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ARTIFICIAL INTELLIGENCE IN RHEUMATOLOGY

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Abstract

Aim: In the field of rheumatology, spectacular advances have been observed in digital health technologies, including electronic health records, virtual visits, mobile health, wearable technology, digital treatments, artificial intelligence (AI), and machine learning.

Material and Methods: We conducted bibliometric analysis in the field of "AI in rheumatology". The entire bibliometric study was conducted on 16.01.2023. The Web of Science (WoS) database was scanned from 1975 to 2023. The data were accessed by typing the keyword "AI" in the first line of the research row (406.807 documents) and adding the keyword "rheumatology" in the second line (146 documents). A total of 146 publications were analyzed. The data were analyzed as publication year, document types, authors, WoS category, affiliation, publication titles, countries/areas, publishers, and citation report (number of total citations, number of cited articles, and h-index).

Results: In this field, 40 (27.3%) articles were published in 2022, 29 (19.8%) in 2021, 30 (20.5) articles in 2020, and 17 (11.6%) articles in 2019. Document types were; article (n=65/44.5%), meeting abstract (n=35/23.9%), review article (n=34/23.2%) etc. According to the WoS category, 73.2% were in rheumatology, 6.8% were in Medicine General Internal, 5.4% were in Computer Science AI, etc... When we look at the total number of articles from countries, the USA (n=35) England (n=28), and Germany (n=19) take the first place. Among 146 publications, the number of cited articles was 1.067 (without self-citations 1.037), times cited was 1.184 (without self-citations 1.124) with h-index=16.

Conclusion: Bibliometric analysis of AI in the field of rheumatology will be useful as it creates awareness and provides an objective perspective to the research field.

Keywords: Artificial intelligence, bibliometrics, rheumatology, bibliometric analysis

INTRODUCTION

Artificial intelligence (AI) refers to the use of computers to model intelligent behavior with minimal human intervention. The development of AI is based on the invention of robots. In the medical field, robots cover a wide spectrum, covering medical definitions, statistics, and human biology. There are two main branches in the field of medicine; virtual and physical. The virtual part includes approaches from controlling health management systems to guiding treatment decisions. The physical branch can be used as surgical assistive devices. The social and ethical complexities of these practices require future reflections, evidence of their medical goals, and revealing of their economic values (1).

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The increase in access to these technologies provides opportunities for important aspects of rheumatology. Growth in access, results, compliance, and research. There is no improved standard practical method for digital health technologies yet (2).

Machine learning is a field of AI that is frequently applied in medicine to help patients and physicians. Sound-based databases are created that provide the machine with learning methods acquired from previous experiences. Machine learning applications that include the patient's opinion and the physician's empirical/experimental suggestions will be developed shortly (3). The wave in which the first AI defeated the world chess champion affected the field of rheumatology and many other medical fields (4).

Bibliometric analysis is the application of mathematical and statistical methods to books and other communication media. In more detailed terms, it provides a quantitative analysis of the publications or documents according to the author, subject, publication information, cited sources, etc... Bibliometric analysis helps us identify the most productive researchers on any subject, among countries and institutions. It allows us to make comparisons and objectively see how scientific communication is carried out in various disciplines (5,6).

The Web of Science (WoS) provides subscription-based access to multiple databases that provide comprehensive citation data for disciplines in different academies. Created by the Institute for Scientific Information, the service is now maintained by Clarivate Analytics (7). In the field of rheumatology, we performed a bibliometric analysis in the WoS database to examine and evaluate the research on "AI". In this way, we aim to compile the current data on "AI in rheumatology" to raise awareness and inspire new research.

MATERIALS AND METHODS

Data Collection

The entire bibliometric study was conducted on 16.01.2023. The WoS database was scanned from 1975 to 2023. The data were accessed by typing the keyword "AI" in the first line of the research (406.807 documents were in the AI field) and adding the keyword "rheumatology" in the second line. A total of 146 publications were analyzed. The data were analyzed as publication year, document types, authors, WoS category, affiliation, publication titles, publishers, and citation reports (number of total citations, number of cited articles, and h-index).

