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Academic Traces of Urban Furniture: A Bibliometric Perspective

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Abstract

Urban furniture, which increases the quality and aesthetics of urban life, has recently been the subject of academic studies. However, a bibliometric and visual analysis in this field has not been conducted in sufficient number. This paper presents a quantitative and descriptive study of 1,063 documents from the Web of Science database (1975-2022) using RStudio's 'Bibliometrix' package. Key bibliometric indicators include 887 documents, 619 references, 582 articles, 12.25 citations per document, 2,558 authors, 1,386 keywords, keywords of 2,968 authors, and a collaboration index of 16.8%. The study found higher scientific productivity in China and the USA. Research status, influential sources, countries, institutions, authors, keywords and data relationships were analysed. In particular, it was observed that academic interest increased after 2000 and focused on technology, environment and urban disciplines rather than architecture. The keywords (Author's Keywords and Keywords plus) vary, with a focus on the urban field of study and the health and environment field of study, but both keywords are increasing. The paper recommends increased interdisciplinary co-operation to broaden the scope of urban furniture research. This is one of the first comprehensive bibliometric and content analyses on urban furniture.

Keywords: *Bibliometric, Landscape architecture, Urban furniture, RStudio, Web of Science (WoS)*

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Kent Mobilyalarının Akademik İzleri: Bibliyometrik Bir Bakış

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Öz

Kentsel yaşam kalitesini ve estetiğini artıran kent mobilyaları son dönemde akademik çalışmalara konu olmaktadır. Ancak bu alanda bibliyometrik ve görsel bir analiz yeterli sayıda yapılmamıştır. Bu makale, RStudio'nun 'Bibliometrix' paketini kullanarak Web of Science veri tabanından (1975-2022) 1.063 belge üzerinde nicel ve tanımlayıcı bir çalışma sunmaktadır. Temel bibliyometrik göstergeler arasında 887 belge, 619 referans, 582 makale, belge başına 12,25 atıf, 2.558 yazar, 1.386 anahtar kelime, 2.968 yazarın anahtar kelimeleri ve %16,8'lik bir iş birliği endeksi bulunmaktadır. Çalışma, Çin ve ABD'de daha yüksek bilimsel üretkenlik tespit etmiştir. Araştırma durumu, etkili kaynaklar, ülkeler, kurumlar, yazarlar, anahtar kelimeler ve veri ilişkileri analiz edilmiştir. Özellikle akademik ilginin 2000 sonrasında arttığı ve mimarlıktan ziyade teknoloji, çevre ve kentsel disiplinlere odaklandığı görülmüştür. Anahtar kelimeler (Yazarın Anahtar Sözcükleri ve Anahtar Sözcükler plus) arasında farklılıklar görülmesiyle birlikte, kent çalışma alanı ile sağlık ve çevre çalışma alanı üzerine odaklanılmıştır ancak her iki anahtar kelimede giderek artan bir yükseliş göstermektedir. Makale, kent mobilyaları araştırmalarının kapsamını genişletmek için disiplinler arası iş birliğinin artırılmasını önermektedir. Bu çalışma, kent mobilyaları üzerine yapılan ilk kapsamlı bibliyometrik ve içerik analizlerinden biridir.

Anahtar Kelimeler: *Bibliometrik, peyzaj mimarlığı, kent mobilyaları, RStudio, Web of Science (WoS)*

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Introduction

The term "urban furniture" or "street furniture" emerged in Europe and North America in the 20th century, encompassing elements like seating, lighting, and transportation that enhance urban comfort and aesthetics (Esen, 2007, p. 39; Ruggiero et al., 2018, p. 664; Soffritti et al., 2020, p. 1; Tarakci, 2003, p. 21). Originating with gas lamps in 1850s England, urban furniture quickly became integral to urban architecture in Europe and America (Durmus, 2008, p. 11). Modern advancements include smart technology and virtual reality (Liu et al., 2021, p. 2; Premier et al., 2022, p. 335), making it a multidisciplinary study topic (Yang et al., 2022, p. 72896).

Bibliometric analysis, which uses statistical methods to analyze publications and trends in a field, can determine the academic validity and development of urban furniture studies (Siyavus & Aydin, 2022, p. 164; Jones et al., 2011, p. 36; Yurdakul, 2021, p. 2; Fan & Chen, 2022, p. 80). This study provides a comprehensive bibliometric analysis of urban furniture, examining trends, influential sources, countries, institutions, authors, and keyword relationships to identify potential research topics in this field.

Cities change according to people's lifestyles, traditions, and needs. Rapid urbanization and technological developments have had a faster impact on the change of cities, causing people to spend more time in urban spaces (Bulut & Atabeyoğlu, 2007, p. 2432; Yang et al., 2022, p. 7289). The increased time people spend in urban spaces has made urban spaces more critical. As a result, urban furniture was needed, and urban furniture started to meet the comfort of urban spaces (Akyol, 2006, p. 34; Ghorab & Caymaz, 2014, p. 757; Ghorab, 2015, p. 33).

The terminology "urban furniture" or "street furniture" emerged in Europe and North America in the 20th century and refers to urban elements that provide comfort and environmental quality in urban areas and serve essential functions such as seating, transportation, lighting, protection, communication, play and sports (Esen, 2007, p. 39; Ruggiero et al., 2018, p. 664; Soffritti et al., 2020, p. 1; Tarakci, 2003, p. 21). While urban furniture provides comfort for individuals in urban spaces, it also allows urban life to create a more enjoyable and urban aesthetic (Tarakci, 2003, p. 22; Esen, 2007, p. 40).

The first urban furniture in England in the 1850s was gas lamps used for lighting. Afterward, it was used frequently in European countries and

America and had an essential share in urban architecture in a short period (Durmus, 2008, p. 11). Today, urban furniture with intelligent technology and virtual reality technology has emerged (Liu et al., 2021, p. 2; Premier et al., 2022, p. 335). Urban furniture, which increases the livability of cities and serves people by improving the quality of the environment, is the subject of interdisciplinary study today (Yang et al., 2022, p. 72896). It is crucial as a common subject of study in technology, environment, design, art, architecture, and landscape architecture. However, it is necessary to determine the validity of urban furniture in the academic field and the course of the subject.

In this context, looking at academic studies in the literature is one of the methods that can be used to determine the current validity of a topic in a field (Siyavus & Aydin, 2022, p. 164). This method, called bibliometric analysis, provides a comprehensive result to the researcher about the trend of studies on a particular subject in a field in line with the data obtained (Jones et al., 2011, p. 36; Ruggiero et al., 2018, p. 663). Bibliometrics is a method of analysis that numerically shows the publications made by individuals or institutions in a particular area in a certain period in a specific region and the relationships between these publications. It is the application of mathematical and statistical methods to show the processing of textual information and the development of the nature and trends of a discipline by calculating and analyzing different levels of textual information (Yurdakul, 2021, p. 2; Fan & Chen, 2022, p. 80).

This method can also be utilized for the status of urban furniture in different fields. This analysis method has been applied to various landscape architecture and architecture subjects, but studies have yet to be conducted on urban furniture. For this reason, the main objective has been to provide a bibliometric analysis of urban furniture in literature. In this context, in this study, a comprehensive bibliometric analysis was conducted to see the trends and current approaches in urban furniture use and to identify potential study topics in this field. The topics analyzed are general data on urban furniture studies, the most influential sources in the studies, the most influential countries and institutions, the analysis of essential authors, and the analysis of keywords and relationships between study data.

Materials and Methods

This study aimed to address the gap in quantitative and qualitative reviews of academic research on urban furniture by analyzing the most influential sources, countries, institutions, authors, and keywords. The study used bibliometric analysis to examine academic publications on urban furniture from 1975 to 2022. Detailed bibliometric data on research on urban furniture were obtained in three successive stages (Fig. 1).

