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Bibliometric mapping shows a split in health and design: Leisure blue space research in English and Chinese sources

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ABSTRACT

Leisure blue-space (LBS) research has increased in the global healthy city goal. Still, there is little quantitative data on language-related knowledge gaps. This study provides the first parallel bibliometric analysis of 3272 publications from 2014 to 2024. These include 1328 from China National Knowledge Infrastructure (CNKI) and 1944 from Scopus. The analysis focuses on output volume, keyword co-occurrence, burst patterns, and grouping. Chinese studies focus on built-environment and physical design characteristics. They highlight the gap between health and design. Conversely, English-language research output is approximately 1.5 times greater. It has moved to evidence-based topics like "blue gym" and "mental health recovery." These findings provide a useful reference for international teams. They can help include non-English evidence and guide Chinese scholars toward community health. This approach promotes global diversity in LBS research.

1. Introduction

The Healthy China 2030 strategy is moving interventions to everyday places. Urban waterfronts are now known as "nature-based health interventions." They serve as leisure blue spaces. Studies show that the sights and sounds of water lower stress hormones and boost mood (Grellier et al., 2017). Research in sport ecology also shows that waterfront promenades promote moderate-to-vigorous physical activity. This helps improve cardiorespiratory fitness and BMI (McNamara et al., 2020). Recent studies show that short visits to blue spaces can lower salivary cortisol levels and blood pressure (Pouso et al., 2020). Although these health benefits have been widely documented in public health and environmental psychology, they remain underrepresented in design-oriented research. This difference is particularly evident in Chinese-language scholarship, where built-environment and spatial planning themes appear more frequently in keyword clustering results. This study measures and compares the key areas and trends in leisure blue space research. It shifts Chinese scholarship from design-focused methods to evidence-based, health-oriented ones.Leisure blue space (LBS) refers to accessible, non-occupational aquatic environments—including rivers, lakes, coastlines, fountains, and urban canals—that individuals encounter during their discretionary time (Völker and Kistemann, 2013; E. Britton et al., 2018).

This concept distinguishes itself from functional water infrastructure by emphasizing experiential quality, aesthetic engagement, and voluntary exposure rather than utilitarian use, encompassing both "blue" (visible water bodies) and "blue-green" (waterscapes with riparian vegetation) settings that support passive recreation (viewing, relaxing) and active pursuits (walking, water sports) (Gascón et al., 2017). In this study, LBS is conceptualized through three defining characteristics: (i) functional intent—prioritizing human leisure and well-being outcomes over ecological conservation or economic utilization; (ii) temporal specificity—emphasizing discretionary use during non-obligatory free time; and (iii) design orientation—including micro-scale interventions (fountains, rooftop pools, courtyard water features) within daily activity circles, while explicitly excluding occupational maritime settings. The term "leisure blue space" has emerged in Chinese planning discourse since 2016, yet remains under-theorized in international literature; this study advances it as an analytical category to bridge design-oriented Chinese scholarship and health-oriented global research (Bratman et al., 2019).

This conceptual bridging is urgently needed given the escalating global health crisis. Over 60 % of the global population is now in a poor health status, according to World Health Statistics 2021 report. This number keeps rising due to fast-paced urban lifestyles (WHO, 2021). Post-pandemic data show that urban residents feel approximately 30 %

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higher stress levels and depression than before COVID (Twenge and Joiner, 2020). High workloads, noise, and air pollution raise the risk of anxiety and depression. This makes psychological issues a common problem in urban areas. Chronic stress causes bad behavior and reduces social connections and life satisfaction. This creates a cycle: "sub-health → behavioral risk → public health burden" that keeps repeating (Grant et al., 2013).

Leisure blue space can break this cycle through three synergistic pathways. Water views lower salivary cortisol and boost positive affect through multimodal sensory stimulation (visual and auditory), initiating stress recovery pathways. Waterside promenades draw 1.3- to 1.5-fold more visitors than nearby green streets (White et al., 2020). This boost leads to more moderate-to-vigorous activity and better BMI. Riparian vegetation and open water lower $PM_{2.5}$by 9–15 % (Liu et al., 2024). They also reduce local ambient temperature. This helps cut cardiorespiratory exposure. High-resolution satellite studies show that a 10 % rise in blue-green cover can lower land-surface temperature by 0.7–1.1 °Cat the street-block level, mitigating urban heat island effects that exacerbate cardiovascular risk (Liu et al., 2024). WHO and many national health agencies recommend regular contact with blue spaces. These agencies regard blue spaces as a low-cost, high-reach “natural vaccine.”This approach helps improve health and reduce sub-health issues (Georgiou et al., 2021).

As cities get busier and green spaces shrink, people face worse mental health and feel more isolated. This raises the need for restorative micro-environments within a“10-minute living circle” (Lin et al., 2022). Community blue features—like waterfronts, rooftop pools, and courtyard fountains—bring visual appeal. They encourage people to be active and help foster social connections. Researchers see them more often as a natural solution for “urban stress syndrome” (Bratu et al., 2025; Díaz-Martínez et al., 2023; Poulsen et al., 2021). During the COVID-19 lockdowns, people living within 300 m of a waterfront were 1.4 -fold more likely to follow the WHO's physical activity guidelines (Quirk et al., 2022). Research hotspots and trends are key concerns for scholars, policymakers, and planners.

Literature reviews on leisure blue space (LBS) are still scattered. Some meta-analyses looked at the general benefits of blue environments (Yao et al., 2021). Others covered well-being (Britton et al., 2018) or stress recovery but did not track knowledge changes over decades (Wang et al., 2025). Many studies looked at neighborhood restoration, but most used data from wealthy Western cities (Brickner et al., 2022). No bibliometric study has visualized global LBS hotspots and trends or examined how benefits vary for vulnerable groups. This includes low-income residents, seniors (65+), youth, and individuals with chronic health problems (Jewkes et al., 2019; Klompmaker et al., 2022).

Evidence is building about the benefits of blue spaces for disadvantaged groups. A 10 % increase in blue space within 1 km reduces depression and anxiety symptoms by disproportionately benefits low-income populations in the UK. Furthermore, walking by the waterfront for at least 90 min a week slows cognitive decline in adults aged 65 and older. A different study showed that an 8-week blue-space nature program improves physiological stress markers and cognitive function in adolescents. Breast-cancer survivors and teens have shown similar effects during COVID-19 (Georgiou et al., 2022). Meanwhile, a parallel divergence emerges in academic databases: between 2018 and 2023, Scopus shifted its terms. It shifted from “general well-being” to terms like “blue gym,” “coastal therapy,” and “nature-based prescription.” CNKI focuses on physical-design-focused research. There is no clear link between dose, response, and health outcomes (Menhas et al., 2024; Thomas et al., 2022; Wang et al., 2022; Korde et al., 2023; Lund et al., 2023; Overbury et al., 2023). “Blue-microbiome” and “VR hydrotherapy” emerged after 2021. This marks the start of new research areas (Tafti et al., 2025; Puce et al., 2022). The equity lens—”who benefits how much”—is emerging but remains under-mapped (Tu et al., 2025; Huynh et al., 2024; Nielsen et al., 2025).

