



RESEARCH ARTICLE

# Bibliometric Analysis in Scientific Research Using R: A Review of Scopus and Web of Science Databases

Mehmet YILDIZ<sup>1</sup> , Türkan KARAKUŞ YILMAZ<sup>2</sup> 

## ABSTRACT

The number of academic studies is increasing with the widespread use of digital tools. This increase makes it difficult to identify research trends, tendencies, themes, and other important points in various fields. Bibliometric analysis allows for the mapping of a field by analysing several academic studies and extracting meaningful conclusions. Therefore, bibliometric studies that are well conducted can build firm foundations for advancing a field in novel and meaningful ways. Bibliometric analysis, which is one of the approaches frequently used by researchers in the process of obtaining meaningful information from big data, has gained popularity especially in recent years. In this study, the bibliometrix package in the R programming language, which is frequently used in bibliometric analyses, is introduced and various analyses applied in the study are shown. Within the scope of this research, studies involving the R bibliometric package were examined as sample applications. While bibliometric studies usually include the Scopus or Web of Science (WOS) databases, this study includes data obtained from both databases. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) steps were followed in the study. Accordingly, it provides an overview of bibliometric analysis, focussing in particular on its different techniques and providing step-by-step instructions on the procedures to be performed to perform bibliometric analysis with confidence. In the study, bibliometric analyses of 957 bibliometric studies obtained from the WOS and Scopus databases were also conducted. Because of the analysis, descriptive statistics such as year, author, journal, frequently used words, citations, etc. were presented. **Keywords:** Bibliometric Analysis, Biblioshiny, Bibliometrix, R Studio, Science mapping



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<sup>1</sup>Sakarya University of Applied Sciences, Distance Education Research and Application Center, Sakarya, Türkiye

<sup>2</sup>Atatürk University, Kazım Karabekir Faculty of Education, Erzurum, Türkiye

ORCID: M.Y. 0000-0002-9523-3805;  
T.K.Y. 0000-0002-5809-3962

### Corresponding author:

Mehmet YILDIZ,  
Sakarya University of Applied Sciences, Distance Education Research and Application Center, Sakarya, Türkiye  
E-mail: mehmetyildiz@subu.edu.tr

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## Introduction

The development of electronic publishing with the widespread availability and accessibility of digital tools, has led to a significant increase in the number of academic publications. The increase in the number of academic publications has made it increasingly difficult to analyse these studies. The increasing number and desire to reveal the development of specific fields and map various fields has led to the development of various computer-based programmes. The number of citations, keywords, titles, abstracts, etc. from various databases has facilitated the analysis of studies using computer programmes. Bibliometric analysis (Donthu et al., 2021), which allows the examination of scientific development in various fields through publications, citations, keywords, authors, journals, countries, sources, etc. using mathematical and statistical methods, provides convenience for researchers in terms of evaluating a large number of studies. Bibliometric studies enable us the identification of trends in this field by quantitatively measuring and evaluating some aspects of research in a particular field (Ahmi, 2022). With bibliometric analysis, it is possible to follow the studies, researchers, institutions, and scientific flow related to the scientific subject (Martí-Parreño et al., 2016).

Bibliometric analysis, which applies quantitative techniques to bibliometric data, has gained popularity in recent years because it provides a systematic, transparent, and consistent review (Kasaraneni & Rosaline, 2022). Thanks to scientific databases, it is possible to access large amounts of data in line with the desired bibliometric data. For example, many databases such as Web of Science (WOS), Scopus, PubMed, and ProQuest offer data in various formats. In parallel with the data provided by databases, various computer software has started to be developed for bibliometric analysis. RStudio Biblioshiny (Aria & Cuccurullo, 2017), VOSviewer (van Eck & Waltman, 2010), CitNetExplorer (van Eck & Waltman, 2014), CiteSpace (Chen, 2006), and SciMAT (Cobo et al., 2012) are examples of these programmes that perform bibliometric or social network analysis.

The reasons why researchers benefit from bibliometric analysis are as follows: (1) gaining an overview at a glance, (2) identifying gaps in the field, (3) generating new ideas for research, and (4) positioning contributions to the field (Donthu et al., 2021). In bibliometric studies, the data used within the scope of the study should be large in order to analyse the data and reveal trends (Rashid, 2023). If the total number of academic studies used for analysis is small, satisfactory results may not be obtained. It is possible to manually analyse some data, and databases usually offer various statistical data.