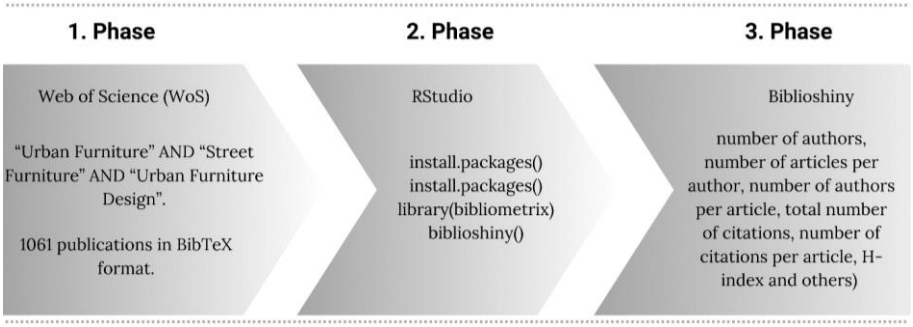

Fig 1. Method flow of the study

In the first stage, relevant documents were identified from the Web of Science (WoS) database, chosen for its authoritative and comprehensive coverage of respected journals (Chen, 2017, p. 3; Zhao et al., 2019, p. 76). The search query, applied on 18.08.2023, used keywords related to urban furniture, yielding 1,061 documents.

The second stage involved performing bibliometric analysis using the R programming language (Aria & Cuccurullo, 2017, p. 962; Cyriac & Firoz, 2022, p. 300; Gonçalves vd., 2023, p. 1466; Peng & Ye, 2021, p. 49). Bibliometric tools provided a comprehensive analysis of the published literature, including trends in publications, keywords, and citations (Zhang et al., 2023, p. 3; Wu & Ren, 2019, p. 243). R and its Bibliometrix package were selected for this purpose (Aria & Cuccurullo, 2017, p. 961).

In the third stage, the dataset in BibTeX format was analyzed using RStudio and the Bibliometrix package, along with its Biblioshiny visual

interface. This analysis produced key bibliometric indicators, identified principal authors, and revealed relevant keywords and citation patterns. Excel was used for tabulating the study's general information.

Results

The 1,063 studies identified were filtered in the Biblioshiny tool to include only English publications up to 2022. The analysis was conducted under seven headings:

1)Main Information on Urban Furniture Works 2)Most Influential Sources
Most Influential Countries and Institutions 3)Analysis of Important Authors 4)Analysis of Keywords 5)Relationships between Study Data These categories provided a comprehensive overview of the academic literature on urban furniture in the Web of Science (WoS) database (Emsen, 2022, p. 4; Matsler et al., 2021, p. 3).

Main Information on Urban Furniture Works

The analysis of 1,063 studies from the WoS database, filtered through the Biblioshiny package, resulted in 887 studies being included. The first publication on urban furniture in the WoS database was in 1975. Between 1975 and 2022, there are 887 documents from 619 sources, with journal articles (582) having the most significant impact. The "Average Annual Growth Rate" of the documents is 8.38%, and the "Average Age of Documents" is 8.77 years. Most documents are articles (582) and papers (263), with additional publications from book chapters and reviews.

The 887 documents have a total of 25,990 references, averaging 11.25 citations per document, indicating their influence (Jones et al., 2011, p. 37; Roldan-Valadez et al., 2019, p. 940). There are 2,558 authors, with 165 single-author publications. The "Co-Author Ratio" is 3.28 per document, and the international author collaboration rate is 16.8%. The dataset includes 1,386 keywords (ID) and 2,968 author keywords (DE), which help understand the document content and how authors describe their work (Table 1).

Table 1. Highlights general information according to the WoS database of urban furniture

Main Information About Data	Findings
Database Summary	**Number**
Timespan	1975:2022
Total Sources	619
Total Documents	887
Annual Growth Rate	%8.38
Document Average Age	8.77
Average citations per doc	11.25
Total References	25990
Authors	2558
Authors of single-authored docs	165
Co-Authors per Doc	3.28
International co-authorships	%16.8
Document Type	**Number**
Article	582
Proceedings Paper	263
Book (Book, Book Review)	4
Review	13
Art Exhibit Review	3
Editorial	13
Note	2
Other	7
Document Contents	**Number**
Keywords Plus (ID)	1386
Author's Keywords (DE)	2968

Most Influential Sources in the Studies

The number of publications and their citation impact are key indicators of academic development in urban furniture research. High citation counts and an increasing number of publications suggest significant academic influence (Roldan-Valadez et al., 2019, p. 941; Emsen, 2022, p. 22).

"A + U-Architecture and Urbanism" is the most prolific source with 27 studies on urban furniture. Among the top 10 sources, there are nine articles and one paper, spanning fields such as architecture, urban research, environmental sciences, ecology, science, technology, physical geography, and remote sensing (Table 2).

Academic activity is also measured by citation counts, with "Atmospheric Environment" having the highest at 913 citations, followed by "Building and Environment" with 280 citations (Table 2). Despite having the most publications, "A + U-Architecture and Urbanism" is the least

cited, possibly due to its publication span from 1983 to 2016. This summary highlights the key academic sources and their influence in the field of urban furniture research.

Table 2. It emphasizes the general knowledge of the most effective sources of urban furniture

Journal	Sc	WoS Index	H Index	G Index	M Index	Total Citation	P. Year	Document Type	Count
A + U-Architecture and Urbanism	Architecture	(A& HCI)	1	1	0,024	1	1982-2021	Article	27
Sustainability	Science\& Technology	(SCI-Expanded); (SSCI)	3	6	0,6	57	2019-2022	Article	16
Building And Environment	Construction \& Building Technology; Engineering	Science (SCI-Expanded)	9	13	0,529	280	2007-2022	Article	11
Atmospheric Environment	Environmental Sciences \& Ecology; Meteorology	(SCI-Expanded)	9	10	0,5	913	2005-2022	Article	10
Design	Art	(A& HCI)					1975-1991	Article	10
Science of the Total Environment	Environmental Sciences \& Ecology	(SCI-Expanded)	5	9	0,179	243	1996-2022	Article	8
Landscape And Urban Planning	Environmental Sciences \& Ecology; Geography; Physical Geography; Public Administration;	(SCI-Expanded); (SSCI)	6	8	0,286	127	2003-2022	Article	7

	Urban Studies								
3rd World Multidisciplinary Civil Engineering, Architecture, Urban Planning Symposium (WMCAUS 2018)	Architecture; Engineering; Urban Studies	(CPCI-S); (CPCI-SSH)	3	3	0,6	12	2019	Proceedings Paper	7
Cities	Urban Studies	Index (SSCI)	5	7	0,417	139	2012-2022	Article	6
ISPRS Journal of Photogrammetry and Remote Sensing	Physical Geography; Geology; Remote Sensing; Imaging Science \& Photographic Technology	(SCI-Expanded)	5	7	0,417	259	2012-2022	Article	6

Interpreting all indexes and values is crucial for discussing a source's academic effectiveness (Jones et al., 2011, p. 37). Table 3 reveals that "Building and Environment" and "Atmospheric Environment" are the most influential journals based on the h and g indexes. These journals have consistently produced highly cited publications. The m-index of "Sustainability" is the highest among the top ten sources, indicating recent but impactful publications, with its first publication on urban furniture in 2019.

The top 10 sources in urban furniture research span various fields, including architecture and art, demonstrating its interdisciplinary nature. Among these, "Urban Design International" is the most effective, with the highest number of citations (28) and h-index. The most influential journals in architecture and art fields are primarily indexed in ARTS & Humanities Citation Index (A&HCI) and Social Science Citation Index (SSCI).

