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Bibliometric Analysis of Studies on Bioclimatic Comfort

Biyoklimatik Konfor Üzerine Yapılan Çalışmaların Bibliyometrik Analizi

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Abstract

Bioclimatic comfort can be defined as the situation in which people are not disturbed by climatic factors such as temperature, humidity and wind in their environment. Today, especially in cities where dense construction is seen, the formation of unsuitable conditions in terms of bioclimatic comfort can lead to negative effects on people's physical and psychological health and work efficiency. In the study, it was aim to explain when, how, where and by whom the concept of Bioclimatic comfort, whose importance is increasing day by day, began to be evaluated, what the prominent concepts were and their relations with each other. The universe of the study was determined as the SCOPUS database, and within this framework, 367 sources and 835 scientific documents constitute the sample volume of the study. By bibliometric analysis, scientific documents related to the study subject, document types, fields of study, authors, institutions, countries, citation situations and their relations with each other were tried to be revealed. As a result of the study, it is seen that the studies on the concept have increased in the last twenty years. It is seen that the most publications were made in Brazil, Spain and Italy, and the most of the studies were published in the journals covering the subject of environment, energy, building (building, housing) and sustainable cities. As a result of the bibliometric analysis, when the publications related to bioclimatic comfort, the scope of the journals in which the publications are included, the keywords, and the expertise of the authors are evaluated, it is seen that the concept is generally focused on climate, climate change, microclimate, buildings (housing), energy use, and sustainable development. In line with the findings, it is possible to say that the Bioclimatic comfort study area has been increasingly developed and changed from past to present.

Keywords: Bioclimatic comfort, Bibliometric analysis, Landscape architecture, Sustainability, Climate.

Özet

Biyoklimatik konfor insanların bulundukları ortamda sıcaklık, nem, rüzgar gibi iklim etkenlerinden rahatsız olmama durumları olarak tanımlanabilmektedir. Günümüzde özellikle yoğun yapılaşmanın görüldüğü kentlerde biyoklimatik konfor bakımından uygun olmayan şartların oluşması insanların fiziksel ve psiklojik sağlıkları üzerinde, iş verimlilikleri üzerinde olumsuz etkilere yol açabilmektedir. Yapılan bu çalışmada "Biyoklimatik Konfor" kavramı değerlendirilerek, kavramın alanyazın tarafından nasıl, nerede, ne zaman ve kimler tarafından incelendiği, kavramla ilgili anahtar kelimeler, birbirleriyle olan ilişkileri ve ön plana çıkan detaylarının neler olduğunun tespiti için bibliyometrik analizin yapılması amaçlanmıştır. Çalışmanın evreni SCOPUS veri tabanı olarak belirlenmiş olup, bu çerçevede 367 kaynak 835 bilimsel döküman çalışmanın örneklem hacmini oluşturmaktadır. Bibliyometrik analiz yapılarak çalışma konusu ile ilgili bilimsel dökümanlar, döküman türleri, çalışma alanları, yazarlar, kurumlar, ülkeler, atıf durumları ve birbirleri ile ilişkileri ortaya konulmaya çalışılmıştır. Çalışmanın sonucunda kavramla ilgili yapılan çalışmaların yaklaşık son yirmi yılda arttığı görülmektedir. En fazla yayının Brezilya, İspanya ve İtalya'da yapıldığı, çalışmaların en fazla çevre, enerji, yapı (bina, konut) ve sürdürülebilir kentleri konu kapsamına yer alan dergilerde yayınlandığı görülmektedir. Bibliyometrik analiz sonucu biyoklimatik konfor ile ilgili yayınlar, yayınların yer aldığı dergi kapsamları, anahtar kelimeler, ve yazarların uzmanlık alanları değerlendirildiğinde genel olarak kavramın iklim, iklim değişikliği, mikro iklim, yapılar (konut), enerji kulanımı, ve sürdürülebilir gelişme odak noktalı olduğu görülmektedir. Bulgular doğrultusunda Biyoklimatik konfor çalışma alanının geçmişten günümüze kadar artarak gelişime ve değişime uğradığını söylemek mümkün olmaktadır.

Anahtar Kelimeler: Biyoklimatik konfor, Bibliyometrik analiz, Peyzaj mimarlığı, Sürdülebilirlik, İklim.

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1. Introduction

In its most general definition, bioclimatic comfort is expressed as a situation in which people are not warned against climatic conditions in the environment or are not stressed (Toy, 2010; Çağlak, 2021). Olgyay (1973) defines bioclimatic comfort as a situation where environmental conditions such as temperature, humidity and wind are within certain value ranges, where people feel healthier and more dynamic (Güngör et al., 2019). In the psychological approach, bioclimatic comfort is completely associated with the human brain's perception of temperature. Human bioclimatic comfort is explained as the condition that the human brain is satisfied with the temperature state of the surrounding environment. In the thermophysiological approach, the concept of bioclimatic comfort has been defined based on the stimuli of the thermal sensing (thermoreceptor) tips in the skin and hypothalamus. According to this approach, bioclimatic comfort “represents the minimum amount of neural signals from heat-sensing terminals (Höppe 2002). Considering the definitions made, it is possible to define it as a situation in which a person does not feel uncomfortable under the influence of climatic conditions such as temperature, humidity and wind.

1.1. Bioclimatic Comfort

In its most general definition, bioclimatic comfort is expressed as a situation in which people are not warned against climatic conditions in the environment or are not stressed (Toy, 2010; Çağlak, 2021). Olgyay (1973) defines bioclimatic comfort as a situation where environmental conditions such as temperature, humidity and wind are within certain value ranges, where people feel healthier and more dynamic (Güngör et al., 2019). In the psychological approach, bioclimatic comfort is completely associated with the human brain's perception of temperature. Human bioclimatic comfort is explained as the condition that the human brain is satisfied with the temperature state of the surrounding environment. In the thermophysiological approach, the concept of bioclimatic comfort has been defined based on the stimuli of the thermal sensing (thermoreceptor) tips in the skin and hypothalamus. According to this approach, bioclimatic comfort “represents the minimum amount of neural signals from heat-sensing terminals (Höppe, 2002). Considering the definitions made, it is possible to define it as a situation in which a person does not feel uncomfortable under the influence of climatic conditions such as temperature, humidity and wind.