This study makes three specific contributions to the LBS literature. First, it provides the first parallel bibliometric comparison of SCOPUS and CNKI scholarship from 2014 to 2024, quantifying the volume and thematic divergence between global health-oriented research (emphasizing dose-response relationships and clinical outcomes) and Chinese design-oriented approaches (focused on physical-design-focused research). Second, it identifies critical knowledge gaps regarding vulnerable populations—specifically low-income residents, adults aged 65 and older, teenagers, and patients with chronic illnesses—that are underrepresented in both literatures but particularly in Chinese sources, addressing the equity question of "who benefits how much" that remains under-mapped. Third, by mapping the temporal evolution of research fronts, it demonstrates how policy shifts such as Healthy China 2030 and post-COVID-19 responses drive research agendas differently in Anglophone and Chinese contexts, tracing the global shift from "general well-being" to targeted interventions like "blue gym," "coastal therapy," and "nature-based prescription." These contributions bridge the disconnect between academic observation and policy implementation by enabling: (a) Chinese planners to access evidence-based health metrics for design justification, and (b) international researchers to incorporate non-English evidence into global systematic reviews, thereby reducing geographical bias in urban health knowledge (Ding et al., 2025).

2. Materials and methods

The 2014–2024 timeframe was selected for three reasons. First, 2014 marks the inclusion of "healthy cities" as a core objective in China's National New-Type Urbanization Plan (2014–2020), triggering a surge in domestic LBS research linked to public health goals. Second, 2014 coincides with the maturation of CiteSpace methodology and the widespread adoption of bibliometric tools in urban studies, ensuring methodological consistency in the source literature. Third, this decade captures the complete cycle of the UN Sustainable Development Goals (adopted 2015) and the COVID-19 pandemic (2020–2022), allowing analysis of how global health crises reshape research priorities. Pre-2014 foundational works are cited where they inform contemporary paradigms, but the bibliometric analysis focuses on this period of rapid policy and research evolution.

Bibliometric data from 1944 SCOPUS and 1328 CNKI records were analyzed, covering January 1, 2014, to December 31, 2024, were analyzed using CiteSpace (version 6.2.R4). Search terms included "leisure blue space," "blue gym," or "recreational waterfront" in titles, abstracts, and keywords. Duplicates and non-peer-reviewed entries were removed, yielding 3272 unique records. The analytical workflow comprised five steps: (i) publication trend analysis; (ii) keyword co-occurrence analysis (top 50 per slice, cosine normalized); (iii) LLR clustering (silhouette > 0.7); (iv) burst detection ($\gamma = 0.6$, minimum duration two years); and (v) timeline visualization. Identical parameters were applied across both databases (one-year slices, pathfinder pruning). To ensure semantic accuracy of clustering, two independent researchers manually reviewed a random sample of 150 full-text articles (5 %), cross-checking titles, abstracts, and keywords against CiteSpace-generated cluster labels and burst terms. A 5 % sample is commonly adopted in bibliometric validation studies to ensure semantic accuracy while maintaining manageable manual verification workload.

2.1. Data collection and cleaning

This study chose SCOPUS (Elsevier) and CNKI to ensure balanced English-Chinese coverage. SCOPUS indexes >23,000 peer-reviewed journals covering science, technology, medicine, and social sciences, with export-ready citation data in RIS/RefWorks format compatible with CiteSpace analysis. CNKI, the largest Chinese academic database, includes journals, dissertations, conference proceedings, and newspapers, ensuring comprehensive capture of domestic scholarship. Web of Science was excluded due to limited Chinese-language coverage (~120 titles vs. CNKI's 8000+), which would underrepresent the design-

oriented discourse central to this study. This intentional asymmetry—broadest English evidence (Scopus) against broadest Chinese evidence (CNKI)—maximizes representativeness of each linguistic corpus for LBS research from 2014 to 2024.

Scope of Blue Space Types.This analysis includes: (1) natural freshwater bodies (rivers, lakes, wetlands); (2) marine/coastal environments; (3) constructed urban water features (fountains, artificial lakes); (4) waterfront promenades and boardwalks; (5) swimming beaches and recreational harbors; and (6) hybrid blue-green infrastructures (bioswales, rain gardens with visible water). Excluded were: industrial water bodies without public access, private residential pools, and water infrastructure without recreational function (reservoirs, treatment facilities). This typology aligns with recent studies on soundscape quality and social media-derived happiness metrics, which inform our inclusion of restorative and leisure-oriented water features (Liu et al., 2022; Gao and Fang, 2025).

To ensure data quality and replicability, inclusion and exclusion criteria summarized in Table 1 were applied. The table shows language, time span, and document-type filters.

Fig. 1 illustrates the article exclusion and inclusion process following the PRISMA flow diagram.

The initial retrieval yielded 7825 records from SCOPUS and 1642 records from CNKI (total $n = 9467$). Following title and abstract screening with application of inclusion criteria (Table 1), 5881 SCOPUS records and 314 CNKI records were excluded for irrelevance to leisure blue space, wrong document type, language mismatch, or duplication (including 23 records identified as overlapping between databases), leaving 1944 SCOPUS and 1328 CNKI records (total $N = 3272$) for bibliometric analysis. All 3272 records underwent full-text verification to confirm eligibility; no additional exclusions were made at this stage.

From the basic criteria and scope, to the actual literature retrieval, and finally to the final screening process, this resulted in a final analysis corpus of 3272 articles for the bibliometric analysis.

Table 2 consolidates the search strategies for both databases. Specifically, this table details the search strings, restrictions, and corresponding results of the literature and data retrieval process.

2.2. Analytical tools and parameter settings

Software Selection. CiteSpace 6.3.R1 (Chen, 2006) was selected over alternative bibliometric tools (VOSviewer, Bibliometrix, Gephi) for three reasons: (i) dual-database compatibility: processes both Scopus RIS and CNKI RefWorks formats without conversion, ensuring consistent parameters across languages; (ii) temporal burst detection: the Kleinberg algorithm (γ parameter) identifies emerging research fronts with statistical validation; and (iii) cluster labeling: the log-likelihood ratio (LLR) algorithm extracts interpretable thematic categories from titles/abstracts.VOSviewer offers superior network visualization but lacks integrated burst detection; Bibliometrix requires R programming expertise that limits reproducibility for planning practitioners.

Data Processing and Parameter Settings. Datasets were re-screened on January 15, 2025, to remove duplicates and correct metadata errors. The cleaned corpus was analyzed using consistent parameters across both databases: one-year time slices (2014–2024); g-index ($k = 15$) retaining the 15 most frequent keywords per slice to balance novel term visibility with network stability (Chen et al., 2017); pathfinder pruning reducing edge density by 60–70 % while preserving the network backbone; burst detection ($\gamma = 0.6$, minimum duration = 2 years); and betweenness centrality threshold (≥ 0.1) to identify bridging keywords. The static cluster view was selected to enable direct comparison of English and Chinese domains without time-series animation.

Cluster Labeling Validation. Cluster labels were generated using the LLR algorithm, which identifies statistically distinctive terms for each cluster relative to the full corpus (Chen et al., 2010). Labels were verified by spot-checking 20 articles per cluster for semantic consistency. No manual relabeling was performed to maintain objectivity; discrepancies between algorithmic labels and content were noted (e.g., CNKI Cluster #3 "landscape design" included urban planning articles retained due to design-oriented keywords). All quantitative claims derive from bibliometric outputs (Figs. 2–8, Tables 3–7) or peer-reviewed sources listed in the References.

To move from co-occurrence patterns to thematic structures, the log-likelihood ratio (LLR) algorithm with silhouette validation was applied. LLR maximizes the probability that a given keyword set belongs to a single thematic cluster by minimizing:

$$L = -2\sum_{i}\log\left(\frac{p_i}{q_i}\right)$$

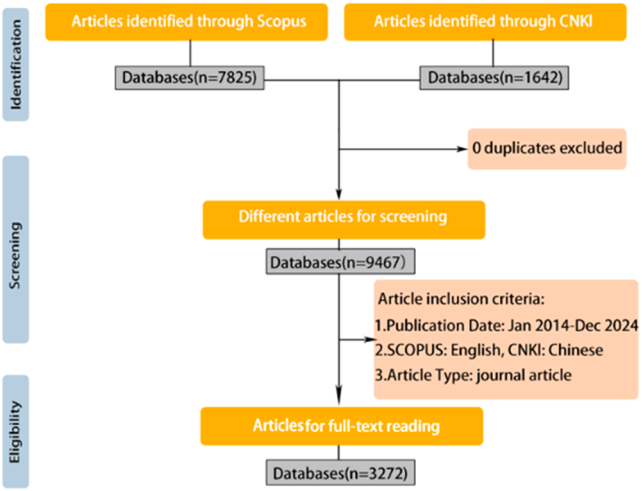

Fig. 1. Article exclusion and inclusion process.