The m and h index values indicate that "Urban Design International," "Open House International," and "The Journal of Asian Architecture and Building Engineering" have published highly cited works. "Frontiers of Architectural Research," with a high m-index and h-index of 2, began publishing on urban furniture in 2020 and is gaining prominence (Table 3).

Table 3. Emphasizes the general knowledge of the resources involved in architecture and art disciplines in urban furniture

Journal	Sc	WoS Index	H Index	G Index	M Index	Total Citation	P. Year	Document Type
Urban Design International	Architecture; Public Administration; Urban Studies	(SSCI); (A& HCI)	2	3	0,222	28	2015-2022	Article
Frontiers Of Architectural Research	Architecture	(A& HCI)	2	2	0,5	11	2020-2022	Article
Open House International	Architecture; Environmental Sciences \& Ecology; Urban Studies	(SSCI); (A& HCI)	2	3	0,182	15	2013-2022	Article
Journal Of Asian Architecture and Building Engineering	Architecture; Construction \& Building Technology	(A& HCI)	2	3	0,182	11	2013-2022	Article
Metu Journal of The Faculty of Architecture	Architecture	(A& HCI)	1	1	0,2	3	2019	Article
Landscape Architecture Frontiers	Architecture	(ESCI)	1	1	0,143	2	2017	Article
Megaron	Architecture	(ESCI)	1	1	0,25	3	2021-2022	Article
Architectural Design	Architecture	(A& HCI)	1	1	0,056	3	2006-2018	Article

Journal Of Design History	Art	(A& HCI)	1	1	0,077	3	2011-2022	Book Review Article
Journal Of Green Building	Art	(A& HCI)	1	1	0,111	5	2015	Article

The impact of academic sources in the field of urban furniture can be assessed through various metrics, such as the number of journal articles published annually and conference papers presented (Eyre-Walker & Stoletzki, 2013, p. 2). Analysis of publication longevity and trends over time reflects academic interest in the subject (Emsen, 2022, p. 23). Figure 2 illustrates the evolution of key sources in urban furniture research.

The "A + U-Architecture and Urbanism" journal shows significant development, with publications spanning from 1982 to 2021. "Atmospheric Environment" began publishing on urban furniture in 2005, while "Building and Environment" started post-2005 and experienced rapid growth. Conversely, "Design" magazine, which initiated urban furniture publications in 1975, ceased publishing after 1991. "Sustainability" magazine saw a substantial increase in publications after 2017 (Fig 2). This analysis highlights the changing landscape of academic contributions to urban furniture research over time.

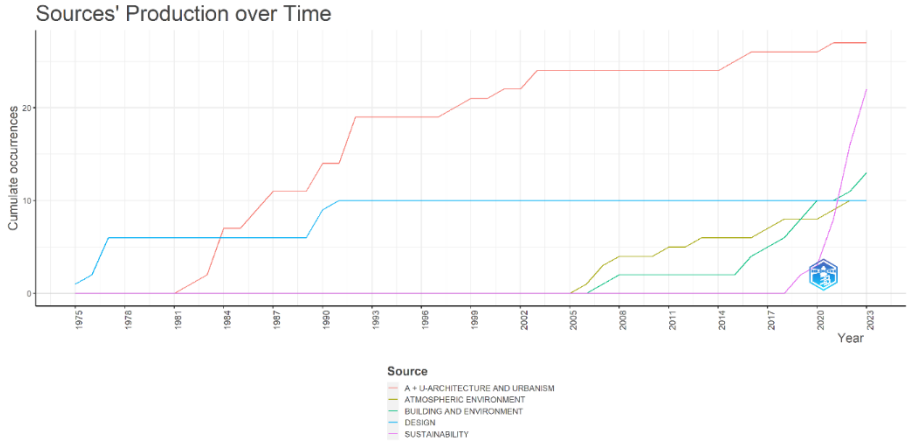

Fig 2. Highlights the increase in the emergence of the most effective sources of urban furniture over the years

The Most Influential Countries and Institutions in the Studies

The data from this analysis reveals the level of engagement and productivity of countries in the field of urban furniture research (Jones et al., 2011, p. 38). Table 4 indicates the frequency of each country's involvement in this area of study. China leads in scientific output, followed by the USA and the UK, reflecting their prominent roles in publications on urban furniture. Spain and Portugal also make significant contributions regionally. Turkey demonstrates robust research and publication activity, while Germany and Brazil contribute significantly to the field (Table 4).

Table 4. Highlights general information on the most influential countries and regions for urban furniture

Region	Frequency	Country	Total Citation	Average Article Citations
China	398	USA	2232	29,00
USA	292	China	1504	13,70
UK	169	United Kingdom	1204	19,70
Spain	160	Germany	836	31,00
Italy	155	Spain	797	16,30
Türkiye	103	Italy	461	7,90
Portugal	94	Belgium	293	29,30
Iran	84	Sweden	226	16,10
Germany	81	Canada	206	13,70

Examining article production by country reveals notable contributors: China (110), the USA (77), the UK (61), Italy (58), and Spain (49) have published significant numbers of articles. Single-Authored Publications (SCP) highlight individual researchers' contributions, with China and the US leading in single-authored articles. The Frequency value indicates how articles are categorized (SCP or MCP). For instance, the UK and Spain prioritize multi-authored articles. The Level of Collaboration (MCP_Ratio) among countries reflects collaborative efforts, with Germany and the UK showing higher MCP_Ratio values, indicating more international collaborations (Table 5).

Table 5. Emphasizes information on article production in urban furniture

Country	Articles	SCP	MCP	Frequency	MCP_Ratio
China	110	95	15	0,126	0,136
USA	77	68	9	0,088	0,117
United Kingdom	61	48	13	0,07	0,213
Italy	58	46	12	0,066	0,207
Spain	49	38	11	0,056	0,224
Turkey	36	35	1	0,041	0,028
Germany	27	19	8	0,031	0,296
Poland	27	24	3	0,031	0,111
Iran	23	19	4	0,026	0,174

Figure 3 illustrates the publication trends of countries in urban furniture research over time. The USA led in publications from 1995 to 2015, with China surpassing it thereafter. All countries experienced an increase in urban furniture studies during the period analyzed (Fig 3).

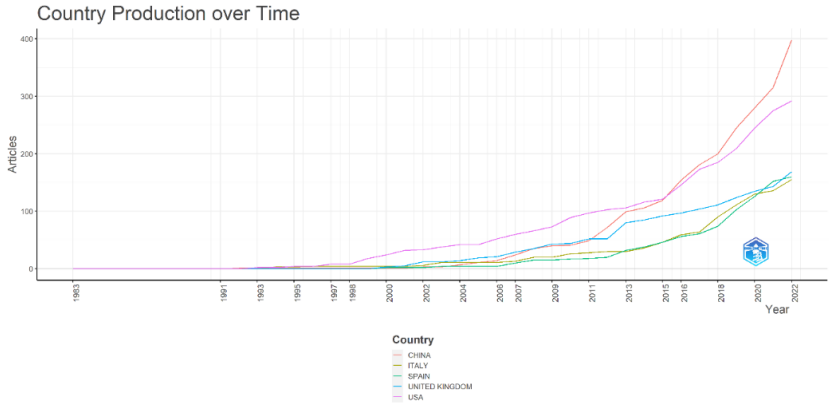

Fig 3. Highlights the production increase of countries over the years 1975-2022 on urban furniture (Countries' Production over Time).

Figure 4 displays bibliometric indicators based on the number of citations received by countries. The USA leads with 2232 citations, underscoring its significant impact on academia. Despite China's highest publication count, its 1504 citations indicate relatively lower citation impact, placing it second in this indicator. Germany ranks fourth with 836 citations despite fewer publications compared to other countries. Similar influential contributions are noted from Belgium, Sweden, Canada, and Denmark, despite not being among the top 10 countries in terms of publication quantity (Fig 4).