Data were taken from the WoS website. We used the following keywords: "AI" and "rheumatology". A total of 146 publications were analyzed.

Statistical Analysis

Analysis and processes were carried out using WoS graphics and tables. Using Microsoft Excel 2010, the data in the tables were converted to absolute values (percentage and frequency). There were no relative frequencies. There were no sophisticated statistical procedures applied, such as mean, median, model, dispersion measures, standard deviation, or statistical tests. Visualizations from the WoS database were also used. Descriptive statistical methods were used in this study.

RESULTS

A total of 146 articles were reached (1975-2023). Of these, 34 were reviewed, 5 were early access, and 7 were open access. The number of publications by years is shown in bar Figure 1. When we look at the total number of articles from countries, the USA

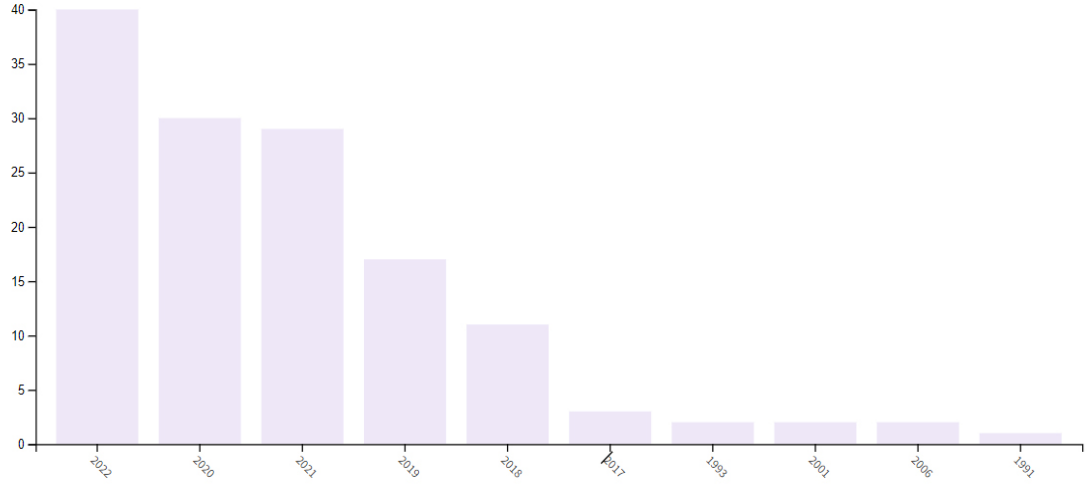

Figure 1. Bar graphs of publications according to years

(n=35), England (n=28), and Germany (n=19) take the first place (Figure 2).

Document types were as follows: article (n=65/44.5%), meeting abstract (n=35/23.9%), review article (n=34/23.2%), editorial material (n=6/4.1%), proceeding paper (n=6/4.1%), early access (n=5/3.4%), correction/addition (n=1/0.6%).

According to the WoS category, 73.2% were in rheumatology, 6.8% in Medicine General Internal, 5.4% in Computer Science AI, 2.7% in Computer Science Interdisciplinary Applications, and 2.7% in Engineering Biomedical (Figure 3).

