in older people; more than 80% of people over the age of 75 are affected. Development in women is twice as high as in men. Gender differences in the incidence of OA after the age of 50 may be due to postmenopausal estrogen deficiency. The fact that articular chondrocytes have functional estrogen receptors suggests that these cells are controlled by estrogen.

A high body mass index has been associated with an increased risk for knee OA in men and women. In addition to increasing the load on joints, obesity also impairs joint biomechanics by altering posture, gait, and physical activity levels. In most obese patients, varus deformity occurs in the knee joint, causing increased reactive loading in the medial compartment of the knee and leading to acceleration of the degenerative process (Bilge et al., 2018). Weakness in the quadriceps muscle has been found to be effective in the initiation and acceleration of knee OA. Impairment of proprioception due to damage to mechanoreceptors in the joints is a risk factor for OA.

The risk of OA increases even in normal joints when sufficient and appropriate exercise is not performed. (Uysal et al., 2009). In addition to the views that smoking increases the risk of OA, there are also views that nicotine increases the GAG and collagen synthesis activity of chondrocytes at physiological levels (Kisand et al., 2018). A relationship between OA and hypertension, hyperuricemia, and diabetes mellitus has been found independent of obesity. Decreased sensory stimuli as a result of impaired joint nutrition in diabetes mellitus predispose to the development of secondary OA (Tuna, 1994).

Treatment of knee OA can be divided into surgical and non-surgical management. The first treatment starts with non-surgical methods and when these methods are no longer effective, surgical treatment is started. There are many non-surgical methods that can be used in the treatment of knee OA. These interventions do not change the underlying disease process, but can significantly reduce pain and disability (Collins et al., 2019).

Physiotherapy is frequently used especially in large joints such as the hip and knee and in moderate OA of the spine. Physical therapy and rehabilitation aim to reduce pain and stiffness, relieve muscle spasm, and strengthen periarticular structures. Thus, the functional capacity of the patient increases and the quality of life improves (Atay, 2000). Exercise is the most commonly applied physical therapy method. The exercise program aims to maintain the joint range of motion, reduce pain and disability by strengthening the muscles, and improve joint stability and aerobic capacity (Kuru, 2002).

The subject of osteoarthritis in women has been the subject of research from many perspectives. The aim is to make a bibliometric analysis of osteoarthritis in women in terms of topics, countries, and keywords used by researchers. Our study aims to analyze all the scientific articles related to knee osteoarthritis in women, indexed in the Scopus database, and the data were downloaded from the, database on October 31, 2023. In this way, academics, orthopedists, physiotherapists and health professionals interested in this subject will be able to easily access these publications.

#### **Literature Review**

No bibliometric analysis study on OA was found in the Scopus database. Our study is the first bibliometric analysis study in the field of OA. However, 6 articles containing some common keywords are given in Table 1 below.

With this study, gaps in the field of OA will be identified and the following questions will be answered.

- Who is the most cited and published author on OA?
- Which is the most cited journal, article, university, and country on the subject?
- What are the most popular topics on the subject?
- Which countries are working together on the subject?

No bibliometric analysis of OA in women was performed in this study.

Authors	Year	Keyword	Period	Number of Publications Reviewed	Database	Software Used
Y Lu and friends	2023	Genetic factors; Osteoarthritis	2014-2023	1127	Web of Science	R package
Yao Yang and friends	2023	Patellofemoral arthroplasty, Osteoarthritis, Knee	1950-2022	503	Web of Science, Pubmed, Medline, Springer	VOSviewer, Bibliometrix, Citespace,
S Cao and friends	2023	Ferroptosis, Musculoskeletal diseases	2012-2023	523	Web of Science	VOSviewer, CiteSpace, R package
Jisu Lee and friends	2023	Acupuncture, Osteoarthritis	2003-2022	380	Web of Science	VOSviewer
Septiana Indratmoko and friends	2023	İcariin, Pharmacology	2010-2021	1116	Scopus	VOSviewer, R-Studio
Present Study	2024-?	Osteoarthritis, Knee, Pain, Women	1997-2024	4254	Scopus	VOSviewer Biblioshiny