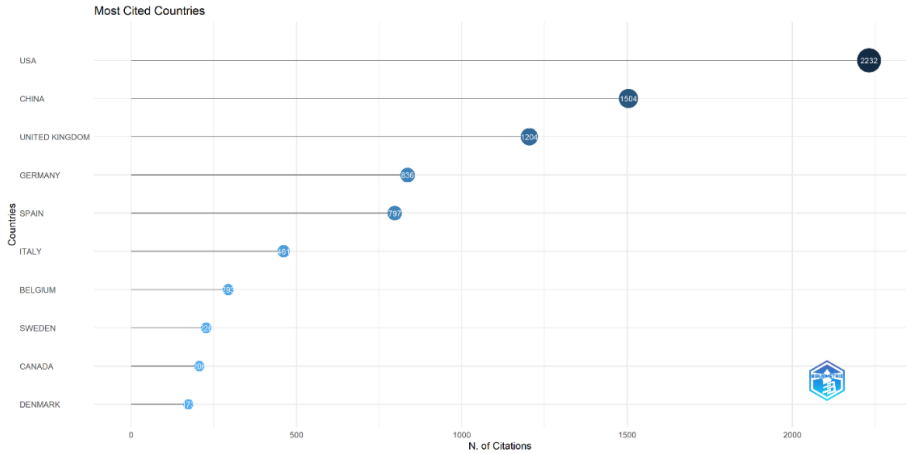

Fig 4. Highlights the most cited countries for urban furniture in 1975-2022 (Most Cited Countries).

Examining institutional effectiveness is crucial for understanding their contributions to academic fields, particularly as centers for research development and dissemination. Islamic Azad University stands out with the highest publication output on urban furniture, largely due to all Iranian publications originating from this institution. In China, despite numerous publications, contributions are spread across institutions like Hong Kong Polytechnic University, Nanjing Forestry University, Wuhan University, and Fudan University, affecting their rankings. Over time, Hong Kong Polytechnic University emerged as a leader in urban furniture research from 2002 to 2004, while institutions like Islamic Azad University, Ferrara University, and Nanjing Forestry University have shown rapid growth since 2017 (Figures 5 and 6).

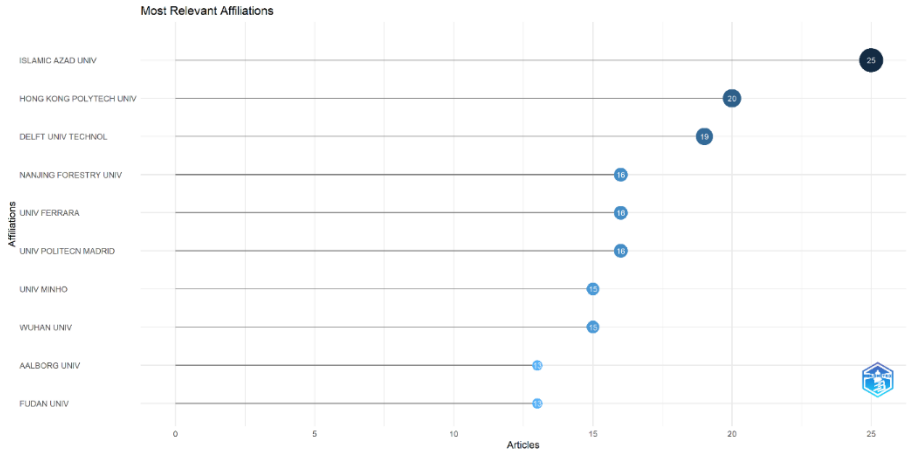

Fig 5. Highlights the most relevant universities about urban furniture (Most Relevant Affiliations)

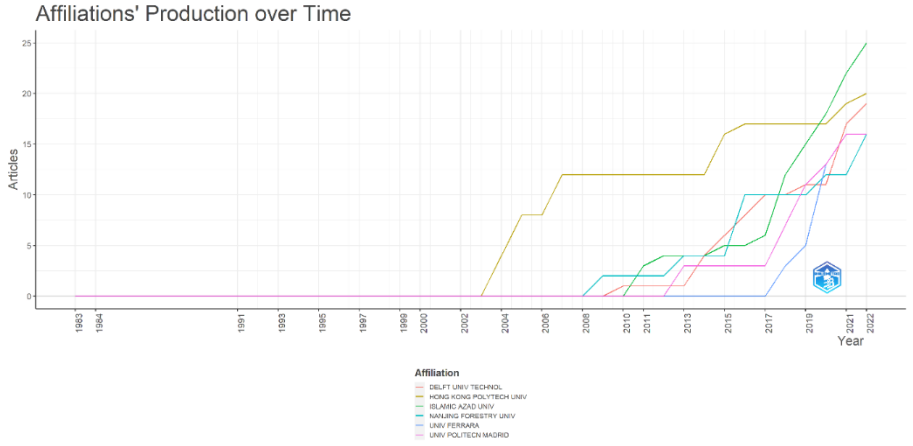

Fig 6. Highlights the increase in universities' production of urban furniture between 1975 and 2022 (Affiliations' Production over Time)

Figure 7 in Biblioshiny visualizes connections between countries and institutions in urban furniture research. China, a leading country in this field, shows connections with the USA and clusters with other countries like Korea, Japan, and Canada in the purple cluster. Nine clusters highlight different research focuses, with China prominently involved in the purple cluster. Nearby are the green cluster (Turkey, Spain, India) and the blue cluster (Germany, Iran, Egypt), indicating shared research interests rather than specific topics (Figure 7a).

Institutionally, Hong Kong Polytechnic University leads in collaborative efforts, particularly with Wuhan University within the purple cluster. Conversely, Islamic Azad University, despite its high publication output, collaborates with authors from only two institutions (Figure 7b).

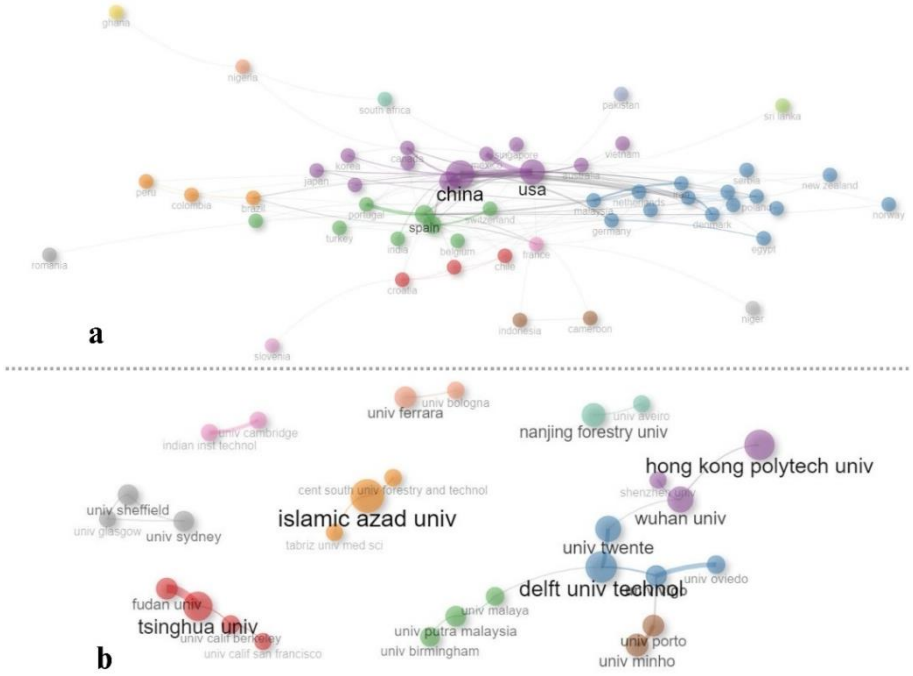

Fig 7. Emphasizes the co-creation of datasets on urban furniture in a) countries, b) universities

Analysis of the Important Authors of the Studies

Table 6 evaluates author effectiveness in urban furniture based on index values, total citations (TC), number of publications (NP), and year of first publication (PY-Start) (Jones et al., 2011, p. 38). Chen J and Wang Y emerge as the most influential researchers in the field. The table identifies the top ten authors by their contributions and impact (Roldan-Valadez et al., 2019, p. 944) (Table 6).