According to the citation topics meso: 31.5% was in rheumatology; 7.5% was in Computer Vision & Graphics; 3.4% was in Nursing;

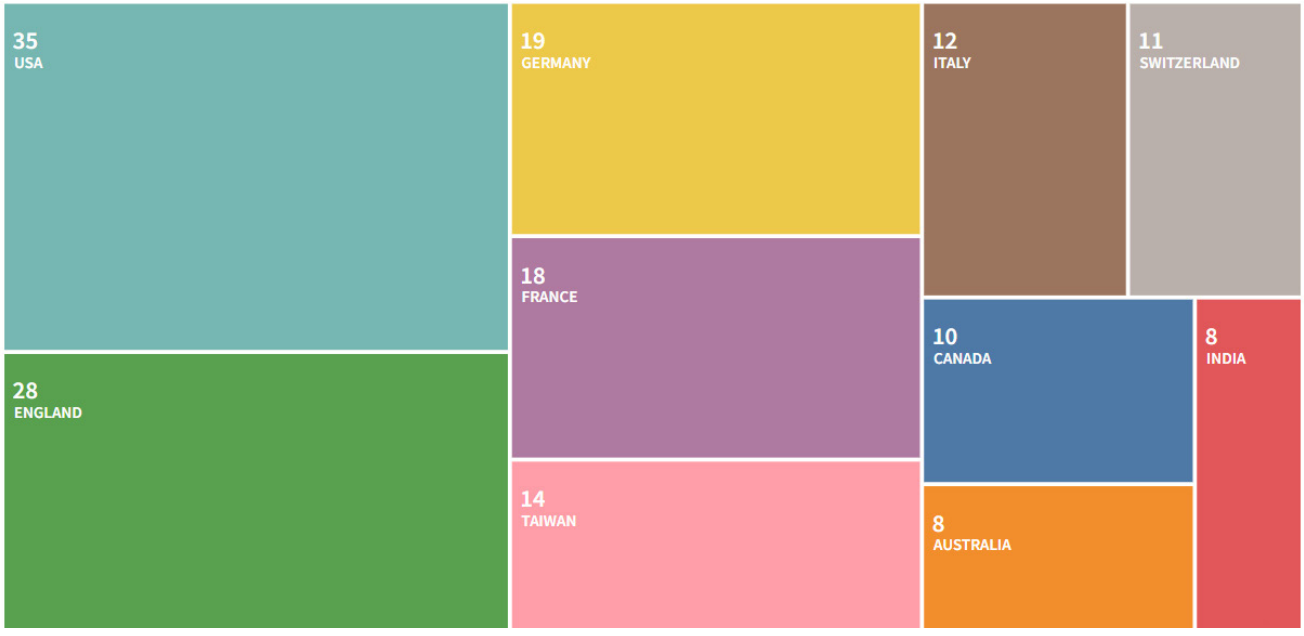

Figure 2. Distribution of documents according to countries/areas

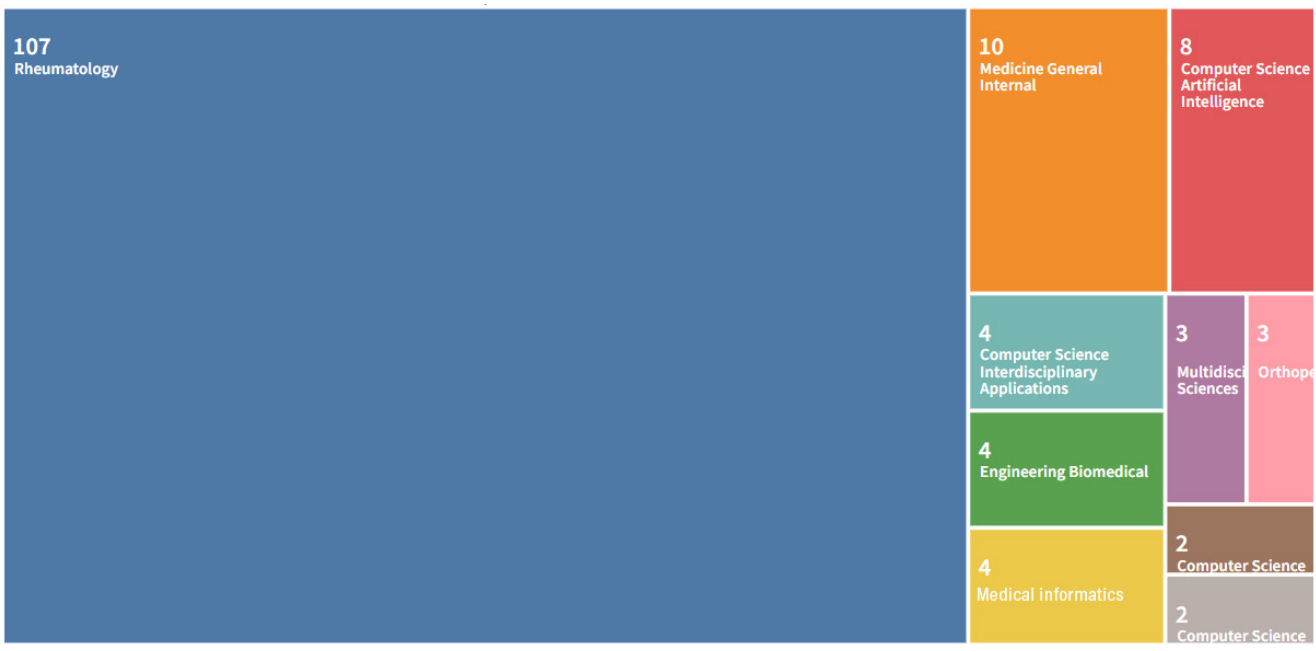

Figure 3. Documents according to the WoS categories
WoS: Web of Science

2.7% was in Orthopedics; and 2.7% was in AI learning (Figure 4). Meso is a level of analysis that examines midrange-sized populations. The top affiliations were as shown in Figure 5.

The characteristics of publication titles are shown in Table 1; publishers in Table 2.

When we look at the countries of the authors with the most articles in this field, Germany, France, and Taiwan take the lead.

Times cited and publications over time are shown in Figure 6. If we look at the graph, an increase in acceleration is seen after 2018.

Among 146 publications, the number of cited articles was 1.067 (without self-citations 1.037), times cited was 1.184 (without self-citations 1.124) with h-index=16.