2. Method

In this study, it is aimed to perform bibliometric analysis in line with the review of the literature in a holistic manner within the framework of the concept of "Bioclimatic Comfort". Pritchard (1969) describes Bibliometrics as a method applied to the study of published books, journals and other communication tools using statistical and mathematical techniques (Mutlu, 2022). In other words, bibliometrics is seen as a study that examines the relationship between numbers and patterns in bibliographic data, that is, the number of articles, the growth of the literature, and library and database usage patterns (Chellappandi et al., 2018). Bibliometric analysis is considered as a method in which the communicative activity in the literature related to a certain concept can be explained and interpreted (Borgman & Furner, 2002; Şahin Ören, 2022). Bibliometric analysis is performed in order to evaluate the scientific research tendency of a particular subject or concept, to examine the impact values of the publications, or to map bibliometric networks in various ways (Ahmi, 2022; Ören, 2022).

2.1. Data Collection and Analysis

In the study, Scopus database was used to collect data in line with the examination of scientific documents published within the scope of "Bioclimatic Comfort" through bibliometric analysis. No restrictions have been placed on scientific publications made within the scope of "Bioclimatic Comfort" over the aforementioned database. It is aimed to obtain data for the purpose of the study by scanning the concept of "Bioclimatic Comfort" in the Scopus database. A total of 367 resources and 835 scientific documents were found between 1964 and 2023 on bioclimatic comfort in the search conducted without language and document type restrictions. "R" software was used in this study to perform bibliometric analysis. In order to achieve the aim of the study, the research questions were determined as follows.

Research Questions:

1. What are the general information about scientific studies published within the scope of bioclimatic comfort in the SCOPUS database?

2. What is the distribution of scientific documents and citations published in the SCOPUS database within the scope of bioclimatic comfort by years?

3. How is the Keyword-Country-Source Triple Field Graph of scientific documents published within the scope of bioclimatic comfort in SCOPUS database formed?

4. How is the source types (Journal, Conference, book, etc.) published within the scope of bioclimatic comfort in the SCOPUS database, the distribution according to the publication source, the production distribution of the sources according to the years, the citation status of the sources and the source co-citation network?

5. Who are the authors who have published the most scientific documents within the scope of bioclimatic comfort in the SCOPUS database? What does the author co-citation network look like?

6. In the SCOPUS database, how do the institutions where scientific documents published within the scope of bioclimatic comfort are published, the number of published documents, and the cooperation network of institutions look like?

7. In the SCOPUS database, how does the scientific document production frequency of the countries in which the scientific documents published within the scope of bioclimatic comfort are published, the distribution of the produced documents according to years, the frequency of citations in scientific documents by the countries, the cooperation network of the countries look like?

8. In the SCOPUS database, what are the most frequently cited authors, document access addresses, total number of citations in the dataset and in the global context regarding the studies conducted within the scope of bioclimatic comfort?

9. How does the keyword cloud, word dynamics and keyword formation network used in studies conducted within the scope of bioclimatic comfort in the SCOPUS database look?

3. Findings and Interpretation

Bibliometric analysis was carried out in order to reveal the distribution of scientific documents made within the scope of bioclimatic comfort throughout the world without language discrimination.

The findings obtained within the scope of the research are given under the headings.

3.1. General Situation of Bioclimatic Comfort Studies

General information on scientific documents carried out within the scope of Bioclimatic Comfort is given in Table 1.

Table 1. General information.

Description	Results	Description	Results
Maın Informatıon About Data		**Authors Collaboratıon**	
Timespan	1964:2023	Single-Authored Docs	119
Sources (Journals, Books, Etc)	367	Co-Authors Per Doc	3,21
Documents	835	InternationalCo-Authorships %	16,53
Annual Growth Rate %	2,38	**Document Types**	
Document Average Age	9,28	Article	518
Average Citations Per Doc	11,94	Book	3
References	24728	Book Chapter	41
Document Contents		Conference Paper	245
Keywords Plus (Id)	3532	Conference Review	2
Author's Keywords (De)	1867	Editorial	1
Authors		Note	1
Authors	2077	Review	24
Authors Of Single-Authored Docs	108		

When Table 1 is evaluated, it is seen that the studies on bioclimatic comfort were carried out between 1964 and 2023. It is seen that 835 scientific work were carried out during this period, and the mentioned studies were primarily 518 Article, 245 conference Paper, 41 book chapter, 24 review, 3 book, 2 conference reviews, 1 note and 1 editorial.

3.2. Distribution of Scientific Document Types by Years

The distribution of scientific documents related to bioclimatic comfort by years is given in Figure 1.

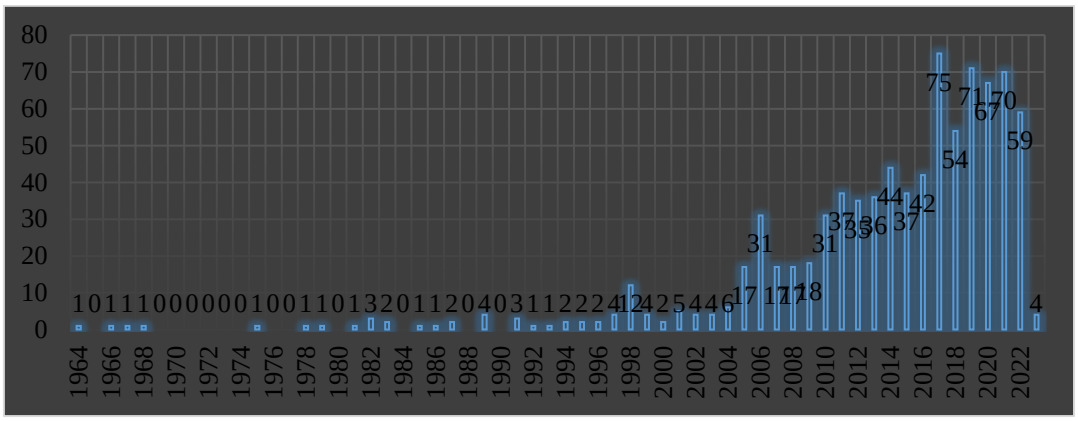

Figure 1. Distribution of scientific documents related to bioclimatic comfort by years.

When Figure 1 is examined, it is seen that the documents created within the scope of Bioclimatic comfort started to be published in 1964. It has been determined that there has been an increase in the number of studies published within the scope of the subject since 2005, and that there has been a rapid increase especially in recent years.

3.3. Citation Distribution of Scientific Documents Related to Bioclimatic Comfort by Years

The citation status of the documents published within the scope of bioclimatic comfort by years is given in Figure 2.