Table 6. Highlights the index, TC, NP, and PY-Start information of most authors and authors of urban furniture

Element	H_Index	G_Index	M_Index	TC	NP	PY_Start
Chen J	5	5	0,556	65	5	2015
Wang Y	5	7	0,556	63	7	2015
Li F	4	4	0,5	34	4	2016
Li X	4	4	0,5	165	4	2016
Li Y	4	4	0,667	73	4	2018
Liu Y	4	6	0,8	49	6	2019
Sundell J	4	4	0,364	68	4	2013
Zhang X	4	5	0,308	159	5	2011
Calzolari L	3	3	0,5	13	5	2018

Figure 8 presents a bibliometric indicator highlighting the prominent authors in urban furniture research. The size of each circle denotes the number of published articles by each author, while the intensity of the circle's color reflects the citations received by their articles. Most authors typically published one or two articles on the topic within the same year (Fig. 8).

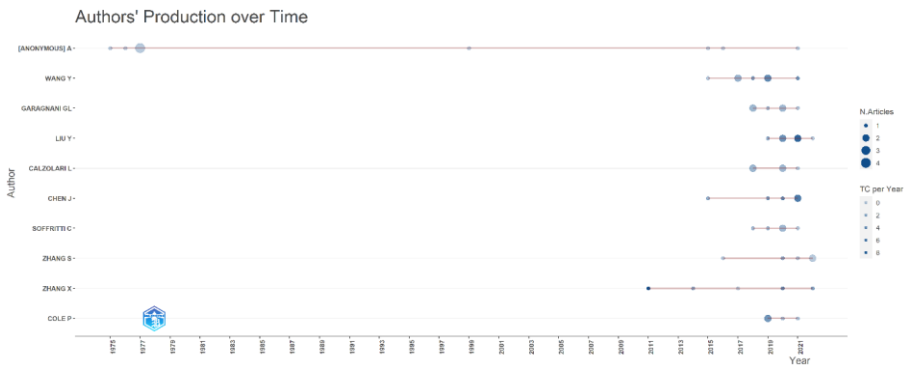

Fig 8. Graphic representing authors' production over time of urban furniture (Authors' Production over Time)

Figure 9a illustrates the collaboration network among authors in urban furniture research, visually representing their collaborative relationships. This network structure depicts how researchers collaborate on publications and other academic activities (Gonçalves et al., 2023, p. 1463). It provides insights into the interactions between different researchers in the field. Figure 9b presents the co-citation analysis in urban furniture, examining the similarity between academic publications and the frequency

with which pairs of articles are cited together (Gonçalves et al., 2023, p. 1464). The analysis identifies three clusters within a dispersed network of publications, indicating diverse approaches to the topic (Fig 9).

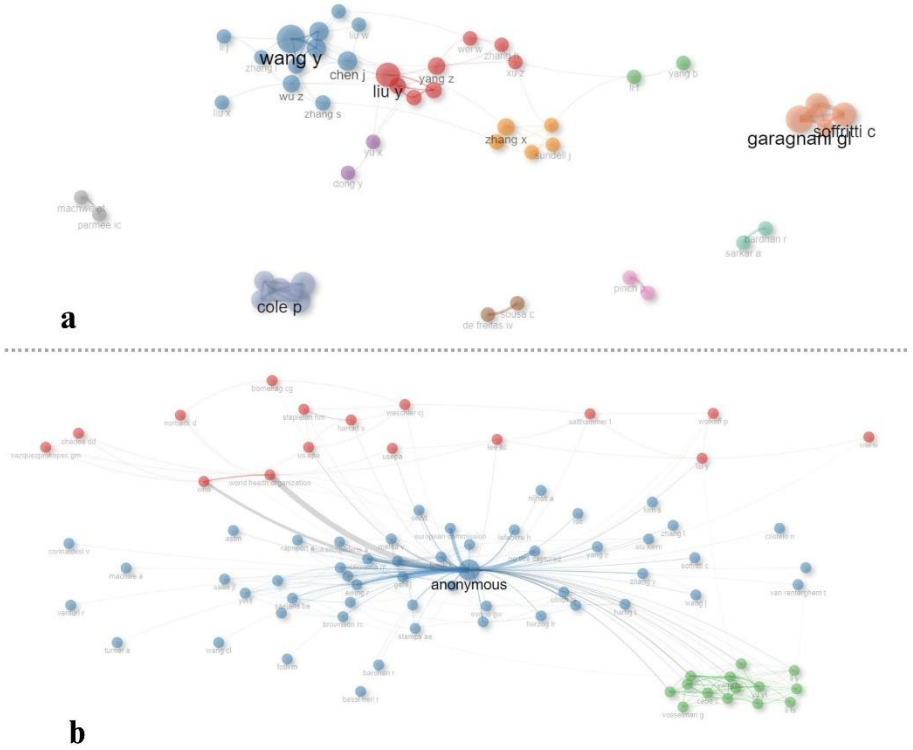

Fig 9. a) Highlights the collaborative network of influential authors on urban furniture; b) Co-citation analysis of authors

Analysis of Keywords Used in Studies

Keywords play a crucial role in identifying trends, tendencies, and trajectories in academic research (Emsen, 2022, p. 23). They provide insights into the potential future popularity of topics. In the bibliometric analysis, two types of keyword results were obtained: author's keywords and keywords plus keywords. Table 7 presents the top ten most frequently used keywords in urban furniture publications, showing distributions of their frequencies. Key terms such as "street furniture," "furniture," "urban," and "urban furniture" are prominently featured, indicating the primary focus areas of the studies. These terms highlight significant trends within the field. While studies cover various scientific fields beyond architecture and

art, they predominantly emphasize these core topics. Additionally, the research is influential in areas such as "urban design," "public space," "smart city," and "sustainability," demonstrating its relevance to related and interconnected subjects (Table 7).

Table 7. Highlights the frequency of use of keywords between 1975 and 2022

Author's keywords		Keywords Plus	
Terms	**Frequency**	**Terms**	**Frequency**
street furniture	29	exposure	26
furniture	21	health	24
urban	21	design	22
urban furniture	19	behavior	21
design	16	urban	21
sustainability	15	City	20
urban design	15	model	16
public space	14	quality	16
smart city	11	volatile organic-compounds	15
point cloud	10	children	13

The keywords "exposure," "health," "design," "behavior," "urban," and "city" are central to the focus of urban furniture studies. These plus keywords highlight significant trends within the field, indicating a strong emphasis on topics related to design and health ("exposure" and "health"). The presence of urban issues ("urban" and "city") underscores the study's focus on urban environments and related themes. "Behavior" pertains to human behavior, while "model" suggests discussions on potential frameworks or approaches. Notably, "volatile organic-compounds" stands out distinctly from the authors' keywords, suggesting a connection to chemical compound issues in urban furniture research. Visualizations such as WordClouds and TreeMaps were created for both "author's keywords" and "keywords plus" (Figure 10a, b). These visual aids facilitate a quick overview of the main topics and prominently featured terms in urban furniture research (Chen, 2017, p. 5), enhancing the analysis of key keywords (Figure 10a, b).