The study provided a comprehensive guide on how bibliometric analysis, which offers important opportunities for researchers, is performed using the R programming language. This study provides important information on what bibliometric analysis is, what bibliometric concepts mean, and how to perform the analysis step by step. The study also provides

explanations on how to conduct the analysis process by combining WOS and Scopus data, which are the most widely used databases in the field, as opposed to the analysis usually carried out from a single database.

This study also analysed bibliometric studies published in the WOS and Scopus databases. In this context, findings such as frequently used words, journals where bibliometric studies are commonly published, authors, countries, etc. are presented.

Research Questions;

1. How to conduct a bibliometric analysis?
2. What is the distribution of bibliometric studies by years?
3. What is the distribution of bibliometric studies by source?
4. What is the distribution of bibliometric studies by authors?
5. What is the distribution of bibliometric studies by country?
6. What are the frequently used keywords in title-abstract-keywords in bibliometric studies and how is the distribution of these words?
7. What is the distribution of frequently used keywords?

## **Literature Review**

In this section, the researcher will briefly discuss the advantages of bibliometric analysis using the R bibliometrix package, the significance of bibliometric analysis, and various concepts used in bibliometric analysis.

## **Bibliometric Analysis**

It is noteworthy that the emergence of scientific databases such as Scopus and Web of Science has made acquiring large volumes of bibliometric data relatively easy, and bibliometric software such as Gephi, Leximancer, and VOSviewer enable the analysis of such data in a very pragmatic way, thereby raising scholarly interest in bibliometric analysis in recent times.

Bibliometric research is a quantitative method used for the analysis, evaluation, and monitoring of published research articles (Župič & Čater, 2014). It involves the application of statistical and mathematical techniques to bibliographic data to identify patterns, trends, and relationships within a specific field of study (Liu, 2023). By utilising bibliometric methods, researchers can gain insights into the intellectual structure of a research field, track research trends, and evaluate the impact of publications (Ramos-Rodríguez & Ruíz-Navarro, 2004).

Bibliometric research plays a crucial role in academia by providing a systematic and transparent way to analyse scientific literature (Khoshroo & Talari, 2022). It allows for

assessing research performance at various levels, such as journals, researchers, countries, and institutions (Singh & Arora, 2022). Through bibliometric analysis, researchers can identify research hotspots, visualise trends, and inform future research directions (Luo, 2023). Additionally, bibliometrics help in recognising the intellectual structure of a field of knowledge and assessing the scientific influence of research outputs (Ruiz–Real et al., 2018).

Moreover, bibliometric studies contribute to the advancement of knowledge by offering comprehensive overviews of research fields and highlighting key contributors and communities within those fields (Mahato et al., 2022). They aid in understanding the evolution of scientific areas over time and provide valuable insights for researchers to navigate through the vast landscape of scholarly publications. Bibliometric analysis also assists in identifying research gaps, shaping research agendas, and promoting evidence-based decision-making in various disciplines.

In conclusion, bibliometric research serves as a valuable tool for researchers to analyse, evaluate, and navigate the vast landscape of scholarly publications. It enables the systematic assessment of research performance, identification of trends, and shaping of future research agendas across diverse fields of study. By leveraging bibliometric methods, researchers can gain valuable insights that contribute to the advancement of knowledge and facilitate evidence-based decision-making in academia.

## **Bibliometric Analysis Using R**

Bibliometric analysis provides an overview and in-depth analysis of research conducted in a particular subject area. In this study, we present a guide on how to perform bibliometric analysis using the R bibliometrix package in RStudio with the biblioshiny plugin. Biblioshiny produces research output to determine the analysis of annual scientific production, the most prolific authors, the most frequently used words, the most popular journals, cross-country collaborations, etc. related to the selected research topic (Rashid, 2023). Among the reasons for choosing the R programming language in the study; features such as making data analysis easier and faster, visualisations and data are clearer, there are many features that can be used for analysis, and Biblioshiny's web interface is constantly updated. In addition, the R programming language is an open source, free software. One of the important reasons for choosing the R programming language is that it allows analysis by combining data from multiple databases, as shown in this study.