#### Table 1. Bibliometric Analyses Performed in OA

#### MATERIALS AND METHODS

Three steps are applied during bibliometric analysis (Demir et al., 2024). While performing bibliometric analysis, firstly, any of the databases such as Scopus, Web of Science, and Pubmed are preferred and the data are prepared for downloading. In this process, some filtering criteria were used while downloading the data. The data were downloaded from the relevant database on 31.10.2023. Then, by filtering in the preferred database, csv.csb file extensions are downloaded from the preferred databases. In the next step, performance analysis and scientific mapping analysis are decided for the bibliometric analysis. In the last step, it is decided to use software such as RStudio, VOSviewer, and CiteSpace to perform all these analyses. In the study, the Scopus database was preferred for the first step. In the second step, Scopus was filtered as article as document type, journal as publication type, and English as publication language. Biblioshiny and VOSviewer software programs were used for the analyses.

#### RESULTS

## **Performance Analysis**

Biblioshiny outputs were used for descriptive analysis of publications. For this purpose, annual publication increase and several citations were analyzed. Using the triple diagram, the most published author, the most cited journal, and the most frequently used keywords were analyzed. In addition, performance analysis was made with the information of the most published author, the most productive country, and the most cited university.

#### **Statistical Analysis**

Basic statistics for the study are given in Table 2. In Table 2, 4254 articles downloaded from Scopus with the keywords "osteoarthritis" and "women" have 15310 authors in the articles examined in the 1957-2023 time interval. 74 of these authors wrote articles alone. The average annual number of citations to the articles is 34. In addition, the average age of the articles is 9.11 years.

#### **Annual Increase In Publications**

The change of "Osteoarthritis in women" studies over the years generally tends to increase. 239 articles were published in 2023, 247 articles in 2022, and 290 articles in 2021.

#### **Average Annual Status Of Citations**

It can be said that the citations of the publications on "osteoarthritis in women" vary by year. The annual citation status is 0.42 in 2023, 1.12 in 2022, 1.57 in 2021, 2.28 in 2020, 2.53 in 2019, 3.09 in 2018, 3.28 in 2017, 2.66 in 2016, 3.21 in 2015, 2.94 in 2014.

## Sankey Diagram

The three variables desired to be associated were set in the options section of the biblioshiny program and the best of each parameter was specified. According to this, the country that has the most work in the field of OA in women is the USA. Authors named Felson DT. and Guermazi A. gave the most works. Finally, osteoarthritis and knee are the most important words in the literature.

# **Analysis Of Journals**

In the field of OA and knee, "Osteoarthritis And Cartilage" ranks first with 285 articles, "Arthritis And Research" ranks second with 184 articles, and "Bmc Musculoskeletal Disorders" ranks third with 119 articles.

## **Universities With The Most Publications**

When the results of the biblioshiny application were analyzed by downloading the data to the universities to which the authors working on the keywords "osteoarthritis and knee" were affiliated, the university with the highest publication content was determined as "Boston University" with 337 publications, followed by "Lund University" in the second place with 281 publications and "Monash University" in the third place with 229 publications.

# **Most Important Authors**

Felson DT. ranks first with 118 studies, Eckstein F. ranks second with 89 studies, Nevitt MC. ranks third with 86 studies.





#### Figure 1. Most Productive Countries

#### Table 2. Determinant Statistics

#### **Most Productive Countries**

In this analysis, the most productive countries and the cooperation map between these countries are analyzed.

The density map of countries working with the keywords "osteoarthritis and knee" is shown in Figure 1. In the map, dark blue-colored regions are the regions with many publications, blue-colored regions are the regions with fewer publications and grey-colored regions are the regions with no publications in this field.