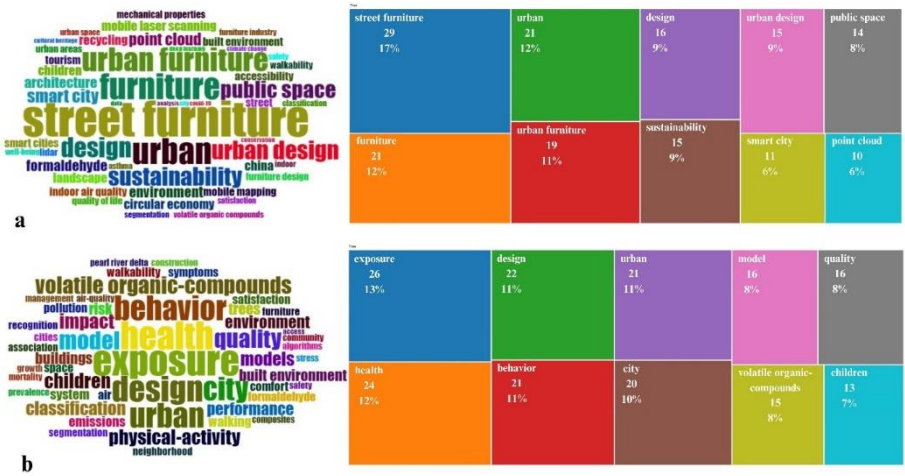

Fig 10. WordCloud and TreeMap visual analysis of the most relevant keywords: a) Author's Keywords; b) Keywords plus

The graph in Figure 11a illustrates the frequency of occurrence of Author's Keywords in academic studies over the years, highlighting 2013 as a pivotal point. While there are no significant differences among keywords, "street furniture" stands out as an early term from 1999 onwards, steadily increasing up to the present. The overall trend shows a rising frequency of these analyzed keywords, suggesting their growing prominence, particularly noticeable in 2021. Figure 11b, which displays Keywords Plus, indicates that "exposure" saw an increase between 1999 and 2001, while "urban" experienced consecutive rises from 2001 to 2003. Over time, these two keywords alternated in dominance, with "exposure" eventually taking the lead. The keyword "urban" demonstrated sustained growth, often in conjunction with other terms. Comparing common terms like "design" and "urban" between the two types of keywords, the Author's Keyword graph shows both began to gain traction around 2009-2011. In the Keywords Plus graph, "design" surged after 2009, whereas "urban" saw significant increases between 2001-2003. Despite parallel growth trends, "urban" emerged earlier in the Author's Keyword analysis, indicating a stronger emphasis and relevance in urban-focused studies (Fig 11).

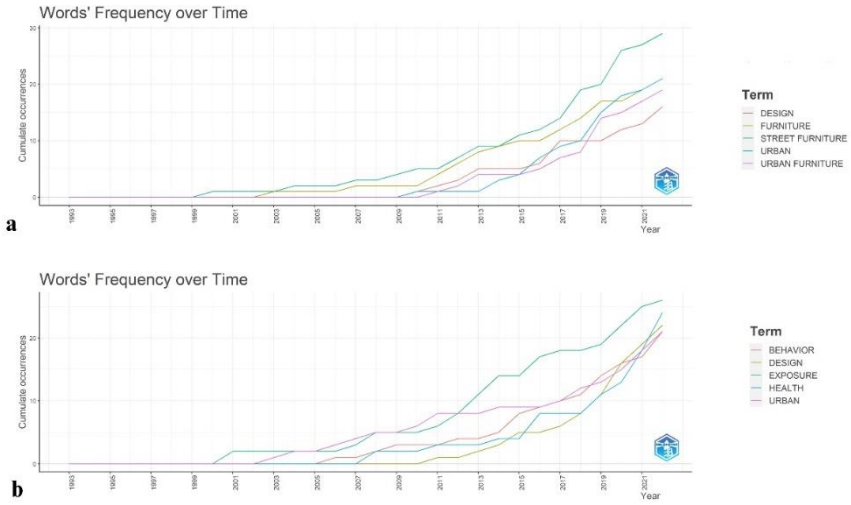

Fig 11. Emphasizes the increase in the occurrence of keywords over the years (Words' Frequency over Time) a) Author's Keywords; b) Keywords Plus

When examining the graphs in Figure 12, it becomes evident that recent trends in keyword usage align closely with Table 7, where circle size reflects frequency of use. Initially, terms like "formaldehyde," "indoor air quality," "asthma," and "mechanical properties" predominated in Author's Keywords. In contrast, more recent periods have seen a shift towards urban-related terms such as "well-being," "safety," "smart cities," "urban design," "urban furniture," "urban," and "environment." This shift suggests a stronger urban focus within the field of urban furniture (Fig 12).

In the Keywords Plus graph, terms like "formaldehyde," "outdoor air," "urbanization," "children," and "symptoms" were prominent initially. However, recent trends highlight keywords such as "impact," "environments," "satisfaction," "cities," "safety," "model," "design," and "buildings" as increasingly frequent and relevant in studies. This indicates that academic research on urban furniture will likely continue to emphasize urban areas, environment, and quality of life.

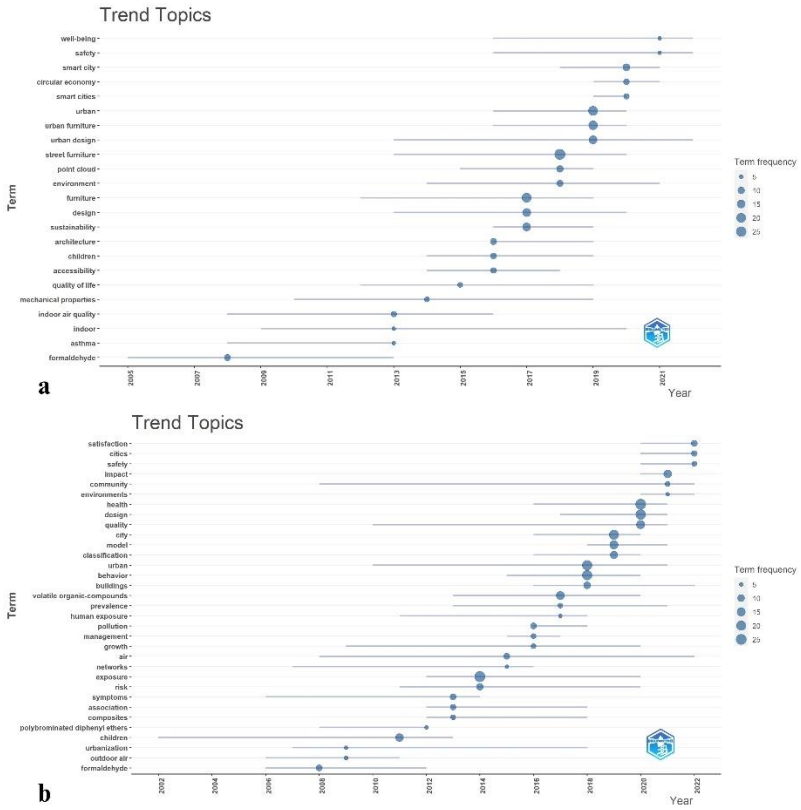

Fig 12. Graph showing the density and number of keywords over the years: a) Author's Keywords; b) Keywords Plus

Figure 13 evaluates the co-occurrence networks of keywords, highlighting the relationships between clusters of similar colors that underscore the diverse approaches within the theme, as depicted in the co-citation network (Fig 13).