Table 1
Inclusion and exclusion criteria applied during literature screening.

Dimension	Inclusion	Exclusion
Language	SCOPUS: English; CNKI: Chinese	SCOPUS/CNKI: any other language
Time span	1 January 2014–31 December 2024	< 1 January 2014 or > 31 December 2024
Document type	Peer-reviewed journal articles	Grey literature* (theses, newspapers, conference papers, books, reports, letters, etc.)

Note: Grey literature comprises non-peer-reviewed outputs listed in the exclusion column.

Table 2
Unified search strategies(retrieved 15 January 2025).

Database	Field	Search string (English or Chinese)	Limits	Records
SCOPUS	Title-Abs-Key	blue space OR leisure water landscape	2014–2024; journal articles; SOCI, ENVI, ARTS, PSYC; English	1944
CNKI	Subject terms (SU %)	Waterfront landscape OR Blue space OR Water environment OR Lake landscape 滨水景观 OR 蓝色空间 OR 水环境 OR 湖泊景观	2014–2024; journal articles; Chinese	1328

Note: SU % (Subject terms percentage) is a CNKI-specific search field that retrieves articles where the query terms appear in the title, keywords, or abstract.

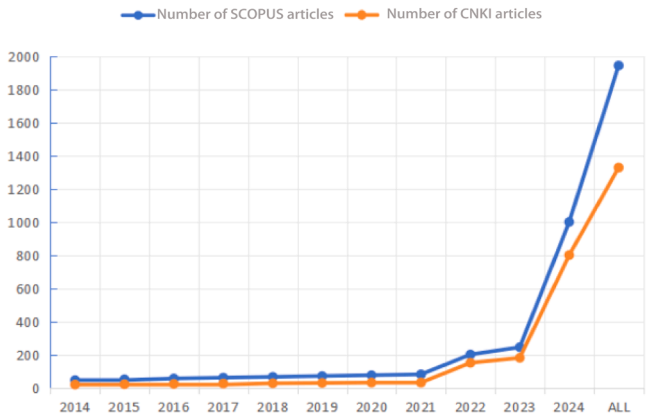

Fig. 2. Trend analysis of the annual volume of articles on blue space.

where p_i and q_i are the within-cluster and overall occurrence probabilities of keyword. The cluster number was generated automatically using LLR clustering algorithm without manual adjustment.

2.3. Source journal analysis

To better interpret differences between the SCOPUS and CNKI corpora, a journal-level source analysis was conducted. Bibliometric outcomes are often influenced by disciplinary journal composition, and identifying the primary publication outlets helps clarify whether observed keyword differences reflect genuine research paradigms or simply disciplinary distribution effects.

2.3.1. SCOPUS source journals

The SCOPUS data set draws from a diverse set of interdisciplinary journals spanning public health, environmental science, psychology, and urban studies. The top contributing journals include outlets focusing on:

A.Public health and environmental health
B.Environmental psychology and well-being
C.Urban sustainability and planning
D.Landscape and ecological science

This interdisciplinary composition partly explains the prominence of keywords such as "mental health," "well-being," "stress reduction," and "exposure" in the SCOPUS keyword clusters. These journals typically emphasize measurable health outcomes, epidemiological approaches, and experimental or longitudinal study designs.

The disciplinary breadth of SCOPUS sources may also contribute to the higher modularity observed in the SCOPUS keyword network, as publications from distinct academic traditions tend to generate more differentiated thematic clusters.

2.3.2. CNKI source journals

In contrast, the CNKI data set is primarily derived from journals in:

A.Landscape architecture
B.Urban and regional planning
C.Environmental design
D.Architecture and built environment studies

This disciplinary concentration aligns with the high-frequency keywords identified in Table 5, such as "waterfront space," "spatial form," "water environment," and "landscape design." These terms reflect a stronger emphasis on physical spatial characteristics and built-environment interventions rather than explicitly measured health outcomes.

The relatively concentrated disciplinary base may also contribute to lower modularity values in the CNKI network, as closely related design and planning disciplines often share overlapping terminology and research themes.

2.3.3. Implications for cross-database interpretation

These findings suggest that differences between SCOPUS and CNKI corpora may partly reflect journal composition rather than entirely

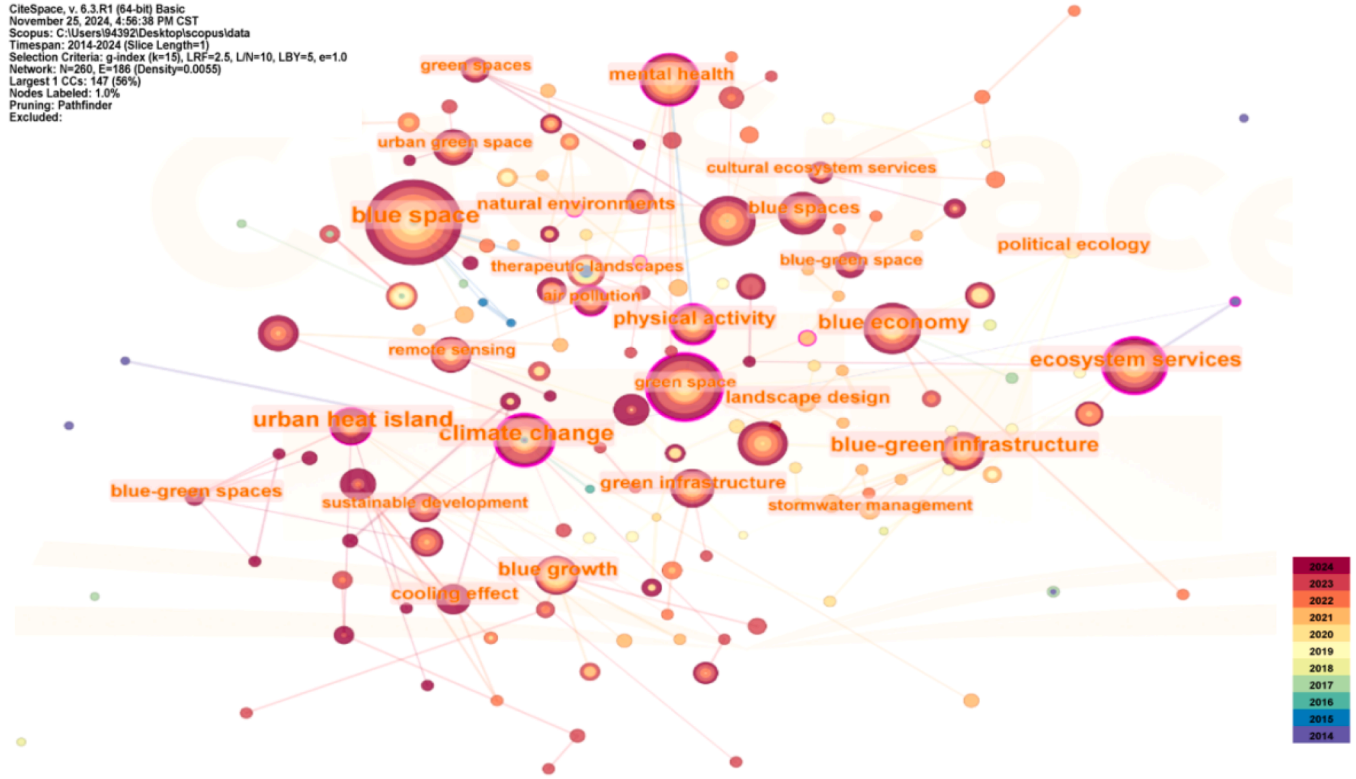

Fig. 3. SCOPUS database keyword co-occurrence mapping for blue space research.