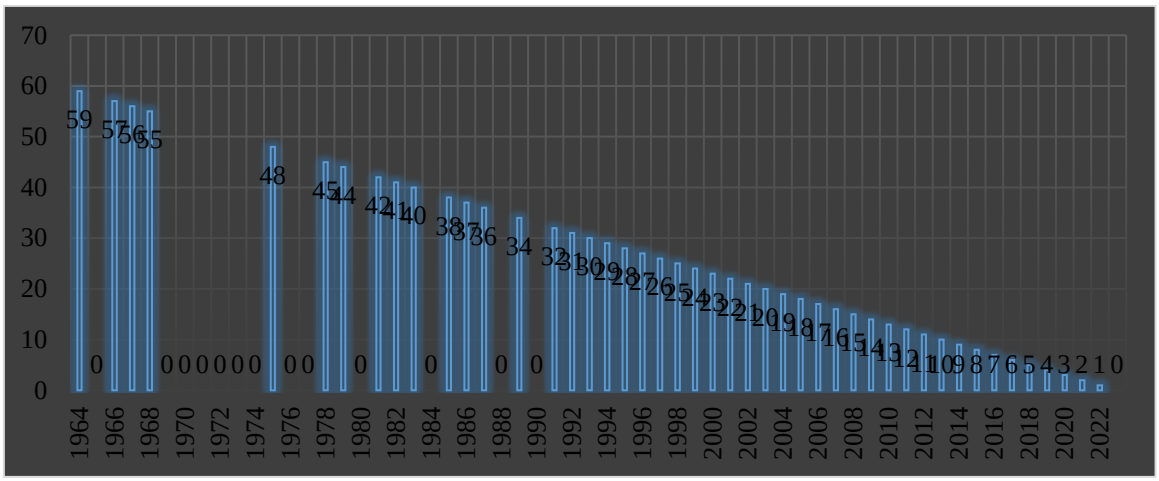

Figure 2. The number of citations by years of documents published within the scope of bioclimatic comfort.

When the citation status of the studies published within the scope of bioclimatic comfort is examined according to the years, it is seen that the studies conducted in 1964-1966-1967 and 1968 received the highest citations. When the citation distribution by years is evaluated, it is seen that the studies conducted in the first years received more citations than the current studies.

3.4. Keyword-Country-Source Triple Area Chart

The triple area graph created in terms of publication place, country and keyword related to the researches carried out within the scope of the concept of bioclimatic comfort is given in Figure 3. In Figure 3, information about the keywords is given in the left area, the country information of the publications in the middle area and information about the published source information in the right area.

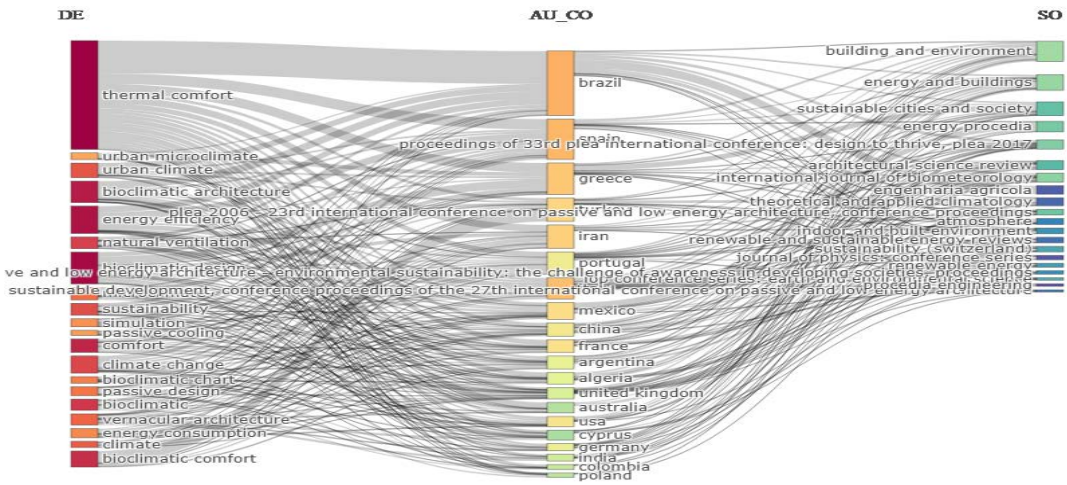

Figure 3. Keyword-country-source triple area graph.

When Figure 3 is examined, it is seen that scientific documents related to bioclimatic comfort are mostly published in "Building and Environment", "Energy and Buildings", Sustainable Cities and Society" journals. It has been determined that the documents are mostly produced in Brazil, Spain, Greece, and Turkey. It is seen that the words "thermal comfort", "urban microclimate", "urban climate" and "bioclimatic architecture" are used intensively as keywords in the studies.

3.5. Examining The Sources of Scientific Documents Related to Bioclimatic Comfort

The distribution of scientific documents produced within the scope of the concept of bioclimatic comfort according to the publication source is given in Table 2. The distribution of the sources in which the studies on the subject are published according to the years is given in Figure 4.

Table 2. Distribution of scientific documents produced within the scope of the concept of bioclimatic comfort by publication source.

Sources	Scientific Documents
BUILDING AND ENVIRONMENT	35
ENERGY AND BUILDINGS	30
INTERNATIONAL JOURNAL OF BIOMETEOROLOGY	22
PROCEEDINGS OF 33RD PLEA INTERNATIONAL CONFERENCE: DESIGN TO THRIVE, PLEA 2017	20
ENERGY PROCEDIA	16
PLEA 2006 - 23RD INTERNATIONAL CONFERENCE ON PASSIVE AND LOW ENERGY ARCHITECTURE, CONFERENCE PROCEEDINGS	16
SUSTAINABLE CITIES AND SOCIETY	15
ARCHITECTURAL SCIENCE REVIEW	14
IOP CONFERENCE SERIES: EARTH AND ENVIRONMENTAL SCIENCE	13
SUSTAINABILITY (SWITZERLAND)	13