## **Method**

In this section, processes such as obtaining data from databases, transforming them, filtering them, making them ready for analysis, analysing them, and obtaining and interpreting the findings are included.

In addition, the processes of making bibliometric studies ready for analysis are mentioned in the study.

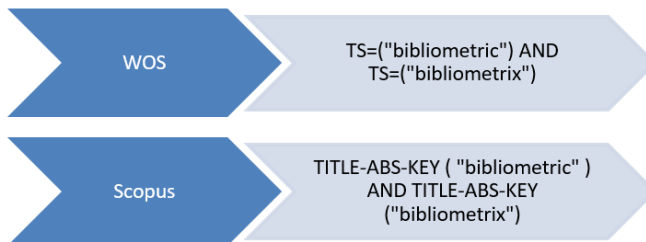
### Research Design

In this study, a bibliometric mapping technique was used based on various criteria such as author, publication, keywords, country, and number of citations. Bibliometric mapping is a visual representation of the links among disciplines, fields, specific publications, and authors (Donthu et al., 2021). Bibliometric studies enable the detection of trends in the field by measuring and evaluating some aspects of research in a particular field (Ahmi, 2022). It is possible to follow the studies, researchers, institutions, and scientific flow related to the determined scientific subject using bibliometric analysis (Martí-Parreño et al., 2016).

### Data Collection

In bibliometric analyses, it is necessary to determine which databases will be searched with which keywords and the inclusion and exclusion criteria of the studies accessed. The scope in which the keywords selected in the searches will be searched is also an important stage that affects the results of the study. Figure 1 shows a sample search conducted within the scope of this study. The search was conducted on 30.03.2024. Information about the database search query is shown in Figure 1.

- Web of Science (<https://www.webofscience.com/wos/woscc/advanced-search>)
- Scopus (<https://www.scopus.com/search/form.uri?display=advanced>)



**Figure 1.** Keyword search process based on databases.

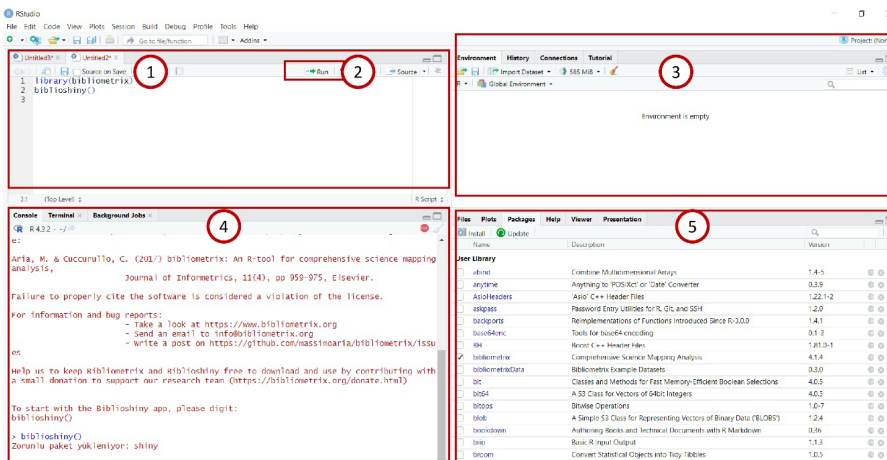
Figure 1 Keywords and criteria according to which these keywords were scanned. As in many bibliometric analyses, both databases were searched within the scope of title-summary-keywords. The data obtained from the study should be limited according to various criteria (e.g. language, study type, year, etc.) and downloaded in the appropriate format. While Scopus data were downloaded in BibTeX format, WOS data were manually merged into two parts in.txt format, as more than 500 data points were not allowed to be downloaded at the same time. The inclusion criteria were that the studies were in English and the document type was an article.

## Data Transformation

In this section, the processes of converting the data obtained from the databases into Excel format using the biblioshiny plug-in of the R programming language, merging the data, and removing the same studies from the data pool are discussed. Through the R Studio programme;

Library(bibliometrix) ----> biblioshiny() codes are run to open the biblioshiny plugin.

The RStudio interface is shown in Figure 2.