In Figure 13a, the red cluster prominently features urban issues alongside keywords like "furniture" and "urban furniture." This cluster is uniquely linked to the blue cluster's "children," which includes terms such as "formaldehyde," "indoor air quality," and "asthma." The purple cluster also connects with the red cluster, focusing on urban areas. Additionally, the brown cluster emphasizes an architectural and design approach and shares proximity with the red cluster. In Figure 13b, which examines Keywords Plus co-occurrence networks, the red cluster exhibits connections with all other clusters. Given that "health" is prevalent in the red cluster,

it serves as a connector to the other clusters. The green cluster, centered around "exposure," delves into urban settings, air quality, and pollution. Meanwhile, the purple cluster centers on construction and performance-related terms but shows weaker connections with other clusters (Fig 13).

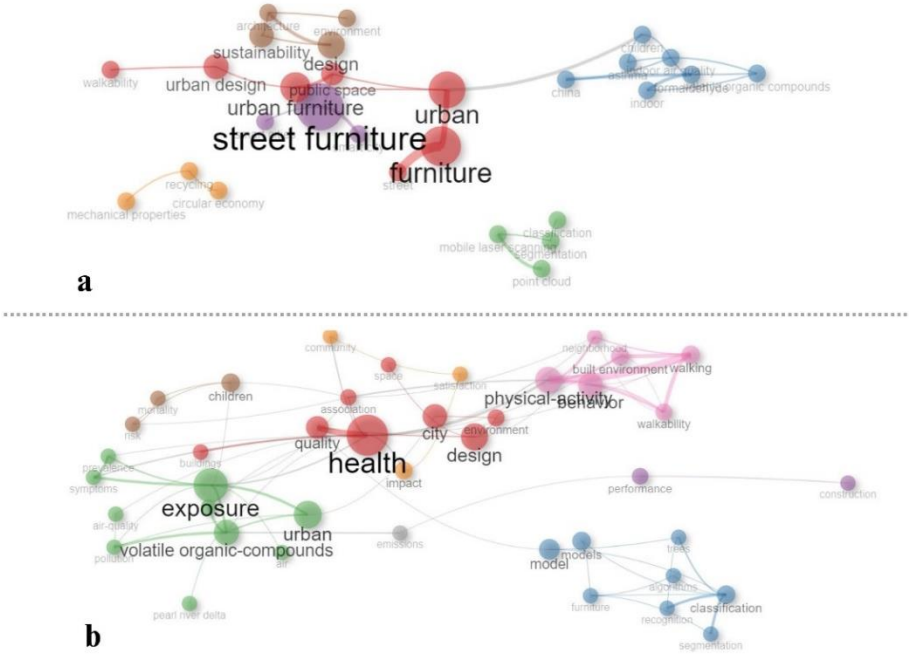

Fig 13. Keywords in urban furniture emphasize the co-occurrence of the dataset: a) Author's Keywords; b) Keywords Plus

Relationships between the Study Data

In the Biblioshiny package, a Three-Field Plot analysis was utilized to visually represent the dimensions of academic fields in urban furniture and their distribution in publications (Emsen, 2022, p. 63). This analysis examines the relationships between three categories: sources (SO) on the left side, Keywords Plus (DE) in the middle, and institutions (AU-UN) on the right side.

Figure 14 depicts the analysis where the top ten institutions (universities), Keywords Plus, and source categories were evaluated. Notably, "Sustainability" journal emerges as the most influential source, emphasizing keywords such as urban, urban furniture, sustainability, and design. Surprisingly, the term "street furniture" was not prominently used in these journals. Among institutions, Hong Kong Polytechnic University, Nanjing Forestry University,

and Delft University of Technology were most frequently mentioned. Aalborg University featured prominently with keywords like furniture and urban (Fig 14).

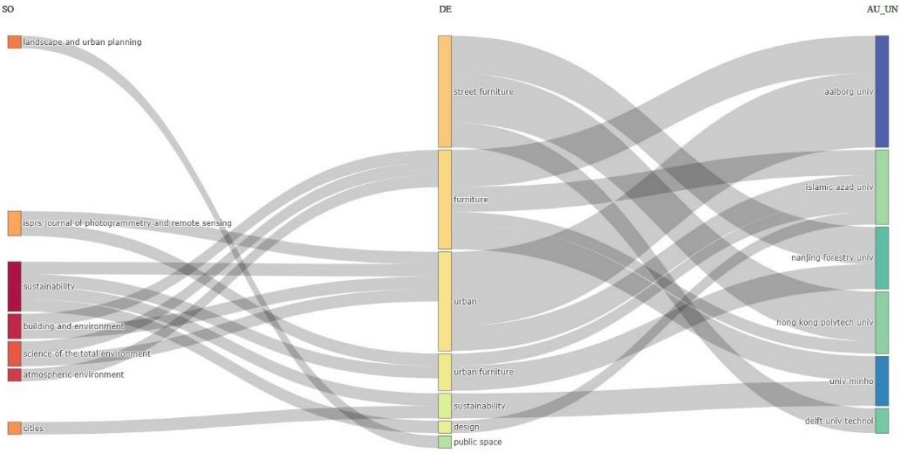

Fig 14. The three-Field Plot highlights the analysis graph (Source, Authors' Keywords, Institution)

In Figure 15, the Three-Field Plot analysis displays keywords identified by authors, modified into Keywords Plus. The term "health" stands out prominently, notably used by "Sustainability" and "Building and Environment" journals. Among institutions, Aalborg University, Hong Kong Polytechnic University, and Delft University of Technology are the most frequent users of the keyword "health." While universities and journals show similarities across both graphs, there are notable differences in the keywords themselves, indicating disparities between computer-generated selections and author-determined keywords. Common terms like "urban" and "design" are consistent across both graphs (Fig 15).

The influential "Sustainability" journal features keywords such as health, urban, exposure, design, and behavior, while "Building and Environment" empha-

sizes health, urban, exposure, city, and quality. These overlapping keywords underscore the shared thematic focus of these influential journals.

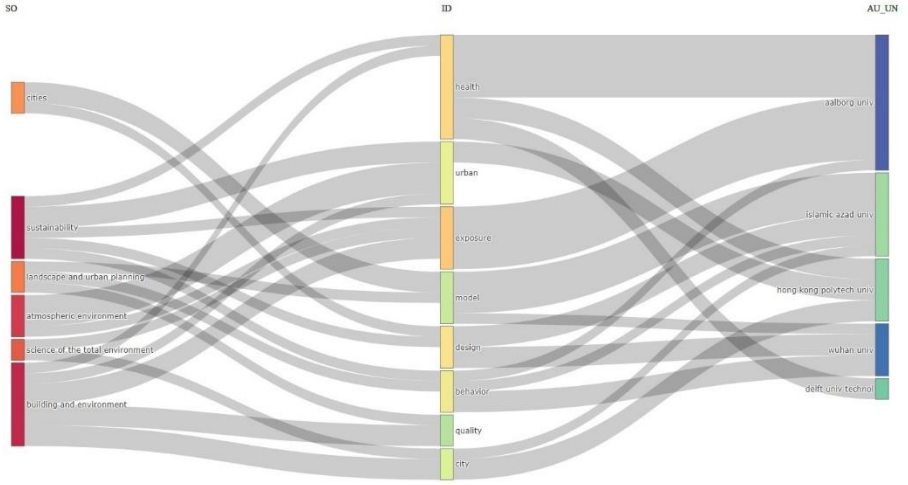

Fig 15. Three-Field Plot highlights the analysis graph (Source, Keywords Plus, Institution)

Discussion

This study used bibliometric methodology to provide a holistic view of the research evolution of urban furniture in an academic field not previously studied. The methodological flow of the dataset obtained from Web of Science (WoS) was analyzed in R software using the RStudio tool (Bibliometrix package and Biblioshiny visualization tool) (Aria & Cuccurullo, 2017, p. 963). In the creation of the data set, many researchers used the WoS tool in their studies due to its effectiveness in academic research (Xu et al., 2019, p. 217; Michelle & Gemilang, 2022, p. 31; Yang et al., 2021, p. 2; Gonçalves et al., 2023, p. 1468; Zhang et al., 2023, p. 4). Researchers use Scopus in the literature review (Aristovnik et al., 2020, p. 4; Liu et al., 2021, p. 7; Matsler et al., 2021, p. 10). Katuk and Koseoglu (2023, p. 89) used both databases in their study. Archambault et al. (2009) reported no significant differences between WoS and Scopus, comparing bibliometric statistics from both databases. They found that their collected data were highly correlated, which implies that there will not be significant differences when choosing the WoS or Scopus database. Harzing and Alakangasn (2016, p. 801) proposed similar findings in their study that these databases provide sufficient coverage stability.