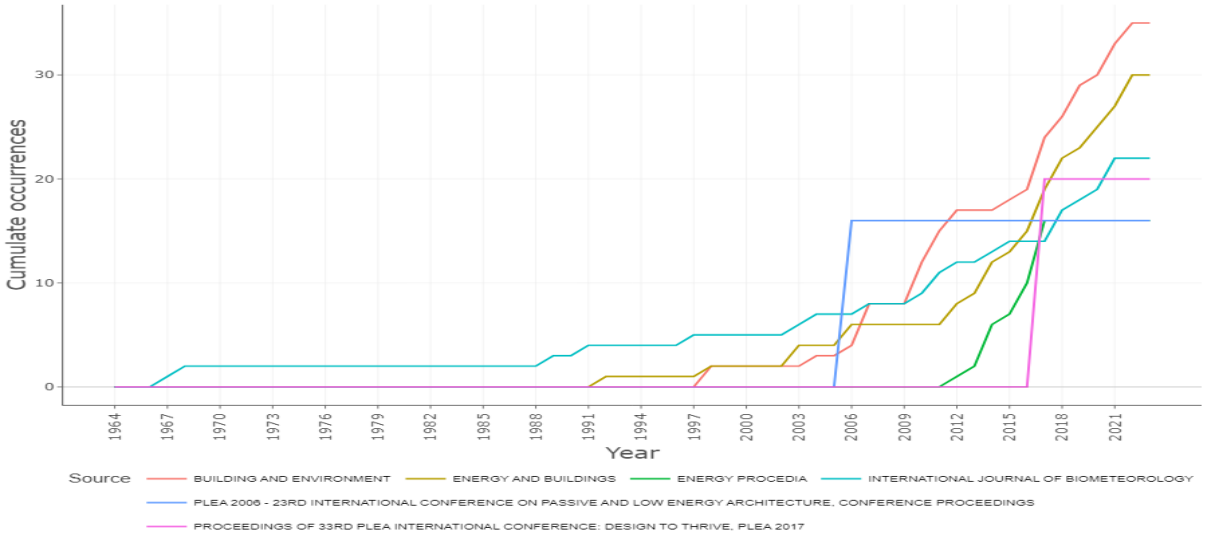

Figure 4. Annual production distribution of resources.

When Table 2 and Figure 4 are examined, it is seen that scientific studies on bioclimatic comfort are mostly in the type of articles. It is seen that the most articles were published in the "Building And Environment" journal. "Energy And Buildings" is in the second place, and "International Journal Of Biometeorology" is in the third place. In addition, it is determined that a large number of papers on the subject were presented at the "Proceedings Of 33rd Plea International Conference: Design To Thrive, Plea 2017". When Figure 4 is examined, it is seen that the annual production of the sources that publish on bioclimatic comfort has started to increase since 1988, and this increase has gained momentum since 2005.

3.6. Citation Status of The Sources in Which Scientific Studies Are Published And Examining The Source Co-Citation Network

The top 10 sources related to bioclimatic comfort are given in Table 3 according to the number of citations.

Table 3. Sources related to bioclimatic comfort according to citation numbers (Table created from bibliography lists).

Sources	Articles
ENERGY BUILD	857
BUILD ENVIRON	608
ENERGY AND BUILDINGS	518
BUILDING AND ENVIRONMENT	501
INTERNATIONAL JOURNAL OF BIOMETEOROLOGY	328
INT J BIOMETEOROL	318
INT J BIOMETEOROL	316
BUILD ENVIRON	307
SOLAR ENERGY	199
RENEW SUSTAIN ENERGY REV	111

When Table 3 is examined, it is seen that "Energy Build", "Building Environment", "Energy And Buildings" and "Building And Environment" are the top 3 most cited sources.

3.7. Source Citation Network

The visual of the Co-citation network of scientific studies carried out within the scope of bioclimatic comfort is given in Figure 5.

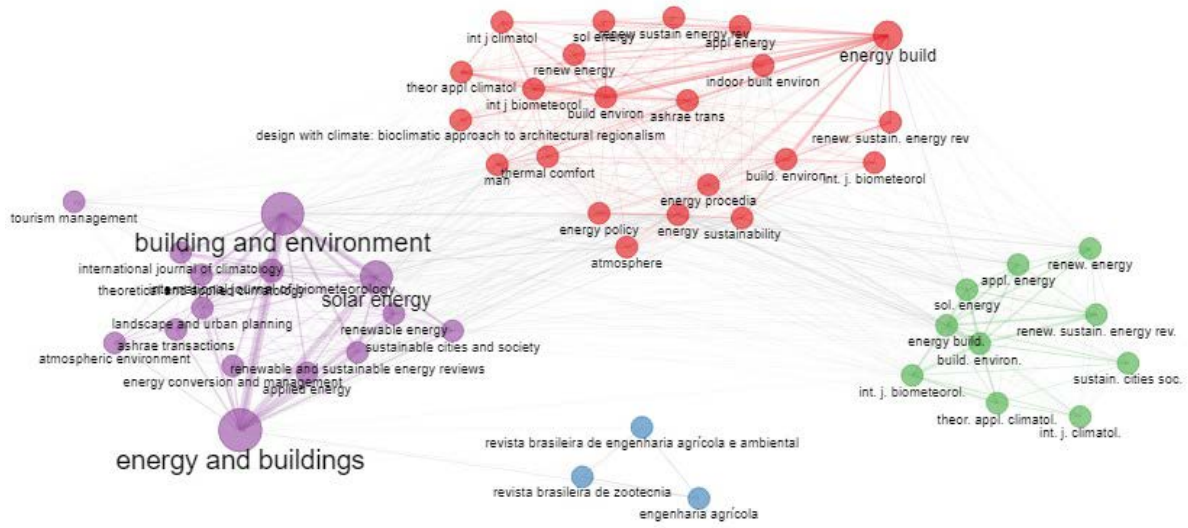

Figure 5. Source citation network.

When the citation networks of the sources in which scientific studies carried out within the scope of bioclimatic comfort are published are examined, it is seen that the citation network consists of 4 clusters. It is possible to say that the citation clusters of the journals "Energy Build", "Build Environ", "Energy and Buildings", "Revista Brasileira de Engenharia Agricola Ambiental" have a common point.

3.8. Examining of Authors Publishing The Most Scientific Studies on Bioclimatic Comfort

Data on the authors with the most number of scientific studies on bioclimatic comfort is given in Table 4.

Table 4. Authors publishing the most scientific studies on bioclimatic comfort.

Authors	Articles
MATZARAKIS A	16
ROSHAN G	15
ATTIA S	11
FURTADO DA	9
MICHAEL A	9
PHILOKYPROU M	8
BERENGUEL M	7
CETIN M	7
SANTAMOURIS M	7
YILMAZ S	7

It appears that in top three authors with the most published works in bioclimatic comfort are Matzarakis A., Roshan G. and Attia S.