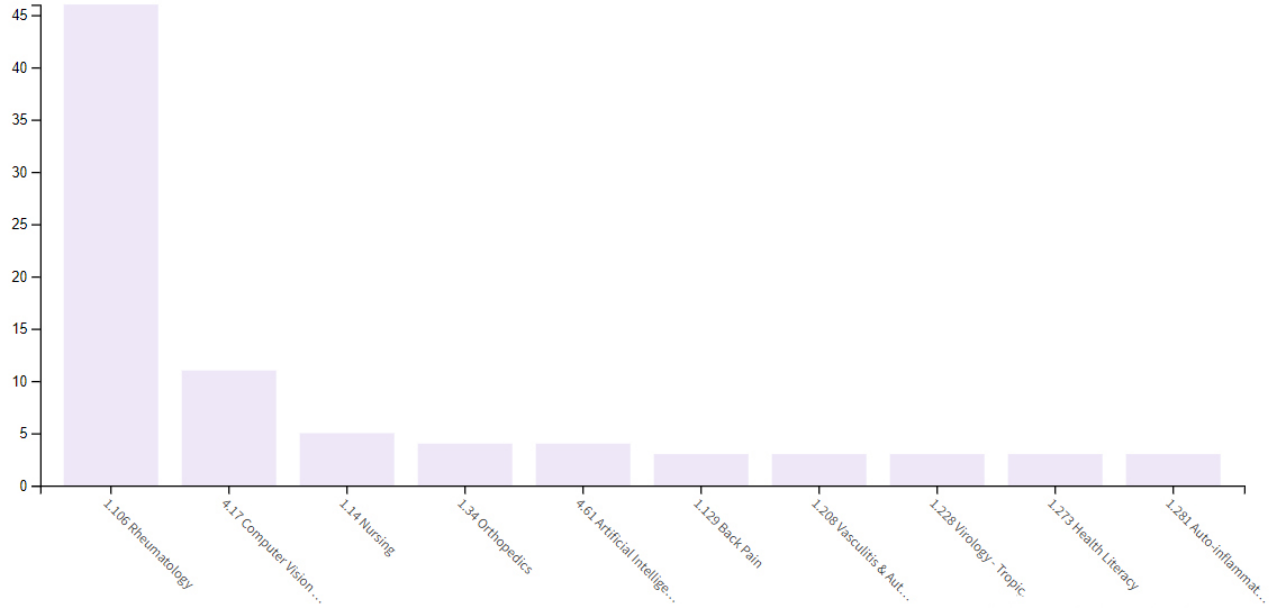

Figure 4. Bar graphs of citation topic meso

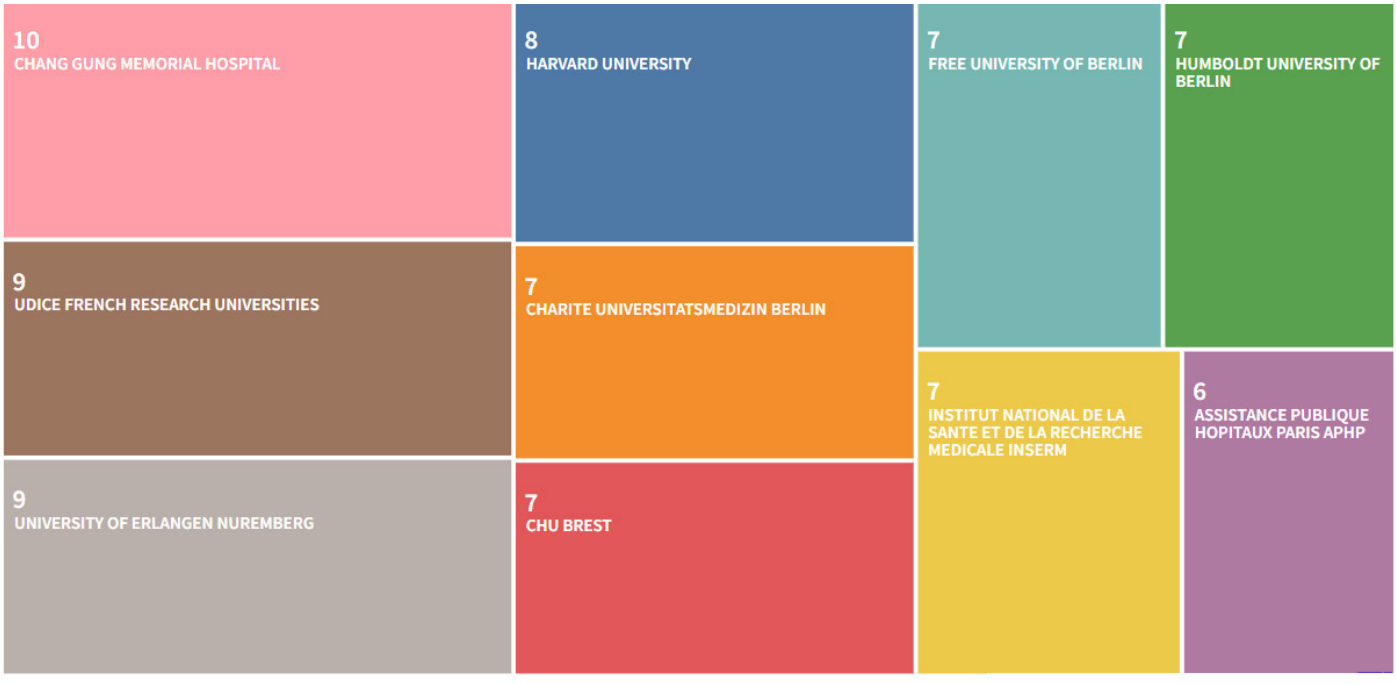

Figure 5. Top affiliations

DISCUSSION

As scientific researches continue at a rapid pace, we should look at them from a broad perspective and compile what we have. Although there are current studies on the use of AI in different areas of rheumatology, bibliometric analysis is few. When we look at our research data, we see that the number of publications in this field has increased in the last decade with the beginning of the digital age. In particular, the increase in the use of the internet and computer technologies throughout the world has also provided its use in the field of health.