According to their productivity, countries can be

ranked as follows; The United States of America (USA) ranks first with 5913 articles, Japan ranks second with 2502 articles, and the UK ranks third with 1468 articles.

Collaboration between countries publishing with the keywords "osteoarthritis and knee" is shown. It is shown in Table 3.

From the USA, there are 89 co-operations with Germany, 85 with the UK, 82 with Australia, 65 with Canada, and 58 with Sweden. Germany, which ranks sixth in terms of cooperation, has 47 co-operations with Austria.

FROM	то	FREQUENCY
USA	GERMANY	89
USA	UNITED KINGDOM	85
USA	AUSTRALIA	82
USA	CANADA	65
USA	SWEDEN	58
GERMANY	AUSTRIA	47
USA	AUSTRIA	40
UNITED KINGDOM	AUSTRALIA	35
AUSTRALIA	GERMANY	34
USA	CHINA	33

#### Table 3. Cooperation Between Countries

#### **Most Cited Articles**

The most important article is the one with the most citations. Accordingly, the ten most important articles are given in Table 4. The article "Radiological Assessment of Osteo-Arthrosis" by JH Kellgren (1957) published in "Annals of the Rheumatic Diseases" is the most cited article with 278 citations.

## **Countries With The Most Publications**

The USA ranks first with 31827 citations, the United Kingdom ranks second with 11072 citations, and Sweden ranks third with 8594 citations.

## **Scientific Analysis Of Publications**

Scientific mapping is the application of computational techniques as a whole to visualize, analyze, and model various scientific and technical activities with scientific maps (Demir et al., 2024a, Demir et al., 2024b).

#### **Conceptual Structure Map**

In this section, factor analysis, conceptual map based on the author's keyword, trending topics, tree map, and thematic map are presented. Figure 2 shows the map of the factor analysis.

According to the results of factor analysis, five important words in the literature in the red cluster are "osteoarthritis", "obesity", "adult", "body mass", "and prevalence". The second important words in the blue cluster in the literature are "knee replacement", and "knee".

#### **Thematic Map**

The thematic search of the articles "Osteoarthritis" refers to keywords used by the most important authors in the field.

In the literature, "human", "female", "article" are motor themes. Basic themes "body mass", "knee radiography", "cohort analysis". Niche theme is " arthroplasty", "replacement", "knee", "knee replacement" and "retrospective study". Emerging declining theme is "knee joint", "knee", "treatment outcome".

## **Trending Topics**

The most important words in the articles containing the words osteoarthritis, and knee in the literatüre between 1957 and 2024 are as follows: The word osteoarthritis was used 3419 times in the literature. It was the most-used word in the first quarter of 2010, the second quarter of 2016, and the third quarter of 2020. The word female was used 7082 times in the literature. It was used in the first quarter of 2010, the second quarter of 2015, and the third quarter of 2019.

The size of the rectangles in the treemap indicates the number of publications of the keyword used. The treemap of the keywords osteoarthritis and knee is given in Figure 3.