3.9. Author co-Citation Network

The visual of the author co-citation network of scientific studies carried out within the scope of bioclimatic comfort is given in Figure 6.

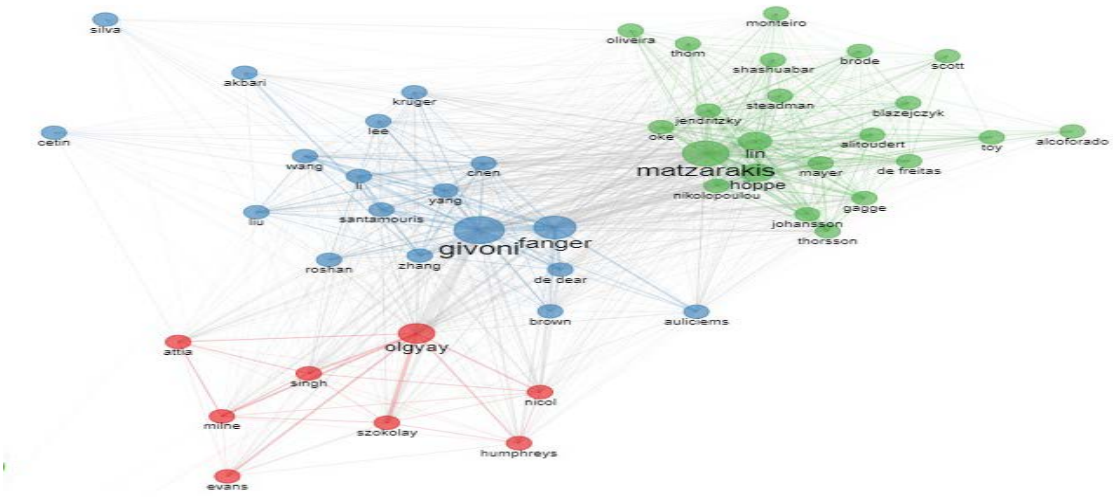

Figure 6. Author co-citation network.

When the author citation networks of scientific documents carried out within the scope of bioclimatic comfort are examined, it is seen that the citation network consists of 3 clusters. It is possible to say that "Baruch Givoni", "Andreas Matzarakis" and "Victor Olgyay" are the common point of author citation clusters.

3.10. Evaluation of Scientific Studies In Terms of Institutions and Countries

The top 10 institutions within the scope of bioclimatic comfort are given in Table 5, and the cooperation network of institutions is given in Figure 7.

Table 5. Institutions that publish the most.

Affiliation	Articles
GOLESTAN UNIVERSITY	23
LOMONOSOV MOSCOW STATE UNIVERSITY	14
NOTREPORTED	14
UNIVERSITY OF CYPRUS	14
UNIVERSIDAD NACIONAL DE COLOMBIA	12
FEDERAL UNIVERSITY OF SANTA CATARINA	11
ISLAMIC AZAD UNIVERSITY	10
UNIVERSITY OF ATHENS	10
KASTAMONU UNIVERSITY	9
UNIVERSIDADE DE LISBOA	9

When the top 5 institutions that make the most publications within the scope of bioclimatic comfort are examined, "Golestan University" (23 publications) is in the first place, "Lomonosov Moscow State University" is in the second place, "University of Cyprus" is in the third place (14 publications), and in the fourth place " Universidad Nacional De Colombia" (12 publications) and "Federal University of Santa Catarina" (11 publications) in fifth place. (Another institution with the 3rd highest number of publications was not reported in the database).

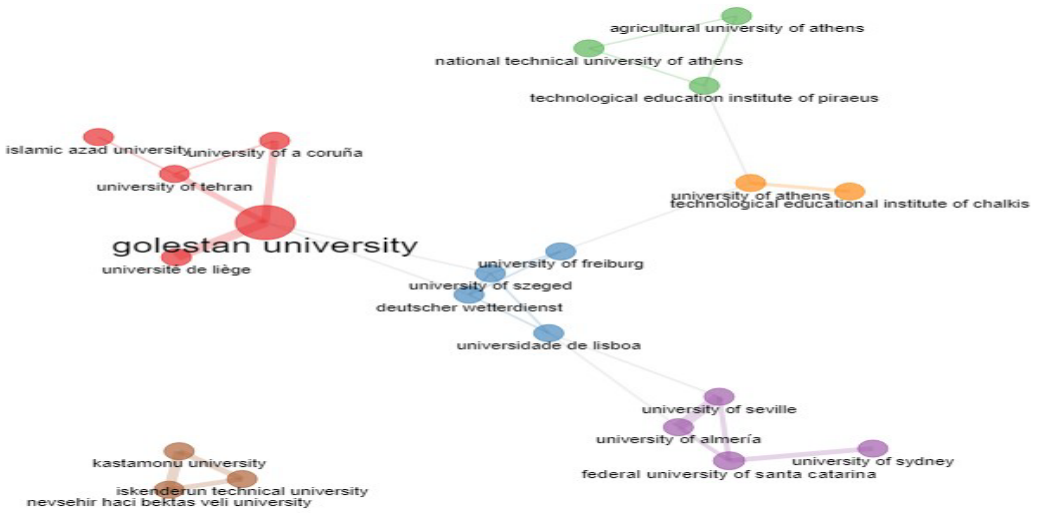

Figure 7. Cooperation network of institutions

When the cooperation network of institutions is examined, it is seen that it consists of 6 clusters. It is seen that the common points of the clusters are "Golestan University",

"National Technical of Athena University", "University of Athens", "University of Szeged", "University of Almeria" and "Kastamon University".

3.11. Examination of Scientific Document Production Frequency of Countries

Distribution of scientific documents related to Bioclimatic comfort by country is given in Table 6, and document production of countries by years is given in Figure 8. The number of citations in scientific studies by country is given in Table 7, the cooperation network of countries Figure 9, world map of cooperation of countries Figure 10.

Table 6. Scientific publication production of countries.

Region	Freq
BRAZIL	249
SPAIN	91
ITALY	85
GREECE	74
IRAN	73
TURKEY	73
MEXICO	60
FRANCE	49
USA	47
CHINA	46

When the distribution of scientific publications on bioclimatic comfort by country is examined; Brazil (249 publications), Spain (91 publications), Italy (85 publications), Greece (74 publications), Iran and Turkey (73 publications) are in the top five secrets.