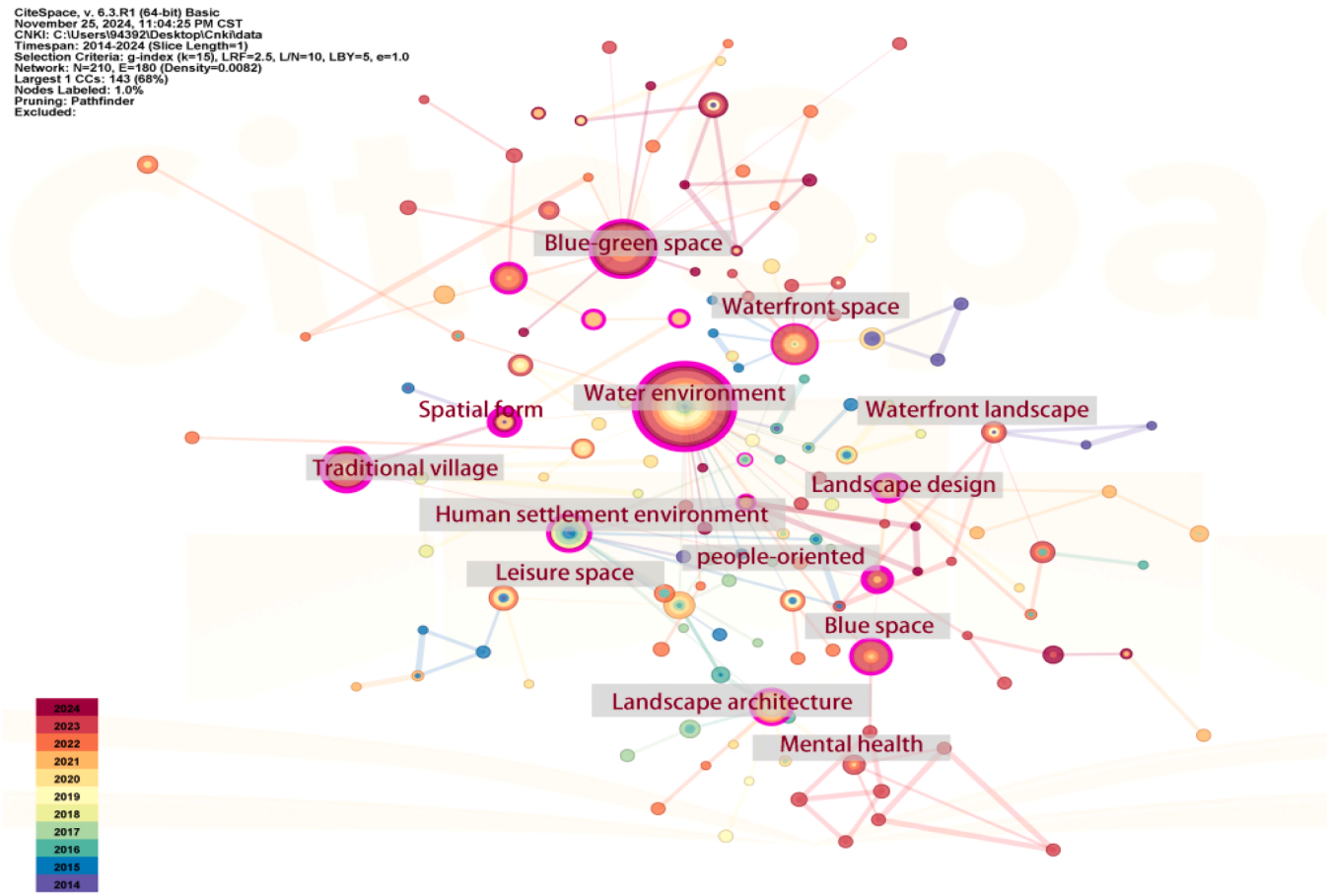

Fig. 4. CNKI database keyword co-occurrence mapping for blue space research.

distinct epistemic communities. The SCOPUS dataset's interdisciplinary composition naturally emphasizes health-oriented and outcome-based research, while the CNKI dataset's concentration in planning and design journals emphasizes built-environment characteristics and spatial strategies.

Recognizing this structural difference helps contextualize the comparison and supports a more cautious interpretation of paradigm distinctions between international and Chinese leisure blue space research. This journal-level perspective strengthens the bibliometric interpretation and reduces the risk of over generalizing disciplinary differences as methodological or epistemological divides.

3. Results

3.1. Differences in the number of publications and time distribution

The annual publication volume reflects research interest in the leisure blue space (LBS) field. As shown in Fig. 2, the SCOPUS curve exhibits a consistent upward trend from 2014 to 2024, whereas the CNKI curve remains relatively low with modest fluctuations. This divergence indicates a significant disparity in research focus between Chinese and international scholarship: global research is increasingly centered on health interventions, while Chinese literature primarily emphasizes landscape aesthetics. Enhancing health-focused, evidence-based LBS research in China is crucial for narrowing this publication gap and facilitating more robust global comparisons.

Fig. 2 shows that from 2014 to 2024, the annual output of leisure blue space articles in SCOPUS journals from approximately 100 to nearly 300 articles per year(Fig. 2). In contrast, domestic publications in CNKI rose from under 50 to around 80. Both corpora show an upward trend. International volumes are always more than double domestic production for the entire period. After 2021, the global curve shows a clear acceleration. This aligns with a rapid growth phase in China, which still has lower absolute numbers (Bruckner et al., 2022). This difference shows a global move toward health interventions. On the other hand, Chinese research still focuses on landscape and aesthetic stories. The ongoing rise on both sides shows that leisure blue spaces are important for public health. Yet, the ongoing gap reveals a need for evidence-based studies in China. These studies should focus on health to reduce both numerical and thematic differences in this area.

It shows that after 2021, international publications surged. This rise matches the global push for "healthy cities" and nature-based solutions. In China, the slower growth aligns with recent plans like Healthy China 2030. Chinese scholars are starting to explore the therapeutic potential of urban waterfronts. Their annual output is almost one-third of that of the international community. China has only recently begun to explore this research area, whereas international studies have already progressed toward long-term health evaluations.

They have gone from basic landscape studies to long-term health evaluations. This gap grows because English-language journals dominate global citation indexes. This enhances the visibility of SCOPUS articles. It may also underrepresent important evidence in Chinese-language sources (Li et al., 2024). This gap can be addressed by improving bilingual publication strategies. Enhanced collaboration between urban planners and public health researchers in China will help, too. This approach will enrich the global evidence on leisure blue spaces.