2. RStudio interface.

Figure

When the numbered sections in Figure 2 are examined in order;

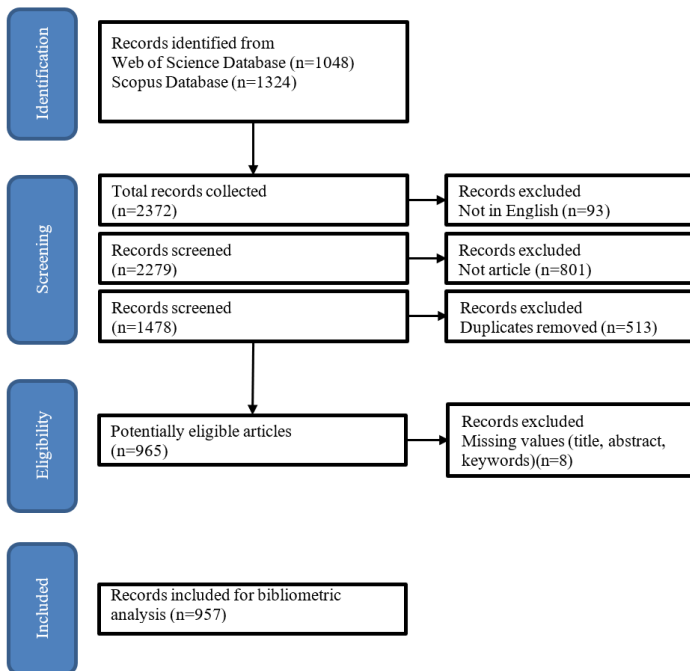
1. Code writing screen
2. Command execution screen
3. Data loading and preview screen
4. Console screen
5. Can be expressed as file, output, or package preview screen

For the analysis, first, the files downloaded from the databases should be uploaded to the programme using the R bibliometrix package and then outputted as Excel files.

After the above steps are taken, the “wos.xlsx” and “scopus.xlsx” files obtained as excel files can be edited according to the needs of the researcher. The following steps are followed in the process of merging the data.

1. Select the folder containing the database files by following the Session->Set Working Directory->Choose Directory steps through the RStudio programme.
2. Adding libraries
  - a. library(bibliometrix),
  - b. library(openxlsx)
  - c. library(xlsx)
  - d. library(fBasics)
3. Writing code
  - a. `Web_data<-convert2df("wos.txt")`  
`Scopus_data<-convert2df("scopus.bib",dbsource="scopus",format="bibtex")`  
`combined<-mergeDbSources(web_data,scopus_data,remove.duplicated=T)`  
`write.xlsx(combined,"combinedabs.xlsx")`

When the above steps are followed, it will be seen that the programme will combine two separate excel files and remove the duplicate data and output as a single excel file. The data collection process of the bibliometric studies analysed within the scope of the study is shown in Figure 3.



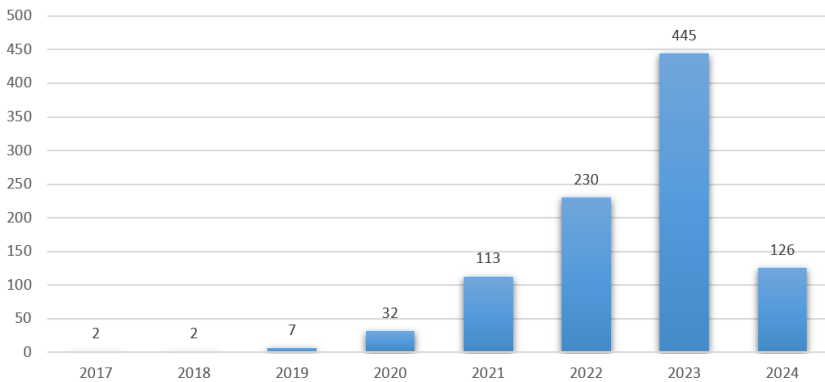
**Figure 3.** Study data selection and filtering.

## Results

In this section, the sample findings are presented in parallel with the data obtained within the scope of the study. The main findings of the study are shown in Table 1. Table 1 shows the statistical information of the publications included in the study. Table 1 presents many findings such as the year range in which the studies were published, the number of sources in which the studies were published, the number of articles, the annual rate of increase in the number of studies, authors, and keywords.