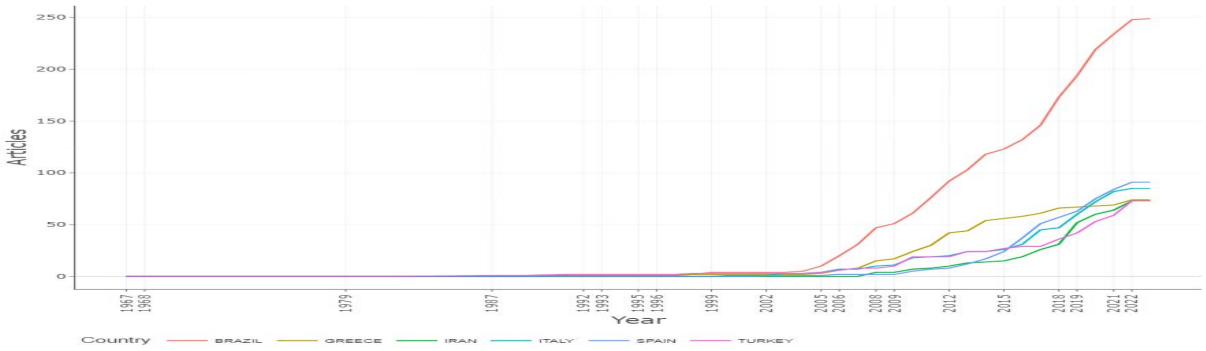

Figure 8. Document distribution of countries by years.

When the distribution of publications by years of the countries that make scientific publications on bioclimatic comfort is examined, it is seen that there has been an increase since 2003-2004. Starting from the aforementioned dates, it is possible to say that the number of publications in almost every country has increased almost every year. Especially in Brazil, it is seen that the number of publications on the subject has gained an increasing momentum.

Table 7. Data on the number of citations by countries in scientific documents.

Country	Total citation
GREECE	1004
TURKEY	692
USA	622
PORTUGAL	478
ITALY	462
GERMANY	436
BRAZIL	421
CHINA	385
SPAIN	366
IRAN	358

When the data on the number of citations in scientific studies conducted in countries are examined, it is seen that Greece (1004 citations), Turkey (692 citations), America (622 citations), Portugal (478 citations) and Italy (462 citations) countries are in the top 5 rank.

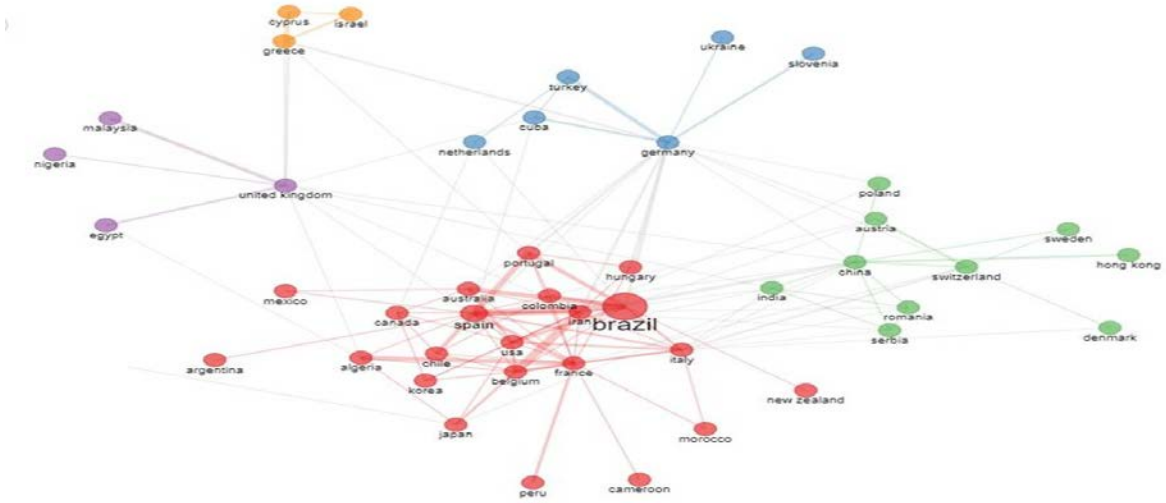

Figure 9. Cooperation network of countries.

When the cooperation network in the countries of the scientific studies carried out within the scope of bioclimatic comfort is examined, it is seen that it consists of 5 clusters. It is possible to say that the countries "Brazil", "Germany", "United Kingdom", "Switzerland", "Greece" are the common point of the cooperation network of countries.