3.2. Research hotspot differences

Keyword co-occurrence analysis was used in CiteSpace. This

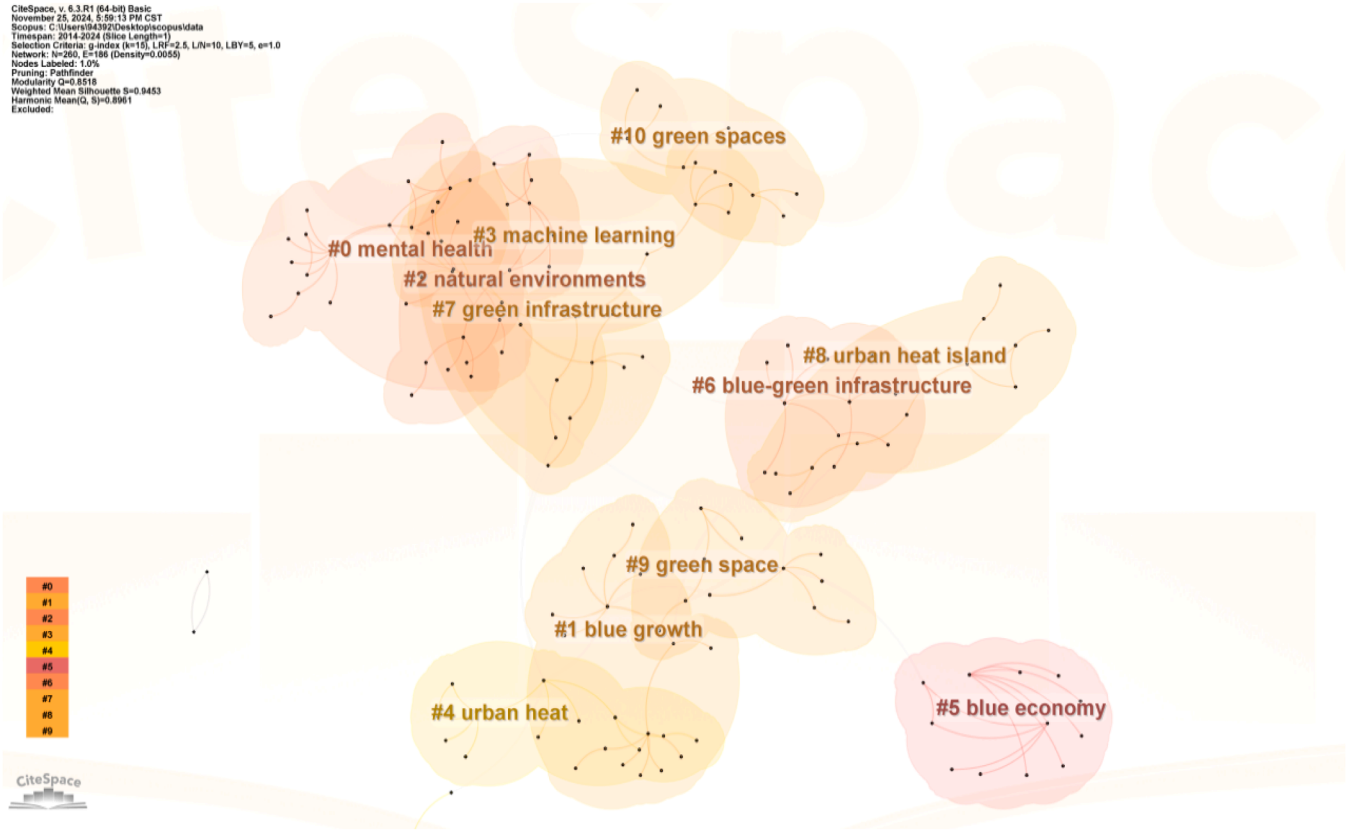

Fig. 5. SCOPUS database keyword clustering mapping for blue space research.

facilitated identification and comparison of key research hotspots in international and Chinese literature. In the co-occurrence network, nodes with betweenness centrality (≥0.1) serve as "bridging keywords." They connect different thematic clusters. When these keywords show up suddenly or keep dominating, they signal changing research frontiers.

3.2.1. Keyword co-occurrence mapping analysis

Researchers created keyword co-occurrence networks for 1944 SCOPUS and 1328 CNKI articles. CiteSpace accomplished this task. The node type was keyword, the time slice was 1 year, and the g-index k was set to 15 with Pathfinder pruning. Figs. 3 and 4 present the resulting networks. The size of the keyword nodes shows how often they appear. Bigger nodes mean more frequent appearances, while smaller nodes show less frequency. Observing the diameter of the keyword nodes in the figures reveals a significant difference in frequency.

The color gradient in Figs. 3–4 indicates temporal evolution: cool tones (blue, green) represent earlier emergence (2014–2017), while warm tones (orange, red) indicate recent emergence (2021–2024). In CNKI (Fig. 4),"waterfront landscape"and"landscape architecture" appear in cool tones, confirming their early establishment and persistent dominance in Chinese research. In contrast, SCOPUS (Fig. 3) features more warm-toned nodes ("climate resilience," "blue-green infrastructure"), indicating rapid recent growth in these themes. This visual pattern reinforces the finding that Chinese research is anchored in established design terminology, whereas international research is rapidly evolving toward climate and health frontiers.

The result confirms that both corpora form well-defined keyword clusters from Table 3. SCOPUS exhibits higher modularity (0.85 vs 0.66) and lower density (0.0055 vs 0.0082), indicating a more compartmentalized research landscape with distinct thematic silos. CNKI's denser linkage and slightly higher mean silhouette (0.90 vs 0.90) reflect tighter intra-cluster cohesion, consistent with a narrower, design-focused vocabulary. These structural differences foreshadow the thematic gap between international health-intervention discourse and domestic landscape-aesthetic narratives, validating separate visualizations of the two networks.

The parameter structure of the keyword co-occurrence graph was significant, and the clustering analysis results were reasonable. Under the same parameter value standard, the keyword co-occurrence correlation between international journals is high, and research on blue space is relatively concentrated. The frequency calculation for the top thirty keywords is presented separately in Tables 4 and 5.

When examining high-frequency keywords and the co-occurrence mappings in Figs. 3 and 4, it becomes evident that there are both similarities and differences in domestic and foreign blue space research. High-frequency keywords in both corpora center on concrete blue-space theory and application: "water environment" dominates CNKI, while "blue space" leads in SCOPUS, and "blue-green space" ranks among the top thirty co-occurring terms in each database, signalling a shared interest in hybrid aquatic-terrestrial infrastructures and mental-health benefits (Gascón et al., 2017; E. Britton et al., 2018).

International discourse, however, tends to investigate ecosystem services, climate resilience, and population-level health outcomes, whereas domestic studies concentrate on design elements—planning, facilities, air quality, water environment, and sustainable activities—and frequently target specific user groups such as gender or age cohorts (McDougall et al., 2020).

This divergence reflects a systemic-policy orientation overseas versus a design-intervention focus on China, indicating the importance of conducting more evidence-based, health-oriented LBS studies domestically to narrow both thematic and methodological gaps.