The most widely used analysis and visualization software in bibliometric studies includes the RStudio Bibliometrix Package(Azad & Parvin, 2022, p. 2700), CiteSpace, and VOSviewer (Zhang et al., 2023, p. 3). RStudio, a free and open-source IDE (Integrated development environment), offers a popular integrated development platform for statistical and data analysis operations (Aria & Cuccurullo, 2017, p. 970). It enables analysis, visualization, reporting, and bibliometric data in a single integrated development platform (Azad & Parvin, 2022, p. 2701). In his study, Emsen (2022, p. 22) analyzed the research data in RStudio's Biblioshiny package and performed visual map analysis through the VosViewer program. Gonçalves et al. (2023, p. 1467) analyzed the leading bibliometric indicators of their study (number of authors, number of articles per author, number of authors per article, total number of citations, number of citations per article, H index, and others) in R software using RStudio tool. The methodology of these studies is like this paper. Studies using software such as CiteSpace and VOSviewer (Tho et al., 2017, p. 1220; Yang et al., 2021, p. 3) yielded parallel analysis results (collaborative network analysis, co-word analysis, author co-citation analysis, document co-citation analysis, and textual and geographical visualization) (Waltman et al., 2010, p. 630). The time limitation of the data in RStudio's Biblioshiny package includes all types of documents written in English only up to 2022.

RStudio's Biblioshiny package includes many analysis techniques. The proper analysis techniques for the research topic, purpose, and objective are essential for the research (Jones et al., 2011, p. 38). This study is similar to the analysis techniques of Matsler et al. (2021, p. 3) and Emsen (2022, p. 25). The analysis techniques used within the scope of the study are general information about the study, the most influential sources, the most influential countries and institutions, the most influential authors, keywords, and relationships between data. Common word and co-citation analyses from bibliometric techniques were frequently preferred in bibliometric studies on various topics (Cobo et al., 2011, p. 1385; Song et al., 2016, p. 1113; Siyavus & Aydin, 2022, p. 179; Gonçalves et al., 2023, p. 1467). In this study, keyword analysis was given importance as an analysis technique (Metinal & Gumusburun Ayalp, 2022, p. 685), and both keywords (author's keyword and keywords plus) were analyzed comparatively. The adoption of the analysis of two types of keywords in this study is like Zhao et al. (2019, p. 78). Bibliometric studies have widely adopted keywords that provide a strong summary of academic work (Zhang et al., 2023, p.

4). In bibliometric studies on academic data, the most influential institutions, countries, sources, and authors form the basis of these studies (Yang et al., 2021, p. 3; Xiong et al., 2022, p. 2). The various analysis techniques can be classified and ranked according to the needs of the study. Three-field plot analysis examined the relationship between three categories within the Biblioshiny package (Emsen, 2022, p. 65). This study has been critical in revealing academic data on the sources, keywords, and institutions of urban furniture.

This research provides a holistic historical overview of the urban furniture literature over the last forty-seven years. Several theoretical and practical implications of the findings are drawn. Identifying the most relevant and prolific authors, publications, and countries in the literature on urban furniture can provide a solid basis for interested scholars to decide where to conduct further research and which journals to submit their findings. Such analyses enable scholars to manage their resources effectively by focusing on the most relevant and prominent studies (Eyre-Walker & Stoletzki, 2013, p. 7). This way, they can direct their efforts to achieve the most significant impact (Jones et al., 2011, p. 37). They can use the findings of this study to select research topics in urban furniture. The findings can be used to establish collaboration between institutions or authors. More in-depth research can be conducted on urban furniture, especially architecture and landscape architecture. While the WoS database is an effective source, other vital databases, such as Scopus, can be used for future research initiatives in urban furniture (Chakravarty & Madaan, 2016, p. 13). In the bibliometric study with urban furniture, both databases (WoS and Scopus) can be compared and discussed with the results of this study. In this study, the fact that the document types include papers, books, and book chapters has detailed the study. However, the study can be further detailed over the last 20 years based only on article studies.

Conclusion

This paper applies bibliometric analysis to urban furniture research publications, offering a comprehensive view of past trends and future prospects. Retrieving 1,063 studies from 1975 to 2022 via the WoS database, 887 were evaluated, marking a pioneering study in this domain. A quan-

titative analysis reveals an increasing trend in urban furniture publications, subject categories, and active journals since 2005, with notable exceptions like "Design" magazine. The field is primarily linked to environmental sciences, ecology, and technology studies. Top journals include "A + U-Architecture and Urbanism," "Building and Environment," and "Sustainability," with architecture-focused journals like "Urban Design International" and "Open House International" also prominent.

China leads in publication volume, yet the USA leads in citations and impact, suggesting higher quality from US contributions despite fewer publications. Noteworthy Chinese universities drive these publications. Influential researchers like Chen J and Wang Y lead in collaboration and impact, their keywords reflecting urban and health studies, aligning with trends identified in Three-Field Plot analyses.

Urban furniture research, crucial for urban aesthetics and functionality, has gained prominence since the 2000s. Recommendations include fostering interdisciplinary cooperation, exploring links between design and environment, and enhancing systematic reviews to guide future research and effectively expand knowledge gaps.

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Esra Bayazıt Solak

Lisans eğitimini Mustafa Kemal Üniversitesi Mimarlık Fakültesi Peyzaj Mimarlığı bölümünde 2015 yılında, yüksek lisans derecesini Kahramanmaraş Sütçü İmam Üniversitesi, Peyzaj Mimarlığı Anabilim Dalında 2018 yılında, Doktora derecesini ise 2019-2022 yılları arasında Çukurova Üniversitesi, Mimarlık Fakültesi, Peyzaj Mimarlığı Anabilim Dalında tamamladı. Çalışmalarında kentsel mekanların estetik ve fonksiyonel gelişimine katkı sağlamak amacıyla kent konulu araştırmalara odaklanmaktadır. Kent çalışmaları üzerine yürüttüğü akademik çalışma konuları arasında; Kent kimliği ve estetiği, Kent belleği, Kent mobilyaları ve Kentsel yaşam kalitesi yer almaktadır. 2023 yılında başladığı Siirt Üniversitesi, Güzel Sanatlar ve Tasarım Fakültesi, Peyzaj Mimarlığı Anabilim Dalında Doktor Öğretim Üyesi olarak görev yapmaktadır.

She completed her undergraduate degree at Mustafa Kemal University, Faculty of Architecture, Department of Landscape Architecture in 2015, her master's degree at Kahramanmaraş Sütçü İmam University, Department of Landscape Architecture in 2018, and her PhD degree at Çukurova University, Faculty of Architecture, Department of Landscape Architecture between 2019-2022. In her studies, she focuses on urban studies to contribute to urban spaces' aesthetic and functional development. Among his academic research topics on urban studies are urban identity and aesthetics, Urban memory, Urban furniture, and Urban quality of life. In 2023, he started working as an Assistant Professor at Siirt University, Faculty of Fine Arts and Design, Department of Landscape Architecture.

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