## Table 4. Most Cited Articles

KELLGREN J.H., LAWRENCE J.S., RADIOLOGICAL ASSESSMENT OF OSTEO-ARTHROSIS, ANN RHEUM DIS, 16, PP. 494-502,	278
(1957)	210
BELLAMY N., BUCHANAN W.W., GOLDSMITH C.H., CAMPBELL J., STITT L.W., VALIDATION STUDY OF WOMAC: A HEALTH STATUS INSTRUMENT FOR MEASURING CLINICALLY IMPORTANT PATIENT RELEVANT OUTCOMES TO ANTIRHEUMATIC DRUG THERAPY IN PATIENTS WITH OSTEOARTHRITIS OF THE HIP OR KNEE, J RHEUMATOL, 15, PP. 1833-1840, (1988)	187
KELLGREN J.H., LAWRENCE J.S., RADIOLOGICAL ASSESSMENT OF OSTEO-ARTHROSIS, ANN RHEUM DIS, 16, 4, PP. 494-502, (1957)	99
ROOS E.M., LOHMANDER L.S., THE KNEE INJURY AND OSTEOARTHRITIS OUTCOME SCORE (KOOS): FROM JOINT INJURY TO OSTEOARTHRITIS, HEALTH QUAL LIFE OUTCOMES, 1, (2003)	66
KELLGREN J.H., LAWRENCE J.S., RADIOLOGICAL ASSESSMENT OF OSTEOARTHROSIS, ANN RHEUM DIS, 16, PP. 494-502, (1957)	63
BELLAMY N., BUCHANAN W.W., GOLDSMITH C.H., CAMPBELL J., STITT L.W., VALIDATION STUDY OF WOMAC: A HEALTH STATUS INSTRUMENT FOR MEASURING CLINICALLY IMPORTANT PATIENT RELEVANT OUTCOMES TO ANTIRHEUMATIC DRUG THERAPY IN PATIENTS WITH OSTEOARTHRITIS OF THE HIP OR KNEE, J RHEUMATOL, 15, 12, PP. 1833-1840, (1988)	62
INSALL J.N., DORR L.D., SCOTT R.D., SCOTT W.N., RATIONALE OF THE KNEE SOCIETY CLINICAL RATING SYSTEM, CLIN ORTHOP RELAT RES, 248, PP. 13-14, (1989)	59
ALTMAN R., ASCH E., BLOCH D., BOLE G., BORENSTEIN D., BRANDT K., ET AL., DEVELOPMENT OF CRITERIA FOR THE CLASSIFICATION AND REPORTING OF OSTEOARTHRITIS: CLASSIFICATION OF OSTEOARTHRITIS OF THE KNEE, ARTHRITIS RHEUM, 29, PP. 1039-1049, (1986)	58
FELSON D.T., ZHANG Y., AN UPDATE ON THE EPIDEMIOLOGY OF KNEE AND HIP OSTEOARTHRITIS WITH A VIEW TO PREVENTION, ARTHRITIS RHEUM, 41, PP. 1343-1355, (1998)	54
BELLAMY N., BUCHANAN W.W., GOLDSMITH C.H., CAMPBELL J., STITT L.W., VALIDATION STUDY OF WOMAC: A HEALTH STATUS INSTRUMENT FOR MEASURING CLINICALLY IMPORTANT PATIENT RELEVANT OUTCOMES TO ANTIRHEUMATIC DRUG THERAPY IN PATIENTS WITH OSTEOARTHRITIS OF THE HIP OR KNEE, JOURNAL OF RHEUMATOLOGY, 15, 12, PP. 1833-1840, (1988)	50



Figure 2. Factor Analysis Graph



Figure 3. Tree Map



Figure 4. Keyword Network Map

According to the treemap in Figure 3, the size of the rectangles indicates the frequency of the keyword used. Female was used 10%, male 7%, aged 7% in the literature.

## **Author-Keyword Network Map**

A keyword is defined as a word or group of words in an article. It is presented as a cluster using the most common form of keywords in the articles. For this, keyword network map analysis from VOSviewer software is given in Figure 4.

"Osteoarthritis" ranks first with 811 links and 1604 citations, "Knee" ranks second with 189 links and 540 citations, and "Female" ranks third with 119 links and 364 citations.

Osteoarthritis, knee, and total knee arthroplasty are

the three most important keywords respectively. Previously used keywords such as osteoarthritis, knee, and total knee arthroplasty are keywords that have been extensively studied in the 2012-2017 period. It can be said that keywords such as plateletrich plasma, adipokines, and total hip arthroplasty have also been widely used in the literature recently.

## DISCUSSION

Publications related to OA and the knee are constantly increasing. Scopus database was used to perform bibliometric analysis of these increasing studies. Initially, 4254 English articles published in journals were filtered and downloaded from the database. The annual growth rate of publications was 9.31%, the average age of articles was 10.1 years and the average citation per document was 34. 74 of 15310 authors published alone. International co-authorship in terms of authors' collaboration in documents is 20.1%.