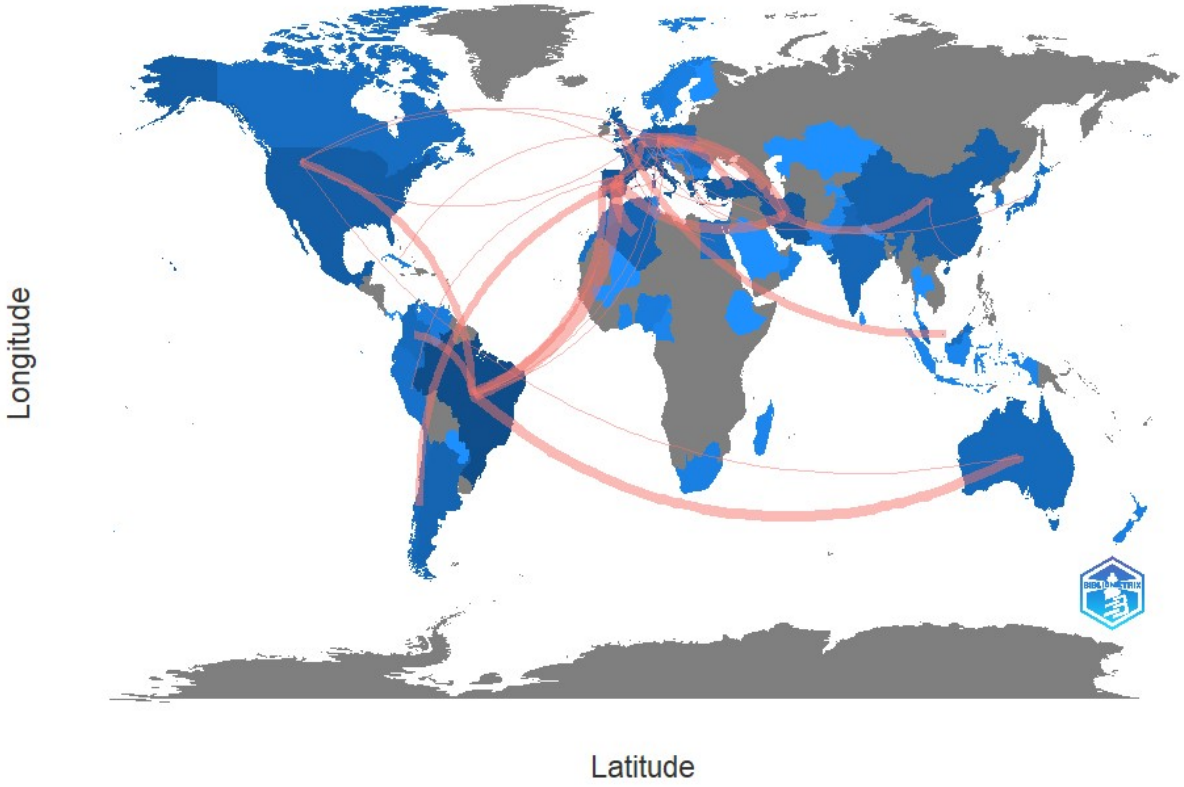

Figure 10. World map of cooperation of countries.

When the cooperation network of the scientific studies conducted within the scope of the subject is examined, it is revealed that the most cooperation is made between Brazil and Spain, Iran and Belgium countries.

3.12. Examining Scientific Studies by Number of Citations

The author of the most cited study worldwide in studies conducted within the scope of bioclimatic comfort, the name of the journal in which the study was published, the accession number of the study, and the list of citations are given in Table 8. Among the studies in the data set, the author of the most cited study in the regional and global area, the name of the journal in which the study was published, the access number of the study and the list of citations are given in Table 9.

Table 8. The most cited author among the studies worldwide, the name of the journal in which the study was published, the accession number of the study and the total number of citations.

Document	DOI	Total citiation
GIVONI B, 1992, ENERGY BUILD	10.1016/0378-7788(92)90047-K	331
THORSSON S, 2004, INT J BIOMETEOROL	10.1007/s00484-003-0189-8	293
GULYÁS, 2006, BUILD ENVIRON	10.1016/j.buildenv.2005.07.001	243
PHILIPPE FX, 2011, AGRIC ECOSYST ENVIRON	10.1016/j.agee.2011.03.012	160
OLIVEIRA S, 2007, INT J BIOMETEOROL	10.1007/s00484-007-0100-0	159
MANZANO-AGUGLIARO F, 2015, RENEWABLE SUSTAINABLE ENERGY REV	10.1016/j.rser.2015.04.095	153
MADER TL, 2010, J ANIM SCI	10.2527/jas.2009-2586	153
CETIN M, 2015, ENVIRON MONIT ASSESS	10.1007/s10661-015-4861-3	147
VANOS JK, 2010, INT J BIOMETEOROL	10.1007/s00484-010-0301-9	146
GEORGI JN, 2010, BUILD ENVIRON	10.1016/j.buildenv.2009.12.003	141

When the table is examined, it is seen that the most citations in the studies related to the subject worldwide belong to the publication titled "Comfort, climate analysis and building design guidelines" in the "Energy Build" Journal of "Baruch Givon" (331 citations). In the second place, the article titled "Thermal bioclimatic conditions and patterns of behavior in an urban park in Göteborg, Sweden" published in the "International Journal of Biometeorology" by "Sofia Thorsson" (293 citations) and in the third place by "Ágnes Gulyás" It appears to belong to an article titled "Assessment of the microclimatic and human comfort conditions in a complex urban environment: modeling and measurements" published in the "Building and Environment" journal (243 citations).

Table 9. Most cited author among the studies in the data set, name of the journal in which the study was published, accession number of the study, regional and global cited numbers (The most locally cited documents).

Document	DOI	Year	Local Citiation	Global Citiation
GIVONI B, 1992, ENERGY BUILD	10.1016/0378-7788(92)90047-K	1992	53	331
MANZANO-AGUGLIARO F, 2015, RENEWABLE SUSTAINABLE ENERGY REV	10.1016/j.rser.2015.04.095	2015	29	153
GAITANI N, 2007, BUILD ENVIRON	10.1016/j.buildenv.2005.08.018	2007	26	113
GULYÁS, 2006, BUILD ENVIRON	10.1016/j.buildenv.2005.07.001	2006	17	243
LAM JC, 2006, ENERGY CONVERS MANAGE	10.1016/j.enconman.2005.05.025	2006	16	93
MAHMOUD AHA, 2011, BUILD ENVIRON	10.1016/j.buildenv.2010.09.007	2011	15	55
VANOS JK, 2010, INT J BIOMETEOROL	10.1007/s00484-010-0301-9	2010	15	146
OLIVEIRA S, 2007, INT J BIOMETEOROL	10.1007/s00484-007-0100-0	2007	15	159
DANESHVAR MRM, 2013, CENT EURO J GEOSCI	10.2478/s13533-012-0118-7	2013	14	54
CETIN M, 2015, ENVIRON MONIT ASSESS	10.1007/s10661-015-4861-3	2015	13	147

When Table 9 is examined, it is seen that the most cited publication on the subject is “Comfort, climate analysis and building design guides” in “Energy Build” by “Baruch Givon” (53 citations locally, 331 citations worldwide). The article titled "Review of bioclimatic architectural strategies for achieving thermal comfort" (29 local citations and 153 citations worldwide) ranks second, and the article titled "Bioclimatic Architecture on the use of outdoor thermal comfort conditions" ranks third.

3.13. Data on Keywords

Keyword cloud, keyword dynamics and keyword formation network were created in order to determine the distribution of keywords and prominent keywords used in scientific articles conducted within the scope of bioclimatic comfort. Keyword find is given in Figure 11, distribution of keywords by years is given in Figure 12, Keyword Co-occurrence Network is given in Figure 13.

Figure 11. Keyword cloud.

When the figure 11 is examined, it is seen that the words "bioclimatology", "climate change", "sustainable development" "ventilation", "energy utilization", "air temperature", "buildings", "climate control", "humidity", "climatology" are among the most frequently used keywords in scientific studies in the field of bioclimatic comfort.