When the findings are analysed, it can be seen that the studies conducted using the R bibliometrix package were first published in 2017. This is also the date of the first release of the R bibliometrix package. The 957 articles analysed within the scope of this research were published in 552 different sources. When the annual increase rate of bibliometric studies is analysed, an increase of 80.74% is observed. A total of 2757 different authors conducted the studies, and 41 persons published as a single author. While 17.66% of the studies had international co-authors, each study by approximately five authors. It was observed that 2337 keywords were included in the analysis. Although the articles are relatively recent, the average number of citations is 15.34.

The number of articles published by years is shown in Figure 4.

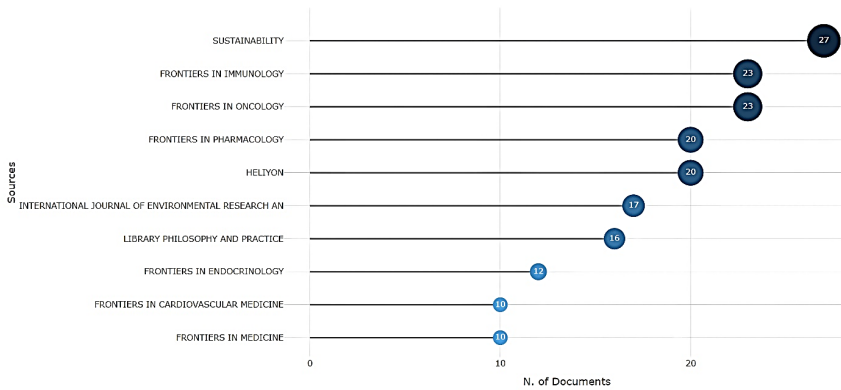


**Figure 4.** Number of articles published by the year.

Figure 4 shows that the number of studies is gradually increasing. The number of studies has increased, especially in recent years, with the highest number of studies published in 2023 (445). Although 2024 (126) is only the beginning of the year, the number of published studies is higher than that in 2021 (113). Since the R bibliometrix package was released in 2017, there have been no studies from previous years.

The sources in which the bibliometric articles were most frequently published in the study are shown in Figure 5.

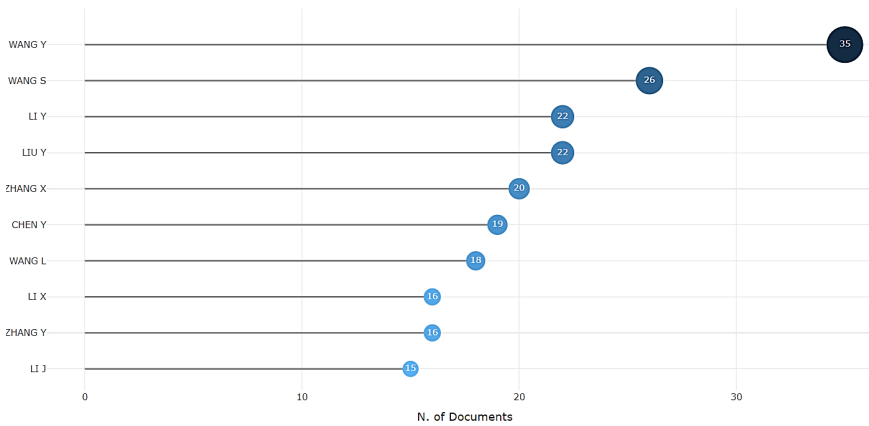




**Figure 5.** Sources where bibliometric articles are frequently published.

Figure 5 shows that most bibliometric studies were published in the journal “Sustainability” (27). In “Frontiers in Immunology” (23), “Frontiers in Ontology” (23), “Frontiers in Pharmacology” (20), and “Heliyon” (20) are similarly the sources where most bibliometric studies are published.

The authors with the most bibliometric articles are shown in Figure 6.



**Figure 6.** Authors with the most bibliometric articles.

Figure 6 shows the top 10 authors with the most bibliometric publications. When the number of publications is analysed, Wang, Y. (35), Wang, S. (26), Li, Y. (22), Liu, Y. (22), and Zhang, X. (20) are the authors with the highest number of publications.

The countries’ total bibliometric article production is shown in Figure 7.