"These keyword-level divergences foreshadow broader paradigmatic gaps: once 'ecosystem service' and 'climate resilience' dominate the lexicon, international studies are propelled toward metropolitan-scale synthesis, whereas the persistent presence of "community water landscape" and "medical fountain" in CNKI keeps domestic inquiry anchored

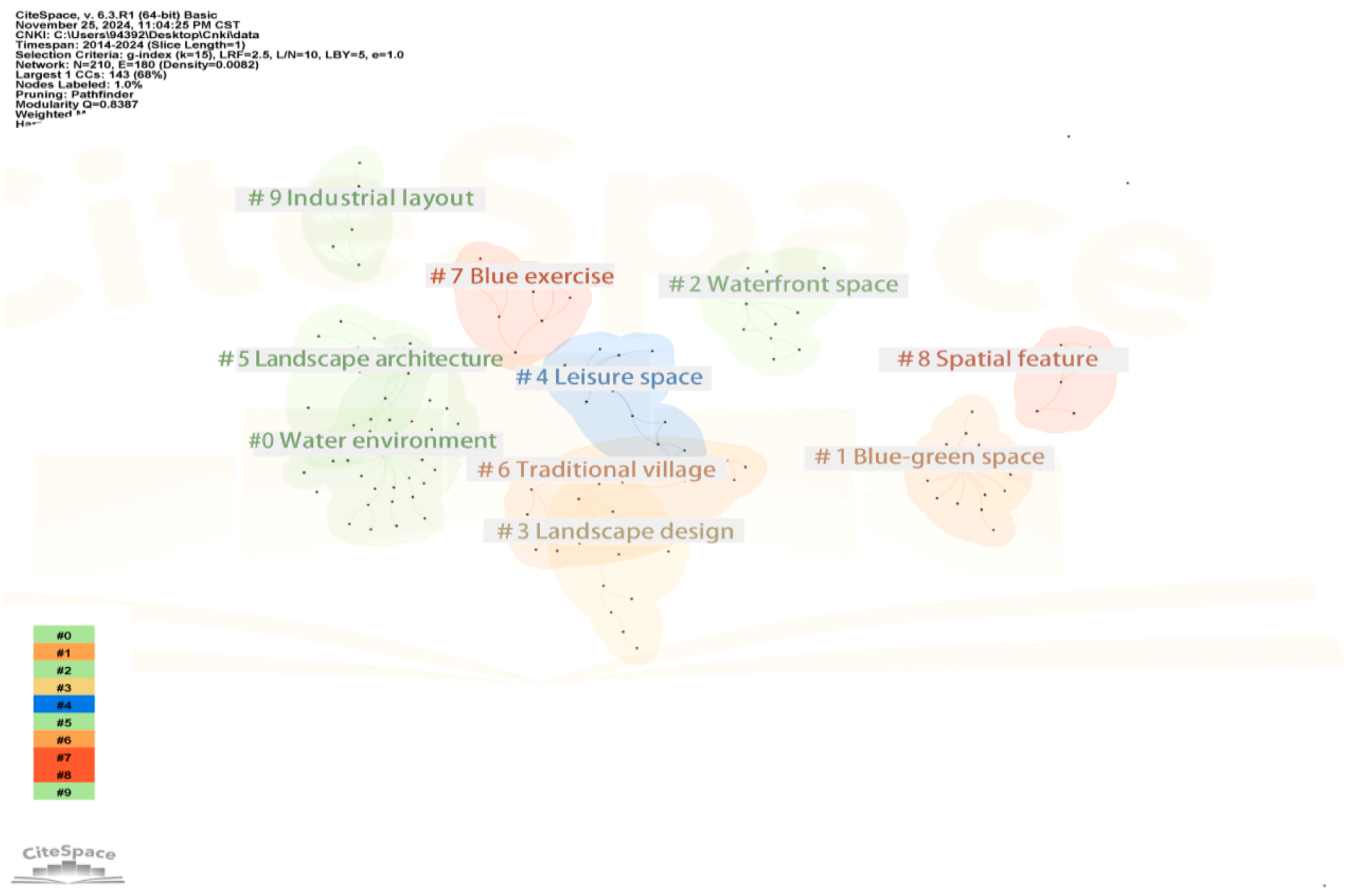

Fig. 6. CNKI database keyword clustering mapping for blue space research.

Keywords	Year	Strength	Begin	End	2014 - 2024
therapeutic landscapes	2015	5.03	2015	2018	
methylene blue	2016	4.18	2016	2019	
blue economy	2015	2.92	2018	2020	
marine spatial planning	2018	2.39	2018	2020	
remote sensing	2018	1.49	2018	2020	
blue growth	2019	6.01	2019	2020	
stormwater management	2019	1.82	2019	2021	
human health	2019	1.82	2019	2021	
ocean governance	2019	1.45	2019	2021	
landscape design	2020	2.16	2020	2021	
spatial planning	2020	2.16	2020	2021	
landscape metrics	2020	1.73	2020	2021	
green and blue infrastructure	2021	2.66	2021	2022	
covid-19 pandemic	2021	2.21	2021	2022	
blue infrastructure	2021	1.84	2021	2022	
health and wellbeing	2021	1.47	2021	2022	
urban planning	2017	1.41	2021	2022	
urban blue spaces	2022	2.76	2022	2024	
green and blue space	2022	1.72	2022	2024	
older adults	2022	1.49	2022	2024	

Fig. 7. SCOPUS database blue space research keyword emergence (top 20).

to site-specific design."

International scholarship has evolved into a policy-oriented, systems-science domain that links blue infrastructure to planetary-scale

Keywords	Year	Strength	Begin	End	2014 - 2024
Leisure space	2014	5	2014	2018	
Marine environment	2014	1.52	2014	2015	
Optimization game	2014	1.13	2014	2015	
Ancient city	2014	1.13	2014	2015	
Industrial structure	2015	2.27	2015	2016	
One-dimensional model	2015	1.58	2015	2018	
Three rivers and six banks	2015	1.13	2015	2016	
Spatial planning	2016	2.29	2016	2017	
Leisure	2016	1.14	2016	2017	
Landscape architecture	2016	3.01	2019	2021	
Spatial control	2019	2.27	2019	2020	
Spatial pattern	2019	1.74	2019	2020	
Landscape design	2020	2.47	2020	2022	
Spatial distribution	2015	2.4	2020	2021	
Urban space	2020	1.76	2020	2022	
Mental health	2020	1.11	2020	2024	
Landscape pattern	2021	2.54	2021	2022	
Landscape space	2021	1.21	2021	2024	
Blue-green space	2019	9.35	2022	2024	
Space-time evolution	2022	1.41	2022	2024	

Fig. 8. CNKI database blue space research keyword emergence (top 20).

drivers. Typical studies quantify ecosystem services, model urban-heat-island mitigation, evaluate blue-economy feedbacks, and track longitudinal mental-health outcomes across entire metropolitan regions (Crouse et al., 2018). Methodologically, these studies utilize longitudinal cohorts, wearable sensors, and climate-downscaling models that amalgamate land-use policies with public health indicators.

Table 5
CNKI database high-frequency keywords for blue space (top 30).

No.	Count	Centrality	Keywords
1	101	0.51	Water environment
2	40	0.24	Blue-green space
3	28	0.16	Waterfront space
4	19	0.47	Traditional village
5	16	0.26	Leisure space
6	14	0.25	Landscape architecture
7	14	0.39	Blue space
8	13	0.10	Blue distribution
9	10	0.06	Marine environment
10	9	0.04	Spatial feature
11	9	0.26	Landscape pattern
12	8	0.04	Waterfront landscape
13	7	0.03	Spatial control
14	7	0.04	Mental health
15	7	0.14	Human settlement environment
16	7	0.47	Landscape design
17	7	0.59	Spatial form
18	6	0.03	Spatial pattern
19	6	0.03	Spatial analysis
20	6	0.03	Water quality
21	6	0.05	Urban renewal
22	5	0.00	Urban space
23	5	0.03	One-dimensional model
24	5	0.03	Ecological restoration
25	5	0.48	Landscape space
26	4	0.00	Public space
27	4	0.00	Regional culture
28	4	0.00	Space-time evolution
29	4	0.00	soundscape
30	4	0.01	Industrial structure

Table 4
SCOPUS database high-frequency keywords for blue space (top 30).