Table 1. Characteristics of publication titles

Publication titles	Record count	% of 146
Arthritis Rheumatology	19	13.0
Annals of Rheumatic Diseases	17	11.6
Rheumatology	15	10.2
Clinical and Experimental Rheumatology	6	4.1
Arthritis Research Therapy	4	2.7
Best Practice Research in Clinical Rheumatology	4	2.7
Frontiers in Medicine	4	2.7
Rheumatology and Therapy	4	2.7
Rheumatology International	4	2.7
Clinical Rheumatology	3	2.0

Computer-mediated clinical decision support systems are likely to become more common shortly. The primary aim is to improve the treatment, save time, and reduce the risk of error. These algorithms are already used in the field of rheumatological diseases. Automatic image recognition and prediction of disease in rheumatoid arthritis is the most advanced, but no decision support system is integrated. AI-intermediate decision systems will be hybrid clinical decision systems that include both the expert's and the patient's decision (8,9).

Table 2. Characteristics of publishers

Publishers	Record count	% of 146
Springer Nature	31	21.2
Wiley	21	14.3
BMJ Publishing Group	20	13.6
Oxford Univ. Press	17	11.6
Elsevier	11	7.5
Frontiers Media SA	7	4.7
Clinical and Exper Rheumatology	6	4.1
Mdpi	4	2.7
Journal Rheumatol Publ. Co.	3	2.0
Nature Portfolio	3	2.0
Lippincott Williams and Wilkins	2	1.3
Mdpi: Multidisciplinary Digital Publishing Institute		