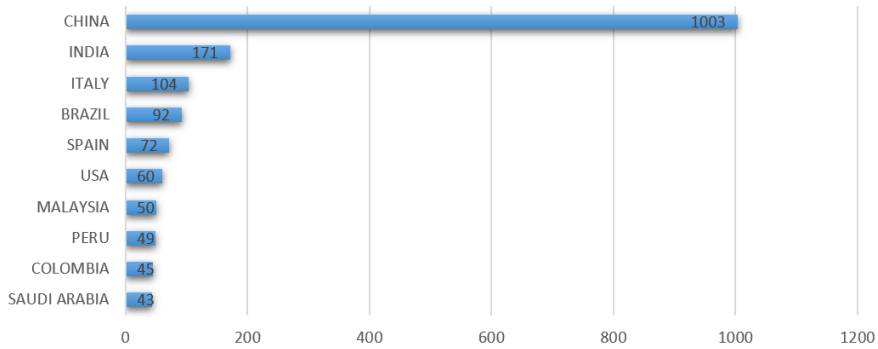


Figure 7. Countries' total numbers of bibliometric publications.

Figure 7 shows the total number of bibliometric publications in each country. Although only article-type publications were analysed in the study findings, publications other than articles were also included in the total number of publications. According to the findings, China (1003) is the country with the highest number of publications, and the number of publications is considerably higher than that of other countries. When we see other countries in India 171, Italy 104, Brazil 92, and Spain 72 articles published. In Türkiye, 26 articles were published.

The three-field plot of the words frequently used in the title-abstract-keywords is shown in Figure 8.

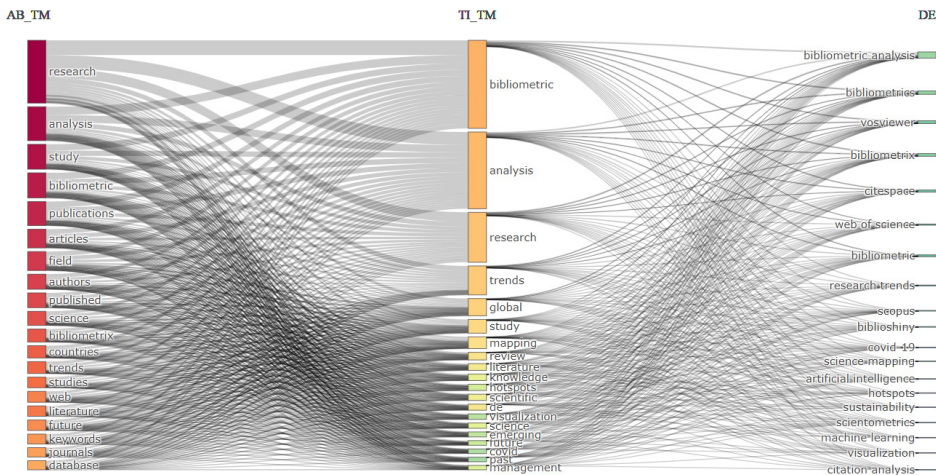


Figure 8. Three-field plot (AB\_TM\*: Title, TI\_TM\*: Abstract, DE\*: Keywords).

Figure 8 shows that the most frequently used words in the title are research (12600), analysis (6830), study (5004), bibliometric (5000), and publications (4820). In the abstract, bibliometrics (17700), analysis (15400), research (10000), trends (5830), and global (3470)

are the most frequently used words. Similarly, words such as bibliometric analysis (1260), bibliometrics (684), however (568), bibliometrix (545), and citespace (421) were frequently used as keywords.

The frequently used keywords in the study are shown in Figure 9.

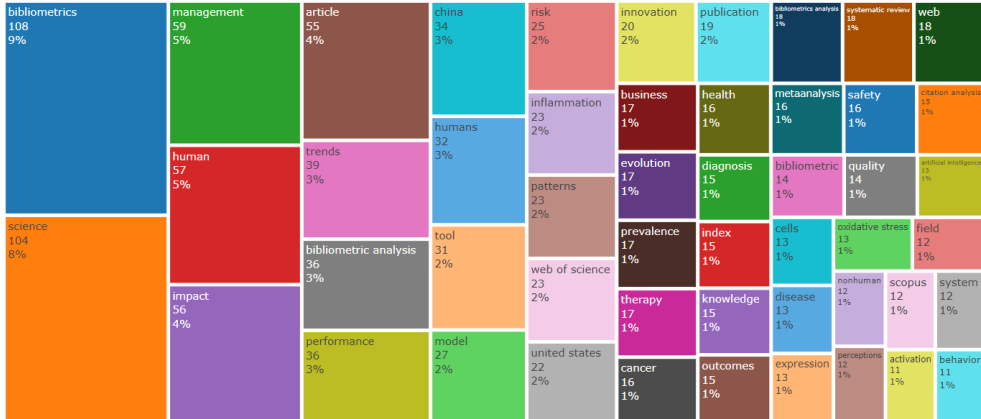


Figure 9. Frequently used keywords in the study.