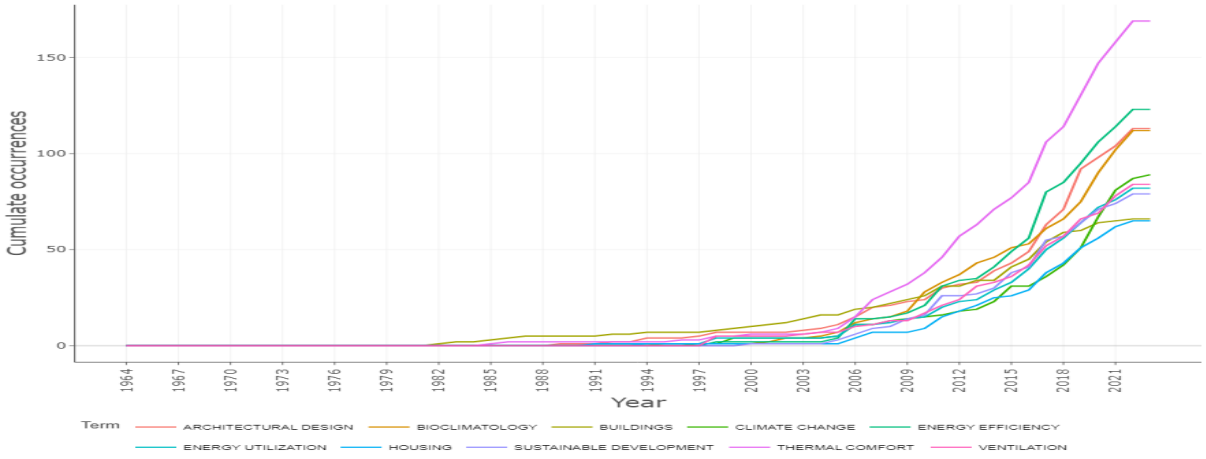

Figure 12. Keyword Dynamics.

When Figure 12 is examined, especially "thermal comfort" (169 times in 2011), "energy efficiency (123 times in 2013), "architectural design" (113 times in 2011), "bioclimatology" (112 times in 2011), " It is seen that the words "climate change" (89 times in 2014) are used more in recent years.

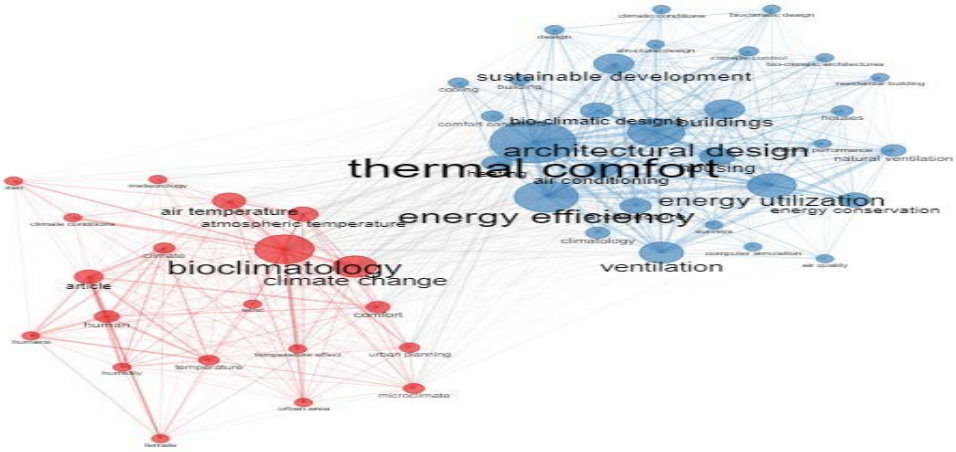

Figure 13. Keyword co-occurrence network.

When the keyword co-occurrence network of scientific studies carried out within the scope of bioclimatic comfort is examined, it is seen that there is not a single word in the center and the keywords form 2 different clusters. In this context, it turns out that the words "bioclimatology" and "thermal comfort" are used intensively, exhibiting separate clusters.

4. Results

In this study, which was carried out with the aim of revealing the general situation of scientific documents related to bioclimatic comfort, it is seen that the number of studies has increased significantly, especially in the last twenty years. In line with this increase, it is possible to say that the significant impact of climate factors on human health has begun to be understood and awareness has been gained. When the general status of the studies on Bioclimatic comfort in the Scopus database is examined, it is seen that a total of 835 studies were conducted between 1964 and 2023, and most of the study documents (518) were in the type of articles. It is seen that the author who produces the most articles is A. Matzarakis, who is an expert in human bioclimatology and urban climatology. It is seen that the journal that produces the most publications in the article type within the framework of the subject is "Building And Environment" and the most cited journal is "Energy Build". This result reveals that the subject of bioclimatic comfort is mostly discussed in the disciplines of climate, environment, energy and structure.

Considering the citation status of scientific documents related to bioclimatic comfort, it is seen that the highest number of regional and global citations is to the article "Comfort, climate analysis and building design guidelines" published by B. Givoni in the "Energy

Build" journal in 1992. When the content of the publication and the scope of the published journal are evaluated, it is seen that the relationship between climatic data, thermal comfort and building design is discussed in the study. When the keyword cloud, keyword co-occurrence network and keyword dynamics are evaluated in the studies on Bioclimatic comfort between 1964 and 2023, it is seen that the keywords that stand out in the studies conducted in the first years are climate change, sustainable development, bioclimatology. In recent years, it is seen that the keywords "thermal comfort", "energy efficiency", "architectural design" are frequently used. Looking at the keyword co-occurrence network, two clusters emerge at the center of the words "bioclimatology" and "thermal comfort". The keywords "climate change, air temperature, atmospheric temperature" come to the fore in the Bioclimatology-centered keyword co-occurrence network. In the thermal comfort-centered keyword co-occurrence network, the words "energy efficiency, architectural design, energy utilization" come to the fore. The keywords "energy efficiency, architectural design, energy utilization" come to the fore in the thermal comfort-centered keyword co-occurrence network. When the change of the keywords used according to the years and the keyword co-occurrence are examined, it is possible to say that the bioclimatic comfort study area has been a subject of interest in researches on energy efficiency and architectural design in recent years.

As a result of the bibliometric analysis of scientific studies conducted within the scope of bioclimatic comfort, it has been revealed that the scope of the concept has developed and changed as a field of study of different disciplines from the starting point to the present. When the development and change aspects of the concept of bioclimatic comfort are evaluated, it can be said that today it has a critical importance in energy efficiency-oriented design studies. Due to the importance of the concept of bioclimatic comfort in terms of ecological sustainability, it should not be ignored by all occupational disciplines with environmental contact. It is thought to be a concept that should be emphasized primarily in both theoretical and practical studies.

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