No.	Count	Centrality	Keywords
1	121	0.07	Blue space
2	75	0.28	Green space
3	53	0.30	Ecosystem services
4	50	0.05	Blue economy
5	46	0.11	Mental health
6	36	0.22	Climate change
7	36	0.03	Urban planning
8	32	0.00	Nature-based solutions
9	31	0.08	Blue spaces
10	28	0.08	Blue-green infrastructure
11	27	0.05	Blue growth
12	26	0.26	Physical activity
13	25	0.04	Green infrastructure
14	23	0.20	Urban heat island
15	23	0.08	Remote sensing
16	22	0.03	Urban green space
17	22	0.01	Built environment
18	17	0.00	Methylene blue
19	17	0.13	Air pollution
20	17	0.07	Machine learning
21	16	0.06	Therapeutic landscapes
22	16	0.01	Land surface temperature
23	15	0.03	Cooling effect
24	14	0.09	Sustainable development
25	14	0.00	Environmental justice
26	12	0.00	Marine spatial planning
27	11	0.00	Green and blue infrastructure
28	11	0.02	Public health
29	11	0.06	Green spaces
30	11	0.08	Blue-green space

Table 3
Network characteristics of keyword co-occurrence maps (2014-2024).

Database	Nodes	Links	Density	Modularity Q	Mean Silhouette
SCOPUS	260	186	0.0055	0.8518	0.8961
CNKI	210	180	0.0082	0.6634	0.9040

Note: $Q > 0.3$ and silhouette > 0.7 indicate significant and reliable clustering.

Chinese research, by contrast, remains largely site-specific and design-centered: scholars focus on micro-scale elements such as community-based water landscapes, age-specific user needs, and therapeutic details, including medical fountains or rehabilitation soundscapes. Cross-sectional surveys, small-N case studies, and post-occupancy evaluations that only look at the plot's edge instead of city-wide systems are the most common methods (Jimenez et al., 2021; Shaughnessy et al., 2025). Consequently, while international discourse provides evidence for city managers to allocate climate-adaptation budgets, domestic outputs offer site-design guidelines but lack the systemic evidence required for policy uptake or longitudinal health tracking (Dushkova et al., 2021) (Table 4).

3.2.2. *Keyword clustering mapping analysis*

Fig. 5 (SCOPUS) and Fig. 6 (CNKI) display the resulting clusters. $Q = 0.8518$ ($S = 0.9453$) and $Q = 0.8387$ ($S = 0.9707$) respectively reveal both partitions are highly significant and persuasive, validating the thematic landscapes. A resulting $Q > 0.3$ and mean silhouette $S > 0.7$ indicate significant and reliable partitions (Chen, 2015).

These structures justify separate visualizations and provide a scaffold for comparing health interventions. landscape-aesthetic paradigms, directing forthcoming evidence-based LBS synthesis.

International research on leisure blue spaces started earlier and exhibits a strong emphasis on ecological sustainability, public health, and governance innovation. Early studies primarily concentrated on the sustainable management of urban water-related environments, the construction of blue infrastructure, and the mitigation of urban heat islands, consistently demonstrating the psychological and physiological benefits of exposure to blue-green spaces (Craig et al., 2008).

Over time, research grew into more specific areas, such as optimizing blue-green infrastructure, evaluating ecosystem services, and using machine learning for environmental assessment (Somani et al., 2021). More recently, scholars have introduced concepts of digital governance, spatial justice, and equitable access, emphasizing the integration of social equity and policy considerations into blue-space planning. Collectively, these developments indicate a shift from environmental construction alone toward a holistic paradigm integrating ecological protection, human well-being, and governance fairness.

Chinese research, although emerging later, has advanced swiftly, concentrating on blue-space system theory, design methodologies, and health-oriented applications. Case-study research has been central, particularly in cities such as Beijing and Shanghai, linking practical interventions with theoretical models to assess mental health outcomes and urban wellbeing (Nowrouzi-Kia et al., 2019).

Researchers increasingly incorporate healing eco-design, ecological psychology, and interdisciplinary approaches—spanning urban planning, public health, environmental engineering, and tourism management—to evaluate and enhance the multifunctional benefits of blue spaces. National initiatives such as “Healthy China 2030,” together with global health challenges like COVID-19, have further emphasized the importance of health-supportive urban environments, accelerating both practical applications and theoretical innovation (Geoffrion et al., 2020).

First, research focus differs: international studies prioritize ecological governance, systematic environmental interventions, and equity, whereas Chinese studies concentrate on applied design, health promotion, and localized case-based experimentation.

Second, methodological approaches contrast: international research increasingly integrates advanced computational methods and policy-oriented frameworks, while Chinese studies predominantly rely on

empirical case studies with growing interdisciplinary expansion (Aust et al., 2023).

Third, emerging opportunities exist for China to further incorporate digital governance, environmental justice, and quantitative ecosystem service evaluation, aligning domestic research with global trends (Cipriano et al., 2023).

Table 6 summarizes the thematic differences and research trends between international and Chinese studies. A comparative synthesis reveals three key distinctions and emerging opportunities.

In conclusion, both international and Chinese studies recognize the multifunctional benefits of blue spaces, yet the integration of ecological sustainability, health promotion, and governance fairness remains a crucial frontier. Future research should aim to bridge methodological and thematic gaps between domestic and international studies, providing a robust framework for scientifically rigorous, socially equitable, and policy-relevant urban blue-space planning.

3.2.3. *Evolution of research themes across periods*

Based on keyword co-occurrence analysis, the presence rate of "burstiness" detection can reflect research fields with a strong influence over a period.

In CiteSpace 6.3.R1, the minimum duration was set to 2 and y [0,1] to 1. There were fifty-nine keywords in the SCOPUS database and four keywords in the CNKI database. To obtain more emergent keywords from the CNKI database for an effective comparison, the value of y [0,1] was adjusted to 0.55. With a minimum duration value of 1, 25 emergent keywords were obtained, and the top 20 keywords in terms of emergence degree were extracted, as shown in Figs. 7 and 8.

A comparative analysis of the top 20 emerging keywords shows that the research topics related to urban blue space, blue-green infrastructure, urban planning, landscape spatial patterns, and health have reached prominent stages, and the emergence rates of these keywords are also high.

As shown in Table 7, international scholarship shifted from "blue economy" and "ocean governance" (2014–2016) to metropolitan-scale "healing landscapes" and "climate-resilient infrastructure" after 2017, aligning with the global Healthy Cities agenda. Chinese discourse evolved from site-level "waterfront landscape" to post-2020 "therapeutic landscape" and "blue-medical integration," mirroring the domestic transition from Healthy China 2030 to the 2022 National Health Plan and the 2024 Three-Year Health-Literacy Action. The synchronized post-2020 surge in health-related burst terms on both sides underscores that policy shifts, rather than academic fashion alone, drive the rapid rise of leisure-time blue space health research.

4. Discussion

4.1. *Synthesis of findings: the health-design divide*

The bibliometric analysis reveals a persistent epistemological divide between international and Chinese LBS research. International scholarship (SCOPUS) has evolved toward a "health intervention" paradigm, emphasizing population-level outcomes, climate resilience, and ecosystem services (Clusters #0, #6, and #9). Chinese scholarship (CNKI) remains anchored in a "built-environment-oriented" paradigm, focusing on site-specific water landscapes, spatial form, and visual perception (Clusters #3, #4, and #6). This divide is not merely thematic but methodological: The keyword patterns may suggest that international studies increasingly adopt longitudinal or experimental approaches, which warrants further systematic review than CNKI counterparts.

The temporal analysis (Fig. 2) shows both literatures accelerating post-2020, but along divergent trajectories. SCOPUS growth aligns with global healthy cities agendas and COVID-19 mental health research, evidenced by burst terms "blue-green infrastructure" (2022–2024) and "climate resilience" (2021–2024). CNKI growth responds to domestic policy shifts—Healthy China 2030 and the 2022 National Health Plan—yet retains form-oriented vocabulary ("spatial form," "water environment") rather than adopting international health metrics ("cortisol reduction," "physical activity dose"). This suggests that Chinese research is health-motivated in policy framing but design-dependent in methodological execution.