Figure 9 shows the numbers and percentages of the 50 most frequently used words in the studies analysed within the scope of the study. The most frequently used words are bibliometrics (108), science (104), management (59), human (57), and impact (56).

### Discussion and Conclusion

In this study, there are explanations about what bibliometric analysis is, how it is analysed findings are obtained. Within the scope of the study, we aimed to introduce the R bibliometrix package and biblioshiny interface in the R programming language, and a step-by-step bibliometric analysis was applied. Within the scope of the study, the stages of keyword selection, database selection, downloading, filtering, transforming, and preparing the data for analysis are shown with sample applications. The reporting process was also presented to the researchers during the data acquisition stages.

One of the most important points in data analysis in bibliometric studies is keyword selection (Yadav et al., 2023). The choice of keywords in bibliometric analysis plays a crucial role in the quality and usefulness of the analysis. Properly selected keywords make the literature review more effective, accurately reflect research trends, and help identify gaps in the field. Therefore, researchers must carefully select keywords and ensure that the words they choose accurately reflect the scope and focus of the research. Keyword selection not only improves the accuracy of bibliometric analyses but also facilitates the scientific community’s access to

and understanding of relevant literature, thus contributing to the advancement of knowledge. Otherwise, it may be difficult to interpret the findings of bibliometric studies, which by their nature present more superficial findings and do not have the opportunity for in-depth analysis.

The second important stage of bibliometric studies is database selection. Because various digital tools facilitate bibliometric analysis, it is often the case that the database is chosen for the tool rather than the tool for the database. However, the scope of the study should be determined in line with the focus of the research and the needs of the literature. While the tools developed for bibliometric analysis mostly work with a single database, in this study, the findings obtained from multiple databases were analysed together. In this process, the data downloaded from WOS and Scopus databases are used in the RStudio programme and both file type conversion and data merging are provided with the help of the codes mentioned in the method section. One of the important operations performed in this study is the removal of duplicate data during data merging. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) process should be considered in the bibliometric analysis process. Accordingly, the keywords, publication type, year, etc. used in the screening process should be expressed step by step. After keyword selection, downloading, transforming, merging, and removing duplicate data, the analysis process can begin.

When the findings are examined, it is seen that since the R bibliometrix package was first published in 2017, the first study was published in 2017. The 957 articles analysed within the scope of this research were published in 552 different sources. Compared with the number of articles, there is variety in the number of sources.

When the annual increase rate of bibliometric studies is analysed, it is observed that there is a great rate of 80.74%. As a matter of fact, the fact that there are nearly 1000 articles in approximately 3-4 years is one of the most important indicators of this. One of the reasons why these studies are published so intensively is that they do not require processes such as long-term application and analysis. The fact that it does not have a high economic cost is also one of the main reasons why bibliometric studies are widespread. In addition to the fact that they can be written and published in a short time, the high number of citations can also be cited as a reason for the widespread use of such studies. The fact that 2757 authors conducted bibliometric studies supports this argument. At the same time, when we look at the average number of citations, it is seen that 15 citations are given for each article despite such a short time. This rate demonstrates why researchers attach so much importance to bibliometric studies.

When the journals in which bibliometric studies are most frequently published are examined, it can be seen that there are mostly journals in the field of health. There may be several reasons for this. The fact that the field of health has a dynamic structure with the use

of new methods, techniques, treatments, and medicines, especially with technology, can be shown as a reason for this. The opportunity to work interdisciplinarily and the high volume of publications with funding support may have prepared a suitable ground for bibliometric studies where a large amount of data is important. The COVID-19 pandemic may have also led to more bibliometric studies in the field of health (Korkmaz & Altuntaş, 2022).