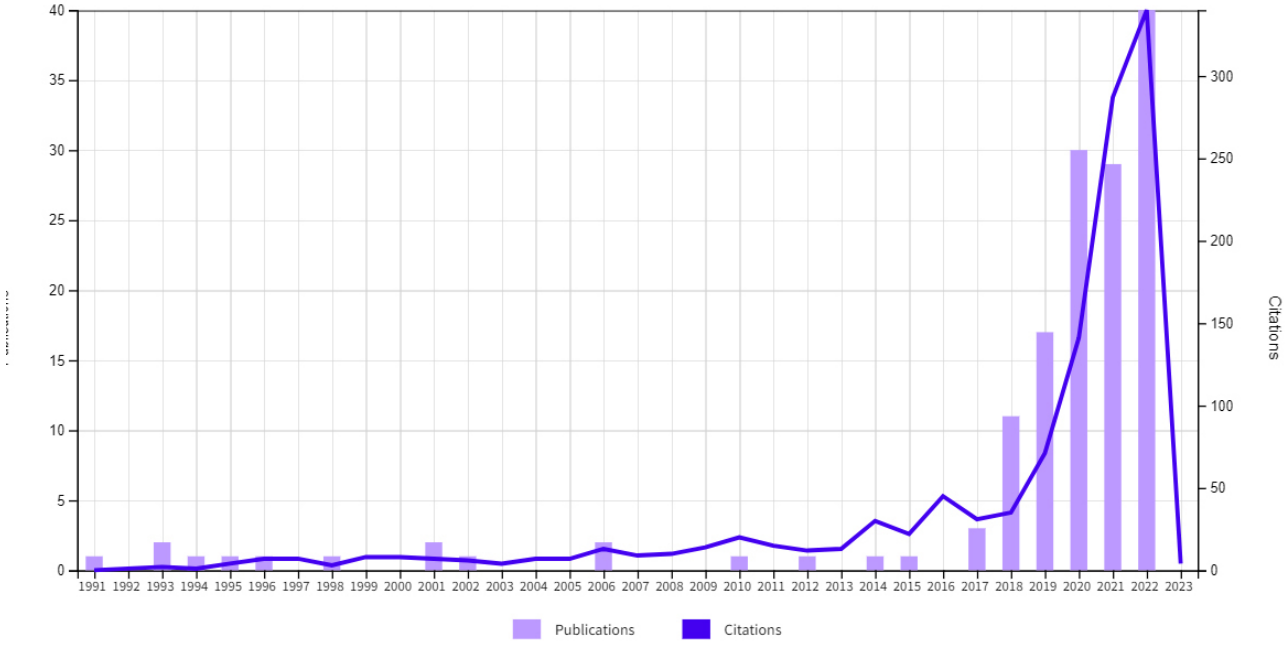

Figure 6. Graphics of citations over time (1991-2023)

Applications in the field of rheumatology have achieved successful advances in detecting joint erosions on plain radiographs predicting future rheumatoid arthritis disease activity, and identifying the halo sign on temporal artery ultrasound. The deep learning method should be based on the clinical experience of rheumatologists (10).

Current studies in the field of rheumatoid arthritis are based on fully demonstrating the applicability of the automatic scoring system and the power of AI. With AI being faster and more sensitive, it will enable the development of effective treatments for rheumatoid arthritis patients (11).

New digital health advances have created opportunities for rheumatologists, patients, and other caregivers through improved outcomes and improved efficiency. The next tier of digital treatments is the Food and Drug Administration approval process. The digitization of healthcare services has gained momentum worldwide in recent years. However, more databases based on observational studies, clinical trials, systematic reviews, and meta-analyses are needed to reach effective and objective results (12,13).

A large proportion of cancer patients do not benefit from a single immune checkpoint inhibitor (ICI) and therefore new combination strategies are needed. AI applications that predict ICI responses are currently being developed. There is increasing data on the applicability of AI in predicting cancer treatment ICI responses (14). Based on this, we can say that in the future, AI may guide us as to which biological/non-biological disease-modifying treatment some rheumatological diseases will respond better to. AI will be able to guide treatment decision-making.

The integration of AI into salivary gland ultrasound, ultrasound-mediated needle biopsy, and known diagnostic and prognostic biomarkers in the diagnosis of Sjögren's syndrome is another promising development in this field (15).

AI applications, including machine learning, provide the opportunity to identify the high-dimensional relationship between large numbers of datasets where human capacity is insufficient. Machine-mediated learning models provide additional information in defining osteoporotic fracture risk and predicting fracture prediction (16). AI tools are finding new applications in medical diagnostics. Machine learning and deep learning models have found a role in osteoporosis. This task is to model the risk of fragility fractures and assist in the identification and segmentation of images (17). In articles before 2017, computational clinical decision models (ChapGPT and other AI tools) containing multiple languages were causing excitement. But today we see that this high expectation has not yet been met.

Study Limitations

Limitations of the study include relying on a single database and documents consist two keywords.

CONCLUSION

We see AI-based publications in the literature on different diseases in the field of rheumatology, such as rheumatoid arthritis, osteoporosis, osteoarthritis, Sjögren syndrome, etc... AI methods based on human experience will of course increase the success of diagnosis, treatment and minimize the risk of error. We hope that our work will raise awareness in this area and shed light on future studies.

Ethics

Ethics Committee Approval: The study complied with the World Medical Association Declaration of Helsinki. Ethics committee approval is not required, as it performs a bibliometric analysis of existing published research.

Informed Consent: There is no human or animal research.

Authorship Contributions

Concept: T.T.K., Design: T.T.K., Data Collection or Processing: T.T.K., Analysis or Interpretation: T.T.K., Literature Search: T.T.K., Writing: T.T.K., C.Z.Y.

Conflict of Interest: The authors have no conflicts of interest to declare.

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