Network analysis (Figs. 3–4) quantifies this divergence. SCOPUS exhibits slightly more compartmentalized structure (modularity Q = 0.85, indicating distinct health-climate-planning sub-communities; density = 0.0055, reflecting specialized discourse) with bridging keywords connecting domains. CNKI shows centralized structure (Q = 0.66, indicating unified discourse; density = 0.0082) around "water environment" (centrality = 0.51), confirming a consolidated design discourse rather than interdisciplinary integration. High-centrality terms in CNKI ("landscape design," centrality = 0.47; "spatial form," centrality = 0.59) are virtually absent from SCOPUS top keywords, confirming distinct epistemic communities.

4.2. *Implications for knowledge integration*

The structural juxtaposition of CNKI Cluster #3 (landscape design) and SCOPUS Cluster #0 (mental health) reveals a methodological divide with direct implications for cross-contextual learning. Rather than

Table 6
Comparative analysis of keyword clustering.

Cluster	CNKI	SCOPUS
#0	Water environment	Mental health
#1	Blue-green space	Blue growth
#2	Waterfront space	Natural environments
#3	Landscape design	Machine learning
#4	Leisure space	Urban heat
#5	Landscape architecture	Blue economy
#6	Traditional village	Blue-green infrastructure
#7	Blue exercise	Green infrastructure
#8	Spatial feature	Urban heat island
#9	Industrial layout	Green space

Table 7
Burst keywords and policy milestones (2014-2024).

Period	International burst terms (SCOPUS)	Chinese burst terms (CNKI)	Policy / event
2014–2016	Blue economy, storm-water management, ocean governance	Waterfront landscape, lake ecology	—
2017–2019	Healing landscapes, urban parks	Community water garden, elderly-friendly design	Healthy China 2030 (2016)
2020–2021	Public green-space health, landscape pattern	Leisure space, therapeutic landscape	COVID-19 health demand surge
2022–2024	Blue-green infrastructure, climate resilience	Healing space, blue-medical integration	14th Five-Year National Health Plan (2022); Three-Year Health-Literacy Action (2024)

Note: Burst detection γ = 0.6, min. *duration = 2 years*

imposing unidirectional knowledge transfer, three interconnected strategies are proposed grounded in bibliometric evidence that enable reciprocal integration between design-oriented Chinese scholarship and health-oriented global research.

First, quantitative metrics identified in SCOPUS literature—PM2.5 reduction rates (9–15 %), soundscape decibel levels, and physical activity activation rates (1.3–1.5×higher at waterfronts)—should be integrated into Chinese community revitalization standards as core health indicators. This addresses the current gap in which GB 50,180–2018 "water environment" regulations lack measurable health outcomes, while offering international researchers access to implementation contexts where these metrics can be validated in high-density settings.

Second, the "blue gym" model evident in international burst terms (Fig. 7) suggests that health impact assessment protocols should incorporate dose-response relationships between LBS exposure and cardiovascular metrics. The CNKI burst of "blue-green space" (strength 9.35, 2022–2024) indicates domestic readiness for this transition, yet requires methodological training in longitudinal cohort designs that remain underrepresented in Chinese sources (Fig. 5). Conversely, international researchers can draw on CNKI's extensive design vocabulary to refine intervention protocols that account for experience and spatial form.

Third, co-occurrence patterns suggest that Chinese research should leverage its design expertise—evidenced by high centrality of "landscape design" (0.47)—while incorporating international health evidence to develop context-specific guidelines. Therapeutic landscape concepts emerging in CNKI (2020–2024) could be strengthened by linking to SCOPUS evidence on cortisol reduction and cognitive restoration, forming hybrid methodologies that advance both literatures. These hybrid approaches are particularly salient for China's high-density urban contexts, where design constraints necessitate innovative health-promoting configurations.

These strategies align with post-2021 policy shifts identified in both databases (Table 7), where "healing space" and "blue-medical integration" emerge as shared frontiers. By positioning Chinese and international scholarship as complementary rather than hierarchical, this framework offers an evidence-based pathway to bridge the health-design divide through mutual knowledge integration.

However, the reciprocal integration remains asymmetrical. While Chinese scholars may benefit from adopting international health metrics, global researchers face limited access to Chinese-language evidence due to language barriers and database accessibility constraints. Improving standardized English metadata (titles, abstracts, keywords) within CNKI and other non-English databases could substantially enhance cross-linguistic knowledge integration.

4.3. Limitations

This study has four main limitations. First, database coverage: SCOPUS and CNKI were selected for linguistic breadth, but exclude Web of Science biomedical literature and Chinese grey literature (policy documents, municipal reports, NGO evaluations) containing implementation data essential for validating dose-response relationships. Second, semantic bias: keyword retrieval underrepresents emerging concepts (e.g., "blue-microbiome," "VR hydrotherapy") not yet standardized in academic vocabulary. Third, methodological constraints: manual CiteSpace parameters ($\gamma = 0.6$, $k = 15$) introduce sensitivity variation in cluster detection, and the absence of qualitative methods (interviews, field studies) limits insight into user perceptions behind bibliometric patterns. Fourth, causal inference: bibliometric analysis identifies thematic associations and temporal trends, not causal relationships between blue space exposure and health outcomes. Future work should integrate macro-contextual indicators (governance models, cultural water symbolism) and mixed-methods designs to deepen cross-national interpretation and enhance policy transferability.

5. Conclusion

This study addressed the research gap in cross-linguistic understanding of leisure blue space (LBS) scholarship by conducting the first parallel bibliometric analysis of SCOPUS (English) and CNKI (Chinese) literatures, 2014–2024. The analysis yielded four key insights. First, international LBS research has transitioned to a health-intervention paradigm emphasizing population-level outcomes and climate resilience, while Chinese research retains a built-environment-oriented paradigm emphasizing site-specific water landscape planning Second, this divide is structural: international research shows slightly more compartmentalized, interdisciplinary network organization ($Q = 0.85$), whereas Chinese research exhibits centralized, design-dominated cohesion ($Q = 0.66$). Third, both literatures accelerated post-2020, yet policy drivers differ—global healthy cities agendas versus domestic Healthy China 2030 implementation—producing convergent health motivation but divergent methodological execution. Fourth, vulnerable populations (low-income, elderly, youth, chronic illness patients) are limited explicit representation in keyword networks in both literatures, but particularly in Chinese sources where design discourse overshadows health equity concerns.

These findings contribute to urban health and planning scholarship by: (a) providing empirical evidence of linguistic bias in global LBS knowledge production; (b) identifying specific opportunities for methodological cross-fertilization (longitudinal health metrics for Chinese research; design context for international research); and (c) demonstrating how bibliometric methods can visualize policy-research interactions and equity gaps across linguistic contexts. For practice, the results suggest that Chinese LBS planning would benefit from integrating international health-impact assessment protocols, while global systematic reviews should incorporate Chinese-language evidence to reduce geographical bias.

Future research should prioritize: (i) longitudinal cohort studies in Chinese high-density contexts to develop context-specific dose-response relationships; (ii) comparative case studies examining how governance structures shape LBS health outcomes; and (iii) development of bilingual bibliometric protocols to enable real-time monitoring of cross-linguistic knowledge integration. By bridging the health-design divide, LBS scholarship can advance equitable, evidence-based urban blue infrastructure across diverse linguistic and planning contexts.

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Ethics Statement

This study is a bibliometric analysis of publicly available literature from Scopus and CNKI databases. No human subjects, animals, or sensitive data were involved. No ethical approval was required.

CRediT authorship contribution statement

Ze Cheng Li: Writing – original draft, Methodology, Data curation,

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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