When the number of publications is analysed, Wang, Y. (35), Wang, S. (26), Li, Y. (22), Liu, Y. (22), and Zhang, X. (20) are the authors with the highest number of publications. The number of publications for each author is quite high. Therefore, it can be said that the indicators that increase the number of bibliometric publications are valid for the authors.

When the number of publications by country is analysed, it is seen that China and the USA publish considerably more than other countries. The high number of publishers in the country can also be a reason for this. The one with the most publications is considered the most productive (Erdoğan, 2021). The United States and China are the most productive countries with the highest number of publications on nursing and COVID-19 (Korkmaz & Altuntaş, 2022). There is a relationship between the number of scientific publications published by countries, the duration of the Covid-19 pandemic, and the level of impact of these countries from the pandemic (Hao et al., 2020; Oh & Kim, 2020; Tao et al., 2020). In Turkey, 26 publications were made, and in this context, it is one of the 20 countries with the highest number of bibliometric studies.

One of the important findings of bibliometric studies is the three-field plot graph (Figure 7). This graph shows us the relationships between various topics. Since the frequency of use with other titles is also important in this graph, frequently used keywords can be seen differently in Figure 7 and 8 within the scope of the study. This finding shows that bibliometric analysis and similar words are frequently used in accordance with the keywords of the study.

When frequently used keywords are analysed, parallel results are obtained with the three-field plot graph. However, it is noticeable that more words are used in the field of health. The high number of bibliometric studies in the field of health confirms that the frequently used words are from the field of health.

In summary, this study provides comprehensive information on bibliometric data analysis. In this study, the bibliometric analysis process shows step-by-step all the processes such as data collection, filtering, organising, analysing and interpreting. This study can be a guide for researchers who want to conduct bibliometric analysis.

In bibliometric studies, where a large number of academic studies can be analysed at the same time, the emphasis on quantity and the presence of various errors can affect any analysis

using such data (Rashid, 2023). To reduce errors, scholars should carefully select keywords and clean their bibliometric data, which involves removing duplicate and erroneous entries. Because only a limited number of databases were selected, there are limitations. In particular, the qualitative claims of bibliometrics can be highly subjective, given that bibliometric analysis is quantitative in nature and the relationship between quantitative and qualitative results is uncertain (Wallin, 2005). In this context, academics should be more careful when making qualitative claims about bibliometric observations and support them with content analysis when appropriate (Gaur & Kumar, 2018). Therefore, academics should avoid making overly ambitious claims about the research area and its long-term impact (Donthu et al., 2021). Despite these limitations, Bibliometric analysis helps academics gain a comprehensive perspective, identify knowledge gaps in the field, obtain research ideas, and find ways to make expected contributions to the field (Ellegaard & Wallin, 2015; Rashid, 2023).

Bibliometric studies using the separate R bibliometrix package were also analysed in the study. For beginners, utilising R packages is easier (Rashid, 2023). In this context, one of the results obtained within the scope of the study is that there is a great increase in the number of bibliometric studies, that they can be written and published in a short time, and that they can be highly cited.

## **Limitations**

The research methodology used in this study has some limitations that should be considered when evaluating the results;

1. This study is limited to studies included in the WOS and Scopus databases.
2. Instead of publishing a large number of scientific articles, some authors contribute in different ways, for example, by taking active roles in important projects or initiatives, or by making a significant impact in their research field. Such contributions are often overlooked in bibliometric analyses.
3. This study focussed only on articles published in scientific journals; future studies may consider other sources such as books or proceedings.
4. This study focussed only on articles published in English; therefore, other languages can be considered in future studies.
5. In this study, only the R bibliometrix package was introduced with the RStudio programme and bibliometric studies published under the bibliometrix keyword were analysed. Different programmes and studies can be analysed in different studies.

**Peer-review:** Externally peer-reviewed.

**Ethics Committee Approval:** Authors declared that this study does not require ethics committee approval.

**Author Contributions:** Conception/Design of Study- M.Y., T.K.Y.; Data Analysis/Interpretation- M.Y.; Drafting Manuscript- M.Y., T.K.Y.; Critical Revision of Manuscript- M.Y., T.K.Y.; Final Approval and Accountability- M.Y., T.K.Y.; Technical or Material Support- M.Y., T.K.Y.; Supervision- M.Y., T.K.Y.

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

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