According to the Sankey diagram, the most published country is the United States of America, the most published author is Felson DT., and the most used word is Female.

It is the first bibliometric study to examine OArelated works to identify reference works, countries, and academic disciplines of the most prolific authors. Since most of the articles are open access, a large number of authors emerge as the subject progresses and contributions spread rapidly and widely. According to previous research, the USA, England, and China are the countries that have produced the most work in this field.

The most important document is the study "Radiological assessment of osteoarthrosis" by Kellgren J.H. published in the journal "Annals of the Rheumatic Diseases". The journal with the highest number of publications is "Osteoarthritis And Cartilage". According to the research, "Boston University" has the highest number of publications among the institutions or universities to which the authors are affiliated. "Felson DT." is the most published author.

The results of the study showed that different colors for keywords created different keyword clusters."Osteoarthritis, knee, and total knee arthroplasty" were the most frequently used keywords.

In this study scientific maps were used to provide a detailed broad overview of the main trends and results in OA-related research, using main themes, trending topics, and conceptual constructs (factor analysis) that delimit how an author's work is influenced. According to the result of the factor analysis, the five most important words in the literature in the red cluster are "osteoarthritis", "obesity", "adult", "body mass", "and prevalence". The second important words in the blue cluster in the literature are "knee replacement", and "knee".

As a result of the analysis performed to determine the themes in which keywords are used in the literature, "female", "osteoarthritis", and "knee" as the basic theme, "arthroplasty", "replacement", "knee" as the niche theme/emerging declining theme, "knee joint", "knee", "treatment outcome" as the emerging declining theme/basic theme. It is the most-used word in the first quarter of 2016, second quarter of 2018, and third quarter of 2019. They are still the most popular words in 2023.

To the authors' knowledge, this is the first bibliometric analysis of OA-related literature published between 1957 and 2023. This study focused on publications indexed in the Scopus database with words related to osteoarthritis and females used in orthopedic studies.

## CONCLUSION

This study investigated and evaluated worldwide scientific achievements in OA research using data from the Scopus database. The current top researchers were identified and publications were mapped according to regional distributions and keywords. The most prolific country in terms of number of articles is the USA, and the most prolific author is Felson DT. The most cited journal for publications related to keywords is 'Osteoarthritis And Cartilage'. OA is the most important keyword used by the authors.

By summarizing in depth the research on OA in women, we hope that our findings will guide additional research directions and perspectives. Several implications for future research are drawn.

This research provides valuable data on keyword evaluation of the most influential sources, most

influential authors, most influential links, most influential countries, and most influential studies in the existing literature. Researchers and practitioners have the option to choose which articles to reference, which articles are most relevant, and which articles have the most impact on OA.

This bibliometric review of studies on oOA and the knee provides a comprehensive overview of past and current research and may help identify future research directions.. The findings of the study reflect the state of research on OA and knee. It also provides researchers with a comprehensive understanding of OA and the knee as a reference point.

By making use of citation analyses, researchers can identify the different research streams or fields that make up their intellectual structure, allowing them to identify themes and knowledge. Depending on the area of interest, it is possible to identify gaps in the literature and potential research methods.

This research provides academics, orthopedists, physiotherapists, health professionals interested in this subject and students with important up-to-date information that they can apply in their future studies within the scope of keywords.

Although the Scopus database is the main focus of this study, other sources such as Web of Science, Cochrane Library, Dimensions, and Pubmed are also available. A potential next step is to design and build graphical tools that present more data and cover more domains.

## LIMITATIONS

The limitation of this article was the scanning of articles up to October 2023 and the interpretation of the results. New analyses can be made by including studies from recent years.

## **Conflict of Interest**

The authors declare no conflict of interest.

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